DRYING AND PULVERIZING DEVICE
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ABSTRACT OF THE DISCLOSURE
A plurality of tray devices positioned within a housing at angles to the horizontal and arranged to migrate material desired to be dried and pulverized downwardly and along successive trays, including a means intermediate the beginning and ending points of material travel for pulverizing partially dried material with a beating action while simultaneously projecting material from the pulverizing zone to a different zone for additional drying.

This invention relates to a method and system for treating material and, more particularly, to a method and apparatus for drying and pulverizing material to render it more easily transportable and reusable. This invention additionally relates to a novel combination wherein an apparatus is utilized in combination with other types of equipment to process and store animal waste matters which must ordinarily be hauled away from the animal enclosure in a natural state.

Throughout this specification and the appended claims the term "offalous material" is utilized to describe types of material which are accrued as by-products in the operation of various different types of concerns. The term includes, but is not necessarily limited to, such materials as the droppings and other waste materials which accumulate in the commercial production of animals, garbage or other types of refuse, and excreta matter which is a by-product of slaughterhouse concerns. More broadly, the term includes all types of products which are relatively moist and bulky in relation to any fermenting value, food value, or other usable characteristic, which they might possess. This is not to imply however, that the method and apparatus set forth herein is limited solely to the treatment of offalous material. Rather, the system is adaptable for use wherever it is desirable to render any type of moisture containing material more easily usable and/or transportable by drying it.

As noted, the term "offalous material" includes animal waste material such as the droppings produced by the caged birds in typical poultry raising buildings. A great deal of time, effort and capital has been devoted to invent and perfect means for removing this material from the enclosure automatically. The more successful of these means now on the market usually include a plurality of elongated pits in the floor of the barn or other type enclosure, one such pit running beneath each set of cage rows. A second pit is provided across the end of the enclosure which connects all of the elongated pits. The droppings from the cage rows fall into the elongated pits positioned therebeneath. Periodically, these pits are scraped by mechanical scraping devices which move the waste matter into the collection pit at the end of the building. Some other type of scraping assembly is utilized to remove the material from the collecting pit. Usually, the collecting pit opens to the outside of the building and the material is scraped onto a loading conveyor from which it falls into a truck or wagon. It is then hauled away to be utilized as fertilizer or, as is usually the case, merely discarded. In addition to the waste droppings, the material to be disposed of usually includes dead birds and varying quantities of egg room waste matter.

It will be obvious that the concoctions of this type are extremely difficult to handle because of their heavy and bulky nature. Further, each time a barn is cleaned, a truck, wagon or the like must be provided to catch the material as it flows from the elevating conveyor and a man must supervise the loading and unloading thereof. It is not uncommon to have to dispose of 14 or 15 tons of this material several times each week from the poultry barns. It will be readily appreciated that the disposing of this material necessitates a large investment in both labor and equipment. This monetary aspect of the matter is particularly aggravated because the material is virtually worthless. Even if a suitable fertilizer market can be found, the return therefrom is usually insufficient to cover handling costs.

Similar comments are pertinent to other types of animal raising operations. They are also pertinent as regards to the disposal of garbage, bones and other types of offalous material, regardless of the particular source. While the problem has not gone unnoticed, none of the widely varying solutions which have been proposed have been successful. Sixty to seventy-five percent of the weight and volume of these materials is liquid, usually in the form of water. Obviously, if this liquid content can be appreciably reduced at or near the site of origin of the offalous material, it can thereafter be handled with relative ease. Additionally, once these liquids have been removed the resulting product which is highly rich in nutrients, will find a ready market for usage in the production of many different types of products.

It is an object of this invention to provide a method and apparatus for treating moisture containing material such as to render it more readily usable and/or transportable.

It is another object of this invention to provide an apparatus and method for the treatment of offalous material which will markedly reduce the expenses which are currently incurred in its disposal.

More particularly, it is an object of this invention to provide a treatment method and apparatus which is relatively simple and which may be installed near the site of origin of the material to be treated.

It is an object of this invention to provide a method and apparatus of the type described which is effective to remove an appreciable percentage of the liquid from the material, thus rendering it significantly lighter and less bulky and, in general, easier to handle.

It is an object of this invention to provide a method and apparatus of the type described which, during the drying process, pulverizes the material being treated in such a manner as to insure that it will be uniformly dried without burning the outer portions of large pieces thereof.

It is an object of this invention to provide an apparatus of the type described embodying novel means for monitoring the flow of material therethrough so as to prevent the apparatus from becoming clogged.

It is an object of this invention to provide a device which is capable of converting offalous material into a product which will find a ready market and a monetary return which, in most cases, will markedly exceed the capital investment required for the installation of the apparatus.

It is yet another object of this invention to provide a novel combination particularly adapted for utilization in animal raising houses having means to periodically remove the animal waste matters to a predetermined exit point without the enclosing of the animal houses.

It is an object of this invention to provide such a combination wherein, each time the enclosure cleaning means are activated, the material appearing at the predetermined
exit will be automatically treated and stored without the necessity of constant oversight from one or a number of employees.

The hopper and other objects of this invention will be readily understood by those skilled in the art by reference to the following specification and accompanying figures in which;

FIG. 1 is a side-elevational view of the treating apparatus with the outer housing and supporting structure immediately in advance of the viewer removed;

FIG. 2 is a front-elevational view of the treating apparatus;

FIG. 3 is a cross-sectional view taken along line III—III of FIG. 1;

FIG. 4 is a perspective view of the upper perforate tray and the pulverizer guard which is overlapped thereon by;

FIG. 5 is a fragmentary perspective view of the tray vibrating assembly;

FIG. 6 is a broken, plan view of the pulverizing assembly showing the hammers as they are extended by centrifugal force in actual operation;

FIG. 7 is a side-elevational view of the pulverizing device illustrating the hammers in their relaxed positions;

FIG. 8 is a fragmentary, rear-elevational view, partially in cross-section, of the upper tray load sensor assembly;

FIG. 9 is a fragmentary plan view, partially in cross-section, of the upper tray load sensor assembly;

FIG. 10 is a fragmentary perspective illustrating the manner in which the upper tray is sealed with respect to the sides of the housing;

FIG. 11 is a fragmentary side-elevational view, partially in cross-section, of the hopper load sensing devices;

FIG. 12 is a cross-sectional view taken along line XII—XII of FIG. 1;

FIG. 13 is a fragmentary schematic view illustrating the apparatus shown in FIG. 1 being utilized in combination with a plurality of other elements to treat and store the waste matter from an animal enclosure;

FIG. 14 is a schematic plan view of the combination shown in FIG. 7;

FIG. 15 is a schematic block diagram of a typical control mechanism for automatic operation of the combination shown in FIG. 13;

FIG. 16 is a schematic block diagram of a modified upper tray load sensor assembly;

FIG. 17 is a front-elevational view of a modified hammer member;

FIG. 18 is a side-elevational view of the hammer member shown in FIG. 17.

Briefly, this invention comprises a housing having a perforate tray positioned therewithin at an angle with respect to the horizontal. Access means, in the form of a hopper, are provided whereby the material to be treated is fed selectively onto the perforate tray at the upper section thereof. Means are provided for vibrating the perforate tray such that the material tends to migrate from the upper section to the lower section. Adjacent the lower section is positioned a pulverizing device which receives the material, pulverizes it and输它 hack toward the upper section of the perforate tray. The perforations are located intermittently the tray extremities and thus, the material is recirculated on the upper tray until such time as it is sufficiently particulate to drop through the perforations. Heat is applied within the housing during the entire operation of the apparatus.

Located directly below the perforate tray are a plurality of receiving trays arranged in zig-zag fashion. The material passing through the apertures in the perforate tray falls onto the uppermost of these receiving trays, and since they are also vibrated, migrates in zig-zag fashion from tray to tray until such time as it flows from the bottom tray. Thus, the material in the apparatus is partially dried during its traverse on the upper perforate tray, pulverized by the hammer mill and, then, further dried during its migration through the receiving trays.

The means for heating the residue preferably comprises an oil or gas combustion chamber positioned within the housing. The chamber communicates with a stack positioned thereover via a path which approximates the zig-zag positioning of the trays. Some of the heated air is allowed, additionally, to flow through the apertures in the bottom of the perforate tray. As a means of insuring that the gases will follow the desired path into the stack, means are provided between the perforate tray and the sides of the housing. The stack may include a cover which will automatically close upon deactivation of the combustion chamber as a means of protecting the inside of the device from the effects of inclement weather.

The hopper which feeds the material to the perforate tray has an endless belt type bottom which is rotated by a suitable motor. Means are provided on the perforate tray for sensing the material load thereon at any particular time and controlling the activation and deactivation of the upper belt motor in response thereto. Level sensing means may conveniently be provided within the hopper for activating the unit when a certain amount of material is present therein and for deactivating whatever type of means is feeding the hopper should it become overfilled.

This invention additionally comprises a novel combination wherein the treatment apparatus is positioned adjacent an animal enclosure having means for transferring the animal waste matter to a predetermined exit point. Some suitable type of conveyor means connects this predetermined exit point to the hopper on the treatment apparatus such that the material will be transferred from the enclosure cleaning means into the hopper automatically. Suitable storage means are provided adjacent the treatment apparatus into which the treated material may be blown for storage until such time as it is withdrawn therefrom for shipment or local utilization. The transfer from the treatment unit to the storage enclosure may be made by means of a conventional blower assembly.

In its broader aspects, this invention comprises a method of and an apparatus for partially drying offalous material, subjecting it to a pulverizing force and, then, drying it further so as to remove a significant percentage of the moisture therefrom. It is by this procedure that forms the basic concept of applicant's contribution to the art. The basic reason for the failure of prior art devices can be traced directly to the fact that offalous materials cannot be effectively pulverized when they are completely wet and cannot be dried effectively when coagulated into chunks.

Referring now to the figures, a preferred embodiment of this invention will be described in detail. The treatment unit as shown in FIGS. 1, 2 and 3 has a housing indicated generally by the reference numeral 10 including upright supports 11, horizontal supports 12, a plurality of lateral supports 15 and a sheet metal jacket 13. As an aid to the understanding of FIG. 1, it is noted that the section of jacket 13 and those upright supports 11 which are closest to the viewer have been removed. Jacket 13 may be provided with any number of removable panels at critical positions therearound so as to provide for means of access for the servicing and adjustment of the apparatus.

Positioned above housing 10 and preferably integral therewith is the stack assembly 20 which comprises a rectangular exhaust conduit 21 having a cover plate 22 positioned thereover. Cover plate 22 is pivotable about axis 23 by solenoid 24 which is affixed to the stack by means of a suitable mounting bracket 25. When the solenoid 24 is energized so as to retract its connecting rod, cover plate 22 will be swung off from exhaust conduit 21 so as to allow gases to escape therefrom. When the apparatus is not in use, the ratchet action of solenoid 24 allows cover plate 22 to swing back across exhaust conduit 21 by means of gravity. Cover plate 22, in its closed position, prevents
rain, snow and the like from entering the machine when it is not in use and, also, serves as a means of retaining the heat within the apparatus to prevent the remnant material therein from freezing.

Formed integrally with the upper section of housing 10 is the hopper assembly 30 comprising a pair of idler rollers 31, an adjustable roller 32 and a drive roller 39. An endless belt 36 is passed around these rollers and the tension thereon adjusted by means of adjustment assembly 33 which may, for example, comprise a pivotable mounting for adjustment roller 32 and some type of device for adjusting the tension thereon. A non-perforate plate 34 forms the base upon which the endless belt 36 passes therearound in the manner indicated in FIG. 1. A belt guard 35 is positioned over the rearward section of the belt to prevent the fouling of idler roller 31 by the material being treated.

The endless belt 36 is driven by a suitable motor 37 in conjunction with a conventional gear reduction box 38. The rotational thrust from motor 37 is transferred to drive roller 39 such that it rotates clockwise as viewed in FIG. 1 and, thus, conveys material within hopper 30 to the right and onto the upper section of upper tray assembly 40. While motor 37 is shown positioned so as to drive endless belt 36 from the upstream side, it will be readily apparent to those skilled in the art that more satisfactory and efficient driving can be obtained when it is positioned so as to drive the downstream side thereof. It has been shown on the upstream side merely as a means of clarifying the drawings.

Referring now additionally to FIG. 4, upper tray assembly 40 has a bottom 41 having a plurality of apertures or perforations 42 therein. The apertures are positioned intermittent the extremities of the tray as shown in FIG. 3. Upper tray 40 also has a pair of upstanding sides 43 and an upstanding back 44 to prevent the material from spilling over the edges thereof. For processing chicken manure, it has been found that a series of ¼ inch perforations or ½ inch centers beginning at approximately 14 inches from each end of the tray will provide satisfactory results.

Positioned directly beneath perforate tray 40 within the housing are a series of post heating trays indicated generally by the reference numeral 50. The post heating tray assembly comprises an upper tray 51, a middle tray 52 and a lower tray 53. Each of these trays, as indicated in FIG. 12, has an imperforate bottom 54, upstanding sides 55 and an upstanding back 56. They are arranged in zig-zag relationship at angles to the horizontal in such a manner the material migrating along tray 51, falls to tray 52, migrates along tray 52, falls to tray 53 and after migrating along tray 53 falls therefrom into the bottom of the housing 10. The uppermost receiving tray 51 is positioned directly below the perforate section of tray 40 such that the material flowing through apertures 42 drops thereon.

The pulverizing or hammer mill assembly 60 is positioned adjacent the lower end of perforate tray 40 and, as shown best in FIGS. 1, 6 and 7, comprises a central shaft 61 having a pair of end plates 62 affixed thereto for rotation therewith. The extremities of shaft 61 are journaled in the sides of housing 10 and a suitable extension and pulley is provided whereby the hammer mill may be driven in a clockwise direction as viewed in FIG. 1. Extending between opposite corners of the square end plates 62 are a series of rod-like hammer supports 63 each of which has a plurality of rectangular hammers pivotally affixed thereon. Pulverizers of this general type are well-known in the art and it is not believed necessary to discuss assembly 60 in detail. Suffice it to say, that the rotation of shaft 61 causes the hammers 64 to be extended to the positions shown in FIG. 5 by centrifugal force but allows them to pivot in the event that they strike a hard object which might otherwise damage the pulverizing mechanism (not shown) and to be provided for preventing the hammers from migrating along each of the hammer supports 63 and bunching at one end thereof. These means might, for example, comprise a series of sleeves spaced between each of the hammer members 64.

An alternative hammer construction is illustrated in FIGS. 17 and 18. Hammer 264 comprises a sleeve 265 adapted to swingably encase the rod-like hammer support 63 in a manner identical to that described in connection with hammers 64. Sleeve 265 has a material engaging section 266 depending therefrom which curves or cups as indicated at 267 so as to scoop the material being treated and hurl it back onto the upper end of perforate tray 40. Four or five such hammers may be placed on each hammer support 63 in the illustrated relationship with hammers 64. Alternatively, hammers 264 may be utilized without hammers 64. As will be readily apparent to those skilled in the art, the most efficient hammer configurations and combinations thereof will vary depending upon the characteristic of the particular material being treated.

Referring now additionally to FIG. 4, the section of the hammer or pulverizing assembly 60 most remote from the perforate tray 40 is enclosed by a curved guard assembly 67 having a planar extension 69 which is over-lapped but not abutted by the lower section of perforate tray 40. The curve guard 68, as will be obvious from FIG. 1, functions to prevent particles of material which have been only partially dried and pulverized from being thrown by the rotating hammer mill in any direction other than back onto tray 40 for recirculation.

Referring now particularly to FIGS. 1, 2, 3, 5 and 10, the vibrating assembly which causes the material to migrate along the various trays consists of a pair of shaker plates 71 which are approximately co-extensive in length with perforate tray 40 and affixed solidly to the sides thereof. Shaker plates 71 are suspended from housing 10 at their upper extremities by means of pivot straps 72 which are pivotably affixed to the housing frame and the shaker plates at 73. The lower extremities of the shaker plates are carried by an eccentric assembly (see particularly FIG. 5) which comprises an eccentric shaft 74 suitably borne at 75 in the sides of housing 10. Shaft 74 has a pair of eccentric sections 76 upon which shaker plate 71 are rotatably borne in a conventional manner by bearings 77. A suitable fly wheel 78 is affixed to shaft 74 as a means of smoothing the oscillating motion transmitted to the housing 10. Conveniently, fly wheel 78 may also be utilized as a means for propelling shaft 74 from motor 83.

Referring now to FIGS. 1, 2 and 3, each of the shaker plates 71 has an arm 79 depending downwardly therefrom. As viewed in FIG. 1, the right-hand end of receiving tray 51, receiving tray 52, shaker plates 71 and depending arms 79 are all solid such that these components move as a unit under the influence of the eccentric vibrating assembly shown in FIG. 4. The bottom receiving tray 53, on the other hand, is pivoted at both of its extremities such that its discharge end may be anchored to the frame. Bottom receiving tray 53 vibrates because of the vibrating motion transferred to it by depending arm 79. Thus, a material on any of the various trays will tend to migrate downwardly under the co-influence of gravity and the shaking motion.

The hot gases for the treating operation are provided by a heater assembly 90 (see FIG. 1) which comprises a conventional combustion chamber 91, an oil gun 92 disposed within a suitable housing 93, and an actuating relay 79. It will be readily appreciated by those skilled in the
art that the particular type of heating assembly which is utilized in the apparatus would depend upon the availability and prices of different types of fuels. Thus, for example, heating assembly 90 might well comprise a bottled or natural gas installation instead of the oil burner shown.

In order to prevent the heat generated by heating assembly 90 from passing through the sides of tray 40 and the housing and thus exiting via stack 20 before it has been efficiently utilized, a sealing assembly 85 is provided between the sides of perforate tray 40 and the housing. As shown, sealing assembly 85 consists merely of an overhanging lip 85 along the sides of housing 10 into which the upstanding edges 43 of tray 40 and the shaker plates 71 are movably positioned. While this arrangement allows the shaker plates and tray to vibrate, it renders the undesirable exit path for gases sufficiently tortuous that they tend to follow the longer and more efficient zig-zag heat-transfer path as they proceed from combustion chamber 91 to stack 20.

Referring again to FIG. 1, a blower assembly 100 is provided within housing 10 near the discharge end of lowermost tray 53. The blower 101 is a conventional suction-blower assembly which sucks the material being discharged from tray 53 out of housing 10 and blows it by flexible conduit 102 to any suitable storage facility.

Relating now to FIGS. 1, 2, 3, 8, and 9, the upper tray load sensor assembly 110 comprises an elongated sweep member 111 which is pivoted to the housing 10 at 112 by means of a depending arm 113. Thus, sweep member 111 is positioned within perforate tray 40 but free to pivot with respect thereto. Pivotally connected at 115 to the upper extremity of sweep member 111 is a connecting arm 114. Connecting arm 114 passes through a suitable aperture in housing 10 and has a bias spring 116 passed over its protruding end and secured in position by a suitable nut or key arrangement. Also carried by the protruding end of connecting arm 114 is a microswitch 117 having a contact 118. A plate 119 for selectively depressing or releasing contact 118 of microswitch is provided on housing 10.

Biasing spring 116 ordinarily biases sweep member 111 to the position shown in FIGS. 9, 10, and 10, i.e., transverse to the conventional flow of material along tray 40. As material migrates along tray 40 it tends to swirl or pivot sweep member 111 in such a manner that it will lie parallel to the flow thereof. When a sufficient amount of material is present on tray 40 to pivot sweep member 111 to this position, microswitch 117 is pulled toward housing 10 a sufficient distance that its contact 118 strikes plate 119 and thus, provides an indication of the amount of material on tray 40. The amount of material required to pivot the sweep member 111 to its parallel position so as to bring microswitch 117 into contact with plate 119 is determined by the characteristics and adjustment of bias spring 116.

As will be noted in more detail hereinafter, when contact 118 strikes plate 119 the endless belt 36 in hopper 30 is deactivated such that no more material flows from hopper 30 onto upper perforate tray 40 until the material already therein has been processed sufficiently to enable it to drop through the apertures or perforations 42 in tray 40. As the load in tray 40 lessens, the biasing influence of spring 116 will cause sweep member 111 to again swing transverse to the path of flow of material on tray 40, and thus, micro-switch 117 will be moved away from plate 119 signaling the hopper drive mechanism that the apparatus is ready to receive more material.

A second separate upper tray load sensor assembly is illustrated in FIG. 16 which consists of a relay-type ammeter or current sensor 271 having a switch 272 in series with the electrical cable from power supply 270 to conveyor motor 37. Current sensor 271 monitors the current drawn by hammer motor 83 and opens switch 272 when this current exceeds a predetermined level. Sensors of this type are well-known in the art and it is not deemed necessary to discuss them in detail. Suffice it to say that when the material on upper tray assembly 40 loads hammer mill assembly 60 such that motor 83 draws a predetermined number of amperes, switch 272 is opened and conveyor motor 37 deactivated. Preferably, sensor 271 is adjusted such that no further material is conveyed onto upper tray assembly 40 until the current drawn by hammer motor 83 drops 2 or 3 amperes from the initial cutoff point. At this time sensor 271 recloses switch 272, hopper drive motor 37 is reactivated and more material is conveyed onto upper tray assembly 40 for processing.

Referring to FIGS. 1 and 11, it will be noted that two separate level sensing assemblies are provided contiguous to the discharge throat of hopper 30. The first of these assemblies comprises a flat plate 121 of approximately the same width as the hopper which is pivoted to stack assembly 20 and 122. A suitable sensing plate 123 is provided for sensing the position of plate 121 which is ordinarily biased in a clockwise manner as viewed in FIG. 1 by a suitable tension spring 124. As material is fed into hopper 30 by some external source, it will build up until such time as it reaches the bottom of plate 121 and pivots it counterclockwise against the biasing influence of spring 124. This will make or break the contact in microswitch 123 and activate the entire treatment unit including motors 37 and 83 and heating unit 90. The operation of the machine will continue until such time as an insufficient amount of raw material is present in hopper 30 to overcome the bias of spring 124. At this time, microswitch 123 will cause the machine to be deactivated.

Plate 121, in addition to functioning as a sensing assembly to activate and deactivate the treatment unit, also functions to monitor the amount of material being fed to perforate tray 40 at any particular time. This monitoring action is accomplished by the tendency of the lower edge thereof to ride on the top of the material passing by it on endless belt 36. The more material that is present, the more plate 121 must pivot counterclockwise as viewed in FIG. 1 and, thus, more tension will be exerted by bias spring 124. This causes a scraping action on the top of the material on belt 36 and is effective to limit the amount of material being passed onto tray 40 at any particular time.

The second level sensing assembly which may be positioned, as shown, adjacent plate 121 comprises a second pivot plate 125 pivotally affixed to the frame of the machine at 127. Plate 125 may be relatively narrow since it does not perform any function other than sensing. Plate 125 is ordinarily biased in such a manner that it does not contact microswitch 126 by a suitable compression spring 128. When the material in hopper 30 is contacted, the weight of the materials will cause plate 125 to pivot about axis 127 against the influence of compression spring 128 and contact microswitch 126. The signal derived thereby is utilized to deactivate the particular external source which is being utilized to supply material to hopper 30.

Operation

In order to facilitate an understanding of the operation of the treatment apparatus shown in FIGS. 1–12, it will be described in the schematic environment pictorially by FIGS. 13–15. A conventional poultry barn indicated generally by the reference numeral 200 has a plurality of alternating islands 202 and pits 201 in the floor thereof. The pits 201 each communicate with a common collection pit 203 in perpendicular fashion. Positioned above upper tray assembly 40 is a plenum chamber 204 and supports therein a plurality of conventional cage rows (not shown) in which the poultry are housed. The droppings from the birds fall through the cage floors into the pits 201 and are periodically cleaned therefrom by a plurality of mechanized scraper devices familiar to all those skilled in the art. The scraper devices each operate in one of the pits 201 and function to move the droppings into the common.
collection pit 203. A second well known type of scraper device positioned in pit 203 moves the droppings to a discharge point exterior of the building from which they are conveyed by a necessary to clean the droppings from the barn 200 to the hopper 30 of the treatment machine. As shown in FIG. 13, the installation is a permanent one in the sense that the treatment machine has been enclosed within a building and has only the stack protruding therethrough. The output of the treatment machine is connected by flexible conduit 152 to a suitable storage enclosure so that a piping system necessary to convey the droppings from the barn 200, the scraper devices operating in the pits 201 and 203 are activated as is the elevating conveyor assembly 204. Conveniently, all of these elements may be controlled from a single activating switch. After the scraping assemblies have been in operation for a short period of time, the waste material which was previously in pits 201 begins to flow into hopper 30 of the treatment machine via elevating conveyor 204. In addition to poultry droppings, this material may include dead birds, egg room wasting and any other types of offal material it is desired to dispose of.

The material flowing up elevating conveyor 204 flows into hopper 30 until such time as it contacts swinging plate 121 and operates microswitch 123. The closing of microswitch 123 activates conveyor motor 37, hammer and shaker motor 65 and the heating unit activating relay 94. When belt 36 begins to rotate, material is transferred from hopper 30 onto the upper section of perforate tray 40. The rate of transfer is controlled by the constant scraping action of plate 121 operating against bias spring 124. As the material strikes perforate tray 40 it is immediately subjected to the shaking motion thereof which causes it to migrate downwardly or to the left as viewed in FIG. 1. During this period the hot gases being generated by heating assembly 90 flow throughout the housing. Some of these gases gain access to stack 21 by flowing through the perforations or apertures 42 in perforate tray 40. Others gain access by flowing between the lower section of perforate tray 40 and the hammer guard 69 as indicated by the arrow 230 in FIG. 3.

The material migrates down perforate tray 40 and any parts thereof which are sufficiently particulate to pass through apertures 42 fall onto receiving tray 51. The remainder of the material migrates until such time as it comes into contact with pulverizing assembly 60. Pulverizing assembly 60 is rotating in a clockwise direction as viewed in FIG. 1. The hammers 64 extending therefrom in centrifugal fashion contact the offalous material, pulverize it and throw it back on to tray 40 to the right as viewed in FIG. 1. The combination drying and pulverizing operation is repeated and the material recirculates on tray 40 until such time as it is sufficiently dry and particulate to pass through the apertures 42 in the bottom thereof.

The load on tray 40 during this period is constantly monitored by elongated sweep member 111. In the event that the material on tray 40 exceeds the prescribed quantity determined by the setting of bias spring 116, the sweep member will be pivoted clockwise as viewed in FIG. 9, switch 117 activated by abutting striker plate 119, and motor 37 deactivated. This, of course, stops the rotation of endless belt 36 and thus, stops the input of material to perforate tray 40. It does not, however, deactivate the remainder of the machine—i.e., the heating, shaking and pulverizing assemblies—and they continue to operate until such time as the load on tray 40 drops within the prescribed limits and allows elongated sweep member 111 to pivot back to the position shown in FIG. 9 and release microswitch 117. At this point, sufficient material within hopper 30 to actuate relay 123 on swinging plate 121, motor 37 is reactivated and more material fed onto perforate tray 40.

If, for any reason, hopper 30 should become over-filled to the point that the material therein strikes pivot plate 125 and compresses it against spring 128 to contact microswitch 126, the elevating conveyor 204 and the scraper mechanisms within the barn 200 will be deactivated. They will remain in this state until such time as the level of material in hopper 30 drops sufficiently to allow compression spring 128 to push pivoting plate 125 back out of contact with microswitch 126.

As material on tray 40 becomes sufficiently particulate to pass through perforations 42, it falls onto receiving tray 51 and continues its migration over trays 51, 52 and 53 through the machine in zigzag fashion. Once the offal material has become sufficiently particulate to pass through apertures 42 in perforate tray 40, the migratory duration of its travel on trays 51, 52 and 53 will be sufficient to thoroughly complete the drying process. As the material drops from the left hand extremity of tray 53 as viewed in FIG. 1, it is picked up by blower assembly 100 and forced via flexible conduit 102 into the storage facility 220.

In the event that the machine should become overheated or the material therein catch fire, a heat sensing thermostat 130 is provided for selectively deactivating heating unit 90. This thermostat may have a lower limit whereby heating unit 90 will be activated so as to prevent the apparatus freezing during idle periods in cold weather. While the cold will not harm the machine per se, it will cause any of the offalous material remaining therein to solidify to such an extent as to render further operation of the machine impractical without a thorough thawing. Thermostat 130 deactivates only the heating unit 90 as its initial upper temperature limit is reached. Should the temperature within the apparatus continue to rise, a second upper limit is preferably provided for deactivating the entire treatment apparatus and the subsidiary feeding units.

The treatment unit is capable of handling almost any type of offalous material. This ability is attributable primarily to the fact that the material is partially dried during its migration along tray 40 prior to the time that it is pulverized. Previous machines which have been designed to execute the treatment process of this type have been markedly unsuccessful because of their inability to dry large chunks of material and their inability to pulverize wet chunks of material. Thus, for example, were it intended to pulverize the material prior to its introduction into the machine, the result would be merely a sticky coagulation in the hammer mill assembly. If, on the other hand, it were attempted to dry it prior to its introduction into the pulverizing mill, the outside of the material would be burned, and perhaps, catch fire while the inside of each chunk was still comparatively wet.

The design of pulverizing assembly 60 allows the continuous recirculation of relatively hard materials along perforate tray 40. Thus, for example, if an entire chicken comes into contact with the pulverizing assembly 60, the hammers 64 will merely pivot about the support 65 so as to prevent breakage thereof. At the same time the bird will be thrown upwardly into the right as viewed in FIG. 1 for recirculation along the tray. The process will be continued until such time as the bird has become sufficiently pulverized and dried to allow the particles thereof to pass through the apertures 42. Similarly, should a stone be accidentally introduced into the machine, it will also be recirculated without damage to the equipment. Such objects obviously, however, must be removed periodically from the machine.

The arrangement shown in FIGS. 13-15 renders possible completely automatic operation of the cleaning and treating combination. The scraper assemblies which scrape the material from pits 201 and 203 and the elevating conveyor assembly 204 may be initiated by an automatic clock at prescribed intervals. The scraper assemblies and the elevating conveyor will thereafter be controlled by the deactivating level detector 126 in hopper 30 and the treatment process will continue until such time as the barn
has been thoroughly cleaned and the material therefrom treated to a dry, particulate consistency and stored in unit 220. The time required for an individual cleaning operation may be roughly calculated and the timing activa-
tor mechanism set to run for that period. When the pre-
scribed time has expired, the scraper units and conveyer assembly will be deactivated, the machine will run through any material left therein and, once plate 121 swings clockwise as viewed in FIG. 1 and into contact with micro-
switch 123, the machine will be deactivated. The dry partic-
ulate material will be periodically removed from storage unit 220 and may be utilized for fertilizer or any number of other uses depending upon the particular type of offenous material which has been ground.

Once such set of treatment unit and storage facility may be provided for each poultry farm in the particular poultry farm in question, the manpower and equipment necessary to dispose of the poultry droppings thereafter will be markedly reduced. Additionally, a valuable by-product will be gained.

While a preferred embodiment of this invention has been described in detail it will be apparent to those skilled in the art that a number of other embodiments may be conceived without departing from the spirit and scope of this disclosure. Such other embodiments are to be con-
sidered as included within the scope of the following claims, unless these claims, by their language, expressly state otherwise.

I claim:

1. Apparatus for drying and pulverizing material, said apparatus comprising:
a housing;
a perforate tray positioned within said housing at an angle with respect to the horizontal;
access means whereby said material may be placed on said tray at the upper section thereof;
means for actuating said tray such that said material tends to migrate from said upper section to the lower section thereof;
pulverizing means positioned in operative relationship with respect to said lower section to receive said material and pulverize it, said pulverizing means being operative to hurl said material back toward the upper section of said tray subsequent to contact therewith whereby said material is recirculated on said tray until such time as it is sufficiently particulate to pass through the perforations therein;
means for heating said material as it circulates along said tray; and
means positioned below said tray for collecting said material as it passes through said perforations.

2. The apparatus as set forth in claim 1 wherein said collecting means comprises:
a plurality of receiving trays positioned below said perforate tray in zig-zag fashion, each of said receiving trays having a discharge opening at its lower end, said discharge openings being positioned such that material passing therethrough falls on the upper section of the next lower receiving tray;
means for vibratting said receiving trays such that said material tends to migrate from the upper sections to the lower sections thereof; and
means for heating said material as it migrates along said receiving trays.

3. The apparatus as set forth in claim 2 wherein the uppermost of said receiving trays is positioned below and generally parallel to the perforate section of said perforate tray.

4. The apparatus as set forth in claim 2 wherein said receiving trays have imperforate bottoms.

5. The apparatus as set forth in claim 1 wherein said heating means comprises a combustion chamber positioned in the bottom of said housing and which further comprises stack means positioned above the upper section of said perforate tray for exhausting the combustion prod-
ucts of said chamber after they have passed through said housing.

6. The apparatus as set forth in claim 5 which further comprises means for moveably sealing the sides of said perforate tray to the sides of said housing whereby the major portion of the gases generated by said combustion chamber must pass either through said perforations or around the lower end of said perforate tray to gain access to said stack.

7. The apparatus as set forth in claim 5 which further comprises cover means operative to close stack means when said combustion chamber is not in operation whereby the inside of said apparatus will not be unduly exposed to the elements.

8. The apparatus as set forth in claim 1 which further comprises:
hopper means positioned above said perforate tray for storing said material prior to its introduction onto said perforate tray, said hopper means having an endless belt mounted therein adapted to convey said material from said hopper onto the upper section of said perforate tray.

9. The apparatus as set forth in claim 8 which further comprises level detector means positioned in operative relationship with respect to said hopper for initiating action of the apparatus in response to the presence of a prescribed quantity of material within said hopper.

10. The apparatus as set forth in claim 8 which further comprises means for sensing the quantity of material present on said perforate tray and for activating and deactivating said endless belt in response thereto.

11. The apparatus as set forth in claim 10 wherein said sensing means comprises:
an elongated member pivotably attached to said housing for pivotable movement into and out of parallel relationship with respect to the path of migration of said material on said perforate tray, said member being pivotable in a plane adjacent the bottom of said perforate tray whereby it will be contacted by material thereon;
means biasing said member out of said parallel relationship; and
means for discerning when said member pivots into said parallel relationship and for deactivating said endless belt in response thereto.

12. The apparatus as set forth in claim 10 wherein said sensing means comprises means for monitoring the load on said pulverizing means.

13. The apparatus as set forth in claim 5 which further comprises thermostat means positioned within said housing for activating said combustion chamber so as to prevent any material which might be within said apparatus from freezing when said apparatus is idle.

14. The apparatus as set forth in claim 13 in which said thermostat means further functions to deactivate said combustion chamber in the event that the temperature within said housing exceeds a predetermined limit.

15. The apparatus as set forth in claim 2 which further comprises means positioned adjacent the discharge of the lowermost receiving tray for conveying said material away from said apparatus.

16. The apparatus as set forth in claim 15 wherein said lowermost tray terminates within said housing and wherein said conveying means comprises a blower positioned within said housing having a conduit exiting therefrom whereby said material is blown through said conduit to any predetermined storage area.

17. The apparatus as set forth in claim 1 wherein said pulverizing means comprises:
a central shaft rotatably mounted within said housing adjacent said lower section;
a plurality of elongated supports spaced radially from said central shaft and rotatable therewith; and
a plurality of hammer members mounted on each of
said supports and free to pivot with respect thereto, said hammer members tending to extend in radial fashion with respect to said central shaft due to centrifugal force.

18. The apparatus as set forth in claim 17 which further comprises an open sided curved shell enclosing those segments of said pulverizing means most remote from said perforate tray, and having a section overlapping with said tray whereby all of said material will be received thereof each time as it is partially particulate to pass through the perforations in said tray.

19. The apparatus as set forth in claim 18 wherein at least some of said hammer members have a curved depending hammer section adapted to scoop said material back toward the upper section of said tray as said central shaft is rotated.

20. Apparatus for drying and pulverizing material, said apparatus comprising: a heated enclosure; means for conveying the material to be treated through said enclosure to dry it; and pulverizing means located intermittent the extremities of said conveying means for pulverizing said material with a beating action and simultaneously projecting material from the zone in which such means is located to a different zone for further drying, whereby said material is first partially dried, then pulverized and then further dried.

21. The device of claim 20 in which the pulverizing means is a rotary device rotating in a direction to cause the material to be thrown upstream of said conveying means.

22. The device of claim 21, in which said rotary device is a hammer mill.

23. In an animal raising operation wherein the animals are kept in enclosures, said enclosures having means for collecting the animal droppings and moving them to a predetermined exit location for disposal, apparatus for treating said droppings comprising: a heated enclosure located at said exit location for receiving said animal droppings; means for conveying the droppings to be treated through said enclosure to dry them; and pulverizing means located intermittent the extremities of said conveying means for pulverizing said droppings with a beating action and simultaneously projecting droppings from the zone in which such means is located to a different zone for further drying, whereby said droppings are first partially dried, then pulverized and then further dried whereby producing a dried fertilizer.

24. The device of claim 23 in which the pulverizing means is a rotary device rotating in a direction to cause the material to be thrown upstream of said conveying means.

25. The device of claim 24, in which said rotary device is a hammer mill.

26. In an animal raising operation wherein the animals are kept in enclosures, said enclosures having means for collecting the animal droppings and moving them to a predetermined exit location for disposal, apparatus for treating said droppings comprising: a drying and pulverizing unit having a housing; a plurality of trays positioned within said housing at angles to the horizontal, each of said trays having a discharge opening positioned such that droppings passing therethrough fall onto the next lower tray; means for vibrating said trays whereby any material thereon will tend to migrate from the uppermost to the lowermost thereof; means for heating said material during said migration; and pulverizing means positioned along the path of migration of said material and intermittent the ends thereof for pulverizing said material with a beating action and simultaneously projecting material from the zone in which such means is located to a different zone for further drying, whereby said material is first partially dried, then pulverized and then further dried; conveyor means for transporting the droppings from said predetermined exit location to the upper section of the uppermost of said trays wherefrom it will pass through said unit and be treated; a storage enclosure; and means for collecting said droppings subsequent to their passage through said unit and transferring them to said storage enclosure.

27. The combination as set forth in claim 26 in which said unit further comprises hopper means positioned above said trays for storing said droppings prior to their introduction onto said trays, said hopper means having an endless belt mounted therein adapted to convey said droppings from said hopper onto the upper section of the uppermost tray.

28. The combination as set forth in claim 27 which further comprises first level detecting means positioned within said hopper for activating said unit when the droppings reach a first predetermined level and second level detecting means for deactivating said conveyor means when the droppings reach a second predetermined level.

29. The combination as set forth in claim 28 wherein said second level detector means also deactivates said collecting means when said droppings reach said second predetermined level within said hopper.

30. The combination as set forth in claim 26 wherein the uppermost of said trays in said unit has a perforate mid-section and wherein said pulverizing means is positioned in operative relationship with respect to the lower section thereof to receive said material and pulverize it, said pulverizing means being operative to hurl said material back toward the upper section of said tray subsequent to contact therewith whereby said material is re-circulated on said perforate tray until such time as it is sufficiently particulate to pass through the perforations therein.

31. A method of processing offal material so as to render it more readily transportable and more readily usable comprising the sequential steps of: partially drying said material by heating the same; pulverizing said material with a beating action and simultaneously projecting material from the pulverizing zone to a different zone for further drying; and drying said material further by heating the same.

32. In an animal raising operation wherein the animals are kept in enclosures, said enclosures having means for collecting the animal droppings and moving them to a predetermined exit location for disposal, the method of treating said droppings comprising the steps of: conveying said droppings from said exit into a heated enclosure; partially drying said droppings within said enclosure; pulverizing said droppings with a beating action and simultaneously projecting droppings from the pulverizing zone to a different zone for further drying; drying said droppings further within said enclosure; and transferring said droppings from said enclosure into a suitable storage means.

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