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Sharpe

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[54] **PROCESS OF BURNING AND APPARATUS THEREFOR**

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[52] **U.S. Cl.** ..... **110/8 R,** 110/28 F, 110/7 S

[51] **Int. Cl.** **F23g 3/00**

[58] **Field of Search** ..... 110/8 R, 7 R, 7 S, 28 F, 110/18 R

[56] **References Cited**

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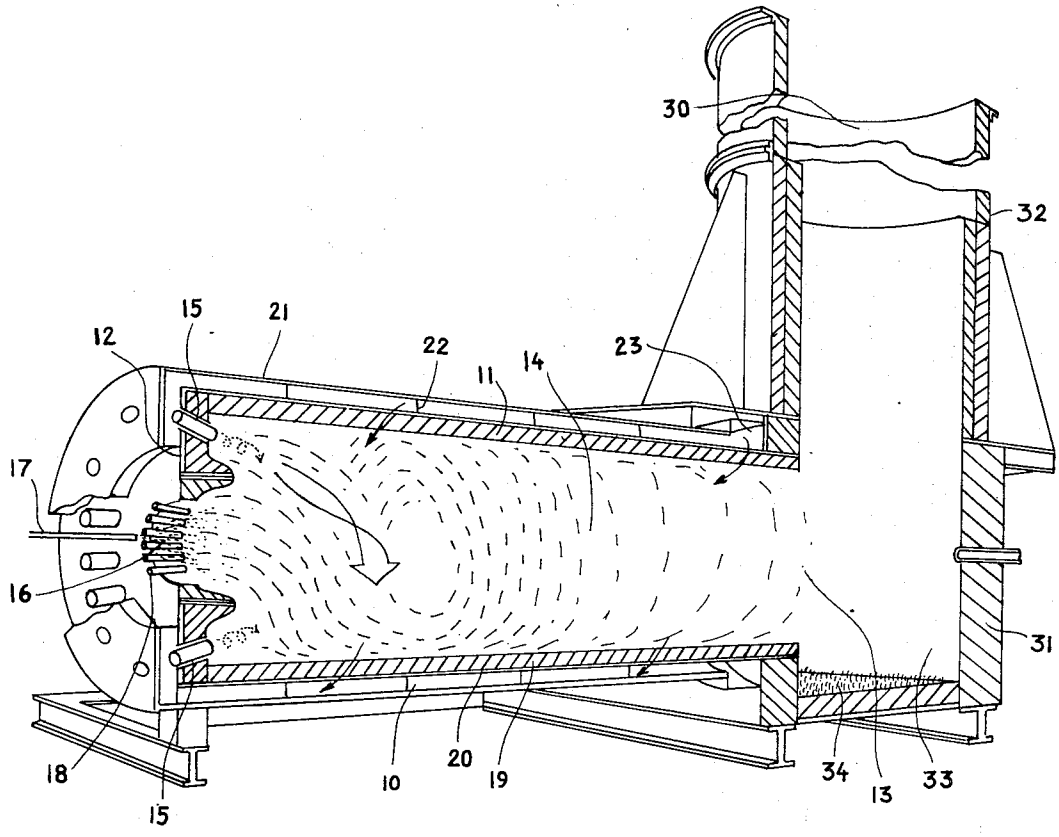
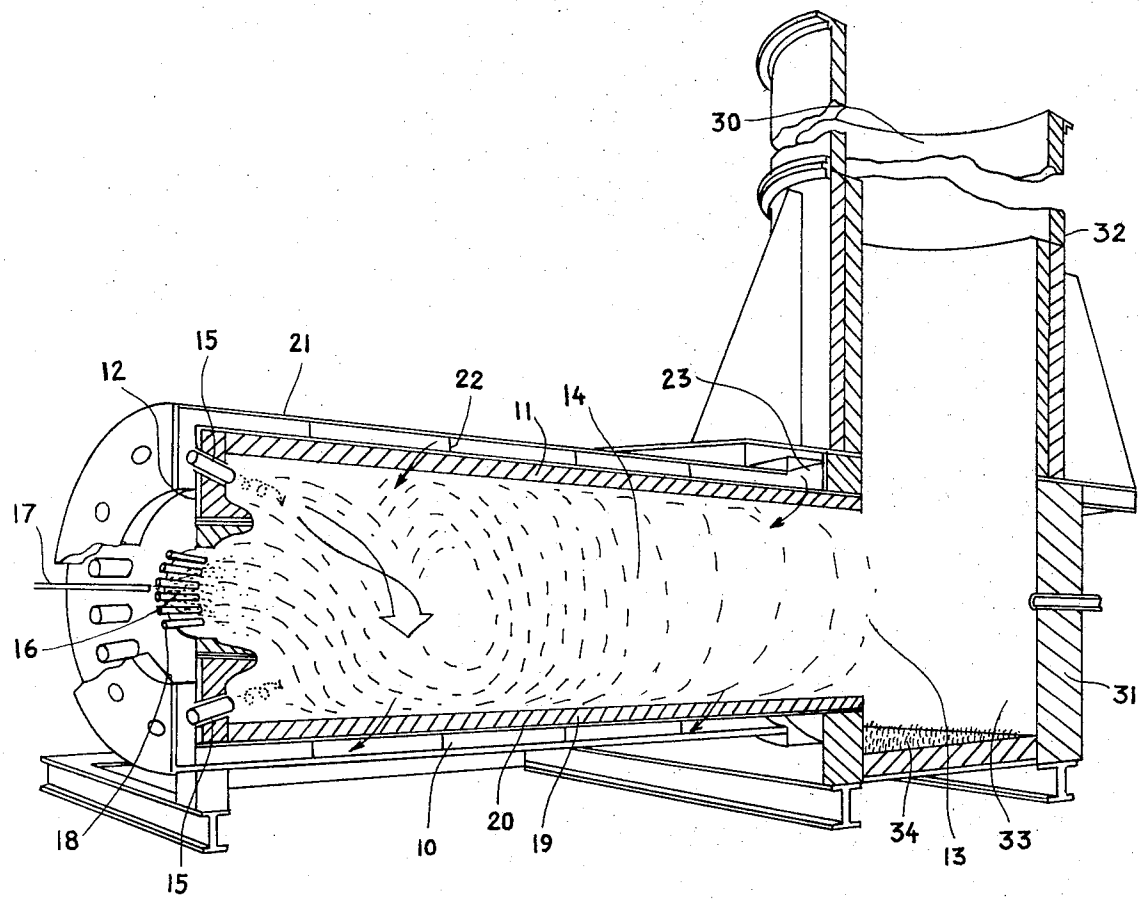
[57] **ABSTRACT**

A process and apparatus for burning gaseous, liquid and solid wastes by passing air spirally around the exterior length of a cylindrical combustion vessel counter-current to the direction of flow of combustion gasses within the chamber and toward the feed end of the combustion chamber to pre-heat said air; introducing the pre-heated air in rotating motion through tangential air ports at the periphery of the feed end of the combustion chamber so that the air moves in a spiral and rotating motion to the exhaust end of the combustion chamber; introducing fuel for combustion through fuel ports spaced about a central port in the feed end of the combustion chamber; igniting the fuel near the fuel ports; introducing waste through a central port in the feed end of the combustion chamber; passing the fuel, air and waste through the combustion chamber in an intimate mixing, spiral, rotating motion at low-pressure to effect high-efficiency combustion of the waste in the central portion of the combustion chamber, the vessel walls of the combustion chamber being cooled by excess air moving spirally in the peripheral portion of the combustion chamber; and passing the products of combustion and excess air from the combustion chamber through an open exhaust end.

8 Claims, 1 Drawing Figure

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PROCESS OF BURNING AND APPARATUS THEREFOR

This invention relates to a process and apparatus for the high efficiency combustion of liquid, gaseous and solid wastes either separately or in combination. The process and apparatus of this invention affects high efficiency combustion of a wide variety of wastes reducing undesired stack effluent, thereby minimizing problems of pollution of the atmosphere. Further, the process and apparatus of this invention provide high efficiency combustion while operating at low pressures thereby minimizing power consumption and noise. The process and apparatus of this invention also provide extended furnace life and minimize furnace maintenance through the cooling of the walls of the furnace both on their exterior surfaces and on their interior surfaces.

An important object of the process and apparatus of this invention is to provide a method and apparatus wherein liquid, gaseous and solid wastes may be burned with high efficiency in the same unit. The solid wastes may be slurried in water and the process and apparatus of this invention has been found highly efficient in the combustion of such slurries containing a high percentage of water.

A preferred embodiment of an apparatus of this invention is illustrated in the drawing wherein:

FIG. 1 is a cross-sectional view of an apparatus embodying the principles of this invention.

The incinerator is shown as **10** in FIG. **1.** The incinerator comprises cylindrical combustion vessel wall **11,** having closed feed end **12** and open exhaust end **13** defining combustion chamber **14.** Closed end **12** has tangential ports **15** at the periphery of end **12.** The number of ports **15** at the periphery of end **12** is not critical but must be sufficient to furnish sufficient air for combustion with an excess of air for cooling the combustion chamber walls. Central waste port **16** is located in the center of closed end **12** and has nozzle **17** which provides for injection of liquids, solid containing slurries and gasses in a manner which provides conical distribution as the waste progresses away from the nozzle through combustion chamber **14.** Surrounding central waste port **16** are a series of fuel ports **18** providing injection of fuel which may be in the same general tangential direction as air from tangential ports **15.**

Cylindrical combustion vessel wall **11** is shown comprised of fire-brick lining **19** and outside the fire-brick may be a circumferential support of non-insulating material **20.** Jacket **21** surrounds the cylindrical combustion vessel and is spaced therefrom. Baffles **22** are positioned in the space between jacket **21** and vessel wall **11** so that when air is forced into the space between the jacket and vessel walls at entrance **23** the air is spirally directed along the exterior of the combustion vessel preheating the air and cooling the exterior of the combustion vesse. Air is supplied to entrance **23** by a supply blower, not shown. Air is supplied to entrance **23** at suitable pressures which may be in the range of about 2 to 6 inches of water. The air having a rotating motion imparted to it by the spiral path through the space between the vessel wall and jacket passes through nozzles **15** with a rotating motion in addition to the tangential direction imparted by the tangential arrangement of ports **15.** Thus, the air may enter the combustion chamber at pressures in the range of about 1 to 4 inches of water and in tangential streams with rotation of the air within each stream. This motion provides intimate mixing and energy exchange between the waste and fuel, thereby affecting efficient burning of the waste.

Fuel is provided to fuel ports **18** in sufficient quantity to insure complete combustion from a fuel source not shown. Liquid and gaseous fuels are suitable for the process and apparatus of this invention. Any fuel having sufficiently high energy to effect substantially complete combustion of the waste material is suitable for use in the apparatus of this invention and may be supplied to fuel ports **18** by any fuel supply means known to the art. It is preferred to use natural gas as the fuel although other natural or synthetic fuels are suitable.

The waste to be burned must be supplied to waste nozzle **17** by any suitable means. The waste may be in the form of gas, liquid or solids, and may be mixtures of any such forms. The waste may be of sufficiently high energy to support combustion or it may be of low energy which requires the transfer of energy from fuel in order to burn. The ratio of waste feed to fuel feed is governed by the required energy transfers necessary for combustion of the waste material. When liquid wastes are used, it is desired that they be atomized in introduction to the combustion chamber. Suitable atomizing nozzles are well known in the art. When solid wastes are used, it is preferred that such solid material is finely divided and suspended in liquid slurry for introduction into the combustion chamber. Such slurry formation of solids is well known and the liquid vehicle may be any suitable liquid such as one which will support combustion such as fuel oil or it may be a liquid which will not support combustion such as water. The process and apparatus of this invention has been found to efficiently burn solid waste in slurry form wherein the slurry is 90 weight per cent water.

The amount of air introduced into the combustion chamber is in excess of the air necessary for combustion so that the periphery of the combustion chamber will continuously be filled with circulating air to cool the inner surface of the refractory material.

The air ports are arranged in a tangential fashion so that the air streams will make multiple revolutions in its spiral passage through the combustion chamber. The tangential air ports must also be so arranged as to direct the air into intimate mixing relationship with the incoming fuel and waste. The high volume, low pressure operation of the incinerator and the introduction of the air fuel and waste causes intimate mixing, spiral rotating motion within the combustion chamber to effect high efficiency combustion of the waste in the central portion of the combustion chamber while maintaining excess air moving spirally in the peripheral portion of the combustion chamber. When the waste material is a combustible liquid or gas, the waste may be mixed with fuel and such mixture or the waste alone introduced through the fuel ports.

The air ports, fuel ports, and waste port, each contain means for introduction of the materials into the combustion chamber in manner specified above. The specific design of each of these ports or the waste injection nozzle may be any suitable design for such purpose as is known in the art.

The open end of cylindrical combustion chamber **13** is in communication with exhaust means generally shown as **30** for emission of the effluent of the combustion chamber to the atmosphere. It is desirable as shown in FIG. **1,** to have an expansion chamber **31** lo-

cated between open end 13 and the final stack 32 open to the atmosphere. It is desirable to pass the products of combustion from the exhaust of the combustion chamber directly into the expansion volume 33 defined by expansion chamber 31, thereby reducing the velocity of flow of the gasses and causing particulate matter to settle to the bottom 34 of expansion chamber 31 prior to passage into stack 32. It is apparent that any pollution control device for removing undesired materials from the stack effluent which operates under low pressure conditions with high volume may be positioned between the exhaust from the combustion chamber and the stack to the atmosphere.

The incinerator, expansion chamber and stack of the apparatus shown in FIG. 1, may be constructed from conventionally available materials, usual construction being steel casings lined with fire-brick refractory materials. Any suitable materials may be used for the construction of the apparatus of this invention.

An ignition means for igniting the fuel of combustion is not shown in FIG. 1 but must be located within the combustion chamber in proximity to the introduction of fuel from the fuel ports. Any suitable ignition means may be used, electric ignition means being preferred.

It may be seen from the above description that the process of my invention for burning gaseous, liquid and solid wastes comprises passing air spirally around the exterior length of a cylindrical combustion vessel counter-current to the direction of flow of combustion gasses within the chamber and toward the feed end of the combustion chamber to pre-heat said air; introducing the pre-heated air in rotating motion through tangential air ports at the periphery of the feed end of the combustion chamber so that the air moves in a spiral and rotating motion to the exhaust end of the combustion chamber; introducing fuel for combustion through tangential fuel ports spaced about a central port in the feed end of the combustion chamber, said fuel being introduced in the same tangential direction as said air; igniting the fuel near the fuel ports; introducing waste through a central port in the feed end of the combustion chamber; passing the fuel, air and waste through the combustion chamber in an intimate mixing, spiral, rotating motion at low-pressure to effect high-efficiency combustion of the waste in the central portion of the combustion chamber, the vessel walls of the combustion chamber being cooled by excess air moving spirally in the peripheral portion of the combustion chamber; and passing the products of combustion and excess air from the combustion chamber through an open exhaust end.

While the invention has been described in relation to specific embodiments thereof, it should be understood that various modifications and variances will suggest themselves to those skilled in the art and will fall within the spirit and scope of the invention.

I claim:

1. A process for burning gaseous, liquid and solid wastes comprising:

pre-heating an airstream;

introducing the pre-heated airstream tangentially into a cylindrical combustion chamber so that the airstream moves as a swirling mass in a spiral and rotating motion to the exhaust end of the combustion chamber and forms an air layer along the side wall of the combustion chamber;

introducing fuel into said swirling mass for combustion through fuel ports spaced about a central port in the feed end of the combustion chamber;

igniting the introduced fuel;

introducing waste into said swirling mass;

maintaining relative amounts of air, fuel and waste in said swirling mass sufficient to effect combustion of the introduced waste and to provide air in excess of the amount needed for said combustion;

passing the fuel, air and waste through the combustion chamber in an intimate mixing, spiral, rotating motion at low-pressure to effect high-efficiency combustion of the waste in the central portion of the combustion chamber while maintaining said air layer along the side walls of the combustion chamber; and

passing the products of combustion and excess air from the combustion chamber through an open exhaust end.

2. The process of claim 1 wherein said waste is combustible and introduced through said fuel ports.

3. The process of claim 1 wherein said waste is introduced through separate waste ports.

4. The process of claim 1 wherein the air is introduced into the combustion chamber at about a pressure of 1 to 4 inches of water.

5. The process of claim 1 passing the products of combustion from the exhaust of the combustion chamber directly into an expansion volume thereby reducing the velocity of flow and causing particulate matter to settle toward the bottom of the expansion volume.

6. An apparatus for combustion of gaseous, liquid and solid wastes comprising:

a cylindrical combustion vessel having one end closed and the other end open for exhaust of products of combustion, said closed end having a central port for introduction of waste, ports spaced about said central port for introduction of fuel, and tangential ports at the periphery of the closed end for introduction of air, said tangential ports positioned in the same tangential direction;

a spaced jacket surrounding said combustion vessel for its full length having an opening toward said open end of said combustion vessel and baffles spirally spaced between the jacket and combustion vessel for the length of said vessel defining an air passage in communication with a blower means at said opening and with said air ports at the other end;

blower means for introduction of air into said opening of said jacket;

ignition means to ignite the fuel of combustion; and

supply means for furnishing fuel and waste to their respective ports.

7. The apparatus of claim 6 having an expansion chamber in communication with the exhaust end of said combustion chamber.

8. The apparatus of claim 6 wherein the fuel ports are tangential.

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