United States Patent [19]

Watts

[11] B **3,913,499**

[45] **Oct. 21, 1975**

[54] **REFUSE BURNER APPARATUS**

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[73] Assignee: **Koppers Company, Inc.,** Pittsburgh, Pa.

[22] Filed: **May 30, 1973**

[21] Appl. No.: **364,022**

[44] Published under the Trial Voluntary Protest Program on January 28, 1975 as document no. B 364,022.

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 339,337.

[52] **U.S. Cl.** ..... **110/8 C;** 110/18 C

[51] **Int. Cl.²** **F23G 5/12**

[58] **Field of Search** ..... 110/7 R, 8 R, 8 A, 8 C, 110/18 R, 18 C

[56] **References Cited**

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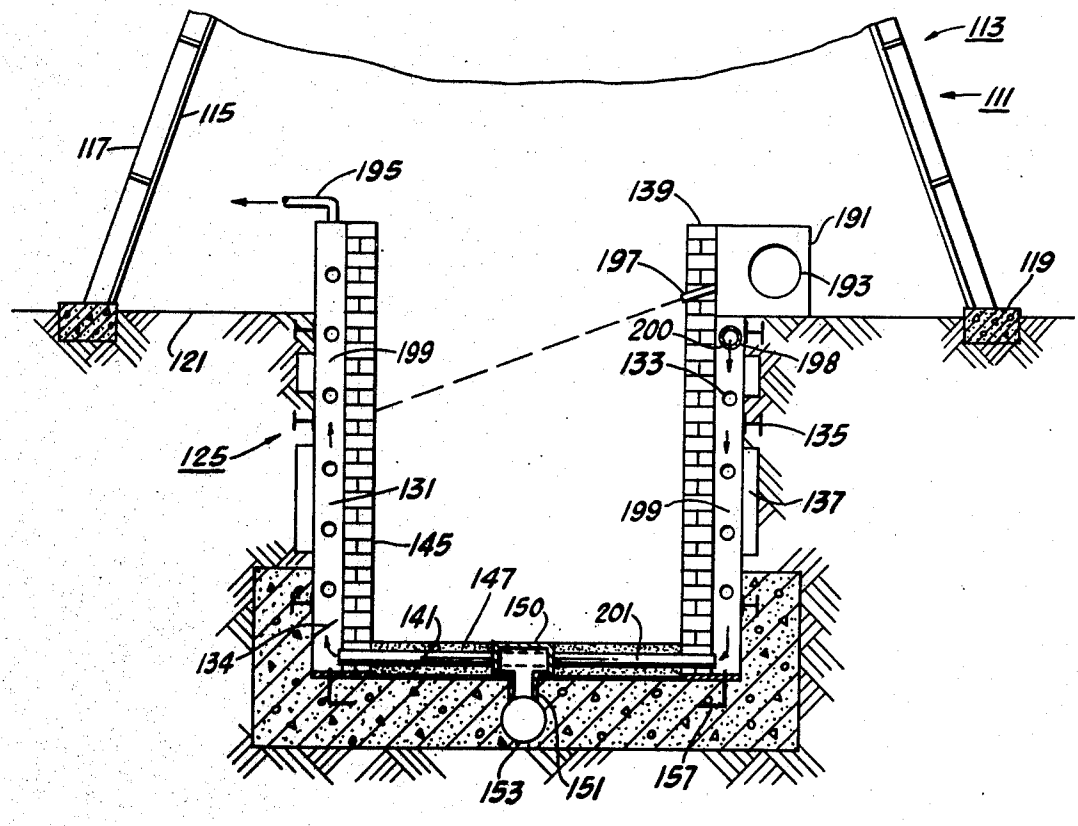
Primary Examiner—Kenneth W. Sprague

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[57] **ABSTRACT**

A subterranean burning chamber for burning refuse, which is covered by a frusto-conical metal shell, comprises a steel structure that is refractory lined and has hollow walls that are fluid-cooled. Means is provided for maintaining the chamber in place when bouyant forces are present.

7 Claims, 6 Drawing Figures



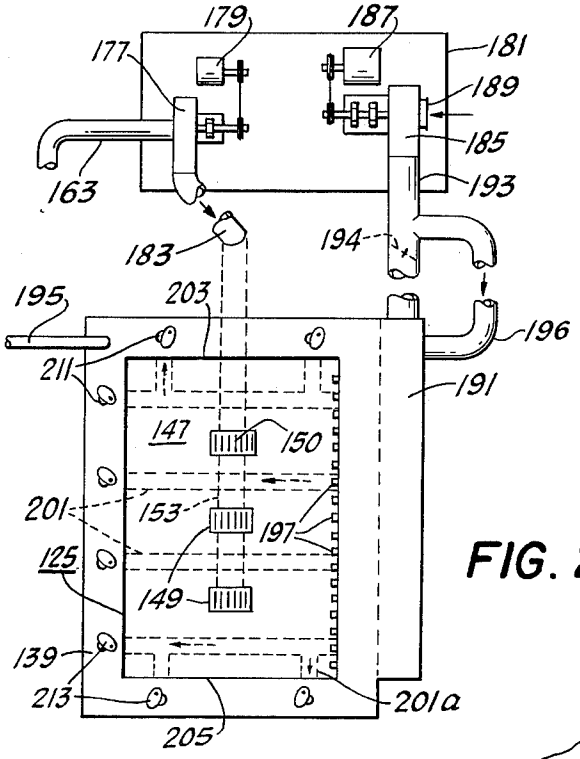

179
187
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211
191
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150
201
153
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125
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139
213
201a
205

FIG. 2

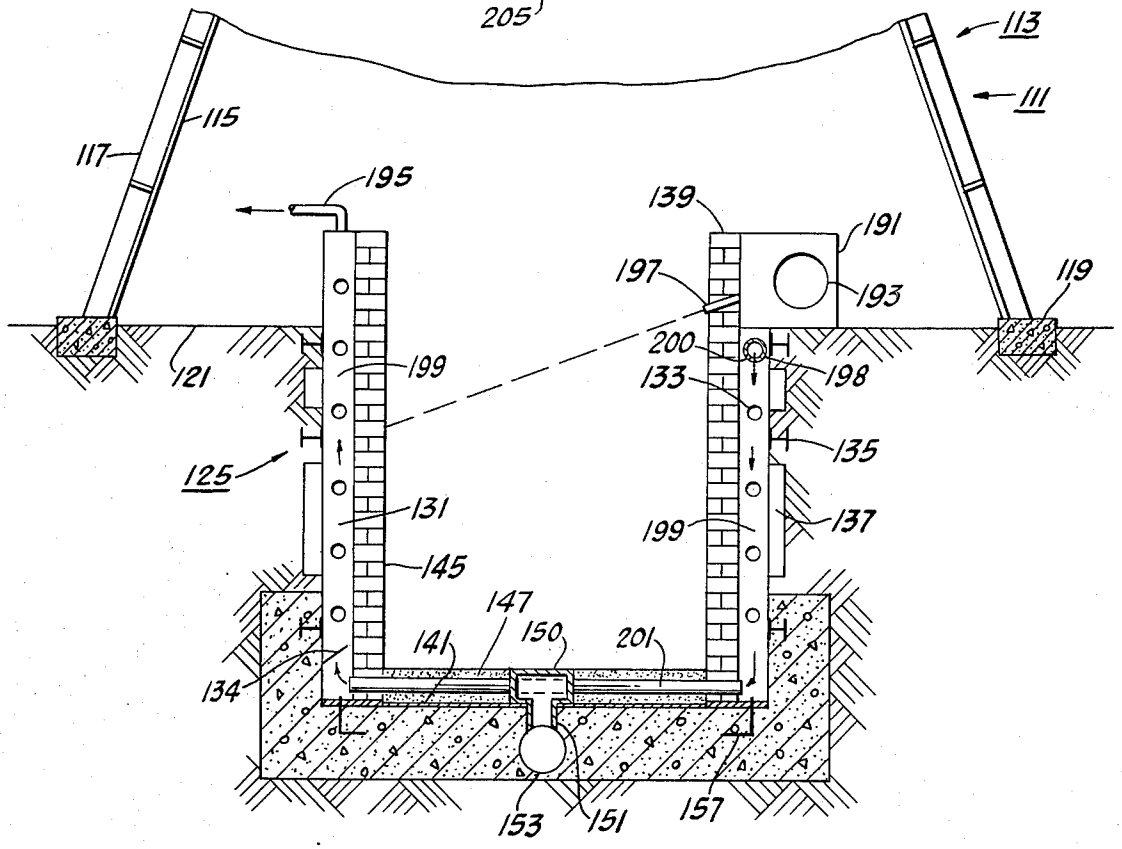

113
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FIG. 1

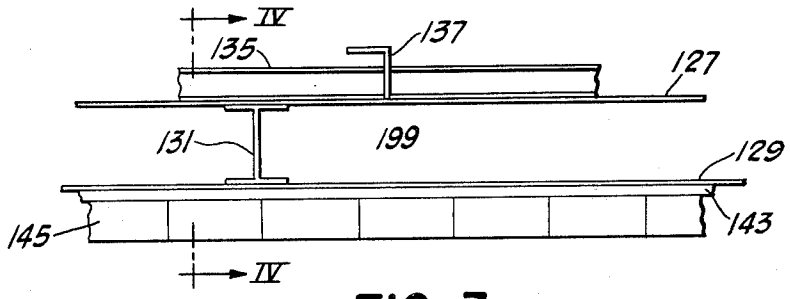


FIG. 3

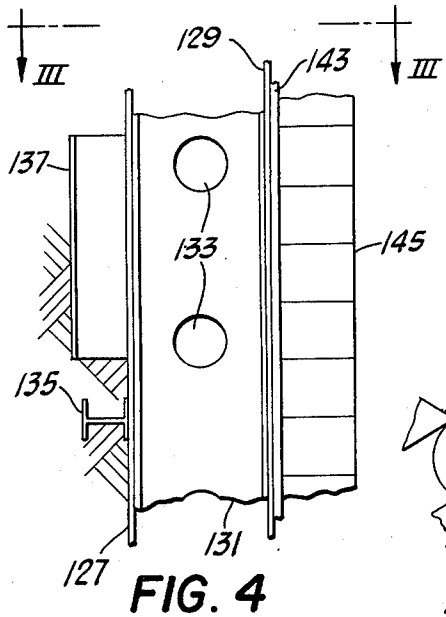


FIG. 4

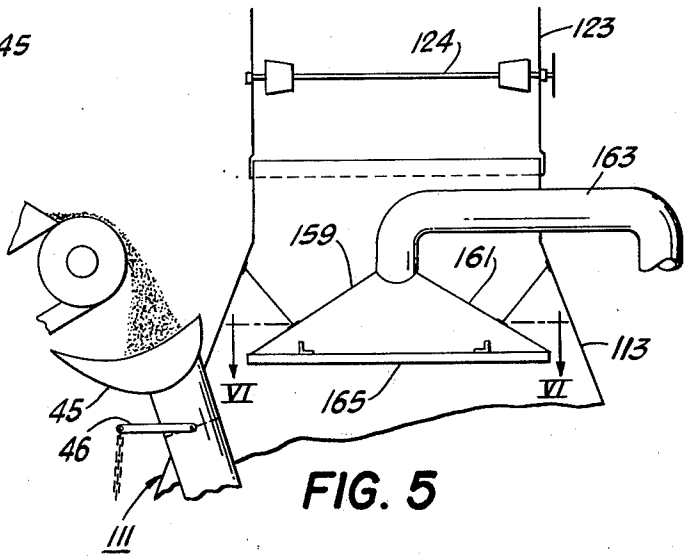


FIG. 5

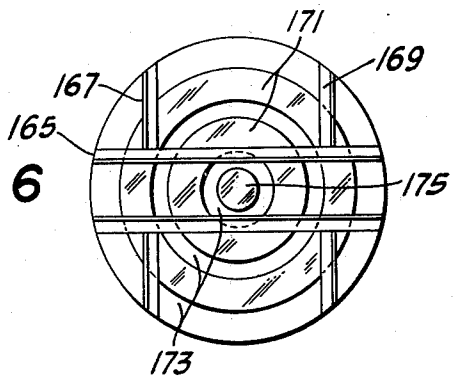


FIG. 6

REFUSE BURNER APPARATUS

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of application Ser. No. 339,337, filed Mar. 8, 1973, now U.S. Pat. No. 3,807,323.

BRIEF SUMMARY OF THE INVENTION

A refuse burner, in accordance with the present invention, includes a subterranean, open-topped pit or chamber, that has hollow, fluid-cooled structural walls, the lower part of which are encased in concrete. The top of the pit or chamber is covered by a frusto-conical shell with means at the top for collecting effluent given off by burning material in the pit or chamber. Such effluent is recirculated into the bottom of the pit or chamber.

For a further understanding of the invention and for features and advantages thereof, reference may be made to the following description and the drawing which illustrates a preferred embodiment of equipment in accordance with the invention which is suitable for practicing the method of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a schematic vertical sectional view of apparatus in accordance with one embodiment of the present invention;

FIG. **2** is a plan view of the lower portion of the apparatus of FIG. **1**;

FIG. **3** is a view along line III—III of FIG. **4**;

FIG. **4** is a view along line IV—IV of FIG. **3**;

FIG. **5** is a view of the top portion of the apparatus shown in FIG. **1**; and

FIG. **6** is a view along line VI—VI of FIG. **5**.

DETAILED DESCRIPTION

Referring to FIG. **1**, a refuse burner **111**, in accordance with one embodiment of the present invention, comprises a frusto-conical shell **113** that surrounds and is located above a subterranean pit or burning chamber; is generally rectangular in shape; is open topped; and is substantially entirely subterranean except for a small portion at the top that extends a short distance above ground level. Such pit or burning chamber **125** is constructed in the manner shown generally in FIGS. **1–4**.

The frusto-conical shell **113** includes an angle iron or structural steel skeleton frame **115** that is covered, preferably, with aluminized sheet steel shell **117**. The skeleton frame may, of course, be made of any other structural members as preferred. Both the frame **115** and the shell **117** are supported upon a circular concrete footing **119** disposed at ground level **121**. The frusto-conical shell **113** is disposed above and surrounding the subterranean pit or burning chamber **125**.

The top of the frusto-conical shell **113** is shown in FIG. **5** and includes a cylindrical-shaped tubular member **123** wherein there is a conventional damper **124**. The damper **124** may be of the vane or the shutter type, and it may be controlled in a conventional manner by a device that responds to the temperature of effluent from burning waste products in the pit or burning chamber **125**, or it may be operated manually, as preferred.

The pit or burning chamber **125** has four vertical side walls that are formed of outer **127** and inner **129** membranes, such as steel plating or heavy gauge sheet steel. These outer **127** and inner **129** membranes are maintained in spaced-apart parallel relation by a plurality of vertically arranged structural beams, such as H-beams **131**. Each of the H-beams **131** is provided with a plurality of holes **133** in its web for a purpose that will be explained hereinafter.

The outer plating or membrane **127** is supported by vertically spaced-apart, horizontally arranged I-beams **135** and by short intercostal sections of vertically arranged structural angles **137**. The wall membranes or plating **127, 129** and the H-beams **131** are capped by a horizontal cap plate **139**, and they are supported upon a steel base plate **141**. Thus, the wall structure is hollow and fluid-tight, and the holes **133** provide a passageway through the structural H-beams **131** for the flow of a fluid, which may be air, in the wall structure to cool it.

Adjacent the bottom of the hollow wall structure on the right hand side (FIG. **1**) is an upwardly inclined baffle plate **134**, that does not contact, but is spaced apart from the inner plating **129**; thereby providing a passage for fluid within the hollow wall space **199** emerging from cross-over pipes **201**, mentioned hereafter.

The inner surface of the inner membrane or plating **129** is covered with an insulating material **143** that may be mineral wool or any other suitable insulating material. Contiguous with the insulating material **143** is a lining of refractory bricks **145**.

The bottom of the burning pit or chamber **125** is loose granular material, such as a layer of sand **147**, disposed over the bottom plating **141**. In the sand layer **147** there are a plurality of cross-over pipes or conduits **201** that afford fluid communication between the spaces **199** in the hollow wall structure.

Extending through the layer of sand **147**, are a plurality of grate boxes **149** which are fitted with top grate structures **150**; each grate box **149** is connected to a riser **151**, extending through the bottom plating **141** and sand **147**, connected to a conduit **153** below the bottom of the pit or burning chamber **125**.

The top or cap plate **139** is perforated by a plurality of vents **211** which are covered by adjustable damper plates **213** so as to regulate the amount of air leaving the hollow wall space **199** during firing of the burner pit **125**. The vents **211**, as will be noticed from FIG. **2**, are located in only one longitudinal cap plate, but they are located in both end cap plates.

The lower one-third portion of the wall structure and the bottom of the pit of burning chamber **125** are encased in concrete **155**. The concrete **155** acts to prevent the hollow, bouyant wall structure of the pit or burning chamber **125** from moving upwardly whenever sub-surface water is present in sufficient quantity to exert a bouyant force on the chamber **125**. Anchor bolts **157** connect the side walls to the concrete, as shown. Of course, other means than concrete may be used, if preferred, to provide enough extra weight in the structure to counteract bouyancy effects of sub-surface water and the like on the chamber **125**. Further, in regions where sub-surface bouyancy is not a consideration, the concrete **155** may be omitted, but yet, in most instances, it may be installed to provide a more rigid support for the pit or burning chamber **125**.

Associated with the pit or burning chamber **125** is a fly ash reinjection system and a fluid-cooling system for the wall structure of the chamber **125.**

The fly ash reinjection system includes a collector cone **159,** shown in FIG. **5,** that is located just below the cylindrical-shaped tubular member **123** at the top of the frusto-conical shell **113.**

The collector cone **159,** however, has a conical outer shell **161** that merges with a conduit **163** at its top, the conduit **163** being disposed horizontally, as shown, through the shell **113,** and directed downwardly outside the shell, as suggested. The collector cone **159** has a bottom portion **165,** shown in FIG. **6,** that is comprised of a structural grid **167** made up of angles **169** to which are applied concentric annular plates **171,** so arranged that there are annular spaces **173** between adjacent concentric annular plates; a center plate **175** is provided that is not annular in shape.

Conduit **163** connects with a centrifugal type fan **177,** that is provided with suitable motor drive **179,** situated on a concrete slab or base **181** adjacent the pit or burning chamber **125,** as suggested in FIG. **2.** A discharge conduit **183** from the fan **177** connects to the header conduit **153** (FIG. 1) with which the risers **151** and grate boxes **149** are associated, as mentioned previously.

On the foundation or concrete slab **181,** there is another fan **185,** preferably of the centrifugal type, having a suitable motor drive **187,** that receives ambient air through an intake **189** and that discharges the air under pressure into conduit **193.** Conduit **193** carries the air either into a plenum chamber **191** or, when a damper **194** is properly set, into conduit **196** that connects to conduit **198** within the hollow wall structure, about where shown in FIG. **1.** The conduit **198** has a plurality of slotted holes **200** in its periphery, along its length, that allow air to enter the hollow wall space **199.** The air passes downwardly in the hollow wall space **199** on the right-hand side as viewed in FIG. **1,** through the cross-over pipes **201** into the end wall spaces via pipes **201***a,* and thence upwardly in the hollow wall spaces to exit vents **211** and outlet conduit **195,** as shown schematically by the flow arrows. The conduit **195** may pass through the hollow shell **113** and terminate outside thereof if preferred.

Associated with the plenum **191** and wall structure are a plurality of nozzles **197** that extend slightly into the pit or burning chamber **125** and at a downward angle, about as shown in FIG. **1.**

In operation, a quantity of wood and paper are placed on the floor of the pit or burning chamber, and they are ignited in a suitable conventional manner. A damper **46** at the top of the shell **113** is closed initially and the fly ash reinjection system is activated to circulate the effluent arising from the burning wood and paper. The effluent is recirculated back into the chamber and, thereby, does not escape to pollute the atmosphere.

The apparatus is quickly brought up to a working temperature as additional waste wood products and other combustible material are thereafter introduced into the pit or burning chamber, as desired, through a chute **45,** as suggested in FIG. **5.**

When the chamber is at the working temperature and the walls have become heated, the cooling air fan is turned on to circulate cooling fluid in the space **199** between the inner and outer walls. The cooling fluid maintains the walls of the pit or chamber relatively cool, and during the burning process, waste wood and other combustible material are introduced, more or less continually, into the chamber through the chute. In some instances a vehicle carrying such combustible material, may be admitted to the shell, through an opening therein, (not shown) in order to dump its load into the chamber.

From time to time, or whenever it is deemed necessary or desirable, mobile equipment, such as a backhoe or other similar apparatus, may be admitted to the shell through the opening for the purpose of removing ash residue from the chamber. Such apparatus can easily approach close enough to the edge of the chamber to quickly and effectively remove the ash residue.

Those skilled in the art will recognize that when the walls of the chamber have reached a desired temperature, the fan, which connects to the nozzles within the chamber, is operated. Air jetting from such nozzles creates a curtain over the burning material and, together with the fly ash recirculating system, develops very high temperatures within the chamber. The temperature, about 2,000°F, is well above that generally regarded as desirable, which is around 800°F, to obtain complete and effective burning of waste material and the effluent produced.

From the foregoing description of one embodiment of the invention, those skilled in the art should recognize many important features and advantages of it, among which the following are particularly significant:

Very high combustion temperatures, as high as about 2,000°F, are obtained in the combustion zone of the chamber of the apparatus of the invention. Since a temperature of only about 800°F will produce clean burning of waste wood products, it is readily apparent that, at the high temperature achieved in the apparatus of the invention, no smoke or effluent escapes to the atmosphere;

Because the temperature in the subterranean chamber may be as high as 2,000°F, the refractory-lined walls, with insulating space in which fluid such as air under pressure circulates, can better withstand such a high temperature that the thin shell portion above ground;

Because the distance between the combustion zone in the chamber and the collection cone in the present apparatus is greater than that of burner apparatus known from the prior art, the fly ash cools down somewhat, and the upward, thermally generated velocity of the fly ash in the present apparatus is much lower than that developed in prior art burner apparatus. These advantages result in less wearing of the conduits of the present fly ash reinjection system;

That batch feeding of waste wood products and other consumable material into the chamber is readily afforded, since there is a large access door and opening in the shell of the apparatus;

That ash removal from the chamber can also be readily accomplished, since mobile ash removal equipment is easily moved into and out of the shell through the access door and opening;

Since almost the entire burning chamber is below ground level, a uniform temperature profile down the walls of the chamber is effected, and no thermal shocks are set up from water or wind, and the like, or from any water seepage below ground level.

Flooding of the burning chamber is prevented, since it is protected by the above-ground shell;

The structural characteristics of the burning chamber, particularly the fluid-cooled walls and the sand floor, promote long life in service with very little loss in burning time or expense; and

The sand floor in the chamber absorbs high-impact loads from batch feeding of large items such as pole cut-offs, stumps, scrap wood, and the like; the sand floor also is an effective insulating medium to prevent spalling of the concrete base.

Although the invention has been described herein with a certain degree of particularity, it is understood that the present disclosure has been made only as an example, and that the scope of the invention is defined by what is hereinafter claimed.

What is claimed is:

1. In a refuse burner apparatus including a hollow wall structure of inner and outer spaced-apart plates and a layer of insulating material disposed on said inner wall plate, with a layer of refractory material covering the insulating layer; with a cap plate covering the top of the wall structure; and with a bottom plate on which the wall structure rests, the combination with said wall structure of:

a. a first conduit communicating with said hollow wall structure for introducing a cooling fluid thereinto to cool said wall structure;

b. means for introducing a cooling fluid into said first conduit;

c. means for flowing said cooling fluid out of said wall structure;

d. a second conduit carrying said cooling fluid; and

e. a third conduit communicating with said second conduit and having a plurality of nozzles that direct fluid flowing in said third conduit into said burner apparatus.

2. The invention of claim **1** including:

a. damper means for regulating the flow of fluid in said conduits.

3. In a refuse burner apparatus including a hollow wall structure formed by spaced-apart membranes with a cap plate covering the top of said wall structure and a bottom plate on which the wall structure rests, the combination with said wall structure of:

a. means for carrying cooling fluid into one portion of said hollow wall structure; and

b. conduit means for carrying said cooling fluid from said one portion to another portion of said hollow wall structure.

4. The invention of claim **3** including:

a. means surrounding and coacting with a portion of said wall structure for resisting upward forces acting on said wall structure.

5. The invention of claim **3** including:

a. a first conduit carrying a cooling fluid into the space between said membranes;

b. a second conduit having a plurality of nozzles that direct fluid flowing therein into said burner apparatus; and

c. damper means for regulating the flow of fluid in said first and second conduits.

6. The invention of claim **3** including:

a. a baffle in said another wall structure portion that is spaced apart from one membrane of said hollow wall structure; and

b. adjustable vent openings in said hollow wall structure whereby said cooling fluid may escape therefrom.

7. In a refuse burner apparatus, the improvement comprising:

a. a hollow wall structure comprised of inner and outer membranes with means therebetween for maintaining said membranes in spaced-apart relation;

b. means for introducing a cooling fluid into one portion of said hollow wall structure; and

c. means for conveying said fluid from said one wall structure portion to another wall structure portion.

* * * * *