Dec. 9, 1969 H. MOUSHEGIAN ET AL 3,482,532

AFTER BURNER TYPE INCINERATOR

Filed March 4, 1968 2 Sheets-Sheet 1

FIG. 1.

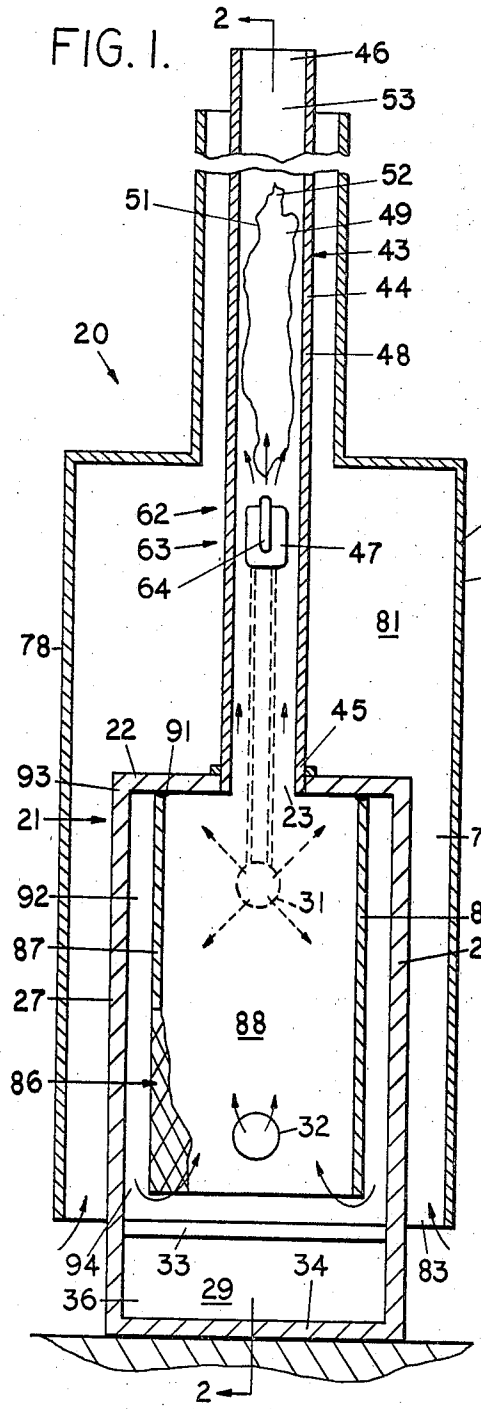
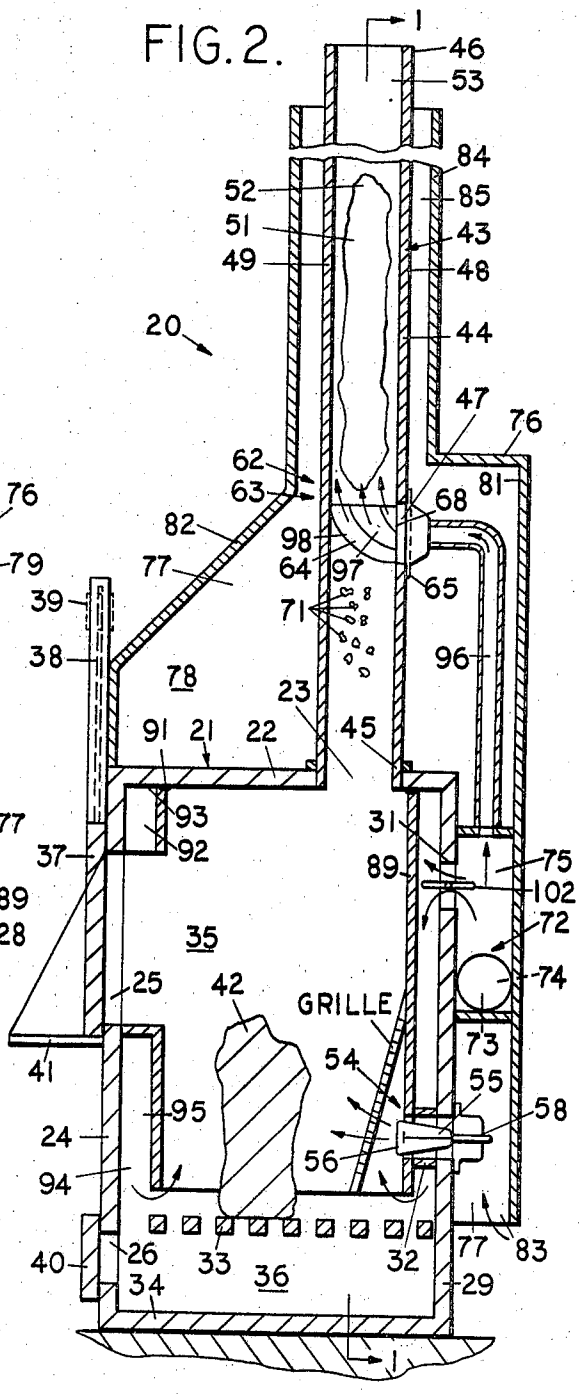


FIG. 2.



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2 Sheets-Sheet 2

FIG. 3.

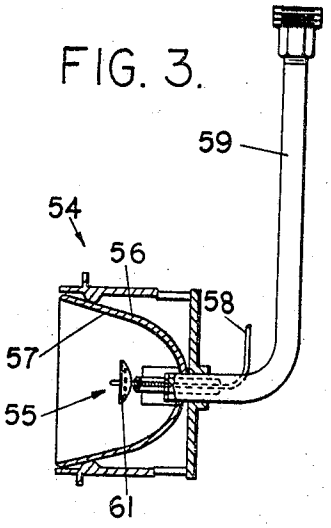
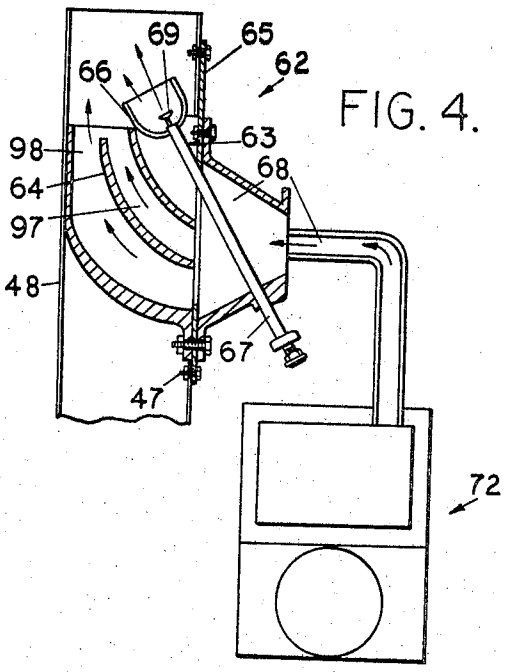


FIG. 4.



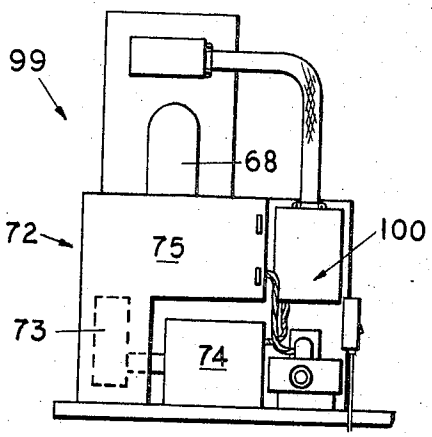


FIG. 5.

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AFTER BURNER TYPE INCINERATOR

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Int. Cl. F23g 3/00
U.S. Cl. 110—8 7 Claims

ABSTRACT OF THE DISCLOSURE

An incinerator is provided with a vertical smoke stack of predetermined height, there being a primary fuel burner in the incinerator combustion chamber and a secondary fuel burner at a spaced location in the stack to form a secondary combustion chamber. The primary and secondary burners operate continuously, and each is supplied with additional air, which has been preheated, to create primary and secondary blast furnaces. The charge in the primary chamber is quickly ignited and consumed and any pollutants in the products of combustion are ignited and consumed in the stack chamber so that the effluent is smokeless and odorless.

BACKGROUND OF THE INVENTION

It has heretofore been proposed to provide an incinerator with a main combustion chamber and with an after burner near the chamber outlet as in U.S. Patent 2,959,140 to Friedberg of Nov. 8, 1960, and U.S. Patent 2,956,526 to Hartmann of Oct. 18, 1960. In these devices the after burner is in advance of the smoke stack or chimney, operates at high temperature often only intermittently, and the main, or primary, burner usually operates at low temperature to either avoid ignition while drying out moisture or to burn slowly to avoid generating pollutants. It has also been proposed to provide false inner walls or shells and exterior shells on incinerators to guide air to various locations in the combustion chamber, as in U.S. Patents 2,146,531 to Craigie of Feb. 7, 1939, and U.S. Patent 2,010,460 to McKinley of Aug. 6, 1935. In both of these patents the incoming air is preheated in the doubled, or false, walls and delivered into the upper portion of the chamber.

However, in the incinerator of this invention, the charge of combustible material, which may be refuse of the type generated at a hosptial, factory or refreshment stand, such as plastic coated receptacles, garbage, paper and the like, or any other type of refuse which produces undesirable polluted smoke when conventionally incinerated, is placed in the air-tight primary combustion chamber. The primary fuel burner and the secondary fuel burner in the smoke stack are simultaneously energized, by electric spark plug ignition, and the blower is also energized all to operate continuously until the charge is consumed. The blower feeds extra air through preheating compartments and thence into the bottom of the primary chamber all around the charge to create a blast furnace effect while also feeding extra air into the centre of the bottom of the secondary chamber in the stack to create a second blast furnace effect which thoroughly consumes any particles moving up the stack. By controlling the amount of extra air injected into the primary combustion chamber, the rate of combustion therein may be slowed to the exact rate which permits the after burner to reduce the smoke at the stack outlet to invisibility.

It is the principal object of the invention to provide a fuel burner incinerator with an after burner in the smoke stack and with pre-heated air blasts associated with each

burner so that a charge is quickly consumed while any pollutants in the stack are simultaneously consumed.

Other objects and advantages of the invention will be apparent from the claims, the description of the drawings, and from the drawings in which:

FIGURE 1 is a front elevation of an incinerator of the invention in section on line 1—1 of FIGURE 2;

FIGURE 2 is a side elevation of the incinerator shown in FIGURE 1, in section on line 2—2 of FIGURE 1;

FIGURE 5 is a rear elevation showing the after burner primary fuel burner and air blast nozzle;

FIGURE 4 is an enlarged, detail, side elevation of the secondary fuel burner means and air blast nozzles; and

FIGURE 5 is a rear elevation showing the after burner assembly of FIGURE 4 as an independent unit attachable on the smoke stack of any incinerator.

As shown in the drawings, the incinerator **20**, of the invention, includes a substantially air-tight furnace casing **21**, preferably of firebox steel, having a top wall **22** with a flue opening **23**, a front wall **24** with an upper charge-intake opening **25**, and a lower ash clean-out opening **26**, and opposite side walls **27** and **28**. The rear wall **29** of casing **21** includes an upper air inlet opening **31** and a lower fuel burner opening **32**, and there is a suitable grate **33** at a spaced distance above the bottom wall **34**. The grate **33** extends between the side, front and rear walls to define an upper primary combustion chamber **35** and a lower ash pit **36**. A suitable ash clean-out door **36** is provided, and a heavy metal door **37** is vertically slidable in frame **38**, with a suitable counterweight **39** to form a closure for the intake opening **25**. Door **37** slides in frame **38** with a predetermined clearance of about one-quarter inch so that it normally tightly seals the opening but is yieldably outwardly in the event of undue pressure in primary chamber **35** caused by discarded pressure cans without damage. A shelf **41** is provided for convenience in temporarily supporting a charge **42** of substance to be incinerated prior to the deposit of the charge on grate **33**.

Vertical smoke stack means **43** includes the smoke stack **44**, preferably of corrosion resistant material such as stainless steel, stack **44** having its lower end **45** fixed in flue outlet **23** and extending upwardly at least eleven feet to an outlet end **46**. A fuel burner opening **47** is provided in the side wall **48** of the usually cylindrical stack **44**, intermediate of the height of the stack and preferably at least ten feet below the level of the outlet **46**. The burner opening **47** in stack **44** defines thereabove, within the stack, a secondary combustion chamber **49**, which is the full diameter of the stack, elongated for four or five feet, and arranged to accommodate a flame **51** of such dimensions. The flame **51** is not normally visible at outlet **46** and its tip **52** is preferably four or five feet below the level of the outlet, although the hot gases of combustion are present in the space **53** between the tip and the outlet. The portion of the side wall **48** enclosing the secondary combustion chamber **49** should preferably be of a material such as stainless steel or a suitable refractory material, even if the remainder of the stack is of other material to avoid break-down due to high temperatures and corrosive pollutants.

Primary blast furnace means **54** includes primary fuel burner means **55**, the burner means **55** preferably being of the gas burner type and having a burner head **56** mounted in the burner opening **32** in the lower portion of primary combustion chamber **35**, just above the level of grate **33**. The term "blast furnace" is used for the reason that the charge **42** is not intended to consume itself without additional fuel, but is intended to be rapidly consumed by the application of a fuel such as gas, and with forced combustion, effected by a current of air under pressure, applied continuously and in controlled volume

to the charge. As best shown in FIGURE 3, the burner head 56 includes a stainless steel cup-shaped reflector 57, a gas inlet pipe 58, and pressurized air inlet pipe 59, all of a well known type, there being a suitable spark plug type ignition 61 and the burner producing a flame which reaches entirely across grate 33 to substantially fill the primary combustion chamber 35.

The secondary blast furnace means 62 includes secondary fuel burner means 63, the burner means 63 also being preferably of the gas burner type and having a narrow burner head 64, mounted on a curved plate 65. Plate 65 covers the opening 47 in side wall 48 of stack 44, and may be welded, bolted, or otherwise secured in place. The narrow head 64 extends transversely across the stack, centrally thereof so as to present a minimum barrier to the straight line, unobstructed flow of the products of combustion, passing up the stack on each opposite side thereof. As best shown in FIGURE 4, the burner head 64 includes a stainless steel cup-shaped reflector 66, a gas inlet pipe 67, and a pressurized air inlet pipe 68, all of a well known type, as well as a spark plug ignition 69. It should be noted that the gas burner means 63 is angled to the axis of the stack 44 to direct a blast of flame in the direction of travel of the smoke toward the outlet, but at an angle of 30°–45° to the stack axis. Thus the blast strikes the opposite wall of the stack and rebounds to create the elongated flame 51 through which all products of combustion 71 must pass and be consumed in advance of the outlet 46.

The forced air blast means 72 of the invention includes a blower 73, which may be of any well known type, driven by an electric motor 74 and delivering air to a plenum 75, all mounted outside casing 21 on the outside casing 21 on the outside of the rear wall 29. An exterior shell 76, of sheet metal, is mounted at a spaced distance outside the primary combustion chamber 35 to form a combined air inlet and air insulation compartment 77 therearound. The shell 76 includes opposite side walls 78 and 79, a rear wall 81, and an inclined front wall 82, there being openings around the bottom at 83 to permit ambient air to be drawn into the compartment by the suction of the blower 73. The exterior shell 76 extends upward vertically around stack 44, as at 84, to form an air inlet and air insulation compartment 85 around the secondary combustion chamber 49, so that substantially the entire incinerator 20 is insulated by ambient cool air flowing through the shell 76 toward blower 73 which is mounted in compartment 77. The air drawn into the single common compartment, formed by compartments 77 and 85, may be slightly preheated depending on the length of time the incinerator has been operating.

However, the principal preheating of influent air is accomplished by an interior shell 86, of sheet metal, mounted at a spaced distance inside the walls of the primary combustion chamber 35, to line the chamber and consisting of the shell walls 87, 88 and 89. The walls 87, 88 and 89 are of heat-resistant material, such as firebox steel, and are welded in place by easily removable welds 91, or detachably bolted, so that the walls can be replaced when necessary. Preferably the pre-heat air compartment 92, formed by the interior shell 86, is closed at the top 93, but provided with air discharge openings 94 at the bottom 95 just above the level of grate 33 and at the level just below the burner head 56. The openings 94 are slot shaped nozzles from which forcible currents of air, indicated by the arrows are continuously discharged entirely around the bottom of charge 42, to support the rapid combustion thereof in primary chamber 35. Not only does the compartment 92 insulate the furnace walls, but the air therein is preheated before reaching the charge to substantially assist combustion. Thus air is induced through air conduit 59 of burner head 56 by the pressurized gas emitted from gas pipe 58, but is also supplied under the pressure of blower 73 to pipe 59 from plenum 75 and additional air is supplied under pressure to nozzles 94

from plenum 75 by way of the opening 25 and compartment 92.

Similarly an air conduit 96 carries air from plenum 75 through air inlet pipe 68 to mix with gas emitted from gas pipe 67 in the secondary burner head 64 and also delivers air under pressure to the curved nozzles 97 and 98 of head 64 to fill the secondary combustion chamber 49 with oxygen for supporting combustion of the products 71 passing therethrough. As shown, nozzles 97 and 98 are angled to the axis of stack 44, and being located in a narrow central zone of the stack supply air to the centre of the upflowing smoke in a pressure blast which strikes the opposite wall and tends to rebound in a fanned shape to thoroughly fill the chamber.

The secondary blast furnace means 62 of the invention, is useful and saleable as a separate after burner assembly 99, shown in FIGURE 5, for mounting in the stack of any incinerator having a primary combustion chamber and air pressurized fuel burner. As shown, assembly 99 is identical with the above described secondary blast furnace means, except that the blower 73 and plenum 75 are part of the assembly, rather than mounted on the main furnace casing.

The electric spark ignition circuit 100, which includes spark plug ignitions 61 and 69 is conventional, as is the gas supply means, including appropriate regulator valves, and the various safety controls which shut off the gas in the event of failure of ignition, and therefore is not described in detail.

A suitable valve, damper, or other control 102 is provided on the plenum 75, operable manually, or automatically, to control the volume of air delivered to the inlet slot nozzles 94, to enable the operator to adjust the same to the optimum results by visually observing the smoke emitted from the stack.

The air supply to the burners should be controlled to have proper burn-off of the pollutants going through the stack.

The primary and secondary burners can be adapted for use of other fuel such as oil, although gas is preferred.

What is claimed is:

1. An incinerator comprising:
primary blast furnace means including a primary combustion chamber for receiving a charge of substances to be incinerated; primary fuel burner means continuously operating in said primary chamber for igniting and substantially consuming said substances, and vertical smoke stack means extending upwardly from said primary chamber for receiving and discharging the products of combustion of said chamber;
secondary blast furnace means at a spaced distance above said primary combustion chamber on said smoke stack means including a secondary combustion chamber within said smoke stack means, and a secondary fuel burner means continuously operating in said secondary combustion chamber for igniting and entirely consuming any unconsumed products of combustion passing therethrough, and
forced air blast means on said incinerator including combined pre-heat and insulation means having air nozzles in the lower portion of said primary combustion chamber for continuously delivering forcible streams of pre-heated air thereinto to control the rate of combustion therein.

2. An incinerator as specified in claim 1, wherein:
said primary blast furnace means includes a sheet metal exterior shell mounted at a spaced distance outside said primary combustion chamber to form an air inlet and air insulation compartment therearound, and
said forced air blast means includes a power driven blower mounted within said compartment to draw ambient air thereinto and discharge the same into said primary combustion chamber.

3. An incinerator as specified in claim 1, wherein:
said combined pre-heat and insulation means includes

a sheet metal interior shell mounted at a spaced distance inside said primary combustion chamber to line the same while forming an air pre-heat compartment therewithin, said interior shell having slot shaped nozzle orifices proximate the lower portion of said primary combustion chamber, and

said forced air blast means includes a power driven blower, mounted outside said furnace means to supply air under pressure into said pre-heat compartment.

4. An incinerator as specified in claim **1**, wherein:

said primary blast furnace means includes a sheet metal exterior shell mounted outside said primary combustion chamber, and said shell extends upwardly outside said secondary combustion chamber to form a single common air inlet and air insulation compartment around both said chambers.

5. An incinerator as specified in claim **1**, wherein:

said secondary fuel burner means includes a narrow burner head extending transversely across the central section of said secondary combustion chamber within said stack means, and having air and gas nozzles to direct flame in the direction of travel of effluent smoke passing on each opposite side thereof, and

said combined pre-heat and insulation means includes exterior shell means for delivering pre-heated air to the said air nozzles of said secondary fuel burner means.

6. In combination with an incinerator having a primary furnace means therewithin and a smoke stack extending upwardly to an outlet at a predetermined height, for receiving and discharging the products of combustion thereof,

secondary furnace means within said smoke stack, comprising fuel burner means at a spaced distance below said outlet having fuel and air nozzles directed toward said outlet to form an elongated combustion chamber therebetween;

forced air blast means including an air blower continuously delivering a forcible stream of air from said nozzles and creating a flame entirely filling said combustion chamber to ignite and consume any unconsumed particles passing therethrough, and

combined pre-heat and insulation means on said incinerator arranged to pre-heat the air delivered by said blower to said nozzles.

7. An incinerator comprising:

a substantially airtight furnace casing having a top wall with at least one flue opening therein, a side wall with an upper charge intake door, and a lower ash clean-out door, an opposite side wall with an upper air inlet opening and a lower burner opening and a grate extending between said side walls to define an upper primary combustion chamber and a lower ash pit;

a flue stack, of corrosion resistant material, extending upwardly from said flue opening for a predetermined height to an outlet, and having a burner opening at a predetermined height above said casing and below said outlet to define an elongated secondary combustion chamber,

primary burner means including a primary power burner positioned in said burner opening, just above the level of said grate to direct flame across said grate and upwardly in said primary combustion chamber,

secondary burner means including a secondary power burner positioned in the burner opening in said stack to direct flame upwardly into said secondary combustion chamber toward said outlet,

interior shell means lining said primary combustion chamber at a spaced distance therefrom, and forming an interior air compartment connected to said upper air inlet opening, said shell means having air discharge orifices just above the level of said grate to supply air into the bottom of said primary combustion chamber below the level of said primary burner, and

forced air supply means, including a powered blower, mounted outside said casing, delivering air under pressure to said primary and secondary burners for mixture with the fuel thereof and to said air inlet opening for preheating in said interior air compartment and for increasing the oxygen content of said primary combustion chamber,

whereby any pollutant particles unconsumed in said primary chamber are consumed in the flame of said second burner in said secondary chamber, and no visible smoke is discharged from said outlet.

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KENNETH W. SPRAGUE, Primary Examiner