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Stockman

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[54] **WASTE HEAT RECOVERY**

[75] Inventor: **Richard F. Stockman,** Friendship, N.Y.

[73] Assignee: **The Air Preheater Company, Inc.,** Wellsville, N.Y.

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[52] **U.S. Cl.** ..... **110/10,** 110/8 A, 110/49 R

[51] **Int. Cl.** **F23g 5/12**

[58] **Field of Search** ..... 110/8 R, 8 C, 8 A, 10, 110/18 R, 18 C, 49 R; 122/2

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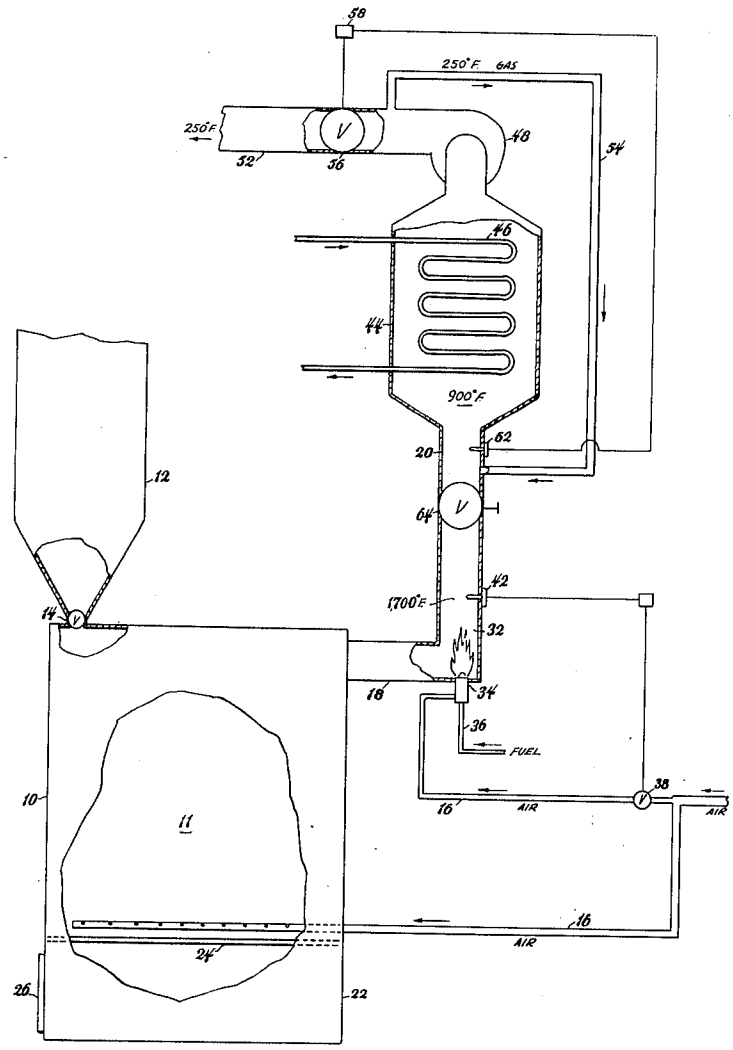
Primary Examiner—Kenneth W. Sprague

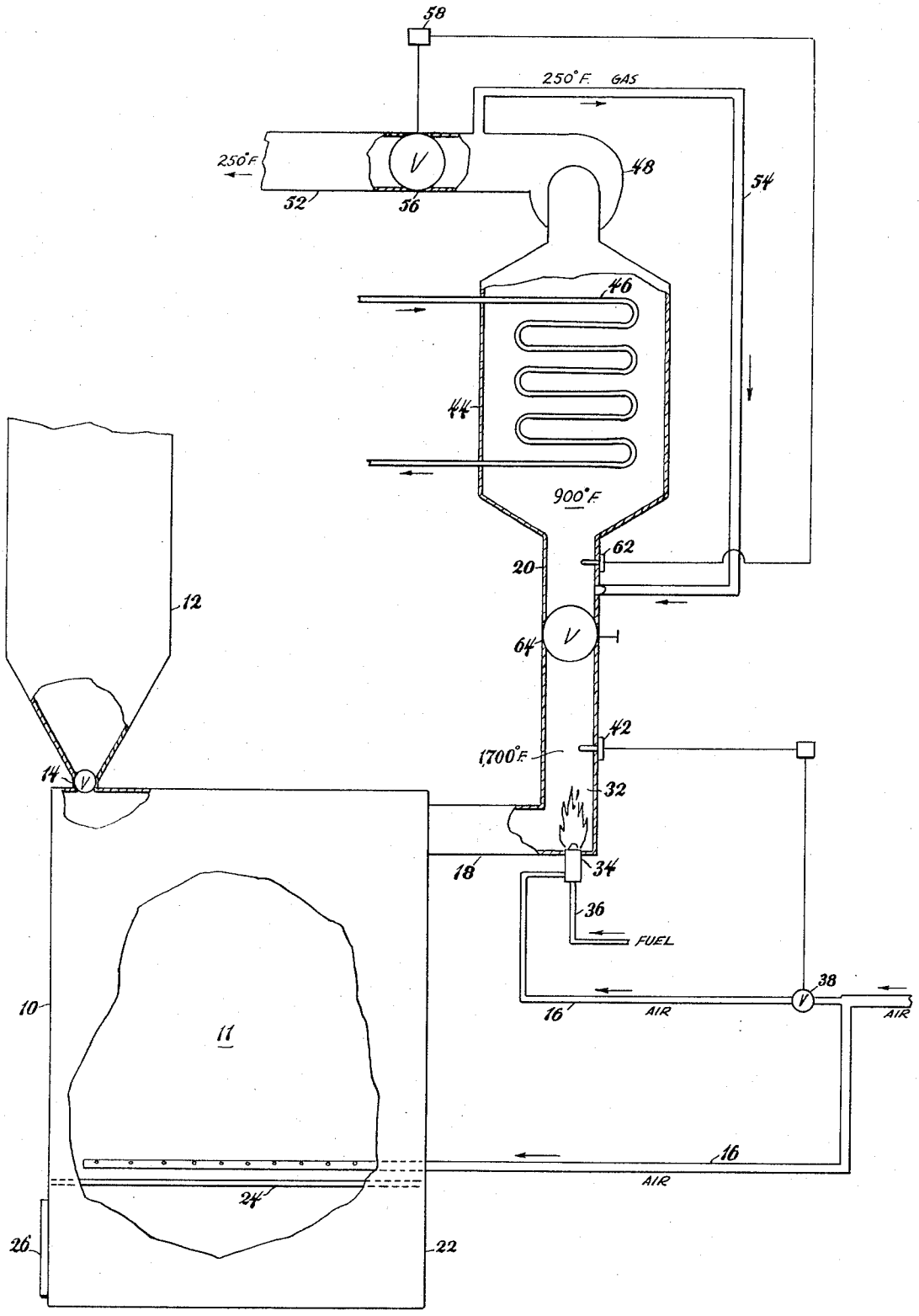
Attorney, Agent, or Firm—Wayne H. Lang

[57] **ABSTRACT**

Apparatus that reduces the high temperature of gas exhausting from an incinerator to a predetermined low temperature at which the exhaust gas may be effectively and efficiently utilized by a waste heat boiler comprised of standard materials.

9 Claims, 1 Drawing Figure

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WASTE HEAT RECOVERY

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an incinerator having a ducting arrangement for hot exhaust gas in which the hot gases exhausting from the incinerator into a waste heat boiler are tempered by gases which have already been cooled by passing through the waste heat boiler by giving up a significant portion of their heat to an independent heat exchange fluid.

2. Description of Prior Art

Conventional incinerators of both industrial and municipal types ordinarily include one or more combustion chambers having an exhaust duct for discharging the hot gaseous products of combustion into the atmosphere. Incinerators of this type satisfactorily eliminate all traces of combustible gases or particulate matter therein due to the high temperature maintained in the secondary combustion chamber through which the gases are directed before they are discharged to the atmosphere. Although the gases being exhausted from the secondary combustion chamber may be free from solid and gaseous pollutants, they are at an extremely high temperature, commonly ranging from 1,700° F. to 2,200° F., a temperature that may be handled only by special heat resistant apparatus attainable at extra cost.

Such high temperature gas has substantial economic value, and various attempts have accordingly been made to utilize the heat contained therein before it is exhausted to the atmosphere.

Before the hot exhaust gas may be processed by conventional heat exchange equipment it is however necessary to reduce the temperature thereof to a level compatible with constituent materials of the heat exchanger. The usual approach is simply to dilute the hot gas with cold ambient air until a suitable low temperature is obtained. Such a procedure satisfactorily lowers the temperature of the hot gas to predetermined levels but it also wastes substantial quantities of heat in raising the cool ambient air to a suitably high temperature before exhausting it to the atmosphere.

The device of this invention therefore lowers the gas temperature by tempering the hot gas with cooler but already heated gas exhausting therefrom. Inasmuch as no cool ambient air is admitted and then heated before being discharged to the atmosphere, the entire process attains a high degree of efficiency not attainable with other known arrangements.

SUMMARY OF THE INVENTION

The apparatus particularly defines an incinerator arrangement wherein the hot exhaust gases thereof are directed in heat exchange relation with a heat exchange fluid in a waste heat boiler. In order that the waste heat boiler may operate at a moderate temperature well below the usual temperature of the incinerator exhaust gas, the incinerator exhaust gas is diluted with already cooled gas that is exhausting from the waste heat boiler.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE is a schematic drawing that shows an incinerator with a waste heat boiler arranged according to this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings an incinerator housing **10** surrounds a chamber **11** that is adapted to receive an amount of waste material to be burned from a storage container **12** that is separated therefrom by a suitable air-lock type feeding device **14.** The incinerator is provided with a duct **16** that provides a source of air for combustion and an exhaust duct **18** through which gases of combustion are exhausted. Subjacent the incinerator housing **10** is an ash pit **22** to which ashes are dropped through trap-door arrangement shown schematically at **24.** A clean-out door **26** is provided to remove any ash accumulation from the ash pit **22.**

The exhaust duct **18** is connected to an afterburner chamber **32** in which is positioned a burner **34** having a source of fuel **36** and air **16.** The flow of air is regulated by a control valve **38** acting in response to thermocouple **42** downstream from the afterburner so that a predetermined temperature is maintained in the afterburner chamber.

In accordance with this invention a waste heat boiler **44** is positioned in the exhaust duct for the incinerator, downstream from the afterburner **34.** The waste heat boiler is provided with a passageway **46** through which a heat exchange fluid may be directed in heat exchange relation with the hot gases exhausting from the afterburner.

After passing through the waste heat boiler the hot exhaust gases from the afterburner are directed to the inlet of a fan means **48** that in turn exhausts the gases through an outlet **52** to the atmosphere.

Inasmuch as the average temperature of gases exhausting from the afterburner chamber **32** may range from 1,700° F. to 2,200° F., the ductwork, the waste heat boiler **44,** and all related equipment must be comprised of materials which are resistant to corrosion and erosion at high temperatures. Since such materials are generally expensive and difficult to obtain, this arrangement will lower the temperature of the hot exhaust gas flowing into the waste heat boiler by tempering it with a cooler gas.

A source of cooler gas, readily available for the tempering purposes is the hot gas being exhausted from the waste heat boiler at duct **52.** Accordingly, I provide a recirculation duct **54** that extends from a point downstream from fan **48** to a point upstream from the waste heat boiler so that hot gas already cooled by passing through the waste heat boiler **44** is directed back into duct **18** to mix with the exhaust gas from the afterburner **34.**

In order that cool gases from fan **48** are forced back through duct **54** instead of being exhausted directly to the atmosphere through duct **52,** a valve **56** is provided in the duct **52.** This valve **56** is controlled by a control device **58** in response to a thermocouple **62** at the inlet of the waste heat boiler, and is adapted move toward a "closed" position upon an increase in temperature at the thermocouple in order that an increased amount of already cooled gas will be directed back through duct **54.**

A damper valve **64** just downstream from afterburner chamber **32** permits precise regulation of the exhaust gas flow from the afterburner necessary to obtain the desired flow conditions that dictate a predetermined temperature.

By this arrangement gas exhausting from afterburner chamber **32** may be cooled to a predetermined temperature that is compatible with construction materials used in the manufacture of waste heat boiler **44.**

It is generally agreed that special materials resistant to high temperature be specified for construction when the temperature of the waste heat boiler is expected to exceed 900° F. Therefore, the controller **58** responding to temperature of thermocouple **62** is set to limit the temperature at the entrance of the waste heat boiler to 900° F. Inasmuch as gases exhausting from the afterburner **34** may be 1,700° F. or more, the thermocouple **62** acting through controller **58** partially modulates valve **56** acting through controller **58** partially modulates valve **56** to force gas exhausting from waste heat boiler at approximately 250° F. to pass through duct **54** back to the inlet **20** to the waste heat boiler where it is mixed with the hot gases exhausting from the afterburner until the resulting mixture at the thermocouple **62** is at the set point, which is in this instance 900° F.

If the temperature at the thermocouple **62** should fall below the set point (900° F.), the thermocouple will signal the controller **58** to open valve **56** whereby there will be less back pressure at this point. Accordingly, less cool exhaust gas will recirculate through duct **54** back to the main exhaust duct to mix with the high temperature exhaust gas. There will be less dilution of the hot exhaust gas and its temperature will rise to compensate for its previous lowering.

The opposite will be true for an increase in temperature at the thermocouple **62** beyond the predetermined set point. Here the controller **58** will move valve **56** toward a "closed" position whereby there will be greater back-pressure upon the exhaust from fan **48** and increased flow back through duct **54** to provide increased dilution with the result that the temperature of the gas at the inlet of the waste heat boiler will be lowered.

While the arrangement of this invention has been defined with respect to particular temperatures, it should be understood that the embodiment shown is illustrative only and not restrictive of the invention.

I claim:

1. Apparatus for the incineration of organic material including a primary combustion chamber having an inlet for waste material and an outlet for the exhaust of hot gases therefrom, a waste heat boiler having an inlet duct for hot gas and an outlet duct for cooled gas, a main duct connecting the outlet of the primary combustion chamber with the inlet duct of the waste heat boiler, a source of heat exchange fluid, means directing the heat exchange fluid through the waste heat boiler in heat exchange relation with the hot gas exhausting from the primary combustion chamber, an inlet port for recirculation gas located in the main duct in advance of the waste heat boiler, an outlet port for recirculation gas located in the outlet duct of the waste heat boiler, a recirculation duct connecting the inlet port to the outlet port, and means for moving cooled gas exhausting from the outlet port, and neons for moving cooled gas exhausting from the outlet duct of the heat boiler through the recirculation duct to the main duct to mix with the hot exhaust gas from the incinerator to lower the temperature thereof before it is directed through the waste heat boiler.

2. Apparatus for the incineration of organic material as defined in claim **1** wherein the means for moving the cooled gas through the recirculation duct comprises an exhaust fan.

3. Apparatus for the incineration of organic material as defined in claim **2** wherein the exhaust fan for moving the cooled gas through the recirculation duct is located in the outlet duct from the waste heat boiler.

4. Apparatus for the incineration of organic material as defined in claim **3** including a damper means in the outlet duct leading from the waste heat boiler positioned downstream from the outlet port for recirculation gas.

5. Apparatus for the incineration of organic material as defined in claim **4** including a thermocouple in the inlet duct leading to the waste heat boiler, and means responsive to said thermocouple for regulating the damper in the outlet duct of the waste heat boiler.

6. Apparatus for the incineration of organic material as defined in claim **5** wherein the means responsive to the thermocouple places a closing bias upon the damper in the outlet from the waste heat boiler in response to an increase in temperature on said thermocouple.

7. Apparatus for the incineration of organic material as defined in claim **6** including a damper in the main duct in advance of the inlet port for recirculation gas controlling the flow of gas exhausting from the incinerator to the waste heat boiler.

8. Apparatus for the incineration of organic material as defined in claim **1** including an afterburner in the main duct in advance of the inlet port for recirculation gas.

9. Apparatus for the incineration of organic material as defined in claim **8** including a flow control means in the main duct intermediate the afterburner and the inlet port for recirculation gas adapted to control the flow of gas exhausting to the waste heat boiler.

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