

[54] INCINERATOR ASH REMOVAL APPARATUS

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[51] Int. Cl. F23j 1/00

[58] Field of Search 55/312, 315, 342, 350; 110/8 R, 119, 165 A

[56] References Cited UNITED STATES PATENTS

3,418,788	12/1968	Sugimoto	110/165 X
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3,716,967	2/1973	Doyle, Jr. et al.	110/119 X
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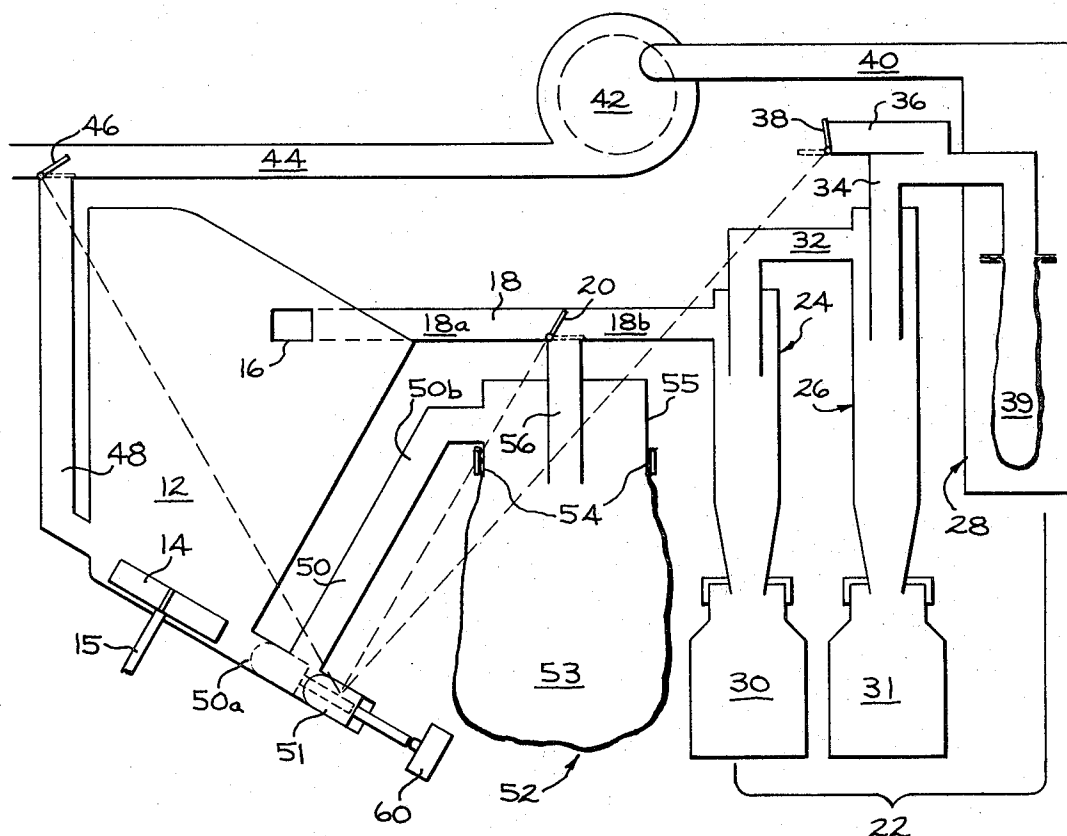
Primary Examiner—Kenneth W. Sprague

[57]

ABSTRACT

A valve and duct means are provided to extract ash-laden air from the combustion chamber of an incinerator and direct it to fly ash separators and a finer filter in order that small particles of ash may be separated from the air before the air is exhausted to atmosphere. An alternate path is provided to remove ash remaining in the combustion chamber after an incineration cycle is completed. Ash-laden air from the combustion chamber is directed to a cyclone separator to remove larger particles of ash from the air. The air is then sent through the fly ash separators and the finer filter in order to remove any remaining smaller particles of ash. The air is then returned to the combustion chamber where particles of ash remaining therein are stirred up by the returning air. Electrical circuitry is provided so that operation of the ash removal apparatus is substantially automatic. A protective circuit prevents operation of the ash-removal apparatus if the temperature in the combustion chamber is above a predetermined level.

6 Claims, 2 Drawing Figures



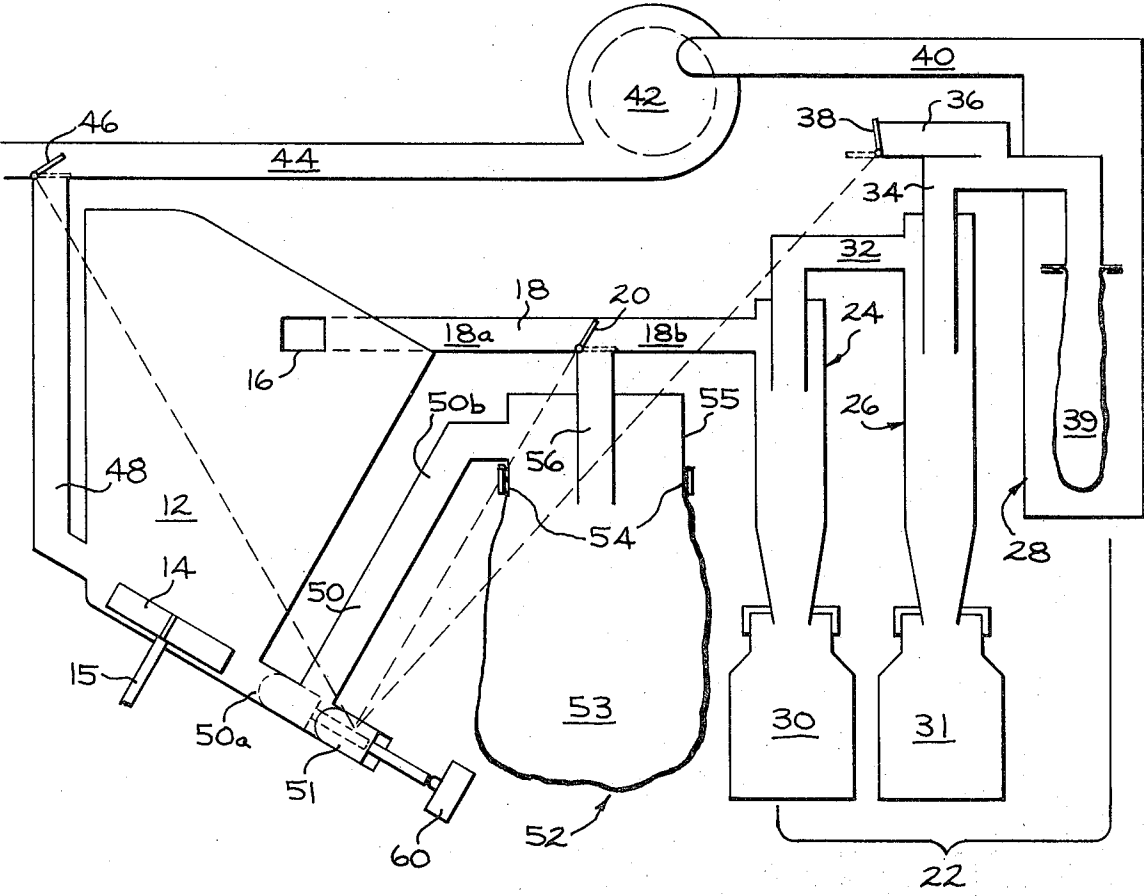


FIG. 1

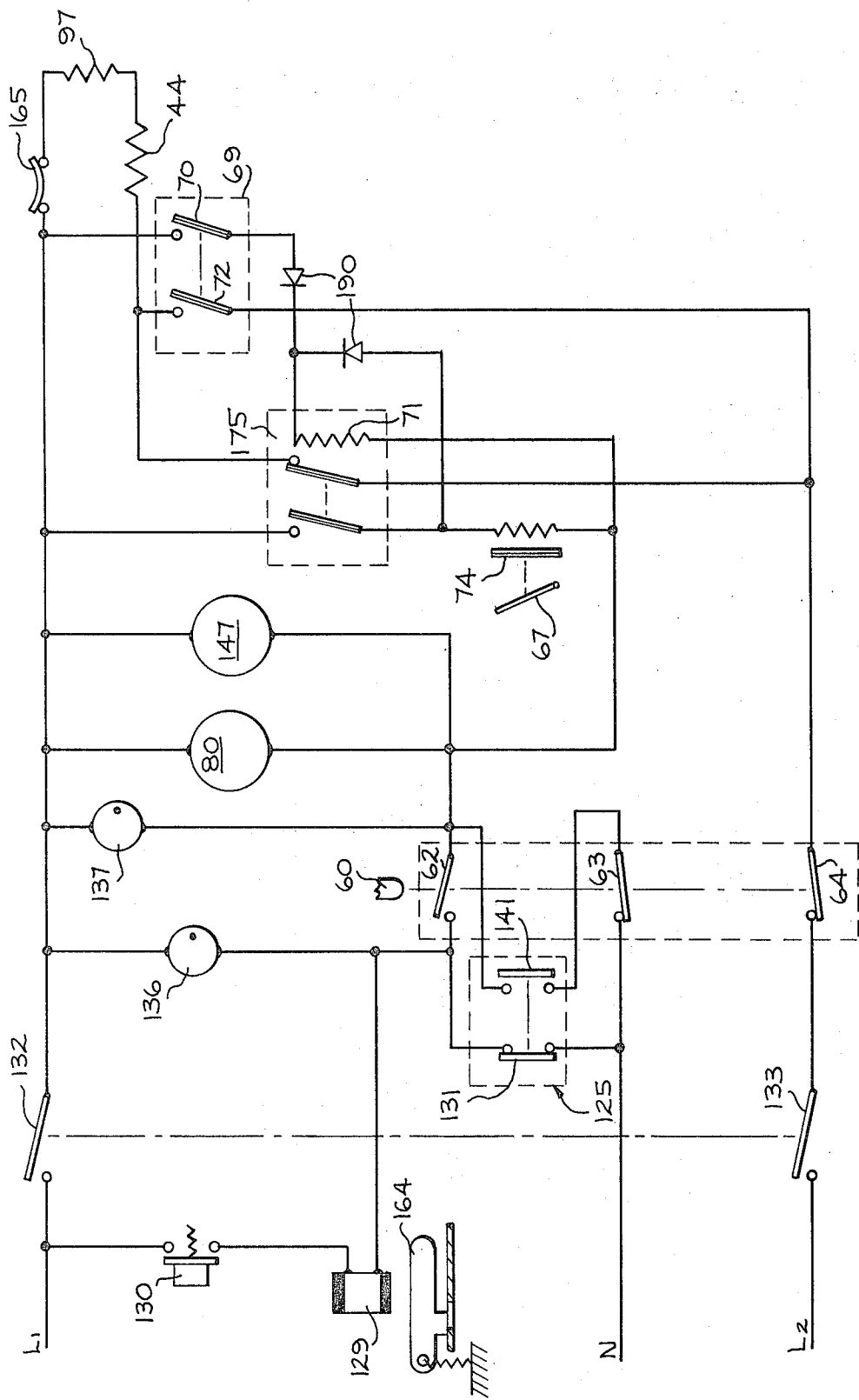


FIG. 2

INCINERATOR ASH REMOVAL APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention is directed to solid waste incinerators and more particularly to new and improved apparatus for removing ash from such incinerators.

2. Description of the Prior Art

In modern solid waste incinerators, combustion is very efficient, so that only small amounts of ash are left in the incinerator after an incineration cycle. A good example of this type of incinerator is shown in U.S. Pat. No. 3,742,874, assigned to the assignee of the present invention.

Although this incinerator works well during incineration no provision is made for removing ash left in the combustion chamber after an incineration cycle is completed. Removal of the remaining ash must be done manually after an incineration cycle is completed and the incinerator has cooled sufficiently. This is an obviously time-consuming, dirty task.

The above-mentioned problems are overcome by the present invention and provision is made for disposing of even residual ash without the necessity of the operator's manually removing it from the incinerator. Accordingly, it is an object of the invention to provide ash removal apparatus for an incinerator which removes ash substantially automatically, so that the time and effort required of the operator is kept to a minimum.

It is another object of the invention to provide ash removal apparatus which removes smaller particles from flue gases during incineration and which removes both smaller and larger particles from the combustion chamber after an incineration cycle is completed.

It is a further object of the invention to provide ash removal apparatus including a protective device so that ash removal after incineration may be accomplished only when the combustion chamber is below a predetermined temperature in order to minimize the risk of a fire.

SUMMARY OF THE INVENTION

In carrying out the invention, in one form thereof, an incinerator is provided wherein particles of ash are removed from a combustion chamber after an incineration cycle is completed. A valve and duct means are provided to extract ash-laden air from the combustion chamber and direct it to a first ash separator in order that larger particles of ash may be separated from the air. The air is then sent through fly ash separators to remove smaller particles of ash before being returned to the combustion chamber where the returning air stirs up any remaining particles. Baffles are provided to selectively divert the air flow as required. Electrical circuitry is provided so that operation of the ash removal apparatus is substantially automatic. The danger of a fire occurring in the separators is minimized by a protective circuit which prevents operation of the ash removal apparatus if the temperature in the combustion chamber is above a predetermined level.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation of the ash removal apparatus of the invention.

FIG. 2 is a schematic representation of electrical circuitry according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there is shown a combustion chamber 12 of an incinerator. An agitator 14 is provided to stir the combustible material and to break up any carbonized residue which may form in the lower portion of the combustion chamber. Agitator 14 is driven by shaft 15 of a motor 147 (shown schematically in FIG. 2). Combustion chamber 12 and agitator 14 operate in the manner described in U.S. Pat. No. 3,742,874.

During an incineration cycle, gases containing smoke and ash particles are generated. These gases exit combustion chamber 12 through opening 16 and are carried away as flue gases by duct 18, which duct is comprised of sections 18a and 18b.

A diverting means in the form of movable baffle 20 is disposed within duct 18. Baffle 20 may occupy a first position, as shown by solid lines, in which it blocks duct 18a. Baffle 20 may be rotated to a second position, shown by dotted lines, in which duct 18 is unobstructed. In this latter position, flue gases evolving from combustion chamber 12 may be carried directly to fly ash separators 22.

Fly ash separators 22 comprise two cyclone separators 24 and 26 in series and a finer filter 28 downstream of cyclone separator 26. Portion 18b of duct 18 is connected to cyclone separator 24 for conducting flue gases to separator 24 during incineration. Separator 24 includes a removable container 30, such as a quart jar, for receiving the ash separated from the flue gases by separator 24. Duct 32 is provided to connect cyclone separator 24 to cyclone separator 26. Cyclone separator 26 acts on the flue gases in the same manner as cyclone separator 24, and more fly ash particles are collected in removable container 31, which container may be identical to container 30.

Separator 26 is connected to finer filter 28 by duct 34. The purpose of finer filter 28 is to collect whatever fly ash particles remain after the ash-laden air has passed through cyclone separators 24 and 26. For collecting the ash particles, filter 28 includes a filtering element 39 arranged within duct 40. Filtering element 39 is typically a vacuum cleaner bag.

In order to cool the flue gases before they enter the filter 28, a duct 36 is provided for admitting cooler outside air. Duct 36 is connected to an intermediate portion of duct 34. A movable baffle 38 is provided at the end of the duct 36. Baffle 38 is movable from the position shown in FIG. 1 to an open position in which cooling air is admitted through duct 36 during incineration.

In order to draw air through the separators, an exhaust blower or fan 42 is connected to duct 40. The blower may be of any conventional type and may be driven by any suitable driving means, such as a motor indicated at 80 in FIG. 2. A duct 44 is connected to the exhaust side of blower 42 for conducting gases to the atmosphere during incineration. Duct 44 is arranged for communication with a duct 48. Duct 48 is connected to the lower portion of combustion chamber 12 so that air passing therethrough stirs any ash remaining in the combustion chamber.

A movable baffle 46 is placed at the junction of duct 44 and 48. Baffle 46 may be placed selectively in a horizontal position, as shown by dotted lines, where it blocks communication with duct 48 during incineration.

tion and causes exhaust gases from duct 44 to pass to atmosphere or in a vertical or intermediate position, represented by solid lines, whereby all or a portion of the gases are directed from duct 44 through duct 48 to the combustion chamber 12 during ash removal.

Baffles 20, 38 and 46 may be actuated either by a mechanical linkage operating from ash valve 51 or by interconnected electrical components such as solenoids. Since any suitable mechanical or electrical interconnections may be employed, the interconnector is illustrated only by dotted lines in FIG. 1.

To effect removal of remaining ash from combustion chamber 12, an alternate path is provided to the separators. This path includes a duct 50 connecting combustion chamber 12 to a cyclone separator 52 which is of a type suitable for handling larger ash particles as opposed to fly ash. Separator 52 includes a large disposable paper bag 53 secured by a clamp 54 mounted on frame 55. Virtually all of the larger ash particles amounting to about 95 percent of the total ash are removed by cyclone separator 52. A separator throat 56, which is an integral part of separator 52, connects separator 52 to portion 18b of duct 18 for discharging gases from separator 52 to separator 24. When this alternate path is employed, baffle 20 is in the solid line position shown in FIG. 1.

In order to permit the path through duct 50 to be selectively opened or closed, the valve 51 is provided. In the solid line portion shown in FIG. 1, valve 51 opens duct 50 providing communication between duct portion 50a and duct portion 50b. When valve 51 is in the dotted line position, duct 50 is blocked. Valve 51 is connected by suitable linkages (shown as dotted lines) with baffles 20, 38 and 46 so that the baffles 20, 38 and 46 occupy their solid line positions when valve 51 is in its solid line position and occupy their dotted line positions when valve 51 is in its dotted line position.

A circuit diagram according to the invention is shown in FIG. 2. Many parts of this circuit are not part of the present invention but are described in U.S. Pat. No. 3,742,874. Therefore, the description of the circuit diagram shown in FIG. 2 will be limited primarily to those parts which are pertinent to controlling the ash removal apparatus of the present invention. It should be understood that applicant has modified and improved the electrical system of the referenced patent in order to automatically and safely operate his ash removal apparatus.

Since container 53 is typically a paper bag, ash particles deposited therein conceivably could cause a fire if the ash particles were hot enough. It is important, therefore, that the separator 52 be bypassed by air flowing from the combustion chamber 12, not only during the incineration cycle but also at any time the temperature in the combustion chamber exceeds a predetermined level. It has been determined that this level should be no higher than about 140°F to insure that the ash particles cannot cause a fire in the separator 52. This control of airflow including the control of other components, such as agitator 14 and blower 42, is accomplished by the interrelationship of elements and the circuitry shown in FIG. 2.

Electrical power is provided by a voltage source comprising a pair of line wires L1 and L2 having a grounded neutral connector N therebetween. Valve 51 (see FIG. 1) is arranged to engage a switch 60 when the valve is in the solid line position shown in FIG. 1. Referring

now to FIG. 2, switch 60 includes switch elements 62, 63 and 64, the first switch element being biased to a normally open position and the latter two switch elements being biased to a normally closed position.

The circuit further comprises an interlock thermostat 125 which includes normally closed contacts 131 and normally open contacts 141. When the temperature in the combustion chamber is below 140°F, the contacts 131 and 141 occupy the normal position shown in FIG. 2. During the ash removal operation, a circuit is provided for the motors 80 and 147 of the blower and agitator, respectively, through the switch element 62 and the contacts 131. The interlock thermostat 125, by effecting opening of the contacts 131 if the temperature goes above the predetermined maximum level of about 140°F, precludes operation of the blower and agitator and the passage of ash into the bag 53 of the separator 52 under such conditions.

During the incinerating operation, the valve 51 is in the dotted line position shown in FIG. 1. Baffles 20, 38 and 46 also occupy the dotted line positions shown in FIG. 1. Under these circumstances heating elements 44 and 97 in the incinerator are energized and, when the incinerator reaches a temperature above 140°F, interlock thermostat 125 shifts the contacts 131 and 141 to their open and closed positions, respectively. This completes a circuit for the blower motor 80 and agitator motor 147 through closed contacts 141 and switch element 63 from line L1 to neutral line N.

With the blower motor in operation, air is drawn from the combustion chamber through duct 18 past the baffle 20 in its dotted line position into separator 24, bypassing separator 52. The air then flows through separators 24 and 26 where fly ash is removed and then through duct 34 into finer filter 28. Ash removed in separators 24 and 26 is deposited in containers 30 and 31. Still finer particles removed in separator 28 are deposited in bag 39.

After leaving the separator 28, the air passes through duct 40 to the blower 42. Air discharged from the blower passes through duct 44 past the baffle 46 in its dotted line position to atmosphere.

A door interlock is provided during incineration. An access door (not shown) provides access to the combustion chamber for the deposition of waste material. In order to prevent opening of the access door during incineration, an interlock circuit including locking bolt 164, solenoid 129, and contact switch 130 serves to lock the access door when the temperature in the combustion chamber is greater than about 140°F. When the door is closed, interlock switches 132 and 133 are closed. It is seen that this permits energization of the rest of the circuitry. Additionally, the door interlock circuit is connected through interlock thermostat 125. Since incineration, not ash removal, is desired, switch elements 62, 63 and 64 are in that position shown in FIG. 2. Therefore, a circuit including indicator light 136 is completed when normally closed contacts 131 are closed, that is, at a temperature below 140°F. Similarly, a circuit including indicator light 137 is completed when normally open contacts 141 are closed, that is, at a temperature above 140°F.

Solenoid 129 engages locking bolt 164 when solenoid 129 is de-energized. After an incineration cycle is complete and the incinerator has cooled below 140°F, the access door may be opened by momentarily pushing normally open contact switch 130 and thus energizing

solenoid 129 to release locking bolt 164 since a circuit to ground is completed through normally closed contacts 131. When another incineration cycle is started, normally closed contacts 131 open after reaching 140°F, the circuit containing solenoid 129 is opened, and solenoid 129 cannot be energized to open locking bolt 164.

A similar procedure occurs during ash removal. However, since the door remains locked even after the incinerator cools, and since there is no need to open the door to effect ash removal, it is likely that contact switch 130 will not be pushed to open the door.

Operation

To start the ash removal cycle, valve 51 is opened, that is, moved to the solid line position shown in FIG. 1, so that the duct 50b is open to the passage of ash-laden air from the combustion chamber. Simultaneously, baffles 20, 38 and 46 are moved to the solid line positions shown in FIG. 1.

With the valve 51 in its open position, it engages switch 60. As shown in FIG. 2, when the switch 60 is engaged by the valve 51, the switch is moved downwardly to close switch element 62 and simultaneously open switch elements 63 and 64. Under these circumstances, and assuming that the temperature in the combustion chamber is below 140°F, a circuit for the blower motor 80 and agitator motor 147 is completed from the line L1 through switch element 62 and normally closed contacts 131 to neutral line N. Ash-laden air is then drawn from the combustion chamber 12 through duct 50 to separator 52 and subsequently through fly ash separators 24 and 26 and finer filter 28.

Since the baffle 46 is in the open or solid line shown in FIG. 1, air discharged from the blower 42 is directed through duct 44 and duct 48 to the bottom of the combustion chamber 12 where it assists in stirring the ash to facilitate removal thereof. Larger ash particles are deposited in the bag 53 of the separator 52 and the smaller particles, or fly ash, are deposited in the containers 30 and 31 of the separators 24 and 26, respectively. The finer filter 28 effects removal of any remaining finer particles, which are collected in the bag 39.

Should the temperature in the combustion chamber rise above 140°F at any time during the ash removal operation, interlock thermostat 125 effects opening of contacts 131, interrupting the circuit to the motors 80 and 147, locking the access door in a closed position, and discontinuing the ash removal operation until such time as the temperature again drops below 140°F, at which time contacts 131 again return to their normally closed position.

While a specific embodiment of the invention has been described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention. It is therefore intended in the appended claims to cover all such changes and modifications that fall within the true spirit and scope of the invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. Ash removal apparatus for an incinerator includ-

ing a combustion chamber comprising:

- a. a blower for providing air flow for the incinerator;
- b. first means for selectively directing air from the combustion chamber to said blower through a first path during ash removal operation and through a second path during incineration;
- c. said first path directing air from said combustion chamber through a first separating means for removing larger ash particles and then through a second separating means for removing smaller ash particles;
- d. said second path bypassing said first separating means and directing air from said combustion chamber directly through said second separating means; and
- e. second means for selectively directing air discharged from said blower through a third path to said combustion chamber during ash removal operation and through a fourth path to atmosphere during incineration.

2. The ash removal apparatus recited in claim 1 wherein:

- a. said first means includes a valve positioned adjacent said combustion chamber and movable between a first position permitting air flow through said first path and a second position blocking air flow through said first path; and
- b. said first means further includes a baffle movable simultaneously with said valve for blocking said second path when said valve is in said first position.

3. The ash removal apparatus recited in claim 1 wherein:

- a. said second means includes a first duct connecting said blower to atmosphere;
- b. a second duct connecting said first duct to said combustion chamber; and
- c. a baffle positioned at the junction of said first and second ducts for selectively directing air from said first duct to atmosphere or through said second duct to said combustion chamber.

4. The ash removal apparatus recited in claim 1 wherein said second separating means includes a plurality of serially connected separators suitable for removing fly ash and a third separator connecting between said plurality of separators and said blower for removing finer ash particles.

5. The ash removal apparatus recited in claim 4 and further including a duct connecting said plurality of said separators and said third separator and means for introducing air from the atmosphere through said duct to maintain the temperature in said third separator below a predetermined level.

6. The ash removal apparatus of claim 2 wherein said first means further includes a valve and electrical circuitry means associated therewith for simultaneously diverting ash-laden air to said first separating means and energizing said exhaust blower, said electrical circuitry means responsive to the temperature within said combustion chamber so that power to said exhaust blower is interrupted if the temperature within said combustion chamber exceeds a predetermined value.

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