

[54] **CANTED VORTEX OPEN PIT INCINERATOR**[76] Inventor: **Mary E. Ahrend**, 1116 E. Ninth St., Ada, Okla. 74119[22] Filed: **Jan. 19, 1973**[21] Appl. No.: **325,204****Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 85,094, Oct. 29, 1970, Pat. No. 3,713,402.

[52] **U.S. Cl.**..... **110/8 R, 110/119**[51] **Int. Cl.**..... **F23g 5/00**[58] **Field of Search**..... **110/8 R, 7 R, 18 R, 119**[56] **References Cited****UNITED STATES PATENTS**

|           |         |                   |         |
|-----------|---------|-------------------|---------|
| 3,392,690 | 7/1968  | Mandelbaum et al. | 110/119 |
| 3,465,696 | 9/1969  | Amundsen          | 110/8   |
| 3,483,832 | 12/1969 | Boll et al.       | 110/7   |
| 3,592,150 | 7/1971  | Lanyon            | 110/7   |
| 3,713,402 | 1/1973  | Ahrend            | 110/8   |

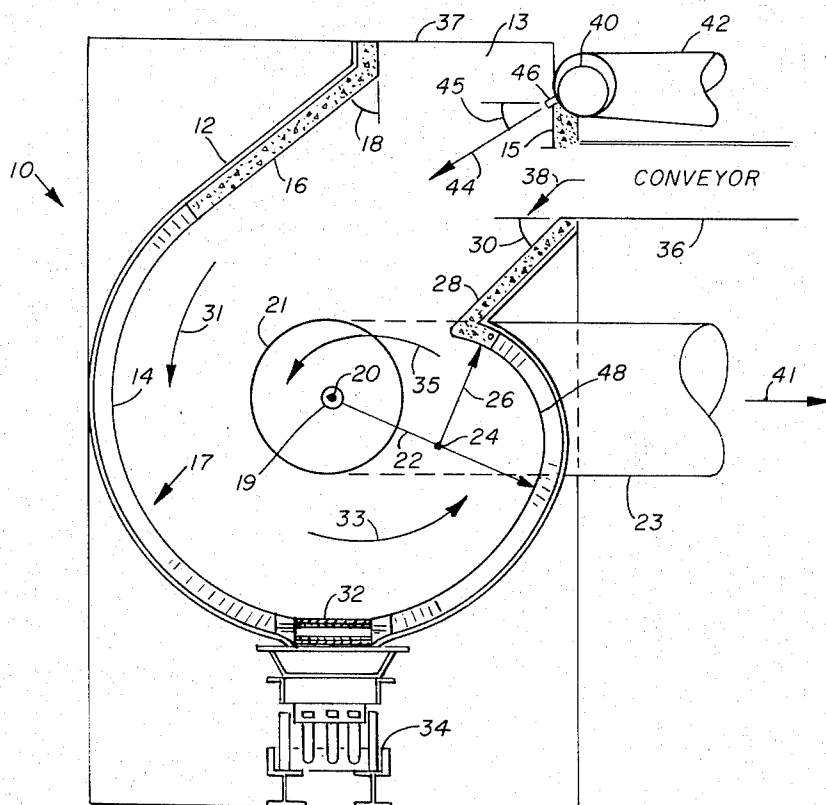
*Primary Examiner*—Kenneth W. Sprague  
*Attorney, Agent, or Firm*—Head & Johnson

[57] **ABSTRACT**

This disclosure describes an open pit incineration system for solid waste and refuse. It comprises a longitudi-

dinal chamber, the lower portion of which is substantially semicylindrical in shape, with two substantially parallel, sloping walls to an open top. A supply of high pressure air is provided and issues through a horizontal longitudinal slit orifice in the form of a continuous sheet of rapidly moving air. The slit orifice is mounted on top of the lower of the two walls and the air is directed across the gap between the two walls at an angle below the horizontal. The action of the high velocity sheet of air is to completely close off the top opening of the combustion chamber to the emission of products of combustion and to force them into a helically moving vortex of flame, hot air and products of combustion within the lower portion of the chamber. A grate is provided in the bottom of the chamber for receiving materials that are incapable of complete combustion. The hot gases resulting from the combustion are withdrawn axially from one or both ends of the chamber through a conduit to a heat exchanger for the generation of steam and the cooling of the hot gases, which then proceed by way of an electrostatic precipitator through the stack.

The input to the combustion chamber comprises shredded solid waste material, metal and ceramic particles which are carried by means of a horizontal conveyer along the edge of the lower wall and are dumped into the combustion chamber underneath the curtain of air issuing from the slit orifice.

**11 Claims, 3 Drawing Figures**

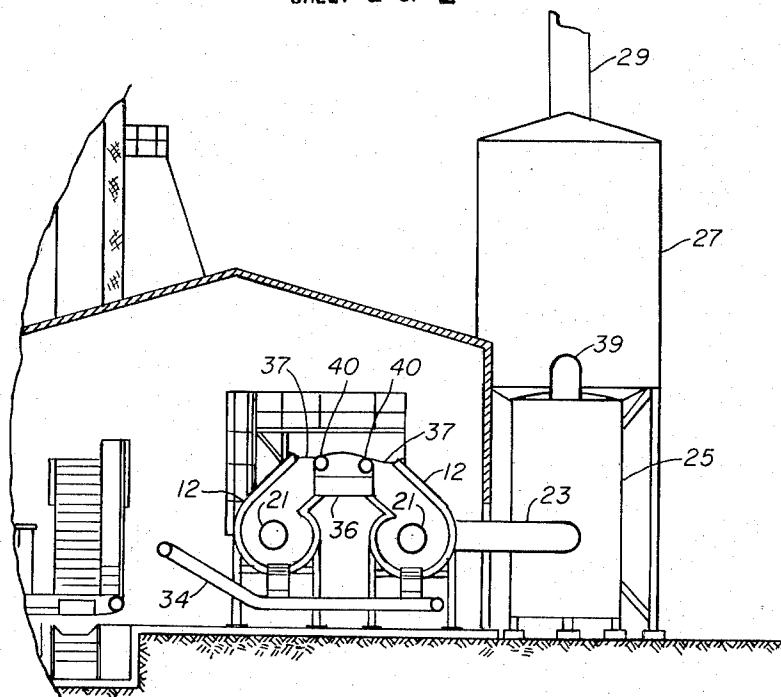


FIG. 2

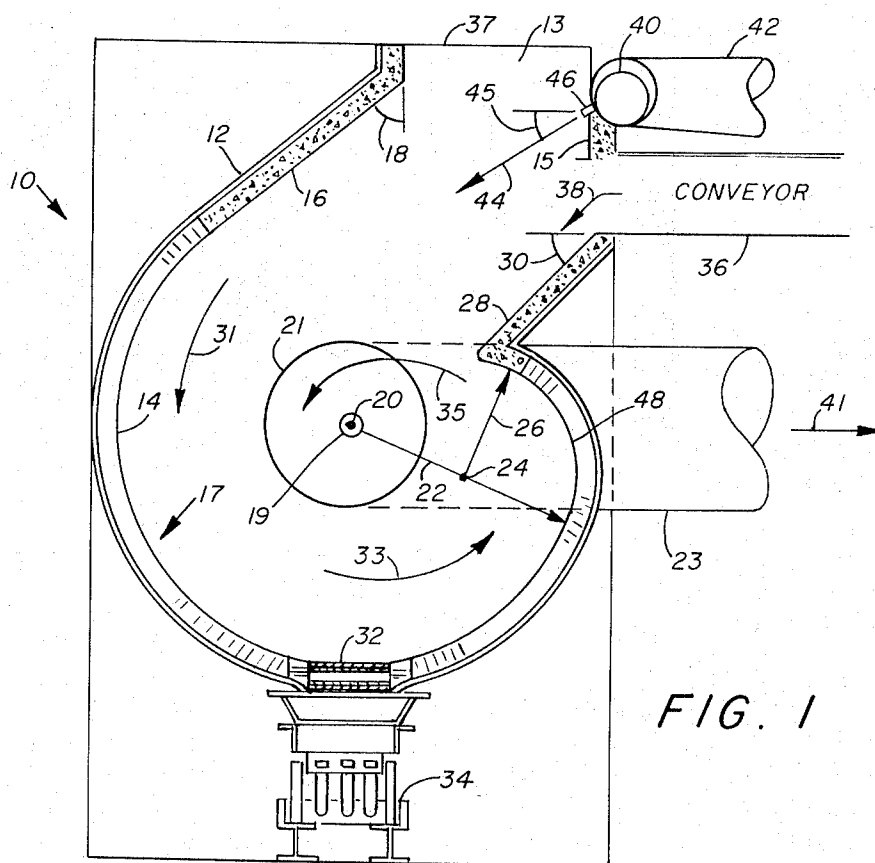


FIG. 1

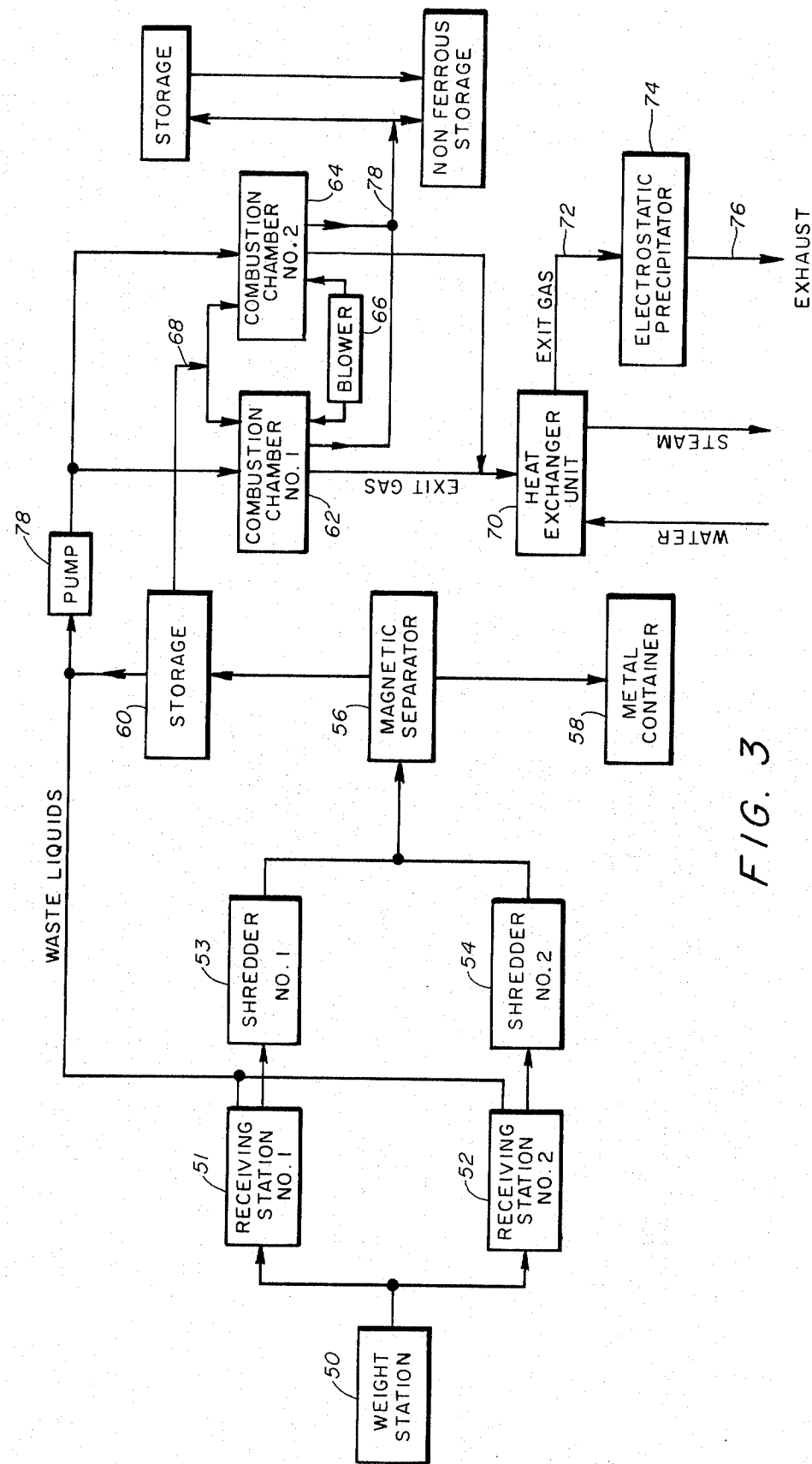


FIG. 3

**CANTED VORTEX OPEN PIT INCINERATOR****CROSS REFERENCE TO RELATED APPLICATION**

This application is a continuation-in-part of the copending application of the same inventor, Ser. No. 85,094, filed Oct. 29, 1970, now U.S. Pat. No. 3,713,402, entitled "Solid Waste Incinerator and Process." This copending application is entered into this application by reference.

**BACKGROUND OF THE INVENTION**

This invention generally relates to the furnace art for use in environmental pollution control and more particularly to structures designed to burn wet fuel products such as garbage, sewage and refuse, to substantially complete combustion thereof.

For the most part, municipalities have utilized land filled processes for disposing of solid and liquid wastes and refuse materials. Those municipalities along the seaboard have also used the dumping of such materials out to sea as a means of disposal. Not only are such processes inefficient and costly, but they pollute the sea, land and air. Also, the land areas are constantly dwindling because of price and location relative to the concentration of the population in specific geographic areas of the world. Further, the filled land is generally not suitable for other use for many years thereafter.

The prior art has taught open pit burning as a means to reduce the mass and volume of waste or refuse. For example, this is recognized in the U.S. Pat. No. 3,465,696. This patent accomplishes this by a combustion chamber involving a plurality of separated planar air jet nozzles. Such nozzles, however, have not been capable of adequately providing a substantially continuous air curtain over and across the top of the open pit incinerator. In some instances the nozzles have become clogged and do not distribute the air evenly across the pit. This leaves gaps within the air curtain for the release of products of incomplete combustion to be admitted into the atmosphere.

In addition, the prior art has not conceived of an overall disposal system which includes preliminary waste or refuse treatment in order to make the open pit incinerator operate more efficiently.

**SUMMARY OF THE INVENTION**

It is a primary object of this invention to provide an open pit furnace or incinerator, which utilizes a high velocity substantially solid curtain of high velocity air, over and across the incinerator pit to effect complete combustion of the products of the waste and refuse product therein, or to reduce the material to a minor amount of noncombustible solid material which is removed, and which is of significantly smaller volume, so as to make more efficient use of land fill disposal areas and to minimize pollution.

It is another object of this invention to provide an overall waste product and refuse disposal system which incorporates means for collecting the waste material, shredding or pulverizing the material into smaller overall sizes, separating noncombustible or high melting point metals or other materials which may be reused, with the remainder being injected into the open pit incinerator or furnace of this invention. In addition, means are provided in the bottom of the incinerator pit

to remove the remaining particles which are incapable of incomplete combustion.

In the prior copending patent application of which this is a continuation-in-part, the inventor has described an open pit incinerator which comprises an elongated chamber made of steel of substantially U-shaped cross section, which is covered on the entire inner surface with heat resisting material. The refuse or material to be burned is dumped into the pit at the top of the wall of the open mouth of the elongated U-shaped chamber. A continuous sheet or curtain of high velocity air is provided by means of an elongated slit type nozzle mounted along the opposite wall of the U-shaped chamber. This curtain is directed across and downwardly to strike the opposite wall of the U and thereby to provide a complete coverage by means of the high velocity sheet of air, so that any products of incomplete combustion that may tend to rise in the chamber are entangled in this stream of air and returned directly to the lower portion of the chamber where a rotating vortex of flame, hot air and combustible material is in turbulent activity.

In this invention the cross-sectional shape of the combustion chamber has been modified so as to provide a more positive vortex action and better coverage and sealing of the open mouth of the combustion chamber. The combustion chamber is an elongated generally sloping U-shaped chamber. The lower part of the chamber is somewhat semicylindrical in shape and the two walls that rise are sloping at some angle in the general range of 45° plus or minus 15°. The lower wall is shorter and provides a longitudinal opening for dumping into the chamber, from a conveyer which runs along the edge of the wall, the material to be incinerated. Above the port of entry of the refuse material is a longitudinal slit type nozzle through which high pressure air is forced to provide a continuous sheet of high velocity air which is directed across and downwardly to the opposite wall of the chamber, and thence into a helical vortex in the cylindrical portion of the chamber. A grate is provided in the bottom of the chamber, through which materials that are incapable of complete combustion can drop through onto a conveyor means.

**BRIEF DESCRIPTION OF THE DRAWINGS**

These and other objects of this invention and a better understanding of the principles and details of the invention will be evident from the following description, taken in conjunction with the appended drawings, in which:

FIG. 1 shows a cross section through the combustion chamber of this invention.

FIG. 2 shows a portion of a disposal system in which two such combustion chambers are arranged in parallel operation.

FIG. 3 illustrates a flow diagram of a complete disposal system.

**DESCRIPTION OF THE PREFERRED EMBODIMENT**

Before explaining the present invention in detail it is to be understood that the invention is not limited in its application to details of construction and arrangement of parts specifically illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in vari-

ous ways. Also, it is understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring now to the drawings, FIG. 1 shows a cross section through the combustion chamber or thermal oxidizer of this invention. It comprises a generally tilted U-shaped chamber of considerable length with end walls closing off the ends of the chamber. The open top of the chamber is indicated by the numeral 13. The chamber is constructed of a heavy steel sheet material 12 which provides a substantially cylindrical portion 17 in the lower area with two side walls 16 and 28 reaching up to an open mouth 13 at the top. The steel wall 12 is supported by other structural materials, not shown in detail, and is lined with refractory materials 14 so as to resist the effective high temperature, in the neighborhood of 2,000°, in the center of the combustion chamber. One end wall is indicated by the numeral 37. The shape of the combustion chamber is substantially cylindrical in the area indicated by numeral 17 with a straight wall portion 16 sloping upwardly and over the chamber and another portion 28 which is plane and sloping substantially parallel to the wall 16.

There is a conveyor 36 which runs longitudinally along the top of the wall 28 by means of which waste material to be incinerated is moved along the top of the wall 28 and in accordance with arrow 38 into the combustion chamber. Another portion of longitudinal wall 15 extends up from the opening from the conveyor, and supports a manifold pipe 40, into which compressed air is blown through pipe 42. The manifold 40 has a longitudinal slit type orifice 46 which is directed at a small angle below the horizontal, of the order of 30°, and provides a continuous sheet of rapidly moving air between the wall 15 and across and down to contact the wall 16, and there follow the curvature of the lower cylindrical portion and around to the point 48 where there is a reentrant portion of the surface 14. This reentrant portion serves to retain all this material and cause it to form a rapidly revolving vortex of combustible material, flame and excess air shown generally by arrows 31, 33 and 35. The vortex action itself tends to prevent the passage of products of combustion upward through the mouth of the chamber. In addition, the sheet of air moving across the nozzle 46 provides a complete closure so far as particles of fly ash, gases, smoke or other products of combustion that might tend to leave by the open mouth of the chamber. The velocity of air in the sheet is of the order of 60-120 miles per hour. The products of combustion are taken out of one or both ends of the chamber by means of an opening 21 and conduit 23 in accordance with the arrow 41. The products of combustion go to a heat exchanger which will be described in connection with FIG. 2.

There is a grate installed longitudinally along the lower portion of the combustion chamber so that materials which are incapable of complete combustion will eventually drop down to the bottom of the chamber and through the grate onto a conveyor belt 34 for storage and disposal.

To start the combustion, gas burning nozzles 19 are inserted axially in each end wall of the chamber and extend toward each other along the axis 20 of the chamber. These serve to heat up the chamber to the point where, when the wet waste material is introduced it is immediately incinerated. The heat generated by the incineration serves to maintain the temperature to the

point where the gas flames can be turned off. In general there will be considerable heat evolved, and carried from the combustion chamber through the conduit 23. As shown in FIG. 2 the hot products of combustion go to a heat exchanger 25 where the heat is removed from the products of combustion and used to provide steam for utility purposes. The products of combustion then go by conduit 39 to an electrostatic precipitator 27 and to the stack 29. Because of the high temperature, the turbulence and recycling due to the vortex action, all combustible products are completely consumed and there should be a minimum of pollutants delivered through the stack to the atmosphere.

In FIG. 2 is shown an arrangement in which two combustion chambers of the type shown in FIG. 1 can be set side by side with a common conveyor 36 supplying them with combustible material. There are two air manifolds 40 providing air to the slit nozzles which form the air screens over the mouth of the chambers.

Referring now to FIG. 3 there is shown in schematic form a flow diagram of a complete disposal system for waste material. It starts at a weight station 50 where the material is entered into the system. There can be one or more paths for carrying this material through the system, such as receiving stations numbers 1 and 2 indicated by numerals 51 and 52 respectively. However, the system will be described (for convenience) in terms of only one processing line comprising one complete system of parts. The entering material is sent to the receiving station 51 where it then goes to a shredder 53 where it is broken up into many small particles. The material then goes to a magnetic separator where the ferrous materials are separated and sent to a metal storage 58. The remaining materials of nonmagnetic nature are sent to storage 60. They are withdrawn from that storage by means 68 and delivered to the combustion chamber either number 1, or number 2, or both. The combustion chambers have air supplied by blower 66. The exit gases go to heat exchanger 70 which has appropriate water input and steam output. They then leave by means 72 to the electrostatic precipitator 74 and by means 76 to the stack. Also, from the combustion chamber by means 78 the noncombustible materials remaining after combustion can be sent to general storage, and to the nonferrous storage, which would include such materials as glass, ceramic, etc. If the material which is coming in is wet there will be liquid wastes which are pumped by means 78 into the combustion chamber where they are immediately evaporated and the products are incinerated.

In a system of this sort the magnetic materials can be separated and sold as junk metal. The nonferrous storage will include nonferrous metals, glass and ceramics, etc. which can be used for road construction. The remaining materials can be used for land fill or other purposes.

The numeral 18 indicates the angle between the upper wall 16 and the vertical, which angle is in the range of  $45^\circ \pm 15^\circ$ . Similarly, angle 30 is in the angle between the lower wall and the horizontal, which is also in the range of  $45^\circ \pm 15^\circ$ . The angle 45 between the plane of the air screen issuing from the nozzle 46 and the horizontal is in the range of  $30^\circ \pm 10^\circ$ .

The invention has been described with a certain degree of particularity, but it is manifest that many changes may be made in the details of construction and the arrangement of components. It is understood that

the invention is not to be limited to the specific embodiment set forth herein by way of exemplifying the invention, but the invention is to be limited only by the scope of the attached claim or claims, including the full range of equivalency to which each element or step thereof is entitled.

What is claimed:

1. An open pit incinerator for waste and refuse products, comprising:

- a. a longitudinal chamber formed of a substantially longitudinal semicylindrical portion with upwardly sloping, substantially parallel walls, an open top and closed at the longitudinal ends, said chamber formed of heat resistant materials and including means at the bottom thereof to remove residual products incapable of complete combustion;
- b. a longitudinal slit type orifice extending substantially along the longitudinal length of the lower one of the two sloping walls of said chamber, the plane of the orifice directed at an acute angle below the horizontal, downwardly and across toward the opposite sloping wall of the chamber to provide a continuous curtain of high velocity air substantially across the open mouth of said chamber;
- c. means to introduce material to be incinerated through a longitudinal slit in the lower of said two walls and below said curtain of air;
- d. means to supply sufficient air to said orifice whereby the air issuing therefrom traverses at a substantially high velocity; and
- e. means along the axis at at least one end wall, for withdrawing hot products of combustion.

2. An incinerator as in claim 1 wherein said means to supply air to said orifice includes a blower or compressor supplying said air to a longitudinal plenum chamber to which said orifice is attached, the pressure being sufficient to create air velocity from said orifice within the range of 60 to 120 miles per hour.

3. An incinerator as in claim 1 wherein the two sloping walls are in the range of 45° to the vertical plus or minus 15°.

4. The incinerator as in claim 1 wherein the angle in said slit orifice is directed at an angle of 30° plus or minus 10° below the horizontal.

5. A solid waste and refuse material disposal system comprising:

- a. a first primary collection hopper to receive said waste and refuse;
- b. shredder means to break up said waste and refuse material into small pieces;
- c. first means to convey portions of said waste and refuse from said hopper means to said shredder

means;

d. a combustion chamber;

e. second means to convey said particles from said shredder to said combustion chamber;

f. said combustion chamber formed of a substantially longitudinal semicylindrical shaped chamber having substantially parallel upwardly sloping walls and an open mouth at the top of said walls with closures at both ends of the chamber, said chamber formed of heat resistant material and including means at the bottom thereof to remove residual products incapable of complete combustion;

g. a longitudinal slit orifice extending substantially along the longitudinal length of the lower of said walls of said chamber and oriented downwardly across and toward the opposite wall of said chamber to provide a curtain of air substantially across said mouth from end to end of said chamber;

h. means to provide sufficient air to said orifice whereby the air issuing therefrom traverses at a substantially high velocity, means to introduce said refuse material along a horizontal opening in the lower wall of said chamber along its complete length; and

i. means to withdraw heated products of combustion through an axial opening in at least one wall of said chamber.

6. The system as in claim 5 including heat exchanger means and means to conduct said hot products of combustion from said combustion chamber to said heat exchanger means.

7. The system as in claim 5 including grate means along the bottom of said longitudinal chamber and conveyor means to conduct from said grate means the particles which are incapable of complete combustion.

8. The system as in claim 5, including means to remove reusable waste and refuse material prior to said combustion chamber.

9. The system as in claim 8 including magnetic separator means for ferrous materials.

10. The system as in claim 5 wherein said means to supply air to said orifice includes a blower or compressor supplying said air to a longitudinal plenum chamber to which said orifice is attached, the pressure being sufficient to create air velocity from said orifice and across said chamber within the range of 60 to 120 miles per hour.

11. The system as in claim 5 including heat exchanger means connected to the outlet of said chamber.

\* \* \* \* \*