United States Patent

Gach et al.

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[54] **BURNER FOR INCINERATOR**

[72] Inventors: **Francis X. Gach; Ralph E. Fanton; Noel D. Hazzard,** all of Wellsville, N.Y.

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

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[52] **U.S. Cl.** ....**110/8 A,** 431/80

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

[58] **Field of Search**.....110/8 A, 8 R; 431/51, 52, 53, 431/78, 80

[56] **References Cited**

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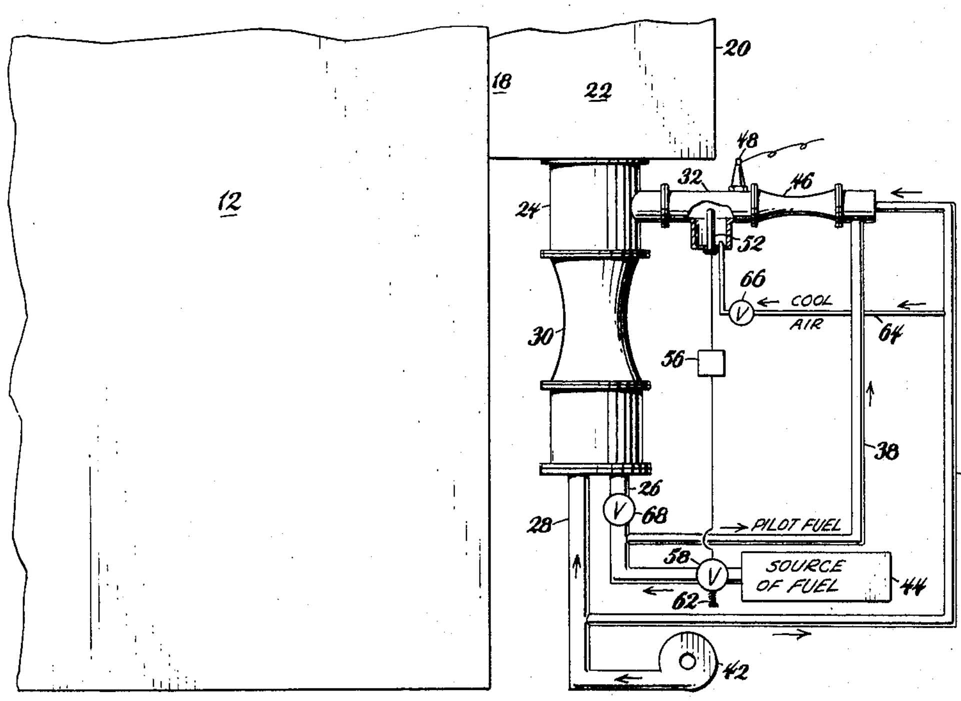
Primary Examiner—Kenneth W. Sprague
Attorney—Wayne H. Lang and Eldon H. Luther

[57] **ABSTRACT**

An incinerator having a pilot burner indicating safety control means that responds rapidly to a change of temperature therein to shut off all fuel flow when the flame is extinguished. This safety control means precludes the collection of unburned fuel in a manner that presents extreme fire and explosion hazards.

7 Claims, 2 Drawing Figures



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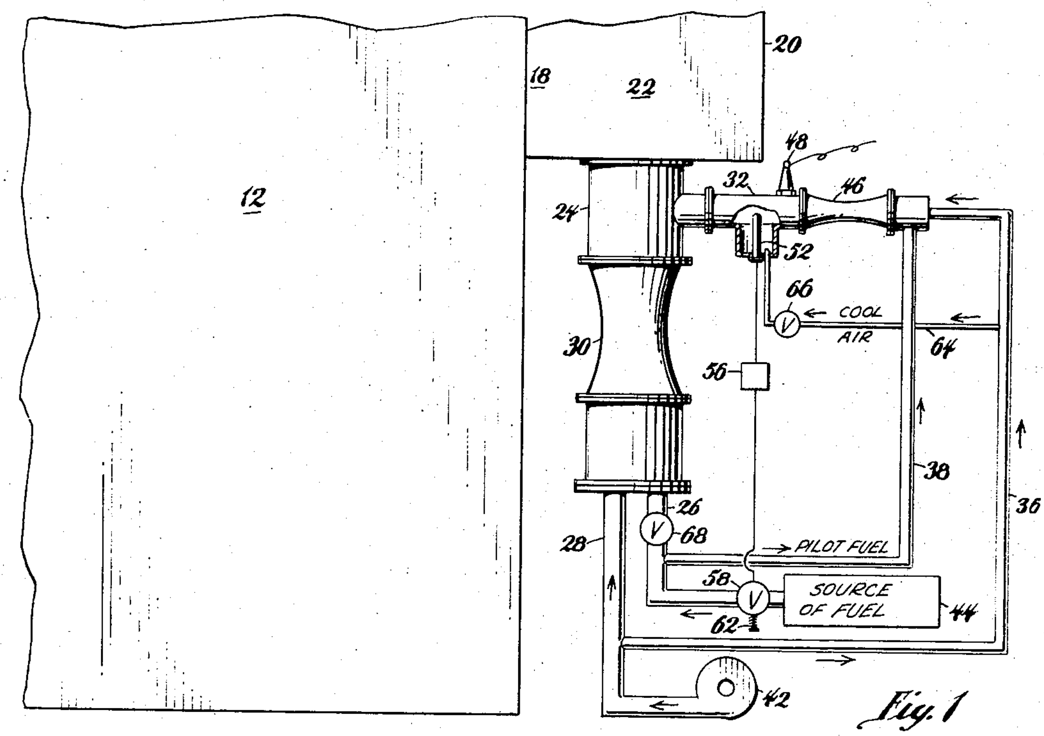

Fig. 1

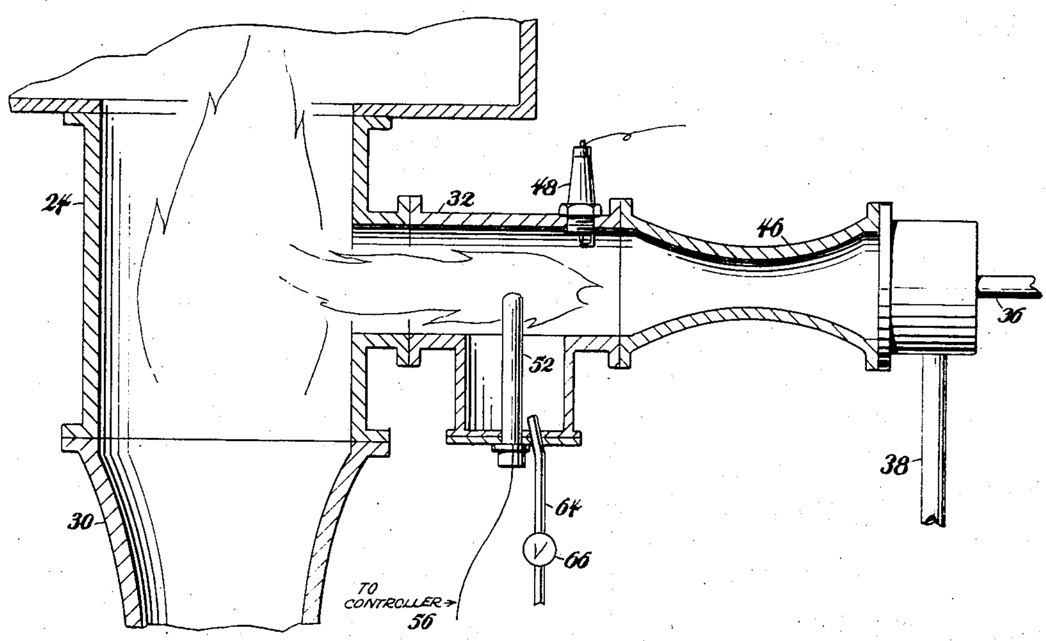

Fig. 2

INVENTOR.
Ralph E. Fanton
Francis X. Gach
BY Noel D. Hazzard

Wayne H. Lang
AGENT

BURNER FOR INCINERATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a control mechanism for the burner of an incinerator that precludes the flow of fuel thereto when the burner flame is extinguished. Unburned fuel is thus prohibited from being freely fed into the combustion chamber where it may collect and cause an explosion or fire hazard when it is again subjected to an open flame.

2. Description of Prior Art

Although "fail-safe" devices depending upon flame ionization or other sophisticated photo-electric components have been developed to perform the above stated function in the manner defined by U.S. Pat. No. 3,551,908, such devices are complex from an operational standpoint and they are economically expensive to operate and maintain so that their use has never been widely accepted by industry for low cost application.

Other available devices which perform a similar function in response to a temperature variation are much less expensive to operate but are slow in response or at best they respond at variable rates of speed so that a response may take from thirty seconds to as much as two minutes after the flame is extinguished. Since raw fuel may continue to be fed into the burner until the control means responds to the loss of flame, fuel may be fed into the burner for up to two minutes after flame cut-off. When combustion is again commenced, excess fuel that has collected in the combustion chamber may create a dangerous explosion hazard or at least it will create conditions that promote incomplete combustion and the harmful generation of excess smoke.

SUMMARY OF THE INVENTION

It is well known that in most applications a significant time delay exists between the extinction of a burner flame and the response of a thermocouple thereto. This is because a thermocouple responds to heat change and the physical structure of the surrounding burner assumes a near flame temperature which loses its heat only slowly when deprived of the heat from the flame. If a safety device such as a fuel shut-off valve is dependent upon a heat variation in the burner similar to that provided by a termination of the flame, fuel may continue to flow for some time after conditions would otherwise warrant a complete shut-down. When combustion is again initiated, the ingredients of an explosion are present in the collection of unburned fuel and the supply of air.

Moreover, a thermocouple used to detect burner conditions is arranged to be subject to maximum temperature variation and thus it is usually placed directly in the path of the flame emanating therefrom. By this arrangement the thermocouple is necessarily placed directly in the zone of greatest corrosion and erosion. Thus a thermocouple applied in this manner is continuously subjected to excess corrosion and erosion from the hot combustion gases so that its life expectancy is comparatively short and frequent replacement is required.

Therefore the arrangement of this invention will find immediate application in the control of fuel to burners when safety conditions require that fuel flow thereto be terminated quickly after the burner flame is interrupted or combustion otherwise ceases. Further, this arrangement may be used to provide conditions that provide for complete and smoke-free combustion in a burner. Finally the arrangement defined will provide extended life to a thermocouple used in combination therewith.

The above and other features and advantages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The nature of our invention and the unique advantages thereof will become clear to those skilled in the art from the following detailed description of the invention and the accompanying drawings in which:

FIG. 1 is a schematic diagram of the burner system including a fuel supply valve and a thermocouple according to this invention, and

FIG. 2 is an enlarged diagram showing the details of the thermocouple cooling means.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 of the drawing we show an arrangement including an incinerator enclosing a principle combustion chamber **12** having an inlet port closed by a door at one end and an outlet port **18** at the other. Gases from the combustion of wastes in the combustion chamber escape through the outlet port and exhaust through stack **20** to the atmosphere.

Gases exhausting through outlet port **18** are subjected to secondary combustion in afterburner **22** by the exhaust from a burner **24** that is lighted by the exhaust from the combustion of fuel and air ignited in pilot burner **32**. Flames exhausting from the pilot burner **32** accordingly discharge into burner **24** and then afterburner **22** at the lower end of stack **20** to subject the combustible gases therein to further combustion.

Although it would appear that the obvious location for a flame sensing means used to detect the existence of flame in the burner **24** would be in or adjacent to the burner itself, such a means to be effective must be of the highly sophisticated photo-electric or electronic devices that are expensive to install and to operate. Moreover, this type apparatus is also subject to viewing extraneous flame so that a true indication of flame condition in the burner is not always available.

Conventional thermocouple type apparatus that responds to a temperature change would be suitable from an economic standpoint but they are erratic and slow. Thus upon flame-out, the temperature of the burner **32** would vary only slowly, the fuel supply valve responsive thereto would remain open as long as there was no substantial change of temperature, and raw fuel would continue to be supplied to the burner, even though its flame has terminated.

In accordance with this invention we provide a pilot burner exhausting into a T shaped extension **25** normal to burner **24** so that a pilot flame produced in burner **32** exhausts into burner **24** to ignite air from line **28** and fuel from line **28** and fuel from line **26** that are mixed into a combustible mixture by a mixing device **30**. The pilot burner may receive its air and fuel via lines **36** and

38 from the same sources 42 and 44 that supply the main air and fuel ducts 28 and 26. Air and fuel are thoroughly mixed together in mixing device 46 for combustion in the pilot burner 32. Combustion of fuel and air in the burner 32 is initiated by a spark plug or glow plug 48 having a suitable source of energy (not shown). Thus fuel and air mixture supplied to burner 32 is brought to combustion so the exhaust therefrom may ignite the gases in burner 24 to in turn maintain combustion of exhaust gases in afterburner 22.

The small pilot burner 32 thus produces a flame that ignites the fuel and air mixture in burner 24. Inasmuch as the small pilot burner 32 is isolated even further from the afterburner 20 than is burner 24, only a small amount of heat from the afterburner 22 is transmitted to the burner 24, so the heat content at any time will approach only that supplied by the flame of the pilot burner 32. Thus while a high temperature is obtained in the flame of the burner 32 when the fuel is ignited, a comparatively low temperature is quickly reached when the flame is extinguished.

It has been experimentally determined that a typical thermocouple 52 in a small pilot burner will respond to termination of the flame in burner 32 in from 30–120 seconds time, the range of time required being largely due to the time required for the burner to lose its heat to the ambient air surrounding the burner 32.

Thus an electric signal produced by thermocouple 52 is used to activate the relay 56 which holds the valve 58 in line 26 open against the force of the spring 62 so that fuel from the source 44 may flow to the pilot burner 32 and to the main burner 24. The gas-air mixture in burner 32 is then ignited by the spark plug 48 while fuel-air mixture in burner 24 is ignited by the flame exhausting from pilot burner 32.

When the flame of pilot burner 32 is extinguished the temperature at the thermocouple 52 slowly falls and the signal produced by the thermocouple eventually ceases to activate the relay 56 sufficient to hold the valve 58 against spring 62, and valve 58 closes. Thus all fuel-flow through line 26 to main burner 24 and through branch line 38 to pilot burner 32 is halted until valve 58 can be manually reset.

In accordance with the particular novel feature of this invention the thermocouple 52 is housed in a T shaped extension 35 that comprises a plenum chamber at the side of burner 32 provided with an air supply line 64 extending between the burner 32 housing thermocouple 52 and the conduit 36. A valve 66 in line 64 is made available for the manual regulation of the air therethrough whereby a small but sufficient stream of ambient air at all times may be directed on to the thermocouple 52. Thus the body of the thermocouple in the T shaped extension 35 may be continuously bathed in a stream of cool air at the side of the burner while only the end portion thereof projects completely into the burner and into the burner flame itself so that it is subjected to the extreme corrosive and erosive conditions of the turbulent flame.

Under the above defined arrangement the thermocouple 52 is constantly bathed in a stream of cool air from line 64. Thus, even though the burner 32 is operating effectively to generate heat that produces a signal in thermocouple 52 is sufficient to activate relay 56 and hold valve 58 in an "open" position, extinction of the flame will permit the cool air from duct 64 to quickly envelop the entire thermocouple and lower its temperature to terminate the signal which effectively holds the valve 58 open. When valve 58 closes all fuel flow to the main burner 24 and the pilot burner 32 is immediately stopped. Valve 68 to the main burner is manually operated so that fuel will not again be permitted to flow to burner 24 until the pilot burner 32 has been placed into operation. It has been found in practice that complete shut-down of valve 58 and curtailment of fuel flow therethrough will occur in but 5–15 seconds after flame extinction when the thermocouple is bathed in a cool air stream according to this invention. To initiate operation of the device the first requirement is to start the blower 42 to supply air to the pilot and main burners. The ignition means 48 is actuated and the operator then depresses the actuator 62 to open valve 58 to permit the flow of fuel through supply line 38 to the mixing device 46 and through open valve 68 in line 26 to the mixing device. Air is then mixed with the gas to produce a combustible mixture which is ignited by means 48 in burner 32. Heat from the burning fuel mixture in the pilot burner activates the thermocouple 52 and produces a voltage signal that in turn holds the valve 58 open so that fuel from source 44 will burn in the pilot burner.

After the pilot burner has been satisfactorily placed in operation, the valve 68 is opened and fuel allowed to flow through line 26 to device 30 where it is mixed with combustion air. As the fuel-air mixture passes through burner 24 it contacts the combustion gases emanating from the pilot burner 32 and the entire mixture is brought to a state of combustion. Combusting gases in burner 24 then exhaust into afterburner 22 to subject the combustible gases from the combustion chamber 12 to complete combustion.

The invention described herein and illustrated in the accompanying drawings is believed to admit to many modifications within the ability of persons skilled in the art, all such modifications being considered to lie within the spirit and scope of the appended claims.

We claim:

1. A burner system for an incinerator comprising a housing, a fuel supply conduit connected to said housing for the supply of fuel thereto, a source of air connected to said housing to supply air for combustion thereto, means for mixing the fuel and air to provide a combustible mixture in said housing, means for igniting the mixture of fuel to and air to produce a flame, a branch chamber at the side of said housing downstream from the means igniting the fuel and air mixture, a thermocouple in said branch chamber subjected to the temperature of the burning fuel and air, valve means in the fuel supply conduit adapted to regulate the flow of fuel to the burner, means responsive to said thermocouple holding the valve in an open position, and an air supply duct connecting the branch chamber to the source of air whereby the thermocouple therein may be continuously bathed in a cool air stream flowing from said source.

2. A burner system for an incinerator as defined in claim 1 including the valve means in the air supply duct connecting the source of air to the branch chamber whereby air flowing over the thermocouple may be regulated to completely bathe the thermocouple when the flame of the pilot burner is extinguished.

3. A burner system for an incinerator as defined in claim **1** wherein the thermocouple in the branch chamber extends concentrically therethrough to the nominal periphery of the flame in the pilot burner.

4. Apparatus for burning combustible waste products including a housing with inlet and outlet ports enclosing a primary combustion chamber, an exhaust stack connected to said outlet port to enclose a secondary combustion chamber, a main burner connected to the secondary combustion chamber to exhaust flame therefrom into said secondary combustion chamber, a source of fuel connected to said burner to supply fuel thereto, a source of air connected to said burner, means for mixing the fuel and air to provide a combustible mixture, a pilot burner for igniting the fuel and air in said main burner, a thermocouple intermediate the pilot burner and the main burner responsive to the temperature of the pilot burner, and means continuously subjecting the thermocouple in the pilot burner to a cooling temperature.

5. Apparatus for burning combustible waste products as defined in claim **4** including air and fuel ducts connected to said pilot burner, and means responsive to said thermocouple controlling fuel flow to the main burner.

6. Apparatus for burning combustible waste products as defined in claim **5** wherein the means that provide a cooling temperature for the thermocouple comprises an air duct connected to the source of air for the burners.

7. Apparatus for burning combustible waste products as defined in claim **6** wherein the means responsive to the thermocouple comprises a valve means, spring means biasing said valve to a closed position, and means responsive to said thermocouple holding the valve open against action of the spring.

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