ABSTRACT

An incinerator and combustion product cleaning system comprises a two stage treating system, the material to be burned being heated and at least partially dried in the first stage and burned in the second stage. Gaseous products are removed from both stages by operation of a vacuum pump of the liquid vortex type which effects a separation of objectionable gaseous products and of particulate matter from the stream of combustion products under treatment.

10 Claims, 12 Drawing Figures
INCINERATOR AND SYSTEM FOR CLEANING PRODUCTS OF COMBUSTION

This application is a continuation-in-part of my co-pending application Ser. No. 472,728 filed May 23, 1974, now abandoned, which is a division of my application Ser. No. 231,148 filed Mar. 21, 1972, and issued on May 28, 1974, as U.S. Pat. No. 3,812,654.

My invention relates to combustion apparatus and more particularly to an improved incinerator and gas cleaning system for disposing of wet waste materials.

The disposal of garbage and other wet or damp material involves difficult problems. Various types of apparatus have been suggested and employed for this purpose including incinerators intended for the burning of wet materials. While such apparatus has been suitable for some applications it has not been fully satisfactory for all applications particularly when a thoroughly cleaned discharge is required in order to prevent pollution of the atmosphere. Accordingly, it is an object of my invention to provide an incinerator for wet wastes and the like including an improved arrangement for effecting the burning of wastes without discharging objectionable substances to the atmosphere.

It is another object of my invention to provide an incinerator for wet or damp waste products including an improved arrangement for effecting substantially complete combustion of the burnable constituents in the waste, a complete separation of solid matter from the gaseous products and a removal of the objectionable gaseous products from the gases discharged from the incinerator.

Briefly, in carrying out the objects of my invention in one embodiment thereof, an incinerator is provided with two stages of treatment of waste material moved therethrough by suitable shakers, in the first stage the wet materials are preheated to at least a partially dried condition and are then moved into the second stage where they are burned. The gaseous products of combustion which contain some particulate solids are removed from both stages by a vacuum pump of the liquid vortex type where objectionable gaseous substances and solids are separated from the combustion gas stream. In another embodiment coal is employed as the fuel and is moved in a bed toward the first stage and ignited and brought to high combustion temperature before it is introduced to the first stage. Combustion air is forced through the coal bed in the first and second stages and accelerates and maintains the combustion process.

The features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. The invention itself however both as to its organization and manner of operation together with further objects and advantages thereof will be best understood by reference to the following description taken in connection with the accompanying drawings in which:

FIG. 1 is an isometric view partly broken away illustrating a liquid vortex pump of the general type used in my invention arranged to treat gases delivered from an incinerator;

FIG. 2 is a longitudinal sectional view of the apparatus of FIG. 1;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is an enlarged top plan view partly in section and partly broken away illustrating the vortex pump construction;

FIG. 5 is a longitudinal section view taken along the line 5—5 of FIG. 5;

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 4;

FIG. 7 is a sectional view taken along the line 7—7 of FIG. 4;

FIG. 8 is an enlarged longitudinal view of a rotor support of the pump of FIG. 1;

FIG. 9 is a diagrammatic view of a two stage incinerator and vortex pump of the invention;

FIG. 10 is a diagrammatic illustration of a coal fired incinerator utilizing the invention;

FIG. 11 is a diagrammatic illustration of a further embodiment of my invention; and,

FIG. 12 is an enlarged sectional view of the equipment of FIG. 11 along the line 12—12 thereof.

Referring now to the drawings the apparatus illustrated in FIG. 1 comprises a vortex pump unit 10 arranged to receive the combustion gases from an incinerator 11, the bottom wall of which is a grating to admit air while supporting the material being burned. The material to be burned is charged into the incinerator through a door 12 and the smoke and fumes are removed from the incinerator through a horizontal duct 13 and a vertical duct 14 which is in communication with the intake of the vacuum pump through a plurality of openings in the pump tank or housing one of which is illustrated at 15. The pump is driven by an electric motor 16 through V-belts 17 and water or treating fluid is supplied to the pump intake through conduits 18 and 19.

During operation the pump produces a vacuum on its intake side and the combustion gases are drawn into the pump where they are mixed with water supplied in a spray, the tank being filled with water to a level sufficient to submerge the pump. A horizontal baffle 21 may be mounted in the tank between the walls and above the pump and terminates in a vertical portion 22 which fits closely about the shroud on the pump indicated at 23. Thus fluids circulated by the pump are moved toward the far end of the tank where they pass around the baffle, gaseous constituents being collected above the water level in the tank. The operation of the pump is such that particulate matter in the combustion gases is mixed with the water and remains in the water where it settles toward the bottom or collects on the surface depending upon the characteristics of the material, its specific gravity and any tendency it may have to agglomerate. The gases discharged above the water level in the pump tank together with any remaining fine particulate matter are delivered to a stack 24 in which may be arranged further purifying equipment such as charcoal briquettes maintained in water or a treating solution through which the gas is passed.

The pump illustrated in FIG. 2 comprises a helical drive rotor mounted on a shaft 25 which is rotated by the motor 16 through the V-belts 17. The rotor includes a double helix portion 26 arranged within the intake zone of the pump and a vortex forming compression portion 27 arranged partly within the shroud 23 and partly axially outside the shroud. The rotor is supported between a mounting and thrust bearing 28 and a stationary hollow shaft 31 secured to the support by a
threaded nut 30; the shaft 25 extends beyond the bearing 28 and carries the sheave for the belts 17 and the stationary shaft 31 extends still farther beyond the right end of the assembly. The rotor 27 is also of double helical construction providing in effect two rotors spaced 180° from one another and each having a relatively long pitch. During operation of the vortex pump, a low pressure or vacuum is created in the right-hand or intake zone of the pump within the shroud 23 and a liquid vortex is formed within the rotor 27 which compresses the gases driven toward it by the rotor 26 and drives them into the liquid within the tank of the vortex pump unit 10. The level of the liquid in this tank may be maintained as desired but is such as to completely submerge the vortex pump and maintain a liquid level above the baffle 21 such as indicated at 32. The web of the channel iron support 29 is provided with elongated openings 29' on either side of the center to afford passage for the liquid stream from the pump.

The compressing action of the liquid vortex pump section produces a violent circulation of liquid in the tank and raises the vapor or gaseous pressure in the tank, a substantial quantity of the gases being dissolved or absorbed in the liquid, and the remaining vapors being discharged through the stack 24. A positive gas pressure substantially higher than atmospheric is maintained within the tank due to the fluid resistance within the stack 24 and may be further controlled by employing a weighted regular valve of the flapper type as described hereinafter.

A substantial quantity of the gas driven into and absorbed or dissolved in the water in the tank is maintained in the water for a predetermined period because of the pressure maintained in the tank. The violent action of the vortex together with the agitation within the tank results in removing major quantities of particulate matter and various gases contained within the gas stream discharged from the incinerator 11 to the pump. The gases rising through the stack 24 are treated to remove any remaining particulate matter and undesired gaseous constituents. A column of water is maintained in the stack 24 to a level determined by the position of the outlet 19. During operation of the pump, gas is continuously delivered to the stack through a screen 33 and the outlet 19 and the gas moves upwardly in a steady stream through this liquid in separate bodies or bubbles and is treated by the chemical content of the liquid as well as by passage over the copper screens and the charcoal briquettes. Overhead liquid from the outlet 19 is returned to the intake of the pump through the outlet 19 conduit which is connected to deliver the liquid to an annular manifold 45 at the intake of the pump. The intensity of the vortex action of the pump may be adjusted by moving a band 46 arranged about the shroud 23 adjacent vortex impeller 27. As shown in FIG. 4, the band 46 is provided with lateral notches 47 which may be moved to selected positions over intake openings 48 in the shroud 23. The band may be rotated by forward or reverse pressure applied by a rod 50 extending tangentially of the band 46 and through the wall of the tank 10, a gland or seal 51 being provided to afford the sliding movement of the rod without leakage of liquid from the tank. The rod is attached to the band 46 in any suitable manner, such as by upturned flanges 52 and 53 formed on the band and having holes for passage of the rod and a nut 54 for securing the rod to the flanges while affording limited movement of the rod upon rotation of the band 46. Water from the tank 10 is recirculated to the interior of the shroud through the openings 48 and varies the intensity or mode of operation of the vortex in the manner described and claimed in my above identified U.S. Pat. No. 3,204,861.

As illustrated in FIG. 4, the hot products of combustion delivered to the vortex pump unit through the vertical duct 14 enter the intake zone of the vacuum pump indicated at 57 through a plurality of openings 58 in the end plate of the tank 10. The annular manifold 45 is also welded or otherwise suitably secured and bonded to the end plate of the tank and the water entering this annular manifold through the pipes 18 and 19 goes upwardly about the shaft 25 of the rotor through an annular clearance about the rotor. This produces a high velocity jet of water which is delivered against a slinger ring 60 which is provided with teeth 61 to further break up the water into small drops or particles. The gaseous matter and water mixed in the chamber 57 are driven by operation of the rotor 26 toward the rotor 27 and the vortex formed thereby are compressed and thoroughly mixed with the water of the vortex and then discharged from the left-hand end of the shroud 23. The effect of the operation of the impeller 27 and the vortex action is to compress the gaseous components of the products of combustion and mix them thoroughly with the water within the vortex. This gas and liquid mixture under the pressure maintained within the tank 10 is agitated and soluble or otherwise absorbable constituents of the gaseous material are added to the water and thereby removed from the gaseous stream. Particulate matter in a similar manner is thoroughly mixed with the water and on flowing out of the shroud 23 circulates in the water and separates by gravity, some of the material floating and other material sinking. The accumulation of solid matter within the tank 17 depends upon the nature of the products of combustion delivered to the vortex pump and depending upon these materials, may sink quickly to the bottom or may be of a nature which tends to float to the top where it may agglomerate and can be removed by skimming off the agglomerated masses. An access opening having a removable cover
such as indicated at 61 in FIGS. 2 and 4 may be provided to remove floating debris from the surface of the water. A drain plug, valve or clean-out door (not shown) is also provided at the bottom of the tank for affording removal of sludge and waste collected on the bottom of the tank.

The level of the liquid in the tank 19 is maintained by the discharge of liquid through an outlet conduit 62, controlled by a valve 63 actuated by float 64, the discharge water and solid matter therein entering from a point below the surface near the bottom of the tank as indicated by the lower end of an intake pipe 65 leading to the valve. For external observation of the level of the liquid, a gauge glass 66 may be provided on the side of the tank, it being connected to the interior of the tank through upper and lower elbows 67 and 68, respectively. A pressure gauge 69 is also provided to indicate the gas pressure above the water in the tank.

As shown in the sectional view FIG. 5, the hollow shaft 25 of the rotor is mounted on the stationary tubular shaft 31 on sleeve bearings 70 and 71, a seal being provided between the bearings and the shaft 31 by pairs of O-rings 72 for the bearing 70 and 73 for the bearing 71. Oil for lubricating the bearings is admitted to the interior of the shaft 31 through an intake fitting 74 and flows from the interior of the fitting through an oil passage 75 into the space between the bearing 71 and the shaft 31, this space being of the order of .007 of an inch and affording a circulation of the oil between the bearing and the shaft. The oil then flows through an annular space between the two shafts, as indicated at 76, and flows out through a passage 77 after passing through the space between the bearing 70 and the shaft 31. Direct flow of oil through the center of the shaft 31 is prevented by a plug 78 secured by a suitable set screw (not shown) to the tube 31 and sealed by a pair of O-rings 80. The oil leaves the center of the shaft 31 through an outlet fitting 81 and is returned to the opposite end of the shaft 31 through a line or conduit 82, an oil reservoir 83, by operation of a pump 84 which circulates the oil under sufficient pressure to force it through the bearing spaces and to maintain the oil within the inner tube 31 at relatively high pressure as well as the oil filling the annular space 76 between the shaft 25 and the stationary shaft 31. The oil pressure is controlled by an adjustable needle valve 82a in the line 82.

The mounting of the shaft to provide the complete filling of the spaces between the stationary and rotatable shaft with oil under pressure and to maintain the pressure within the clearance within the bearings 75 and 77 at the ends of the rotating shaft effects a floating mounting of the rotating shaft and this mounting cushions the shaft and rotors against shock and vibration during operation. It has been found that during operation of a rotor such as illustrated in the drawings that even though the rotor is out of balance it operates smoothly with a minimum vibration of the equipment. The pump operates smoothly under all loads and precision balancing of the rotor has been found to be unnecessary. It appears from the operation of a rotor constructed in the manner illustrated in FIG. 5 that even with the long distance of shaft suspension between the mounting bearings that quick action and distortion of the rotation of the helical members is damped to a degree that it becomes unnoticeable in the operation of the machine. By way of illustration and not by way of limitation, it has been found that in a system constructed as illustrated in the drawings, lubricating oil at a pressure of 125 pounds per square inch delivered to the shaft 31 provided effective lubrication and damping and minimizes the effects of off-balance masses on the rotor.

The rotors 26 and 27 as shown in FIGS. 7 and 6, respectively, each comprises double helical arranged at 180° from one another. In this way, they employ a longer pitch for each helix with a spacing of one-half the pitch distance between adjacent turns of the two helical elements. This double helix arrangement facilitates good balance of the rotors and also provides balanced action on the fluids circulated by the rotors.

In FIG. 9 there is illustrated a two stage incinerator 85 arranged to discharge the products of combustion through a duct 86 to a vortex pump 87. The incinerator 85 comprises a preheat section or chamber 88 and final burning section 90 connected in series for the feed of material to be burned and having their outlets 91 and 92, respectively, connected to the duct 86. The pump 87 is of essentially the same construction as the pump unit 10 described above; this pump is capable of producing a high vacuum and of handling a large volume of gas. The pump thus provides the draft required for effective burning of waste materials and further effectively eliminates the discharge of objectionable gaseous material from the stack while separating the solids therefrom.

The preheater 88 comprises a generally sloping chamber having an intake 93 and a shaker conveyor 94 which discharges the material to be burned into the preheater chamber. A gravity biased door 95, hinged at 96 along the top of the opening 93 is provided to restrict the amount of air passing through the opening 93 to the preheater chamber. The lower wall of the chamber 88 is slanting as indicated at 97 and has mounted thereon gas burners 98 and 99 which operate to preheat the material falling through the preheater chamber and to reduce the oxygen content of the gas therein. To facilitate the movement of the material supplied to the preheater chamber a second shaker table 101 is provided in the lower zone of the chamber extending from the wall 97 and moves material falling thereon outwardly to the right for heating by the lower burner 99.

The heated material is supplied to the main combustion chamber 90 through an opening 102 at the bottom of the vertical wall 103 between the two chambers. The material which has been preheated in the chamber 88 is moved across the preheat chamber to the main chamber by a shaker table 104 which is provided with a multiplicity of perforations at its portion below the chamber 90 so that air for combustion purposes may be supplied to the chamber 90 by operation of a blower 105. The shaker table below the chamber 90 is of sufficient length that burnable materials are burned before they can leave the chamber 90, and pass to the right and out through an opening 106. The nonburnable articles and only the nonburnable articles fall to a shaker table 104 so that they may be removed as desired. In order to maintain the required gas pressures within the burning chambers a flap door which is gravity biased to close the opening 106 is provided as indicated at 108. When employing a single pump 87 as illustrated the openings 91 and 92 are sized so that the opening 91 is more restricted and the major flow of combustion products is upwardly through the opening 92 to the pump.
The operation of the two stage incinerator as illustrated in FIG. 9 provides intense heating of the materials flowing through the preheat chamber and dries these materials substantially so that heated materials are supplied to the main incinerator chamber 90 which is provided with an ample flow of oxygen to support combustion and burn the preheated materials as desired. A two stage incinerator constructed in this manner provides for continuous incineration of material and, at the same time, by employing the vortex pump 87 eliminates particulate matter and noxious fumes from the gases discharged from the incinerator. Furthermore, it provides an effective system for the incinerator of wet or damp waste materials such as garbage.

For locations near adequate coal supplies even though the coal may be a high sulphur or a low grade coal, it may be desirable to employ coal as the fuel for the incinerator and, in FIG. 10 there is illustrated an embodiment of my invention wherein a bed of coal is prepared and maintained on a shaker conveyor in a manner to effect a two stage treatment of sewage sludge or garbage and other wet waste. In FIG. 10 coal is supplied to the incinerator from a hopper 110 and falls through a supply chute 111 onto the shaker conveyor indicated at 112. The conveyor is arranged within a housing 113 and is agitated by operation of an eccentric drive mechanism 114 which is connected to the conveyor by linking 115. The drive moves the conveyor continuously between positions represented generally by the full line and dotted line indications of the driving connection 116 secured to the lower side of the conveyor. The conveyor includes a lower closed wall 117 and an upper foraminous or perforated grate 118. The shaker may be actuated by way of example to provide a slow forward movement in the direction of flow of the coal and a quick return thereby utilizing the inertia of the coal to maintain the required direction of movement of the bed of coal during the operation of the incinerator.

The incinerator is operated in three stages. The first utilizes a fuel supply such as fuel oil or reject crankcase oil injected through a nozzle 120 which is sprayed over the coal and is ignited by a flame 121 supplied from the tank 122 and which ignites the coal. Combustion air is supplied to the chamber formed between the grate 118 and the wall 117 by operation of a blower 123 and is supplied through perforations in top of shaker conveyor to jet upward through the coal which is the most efficient way to supply air to burn the coal at a high heat intensity which is maintained throughout the remainder of the preheating stage. The highly heated bed of coal is moved forward under a depending partition 124 and reaches a compartment 125 which is the preheating compartment for the waste to be burned. Waste is supplied through a pressure assembly 126 which may be a grider or a shredder depending upon the nature of the waste to be burned and which supplies the waste by gravity to the conveyor where it falls upon the highly heated bed of coals. The separate central chamber 127 is provided within the conveyor between two walls 128 and 129 and is supplied with air by a blower 131. The air from blower 131 is maintained at a rate sufficient to assure continued combustion of the coal, but at a reduced rate as compared with that of the preheat compartment. This minimizes the amount of carbonizing of the preheated waste material. The purpose of the preheating of the chamber 125 is to dry the waste to a predetermined degree to prepare it for the burning stage. The burning is more readily effected when the waste has not been carbonized before introduction into the burning chamber. The temperature of the coal bed and the amount of air needed to maintain the required heat in the chamber 125 is maintained by a control unit 132 including three temperature sensors 133 arranged along the carrier or grate.

Burning is effected in the final stage in a compartment 134, combustion air being supplied by blower 135 to the final chamber within the carrier, indicated at 136.

In order to maintain a free flow of the gases within the apparatus and to provide the required vacuum for facilitating the removal of the products of combustion, the compartments 125 and 134 are connected through ducts 137 and 138 to the intake 140 of a liquid vortex pump not shown.

The combustibles within the waste material are burned completely in the compartment 134 and the noncombustible product is supplied to a dust or collector through an outlet 141 at the right-hand end of the carrier. The noncombustibles as they settle on the top of the conveyor by the shaking process are cooled by the air flowing through the grate and do not fuse or form formers and are easily handled upon discharge from the furnace. The high rate of flow of air effected by operation of the liquid vortex pump greatly facilitates the complete burning of the combustibles in the waste material and in addition provides a highly effective system for separating the gaseous materials from the solids and for eliminating objectionable gaseous materials from the products of combustion. This makes it possible to discharge a non-polluting gas to the atmosphere. The arrangement of a continuous coal bed for heating the waste material and for providing combustion air independently controlled at each of the three stages thus provides a continuous and highly effective system for the incineration of garbage, sewage sludge and other dump or wet waste products.

Referring now to FIG. 11, the embodiment illustrated is similar to that of FIG. 9 in that it includes a plurality of stages of gas fired treatment in combination with the exhausting of the products of combustion by operation of the liquid vortex pump. In this embodiment the incinerator includes a first enclosure 144 and a second enclosure 145. The product to be burned is supplied through a grinder or shredder mechanism 146 corresponding to the mechanism 126 of FIG. 10, and the product to be burned is supplied to a shaker table or grate 147 actuated by a reciprocating drive 148. The waste material is spread over the shaker table 147 and is supplied to a second table 150 to which it falls from the right-hand end of the table 147. A gas burner 151 for preheating the waste is mounted at the end of the table 147 and is operated with an air supply sufficient to produce the required heat without adding free oxygen to the chamber atmosphere. The waste on the shaker table 150 is predried and then passed from the first stage to the second stage past a flapper or door 152 where it enters the chamber 145. The shaker table 150 extends into the chamber 145 and the material preheated and dried thereon is supplied from the left end of the shaker table 150 by gravity and is ignited by a gas burner 151a and falls to a third shaker table or grate 153 which is actuated by a reciprocating mechanism 154 to produce a movement of the material through the
heating chamber where it is burned; air is supplied through the grate 153 by operation of a blower 153a. The non-combustibles are retained on the table 153 and finally are dumped from the right-hand end thereof past a control panel or door 155 to a suitable collection means (not shown). The chambers 144 and 145 are connected by outlet ducts 156 and 157 which are both connected through a separating or settling chamber 158 for removing relatively large solid matter from the combustion product stream and delivering it through a duct 160 to a liquid vortex pump 161. The operation of the system is thus essentially the same as the two stage system disclosed in FIG. 9. The gaseous and particulate matter are separated within the liquid vortex pump 161, the gases being removed through the stack indicated at 162 under control of a pressure regulating valve 163 and the liquids being supplied upon overflow through an outlet duct 164 to a distillation chamber 165.

A distillation chamber 165 is provided to purify the water flowing from the pump 161 and to remove the solids therefrom. The distillation chamber 165 utilizes the invention described and claimed in my U.S. Pat. No. 3,317,405, issued May 2, 1967. The distillation apparatus utilizes a second liquid vortex pump 166 arranged to remove gaseous matter through a duct 167 from the distillation chamber 165. In the chamber 165 the entering liquid is caused to flow over a sloping plate 168 which is vibrated by a plurality of ultrasonic transducers 170 which effectively vaporize the liquid flowing thereover. The gaseous vapors are removed through the duct 167 by operation of the pump 166 and the solids fall to the bottom of the distillation chamber 165 where they accumulate and may be removed by operation of an auger 171 for collection and handling as desired. The auger 171 may be operated by a suitable driving mechanism (not shown) at selected intervals depending upon the rate of accumulation of the solid matter which settles in the bottom of the tank 165. A suitable sealing arrangement (not shown) is employed to prevent direct flow of fluid from the tank to the outside.

The distilled water received from the tank 165 is condensed within the pump 167 and is supplied to a discharge line 172 from which a portion may be removed by operation of a pump 173 and returned to the tank 161 while distilled water may be removed as desired under control of the valve 174 and utilized elsewhere.

The enclosure 145 comprises a channel shaped conveyor as indicated in FIG. 12 so that a substantial body of burning material may be held thereon. The walls are lined with refractory material 175 and are provided with a heavy layer of insulation as indicated at 176. The system operates to discharge pollution free gaseous product at the stack 162 and to provide for the collection of solid matter which is well dried by the operation of distillation chamber 165 wherein the liquid is removed by evaporation. Thus the solid materials may be hauled away and are not required to be retained in a settling pond or the like.

My invention provides an effectively arrangement for utilizing the vacuum pump of a liquid vortex type for drying and burning combustible material and for separating gaseous matter from solid matter in the course of waste disposal.

While I have illustrated my invention in connection with particular arrangements and systems, various other modifications and applications will occur to those skilled in the art. Therefore, I do not desire my invention to be limited to the details illustrated and described, and I intend by the appended claims to cover all modifications which fall within the spirit and scope of my invention.

I claim:

1. An incinerator and combustion product cleaning system for burning sewage and other moist waste material and the like comprising:
   means including a preheating chamber for heating and at least partially drying the moist waste to be burned;
   means for supplying waste material to said preheating chamber;
   means providing a combustion chamber;
   means providing a passage for waste between said chambers and including a conveyor for moving heated waste from said preheating chamber into said combustion chamber;
   blower means for supplying combustion air to said combustion chamber; and,
   means including a vacuum pump of the liquid vortex type for withdrawing gaseous matter from both of said chambers and for cleaning the withdrawn gas.

2. An incinerator and combustion product cleaning system as set forth in claim 1 including a dish chamber and a second liquid vortex pump for withdrawing water from said first mentioned pump and for purifying the water.

3. An incinerator and combustion product cleaning system as set forth in claim 1 including a gas burner adjacent said passage for igniting the waste entering said combustion chamber.

4. An incinerator and combustion product cleaning system as set forth in claim 1 including a conveyor grate for moving coal through said chambers and for means for igniting the coal and burning it during passage through said chambers whereby a bed of hot coals is formed on said conveyor in said preheating chamber to dry the waste before it moves into said combustion chamber to facilitate the burning of the waste.

5. An incinerator and combustion product cleaning system as set forth in claim 1 including temperature control means for regulating the flow of air through the bed of coals in the preheating chamber to minimize charring of the waste in said preheating chamber.

6. An incinerator and combustion product cleaning system as set forth in claim 1 wherein said conveyor comprises a grate and an air duct below the grate for conveying air along the grate for passage therethrough and through a bed of coals thereon.

7. An incinerator and combustion product cleaning system as set forth in claim 6 including means for independently controlling the flow of air through the grate in each of said chambers.

8. An incinerator and combustion product cleaning system as set forth in claim 1 including means providing an ignition chamber for supplying burning coal to said preheating chamber, and means supplying coal to said ignition chamber and for igniting it and supplying combustion air thereto through said grate.

9. An incinerator and combustion product cleaning system as set forth in claim 8 wherein said conveyor is a single continuous shaker conveyor extending through all three of said chambers, and means for effecting in-
11. dependent control of combustion air flowing through said grate in each of said chambers.

10. An incinerator and combustion product cleaning system comprising:
   means providing a waste material preheater chamber including gas burning means for supplying heat thereto;
   a combustion chamber;
   means providing a passage between said chambers and a conveyor for moving preheated materials through said passage into said combustion chamber;
   blower means for supplying combustion air to said combustion chamber;
   means including a vacuum pump of the liquid vortex type for withdrawing gaseous matter from both said chambers and for cleaning the withdrawn gaseous matter; and,
   a gas cleaning stack on said pump for effecting a final cleaning of the gases discharged from said pump.

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