Sept. 16, 1969 C. A. ANDERSON ETAL 3,467,035

ELECTRIC INCINERATOR

Filed Sept. 18, 1967 4 Sheets-Sheet 1

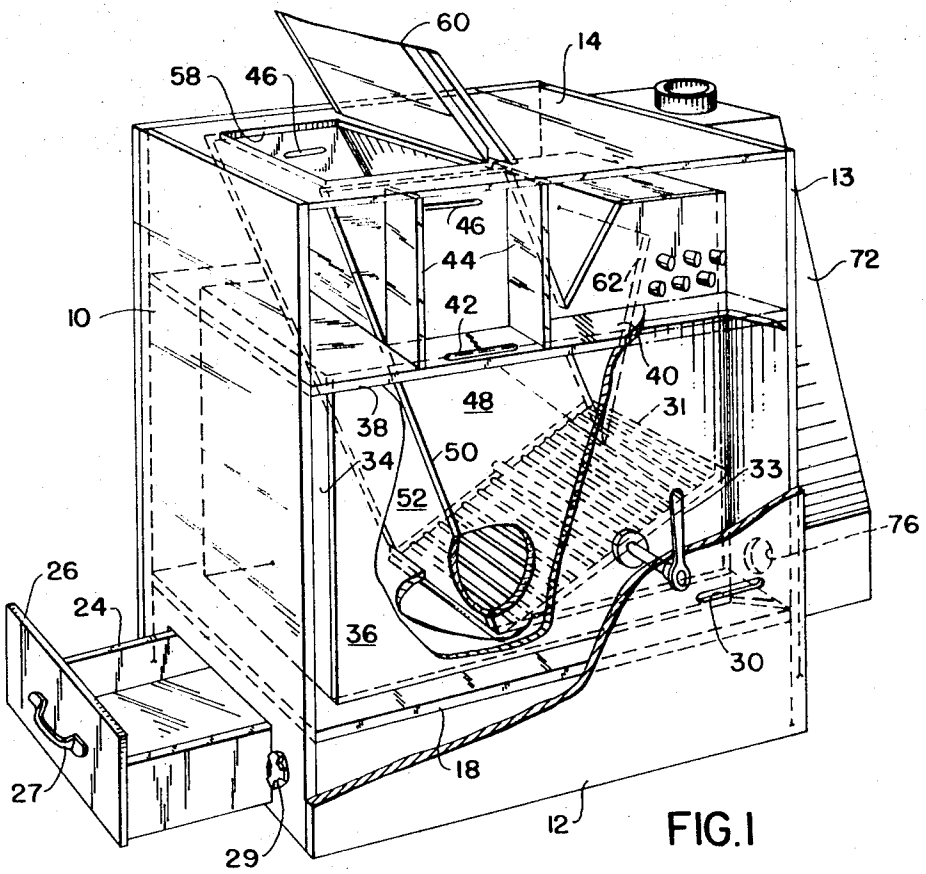


FIG.1

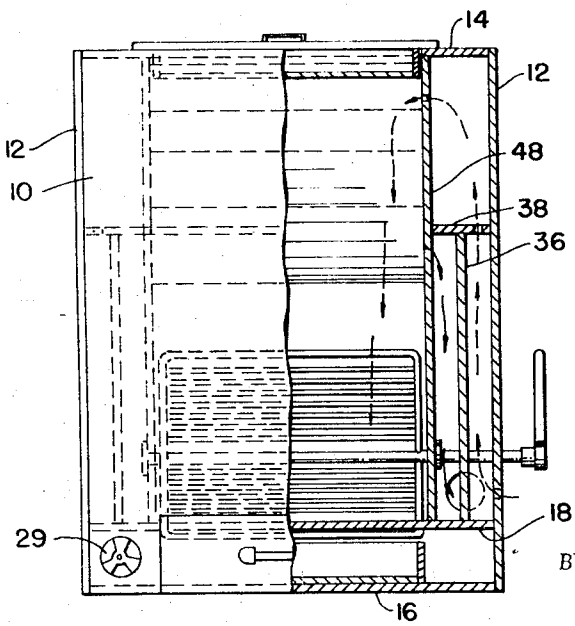


FIG.2

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ELECTRIC INCINERATOR

Filed Sept. 18, 1967 4 Sheets-Sheet 2

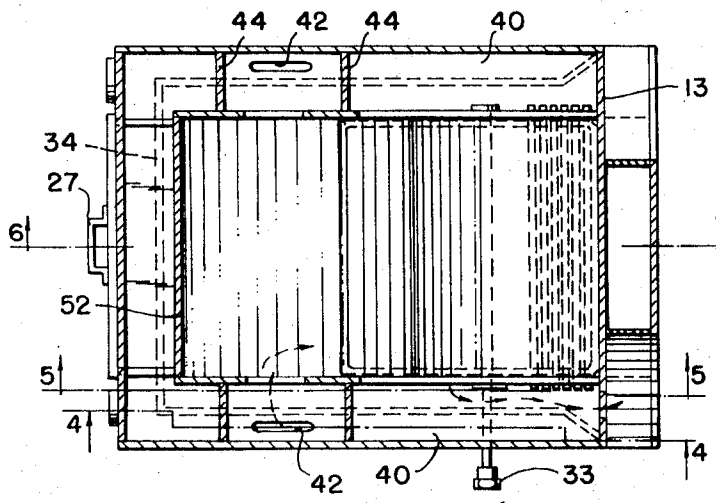


FIG.3

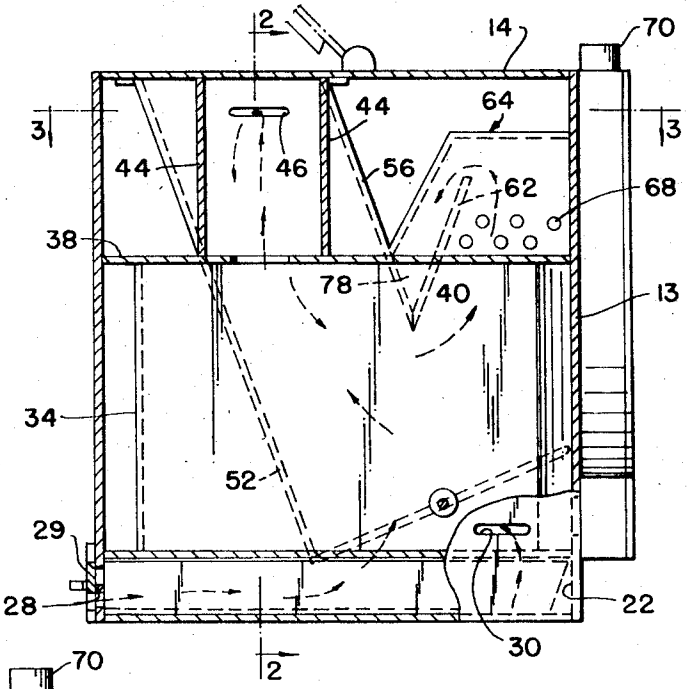


FIG.4

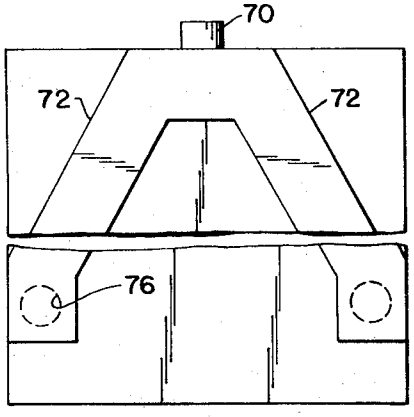


FIG.7

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ELECTRIC INCINERATOR

Filed Sept. 18, 1967 4 Sheets-Sheet 3

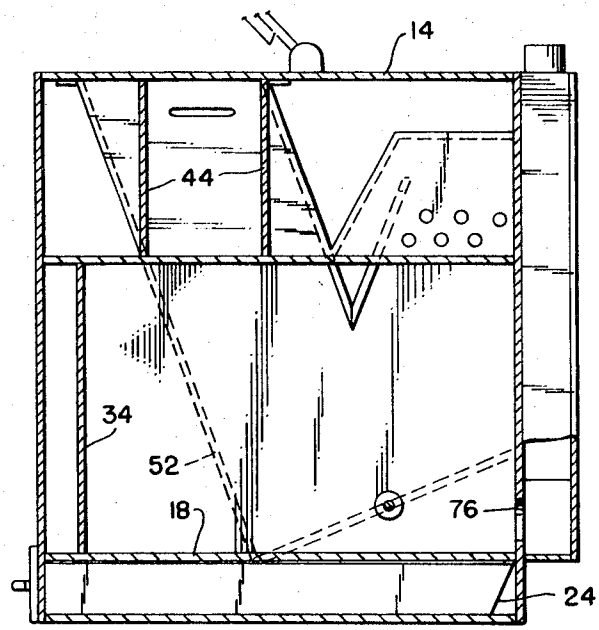


FIG.5

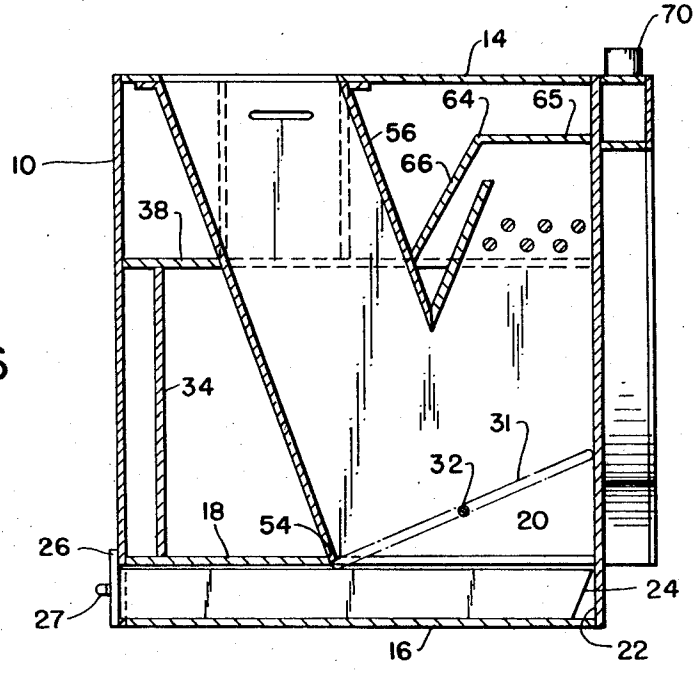


FIG.6

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Filed Sept. 18, 1967 4 Sheets-Sheet 4

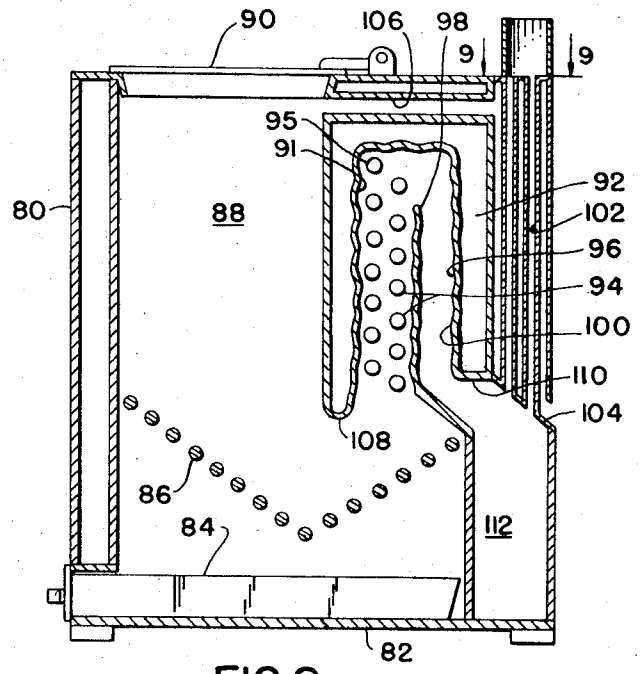


FIG.8

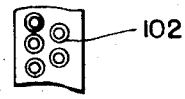


FIG.9

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ELECTRIC INCINERATOR

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Int. Cl. F23g 3/04; H05b 3/64
U.S. Cl. 110—8 8 Claims

ABSTRACT OF THE DISCLOSURE

An electric incinerator having radiant resistance heating elements disposed above the grate in the path of the products of combustion, and further having spaced walls surrounding at least a substantial portion of the interior chamber with combustion air traversing the space between said walls to cool the outer wall of the incinerator while heating the air before it reaches the combustion chamber.

BACKGROUND OF THE INVENTION

The invention relates to incinerators, and primarily home incinerators, adapted to result in substantially complete combustion of garbage as well as combustible trash, and to minimize the production of smoke, fumes and odors. In the past home incinerators have for the most part depended upon combustibility of the material being incinerated, or alternatively, have employed gas as an agent for providing heat for drying the refuse and for initiating and maintaining its combustion. Electric incinerators have been available. However, we know of none which can pass a typical city code for smokeless and odorless requirements. While radiation is a large factor in transferring heat to the refuse, some heat is delivered directly to the refuse by contact with preheated incoming air, and some by conduction through the rubbish chamber walls being heated by exhaust gases.

SUMMARY OF THE INVENTION

In accordance with the present invention an electric incinerator is provided having ducted air passes which provide for maintaining a fluent blanket of air interposed between the outer wall of the incinerator and an interior wall thereof substantially surrounding the combustion space so that the outer wall of the incinerator is in general maintained relatively cool while at the same time the combustion air flowing through the space between the aforesaid walls is heated. Initiation of combustion is by supplying current to the electric resistance heating elements bringing them to a condition in which they radiate heat to the material to be incinerated. If this material includes wet garbage for example, the garbage is dried rapidly by the radiant heat and when it is sufficiently dry it is ignited thereby. Moreover, the heating elements are disposed in a baffle arrangement in the passage through which flow products of combustion produced in the combustion chamber, thus the escaping gases receive heat by direct contact with the radiant heating elements so that escape of unburned gases is substantially eliminated. Odorous gases may be cracked by the

elevated temperature to form simpler nonodorous components. At the same time, the radiant heating elements may be maintained at elevated temperatures sufficient to insure self-cleaning thereof.

It is an object of the present invention to provide an electric incinerator characterized by the use of electrical resistance radiant heating elements and more particularly, the use of such elements in a passage leading to the exhaust passage for the products of combustion.

It is a further object of the present invention to provide an electric incinerator having an outer wall and an inner wall spaced from the outer wall and substantially surrounding the combustion chamber, and means for providing for flow of air through the space between the walls to provide a blanket of air effective to maintain the outer wall of the incinerator relatively cool and at the same time to effect substantial heating of the combustion air before it enters the combustion chamber.

It is a further object of the present invention to provide a residential incinerator characterized by the maximum simplicity and freedom from maintenance requirements by keeping the number of components to a minimum.

It is a further object of the present invention to achieve the objects of the preceding paragraph by employing a single element or cluster of elements controlled by a single thermostat which fulfills the functions of a main burner, an after-burner, and ignition means, each of which might otherwise require their own timers and/or thermostats.

Finally, it is an object of the present invention to provide an incinerator which, by the use of radiant heating means, causes two or more of the following events to occur in the sequence stated: (a) brings the after-burner zone up to efficient operating temperature before any other substantial effect; (b) induces air flow through the material on the grate and out of the stack before odors are emitted, thus preventing a back-up of odors into the space in which the incinerator is located; (c) effects drying at least a portion of any moist garbage or refuse on the grate; and (d) ignite the dried garbage or other combustible material on the grate; and which in addition preheats air prior to its flow through the material on the grate, and which maintains a sufficiently high temperature in the combustion zone to crack certain odoriferous gases to form simpler nonodorous compounds.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, illustrating a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a perspective view of the incinerator with parts broken away.

FIGURE 2 is a front elevational view of the incinerator with parts broken away, substantially to the plane

FIGURE 3 is a sectional view on the line 3—3, FIGURE 4.

FIGURE 4 is a sectional view on the line 4—4, FIGURE 3.

FIGURE 5 is a sectional view on the line 5—5, FIGURE 3.

FIGURE 6 is a sectional view on the line 6—6, FIGURE 3.

FIGURE 7 is a fragmentary rear elevational view of the incinerator.

FIGURE 8 is a vertical sectional view through a somewhat different embodiment of the present invention.

FIGURE 9 is a fragmentary sectional view on the line 9—9, FIGURE 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The incinerator comprises a generally rectangular outer box-like construction comprising a front wall **10**, side walls **12**, a rear wall **13**, a top wall **14**, and a bottom wall **16**. Spaced a short distance above the bottom wall **16** is a wall **18** having an opening **20**. The wall **18** constitutes the top wall for the ash pit **22** which receives an ash receiving drawer **24** having a front cover plate **26** and a handle **27**. The front wall **10** at its lower portion is provided with a passage **28** providing for flow of combustion air to the interior of the incinerator. The passage **28** may be closed or selectively restricted by a rotary valve or damper **29**. In addition, combustion air flown into the interior of the incinerator through a pair of elongated ports or openings **30** provided in the outer side plates **12** at each side of the incinerator.

Positioned above the opening **20** is a grate **31** which is carried by a pivoted shaft **32** having an exterior operating handle **33**.

Above the wall **18** there is provided an air space through which combustion air flows, the space substantially surrounding the inner combustion space and being adapted to maintain the outer walls of the incinerator relatively cool while at the same time providing for heating of the combustion air before it is led to the combustion chamber. This air space is defined by an inner front wall **34** and inner side walls **36**. The space between the inner front wall **34** and the inner side walls **36**, and the outer front wall **10** and the outer side walls **12**, is substantially U-shaped in horizontal section and the upper end of this space is closed by a horizontal plate **38** which is of generally U-shaped configuration having rearwardly extending legs **40**. Elongated openings **42** are provided in the plate **38** and specifically in the rearwardly extending legs **40** for a purpose which will presently appear.

Intermediate the horizontal plate **38** and the top wall **14**, and intermediate the front wall **10** and the rear wall **13**, are provided vertically extending walls **44** defining an air passage communicating with the elongated openings **42** and provided with a further opening **46**, as will subsequently be described.

Located inwardly of the wall **36** and contacting the inner edge of the rearwardly extending legs **40** of the plate **38** are inner side plates **48**, the forward edge of which is inclined as indicated at **50**, and the forward edges of the plates **48** are connected by an inclined plate **52**. The lower edge of the inclined plate **52** engages the rear edge of the front portion of the plate **18** as indicated at **54** in FIGURE 6. Parallel to the plate **52** and extending downwardly from the top wall **14** is a second inclined plate **56**, this plate together with the plate **52** defining an inclined chute through which material to be incinerated is introduced through the top opening **58** normally closed by a tiltable cover **60**. Extending upwardly and rearwardly from the lower edge of the plate **56** is a baffle plate **62**. Associated with the inclined plates **56** and **62** is a bent plate **64** having a fixed portion **65** and an inclined portion **66** spaced from the inclined plate **62** and defining therebetween a passage for products of combustion, as will subsequently be described.

Before referring to the complete operation it will be noted from what has already been described that the products of combustion flowing upwardly from the grate **31** at the rear of the incinerator pass between inclined wall **62** and the rear wall **13**. In this space there are provided

a multiplicity of electrical resistance radiant heating rods **68**. It will be noted that these rods are in position to direct radiant heat downwardly onto material to be incinerated on the grate. It will moreover, be observed that these rods are in the path of outflow products of combustion and gases derived from the material being incinerated.

The heating elements or rods **68** are preferably in the form of nickel chromium resistance heating wire provided in coil condition and received within a ceramic tube, preferably a tube formed of aluminum oxide. Specifically, excellent results have been obtained when the aluminum oxide tube has ⅞ inch outside diameter and ⅛ inch wall thickness. These tubes may not be perfectly impervious to gases and they are provided, as best seen in FIGURE 1, so that the ends of the tubes extend into the space intermediate the outer wall **12** and the inner walls or plates **48**. Since the intermediate portions of the tube are within the exhaust passage, any leakage through the tube walls is into the combustion space.

The actual products of combustion ultimately flow through a vent **70** connected to a stack in the usual way, the vent being provided at the rear of the incinerator and in communication with a pair of passages **72** and **74** each of which is in communication through a circular opening **76** provided in the rear plate **13**.

When material on the grate **31** is to be incinerated the ash drawer **24** is closed and some combustion air enters through the damper **29**. This air, as best seen in FIGURE 4, flows through the ash pit **22** and thence upwardly through the opening **20** below the grate **31** and into and through the material on the grate. In addition, combustion air enters the incinerator through the inlet ports **30**, this flow being as best illustrated in FIGURE 2. Initially, the air flows into the space above the plate **18** and below the plate **38**, and between the side plates **12** and **36**, which space further communicates with the space between the front plates **10** and **34**. This forms a blanket of relatively cool air substantially surrounding the interior combustion space at least at the front and sides thereof, thus maintaining the outer walls **10** and **12** relatively cool. At the same time, and as will subsequently appear, the air in this space is heated by heat transfer from hot air within the combustion space and spaces in communication therewith. The air flows upwardly through the elongated openings **42** provided in the rearwardly extending legs **40** of the intermediate horizontal plate **38**, into the space between the vertical walls **44** and thence through the inner ports or passages **46** when the air flows downwardly through the supply chute defined between the inclined plates **52** and **56**, and over the material on the grate. At this time material on the grate is assumed to be burning or evolving combustible gases which are mixed with the heated combustion air as well as the combustion air passing upwardly through the grate, this mixture of air and combustible gases in part burning within and directly above the combustible material and in part passing upwardly through the closely spaced heating rods **68** where substantially complete combustion is insured. Thereafter, the exhaust gases flow across the upper edge of the plate **62** as best seen in FIGURE 4, and then flow downwardly and laterally outwardly through triangular ports **78** defined between inclined plates **56** and **62** and the horizontal plate **38**. These hot products of combustion occupy the space between the vertical plates **36** and **48** and are in communication with the space between the inclined plate **52** and the front plate **34**. Accordingly, these hot products of combustion are in good heat transfer relationship to the relatively cool blanket of air flowing between the outer plates and the vertical plates spaced inwardly therefrom. Ultimately, the hot products of combustion flow through the circular openings or ports **76** into the inclined passages **72** and **74** and out through the vent **70** to the stack.

A somewhat different embodiment of the invention is illustrated in FIGURE 8. In this figure the incinerator comprises outer wall structure, a portion of which is indicated at **80**, the bottom wall **82**, and ash pan **84**, and a grate **86** located above the ash pan. A garbage reception space is indicated at **88** having an open top closed by a hinged cover **90**. Received within a chamber **91** within the insulated housing **92** are a multiplicity of resistance heating elements **94** which may be of the type previously described in detail. A thermostat **95** is provided above the heating elements **94**, as shown. The housing **92** provides an air chamber **96** which is separated by a baffle **98** into a passage containing the heating elements **94** through which products of combustion and heated gases flow upwardly, and an outlet passage **100** through which products of combustion flow downwardly, and thence to the stack through a multiplicity of tubes **102**. Combustion air flows through an air inlet **104** and around the tubes **102** and thence horizontally through a passage **106** into the garbage reception space **88**, and thence downwardly through the garbage and upwardly through the space containing the heating elements.

From the foregoing it will be seen that inlet air is preheated in the heat exchanger including the tubes **102** so that hot combustion air flows downwardly through the garbage, drying it and assisting in promoting combustion.

It will be observed that the chamber **91** constitutes an air chamber which upon energizing the heating elements is at room temperature. It is desired to minimize the air flow through the incinerator until ignition occurs and conditions have been attained which effect substantially complete combustion of gases formed by the garbage. The chamber **91** has at the inner side of the incinerator a lower end wall **108** which is slightly lower than the wall **110** leading to some of the outlet tubes **102**. Accordingly, as the air within the chamber **91** is heated there will be a minimal air flow through the chamber and thence upwardly through the exhaust tubes **102** which will produce a minimal air flow through the garbage. At the same time, the lowermost heating tubes or elements **94** project radiant energy onto the garbage on the grates **86**, drying this garbage and initiating combustion thereof. As combustion proceeds the garbage in the chamber **88** feeds downwardly onto the grate where it is consumed.

Within the incinerator is a dust settling chamber **112** into which dust separated from the flow of air and products of combustion is allowed to settle.

This embodiment of the invention has in common with the embodiment previously described, the initiation of combustion by the direction of radiant heat onto a portion of the garbage from heating elements disposed in the outlet passage so that substantially complete combustion of all gases is obtained.

The operation of the two embodiments of the invention as described above, involves the following sequence of events: In the first place, the material on the grate may include moist garbage or other trash. When the radiant heating elements of the incinerator are energized the first substantial effect is to bring the after-burner zone of the incinerator surrounding the heating elements to an efficient operating temperature which will insure that any gases reaching this zone will be burned. The operation of the heating elements induces a convection flow of air through the after-burner zone and thus produces a flow of air through the grate and the material thereon and out of the stack. This prevents initial emission of gases from the garbage or other material from backing up into the space occupied by the incinerator The next step in sequence is the drying of any moist garbage or other material on the grate. This results primarily from radiant heat received from the heating elements. However, this effect is augmented by some preheating of combustion air drawn through the material on the grate. Finally, heat radiated from the heating elements to the dried or other combustible material on the grate causes ignition. During combustion a sufficiently high temperature is maintained in the after-burner zone to not only insure substantially complete combustion of gaseous products in the after-burner zone, but also to crack certain odoriferous gases to form simpler and non-odorous compounds.

The drawings and the foregoing specification constitute a description of the improved electric incinerator in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

We claim:

1. An electric incinerator comprising a combustion chamber having front and side walls and an opening provided with a grate a the bottom thereof, intermediate front and side walls surrounding the front and side walls of said combustion chamber and defining with the front and side walls of said combustion chamber an intermediate air space, outer front and side walls surrounding the intermediate front and side walls and defining therewith an outer air space surrounding the front and side of said inner space and said chamber, first passage means within said intermediate walls connecting the interior of said combustion chamber to said intermediate air space and providing for a flow of hot products of combustion within said intermediate air space and in contact with said intermediate walls to heat the air within said outer air space, ports in said outer walls providing for flow of combustion air into said outer air space and second passage means extending from said outer air space to said combustion chamber to provide for flow of heated combustion air through said outer air space and thence into said combustion chamber.

2. An incinerator as defined in claim **1** in which said first passage means comprises wall structure above said combustion chamber defining the outlet for products of combustion and including ports extending through the side walls of said combustion chamber communicating with said inner air space.

3. An incinerator as defined in claim **2** in which said outer, intermediate and combustion chamber walls define front and side outer and inner air space portions, the front and side portions of each air space being in communication with each other.

4. An incinerator as defined in claim **1** comprising a first combustion air inlet communicating with the space in said combustion chamber below said grate, and a second inlet communicating directly with said outer air space.

5. An incinerator as defined in claim **4** in which the second passage means extends from said outer air space to the upper portion of said combustion space and directs heated combustion air from said outer air space downwardly into the top of said combustion chamber.

6. An incinerator as defined in claim **4** in which said second passage means directs combustion air from said outer air space downwardly into the top of said combustion chamber at one side thereof, said first passage means for the flow of products of combustion leading upwardly from the opposite side of said combustion chamber.

7. An electric incinerator comprising a combustion chamber, a grate in the lower portion of said combustion chamber, a passage for products of combustion communicating with the interior of said combustion chamber at an opening in the upper portion of said combustion chamber, a multiplicity of elongated heat radiating elements disposed adjacent the top of said combustion chamber in position to transmit heat by direct radiation to material on said grate, said heat radiating elements being disposed adjacent said opening in closely spaced parallel relationship to each other to define a plurality of relatively narrow elongated paths for products of combustion, said elements being disposed along the path of products of combustion so that the products of combustion are required to flow through a plurality of the rela-

tively narrow spaces between adjacent heat radiating elements to establish an after-burner zone in which incompletely burned products of combustion are substantially completely burned.

8. An incinerator as defined in claim **7** in which said elongated heat radiating elements are disposed in a plurality of banks, the elements in each bank being uniformly spaced from each other and the elements in adjacent banks being staggered so as to prevent any substantial straight-line flow of products of combustion through the afterburner zone containing said elements.

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U.S. Cl. X.R.

110—18; 219—260