

FIG. 1

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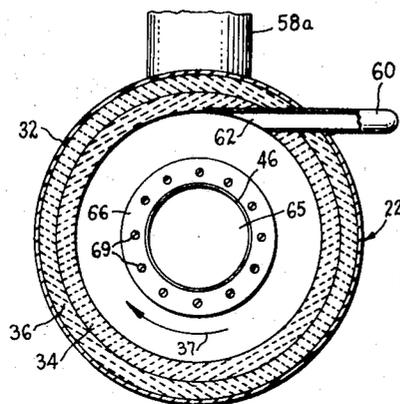
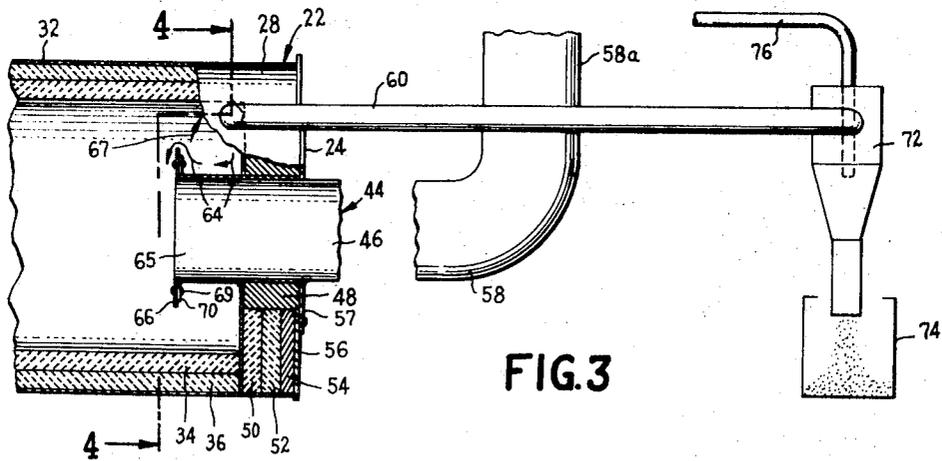
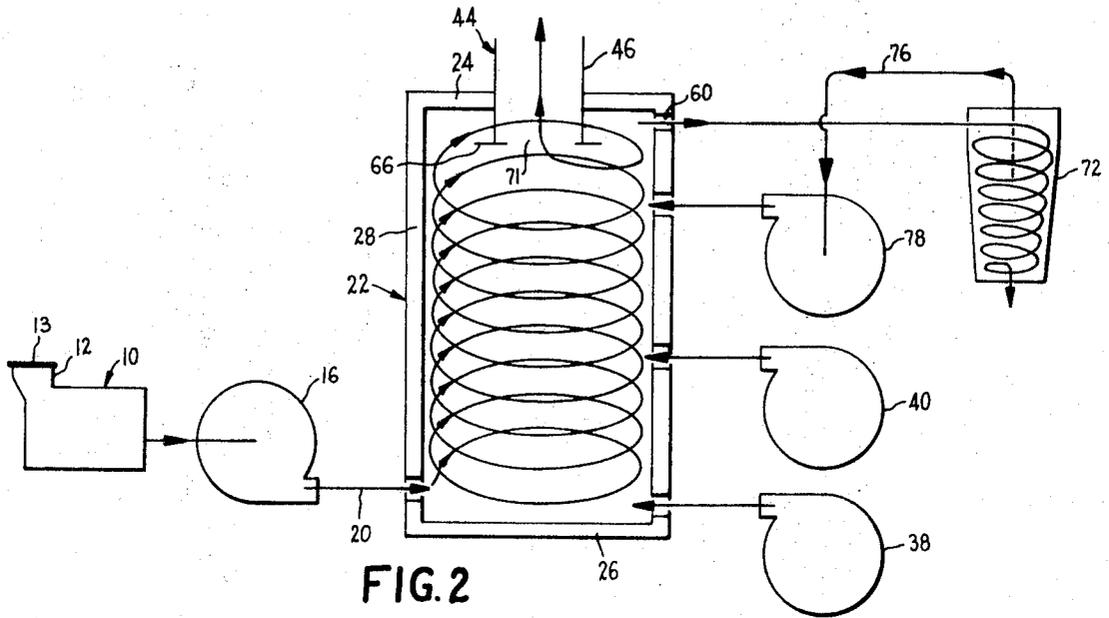


FIG. 4

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INCINERATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to incinerators and has particular relation to industrial and municipal-type incinerators for burning waste material.

2. Description of the Prior Art

Conventional industrial and municipal-type incinerators ordinarily include one or more combustion chambers having drying grates with a flue for discharging to atmosphere the gaseous products of combustion of waste material in the chambers. Depending upon the efficiency of a particular incinerator design varying amounts of noxious gases and ash are discharged through the flue to atmosphere. Prior incinerator designs in general have been incapable of effecting good combustion of waste material such that the products of the resulting incomplete combustion consist of a large quantity of noxious gases and ash which are discharged to the surrounding atmosphere in the form of dense acrid smoke.

In an effort to comply with regulatory air pollution codes, more recent incinerator designs have provided for cleaning the gaseous products of combustion prior to their discharge to atmosphere. Such flue gas cleaning apparatus is usually of costly and bulky construction and in some cases has not operated to clean the flue gases sufficiently to comply with the regulatory codes. One known flue gas cleaning apparatus includes means for conducting the gaseous products of combustion through water sprays so that the suspended ashes and other particulate matter are entrained in the water which is then collected and conveyed to a suitable clarification system. This type of flue gas cleaning apparatus is expensive and complex and contributes not only to the high cost and massive structure of prior art incinerators but also to water pollution. Further, the very high temperatures within the chambers necessary to effect good combustion result in very hot flue gases which may result in inefficient operation of the flue gas cleaning apparatus and resulting undesirable pollution of the surrounding atmosphere. The provision of flue gas cleaning apparatus thus imposes a limitation upon the temperature within the combustion chambers which contributes to the poor combustion realized by certain prior art designs.

It is necessary of course that provision be made for collecting and disposing of any residual combustible material and noncombustible material. One known apparatus for accomplishing this function comprises a conveyor disposed beneath the combustion chambers for receiving such material and for conveying the same from the combustion chambers to a suitable disposition area. Such conveying apparatus is also very costly and in addition occupies considerable space which further contributes to the high cost and massive structure of prior art incinerators.

OBJECTS OF THE INVENTION

It is therefore a primary object of the invention to provide a novel and improved incinerator capable of effecting substantially complete combustion of waste material and wherein essentially solid-free flue gases are discharged to the atmosphere to minimize air and water pollution.

It is another object of the invention to provide a novel and improved incinerator of such character which avoids the use of costly and complex flue gas cleaning apparatus.

It is a further object of the invention to provide a novel and improved vortex incinerator of the foregoing character wherein residual combustible material and noncombustible material are discharged from the combustion chamber during the burning process by action of the vortex without the use of costly and bulky material-handling and conveying apparatus.

SUMMARY OF THE INVENTION

In carrying out the invention in one preferred form, an incinerator is provided which includes a combustion chamber having spaced end walls and a sidewall with its central longitu-

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dinal axis extending between the end walls. The chamber is preferably disposed in operative position with its central longitudinal axis extending horizontally or substantially horizontally. Means are provided for introducing a mixture of waste material and air under pressure into the chamber tangentially to the sidewall for establishing a vortical movement of the waste material toward one of the end walls and provision is made for igniting the waste material during its vortical movement. A discharge flue is located adjacent the one end wall and extends substantially concentric with the central longitudinal axis of the chamber and a second discharge port is located in the region of the one end wall adjacent the inner surface of the sidewall for discharging from the chamber residual combustible material and noncombustible material entrained in the outer region of the vortex. The material discharged by the second port is conveyed through a conduit to a separator which separates the gases and the solid material and means are provided to introduce the separated gases and any solid particles suspended therein back into the combustion chamber.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a view in top plan of an incinerator embodying the invention;

FIG. 2 is a schematic diagram of the incinerator of FIG. 1 showing in particular the path of vortical movement of the waste material within the combustion chamber;

FIG. 3 is a view in side elevation of the combustion chamber and the separator associated therewith with parts of the combustion chamber broken away and shown in section; and

FIG. 4 is a view in section taken along the line 4-4 of FIG. 3.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the drawing there is illustrated in FIGS. 1 and 2 an incinerator embodying the invention and comprising in general a size-reduction unit for chopping up the waste material, a pneumatic conveying system which receives the chopped material, a vortex combustion chamber for receiving the chopped material from the pneumatic conveying system, discharge means for discharging gaseous products of combustion, residual combustible material and noncombustible material from the combustion chamber, and a separator for separating the gases and solid material discharged by the discharge means. The incinerator of the present invention is particularly suited for disposing of solid industrial and municipal waste material such as for example, paper, peanut hulls, cardboard cartons, wood scrap, garbage, foliage, bottles, cans and combustible floor sweepings. However, the incinerator is also capable of disposing of liquid waste material such as oils, paint sludges and plating tank residue.

More specifically, the incinerator as shown in FIG. 1 includes a size-reduction unit 10 designed to shred and chop the waste material into pieces small enough to be efficiently conveyed to and burned in the combustion chamber. If the waste material to be disposed of is already of an acceptable size, such as sawdust, then the size-reduction unit 10 is not required. The size-reduction unit 10 may be of any suitable construction and includes a hopper 12 having an open end 13 into which the waste material is fed for size reduction by a shredding and chopping mechanism (not shown) operated by a motor 14. After being reduced in size the waste material is drawn into a pneumatic conveying system including a blower 16 operated by a motor 18 which entrains the size-reduced material in an airstream and transports it through a pipe 20 which opens into a combustion chamber 22.

The combustion chamber 22 may be of any suitable configuration and is preferably cylindrical including a pair of spaced end walls 24 and 26 connected by an annular sidewall 28. The chamber 22 is preferably disposed when in operative position so that its central longitudinal axis which extends between the end walls 24 and 26 is horizontal or substantially horizontal as shown in FIG. 3. If desired, the end wall 26 of the

chamber 22 may include an access door 30 to permit access to the interior of the chamber 22. In the specific embodiment of the invention illustrated, the sidewall 28 of the chamber 22 comprises an outer casing 32 (FIGS. 3 and 4) formed of suitable material such as a low carbon steel and the casing 32 is lined with one or more inner layers 34 and 36 of suitable material such as fire brick. The innermost layer 34 is designed to exhibit good resistance to abrasion whereas the layer 36 may be designed to have good heat-insulating qualities or to transfer the heat to a remote location. The end walls 24 and 26 of the chamber 22 may be similarly formed of an outer layer of low carbon steel with inner layers of fire brick. In the embodiment illustrated, the pipe 20 enters the chamber 22 tangentially of the sidewall 28 near the top of the chamber 22 adjacent the end wall 26 and at the left side of the chamber as viewed in FIG. 1. In certain installations it may be desirable to have the pipe 20 enter the chamber 22 at an area which is substantially midway between the end walls 24 and 26.

Continuous injection of a mixture of waste material and air into the chamber 22 under pressure from the pipe 20 tangentially to the sidewall 28 establishes a vortical flow of the waste material which travels from adjacent the end wall 26 toward the end wall 24 in a clockwise direction as viewed from the end wall 26 in FIG. 1 or in the direction of the arrow 37 in FIG. 4. It is understood of course that the pipe 20 may be disposed to enter the chamber 22 at the upper right-hand side thereof instead of at the upper left-hand side in which event the direction of the vortex would be reversed from the clockwise direction illustrated to a counterclockwise direction.

In order to ignite the waste material entering the chamber 22, a suitable gas burner 38 is disposed near the end wall 26 of the chamber 22 to fire tangentially into the chamber adjacent the bottom and at the right side thereof as viewed in FIG. 1. Under conditions wherein a mixture of waste material and air is continuously fed into the chamber 22, it has been observed that the burner 38 may ordinarily be turned off after ignition of the waste material is accomplished.

In order to enhance combustion of the waste material and to maintain its vortical flow provision is made for introducing a controlled quantity of secondary air into the chamber 22 continuously during the burning process. To this end a fan 40 driven by a motor 42 is disposed to introduce secondary air into the chamber 22 preferably near the bottom and at the right side thereof as viewed in FIG. 1. The secondary air is injected tangentially to the sidewall 28 at an area downstream of the area of introduction of the mixture of primary air and waste material. If desired, means (not shown) may be provided for preheating the secondary air which is introduced into the chamber 22 by the fan 40. With the described arrangement the combustible waste material is substantially completely burned in suspension in a free vortex with the heavier solid waste fragments and noncombustible material traveling in a vortical path along the inner surface of the layer 34 and migrating toward the end wall 24. The solid material is forced toward the inner surface of the layer 34 by the tangential component of velocity of the vortex whereas the radially inward component of velocity creates high relative velocity between the air and burning material which greatly accelerates the combustion rate.

In order to discharge gaseous products of combustion from the chamber 22 to atmosphere first discharge means is provided including a first discharge port or flue 44 having an open end opening in the chamber in the region of the end wall 24 and substantially concentric with the central longitudinal axis of the chamber 22. As best shown in FIG. 3 the flue 44 includes a hollow cylinder 46 of any suitable material extending through an opening of a casting 48 which forms part of the end wall 24. In the particular embodiment of the invention shown the end wall 24 includes adjacent layers 50 and 52 formed of suitable material such as fire brick, a casting 54, and an outer annular plate 56 all secured together by suitable fasteners (not shown) and all surrounding the casting 48. An annular plate

57 surrounds the cylinder 46 and is joined to its outer periphery. The plate 57 is secured to the casting 48 at its outer surface by suitable fasteners (not shown) and overlaps a portion of the plate 56. The plates 56 and 57 are detachably secured together in any suitable manner at their overlapping portions in order to detachably connect the flue 44 and the casting 48 to the end wall. The cylinder 46 is releasably attached to a flue section 58 shown in FIGS. 1 and 3 which includes a vertically extending portion 58a outside the chamber 22 which terminates in an open end 59 (FIG. 1) opening to atmosphere.

In accord with the invention second discharge means is provided for discharging from the chamber 22 during the burning process residual combustible material and noncombustible material. For this purpose the preferred embodiment provides a second discharge port 60 having an open end 62 opening in the chamber 22 in the region of the end wall 24 and adjacent the inner surface of the layer 34 for receiving and discharging from the chamber residual combustible material and noncombustible material which are entrained in the outer region of the vortex. In the illustrated embodiment the port 60 comprises a conduit extending through the sidewall 28 tangentially thereto and substantially horizontally at the top of the chamber as viewed in FIG. 4 with its open end 62 opening at the inner surface of the layer 34. The conduit 60 leads to suitable separator and disposal means described hereinafter. With the described arrangement the open end 62 of the conduit 60 is in the path of the residual combustible material and the noncombustible material which are at the outer region of the vortex and which have migrated to adjacent the end wall 24, and the action of the vortex causes such material to enter the open end 62 for discharge from the chamber 22. While the conduit 60 is shown in FIG. 4 as extending horizontally at the top of the chamber 22, it is understood that the conduit 60 may be disposed in any angular position about the axis of the chamber 22. For example, in certain installations it may be desirable to position the conduit 60 so that it extends vertically and downwardly. It is also understood that although a single conduit 60 is illustrated, a plurality of such conduits may be provided if desired spaced angularly about the axis of the chamber. Moreover, the conduit 60 may be replaced by a scoop positioned to receive material in the outer region of the vortex and connected to a conduit extending through the end wall 24.

Most if not all of the residual combustible material and noncombustible material will enter the conduit 60 as they initially reach the end wall 24. However, in the event that such material does not enter the conduit 60 when it initially reaches the end wall 24, this material becomes entrained in the stream of hot gases which normally flows in the direction of the arrows 64 along the inner surface of the end wall 24 toward the open end 65 of the flue pipe 46 where a low-pressure area exists. If the open end of the flue pipe 46 were flush with end wall, a considerable portion of this material would enter the flue pipe 46 thus necessitating provision of flue gas cleaning apparatus to avoid pollution of the surrounding atmosphere. In accord with the invention means are provided to minimize the amount of such solid material which exits from the chamber 22 through the flue pipe 46. As illustrated in FIG. 3 such means comprises an extension of the flue pipe 46 into the chamber 22 so that the open end of the flue pipe 46 is spaced axially from the end wall 24. With this arrangement the solid material which does not enter the conduit 60 tends to move from adjacent the end wall 24 along the outside diameter of the flue pipe 46 toward its open end. Such movement increases the time of residence of the material in the chamber 22 thus resulting in more complete combustion and a reduction in the amount of this material which enters the flue pipe as compared to the amount entering the flue pipe if its open end were flush with the end wall 24.

In order to still further reduce the amount of solid material entering the flue pipe 46 the invention provides a baffle 66 positioned adjacent the open end of the flue pipe 46 to divert

outwardly toward the inner layer 34 of the chamber 22 residual combustible material and noncombustible material which move from adjacent the end wall 24 toward the open end of the flue pipe 46. The arrangement is such that solid material moving in the direction of the arrows 64 engages the baffle 66 and is there by deflected in the direction of the arrow 67 so that the material so diverted once again becomes entrained in the vortex for further burning and movement toward the end wall 24 for discharge through the conduit 60. As shown in FIG. 3, the baffle 66 preferably comprises a plate of any suitable material in the form of a ring releasably attached as by bolts 69 to another ring-shaped plate 70 which is welded or otherwise secured to the pipe 46 adjacent its open end. As shown in FIG. 2 the baffle 66 may overlie the open end of the flue pipe 46 and includes a central orifice 71 which has a diameter less than the inner diameter of the flue pipe 46. The outside diameter of the baffle 66 and the diameter of its orifice 71 are selected to provide optimum performance for the conditions involved. Under certain conditions the baffle 66 may surround the pipe 46 adjacent its open end as shown in FIG. 3. The detachable mounting of the flue 44 to the end wall 26 as previously described permits detachment of the flue pipe 46 and the baffle 66 from the chamber 22 so as to permit replacement or repair of pipe 46 and baffle 66 as desired.

The present invention further provides a separator 72 which is effective for separating the gases and the solid material discharged through the conduit 60 and for dropping the solid material into a suitable container 74. The separator 72 is preferably a commercially available cyclone or vortex-type separator wherein material discharged through the conduit 60 is introduced tangentially into the separator 72 with the result that the solid material drops out the open end of the separator 72 into the container 74. Such solid material constitutes ashes and other particulate matter formed in the combustion process and also noncombustible material which can be disposed of in any suitable manner. While most of the residual combustible material and the noncombustible material are delivered to the separator 72, a small portion of such material settles to the bottom of the chamber 22. This settled material may periodically be removed from the chamber in any suitable manner.

In accord with the invention the hot gases separated out by the separator 72 are introduced back into the chamber 22. This is very advantageous in that it maintains the vortex within the chamber 22, further cleans such gases by removing residual fly ash, and dries out wet waste material within the chamber 22. For this purpose a conduit 76 extends coaxially into the separator 72 at the top thereof so that the hot gases separated by action of the separator 72 are drawn into the conduit 76 through the central low-pressure area and are conveyed through the conduit 76 to a fan 78 operated by a motor 80 to withdraw the separated hot gases from the conduit 76 and to introduce such into the chamber 22. These gases are preferably introduced into the chamber 22 at an area downstream from the area of introduction of the secondary air. However, under certain conditions the secondary air fan 40 may be employed instead of the fan 78 to introduce the separated gases back into the chamber 22.

By means of the invention a very efficient incinerator is provided characterized by the exhaust of gases to the atmosphere which are substantially free of particulate matter so as to minimize air and water pollution. In addition, residual combustible material and noncombustible material are discharged from the combustion chamber during the burning process by action of the vortex so as to avoid the provision of costly and complex material-handling apparatus for conveying such material away from the combustion chamber. Further, the provision of costly and complex flue gas cleaning apparatus is avoided by the invention which allows operation of the incinerator at temperatures which are higher than that which would be allowable in the event flue gas cleaning apparatus were utilized. Moreover, the incinerator effects substantially complete combustion of combustible waste material resulting

in an extremely high percentage reduction in the original volume of waste material.

A typical design of the incinerator of the present invention includes a combustion chamber having an internal length of 8 feet and an inner diameter of $4\frac{1}{2}$ feet. The flue pipe 46 has an inner diameter of 4 feet and extends into the chamber a distance of about 16 inches from the inner surface of the wall 24. The baffle plate 66 has a diameter of approximately 35 inches and its orifice 71 has a diameter of about 2 feet which is the same as the inner diameter of the flue pipe 46. Also, the conduit 60 has an inner diameter of 4 inches. An incinerator of such design presently appears capable of disposing of solid waste having up to 20 percent moisture content and normally 10 percent ash content with a heat value of 6,000 B.t.u. per pound at a rate 4,000 pounds per hour to effect close to 98 percent destruction of combustible material. It presently appears that such an incinerator design emits particulate matter to the atmosphere of not more than 0.2 grains per standard dry cubic foot of flue gas. The foregoing results seem to be obtainable with chamber temperatures between 1,200° F. and 2,200° F.

FIG. 2 shows dimensions of the diameter of the orifice 71 and the inner diameter of the chamber 22 which are such that the ratio of the diameter of the orifice 71 to the inner diameter of the chamber 22 is about 0.3. Also, the corresponding dimensions shown in FIG. 3 provide a corresponding ratio of approximately 0.4. The concept of providing predetermined ratios of the diameter of the open end of the discharge flue port 44 to the inner diameter of the chamber 22 is not our invention but is the joint invention of Norman R. Dibelius and William L. Zabriskie.

Although the invention has been described with reference to certain specific embodiments thereof, numerous modifications are possible and it is desired to cover all modifications falling within the spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

We claim:

1. An incinerator for burning waste material comprising in combination;
 - a combustion chamber having spaced end walls and a combination; with its central longitudinal axis extending between said end walls,
 - means for introducing a mixture of waste material and air under pressure into said chamber tangentially to said sidewall for establishing a vortical movement of said waste material toward one of said end walls,
 - means for igniting said waste material during its vortical movement,
 - a first discharge flue port having an open end opening in said chamber near said one end wall and substantially concentric with said central longitudinal axis, and
 - a second discharge port having an open end opening in said chamber near said one end wall and adjacent the inner surface of said sidewall for discharging from said chamber during the burning process residual combustible material and noncombustible material which are entrained in the outer region of the vortex, whereby essentially solid-free gases are discharged by said first port.
2. An incinerator as defined in claim 1 wherein the open end of said first port is spaced axially of said one end wall.
3. An incinerator as defined in claim 2 including a baffle adjacent the open end of said first port to divert outwardly toward said sidewall residual combustible material and noncombustible material which move from adjacent said one end wall toward the open end of said first port.
4. An incinerator as defined in claim 1 including means for separating the gases and the solid material discharged by said second port and for introducing said separated gases and any solid particles suspended therein back into said combustion chamber.
5. An incinerator as defined in claim 4 wherein said means for separating includes a separator for receiving material

discharged by said second port, a receptacle beneath said separator for receiving solid material separated by said separator, a conduit in said separator for receiving the gases separated by said separator, and a blower connected to said conduit for introducing said separated gases into said chamber.

6. An incinerator as defined in claim 1 including means for introducing secondary air into said chamber tangentially to said sidewall at an area downstream from the area of introduction of said waste material.

7. An incinerator as defined in claim 1 wherein the central longitudinal axis of said chamber extends substantially horizontally, said first port extending coaxially of said central axis through said one end wall, said second port extending tangentially through said sidewall.

8. An incinerator for burning waste material comprising in combination;

a combustion chamber having spaced end walls and a sidewall with its central longitudinal axis extending between said end walls,

means for introducing a mixture of waste material and air under pressure into said chamber tangentially to said sidewall for establishing a vortical movement of said waste material toward one of said end walls,

means for igniting said waste material during its vortical movement,

discharge flue means extending substantially coaxially of said central longitudinal axis through said one end wall and having an open end in said chamber spaced axially of said one end wall, and

a second discharge port extending through said sidewall tangentially thereto adjacent said one end wall for discharging from said chamber during the burning process residual combustible material and noncombustible material which are entrained in the outer region of the vortex, whereby essentially solid-free gases are discharged by said flue means.

9. An incinerator as defined in claim 8 including a baffle plate mounted on said flue means adjacent the open end thereof to divert outwardly toward said sidewall residual combustible material and noncombustible material which move from adjacent said one end wall toward the open end of said flue means.

10. An incinerator as defined in claim 9 wherein said baffle plate overlies the open end of said flue means and includes an orifice having a diameter less than the diameter of the open end of said flue means, said baffle plate being removably mounted on said flue means.

11. An incinerator as defined in claim 8 including means for introducing secondary air into said chamber tangentially to said sidewall at an area adjacent the bottom of said chamber and downstream from the area of introduction of said waste material.

12. An incinerator as defined in claim 9 including connecting means detachably connecting said flue means to said one end wall, said connecting means being accessible from the exterior of said chamber to permit detachment of said flue means from said one end wall and withdrawal of said flue means and said baffle plate through said one end wall.

13. An incinerator as defined in claim 8 including means for separating the gases and the solid material discharged by said second discharge port and for introducing said separated gases and any solid particles suspended therein back into said combustion chamber.

14. An incinerator as defined in claim 13 wherein said means for separating includes a separator for receiving material discharged by said second port, a receptacle beneath said separator for receiving solid material separated by said separator, a conduit in said separator for receiving the gases separated by said separator, and a blower connected to said conduit for introducing said separated gases into said chamber.

15. An incinerator for burning waste material comprising in combination;

size-reducing means for receiving waste material and reducing it in size,

blower means for drawing the size-reduced material from the size-reducing means and entraining it in an airstream, a generally cylindrical combustion chamber having spaced end walls and an annular sidewall, said chamber being disposed such that its central axis extends substantially horizontally,

a conduit extending between said blower means and said chamber for delivering the entrained size-reduced material to said chamber and introducing it into said chamber tangentially to said sidewall for establishing a vortical movement of said waste material toward one of said end walls,

means for igniting said waste material during its vortical movement,

discharge flue means extending substantially coaxially of said central axis through said one end wall and having an open end in said chamber spaced axially of said one end wall,

a second discharge port having an open end opening in said chamber at an area adjacent said one end wall and at the extremity of the inside diameter of said sidewall for discharging from said chamber during the burning process residual combustible material and noncombustible material which are entrained in the outer region of the vortex, and

a baffle plate mounted on said flue means adjacent the open end thereof to divert outwardly toward said sidewall residual combustible material and noncombustible material which move from adjacent said one end wall toward the open end of said flue means, whereby essentially solid-free gases are discharged by said flue means.

16. An incinerator as defined in claim 15 wherein said baffle plate overlies the open end of said flue means and includes an orifice having a diameter less than the diameter of the open end of said flue means, said baffle plate being mounted for removal from said flue means.

17. An incinerator as defined in claim 15 including means for separating the gases and the solid material discharged by said second discharge means and for introducing said separated gases and any solid particles suspended therein back into said combustion chamber.

18. An incinerator as defined in claim 17 wherein said means for separating includes a separator for receiving material discharged by second port, a receptacle beneath said separator for receiving solid material separated by said separator, a conduit in said separator for receiving the gases separated by said separator, and a blower connected to said conduit for introducing said separated gases into said chamber.

19. An incinerator as defined in claim 15 wherein said second port extends tangentially through said sidewall.

20. An incinerator as defined in claim 15 wherein said conduit introduces the size-reduced material into said chamber at an area adjacent the top of the chamber at one side thereof, and means for introducing secondary air into said chamber tangentially to said sidewall at an area which is downstream from the area of introduction of the size-reduced material and which is adjacent the bottom of the chamber at the opposite side thereof.

21. An incinerator for burning waste material comprising in combination;

a combustion chamber having spaced end walls and a sidewall with its central longitudinal axis extending between said end walls,

means for introducing a mixture of waste material and air under pressure into said chamber tangentially to said sidewall for establishing a vortical movement of said waste material toward one of said end walls,

means for igniting said waste material during its vortical movement,

discharge port means in the region of said one end wall for discharging from said chamber gaseous products of com-

bustion, residual combustible material and noncombustible material, and means connected to said discharge port means for separating the gases and the solid material discharged by said discharge port means and for introducing said separated gases and any solid particles suspended therein back into said combustion chamber.

22. An incinerator as defined in claim 21 wherein said last-named means includes a separator for receiving the discharged material, a receptacle beneath said separator for receiving solid material separated by said separator, a conduit

in said separator for receiving the gases separated by said separator, and a blower connected to said conduit for introducing said separated gases into said chamber.

23. An incinerator as defined in claim 22 wherein said waste material is introduced into said chamber at an area adjacent the top of the chamber at one side thereof, said separated gases being introduced back into said chamber at an area which is downstream from the area of introduction of the waste material and which is adjacent the bottom of the chamber at the opposite side thereof.

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