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Hemsath et al.

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[54] **METHOD FOR INCINERATING FLUE GASES**

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Related U.S. Application Data

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[52] **U.S. Cl.** **423/210;** 423/246; 431/5

[51] **Int. Cl.** **F23c 5/00;** F23c 9/04; F23m 3/04; F23q 7/06

[58] **Field of Search** .... 423/210, 246; 431/5, 202, 431/352; 110/8 A

[56] **References Cited**

UNITED STATES PATENTS

3,607,119	9/1971	Nesbitt et al.	23/277 C
3,695,192	10/1972	Von Brimer	110/8 A
3,741,713	6/1973	Reed	431/202

FOREIGN PATENTS OR APPLICATIONS

1,585,340	1/1970	France	431/5

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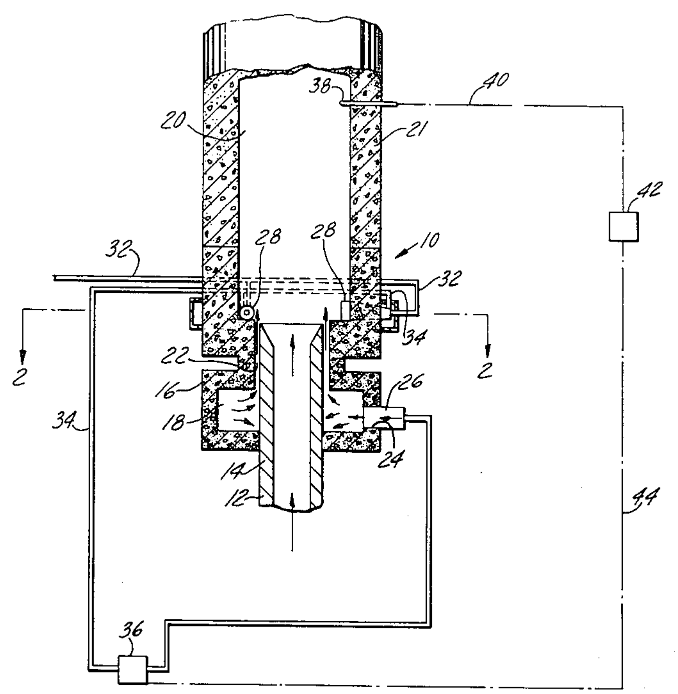
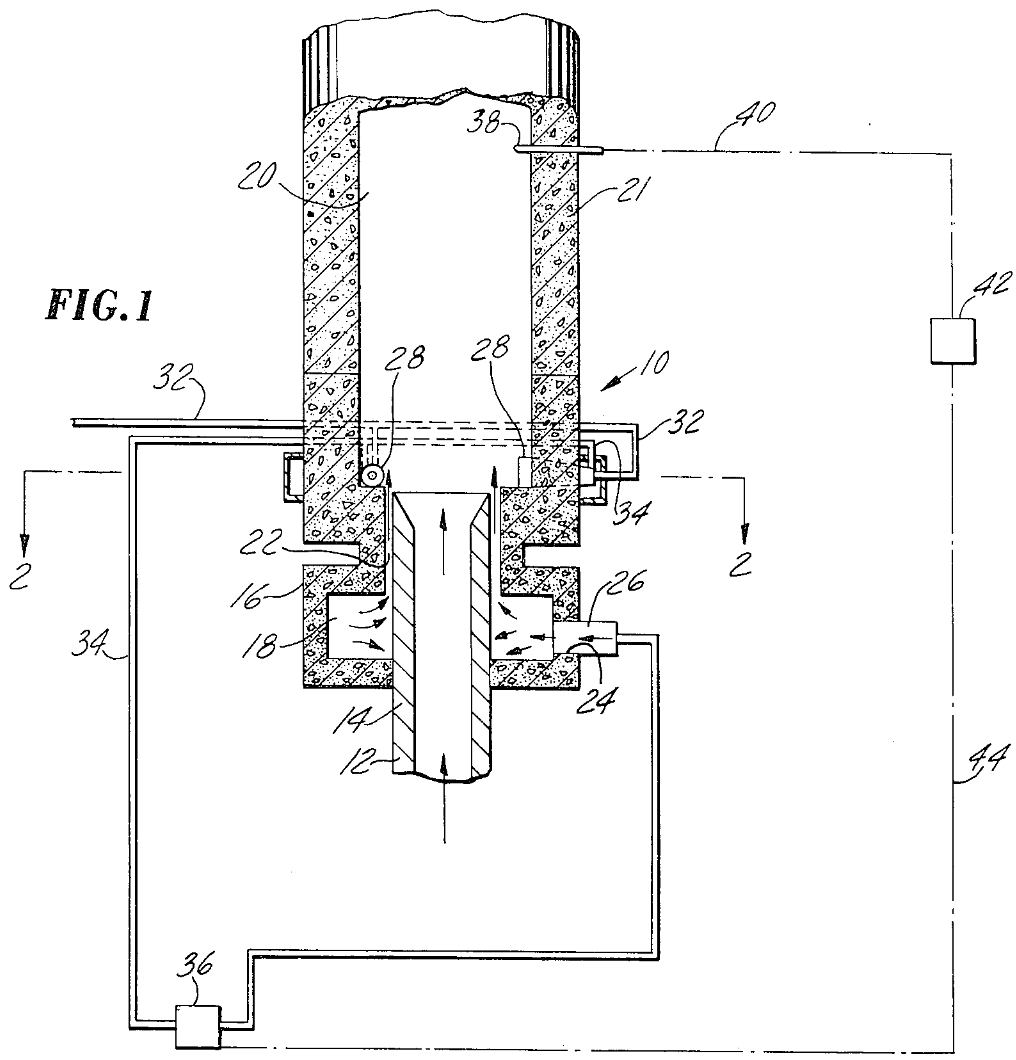
[57] **ABSTRACT**

An incineration system for incinerating flue gases which contain varying quantities of combustibles therein. Means is provided for controlling combustion air added to the flue gases when they contain combustible matter and means is provided for sensing the temperature of the combusting waste gases. When a preset temperature is exceeded, additional air is added to reduce the temperature of the gas, but when the temperature falls below the preset point, the burner firing rate is increased and the added air is cut off to insure proper incineration and achieve fuel efficiency.

3 Claims, 2 Drawing Figures




40
38
20
21
42
28
28
10
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32
34
2
2
22
26
16
18
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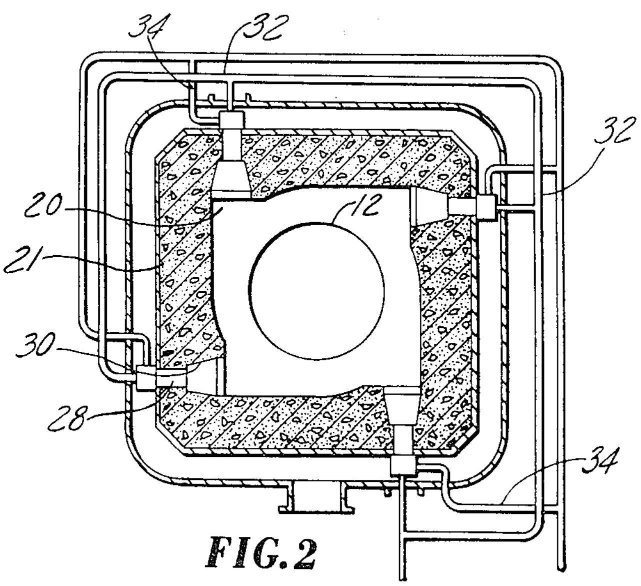
24
14
12
44
36

FIG. 1


34
32
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20
12
21
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28
34

FIG. 2

METHOD FOR INCINERATING FLUE GASES

This is a division, of application Ser. No. 274,406, filed July 24, 1972, now U.S. Pat. No. 3,838,974.

BACKGROUND OF THE INVENTION

Industrial fumes containing common air pollutants, such as hydrocarbons, alcohols, ethers, soot and other combustibles, are frequently encountered. These fumes can be broadly divided into two types. The first type of fumes contains relatively insignificant quantities of combustible pollutants and there is an ample supply of oxygen for the combustion of the pollutants. Standard types of incinerators are readily available on the market which can be used for the incineration of such fumes.

The other type of fumes contains mainly a mixture of combustibles (hydrocarbons, soot particles, etc.) and other inert gases. The oxygen content of such fumes is relatively small. When a source of ignition, such as a premix pilot or a burner operating at stoichiometric air/fuel ratio, is placed in the fume stream, the fume cannot continue to burn because of insufficient oxygen. Presently available incinerators, as a rule, are not able to complete combustion of the exhausts; thereby yielding exhaust gases with high quantities of pollutants.

It is, therefore, an object of this invention to provide an incineration system for incinerating industrial waste gases which contain varying amounts of combustibles therein.

It is another object of this invention to provide means for incinerating waste gases and maintaining the temperature of the combustion uniform.

It is a further object of this invention to provide apparatus to incinerate rich fumes.

It is still another object of this invention to provide means for incinerating rich fumes that achieve high fuel efficiency.

Other objects, purposes and advantages will be apparent from a consideration of the following description and the accompanying drawing in which:

FIG. 1 is a vertical cross-sectional view, partially schematic, of an incineration system incorporating the features of this invention; and

FIG. 2 is a cross-sectional view taken along line **2—2** of FIG. **1.**

SUMMARY OF THE INVENTION

A double chambered system is added to a stack emitting industrial waste gases which contain various amounts of combustibles therein. The first chamber terminates at the exit end of the stack in an annular passage, or restriction, so that air at high velocity is directed longitudinally relative the stack. This air acts as an air pump to enhance egress of the flue gases. These gases then enter into the second chamber of the housing, which chamber includes a plurality of burners. Within the second housing is a thermocouple which senses the temperature of the waste gases. A preset temperature is achieved by varying the quantities of air emitted from the first chamber as opposed to the amount of fuel and air supplied to the burners in the second chamber. In this way a constant temperature may be maintained despite the variance of combustibles within the exhaust gas.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

It has been found with regard to the explosion of a gas mixture containing combustibles, such as hydrocarbons, inert gases and air, that if the oxygen content of the mixture is less than 3 percent, the mixture cannot combust merely by increasing its temperature. Such mixtures are considered as above the upper combustion limit, and they are generally referred to as "rich fumes."

For proper and efficient incineration of rich fumes, it is necessary to mix air with the combustibles in the fumes, and the temperature of the air/-fume mixture should be raised to a level where the reaction rates are very rapid. Thus, addition of air, proper mixing of the air with the fumes, and heating of the fumes to incineration temperature are the three most important requirements for the incineration of rich fumes. In case of very rich fumes containing combustibles which have a heating value in excess of approximately 40 Btu/ft.^{3}, it is necessary to supply excess air, in addition to the combustion air, to reduce the temperature of combustion products to the practical incineration temperature, which is between 1500°–1800°F. The amount of excess air, of course, depends on the selected incineration temperature, the heating value of the fumes and the oxygen content of the fumes. By controlling the incineration temperature, the refractory materials in the incinerator are protected.

In case of a batch type process, the fume composition, volume and temperature can vary considerably with time. For the maximum fuel economy, air and fuel supply to the incinerator must be controlled very carefully and independently.

Referring now to the drawing, an incineration system is shown generally at **10** and is adapted to incinerate exhaust fumes coming from a stack **12.** The stack **12** has refractory bricks **14** lined on the inside thereof in order to preserve its heat and, as shown, has its inner wall flared out at its upper end at a shallow angle to its axis to approximately meet with its outer wall. Disposed about and above the stack **12** is a housing **16** having a lower chamber **18** and an upper chamber **20,** the housing also being lined with refractory material **21.** The lower chamber **18** terminates at the upper end of the stack **12** and has a restricted channel **22** portion. The lower chamber **18** also has an opening **24** therein which receives an air pipe **26.**

The upper chamber **20** which, as shown, is formed of appreciably wider cross-sectional size than the restricted channel portion **22** to form within the chamber an upwardly facing flame stabilization shoulder or step located just above the upper end of the stack **12,** is supplied with tangential burners **28** that are received within openings **30** in the refractory **21** and are located laterally outward of the exit end of the annular passageway **22** and immediately above the exit end of the stack **12.** Gas lines **32** are attached to the burners **28** as are air lines **34.** The air lines **26** and **34** are in communication with an air control unit **36.**

Received within the upper portion of the upper chamber **20** is a thermocouple **38** which has a lead **40** communicating with a temperature measuring and recording instrument **42.** The temperature measuring instrument **42** in turn has a lead **44** that communicates with the air controller **36.**

In operation, the rich fumes are emitted from the stack **12** into the upper chamber **20**. Initially, the burners **28** are fired in order to provide the heat of combustion necessary for the exhaust gases. Simultaneously, a quantity of air is supplied to the lower chamber **18** from the air line **26** and passes through the channel **22** about the exit end of the stack **12**. This air passing through the channel **22** acts as an air pump to aspirate and thereby enhance the discharge, or emission, of the exhaust gases from the stack **12**. Additionally, the annular stream of air from channel **22** promotes uniform mixing of the gases within upper chamber **20**.

The combustion products will ignite in the upper chamber **20** and the temperature thereof is sensed by thermocouple **38**. The measuring instrument **42** will set a given temperature for the combustion products and will control the amount of air supplied to the lower chamber **18** and the upper chamber **20** in response to this temperature. When the temperature is low, additional air will be supplied to the burners **28** in order to raise the temperature and assures complete incineration of the waste gases. The burners **28** may be of the type that gas is supplied thereto in proportional response to the amount of air supplied to the burners. If the temperature becomes too high, the supply of air to the burners is discontinued and the temperature is controlled by air supplied through the air pipe **26** into the housing **16**. So long as the temperature can be maintained at the set point through the supplying of air to the exhaust gases, the burners **28** need not be operated. This obviously means that the exhaust gases have a sufficient quantity of combustibles therein to independently support combustion. If the amount of combustibles in the exhaust gases are so high that the preset temperature is exceeded, an excess amount of air will be added through pipe **26** in order to lower the temperature of the combusting exhaust gases. Thus, an incineration system is provided which is operative to completely combust waste gases emitted from a stack, regardless of the amount or percentage of combustibles contained in the gases.

What is claimed is:

1. A method of incinerating rich fume combustible gases emitted from a generally cylindrical stack into a larger, generally cylindrical combustion chamber having an open upper end and a reduced diameter lower end surrounding said stack in spaced relation to define an axially extending annular passageway circumscribing said stack, said method comprising the steps of:
   - introducing combustion air through said annular passageway at a velocity sufficient to enhance the egress of said fumes from said stack into the annulus of air exhausted from said passageway to define a mixture which expands radially in said combustion chamber until striking the walls thereof at some distance dependent on said velocity whereat stoichiometric mixing is assured;
   - heating said mixture to assure combustion by directing combusting gases from a burner in said combustion chamber to penetrate said mixture prior to said mixture striking the walls of said combustion chamber;
   - sensing the temperature of said combustion chamber at a point therein removed from said stack; and
   - controlling the air supplied to said passageway and said burner in a dependent manner to maintain a predetermined temperature in said combustion chamber whereby thorough combustion of said rich fumes is achieved independent of the composition of said fumes.

2. The method of claim 1 further including the step of introducing said combusting gases from said burner tangential to the walls of said combustion chamber at a position approximately aligned with the exit end of said stack.

3. The method of claim 1 further including the step of increasing said flow of air through said passageway to effect cooling of said chamber walls while said heat dissipated from said burner is correspondingly decreased by a decrease of air supplied thereto when said temperature of said combustion chamber increases above said predetermined value.

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