Oct. 1, 1968 G. H. FLOWERS, JR 3,403,645

INCINERATOR

Filed Jan. 31, 1967 3 Sheets-Sheet 1

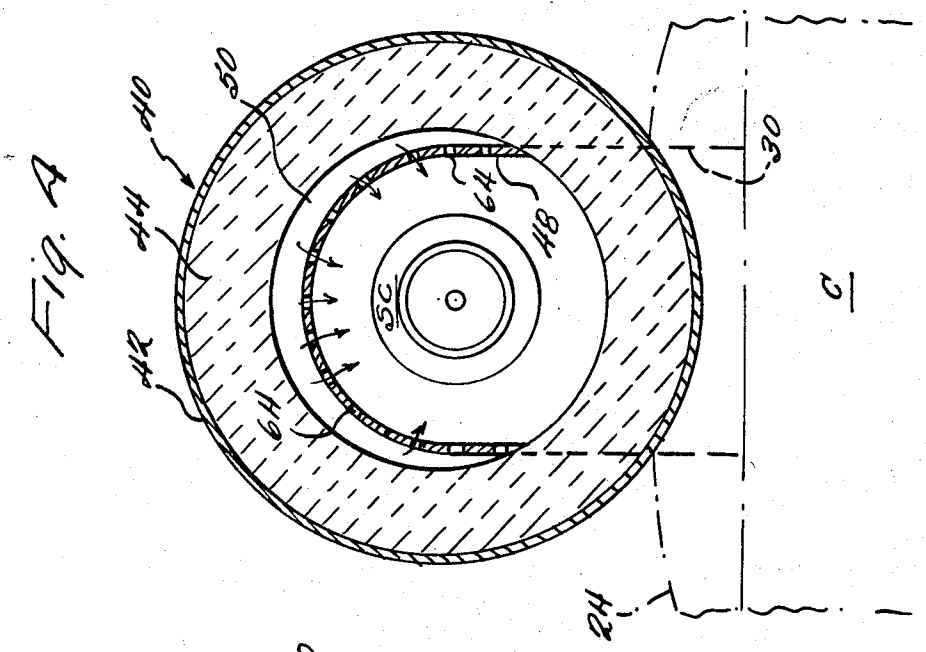

Fig. 2

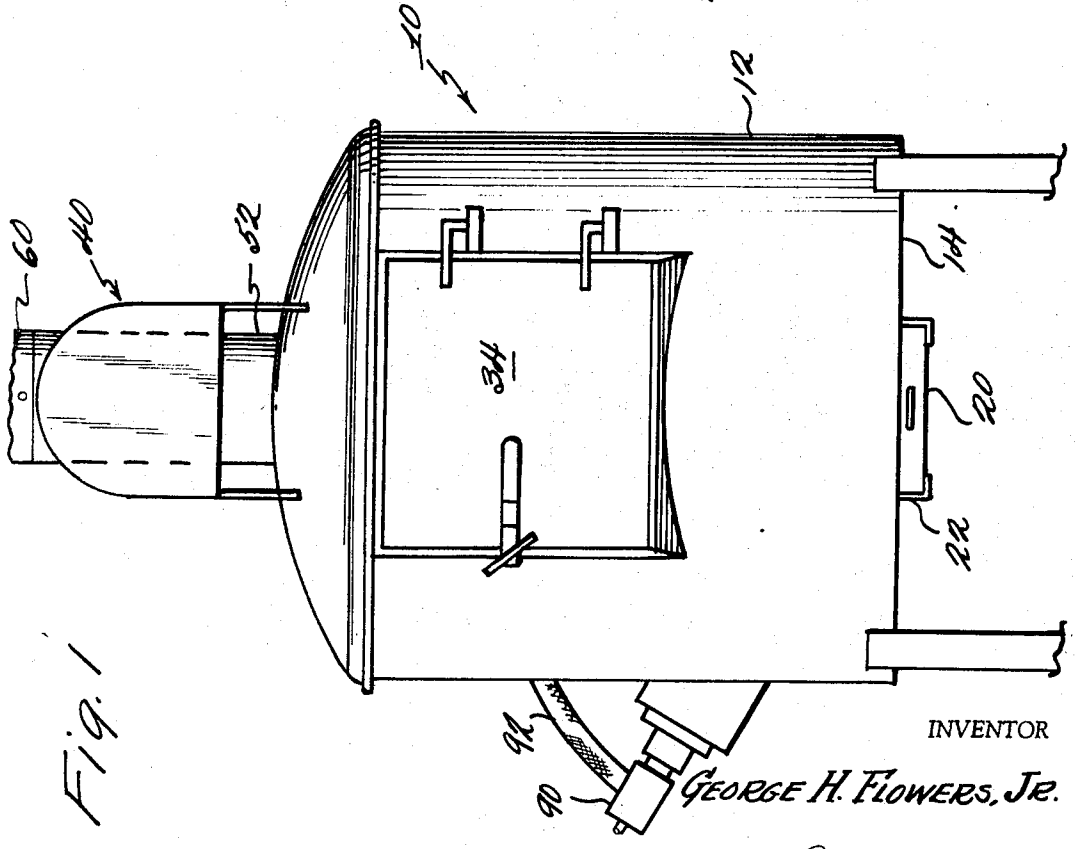

Fig. 1

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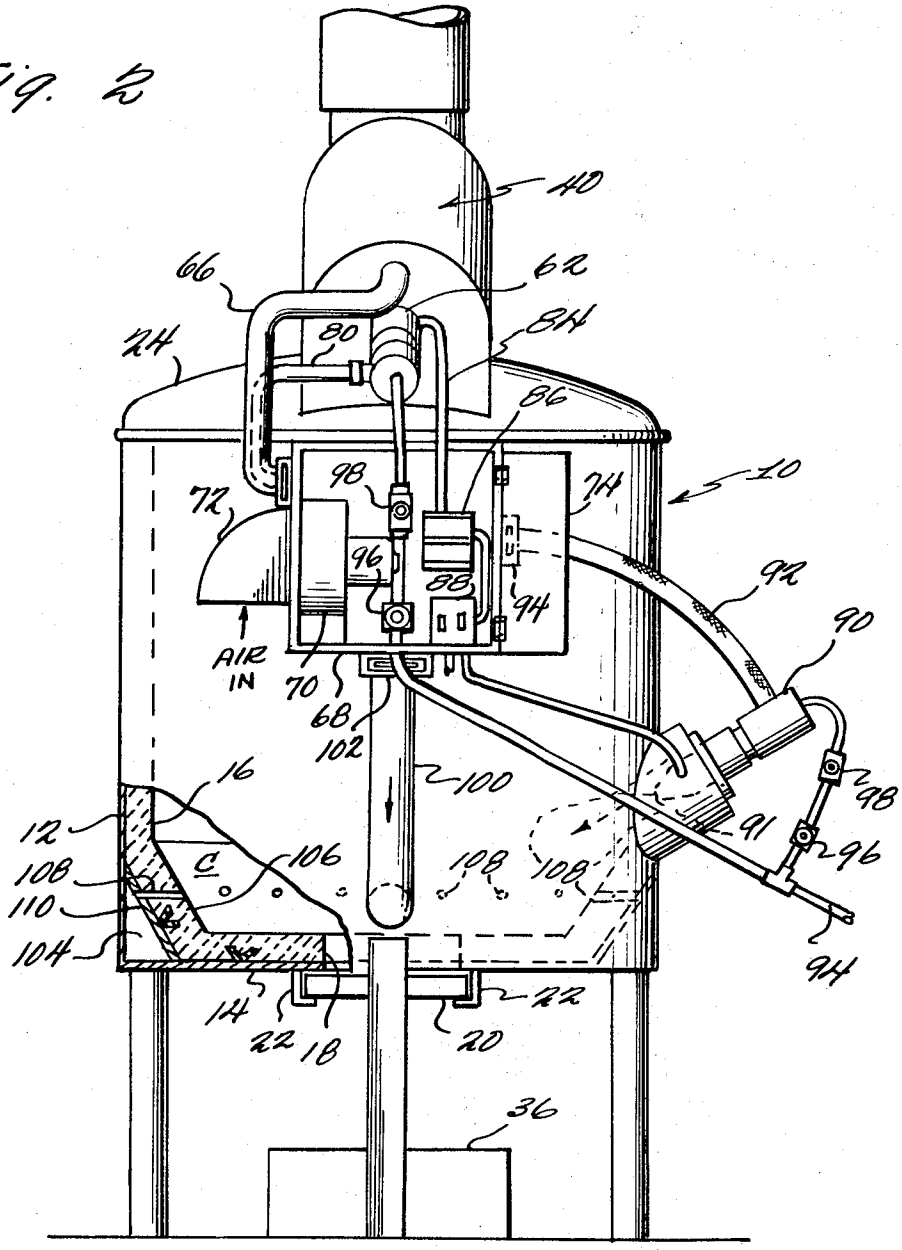
Fig. 2



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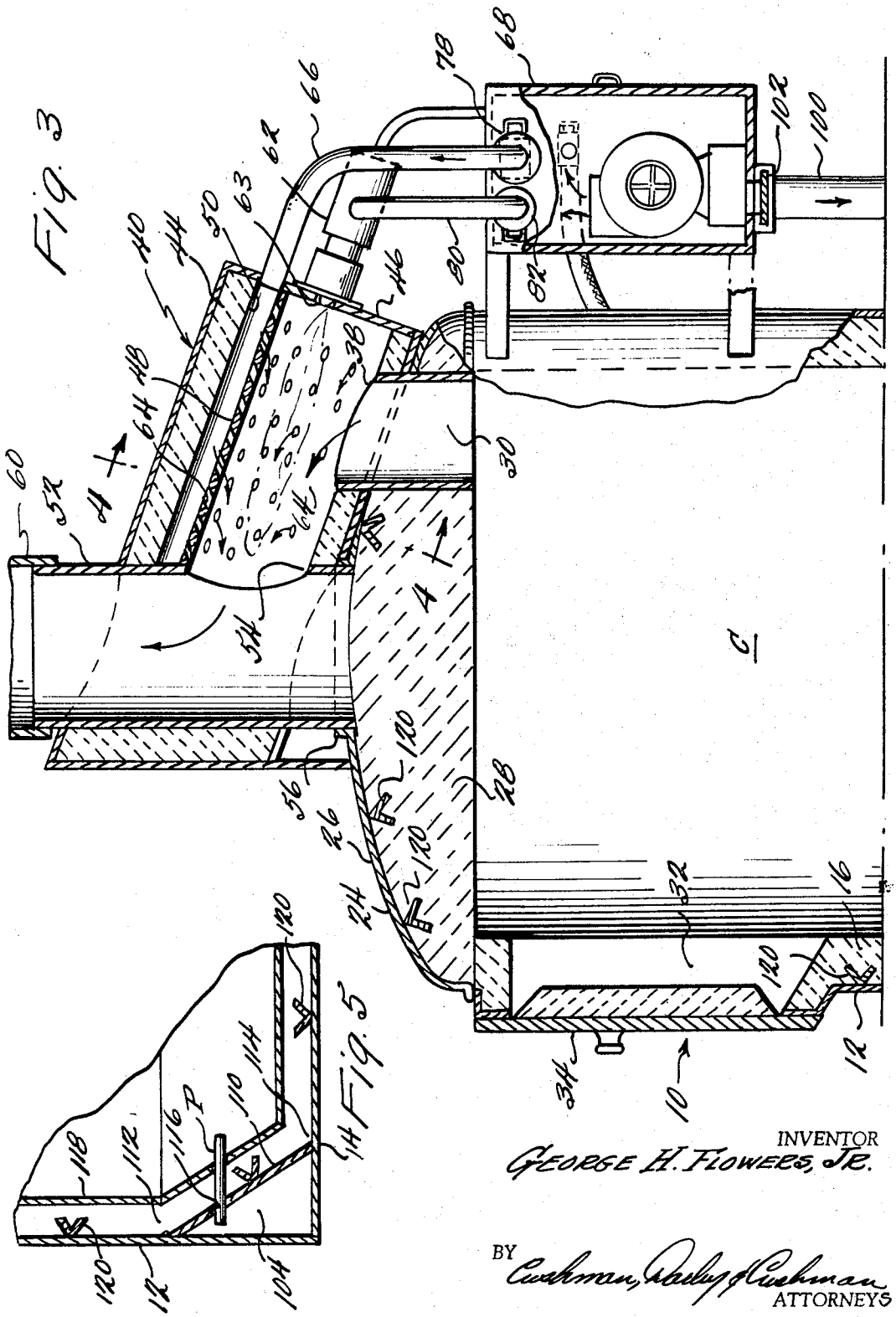

United States Patent Office

3,403,645
Patented Oct. 1, 1968

3,403,645

INCINERATOR

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Filed Jan. 31, 1967, Ser. No. 613,006
17 Claims. (Cl. 110—18)

ABSTRACT OF THE DISCLOSURE

An incinerator capable of burning in large volume of all types of rubbish and waste material with the exhaust gases from the main combustion zone being further subjected to another burning zone thus insuring complete combustion of any combustible products remaining in the exhaust gases thereby reducing air pollution to a minimum. The incinerator utilizes forced air to assist combustion in the main and secondary combustion zones as well as pressure burners for each zone with selective control for the air and/or burners.

The present invention relates to an incinerator and to a method of making the combustion chamber for such an incinerator, the incinerator being of the type used in burning large volumes of rubbish and waste material from commercial establishments, apartment houses, and the like.

In recent years, cities have become acutely aware of the problem of air pollution, this problem resulting from the high concentration of population necessitating numerous incinerators for disposal of rubbish and waste material. While the use of incinerator units is but one of the causes of air pollution, it has resulted in an awareness by the public that improved constructions of incinerators are necessary to reduce the heavy smoke and other obnoxious waste discharged into the atmosphere. Recently efforts have been made to improve incinerator designs and operation by providing a plurality of secondary spaced burning zones in the exhaust stack of an incinerator in an effort to insure complete combustion and, thus, the elimination of residues in the exhaust gases. The prior arrangements have proved satisfactory to a certain extent but they have necessitated the use of rather long smoke stacks in order to provide for the additional spaced burning zones. Additionally, such units have proved quite costly in that special provisions or means had to be provided in the smoke stacks for the entrance of air to supply additional oxygen. Also, the smoke stacks generally had to be provided with a refractory liner due to the increase temperatures incurred in the smoke stacks because of the provision of additional burning zones. The overall effective flow volume of the stack was also reduced because of the positioning of the burner in the path of flow or the arrangement of the burner in such a maner as to create turbulence in the stack thus impeding flow.

An object of the present invention is to provide an incinerator that eliminates or substantially reduces the emission of obnoxious and polluting waste products of combustion to the outside atmosphere and yet the incinerator has a smoke stack of minimum height and simple design.

Ancillary to the preceding object it is a further object of the present invention to provide an incinerator in which the smoke stack does not have to be lined with a refractory material although it may be so lined if desired.

Still another object of the present invention is to provide an incinerator having a main combustion zone wherein combustion of rubbish and other waste material occurs, the incinerator being provided with an exhaust system for exhaust gases, the exhaust system utilizing a secondary burning zone which is in a generally upwardly inclined

confined area rather than in a vertical direction within a smoke stack.

Still another object of the present invention is to provide an incinerator with a secondary or auxiliary burning zone for exhaust gases, the burning zone be so arranged to give impetus to the exhaust gases leaving the main combustion zone of the incinerator.

A further object of the present invention is to provide an incinerator having a secondary burning zone in a conduit leading from the primary burning zone to a stack, the burner for establishing the secondary burning zone being located outside the area of the conduit so as to provide no obstruction to the exhaust gases in their flow from the main combustion zone.

Ancillary to the preceding object, it is a further object of the invention to provide an improved exhaust system for insuring complete combustion with a minimum of obstruction to the flow therein.

Another object of the present invention is to provide an incinerator having a manifold surrounding the lower portion thereof for providing air under pressure to the main combustion zone to assist in supporting combustion therein.

Ancillary to the immediately preceding object it is a further object of the present invention to provide an incinerator with an auxiliary pressure burner for the main combustion zone which may be utilized to initiate combusion or assist combustion in the main combustion zone.

Still another object of the present invention is to provide an incinerator utilizing air under pressure to assist combustion in the main combustion zone as well as air under pressure to assist combustion in a secondary combustion zone, the incinerator being provided with a plenum box and means to selectively supply air to the two burning zones from the plenum box.

Still another object of the present invention is to provide an improved method of installing the refractory liner in the main combustion chamber of an incinerator, the refractory liner being contiguous with a metal casing or the like on its exterior surface.

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 front elevational view of the incinerator of the present invention;

FIGURE 2 is a rear elevational view of the incinerator of FIGURE 1 with a portion thereof shown in section, the view illustrating the plenum box for supplying air to the combustion zones and to the burners;

FIGURE 3 is an enlarged fragmentary vertical sectional view, partly in elevation, and showing details of the secondary burning zone;

FIGURE 4 is a sectional view taken substantially on the line 4—4 of FIGURE 3, and

FIGURE 5 is a fragmentary sectional view of the lower portion of the shell or casing of the incinerator and illustrating the method of providing the liner for the same.

Referring now to the drawings wherein like character or reference numerals represent like or similar parts, the incinerator of the present invention is generally designated by the reference numeral **10**. In more detail, the incinerator **10** includes a metallic shell **12** having a bottom end or wall **14** and defining an outer casing for a liner **16** of refractory material. The outer casing is generally cylindrical and has a vertical axis, the bottom wall **14** being provided with an opening **18** therein closed by a door **20** slidable in the tracks **22**. The upper end of the shell **12** of the outer casing is closed by a top end wall **24** which includes a metallic dome-shaped element **26** having a refractory liner **28**. The top end wall **24** is provided with a vertically extending passageway **30** having

an axis offset laterally from the vertical axis of the shell **12** as will be explained in more detail later in the specification.

The outer casing and its refractory liner **16** is provided with an opening **32** adjacent the top of the shell **12**, the opening being normally closed by a loading door **34** of conventional structure. As will now be appreciated, the outer casing and the bottom wall **14** together with the refractory liner **16** define a substantially airtight main combustion zone C where primary burning of waste and rubbish occur. The waste and rubbish is loaded through the loading door **34** and ash is removed through the lower or sliding door **20** into an ash pan **36** positioned therebeneath.

The vertical passageway or exhaust gas duct **30** leading from the main combustion zone C is cut on a bias as indicated at **38** as it is arranged to discharge into a transition conduit generally designated at **40**. In more detail, the transition conduit **40** has an axis which is inclined upwardly at an acute angle to a horizontal, the transition conduit **40** having an outer metallic casing **42**, an annular refractory liner **44** and a closed end wall **46**. Provided within the annular refractory liner **44** of the transition conduit **40** is a stainless steel, sixteen gage metal wall **48**, the wall being spaced from the upper interior portion of the liner **44** to define a manifold **50**. It will be noted that the transition conduit **40** is provided with a tubular section **52** at its upper end having an opening **54** therein communicating with the interior of the transition conduit **40** at the end of the conduit opposite the end wall **46**. The tubular section **52** is received at its lower end in an annulus **56** provided on the top of the dome-shaped element **26**, the tubular section **52** receiving the lower end of a smoke stack **60** so that in effect the tubular section **52** forms a lower portion of the stack **60**. As is evident from FIGURE 3 of the drawing, the stack **60**, including the section **52** does not communicate directly with the main combustion chamber C and thus is effectively closed at its lower end except where the section **52** is open to the interior of the transition conduit **40**. The vertical axis of the stack **60** is offset transversely from and parallel to the axis of passageway **30** and is also at an acute angle to the axis of the transition conduit **40** so that the flow of exhaust gas from the main combustion chamber C through the passageway **30** is first turned at an angle less than 90° when it enters the transition conduit **40** and then is turned back to a vertical axis without being turned 90° when it leaves the transition conduit **40** and enters the stack **60**. By such an arrangement, the flow of exhaust gases is not impeded by trying to make the same make right angle turns where turbulence would result.

The transition conduit **40** provides a secondary combustion zone SC between the passageway **30** and the stack **60**, the combustion zone SC being in a direction generally parallel to the flow of gas in and axis of the transition conduit.

A pressure burner **62** is supported on the outer side of the end wall **46**, the pressure burner having its nozzle arranged to shoot a blast of flame into the transition conduit in a direction parallel with the axis of the transition conduit, the flame being directed toward the opening **54**. In order to supply sufficient oxygen for burning of all combustible products in the exhaust gases while in the transition conduit, the element or member **48** is provided with a plurality of apertures **64** therethrough, the apertures **64** each having an axis intersecting a plane through the transition conduit **40** at an acute angle in the normal direction of flow. The reason for arranging the apertures in this particular manner may be coupled with the reason for positioning the nozzle **63** of the burner flush with or recessed in the interior surface of the end wall **46** as the purpose of the apertures **64** and of the flame **63** is to give impetus to the flow of exhaust gases without creating turbulence in the exhaust gases and without reducing the flow area for the exhaust gases.

At this time, it should be mentioned that the manifold **50** within the transition conduit **40** is connected at its lower end to an air duct **66**, the duct being connected to a plenum box **68** having a blower **70** mounted therein and capable of drawing outside air through an air intake **72**. The plenum box **68** is substantially airtight but is provided with an access door **74** so that access may be had for the controls to the pressure burner **62** and other equipment. It will be noted by reference to FIGURE 2 that a plate-type or slide valve **78** is provided at the connection of the duct **66** with the plenum box **68** and thus be regulating the size of opening between the duct and the interior of the plenum box, the amount of air discharged into the secondary combustion zone through the aperture **64** may be controlled.

The pressure burner **62** may be either a burner utilizing oil or gas such as natural or propane gas as fuel, the burner also being provided with an air inlet duct **80** connecting the same to the interior of the plenum box **68**. A plate-type or slide valve **82** is provided at the point where the duct **80** enters the plenum box so that the amount of air supplied to the pressure burner **62** may be controlled. The burner **62** is provided with an electrical ignition such as an electrode or a spark plug (not shown), the ignition system generally designated at **84** being connected through a transformer **86** to a source of power controlled by the electric switches **88**.

As best shown in FIGURE 2 of the drawing, the main combustion chamber C is also provided with a pressure burner **90** similar to the burner **62**, the burner **90** being supplied with air through a duct **92** extending from the plenum box **68**. A plate-type or slide valve **94** is provided for controlling the amount of air to the burner **90** whereas the electric switch means **88** through the transformer **86** may also be used for igniting the burner. Both burners **62** and **90** are supplied fuel from an inlet line **94** through their respective fuel cutoff valves **96** and pressure regulator valves **98**.

Air from the plenum box **68** is also supplied under pressure to the main combustion chamber C. In more detail, a duct **100** leading from the bottom of the plenum box **68** and provided with a slide or plate valve **102** extends down to an annular manifold **104** surrounding the lower end of the liner **16**. The manifold **104** is formed between liner **16** and the outer casing including the shell **12** and end wall **14** by bevelling the lower end of the liner as indicated at **106**. Circumferentially spaced around the liner are a plurality of air holes **108**, the air holes **108** communicating with the manifold **104** and supplying air inwardly into the main combustion chamber C. It will be noted that the air holes **108** are positioned below the nozzle **91** of burner **90** with the nozzle **91** being so directed that the flame emitted therefrom is directed downwardly in a general direction toward the air inlet holes.

Referring to FIGURE 5 of the drawing there is disclosed a novel means of making the main combustion chamber C and forming the air manifold therefor. In more detail, the cylindrical shell **12** having the bottom end wall **14** is provided with a plate member **110** welded thereto as indicated at **112** and **114**. The plate member **110** is annular and once it is welded into position as shown in FIGURE 4, it makes the chamber or manifold **104**. Holes **116** are circumferentially spaced around the plate member **110** and wooden pegs P are positioned in these holes, the pegs extending inwardly toward the axis of the shell **12**. A mold form **118** is positioned within the outer casing and spaced from the shell **12** and the end wall **14**, the mold form **118** having holes for receiving the inner ends of the pegs P. A castable refractory material is then poured into the space between the mold form **118** and the outer casing and when this refractory

material has hardened then the pegs P are removed first and then the mold form **118** is removed. Thus, the refractory liner **16** is formed and it will be noted that the outer surface of the liner **16** is contiguous with the casing and metal plate backing it up at all points thereon. By providing the plate **110**, it has been found that the refractory material does not have a tendency to chip in the area of the manifold and thus fall into the manifold where it might interfere with the flow of air therein through the holes **108**.

Angle plates **120** are provided on the interior surface of the outer casing for the purpose of anchoring and thereby supporting the refractory material after it has been cast and set.

The incinerator of the present invention may be operated as follows. Rubbish or waste material is loaded into the main combustion chamber C through the access door **34**. Once the incinerator has been charged with rubbish, then the blower **70** is started so as to pressurize the plenum box **68**. Air is supplied through the conduit or duct **100** to the manifold **104** and from there through the air inlet holes **108** into the bottom of the main combustion zone. The burner **90**, which may be supplied air through the duct **92**, is started and since it is supplied air under pressure it acts as a blast burner thus producing a very hot fire on the rubbish. Once the rubbish is started and exhaust gases begin to flow out of the passageway **30**, the burner **62** must be also operating with air being supplied to the transition conduit **40** through the apertures **64**. The length of flame in the transition conduit and temperature may be controlled by suitable adjustment of the amount of air being supplied to the conduit from the plenum box **68** through duct **66** as well as the amount of air supplied to the burner **62**.

When it is desired to either add additional rubbish to the main combustion chamber C or it is desired to remove ash from the bottom thereof, the air being supplied to the manifold **104** may be completely shut off at the plenum box by merely closing the valve **102**. This will prevent a blowout through either the loading door or the ash removal door. It will be appreciated that the burner **90** does not have to be continuously operated and is only used when it is desired to increase the temperature of combustion within the main combustion chamber or when it is desired to start the fire therein.

While the casing for the main combustion zone C has been shown in the drawings as being circular in section with a vertical axis, it will be understood that the casing may have other annular shapes in cross section and/or the axis of the combustion zone may be horizontal so long as the passageway from the combustion zone for the exhaust gases is through the upper portion of the casing.

The objects and advantages of the present invention have 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 embodiment 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 defined in the claims.

What is claimed is:

1. An incinerator for disposing waste material comprising: a generally annular casing member having a vertical axis and a top end wall and a bottom end wall and defining a main combustion chamber for waste material, said casing member having a refractory liner and being substantially airtight; said top end wall having a passageway therethrough, for discharge of exhaust gases from the main combustion chamber; an exhaust stack supported on said top end wall and having an axis offset from and parallel to the axis of the passageway in said top end wall; a transition conduit having a closed end and an opening adjacent the other end communicating with the lower end of said exhaust stack, said transition conduit further communicating at a point longitudinally spaced from its closed end with the passageway in said top end wall of said casing member, said transition conduit having an axis extending toward said exhaust stack and extending at an angle to the axis of the passageway in said top end wall and the axis of said exhaust stack; a pressure burner having a nozzle positioned at said closed end of said transition conduit out of flow of exhaust gases therethrough, said nozzle having an axis for effecting a burning zone in said transition conduit in a direction toward said exhaust stack and generally parallel to the axis of said transition conduit for burning waste products in the exhaust gases.

2. An incinerator as claimed in claim **1** including means to supply air under pressure to said burning zone in said transition conduit at an acute angle to the axis of said burning zone in a direction toward said exhaust stack.

3. An incinerator as claimed in claim **2** in which said transition conduit is provided with a refractory liner.

4. An incinerator as claimed in claim **1** including means for supplying air under pressure to the lower end of the main combustion chamber in said casing, said means comprising a manifold surrounding the lower end of the casing and said refractory liner having a plurality of holes therethrough communicating with said manifold, and a blower for supplying air to said manifold.

5. An incinerator as claimed in claim **4** including an auxiliary burner having a burner nozzle positioned within the main combustion chamber in said casing above the air inlet holes.

6. An incinerator as claimed in claim **1** in which said annular casing member includes a metallic shell on the exterior of said refractory liner said shell also defining a portion of the bottom end wall, said refractory liner being bevelled at its lower end to define with said shell a manifold around said casing, said refractory liner having spaced holes therein in its bevelled portion; and means for supplying air under pressure to said manifold for discharge through said holes into the main combustion chamber of said casing.

7. An incinerator as claimed in claim **6** including means to supply air under pressure to said burning zone in said transition conduit.

8. An incinerator as claimed in claim **7** in which said means to supply air under pressure to said manifold and said means to supply air under pressure to said transition conduit includes a plenum box, a blower for supplying air under pressure to said plenum box, an air supply duct from said plenum box to said manifold, a second air supply duct from said plenum box to said transition conduit.

9. An incinerator as claimed in claim **8** including valve means for selectively supplying air from said plenum box to said first duct and said second duct.

10. An incinerator for disposing waste material comprising: a cylindrical metallic shell having a vertical axis; a metallic bottom wall secured to said shell; a generally cylindrical refractory liner within said shell and having a closed bottom, said cylindrical liner adjacent its closed bottom being bevelled to define an annular manifold between it and the shell and bottom end wall at the junction of the same; said refractory liner in its bevelled lower end having circumferentially spaced holes therethrough communicating the interior of the liner with the manifold; a top end wall enclosing the upper end of said shell, said top end wall having a refractory material on its interior; said shell and bottom end wall with their liner and said top end wall defining a combustion chamber; said shell and its refractory liner having an opening therethrough for charging the interior with waste material; a closure means for said opening; and said bottom end wall and said refractory liner having an opening therethrough for discharge of ash; a closure means for said discharge opening; means for discharging exhaust gases from the interior; a means for supplying air under pressure to said mani-

fold and through said holes in said liner to assist in combustion.

11. An incinerator as claimed in claim **10** including a plate secured at an angle to said shell and said bottom end wall and abutting the bevelled portion of said refractory liner said plate having holes therein aligned with the holes in said refractory liner.

12. An incinerator as claimed in claim **11** in which said refractory liner is made of a castable refractory material and is cast within said shell and said bottom end wall with said plate in position so that said refractory liner is supported on its exterior by said shell, plate and bottom end wall.

13. An incinerator as claimed in claim **10** in which said means for discharging exhaust gases from the interior of the liner includes a passageway through the top end wall having a vertical axis; a transition duct communicating adjacent one end thereof with said passageway and having an axis extending upwardly from the axis of said passageway at an acute angle to a horizontal; a stack having a vertical axis, said stack communicating at its lower end with the other end of said transition conduit; and burner means for injecting a flame under pressure into said transition conduit on an axis parallel to the axis of said transition conduit in an upwardly inclined direction.

14. An incinerator as claimed in claim **13** including means to supply air under pressure into said transition conduit at an acute angle to the axis of said transition conduit in the same general direction as the flame from said pressure burner.

15. An incinerator as claimed in claim **14** including selectively operable valve means for controlling said means to supply air to said manifold and said means to supply air to said transition conduit.

16. An incinerator for disposing of waste material comprising a casing member defining a substantially airtight main combustion chamber, said casing member having means for charging the combustion chamber with waste material and means for removing ash from the combustion chamber; a passageway through the top portion of said casing member for discharging exhaust gases from said main combustion zone; an exhaust stack offset laterally from said passageway; a transition conduit having a closed end and an opening adjacent the other end communicating with the lower end of said exhaust stack, said transition conduit further communicating at a point longitudinally spaced from its closed end with the passageway in said top portion of said casing member, said transition conduit having a longitudinal axis extending from said passageway to said stack; a pressure burner having a nozzle positioned at said closed end of said transition conduit out of flow of exhaust gases therethrough, said nozzle having an axis for effecting a burning zone in said transition conduit in a direction toward said exhaust stack and generally parallel to the axis of said transition conduit for burning waste products in the exhaust gases.

17. An incinerator as claimed in claim **16** including means to supply air under pressure to said burning zone in said transition conduit, the air being supplied at an acute angle to the axis of said burning zone in a direction toward said exhaust stack.

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