United States Patent

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[73] Assignee **Wals, Inc.**

[54] **INTEGRATED WASTE-CONVERSION EQUIPMENT**
6 Claims, 8 Drawing Figs.

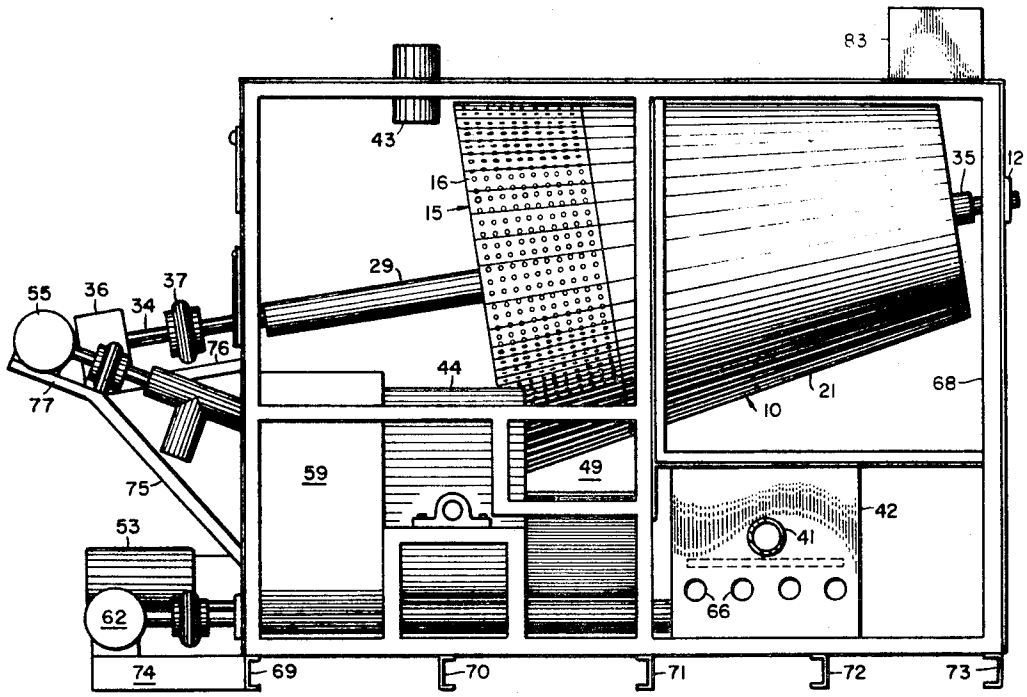
[52] **U.S. Cl.** **110/14,** 110/15
[51] **Int. Cl.** **F23g 5/06**
[50] **Field of Search** 110/14, 15

[56] **References Cited**
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ABSTRACT: A machine for converting waste material. The machine includes a drier with provision for burning the gaseous discharge produced by the drying process. Dried and partially dried material is recirculated in a rotative drum subject to heat to maintain a workable consistency in the material. Some of the dried material is utilized as fuel, or is otherwise reduced to ashes.



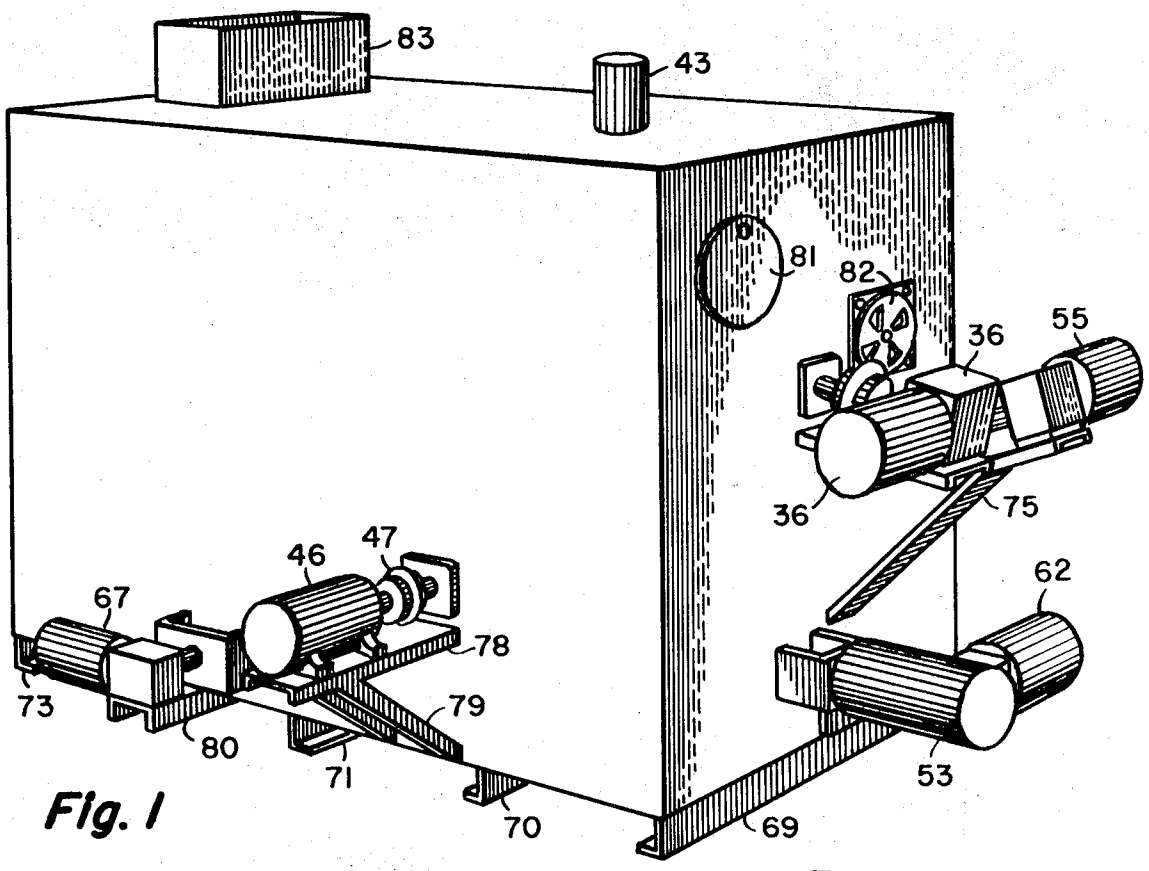


Fig. 1

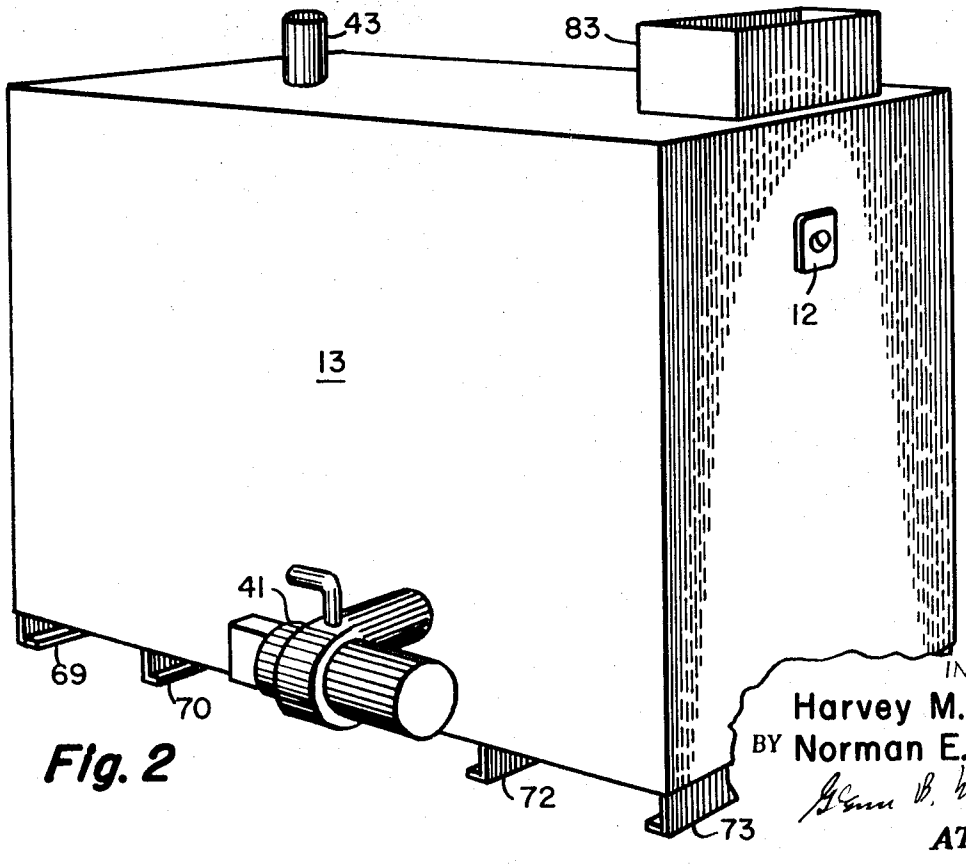


Fig. 2

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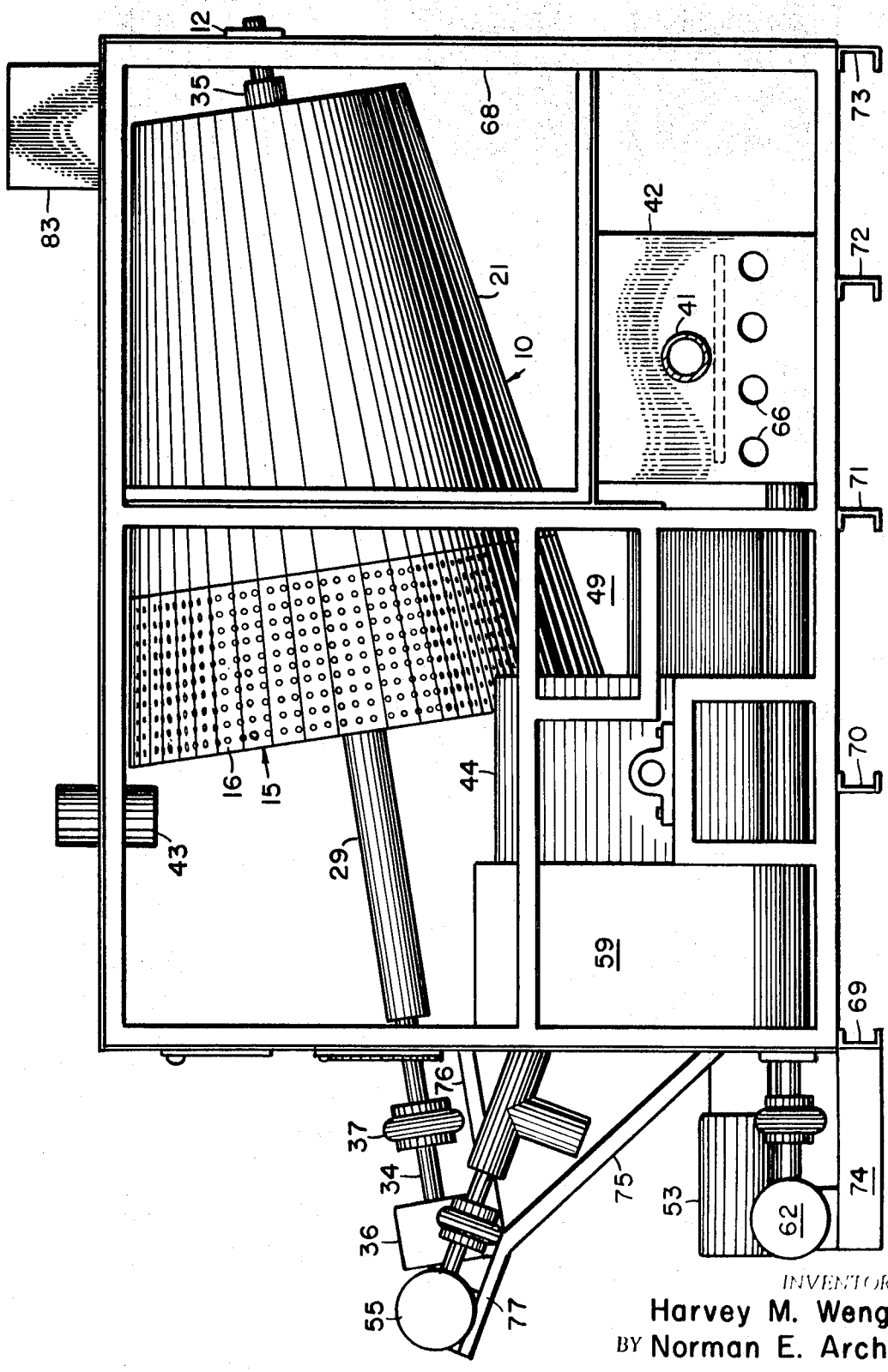


Fig. 3

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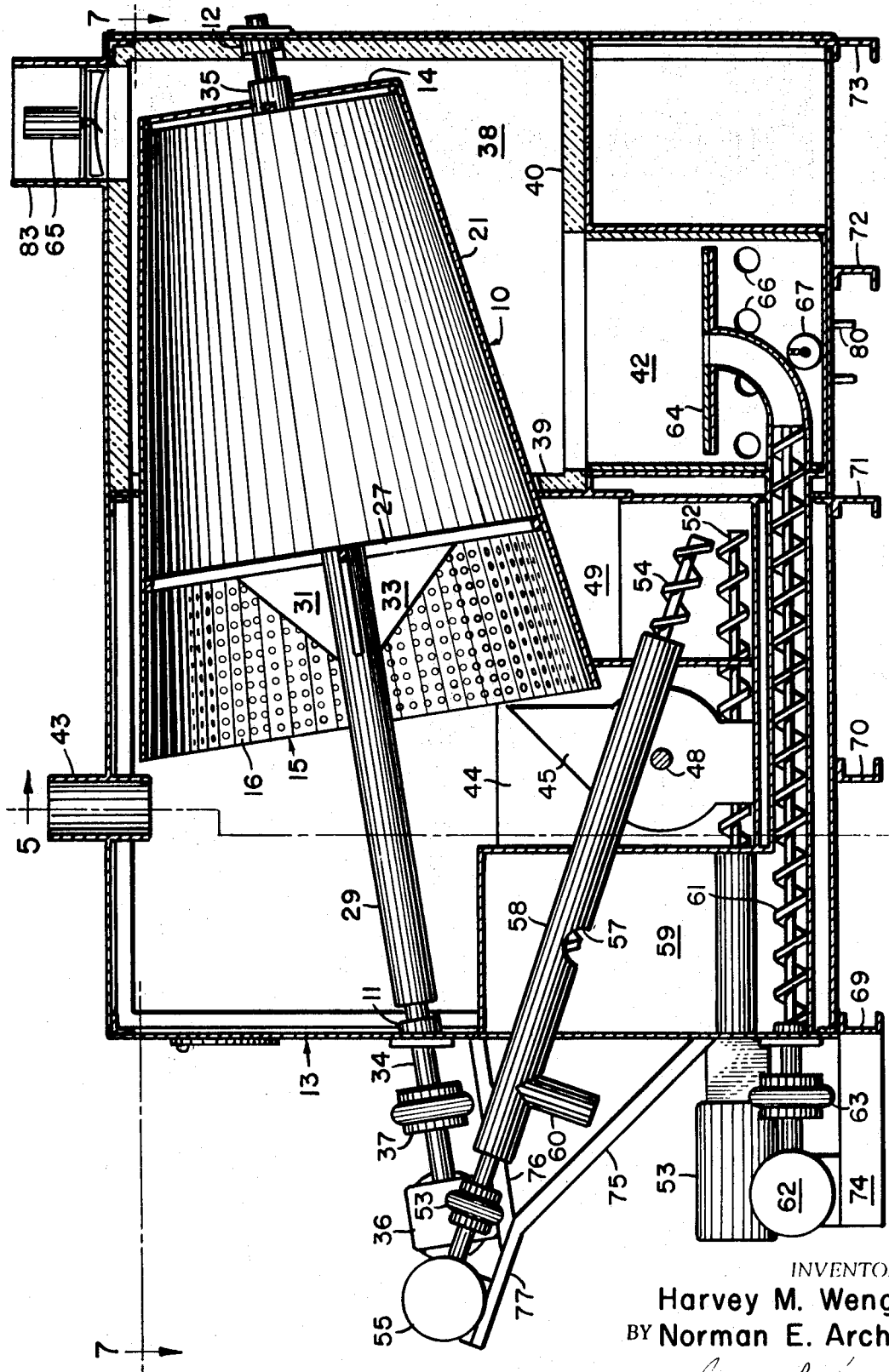


Fig. 4

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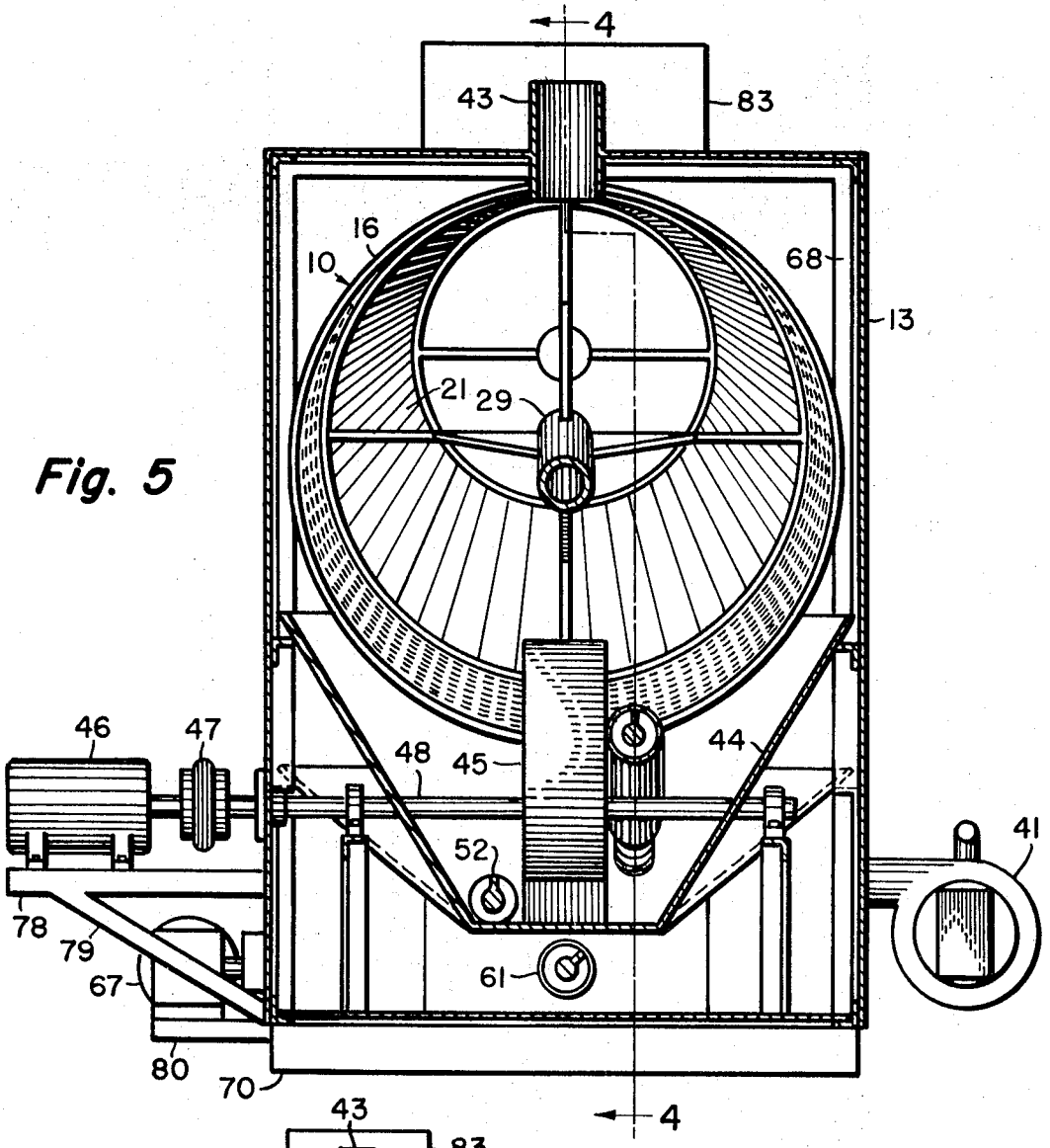


Fig. 5

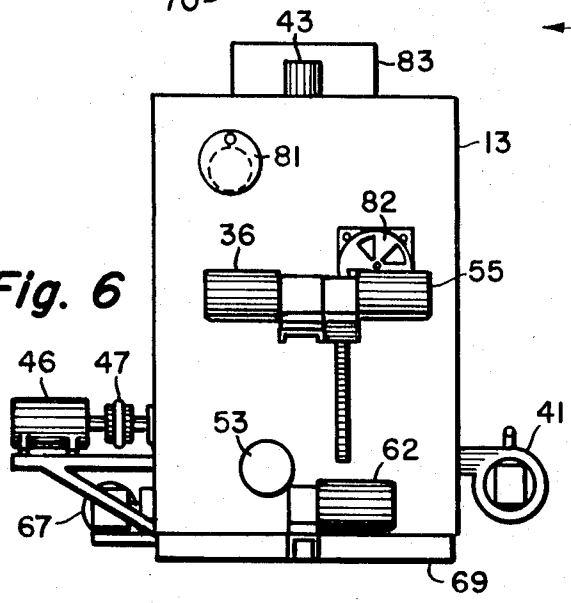


Fig. 6

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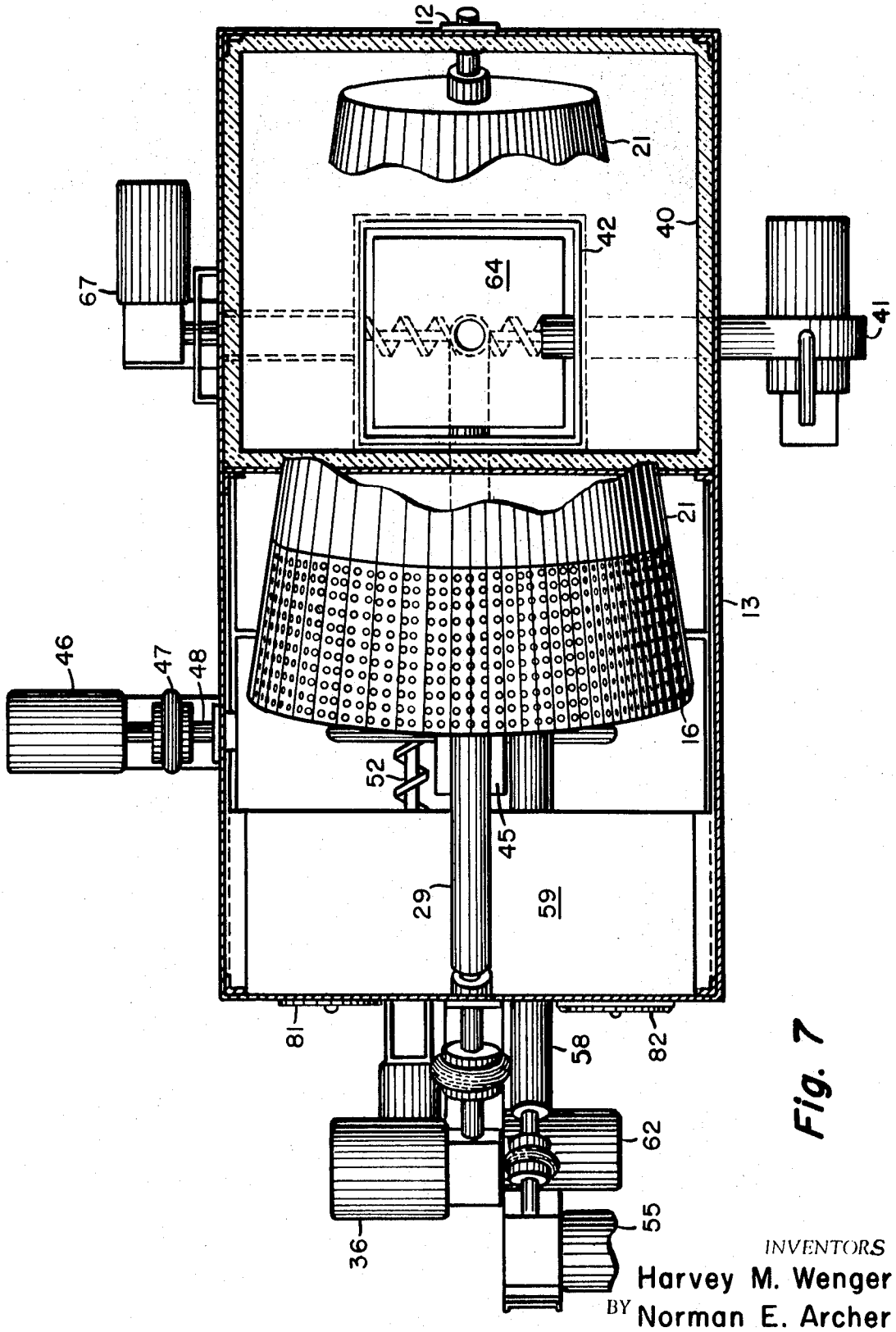


Fig. 7

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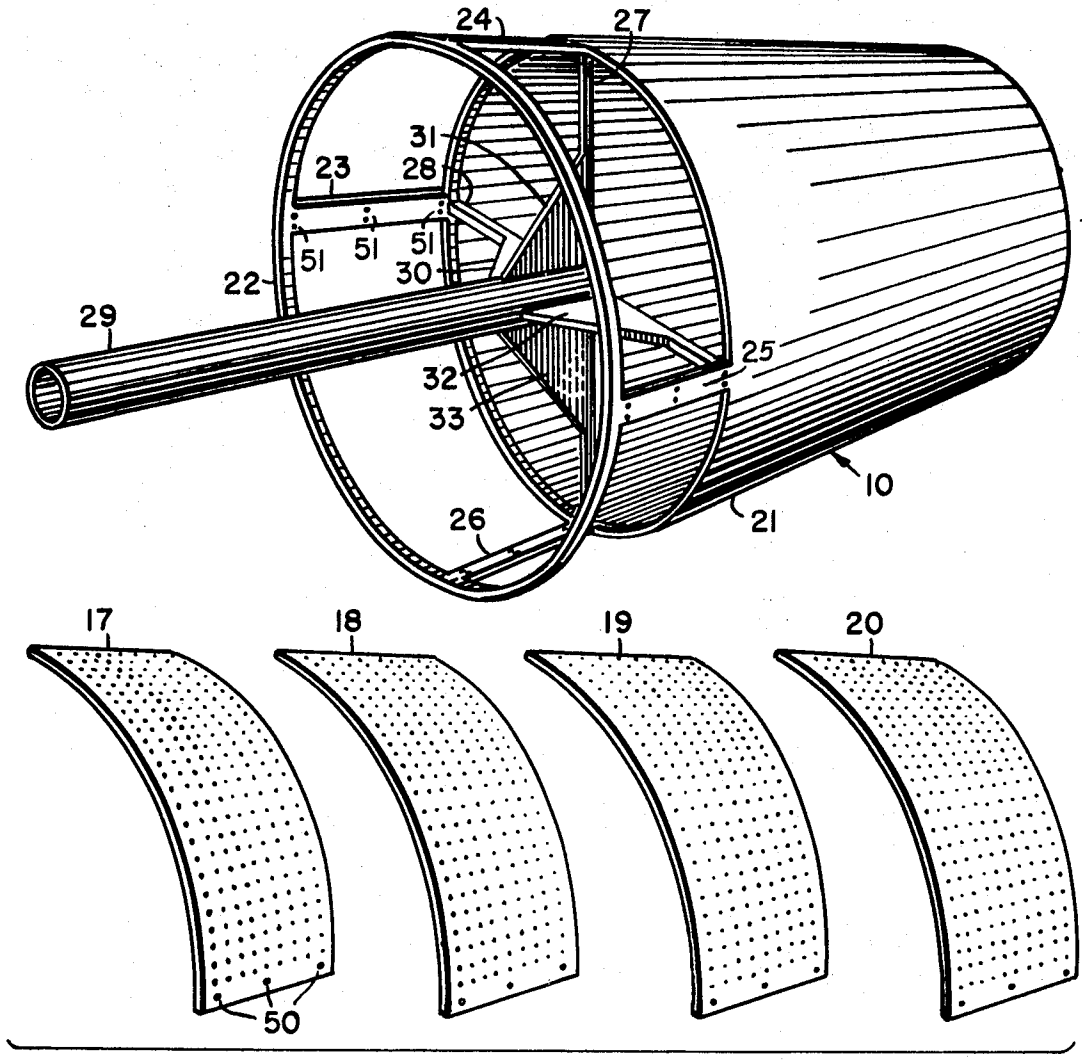


Fig. 8

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INTEGRATED WASTE-CONVERSION EQUIPMENT

BACKGROUND OF THE INVENTION

The disposal of animal wastes and sewage without contaminating the surrounding environment is recognized as a critical problem. One of several possible approaches to this problem has been to remove the moisture from the raw bulk material, and then either incinerate the residue or process it to produce byproducts. The nature of the initial waste material will determine whether or not the latter is economically feasible. The removal of the moisture has been handled by the use of cylindrical rotating drums subject to elevated temperatures, the drums being sufficiently inclined so that relatively low-speed rotation will result in gradual movement of the bulk material from the place of deposit in the drum at one end along to the point of discharge at the opposite end. The slow tumbling action produced by these drum driers produces a relatively even exposure of the waste particles to the drying temperatures. Tray-type driers have also been used for this purpose, in which vibration or other action produces a tendency for particles deposited on the first of a series of inclined trays to induce movement of the waste particles downwardly along each tray to the point where they fall off onto the next tray below. The chamber containing the trays is subject to the elevated drying temperatures, and the action of the trays smooths out the flow of waste material into a thin layer to produce the desired uniform exposure.

The general muddy consistency of the waste material initially fed to the machine makes it necessary to recirculate a portion of the dried and partially dried material to mix it with the raw intake. By suitable control of the ratio of the raw to the recycled material, any desired consistency can be produced. Startup procedure will normally involve the use of a quantity of predried material, or of some other substance which can be initially mixed with the raw intake to produce a consistency which can be handled by the drum or tray system without adhesion to the heated surfaces. Dried material in excess of the amount required for recirculation is usually accumulated in a hopper of some type, and its disposition from this point depends primarily upon economic factors. Animal wastes can frequently be packaged and sold as fertilizer, and sewage can often be handled in the same manner. Where circumstances render it impractical to utilize the dried material, it is usually incinerated or discarded in some sort of dumping facility. The dried material is much easier to handle than the initial raw waste, both with regard to bulk and to consistency. The raw material is likely to have the consistency of mud or sludge, whereas the dried output of the process can be handled like gravel.

SUMMARY OF THE INVENTION

The present invention provides an integrated plant for handling and converting waste material by the removal of moisture, burning any gaseous discharges from the drying process, and incinerating or accumulating the output of the drying process according to whichever procedure is preferable. These successive stages in the process are incorporated in a single machine which can be placed in position immediately ready to operate, rather than involving a built-in installation. This compactness is obtained by interrelating the space requirements of a rotating drum and the combustion chamber, together with the relative position of receiving hoppers and conveyors to maintain a continuous flow of material from point to point in a relatively confined space. The rotative drum within which the bulk material is dried is formed in a conical configuration, and is mounted for rotation on an inclined axis. The angle of inclination is selected so that the uppermost portion of the drum is approximately horizontal. The downward inclination of the bottom of the drum produces the incline along which the particles of material proceed as they are dried. These particles are thrown from a hammer mill into the upper portion of the slowly rotating drum, and are subject to a screening operation as they move out of the lower

end of the drum. Gaseous discharge driven off from the drying process is drawn into the combustion system. The space underneath the conical drum is utilized by the combustion system to burn these gases, and also to provide a large unobstructed passage for the hot products of combustion around the drum surface to a point of discharge at a flue. Combustion temperatures are preferably initiated by a gas burner, which may be supplemented by a stoker feeding the dried material into the combustion area. The percentage of the the heat which can be generated by the stoker system will be determined by the nature of the dried material. Even where it is relatively incombustible by itself, the subjection of the dried material to the combustion temperatures can be utilized to reduce the material to ashes.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing the exterior of the complete machine.

FIG. 2 is a perspective view from the opposite side of the machine from that shown in FIG. 1.

FIG. 3 is a side elevation of the machine, with one of the housing panels removed to show the interior arrangement of the components.

FIG. 4 is a sectional elevation on the plane 4—4 of FIG. 5.

FIG. 5 is a sectional elevation on the plane 5—5 of FIG. 4.

FIG. 6 is an exterior end view of the machine, on a reduced scale.

FIG. 7 is a sectional view on the plane 7—7 of FIG. 4.

FIG. 8 is an exploded view showing the components of the rotary conical drum, including the screen elements.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring particularly to FIGS. 4, 5, and 7, the conical drum 10 is rotatably supported in the bearings 11 and 12 secured to the housing 13. The small end 14 of the drum, in a successful model embodying the invention, is approximately 2 feet in diameter. The large end 15 is approximately 4 feet in diameter, and the length of the drum between these ends is approximately 6 feet. A portion of the length of the drum at the large end is occupied by the screen assembly 16. The screen segments 17–20 are supported by a frame extending from the large end of the imperforate section 21 of the drum, and including the end ring 22 and the axial beams 23–26. A pair of diametral beams 27 and 28 intersects to provide support for the tubular axial extension 29, with the assistance of the gusset plates 30–33. The shaft 34 traverses the axial extension 29, and also the boss 35 secured to the end 14 of the drum to complete the rotary structure. The drum is rotated at about 15 r.p.m. by the gear motor assembly 36 driving through the coupling 37.

Most of the imperforate section 21 of the drum protrudes into the combustion chamber 38 through an opening in the wall 39 which registers closely with the periphery of the drum. A ceramic insulating material 40 defines the interior of the combustion chamber 38 in the usual construction associated with furnaces. The gas burner 41 of conventional construction delivers a flame into the fire pot 42 to generate heat for maintaining the temperature of the imperforate section 21 of the drum somewhere on the order of 400° F. to produce the drying action. Normally, it will be desirable to maintain a temperature in the chamber 38 of around 600° F. to accomplish this. These temperatures are easily controllable with conventional equipment forming no part of the present invention.

Raw material taken into the machine at the inlet 43 finds its way into the open top of the hopper 44 which serves as the intake for the hammer mill 45. This unit has the dual function of pulverizing the material present in the hopper 44, and of throwing it into the drum 10 with enough velocity to deposit the material near the small end 14. The hammer mill is driven by the motor 46 driving through the coupling 47 and the shaft 48. The structure of a hammer mill itself is conventional.

The slow rotation of the drum 10 produces a tumbling action which thoroughly exposes the particles to the effects of the elevated temperature as they move slowly down the incline established by the lowermost portion of the drum surface. As the particles reach the larger extremity of the imperforate section 21 of the drum, they continue to move downwardly over the screen elements 17–20. Particles in excess of the size of the openings in the screen elements are redeposited in the hopper 44, where they are again subject to the action of the hammer mill and projected back into the rotating drum. Particles falling through the screen sections are received within the hopper 49. The screen sections are readily removable so that they can be changed to suit the needs of the particular processing operation. They are formed in the conical curvature corresponding to a continuation of the imperforate section 21, and are secured in position by screws or bolts traversing holes such as are identified at 50 in FIG. 8, and similar holes as shown at 51 which register with the screen holes 50.

At least a portion of the material deposited within the hopper 49 is recycled by the auger conveyor 52 driven by the motor unit 53. The functioning of this auger is to transfer the material from the hopper 49 into the hopper 44, where it becomes intermixed with the raw material received through the inlet 43. A manually set control (not shown) will determine whether the entire contents of the hopper 49 is recycled for further removal of moisture, or whether the amount withdrawn by the auger conveyor shall be determined exclusively by the needs for the machine to maintain a workable consistency of the material thrown into the rotating drum 10. As the moisture content of the material in the hopper 49 falls down to the control figure, the reduced activity of the auger conveyor 52 will permit the material to accumulate in the hopper 49 to a point where it can be acted upon by the withdrawal auger conveyor 54 driven by the motor unit 55 through the coupling 56. An opening 57 in the tubular conduit 58 in which the auger of the conveyor 54 operates deposits material within the bin 59. Material received within this bin will be of the selected size determined by the screens 17–20 and will be reduced to the control level of moisture content As the level of the material within the bin 59 rises to the point where it covers the opening 57, further outflow of the material is prevented. After this condition has developed, further action of the auger conveyor 54 will cause continued movement of the dried material out to the discharge spout 60.

Dried material accumulating within the bin 59 may be used as a supplemental source of fuel. The stoker 61 is driven by the motor 62 through the coupling 63, and returns material into the fire pot 42 at the support plate 64. If the material in the bin 59 is readily combustible, it may be used to either supplement or replace the effect of the gas burner 41. If the material is not such that it is readily combustible, the stoker 61 may still be used to deliver material to the fire box 42 so that it may be incinerated under the continued action of the gas burner. Gases emitted from the material drying within the section 21 of the drum move outwardly through the large end of the drum and around through the space defined by the housing 13 under the action of the exhaust fan 65. These gases find their way inward through the openings 66 in the fire pot, and participate in the combustion within the fire pot, and participate in the combustion within the fire pot and in the chamber 38. Ashes resulting from the combustion process accumulate in the bottom of the fire pot and are withdrawn by the conveyor 67.

Fig. 3 provides the best illustration of the space relationships within the machine, and illustrates the frame structure generally indicated at 68, which provides support for the housing panels and for mounting the internal components. Preferably, a group of supporting rails 69–73 is provided under the machine for transferring the weight to a supporting floor structure without concentrations of stress. The beams 74–77 supporting the motor units at the end of the machine, and the beams 78–80 at the side, may be considered as part of the frame work of the machine. These auxiliary beams function as mounting brackets for the associated equipment. It is preferable to incorporate an inspection port 81, and a draft control unit 82, which are best shown in FIG. 1. A balanced damper may be used in place of the control unit 82 if desired. The stack 83 will normally be connected to a conventional chimney.

We claim:

1. A waste-processing machine having a housing, a drum rotatably mounted in said housing in an attitude such that a plane tangent to the bottom of said drum is inclined to the horizontal, a hopper adjacent the lower end of said drum, a screen on said drum disposed to limit the size of particles proceeding from said drum to said hopper, charging means adapted to project particles of waste material into said drum, a heating chamber surrounding at least a portion of said drum, recirculating conveyor means adapted to transfer material from said hopper to said charging means, and discharge conveyor means adapted to remove material from said hopper, wherein the improvement comprises:

a second hopper disposed to receive raw material and material moving over the lower end of said screen, said second hopper communicating with inlet means and with the intake of said charging means; and

a receiving bin disposed to receive material from said discharge conveyor.

2. A machine as defined in claim 1, wherein said drum is tapered, the larger end thereof being adjacent said hopper.

3. A machine as defined in claim 2, wherein the top of said drum is substantially horizontal.

4. A machine as defined in claim 3, additionally including a firepot disposed below the smaller end of said drum and communicating with said heating chamber.

5. A machine as defined in claim 1, wherein said screen includes at least one annular screen means secured to said drum in a configuration forming a continuation of the surface thereof.

6. A machine as defined in claim 1, additionally including stoker means adapted to transfer material from said bin to said combustion chamber and burn the material so transferred therein.

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