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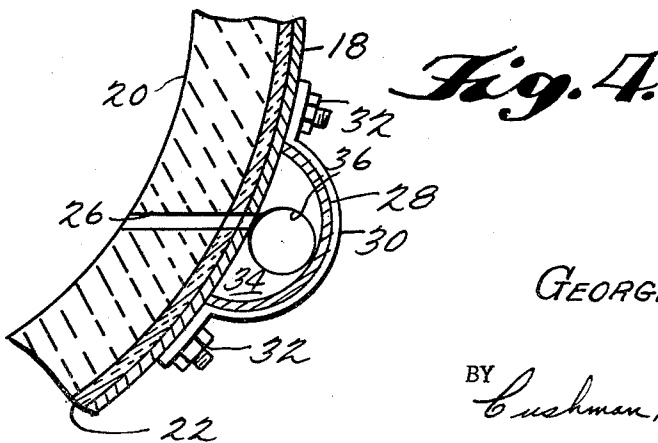
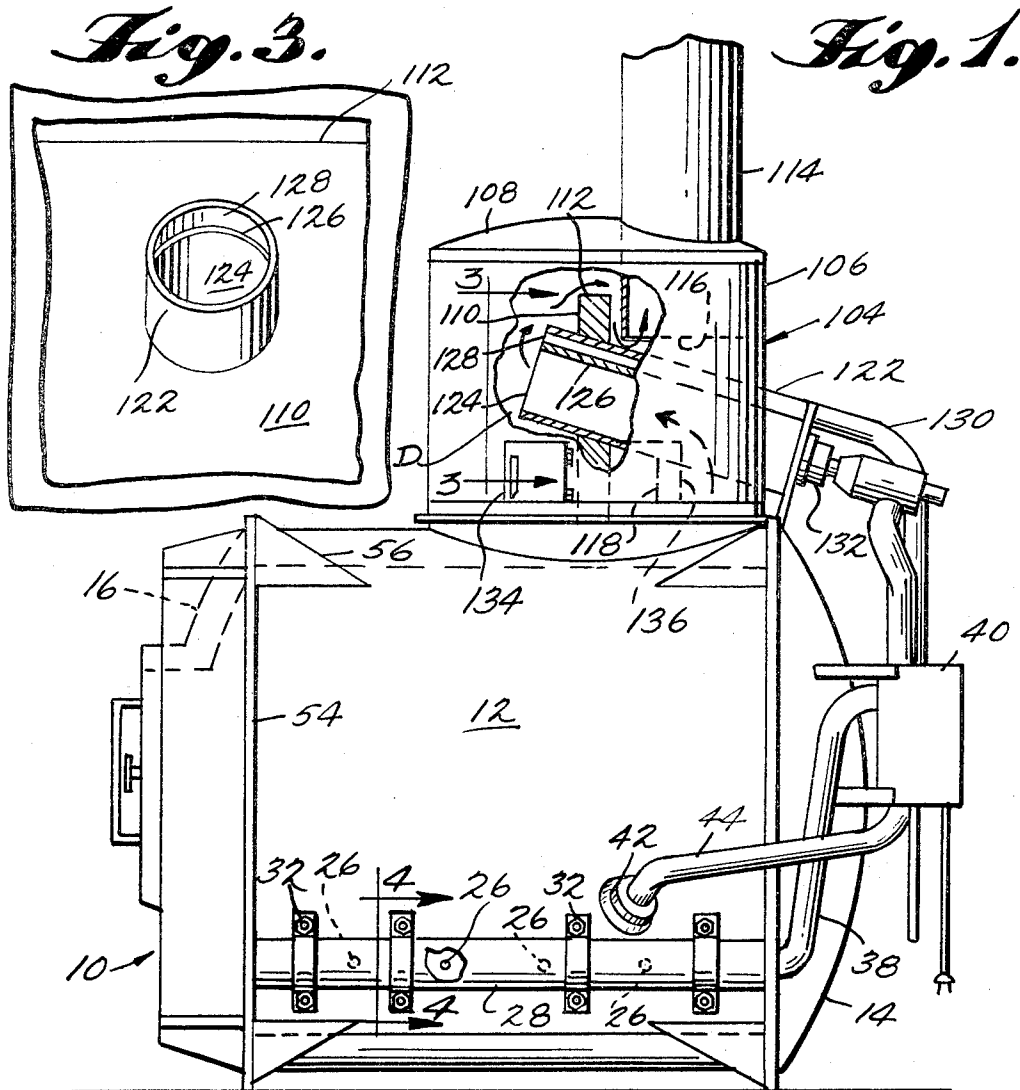
G. H. FLOWERS, JR

3,489,109

APPARATUS FOR BURNING COMBUSTIBLE PRODUCTS IN
EXHAUST GASES AND REMOVING FLY ASH THEREFROM

Filed July 9, 1968

3 Sheets-Sheet 1



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Fig. 8.

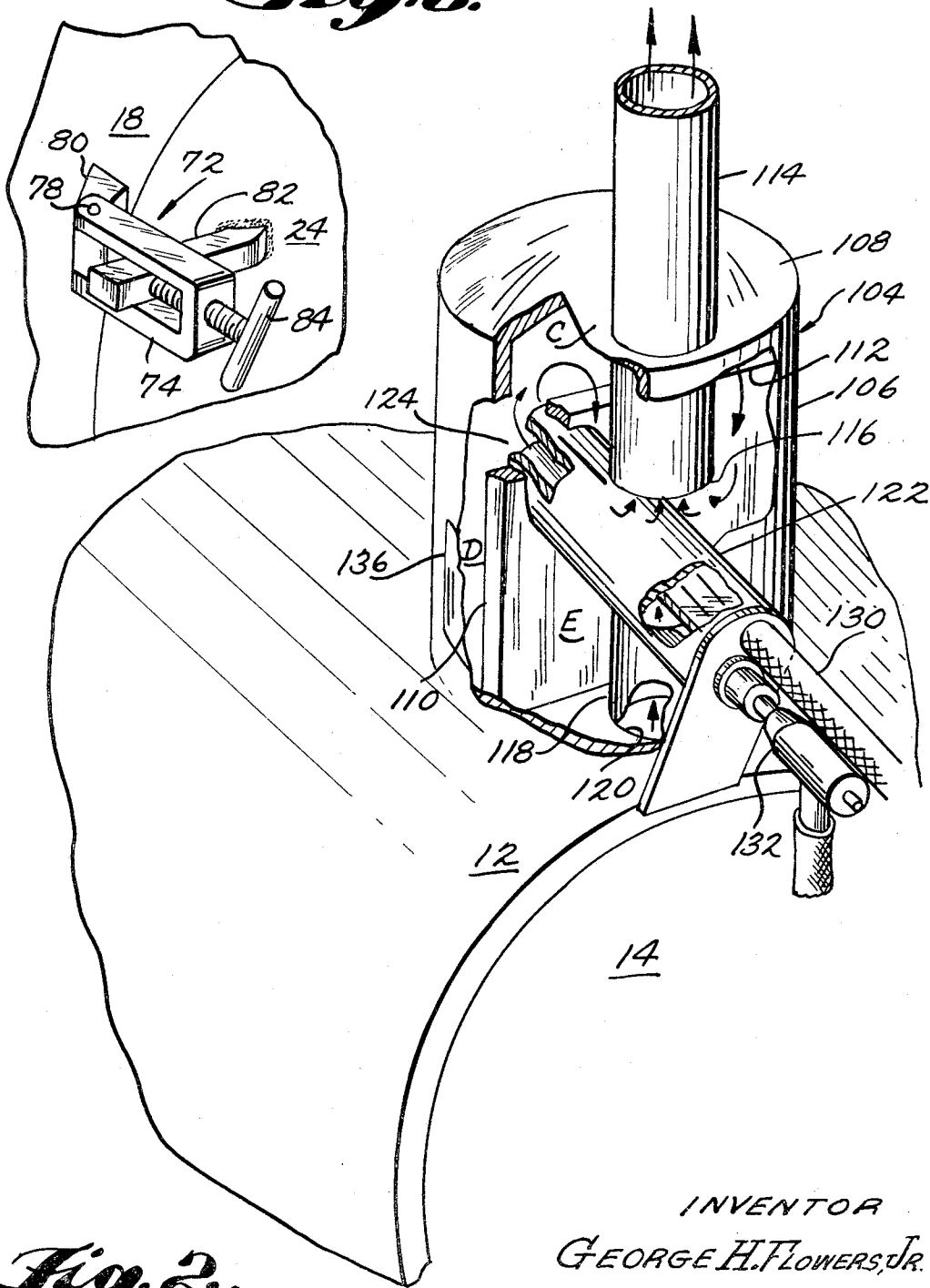


Fig. 2.

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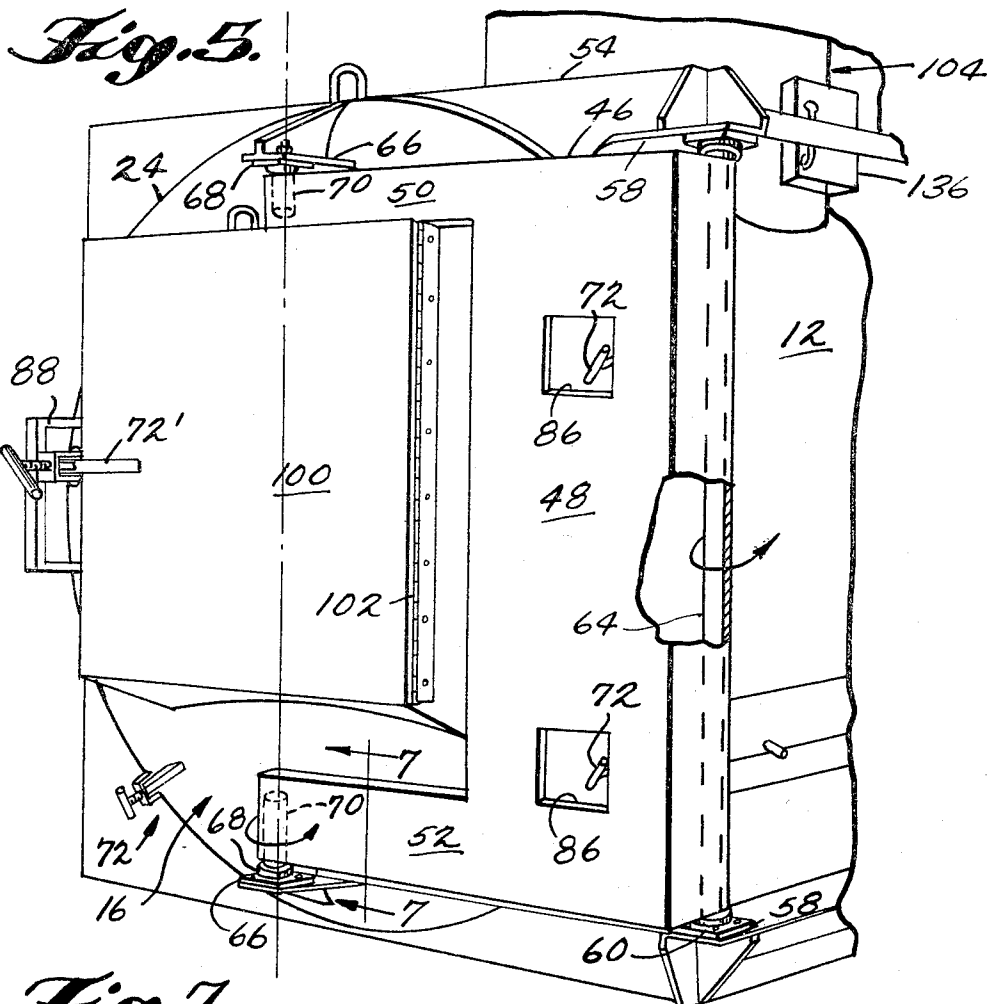


Fig. 7.

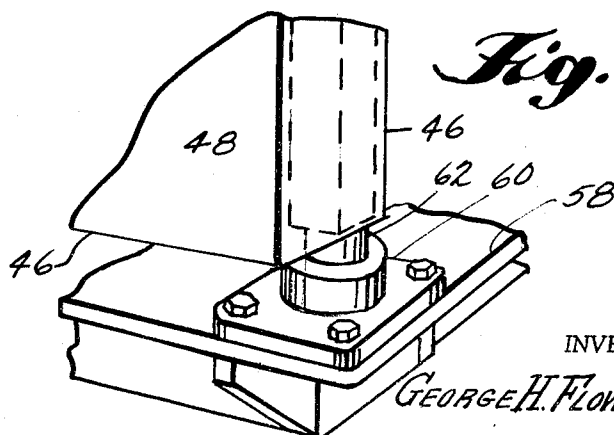
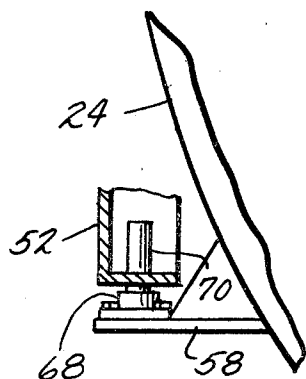


Fig. 6.

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APPARATUS FOR BURNING COMBUSTIBLE PRODUCTS IN EXHAUST GASES AND REMOVING FLY ASH THEREFROM

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17 Claims

ABSTRACT OF THE DISCLOSURE

An incinerator for burning in large volume all types of rubbish or waste material, the exhaust gases from the main combustion zone being further subjected to another burning zone insuring complete combustion by combustion of any combustible products remaining in the exhaust gases and to a zone removing fly ash from the exhaust gases thereby reducing air pollution to a minimum. The incinerator utilizes an apparatus for combustion of combustible products in the exhaust gases, the apparatus also removing the fly ash by discriminately directing the exhaust gases so that fly ash is separated therefrom. Forced air for the main combustion zone of the incinerator is supplied through holes in the casing member, the holes being capable of being cleaned from the exterior of the incinerator.

The present invention relates to an incinerator of the type used in burning large volumes of rubbish or waste material from commercial establishments, apartment houses, and the like. More particularly, the present invention is an improvement of the incinerator disclosed in my copending application Ser. No. 613,006 filed Jan. 31, 1967, now Patent No. 3,403,645.

The problem of air pollution has become more apparent in recent years in areas of high concentration of population due to increased disposal of combustible waste material by burning. Heretofore there has been little municipal control of burning and consequently no concern was taken over the amount of smoke produced, the odor, or the fly ash distributed into the atmosphere. Recent regulations and laws in most municipalities controlling air pollution have resulted in continued efforts to improve incinerator designs and operation and one such unit is disclosed in my aforesaid application Ser. No. 613,006 which subjects exhaust gas to a burning zone. The present invention not only effectively burns all of the combustible products of the exhaust gases but it also effectively removes fly ash from the exhaust gases so that the gases ultimately discharged to atmosphere are smokeless, odorless and substantially without fly ash.

An object of the present invention is to provide an improved apparatus for burning combustible products of exhaust gases received from a combustion zone as well as removing fly ash from such gases to thereby substantially reduce the emission of obnoxious and polluting products to atmosphere.

Ancillary to the preceding object, it is a further object of the present invention to provide an incinerator utilizing an apparatus for burning combustible products and removing fly ash from exhaust gases of the main combustion chamber.

Still another object of the present invention is to provide an improved incinerator utilizing a fly ash removal apparatus which includes an enclosed chamber divided into at least two fly ash removal chambers, the exhaust gases being discharged into one of the fly ash removal chambers and then directed in a tortuous path to the

other fly ash removal chamber before being directed into the exhaust stack.

Another object of the present invention which is ancillary to the immediately preceding object is to provide a secondary or auxiliary burning zone for an incinerator, the same being positioned within the fly ash removal apparatus to thereby reduce overall space for such an incinerator and to also provide means whereby the secondary or auxiliary burning zone may be effectively extended in length.

A still further object of the present invention is to provide an improved incinerator having a main combustion zone utilizing forced air, the air being supplied to the main combustion zone through holes provided in the wall of the casing member for the incinerator, the holes being capable of cleaning from the exterior of the incinerator even while the incinerator is in operation.

Still another object of the present invention is to provide an incinerator which is generally annular in shape and which has an open end adapted to be closed by a novel door structure which permits airtight sealing.

Ancillary to the preceding object, the improved door structure which may be opened to permit ash removal or loading with large objects, also includes a smaller loading door for small objects.

These and other objects and advantages of the present invention will appear more fully in the following specification, claims and drawings in which:

FIGURE 1 is a side elevational view, partly in section, of the incinerator of the present invention;

FIGURE 2 is an enlarged perspective view partly broken away and illustrating the apparatus for removing fly ash from exhaust gases as well as burning combustible products in exhaust gases;

FIGURE 3 is a fragmentary view taken substantially on the line 3—3 of FIGURE 1;

FIGURE 4 is an enlarged sectional view taken on the line 4—4 of FIGURE 1 and disclosing the removable manifold which permits cleaning of the airholes for the main combustion chamber from the exterior of the incinerator;

FIGURE 5 is a fragmentary perspective view of the incinerator and illustrating the improved balanced door structure of the same;

FIGURE 6 is an enlarged fragmentary perspective view of the pivot means for the hinge member of the door structure;

FIGURE 7 is a sectional view taken on line 7—7 of FIGURE 5 and illustrating the pivot means between the hinge member and the door member of the door structure; and

FIGURE 8 is a perspective view of a typical locking latch for latching the door member in sealing relationship to the casing member.

Referring now to the drawings wherein like characters or reference numerals representing like or similar parts, the incinerator of the present invention is generally designated by the reference numeral 10. In more detail, the incinerator includes an annular casing member 12 which is preferably cylindrical and which has a horizontal axis. The casing member 12 has a closed end 14 and an open end closed by a door structure generally designated at 16. The casing member 12, including its dome-shaped end 14, is made up of an outer metallic shell 18 and a refractory liner 20 (FIGURE 4), the refractory liner including block insulation 22 next to the inner surface of the shell. A door member 24 of the door structure 16 is similarly constructed in that it has an outer metallic shell with a refractory lining.

Referring now to FIGURES 1 and 4, the casing member 12 is provided along each side of the same adjacent

its lower portion with a plurality of horizontally spaced and horizontally extending holes 26 which extend through the metallic shell 18 and refractory liner 20. The exterior of the holes 26 is covered by an elongated manifold member 28 detachably supported on the casing 12 by straps 30 bolted as indicated at 32. A suitable asbestos gasket, or the like, may be provided between the manifold and the exterior of the shell to prevent leakage of air to atmosphere. One end (not shown) of the manifold 28 is closed whereas the other end 34 (FIGURE 5) is provided with a hole 36 which receives the end of a flexible air supply pipe 38 extending from a plenum box 40 housing a blower (not shown). Since the plenum box 40 is substantially similar to that shown and described in my aforementioned application Ser. No. 613,006, a further description of the plenum box is not believed necessary herein but the subject matter of that application pertinent thereto is incorporated by reference. It will suffice to say that air under pressure flows through the pipe 38 into the manifold from which it is delivered in high speed jet streams through the holes 26 to the interior of the main combustion chamber of the incinerator 10.

As may be the case where rubbish or the like is burned in the incinerator, debris might eventually clog the holes 26 although the air pressure normally clears the same. Should any of the holes 26 become clogged, it is easy to remedy as the manifold cover member 28 may be removed and the holes 26 cleared by insertion of a pin therethrough. Positioning of the manifold member 28 exteriorly of the casing member 12 has an added advantage in that the incinerator does not have to be shut down to clean out the holes.

If desired, the main combustion chamber of the incinerator 10 may be provided with a pressure burner 42 for igniting the waste material within the combustion chamber. The pressure burner 42 may be either a burner utilizing oil or a gas burner utilizing natural or propane gas or the like. Air may be supplied to the burner by a pipe 44 also extending from the plenum chamber 40.

The door member 24 of door structure 16 is complementary in size and shape to the open end of the casing member 12. Such door member 24 on large incinerators oftentimes weighs in the order of 3½ tons and are difficult to hang and operate. Consequently, the door structure 16 due to the heavy weight of the door member 24 as well as due to the annular shape of the door member must be provided with means making it easily handled by a single person and yet capable of providing an airtight seal about the open end of the casing member 12. In order to accomplish such results, the door structure 16 is provided with an enlarged U-shaped hinge member 46 having a base portion 48 and a pair of spaced horizontally extending legs 50 and 52. The U-shaped hinge member 46 is made of a box or angle iron construction in cross section and is pivoted on a vertical axis adjacent the edge of its base member 48, the axis being generally tangent to the periphery of the casing member 12. In more detail, a plate member 54 welded to the exterior peripheral surface of the casing 12 adjacent the open end of the same and further braced by gussets 56 supports a pair of vertically spaced brackets 58. The brackets 58 (FIGURE 6) support oppositely disposed vertically aligned bearings 60 which receive the opposite ends 62 of a pivot rod 64 fixedly secured to the base portion 48 of hinge member 46. Since the pivot axis of the hinge member 46 is vertical, it takes very little force to pivot the hinge member.

The door member 24 is pivotally supported on the ends of the legs 50 and 52 on an axis which is parallel to the vertical pivot axis of the base portion of the hinge member. This last mentioned pivot axis for pivoting the door member 24 relative to the hinge member 46 is in a plane extending through the center line of the door member so that the weight of the door member is evenly distributed or balanced on both sides of its pivot axis. In more detail, the door member 24 is provided with a

pair of vertically spaced brackets 66 each supporting a bearing 68; one bearing 68 being vertically aligned with the other bearing. The ends of the legs 50 and 52 each have a pin member 70 fixedly attached thereto and extending outwardly therefrom and received in the upper and lower bearings 68.

Locking latches 72 are spaced peripherally around the door member 24 so that when the door member is moved to its closed position it can be brought firmly and evenly into sealing engagement with the edge of the casing member 12. Referring to FIGURE 8, one of such locking latches is disclosed. The locking latch 72 includes a U-shaped member 74 pivotally supported at 78 from a bracket 80 welded to the shell 18 of the casing member 12. An arm 82 welded to the door member 24 is arranged to fit between the bifurcated legs of the U-shaped member 74 and a tightening screw 84 carried by the base of the U-shaped member is arranged to abut the arm 82 and force the door member into uniform tight sealing engagement. Of course, an asbestos gasket or the like may be positioned between the door member and the edge of the casing member. Since two of the locking latches 72 will be positioned behind the base portion of the hinge member 46, access holes 86 are provided in the hinge member. A handle 88 is provided on the periphery of the door member 24 so that the door structure may be swung openly to provide clear access to the interior of the combustion chamber when it is desired to either load the combustion chamber with large articles or to remove ash therefrom.

Door member 24 is provided with a smaller feed door 100 hingedly secured to the main door member as indicated at 102. The feed door is provided with a locking device 72' similar to that previously described. When it is desired to load the incinerator with small combustible articles, it is merely necessary to operate the smaller feed door 100.

Referring now to FIGURES 1, 2 and 3, it will be noted that the incinerator 10 is provided on the upper portion thereof with a fly ash removal apparatus generally designated at 104. The fly ash removal apparatus includes a generally annular casing member 106 welded to the top of the shell 18 of the casing member 12, the casing member 106 having a dome-shaped cover 108 which provides an enclosed chamber C. Suitable refractory material is provided on the interior of the casing member 106. A baffle wall member 110 is provided within the chamber C, the wall member having a free end 112 spaced from the top cover 108. The wall member 110 divides the chamber C into two fly ash removal chambers D and E having communication with each other over the top of the wall member 110. A stack 114 for discharging exhaust gases to atmosphere extends through the cover 108 of casing member 104 and terminates in chamber E with its lower end 116, which provides an inlet opening for exhaust gases, terminating well below the upper end 112 of baffle member 110.

A conduit 118 communicating at its lower end with an opening 120 in the casing member 12 extends upwardly in chamber E, the conduit 118 communicating with a transition conduit 122. The transition conduit, which may be refractory lined as may be the conduit 118, is substantially similar to the transition conduit described in my aforementioned application Ser. No. 613,006. As shown in drawings, the transition conduit 122 extends through the wall 110 and terminates in the fly ash collection chamber D with its discharge opening 124 positioned well below the free end 112 of wall 110 and facing away from the wall 110. Transition conduit 112 is provided with an arcuate shaped wall 126 which extends from the closed end of the transition conduit and terminates in an opening 128 immediately adjacent the discharge opening 124. A pipe 130 from the plenum box 40 supplies air under pressure to the conduit formed by the wall 126, the conduit segregating the air from

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exhaust gases in the transition conduit until the air is discharged from the opening 128.

Transition conduit 122 is provided with a pressure burner 132 having a nozzle for directing a blast of flame parallel to the axis of the transition conduit, the flame burning the combustible waste products of the exhaust gases passing through the transition conduit from the passage defined by the conduit 118. As the hot gases are discharged from the discharge opening 124 of the transition conduit, they will engage the air being discharged through the opening 128, this air having been heated. If there are still combustible waste products in the exhaust gases, they will be burned as the air assists in supporting combustion. By having air discharge from the opening 128, the burning zone of the transition conduit is effectively lengthened thus permitting more complete combustion.

The exhaust gases being discharged from the discharge opening 124 are directed against the wall of the casing member 106 within the fly ash collection chamber D and then are directed upwardly and back over the top edge of the free end 112 of wall 110 and then downwardly into the fly ash collection chamber E. The exhaust gases must then again change their direction to flow upwardly through the inlet opening 116 and then out of the stack. Since the direction of the exhaust gases is abruptly changed in the first fly ash collection chamber D, minute particles of fly ash will drop therefrom to the floor of chamber D. If any fly ash remains in the exhaust gases as they are directed over the free end 112 of the wall 110, the fly ash particles will separate from the exhaust gases as it changes direction again to go upwardly out of the stack 114.

Chambers D and E may be periodically easily cleaned of accumulations of fly ash as a pair of doors 134 and 136 are provided on the casing member 106 adjacent the lower end thereof and on opposite sides of the same and of the baffle wall 110. The doors 134 and 136 may be hinged and provided with handles and a refractory liner.

While the fly ash removal apparatus 104, including the transition conduit, have been described in connection with an incinerator, it will be appreciated by those skilled in the art, that such apparatus could be used with any burning device discharging exhaust gases, such as a furnace, heater or the like.

The objects and advantages of the present invention having been fully and effectively accomplished by the incinerator described above and illustrated in the drawings. It will be realized that various changes may be made to the specific embodiments shown and described without departing from the principles and spirit of the present invention.

Therefore the terminology used throughout the specification is for the purpose of description and not limitation, the scope of the invention being described in the appended claims.

What is claimed is:

1. An incinerator for disposing of waste material comprising:
 - a casing member defining a main combustion chamber;
 - a passageway through said casing member for discharging exhaust gases from said main combustion chamber;
 - a transition conduit communicating with said passageway for receiving exhaust gases therefrom, said transition conduit having a discharge opening adjacent one end;
 - a pressure burner for effecting a burning zone in said transition conduit to burn waste products in the exhaust gases;
 - a second casing member defining a fly ash collection zone;
 - baffle means within said second casing member and dividing said second casing member into two chambers in communication with each other, in one of

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which the discharge opening of said transition conduit is positioned; and

a stack extending into said second casing member and having an inlet opening in the other chamber of said casing member.

2. An incinerator as claimed in claim 1 in which said baffle means includes a vertically extending wall member having a free end positioned above a discharge opening of said transition conduit and the inlet opening of said stack whereby gases from discharge opening of said transition conduit must go upwardly and over the free end and downwardly to the inlet opening of said stack.

3. An incinerator as claimed in claim 2 in which said second casing member is provided with a fly ash removal door for each of the chambers therein.

4. An incinerator as claimed in claim 2 in which said transition conduit extends through said wall member.

5. An incinerator as claimed in claim 4 in which said transition conduit has a longitudinal axis inclined upwardly toward its discharge opening.

6. An incinerator as claimed in claim 1 in which said transition conduit includes means for discharging air adjacent its discharge opening.

7. An apparatus for removing fly ash out of exhaust gases received from a combustion zone comprising:

- a casing member defining an enclosed chamber;
- a wall member within said casing member and extending across said chamber to divide the same into at least a pair of fly ash collection chambers, said wall member having a free end spaced from the interior of said casing member to provide communication between said fly ash collection chambers;

- a conduit for receiving exhaust gases from the combustion zone, said conduit having a discharge opening within one of said fly ash collection chambers;
- means for burning waste combustible products in the exhaust gases within said conduit;

- and a stack extending into said casing, said stack having an inlet opening position within the other of said fly ash collection chambers whereby gases discharged from the outlet opening of said conduit will discharge fly ash in the one of said fly ash collection chambers and then will travel over the free end of said wall chamber into the other of said fly ash collection chambers and discharge any other fly ash therein before entering the inlet opening of said stack.

8. An apparatus as claimed in claim 7 in which said wall member extends upwardly from the bottom of said casing member and its free end is spaced from the top of the casing member 29.

9. An apparatus as claimed in claim 8 in which said conduit extends through the other of said fly ash collection chambers but out of communication therewith and then through said wall member, said conduit having its discharge opening facing away from said wall member in the one of said fly ash collection chambers below the free end of said wall member, the inlet opening of said stack being positioned below the free end of said wall member in the other of said fly ash collection chambers.

10. An apparatus as claimed in claim 9 in which said means for burning waste combustible products is a burner having a nozzle for effecting burning within said conduit.

11. An apparatus as claimed in claim 10 including means supplying air through said conduit but out of contact with exhaust gases therein, said means discharging air adjacent the discharge opening of said conduit whereby there may be continued burning of waste combustible products in the exhaust gases within the one of said fly ash collection chambers.

12. An incinerator for disposing waste material comprising:

- a casing member defining a combustion chamber for the waste material, said casing member having an outer metallic shell and an inner refractory liner,

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said casing member further having a plurality of horizontally extending holes through said outer metallic shell and inner refractory liner whereby the combustion chamber is in communication with the exterior of said casing member, said plurality of holes being spaced from each other adjacent the lower portion of said casing member;

a manifold member enclosing the outer ends of said plurality of holes;

means for detachably supporting said manifold on the exterior said casing member whereby the manifold may be removed for cleaning said holes from the exterior of the incinerator;

and means for supplying air under pressure to said manifold and through said holes to assist in combustion in said chamber.

13. An incinerator as claimed in claim 12 in which said casing member is substantially annular and is provided with a horizontal axis said plurality of holes being horizontally spaced from each other with their axes normal to a plane through the horizontal axis of said member.

14. An incinerator as claimed in claim 13 in which said means for detachably supporting said manifold member includes a plurality of straps bolted to said casing member.

15. An incinerator for disposing of waste materials comprising:

an elongated generally annular casing member having a horizontal axis and an unobstructed open end, said casing member defining a combustion chamber;

door means for closing the unobstructed open end of said casing member for making the combustion chamber substantially airtight, said door means including, a U-shaped hinge member having a base portion with spaced legs extending therefrom, said U-shaped hinge member being pivotally connected to

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said casing member on an axis adjacent an edge of said base member and generally tangent to the periphery of the casing member, a door member complementary in shape and size to close the open end of said casing member, said door member being pivotally connected to the ends of the legs of said U-shaped hinge member on an axis parallel to said first mentioned axis and extending in a plane through a center line of the door member, and a plurality of locking latches peripherally spaced about the periphery of said door member and said casing member at its open end for uniformly sealing said door member to said casing member;

means to supply air under pressure to said combustion zone to assist in combustion;

and means for discharging exhaust gases from said combustion zone.

16. An incinerator as claimed in claim 15 including a feed door smaller in size than said door member, said door member having an opening therein closed by said feed door and said feed door being pivotally connected to said door member along a side of said opening and arranged to swing between the spaced legs of said U-shaped hinge member.

17. An incinerator as claimed in claim 16 in which said annular casing member is substantially cylindrical.

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