May 17, 1966 R. E. EDWARDS 3,251,656

FUME INCINERATION SYSTEM

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Fig. 1.

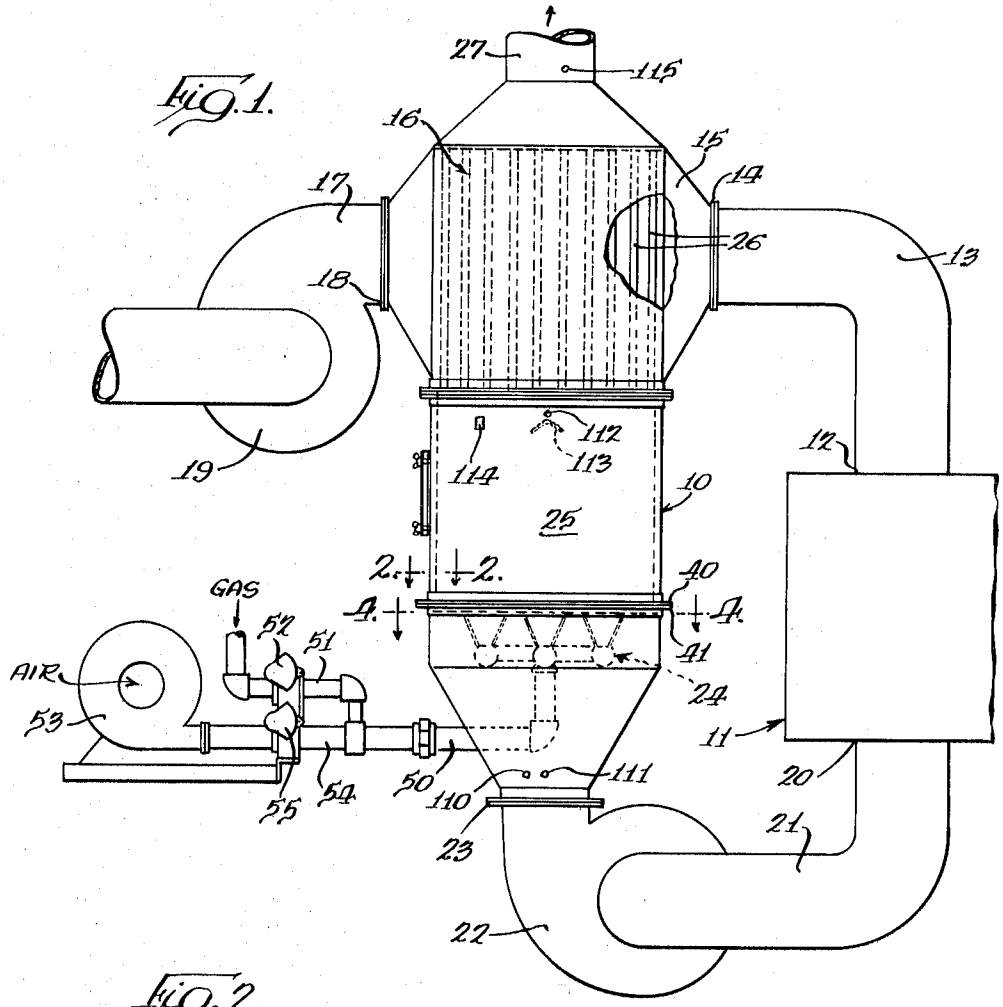


Fig. 2.

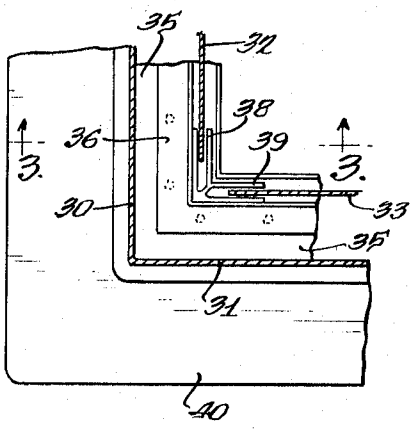
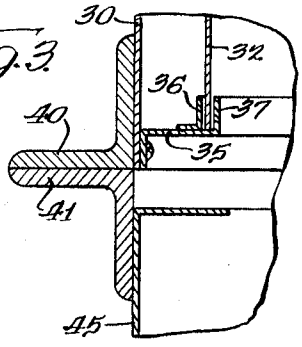


Fig. 3.



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Fig. 4.

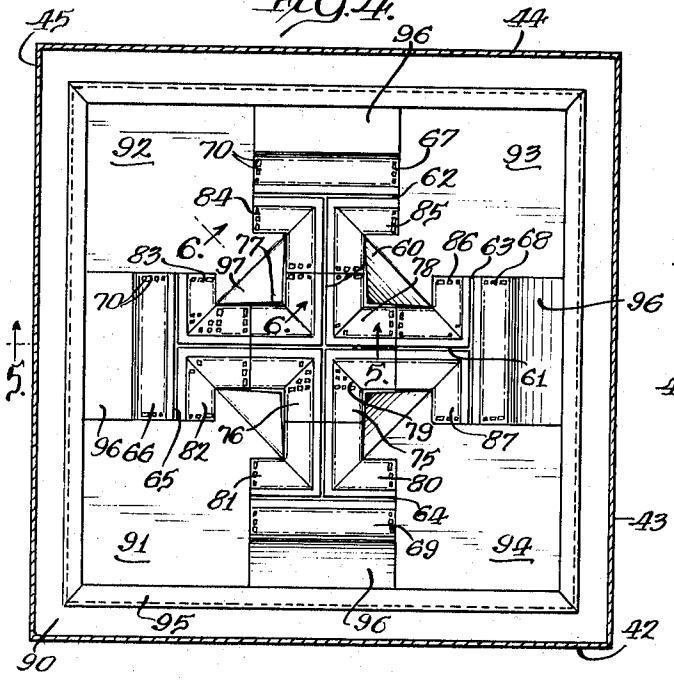


Fig. 7.

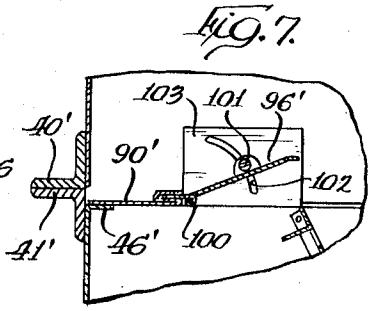


Fig. 5.

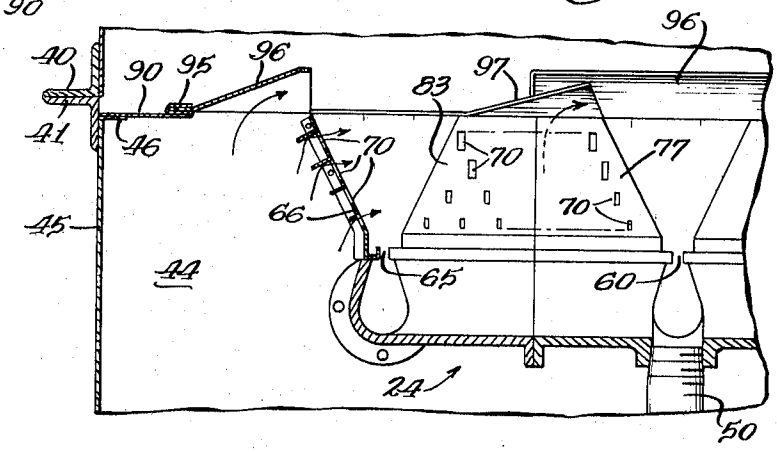
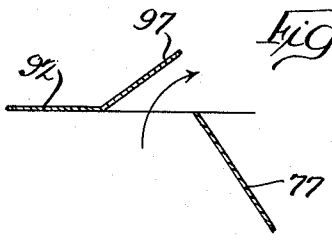


Fig. 6.



United States Patent Office 3,251,656 Patented May 17, 1966

3,251,656

FUME INCINERATION SYSTEM

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Filed July 13, 1961, Ser. No. 123,861
6 Claims. (Cl. 23—277)

This invention relates to a system utilizing heated gas, such as air, and creating combustible fumes and more particularly to a fume incinerator for such a system.

An object of this invention is to provide a new and improved method and apparatus for burning combustible fumes.

Another object of the invention is to provide a fume incinerator for burning combustible fumes which forms part of a system utilizing heated gas and creating the fumes which may be noxious in which the fumes are burned for discharge and the heat created in combustion of the fumes is caused to heat air for make-up or ventilation.

Still another object of the invention is to provide a fume incinerator in which fume-laden air is supplied to a combustion area at a predetermined velocity to function as secondary air in combustion, fuel and primary air are supplied through a burner to the combustion area at a predetermined rate to provide a temperature sufficient for combustion of the fumes, and means are provided in the form of apertured members and baffles providing for complete intermixing of the primary air and fuel with the fume-laden air to insure complete combustion of the fumes.

Further objects and advantages will become apparent from the following detailed description taken in connection with the accompanying drawings in which:

FIG. 1 is a front elevational view of the system disclosed herein and the fume incinerator forming a part thereof;

FIG. 2 is a fragmentary plan view on an enlarged scale taken generally along the line 2—2 in FIG. 1;

FIG. 3 is a vertical fragmentary section taken generally along the line 3—3 in FIG. 2;

FIG. 4 is a horizontal section taken on an enlarged scale taken generally along the line 4—4 in FIG. 1;

FIG. 5 is a fragmentary vertical section taken generally along the line 5—5 in FIG. 4 and on a further enlarged scale;

FIG. 6 is a fragmentary section taken generally along the line 6—6 in FIG. 4; and

FIG. 7 is a fragmentary view similar to the left-hand part of FIG. 5 of a modified form of baffle mounted for adjustment.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail an embodiment of the invention together with a modification thereof with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

As shown in FIG. 1, the system embodies a fume incinerator indicated generally at 10 associated with a unit 11 which gives off noxious or other combustible fumes, such as a dryer for lithographed sheets or plates. As an example, such fumes can be aromatic hydrocarbons or generally resinous fumes, such as vinyls. In the drawing, the unit 11 is shown as utilizing heated air and thus an inlet end 12 thereof is connected by a duct 13 to an outlet 14 of a casing 15 which houses a heat exchanger indicated generally at 16. Air enters the heat exchanger 16 through an inlet duct 17 connected to an inlet 18 of the heat exchanger casing 15. Air is caused to flow through the inlet duct 17 by a blower 19 and through the heat exchanger 16 to the unit 11 with the air being heated to a desired temperature by the heat exchanger.

The unit 11 has an outlet end 20 connected by a duct 21 to a blower 22 which draws the noxious fumes from within the unit 11 and directs them to an inlet end 23 of the incinerator 10. In general, the fume incinerator 10 embodies a pressure burner structure, indicated generally at 24, located near the lower part of the incinerator (when disposed vertically as shown) which supplies a mixture of a fuel, such as gas, and primary air to the interior of the fume incinerator. The fume-laden air entering through the inlet 23 is caused to mix with the fuel and primary air mixture supplied by the burner 24, with combustion taking place immediately above or downstream of the burners and within a central area of the casing indicated at 25. The products of combustion then pass from the chamber 25 through a series of tubes 26 in the heat exchanger and then through a flue 27 for discharge to atmosphere.

The casing of the fume incinerator, as well as that of the heat exchanger section 15, is generally square in cross section with a hollow interior and with the construction being shown in more detail in FIGS. 2, 3 and 4. As shown in FIG. 2, the combustion chamber 25 is defined by a double-wall construction in which the four external side walls, two of which are shown at 30 and 31, are spaced from a set of interior walls, with interior walls 32 and 33 being disposed adjacent the external walls 30 and 31, respectively. In order to prevent warping of the interior walls, these walls are mounted for expansion. As shown with respect to the interior wall 32 in FIG. 3, the lower edge of the wall is supported by a bracket 35 running along and attached to the lower edge of the external wall 30 and a L-shaped channel 36 is spaced from an up-turned flange 37 on the bracket to define a channel loosely receiving the lower edge of the interior wall. Also at each corner of the casing the vertical edges of the walls are received in channels extending between the lower brackets 35 and corresponding upper brackets (not shown) at the upper end of the combustion chamber. These channels are indicated at 38 and 39.

The casing is formed of sections with adjacent sections secured together by butted joint members, such as indicated at 40 and 41 in FIG. 3. The casing at a level beneath the joint members 40 and 41 is defined by four side walls 42, 43, 44 and 45 which, as shown in FIG. 5, have inturned upper flanges as indicated at 36 with respect to the side wall 45 for support of partition means described hereinafter.

The fuel and primary air mixture enters the casing of the fume incinerator under pressure through a pipe 50. The gas is supplied to the pipe 50 through a line 51 including a metering valve 52 while the primary air is supplied by a blower 53 connected to a line 54 having a metering valve 55 therein. With the adjustment of the valves 52 and 55, the desired ratio and quantity of primary air and fuel can be supplied to the pipe 50 and therefore to the burner 24 for obtaining the proper temperatures within the combustion chamber.

The primary air and fuel mixture passes from the pipe 50 into a base section of the burner 24 which is formed of generally hollow cast members which have emitting orifices along the top thereof as shown in FIGS. 4 and 5. Specifically, the burner 24 is composed of a plurality of commercially available sections which, when assembled as shown in FIG. 4, result in fuel and primary air emitting orifices with two primary elongate orifices 60 and 61 extending at right angles to each other as viewed in FIG. 4 and with additional emitting orifices

62, 63, 64 and 65 arranged transversely and at the ends of the orifices 60 and 61.

The burner 24 has a series of inclined apertured plates associated therewith and arranged adjacent to the emitting orifices of the burner with a peripheral set of the plates being indicated at 66, 67, 68 and 69 in FIG. 4 and with the plate 66 being shown in detail in FIG. 5. The plates 67, 68 and 69 are arranged in similar relation with respect to their respective orifices 62, 63, and 64. As shown in FIG. 5 with respect to the apertured plate 66, a series of ports 70 provide for gas flow from the left-hand side to the right-hand side thereof. Additional apertured plates are provided so that the entire length of all of the emitting orifices has apertured plates adjacent thereto. A set of four apertured, inclined plates 75, 76, 77 and 78 are arranged within the four quadrants at the intersection of the orifices 60 and 61 with each of the plates having a fold-line, such as shown at 79, for the plate 75 whereby apertured plate area is adjacent the emitting orifice portions of the burner. To complete the relation of apertured plates to the emitting orifices, additional inclined plates 80, 81, 82, 83, 84, 85, 86 and 87, with central creases or folds therein, lie adjacent the interior surface of the emitting orifices 62, 63, 64, and 65 and abut the plates 75–78, respectively.

The aforesaid series of apertured plates span a substantial part of the casing interior whereby the fume-laden air entering the inlet 23 is caused to pass at a relatively high velocity into the casing and through the apertures 70 in the plates. This passage of high-velocity, fume-laden air results in establishing a negative pressure at the downstream side of said plates relative to the flow of the fume-laden air, which draws the fuel and primary air mixture emitted from the orifices along the plates to insure thorough intermixing thereof with the fume-laden air. This fume-laden air thus provides secondary air for combustion and due to the intermixing insures that all of the noxious fumes passing through the apertures 70 will be burned.

In order to reduce the static pressure drop across the burner resulting in less horsepower required for the blower 22, baffling is provided to permit certain amounts of the fume-laden air to pass into the combustion area for combustion without passing through the apertures 70 in the apertured plates. In order to control the passage of the air, the upper ends of the walls 42–45 have the in-turned flanges 46 as described previously, which support a peripheral panel 90 which has a series of plates 91, 92, 93 and 94 secured to the internal edges thereof by a suitable sheet metal lock as indicated at 95. These panels effectively close off the cross-sectional area within the casing except for the series of baffles 96 associated one with each of the panels which overlie the apertured plates 66–69. Each of the panels has a second baffle 97 turned upwardly therefrom to overlie the apertured plates 76–79 as well as parts of the apertured plates 80–87.

The baffles 96 and 97 thus provide passages for fume-laden air other than through the apertured plates which cause the fume-laden air to be directed into the area of the flame and break up the flame, which prevents a direct upward passage of the hottest part of the flame.

In order to control the static pressure drop across the burner to compensate for temperature and volume changes in the fume-laden air as well as to control the velocity of the fume-laden air through the burner, to maintain constant flame length, the baffles 96 can be adjustably mounted as shown in the embodiment of FIG. 7. In FIG. 7, parts similar to those shown in FIGS. 1–6 are identified with the same reference numerals with a prime affixed thereto. The baffle 96' is pivotally mounted to the partition member 90' as by a hinge joint 100 and the inclination of the baffle 96' can be adjusted and held in adjusted position by a suitable tightening bolt 101 attached to the baffle and passing through a slot 102 in a plate 103 upstanding from the associated panel 91–94. By this adjustment of the baffles, the quantity of fume-laden air bypassing the apertured plates can be controlled.

The casing is provided with several test openings with a pair of lower openings 110 and 111 providing a sampling port for the fume-laden air and a temperature check probe, respectively. A control bulb 112 is located near the upper end of the combustion chamber and it is shielded by a radiant baffle 113. The bulb determines the temperature within the combustion chamber and controls the fuel and primary air mixture passing through the pipe 50 by a suitable control circuit. An additional sampling port is provided at 114 and a probe is provided in the flue 115 for checking the stack temperature of the combustion products. As is well known in connection with burners, a suitable remotely controlled pilot can be located adjacent the burner 24.

In order to burn the noxious fumes, as an example, the ignition temperature thereof may be 900° F., and this temperature is maintained by supplying suitable quantities of fuel through the line 50 to the burner. The velocity of the fume-laden air is controlled by suitable control of the blower 22 in a known manner to maintain a constant operating velocity providing for a proper flame length, since it is necessary to keep the flame within limits to insure that all of the fume-laden air is caused to contact the flame. Also, the static pressure drop across the burner can be controlled by adjustment of the baffles 96 to provide for the minimum horsepower utilization by the blower 22 and the baffles also function to direct fume-laden air into the flames and break up the upward passage of the hottest part of the flame to avoid any bypassing action.

As stated previously, the heat exchanger 16 utilizes the heat from combustion for heating air passing therethrough which, as shown, passes to the unit 11 which may be a dryer utilizing the air as make-up air or, alternatively, air passing out of the heat exchanger can be used as ventilating air for the plant in which the incinerator is located.

I claim:

1. A fume incinerator and blower combination for burning combustible fumes comprising, a casing having side walls and an inlet for fume-laden air, a series of perforated plates extending generally transversely of the casing, partition means extending generally transverse of said casing between the side walls and said plates, blower means in advance of said perforated plates for causing the fume-laden air to pass through the perforations in said plates at a high velocity and burner means having nozzles extending along an edge of said plates for directing a fuel and primary air mixture across the downstream side of said plates whereby the fume-laden air intermixes therewith to provide secondary air for combustion with the negative pressure created by passage of the fume-laden air through the perforations drawing the fuel and primary air mixture along said plates to ensure a mixing of fuel with the fume-laden air for combustion of the fumes.

2. A fume incinerator and blower combination for burning combustible fumes comprising, a casing having side walls and an inlet for fume-laden air, a series of perforated plates extending generally transversely of the casing, partition means extending generally transverse of said casing between the side walls and said plates, blower means in advance of said plates for causing the fume-laden air to pass through the perforations in said plates at a high velocity, burner means having at least one nozzle adjacent an edge of said plates for directing a fuel and primary air mixture across the downstream side of said plates whereby the fume-laden air intermixes therewith to provide secondary air for combustion with the negative pressure created by passage of the fume-laden air through the perforations drawing the fuel and primary air mixture along said plates to ensure a mixing of fuel with the fume-laden air for combustion of the fumes, a series of bypass passages through said partition means for causing some fume-laden air to bypass the perforated plates, and

a series of baffles associated one with each of said passages for directing the bypassing fume-laden air toward the fuel and air mixture at the downstream side of said plates to break up a flame resulting from the burning.

3. A fume incinerator as defined in claim 2 in which one or more of said baffles is adjustable to control the static pressure drop across the perforated plates.

4. An incinerator as defined in claim 1 in which said partition means have baffles extending generally transverse of the casing and spaced from the perforated plates defining fume-laden air channels adjacent the plates directing fume-laden air generally transverse to the path of the flame from the burner means to break up the flame and obtain intermingling while reducing the static pressure drop across the burner means.

5. An incinerator as defined in claim 4 in which one or more of said baffles are adjustably mounted to control the size of the associated fume-laden air channel.

6. An incinerator as defined in claim 4 having a heat exchanger downstream from the combustion area and

means for directing air through the heat exchanger to be heated for use as make-up or ventilating air.

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