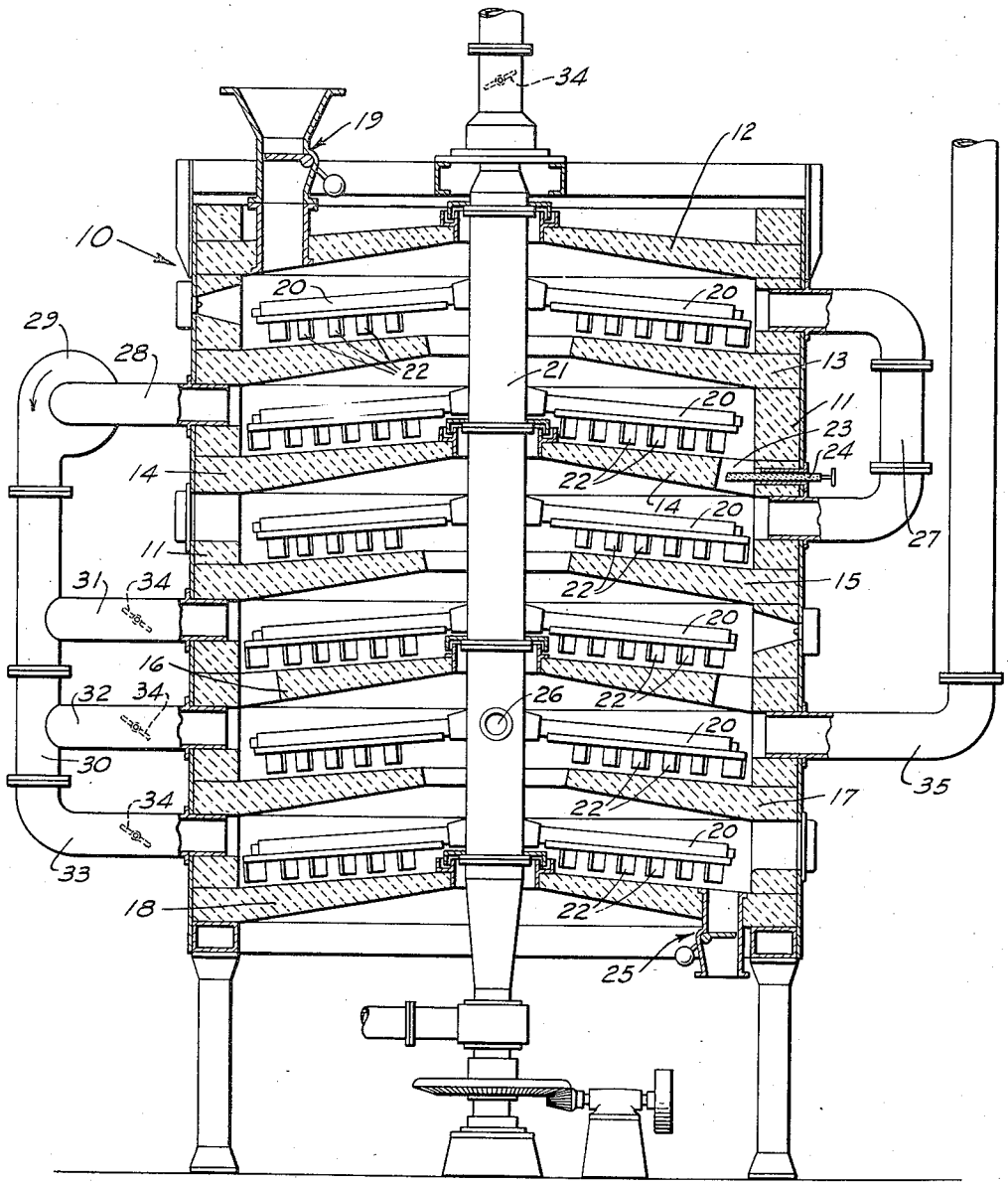
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INCINERATION

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INCINERATION

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5 Claims. (Cl. 110—12)

This invention relates to improvements in incineration and more particularly to improvements that may be carried out in a multiple hearth furnace.

The main object of the invention is to provide novel and advantageous improvements in incineration. Another object is to provide a novel and advantageous multiple hearth furnace. A further object is to provide for regulation of temperatures above hearths in the burning section of the multiple hearth furnace having an upper drying section and a lower burning section.

According to one embodiment of the present invention, the division between the upper drying section and the lower burning section is at an intermediate hearth provided with one or more ports of capacity just about sufficient for the discharge of the dried material therethrough into the burning section, the gases from the burning section being carried to the drying section through a flue provided for that purpose and through which the gases may pass much more easily than through the port or ports of the dividing intermediate hearth. This arrangement tends to prevent the fire in the burning section from working up into the drying section particularly when the furnace is shut down. In order to render this arrangement even more effective, each port or outlet in the dividing hearth may be provided with closing means, such as a slide or gate.

To assure deodorization of the gases and vapor in the drying section, they may be drawn therefrom as by means of a fan and passed into the lower or burning section of the furnace. The gases and vapors from the drying section may also serve to cool the ashes in the lower compartment and to lower temperatures in other zones where the temperatures might become excessive. To this end the connections through which gases and vapor pass from the drying section to the burning section are preferably such that the gases and vapor may be introduced into the compartment above the bottom hearth of the burning section and also into compartments above higher hearths in that section, the admission of such gases and vapor into the compartments above these hearths being controlled in any suitable manner so that all of the gases and vapor may be passed into the lowermost compartment to cool the ashes and take up the heat therefrom or into higher hearths in the proportions desired.

Air may be admitted to the burning section, as for example into an intermediate part thereof through the usual hollow central shaft of the furnace. Exit gases may be drawn from the burning section at one of the lower compartments thereof and discharged from the furnace in any suitable manner as by passing them to a stack. With this arrangement the fan tends to draw the gases from the burning section into the drying section and the discharge flue tends to pass exit gases to a stack and there may be some recirculation. In this way the drafts are more or less balanced and may be varied, as by dampers in the connections from the fan to the lower compartments of the burning section.

Other objects, features and advantages will appear upon consideration of the following description and of the drawing in which:

The figure is a view in vertical section of apparatus embodying the approved form of the invention.

Referring to the drawing, the apparatus is illustrated as including a multiple hearth furnace 10, having a peripheral wall 11, a top 12 and hearths 13, 14, 15, 16, 17 and 18. Material may be introduced into the uppermost compartment, that is above the hearth 13, through a gas seal 19 of any suitable form. The material is passed downwardly from hearth to hearth through suitable ports or outlets which are arranged alternately at the centers or peripheries of successive hearths, the material being fed either to the center or to the periphery by suitable rabbling means which may include arms 20 projecting from a usual rotatable hollow central shaft 21 and having downwardly extending inclined blades 22 which tend to move the material to the outlets of the corresponding hearths. The hollow shaft 21 may be rotated by any suitable means.

The furnace may be divided into an upper drying section and a lower drying section by means of an intermediate hearth such as hearth 14 which, as illustrated, is provided with one or more ports 23 of just about sufficient capacity for the dried material to pass downwardly therethrough into the next lower compartment. Each of these outlets or ports 23 may be provided with regulating means such as a slidable valve member or gate 24 which serves to regulate the size of the opening and may be used to shut off direct connection between the drying and burning sections, for instance, to prevent the fire from working upwardly therethrough when the furnace is shut down. From the lowermost compartment the ash or ashes are discharged through a suitable gas seal 25.

Air may be admitted to an intermediate part

of the burning section, for example through the hollow shaft 21 and one or more openings 26 therein. It will be evident that in passing through the hollow shaft 21 to the opening or openings 26 the air will be preheated. Gas, including products of combustion, may be passed from the upper part of the burning section, preferably the uppermost compartment thereof, through a flue 27 to the drying section, preferably to the uppermost compartment of the drying section. From the lower part of the drying section, gases and vapor may be withdrawn through a flue 28 by a fan 29 which passes the gases and vapor to a manifold 30 which is connected by branches 31, 32 and 33 with various compartments in the burning section of the furnace, one of said branches 33 being connected to the lowermost compartment of the burning section and the others to higher compartments. All of said branches 31, 32 and 33 are preferably provided with regulators or dampers 34 to vary the supply of gases and vapor to the different compartments. Exit gases not drawn upwardly through the flue 27 connecting the burning section with the drying section may be passed out of the lower part of the burning section through a flue 35 under the influence of a draft, either induced or resulting from the use of a stack. Air may be supplied to the lower end of the hollow shaft 21 in the usual manner or any other suitable way and the passage of air from the upper end of the hollow shaft may be controlled in any suitable manner as by means of a damper 34 adjacent the upper end thereof.

The apparatus of the present invention is particularly designed for drying and burning material such as sewage sludge which preferably has been previously dewatered to as great an extent as is practicable. The apparatus may be operated substantially as follows:

The material such as sewage sludge may be admitted through the gas seal 19 into the compartment above the uppermost hearth 13 and by means of the rabbling mechanism comprising the hollow shaft 21, the arms 20 and the blades 22 may be worked over the various hearths and downwardly therethrough until it falls in the form of ash on the lowermost hearth 18 from which it is discharged by the rabbling devices through a gas seal 25. The rabbling action on each hearth is so carried out as to maintain the material in a layer which is gradually worked towards one or more outlets or ports from which it is discharged to the next lower hearth, the outlets being preferably arranged so as to be alternately at the centers and circumferences of successive hearths.

In the illustrated embodiment of the apparatus, the hearth 14 is utilized to divide the furnace into an upper drying section and a lower burning section, the port or ports 23 in this hearth being just about the proper size to accommodate the material passing down through that hearth so that provision of the duct 27 is necessary in order that the gases, including hot gases of combustion, from the upper part of the burning section may be passed to the drying section, for example, into the uppermost compartment of the furnace. Air may be introduced into the central part of the burning section through one or more ports 26 in the hollow shaft 21, to assist in burning the material.

The hot gases passing from the burning section through the duct 27 to the drying section serve to dry the material in hearths of the drying section by vaporizing and taking up the moisture from such material. The gases and vapor are withdrawn from the lowermost compartment of the drying section by means of a fan 29 connected with the lowermost compartment of the drying section by duct 28. The gases and vapor thus withdrawn from the drying section are relatively cool and are passed from the fan to a manifold 30 connected by the branch 33 with the lowermost compartment of the burning section and by branches 32 and 31 with higher compartments of the burning section. The branches 31, 32 and 33 may be provided with dampers 34. The gases may be withdrawn from the furnace through a duct 35 which may be connected with induced draft apparatus or with a stack. Preferably the duct 35 is connected with the compartment above the hearth 17 which hearth is at the top of the lowermost compartment of the burning section.

The relatively cool gases passing through the branch 33 into the lowermost compartment of the furnace may serve to cool the ashes in this compartment before their discharge from the furnace and these gases will at the same time be raised in temperature so as not to interfere so much with the final burning of the material in the higher compartments of the burning section. Where cooling of the ashes only is required, the dampers 34 in the branches 31 and 32 may be kept closed. Under some circumstances, however, the temperatures in the compartment over the hearths 16 and 17 may be too high and under such conditions the relatively cool gases from the drying section may be admitted to these compartments in the quantities desired.

It will be seen that during operation of the apparatus gases are withdrawn from the burning section through the duct 35 and also through the duct 27 due to the action of the fan 29 which draws the hot gases through the drying section. As a result of this arrangement, there is to a certain extent, a balancing of the drafts and if it should be desired to decrease the amount of gases drawn through the drying section, this result may be obtained by closing the dampers 34 in the branches 31, 32 and 33 to the desired extent. By such adjustments the action of the furnace can be regulated to a considerable extent.

In the event that the furnace is to be thrown out of operation due, for example to lack of material to be dried and burned, the fan 29 may be stopped and the supply of air to the lower part of the shaft 21 shut off. When the furnace is shut down in this way the fire in the burning section may tend to work up through the port or ports 23 into the drying section. This condition would be undesirable and may be guarded against by closing the damper or slide 24 provided for each port 23. If desired, the dampers 34 may also be closed.

It should be understood that various features may be changed and that certain features may be used without others, without departing from the true spirit and scope of the invention.

What I claim is:

1. A multiple-hearth furnace comprising a plurality of hearths and corresponding compartments above the same, an intermediate hearth of said plurality dividing the furnace into an upper drying section and a lower burning section, said intermediate hearth having at its circumference one or more ports through which material drops to a lower hearth, means for varying the effective cross section of each port so that material passing downwardly therethrough will prevent up-

ward flow of combustion gases therethrough, means including a flue for carrying hot combustion gases from said burning section to said drying section, means including a fan for drawing from said drying section relatively cool gases and vapors and consequently drawing combustion gases from said burning section to said drying section, means for conducting gases and vapor from the fan to the burning section including a duct leading to the lowermost part of the burning section to cool the ashes and be reheated thereby and a duct leading to a higher part of the burning section, means for supplying air to a part of said burning section higher than said lowermost part, and means for discharging gases from the furnace at the lower part of the burning section.

2. A multiple-hearth furnace comprising a plurality of hearths and corresponding compartments above the same, an intermediate hearth of said plurality dividing the furnace into an upper drying section and a lower burning section, said intermediate hearth having at its circumference one or more ports through which material drops to a lower hearth, means for varying the effective cross section of each port so that material passing downwardly therethrough will prevent upward flow of combustion gases therethrough, means including a flue for carrying hot combustion gases from said burning section to said drying section, means including a fan for drawing from said drying section relatively cool gases and vapors and consequently drawing combustion gases from said burning section to said drying section, means for conducting gases and vapor from the fan to the burning section including a duct leading to the lowermost part of the burning section to cool the ashes and be reheated thereby and a duct leading to a higher part of the burning section, means for supplying air to an intermediate part of said burning section, means for discharging gases from the furnace at the lower part of the burning section, and means for controlling the flow of gases and vapor from the fan and through such ducts to the burning section, thereby regulating the temperature in the different compartments.

3. A multiple-hearth furnace comprising a plurality of hearths with corresponding compartments thereabove, an intermediate hearth of said plurality dividing the furnace into an upper drying section and a lower burning section, said intermediate hearth having at its circumference one or more ports through which material drops to a lower hearth, means for varying the effective cross section of each port so that material passing downwardly therethrough will prevent upward flow of combustion gases therethrough, means including a flue for carrying hot combustion gases from the uppermost compartment of said burning section to the uppermost compartment of said drying section, means including a fan for drawing relatively cool gases and vapors from the lowermost compartment of said drying section and consequently drawing combustion gases from said burning section to said drying section, means for passing gases and vapor from the fan to the burning section comprising three ducts leading respectively to the lowermost compartment and the two compartments immediately thereabove, means for supplying air to an intermediate part of said burning section, and means for discharging gases from the furnace at the lower part of the burning section but above the lowermost compartment thereof.

4. A multiple-hearth furnace comprising a plurality of hearths with corresponding compartments above the same, an intermediate hearth of said plurality dividing the furnace into an upper drying section and a lower burning section, said intermediate hearth having one or more outlet ports in its peripheral part to permit material to drop therethrough to the next lower hearth and means for adjusting the effective cross-section of each port so that the material passing downwardly through the port will prevent any upward flow of hot gases therethrough, means for introducing air into the burning section, means including a duct for passing hot gases from said burning section around said interemediate hearth to the drying section, means including a discharge duct for drawing hot gases of combustion from the burning section and discharging them from the furnace and adjustable means for drawing gases and vapors from the drying section and gases from the burning section into the drying section and for discharging into the burning section the gases and vapors drawn from the drying section.

5. A multiple-hearth furnace comprising a plurality of hearths with corresponding compartments above the same, an intermediate hearth of said plurality dividing the furnace into an upper drying section and a lower burning section, said intermediate hearth having one or more outlet ports in its peripheral part to permit material to drop therethrough to the next lower hearth and means for adjusting the effective cross-section of each port so that the material passing downwardly through the port will prevent any upward flow of hot gases therethrough, means for introducing air into the burning section, means including a duct for passing hot gases from said burning section around said intermediate hearth to the drying section, means including a discharge duct for drawing hot gases of combustion from the burning section and discharging them from the furnace and adjustable means for drawing gases and vapors from the drying section and gases from the burning section into the drying section and for discharging into the burning section the gases and vapors drawn from the drying section, said adjustable means including branch ducts leading to different compartments of the burning section and dampers in said branch ducts.

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