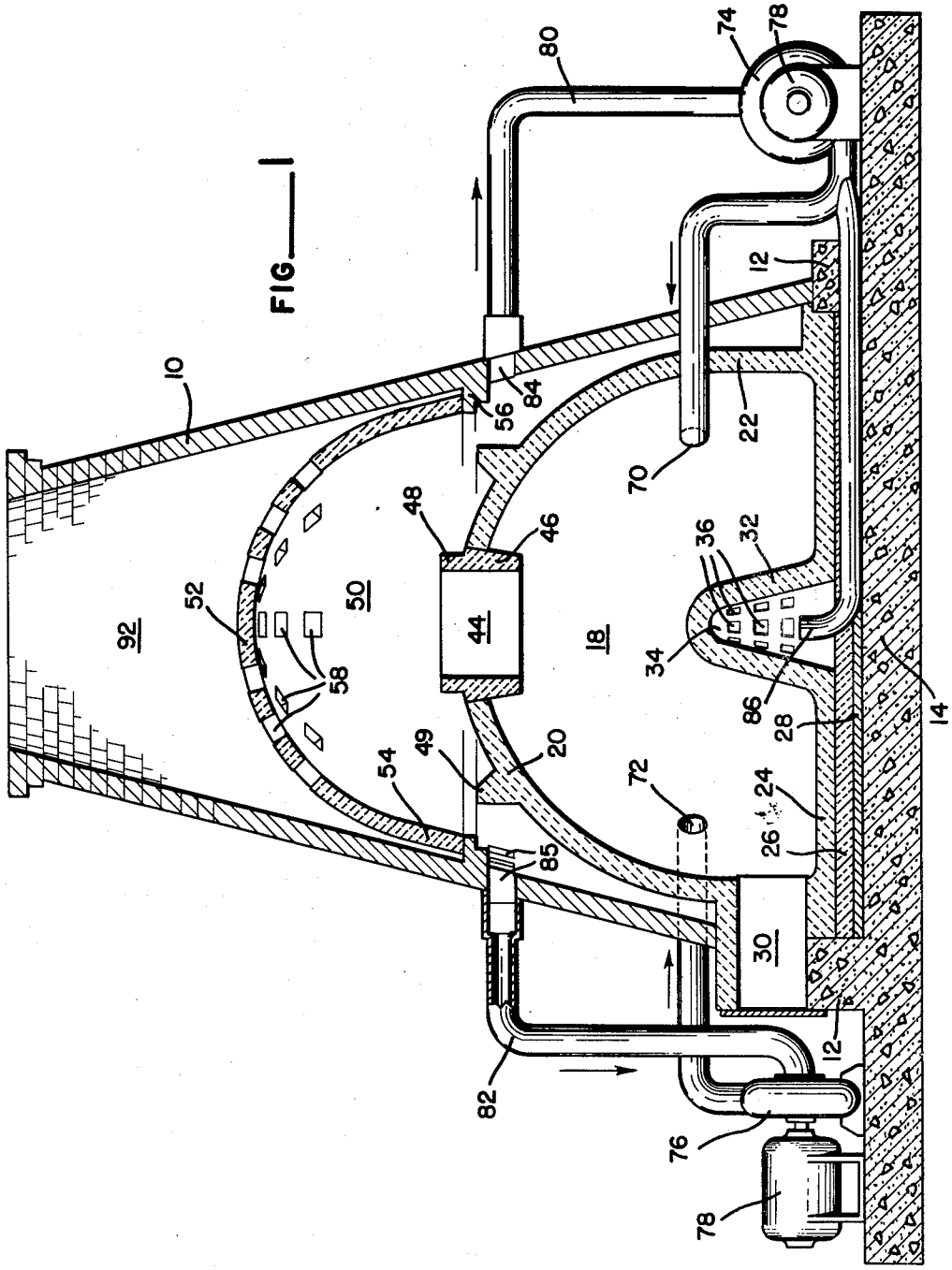
July 17, 1956 F. C. TOEPEL 2,754,779

TWO ZONE GARBAGE INCINERATOR

Filed Aug. 12, 1952 4 Sheets-Sheet 1

FIG. 1




FLORIAN C. TOEPEL
INVENTOR

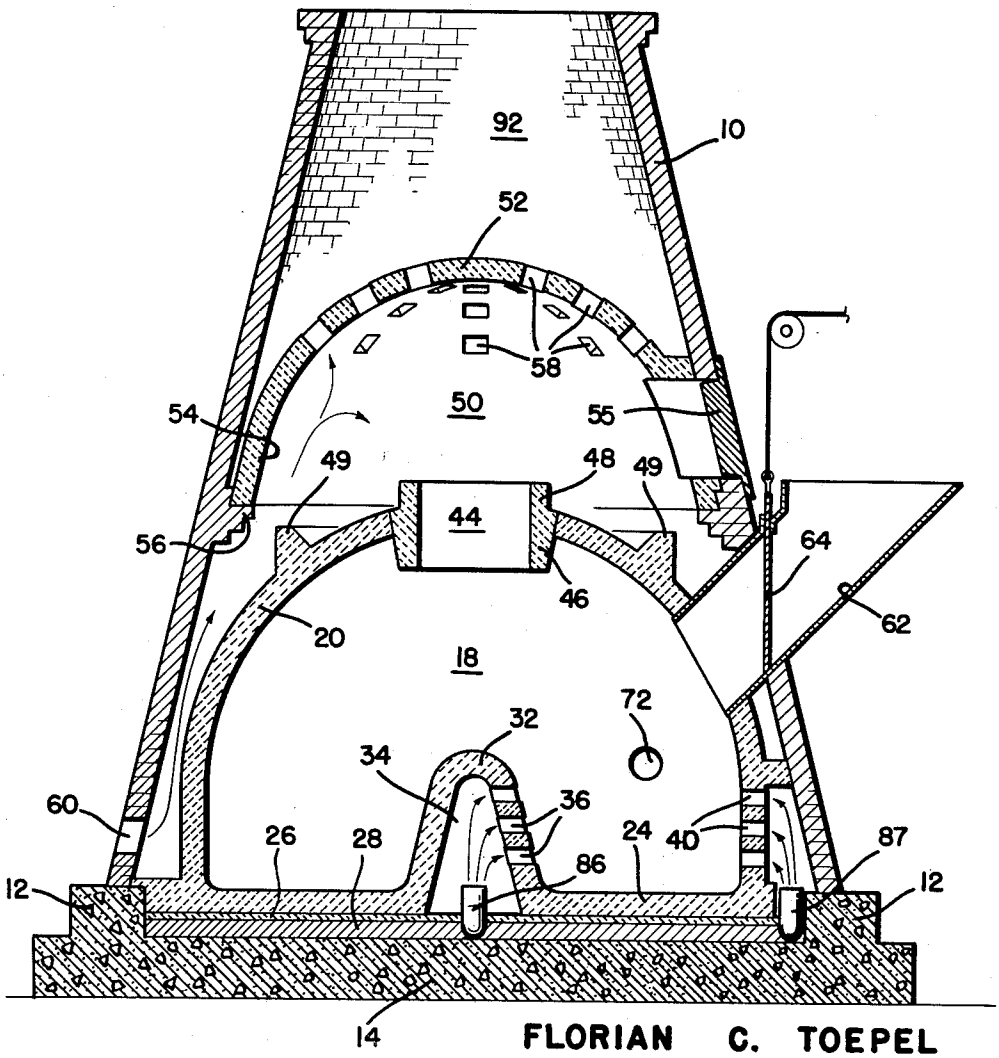
BY Smith & Tuck
ATTORNEYS

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TWO ZONE GARBAGE INCINERATOR

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FIG. 2




FLORIAN C. TOEPEL
INVENTOR

BY Smith & Tuck
ATTORNEYS

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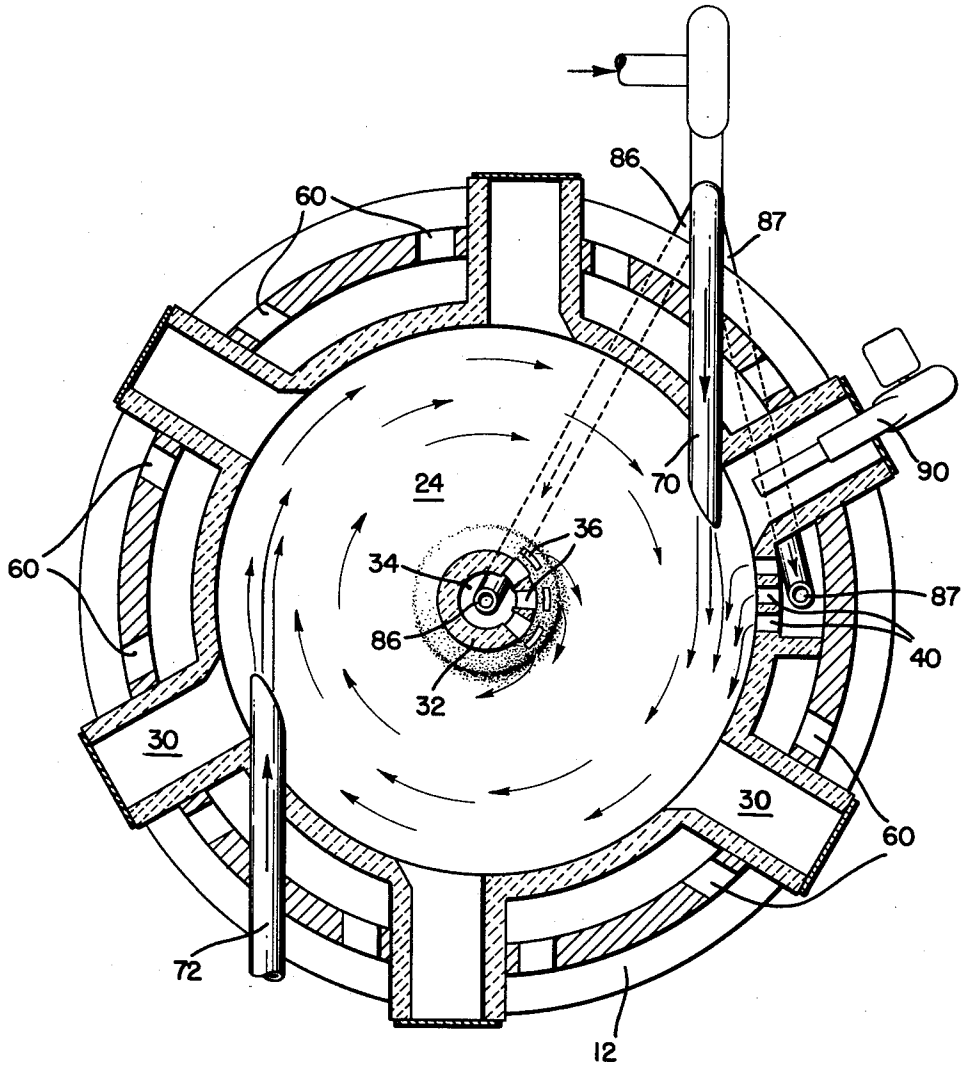



FIG. 3

FLORIAN C. TOEPEL
INVENTOR

BY Smith & Tuck
ATTORNEYS

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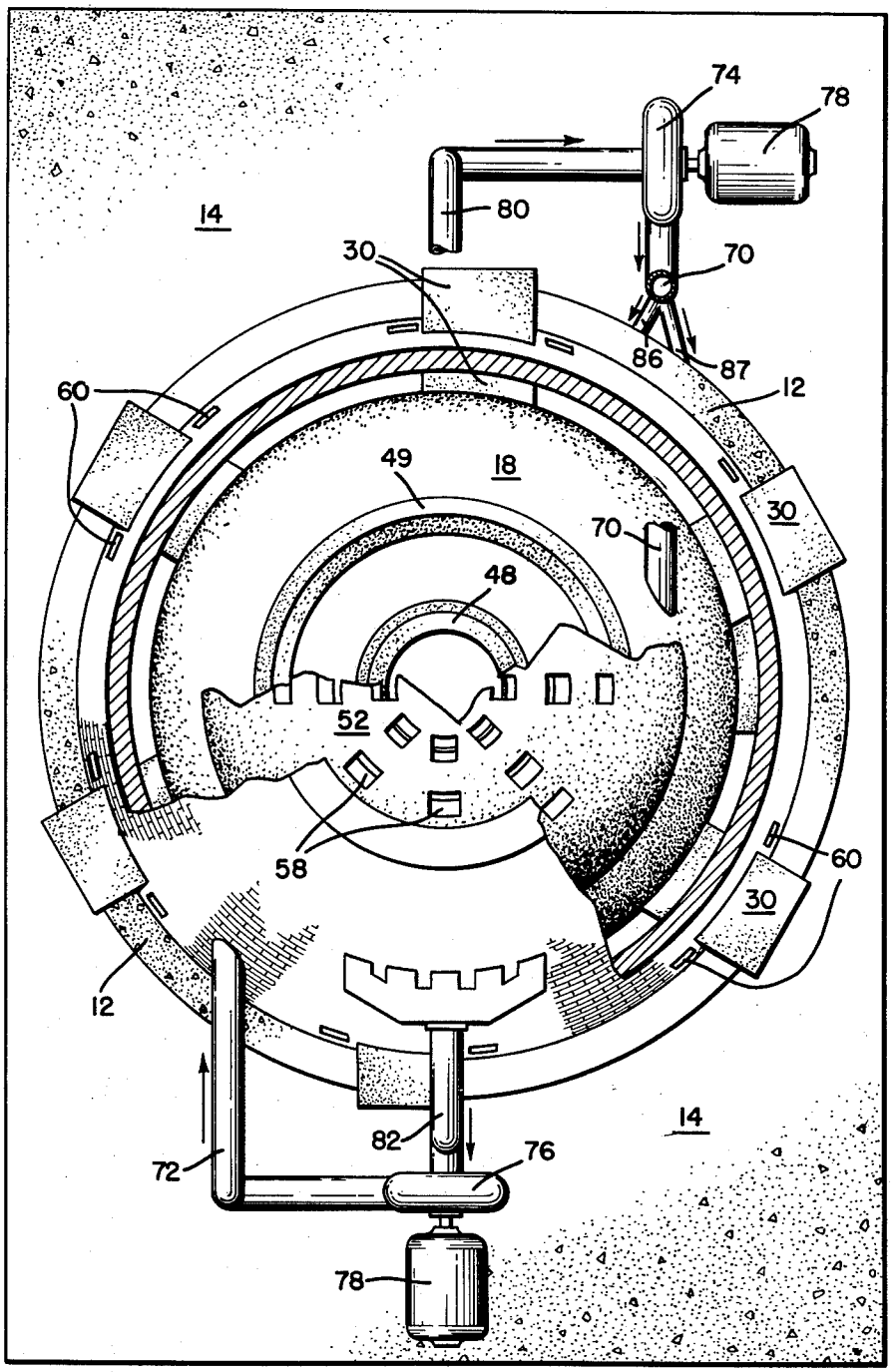



FIG. 4

FLORIAN C. TOEPEL
INVENTOR

BY Smith & Tuck
ATTORNEYS

United States Patent Office 2,754,779 Patented July 17, 1956



2,754,779

# TWO ZONE GARBAGE INCINERATOR

Florian C. Toepel, Seattle, Wash.

Application August 12, 1952, Serial No. 303,885

4 Claims. (Cl. 110—8)

This present invention is intended as a fixed, permanent unit for the disposal of garbage and other waste materials and consists of a lower drying and burning zone and has disposed immediately above it an upper combustion chamber wherein particularly the lighter materials that are air borne, and which have not been consumed in the lower combustion zone or chamber, will be completely consumed. When an attempt is made to burn garbage and the like in a single combustion chamber, it has been found that the drying of the wet garbage to the point where it can be burned lowers the temperature very appreciably of the gases in that chamber so that incomplete combustion results. In this present invention means are provided wherein those materials, which have been dried to the point, and which have sufficient bulk, so that they can become air borne in the strong air and gas currents provided, will be arrested after passing out of the primary or lower combustion chamber and additional air will be supplied so that complete combustion can be assured.

This present application has certain points in common with a recent patent issued to this same inventor, No. 2,592,491. This present application overcomes certain of the deficiencies of the former patent and is believed to be quite distinct from the previously conceived types of incinerators used for this general purpose. If all the garbage were of uniform character then a single combustion chamber could be arranged which would facilitate the drying of the same and incinerating it. However experience proves that garbage is a very inclusive term which includes not only waste food products but also paper bags, cartons, wooden boxes, and many forms of food which are largely in their original form in that they have spoiled or otherwise are not wanted. Such a wide array of materials is very difficult to consume completely in a single combustion chamber. Consequently this present invention has been provided with an upper combustion chamber distinct from the stack portion which is also used in this present form and which in the former patent noted assisted in the complete burning of any gases produced and small particles of dried materials. This same function is present in this equipment. However means are definitely provided for arresting the air borne materials and providing a turbulence which will tend to keep them in the high heat zone where additional air can be provided so as to insure most complete combustion of the materials.

In providing an incinerator having two combustion chambers, aside from the stack portion of the unit, it is possible to make special provision in the lower unit so that the heavy wet materials can be thoroughly dried in the presence of adequate heat and an abundance of air. This drying operation must of course evaporate a great deal of water and the latent heat absorbed in this operation tends to lower the over-all temperature in the lower combustion chamber. When however the materials have been dried and broken down to the degree that they will become air borne in the swirling gases and flames of the



lower combustion chamber, they will be carried upwardly into the upper combustion chamber where they will be fully consumed. This is believed to be a very important departure from accepted forms of garbage incinerators.

A principal object of this invention is to provide an incinerator having a lower zone for burning heavy refuse and drying wet refuse and an upper zone for the more complete combustion of air borne refuse and gases.

A further object is to provide arresting means for the retention of burning refuse in the lower zone of an incinerator until it has lost a greater proportion of its weight.

A further object is to provide an upper zone, disposed to receive burning refuse from the lower zone and retain the same until, by the introduction of additional air, in combination with increased temperature, combustion can be substantially complete.

A further object is to provide a revolving mass of burning material by tangential air blasts and to cause the same to pass through a sector where air, at a low level, is directed into the burning mass from a plurality of central openings and a plurality of peripheral openings radially disposed thereto.

Further objects, advantages and capabilities will be apparent from the description and disclosure in the drawings, or may be comprehended or are inherent in the device.

In the drawings:

Figure 1 is a vertical sectional view through a typical incinerator made after the teachings of this present invention;

Figure 2 is a vertical sectional view similar to Figure 1 except taken on a plane passing through the charging opening;

Figure 3 is a horizontal sectional view taken substantially on the plane passing through the cleanout openings with the tangential air supply pipes superimposed thereon;

Figure 4 is a top plan view with certain parts broken away and sectioned to illustrate more thoroughly the construction employed.

Referring more particularly to the disclosure in the drawings, the numeral **10** designates the outer enclosing wall or housing of this incinerator. This is preferably formed as a truncated cone and may be made of any suitable materials. The preferred material is masonry blocks or brick although in certain sizes steel platings may be employed. Wall **10** rests preferably on a raised annular foundation ring **12** which in turn rests upon or is part of the foundation slab **14**.

Concentrically disposed within housing or wall **10** is the lower combustion chamber **18**. This chamber has a dome-shaped roof portion **20** connected to a vertical wall **22** which wall portion rests upon floor **24**. The various parts of the lower combustion chamber **18** should be made of some form of high heat-resistant material. While formerly it was necessary to make such structures of masonry, usually firebrick, it is now possible to use cementitious materials which have the necessary refractory properties and which are not injured by the intermittent heating and cooling which is a normal operational routine with equipment of this order. Due to the high temperatures encountered in chamber **18**, and especially on floor **24**, it is desirable to employ one or more layers of insulating materials, as **26** and **28**, so as to on one hand protect the foundation slab **14**; and secondly, to prevent unnecessary heat losses; and, lastly, to permit a certain degree of expansion and contraction movement between floor **24** and slab **14** as this structure is alternately heated and cooled. Formed preferably of the same materials and as a unit with chamber **18** is a plurality of access tunnel openings **30**. It has been found very desirable to have a

plurality of these openings due to the fact that all sorts of debris is included with garbage and waste materials and it is necessary periodically to remove accumulations of glass, crockery, metals, and especially wire which quite often is used in banding crates, cartons and the like and it is therefore very desirable to be able to reach in with suitable tools and rake out this material, and, by having a plurality of these access openings, this cleaning out of the lower chamber is greatly expedited.

Centrally disposed with respect to chamber **18** is a conical tuyere member **32**. Air under pressure is supplied into the central cavity **34** and passes out through a plurality of discharge openings **36** positioned at different heights. At each level normally a plurality of openings **36** is provided but they are all contained within one sector, approximately one-quarter of the circumference of the tuyere. Radially disposed with respect to openings **36** is a series of coacting openings **40** in the vertical wall portion **22**. These openings of which there are preferably several at each level provide discharge openings for air supplied thereto under pressure.

Disposed on the vertical axis of chamber **18** is the discharge tube **44**. This tube has a downwardly extending skirt portion **46** which extends well down into combustion chamber **18** and acts as a retaining or restraining means so that the heavier garbage elements that have been air borne in the swirling atmosphere of the chamber will be directed outwardly from the vertical axis, and be prevented from passing upwardly until they have lost sufficiently in weight so that the centrifugal forces throwing them out can be overcome by the draft up through opening **44**. Tube **44** is also provided with an upwardly extending portion **48** which also acts as a baffle, and partly in the same way in which tuyere member **32** functions, it assists in keeping the materials being consumed out near the periphery of the upper combustion chamber **50**.

On the outer surface of the dome or compression chamber **18** is provided an annular smoke ledge **49**. The outer wall of this ledge is substantially vertical and acts as a deflector for air which has been drawn in near the base of wall **10** and this secondary air is then directed upwardly against the inner wall of the upper combustion chamber **50**. The inner wall of ledge **49** is angularly disposed so that the excess gases, produced in part by the heating of the gases and due almost to the large amount of air supplied to the lower combustion chamber, pass at considerable velocity through tube **44**. As these gases hit the dome of chamber **50** they are deflected into the sloping wall of shelf **49** which redirects these gases against the inner wall of dome **50**.

Axially disposed above combustion chamber **18** is the dome shaped upper combustion chamber **50**. This is normally formed with a domed wall of preferably refractory cementitious material as here again the materials are subjected to intense heat and then allowed to cool, under normal operations this being a daily occurrence. The actual wall of chamber **50** has the upper curved or domed ceiling **52** and the conical side wall **54** which is an annular arrangement. A through opening and door **55** provide access to dome **50**. This structure is supported in turn from the outer housing or wall **10** as by means of shelf **56** which extends annularly around the inner wall of housing **10**. It will be noted throughout the various views that the ceiling **52** is solid throughout the major portion of the area immediately above tube **44** and, as fluids passing through an orifice are restricted, the solid portion covers the normal discharge stream from tube **44**. Ceiling **52** has disposed around this solid portion a plurality of relatively small openings **58**. The area of these openings is to be proportioned in keeping with the air supply to the incinerator, this air being supplied under forced circulation by power driven fans. Air also is induced by convection through a plurality of intake openings **60** disposed around the base of wall **10**. This ceiling and the restricted arrangement of openings **58** restrains or retains those air borne fragments of burning refuse until the high temperatures within chamber **50**, together with an abundance of air, substantially complete their combustion. Products passing out through openings **58** can be restricted to gases produced by distillation and combustion and to a small amount of air borne fly ash.

Charging of the incinerator is preferably through an elevated hopper arrangement having the sloping chute **62** so that materials will slide into the lower combustion chamber **18** by gravity. A retractable gate is provided at **64** so as to effectively seal the charging opening except when new materials are being added. Reference is made to Figure 2 in the drawings which shows that the charging chute **62** is disposed so as to deposit incoming refuse garbage in that sector of the chamber intermediate air discharge openings **36** and **40**. At this point materials may pile up and it is very desirable to have air in overabundance at this point and to have the same introduced at a relatively low level. This is achieved by the showing in Figure 2 that adds very materially to the efficiency of this incinerator.

In keeping with Patent No. 2,592,491, the initial drying and incineration within chamber **18** is obtained by producing a violent swirling action within the chamber. This action is produced by the tangentially disposed air discharge nozzles **70** and **72**. These nozzles are supplied by air under pressure from the relatively large pressure fans **74** and **76** respectively. These fans are driven by suitable means as electric motors **78** shown. The air intake to blowers **74** and **76** is taken by means of pipes **80** and **82** from a series of openings **84** and **85** in wall **10**. The vertical position of these openings is well illustrated in Figure 1 and it is to be noted that they are relatively high so that the air they draw in and supply out through nozzles **70** and **72** will be highly heated air, heated by contact with the dome of combustion chamber **18**. This air has been supplied by the plurality of openings **60** in the bottom of wall **10** and thus two functions are achieved, air at high temperature is supplied which greatly accelerates the combustion within chamber **18**, and the cold air being drawn in cools wall **10** to a point that it is neither dangerous nor unpleasant for workmen to be near. Air is supplied by one or both blowers **74** and **76** to the discharge openings **36** and **40**. One satisfactory arrangement is shown in Figures 1 and 3 where it will be noted that pipe **86** supplies the tuyere openings **36** and pipe **87** supplies the coacting air streams out through openings **40**.

*Method of operation*

In operating this equipment garbage and refuse is introduced through chute **62** where it is deposited between air discharge openings **36** and **40**. After gate **64** is closed, initial heating and ignition is promoted by some suitable means as by the oil burning jets indicated at **90**. Usually there is a large percentage of the materials which is combustible and after the cycle has been in operation for some time, the workmen can usually dispense with auxiliary jet **90**. Air from blowers **74** and **76**, and particularly that air discharged by nozzles **70** and **72**, creates an extremely turbulent condition within chamber **18**. This action is of course greatly accelerated by the tangential positioning of jets **70** and **72**. These jets as will be noted in Figure 2 are disposed well above the bottom area of the combustion chamber. This is a desirable positioning of these jets in that it gives the greatest impetus to the burning of materials above floor **24** and creates, thus, a source of intense heat above the mass of material which will soon become strewn about floor **24**. This is particularly desirable when wet garbage and the like is to be handled as this arrangement quickly dries out excess moisture so that the materials can be consumed. The lower combustion chamber **18** thus has two functions; first to dry the refuse garbage so that combustion can be started, and then to support the combustion to a point where the weight will be reduced in the materials and they

can become air borne in the swirling mass of gases within the chamber and finally be carried up through the discharge opening 44 into the upper combustion chamber 50. Heavier materials will be retained longer particularly due to their weight and to the fact that baffle wall 46 extends well down into the combustion chamber.

As materials pass out of chamber 18 into the upper chamber 50 they are normally carried up to the ceiling where they are deflected downwardly. In chamber 50 there are two sources of gas that tend to convey the material upwardly. One is the hot product of combustion from chamber 18 and the other is the additional supply of air introduced from the plurality of openings 60 in wall 10. This air, while cold when introduced, is quickly heated by coming into contact with the heated dome of chamber 18 so that within chamber 50 we now have a turbulence caused by a centrally-introduced air stream and peripherally introduced streams of air. This creates a turbulence which lessens the tendency for materials to be blown out through the open top of the chimney-like wall 10 and this is greatly assisted by the central solid dome portion 52 and the fact that the actual discharge from this chamber is by means of a large number of relatively small discharge openings 58. As all the materials burning in chamber 50 have been air borne in to it, they are relatively dry so there is no great absorption of heat as is present in the lower chamber 18. Resultant temperatures then become high and complete combustion of the materials is effected, and any discharge from combustion chamber 50 is in the form of fly ash so finely divided that it is normally not discernible on the outside and is so light that it is dissipated into the atmosphere without any notable collection of the same in the vicinity of the incinerator. The complete breaking down of the ash into small particles is assisted by secondary combustion which takes place in the upper part of housing 10 where a secondary combustion chamber in effect is produced in the space indicated at 92.

It is believed that it will be clearly apparent from the above description and the disclosure in the drawings that the invention comprehends a novel construction of a two zone garbage incinerator.

Having thus disclosed the invention, I claim:

1. In a garbage disposal unit having a primary combustion chamber which has a dome shaped top with a discharge opening centered in said top and has means therein for burning refuse under forced air and at high temperatures and a frusto-conical shield wall having an open top and disposed concentrically around said primary combustion chamber and spaced therefrom, the improvement, comprising: said shield wall having an inwardly extending shelf at approximately the level of the uppermost portion of said top of said primary combustion chamber and said shield wall having a plurality of openings leading from the outside of said shield wall to the inside thereof substantially below said shelf; a dome shaped member resting on said shelf and forming an intermediate combustion chamber in said shield wall in the intermediate portion thereof above said primary combustion chamber and below the upper portion of said shield wall, the top of said primary combustion chamber forming the bottom of said intermediate combustion chamber and said dome shaped member forming the top of said intermediate combustion chamber, said dome shaped member having a multiplicity of small egress openings therethrough but being solid throughout the major portion of the area directly above said discharge opening; an annular smoke ledge on the upper surface of the top of said primary combustion chamber disposed concentrically with relation to said discharge opening and positioned adjacent said shelf, the outer face of said ledge being substantially vertical and the inner face of said ledge flaring upwardly and outwardly from the vertical, said discharge opening being bordered at its bottom edge by a depending annular skirt extending into said primary combustion chamber and said discharge opening



being bordered at its top edge by an upstanding annular baffle extending upwardly into said intermediate combustion chamber; and said shield wall forming an upper combustion chamber within said shield wall and above said dome shaped member and communicating with said intermediate combustion chamber through said egress openings, said dome shaped member forming the bottom of said upper combustion chamber and said upper combustion chamber being open to the atmosphere through the open top of said shield wall.

2. In a garbage disposal unit having a primary combustion chamber which has a circular, dome shaped top with a discharge opening centered in said top and has means therein for burning refuse under forced air and at high temperatures and a frusto-conical shield wall having an open top and disposed concentrically around said primary combustion chamber and spaced therefrom, the improvement, comprising: said shield wall having an inwardly extending shelf at approximately the level of the uppermost portion of said top of said primary combustion chamber; a circular dome shaped member resting on said shelf and forming an intermediate combustion chamber in said shield wall in the intermediate portion thereof above said primary combustion chamber and below the upper portion of said shield wall, the top of said primary combustion chamber forming the bottom of said intermediate combustion chamber and said dome shaped member forming the top of said intermediate combustion chamber, said dome shaped member having a multiplicity of small egress openings therethrough but being solid throughout the major portion of the area directly above said discharge opening; and said shield wall forming an upper combustion chamber within said shield wall and above said dome shaped member and communicating with said intermediate combustion chamber through said egress openings, said dome shaped member forming the bottom of said upper combustion chamber and said upper combustion chamber being open to the atmosphere through the open top of said shield wall.

3. In a garbage disposal unit having a primary combustion chamber which has a dome shaped top with a large discharge opening centered in said top and has means therein for burning refuse under forced air and at high temperatures and a shield wall which tapers as it extends upwards disposed concentrically around said primary combustion chamber, the improvement, comprising: an upper circular wall disposed above and spaced from said top of said primary chamber and substantially spanning the enclosure formed by said shield wall substantially below the top of the shield wall and forming an intermediate combustion chamber with said upper wall forming the top of said intermediate chamber and with said top of said primary combustion chamber forming the bottom of said intermediate combustion chamber and said intermediate combustion chamber communicating with said primary combustion chamber by means of said discharge opening, said upper circular wall having a multiplicity of small egress openings therein but being solid throughout the major portion of the area directly above said discharge opening; and said shield wall forming an upper combustion chamber within said shield wall and above said intermediate combustion chamber and communicating with said intermediate combustion chamber through said egress openings, said upper circular wall forming the bottom of said upper combustion chamber, the cubical capacity of said intermediate chamber being at least one-third of the cubical capacity of said primary chamber.

4. In a garbage disposal unit having a primary combustion chamber which has a dome shaped top with a discharge opening in said top and has means therein for burning refuse under forced air and at high temperatures and a shield wall disposed concentrically around said primary combustion chamber and spaced therefrom, the improvement, comprising: an upper circular wall disposed above and spaced from said top of said primary chamber

and substantially spanning the enclosure formed by said shield wall substantially below the top of the shield wall and forming an intermediate combustion chamber with said upper wall forming the top of said intermediate chamber and with said top of said primary combustion chamber forming the bottom of said intermediate combustion chamber and said intermediate combustion chamber communicating with said primary combustion chamber by means of said discharge opening, said upper wall being dome shaped and having a multiplicity of small egress openings therethrough, said shield wall having a plurality of air ingress openings disposed at its lower portion and leading to the space between the lower portion of said shield wall and said primary combustion chamber at a level below said dome shaped upper wall, conduit means connecting said space between said shield wall and said primary combustion chamber at a level below said dome shaped upper wall and above said air ingress openings providing a source of heated air for said primary combustion chamber, said intermediate combustion chamber communicating with the space between said shield wall and



said primary chamber whereby said intermediate chamber receives a supply of air from said air ingress openings; and said shield wall forming an upper combustion chamber within said shield wall and above said intermediate combustion chamber and communicating with said intermediate combustion chamber through said egress openings, said upper wall forming the bottom of said upper combustion chamber and said upper combustion chamber being open to the atmosphere through the top of said shield wall, the cubical capacity of said intermediate chamber being at least one-third of the cubical capacity of said primary chamber.

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