

- [54] **METHOD OF INCINERATING VENT GAS**
[75] Inventor: **Harold O. Ebeling**, Houston, Tex.
[73] Assignee: **Black, Sivalls & Bryson, Inc.**,
Houston, Tex.
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1972, abandoned.
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[58] **Field of Search** **423/210; 431/5, 12**

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Primary Examiner—L. Dewayne Rutledge

Assistant Examiner—Arthur J. Steiner

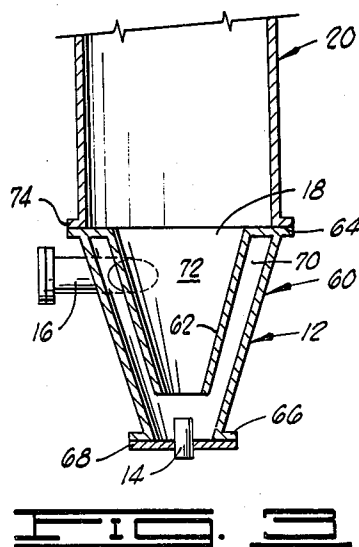
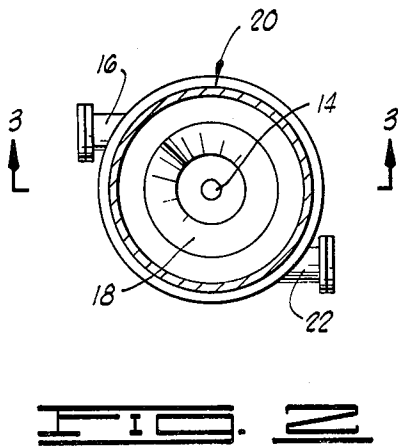
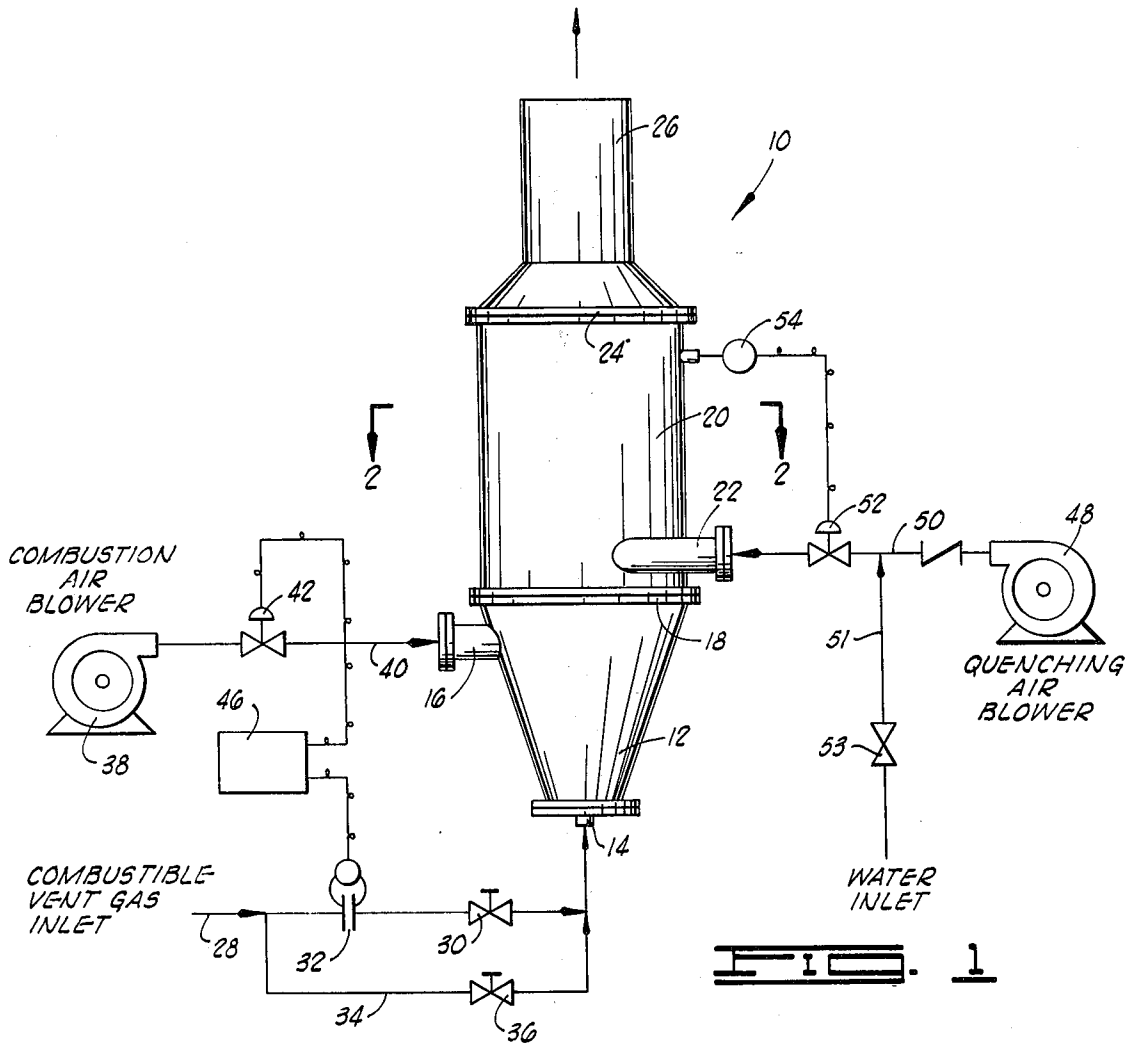
Attorney, Agent, or Firm—C. Clark Dougherty, Jr.

[57]

ABSTRACT

A method of incinerating a stream of combustible vent gas wherein the vent gas is intimately mixed with a stream of combustion air and the resulting air-gas mixture is combusted so that the stream of vent gas is converted to inert products of combustion. The products of combustion are quenched and released to the atmosphere.

4 Claims, 3 Drawing Figures



METHOD OF INCINERATING VENT GAS

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part of Application Serial No. 272,785 filed July 18, 1972 now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method therefor incinerating vent gas and more particularly, but not by way of limitation, to a method therefor converting a stream of combustible vent gas to inert non-polluting relatively low temperature products of combustion.

2. Description of the Prior Art

Methods of incinerating waste products including streams of vent gas have been developed and used heretofore. Generally, however, such therefor suffer from the disadvantage that complete combustion of the vent gas is not achieved thereby allowing the release of pollutants to the atmosphere or the products of combustion produced are at such a high temperature very tall stacks are required, or both. Further, apparatus for carrying out prior methods of incinerating streams of combustible vent gas are often relatively expensive to install and operate and require considerable time to start up.

In recent years the use of liquefied natural gas as a source of fuel in areas where natural gas is unavailable has increased. Commonly, the natural gas is liquefied at the area where it is produced and then shipped over land or by sea to the area of use by means of special refrigerated vessels. A problem encountered in such shipment of liquefied natural gas is the disposal of vent gas continuously formed due to the vaporization of small portions of the transported liquefied natural gas. In order to eliminate a fire hazard and to prevent pollution of the atmosphere, such vent gas must be incinerated, and particularly with respect to the transport of liquefied natural gas by ship, the incinerator apparatus must be inexpensive, easily and quickly operated and cannot include a high stack.

SUMMARY OF THE INVENTION

The present invention relates to a method of incinerating a stream of combustible vent gas which comprises the steps of intimately mixing the stream of vent gas with a stream of combustion air, combusting the resultant combustion air-vent gas mixture so that the stream of vent gas is converted to inert products of combustion, quenching the products of combustion and releasing the resultant quenched products of combustion to the atmosphere.

It is, therefore, a general object of the present invention to provide a method therefor incinerating a stream of combustible vent gas.

A further object of the present invention is the provision of a method of incinerating a stream of combustible vent gas wherein the vent gas is completely converted to inert products of combustion which are released to the atmosphere at a temperature of 1000°F or less.

Yet a further object of the present invention is the provision of a method of incinerating vent gas which can be carried out in apparatus which is relatively inexpensive and simple to install and operate.

Another object of the present invention is the provision of a method of incinerating vent gas which can be carried out in which does not require a tall stack and which may be started up and shut down without delay.

Other and further objects, features and advantages of the invention will be readily apparent from a reading of the detailed description of preferred embodiments of the invention which follows when taken in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates, in diagrammatic form, apparatus for carrying out the method of the present invention;

FIG. 2 is a cross-sectional view of the apparatus of FIG. 1 taken along line 2—2 thereof; and

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Broadly described, the method of the present invention for incinerating a stream of combustible vent gas comprises the steps of intimately mixing the stream of vent gas with a stream of combustion air, and then combusting the resulting combustion air-vent gas mixture to convert it to inert products of combustion. The products of combustion are quenched, i.e., the temperature thereof reduced, by mixing the products of combustion with a stream of quenching medium, and finally the resulting quenched products of combustion are released to the atmosphere.

Referring now to the drawings, and particularly to FIG. 1, apparatus for carrying out the method of the invention is illustrated diagrammatically and generally designated by the numeral 10. The apparatus 10 basically comprises a combustion chamber 12, which will be described in detail hereinbelow, having a vent gas and pilot light inlet connection 14, a tangential combustion air inlet connection 16 and a combustion products outlet 18. Attached to the outlet connection 18 of the combustion chamber 12 is a quenching or mixing chamber 20. The mixing chamber 20 may take a variety of forms, but is preferably cylindrical in shape and includes a quenching medium inlet connection 22 attached thereto. The inlet connection 22 connects to the cylindrical mixing chamber 20 tangentially at or near the lower portion thereof so that centrifugal action is imparted to the stream of quenching medium within the mixing chamber and intimate mixing of the quenching medium with the products of combustion entering the lower portion of the mixing chamber is achieved. The outlet 24 of the mixing chamber 20 is connected to a short stack 26.

Referring now to FIGS. 2 and 3, the combustion chamber 12 and mixing chamber 20 are shown in detail. The combustion chamber 12 includes an outer shell 60 (FIG. 3) generally of inverted frusto-conical shape and an inner shell 62, also of frusto-conical shape. The outer shell 60 and inner shell 62 are connected at their top ends to an annular flange member 64. The bottom end of the outer shell 60 is connected to an annular flange member 66 which is in turn connected to the flanged vent gas inlet connection 14.

The inner and outer shells 60 and 62 define an annular space 70 which is closed at the top end by the flange member 64 and which opens at the bottom end into the internal space 72 of the inner shell 62. The combustion air inlet connection 16 is attached to the outer shell 60

tangentially at the upper end portion thereof so that combustion air entering the annular space 70 is imparted centrifugal action and is caused to follow a downward helical path in the annular space 70 and an upward helical path upon entering the space 72 within the shell 62. The space 72 constitutes a combustion area and is open at its upper end forming the combustion products outlet 18 of the combustion chamber 12.

The cylindrical mixing chamber 20 includes an annular flange member 74 at its lower end which is attached to the flange member 64 of the combustion chamber 12 in a conventional manner. As shown best in FIG. 2, the tangential quenching medium inlet connection 22 is attached to the mixing chamber 20 at its lower end and is positioned in a manner with respect to the combustion air inlet 16 of the combustion chamber 12 so that the quenching medium introduced into the mixing chamber 20 is caused to follow a helical path in an opposite direction to the direction of the helical path followed by the combustion air entering the combustion chamber 12.

Referring now specifically to FIG. 1, a vent gas inlet conduit 28 is provided connected to the vent gas inlet connection 14 of the combustion chamber 12. A shutoff valve 30 and a conventional flow sensing device 32 are disposed within the conduit 28. A conduit 34 is connected to the conduit 28 at points upstream and downstream of the shutoff valve 30 and the flow sensing device 32 for conducting a side stream of vent gas to the chamber 12 and maintaining a pilot light therein. A pilot gas shutoff valve 36 is disposed in the conduit 34.

A conventional combustion air blower 38 is provided connected to the combustion air inlet 16 of the chamber 12 by a conduit 40. A flow control valve 42 is disposed in the conduit 40 for controlling the quantity of combustion air conducted to the chamber 12. The control valve 42 is operated by a conventional flow controller 46 which is operably connected to the flow sensing device 32.

As will be discussed further hereinbelow, a variety of materials can be utilized to cool or quench the products of combustion exiting the burner apparatus 12, e.g., air, steam, air and water, and other materials depending upon the availability of such materials. For purposes of this disclosure, apparatus for quenching the products of combustion with air and water is disclosed.

A quenching air blower 48 is provided connected to the quenching medium inlet connection 22 of the quenching chamber 20 by a conduit 50 which is operably connected to a conventional temperature controller 54 positioned in the upper portion of the mixing chamber. A conduit 51 is provided connected to the conduit 50 for introducing a stream of water into the stream of quenching air. A shutoff valve 53 is disposed in the conduit 51.

Operation of the Apparatus 10

In operation of the apparatus 10, the shutoff valve 30 disposed in the conduit 28 is opened so that the stream of combustible vent gas to be incinerated is conducted to the apparatus 10 by way of the conduit 28. The flow sensing device 32 senses the quantity of vent gas flowing to the apparatus 10 by way of conduit 28 and transmits a signal proportional to the flow of vent gas to the flow controller 46. The flow controller 46 in turn regulates the quantity of combustion air conducted to the combustion chamber 12 at substantially a predeter-

mined stoichiometric quantity by opening and closing the control valve 42.

The stream of combustion air generated by the combustion air blower 38 flows by way of the conduit 40 and flow control valve 42 into the annular area 70 between the inner and outer shells 60 and 62. Because the combustion air inlet connection 16 is positioned tangentially with respect to the shells 60 and 62, the combustion air follows a helical path within the area 70 to the bottom end of the inner shell 62. The stream of vent gas entering the combustion chamber 12 by way of the inlet connection 14 thereof is intimately mixed with the stream of combustion air prior to entering the interior area 72 of the inner shell 62 where combustion of the resulting mixture takes place. That is, as the combustion air flows from the area 70 within the chamber 12 into the area 72 thereof, it intimately mixes with the combustible vent gas flowing through the connection 14. The resulting gas-air mixture is ignited as it flows into the area 72 within the inner shell 62 and is combusted as it flows upwardly through the area 72. The hot products of combustion generated exit the area 72 and the chamber 12 by way of the outlet connection 18 thereof following a helical path due to the centrifugal action imparted the combustion air. From the combustion chamber 12, the products of combustion enter the mixing chamber 20. While passing through the chamber 20 the hot products of combustion are cooled by mixing with a stream of quenching medium entering the chamber 20 by way of the inlet 22 thereof. As stated previously, the quenching medium may be any of a variety of materials such as air, water, steam, etc. The particular quenching medium utilized must be provided in a quantity and at a temperature such that upon mixing with the products of combustion within the quenching chamber 20, the resultant mixture exists at a desired temperature level. When atmospheric air and water are utilized as the quenching medium, a stream of quenching air generated by the air blower 48 is conducted to the inlet connection 22 of the quenching chamber 20 by the conduit 50. A stream of water is introduced into the conduit 50 by way of the conduit 51 and the resulting air-water mixture flows into the mixing chamber 20 tangentially to the walls thereof. Because the tangential connection 22 of the mixing chamber 20 is positioned oppositely to the connection 16 of the combustion chamber 12, the products of combustion entering the bottom of the mixing chamber 20 flow in a helical path opposed to the helical path of the stream of air and water entering the chamber 20 by way of the connection 22. This opposite flow brings about rapid and intimate mixing of the quenching medium with the hot products of combustion so that the products of combustion are cooled to the desired temperature level and diluted. As will be understood, the particular quantity of water mixed with the quenching air and the particular quantity of air-water mixture required depends on the quantity of combustion gases generated in the combustion chamber 12. Upon mixing with the combustion gases the water is converted to steam thereby extracting heat from the combustion gases and reducing the quantity of air required. The cooled combustion gases-steam-air mixture exits the chamber 20 by way of the outlet connection 24 thereof and passes into the stack 26 from where it is vented to the atmosphere.

A variety of instruments and controls other than those described herein may be utilized for automati-

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cally controlling the ratio of combustion air to vent gas at a level which results in a substantially stoichiometric mixture of air and gas. This insures the complete combustion of the vent within the combustion chamber 12.

The products of combustion exiting the burner 12 and entering the quenching chamber 20 are at a relatively high temperature level, e.g., 3000°F, and unless cooled, a high stack would be required to insure the safe operation of the apparatus 10. By the present invention, a stream of a quenching medium is intimately mixed with the products of combustion within the quenching chamber 20 so that the products of combustion are cooled to a desired temperature level. The temperature controller 54 senses the temperature of the gas mixture exiting the chamber 20 and opens and closes the valve 52 accordingly.

When the apparatus 10 is shut down, the shutoff valve 30 disposed in the conduit 28 is closed and the pilot gas valve 36 disposed in the conduit 34 is allowed to remain open so that a portion of the vent gas is continuously flowed into the burner 12 by way of the inlet connection 14 thereof thereby insuring the existence of a pilot light within the burner. As will be understood, the combustion air blower 38, the quenching air blower 48 and the shutoff valves 30 and 53 may all be automatically controlled by means of a central control panel so that the startup and shutdown of the apparatus 10 can be simply and quickly accomplished.

While presently preferred embodiments of the invention have been described for purposes of disclosure, numerous changes in the details of construction and arrangement of parts can be made by those skilled in the art which are encompassed within the spirit of this invention as defined by the appended claims.

What is claimed is:

1. A method of incinerating a stream of natural gas comprising the steps of:

conducting said stream of natural gas to a combustion chamber;

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conducting a stream of combustion air to said combustion chamber;

intimately mixing said stream of natural gas with said stream of combustion air within said combustion chamber;

varying the quantity of combustion air conducted to said combustion chamber in direct predetermined proportion to variations in the quantity of natural gas conducted thereto so that when said stream of combustion air is mixed with said stream of natural gas a substantially stoichiometric mixture results; combusting the resultant combustion air-natural gas mixture within said combustion chamber so that the mixture is converted to a stream of inert products of combustion;

conducting the stream of inert combustion products to a mixing chamber;

conducting a stream of quenching medium to said mixing chamber;

intimately mixing said stream of combustion products with said stream of quenching medium;

varying the quantity of quenching medium conducted to said mixing chamber in direct proportion to variations in the temperature of said mixture of combustion products and quenching medium so that said mixture attains a desired temperature; and releasing said combustion products-quenching medium mixture to the atmosphere.

2. The method of claim 1 wherein the quenching medium conducted to said mixing chamber is a stream of air.

3. The method of claim 1 wherein the quenching medium conducted to said mixing chamber is a stream of a mixture of water and air.

4. The method of claim 1 wherein the step of varying the quantity of quenching medium conducted to said mixing chamber is carried out so that the temperature of the resulting combustion products-quenching medium mixture is less than 1000°F.

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