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**GREENSCENE AGRITEK INC.** [CA/CA]; 40874 Yale Road West, Chilliwack, British Columbia V2R 4J2 (CA).
- (72) **Inventor; and**
- (75) **Inventor/Applicant (for US only):** **WILFORD, Philip** [CA/CA]; #78 - 5550 Langley Bypass, Langley, British Columbia V3A 7Z3 (CA).
- (74) **Agents:** **NAKANO, Robert** et al.; McCarthy Tétrault LLP, P.O. Box 48, Suite 5300, Toronto Dominion Bank Tower, 66 Wellington Street West, Toronto, Ontario M5K 1E6 (CA).
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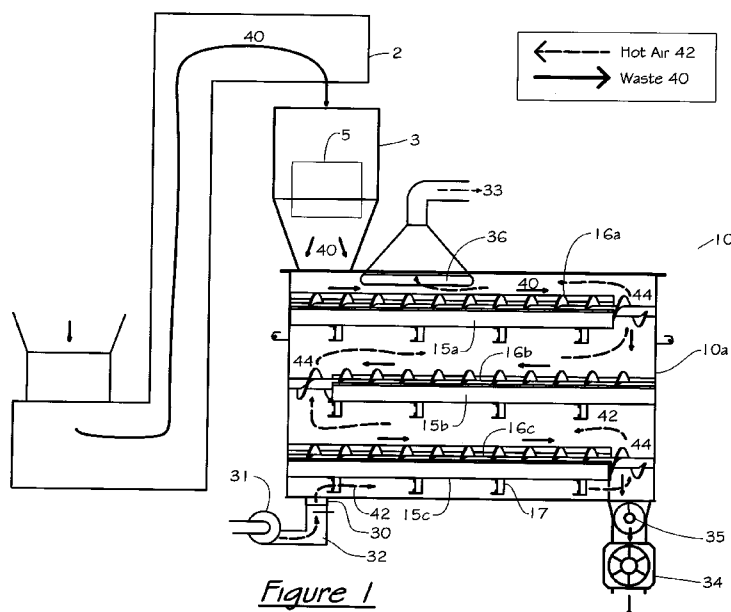


Figure 1

(57) **Abstract:** A method and apparatus for reducing or eliminating mold spores, pathogens and odour from waste organic material, such as waste equine bedding, is provided. The apparatus includes two or more pairs of augers including blades to control the size of the material and to move it in a zigzag fashion through heated air.

## SYSTEM AND METHOD FOR PROCESSING WASTE ORGANIC MATERIAL

### Technical Field

**[0001]** This disclosure relates to a system, method and apparatus for treating materials having animal waste therein to reduce pathogens and to form a re-usable product from the materials.

### Background of Disclosure

**[0002]** Current practices for equestrian facilities and farms is to remove daily soiled bedding from a horse's stall and transport it to a storage pile. Replacement bedding is then added to the stall and raked to provide even sleeping/resident bedding for the animal. The soiled bedding is essentially manure and is stockpiled over a period of time, depending on the number of horses at the facility until the volume reaches such levels that it requires removing from the farm. Bins or other devices are then utilized to hold the manure, and then it is trucked away to a landfill site or other collection area, where it is dumped. There are very limited uses for this waste product at this stage, and it often becomes a nuisance material, accumulating and causing foul odours, greenhouse gas release and other environmental concerns.

**[0003]** Current equine manure disposal methods include composting, spreading on land, landfill dumping and stockpiling. Composting reuses the waste for potting soil. Spreading on land has been implemented on some crops. Studies of the long-term ramifications of this practice indicate possible dilution of soils by the addition of wood products to the soil and water contamination caused by leaching. Landfill dumping is used when other options are not available. Transportation and landfill tipping costs are increasing significantly. Many landfills are not accepting manure, as this interferes with the anaerobic decomposition if not applied properly. Stockpiling is used as a cost savings method when a farm cannot afford storage bins for pickup and does not produce enough manure to make pickup attractive to the haulers. This method may have adverse effects on aquifers and properties because of odour and leaching concerns.

**[0004]** US Patent No. 5, 201,473 discloses a feeder and measuring device in which bulk material is heated and agitated by a plurality of tines mounted upon rods to control material which is loosened and dispensed.

**[0005]** US Patent No. 5,347,729 discloses a plurality of auger-like devices mounted within cylindrical shells for drying food and materials.

**[0006]** US Patent No. 5,361,708 discloses an apparatus and method for pasteurizing and drying sludge wherein the material to be dried passes through three separate cylinders while being in contact with hot gasses.

**[0007]** US Patent No. 5,689,941 discloses a high-density combination dry hay and hay silage livestock feed-making apparatus processing crude silage and dried powder into a consumable product which is then packaged.

#### Summary of the Disclosure

**[0008]** An aspect of disclosure includes a process of cutting or declodding the input to prevent jams while providing agitation and heat to result in dried, shredded and pathogen-free material. A method and apparatus is provided for reducing or eliminating mold spores, pathogens and odour from waste organic material such as waste equine bedding.

**[0009]** An embodiment per this disclosure efficiently dries material to a desired level and in suitable throughput volumes. Drying level can be controlled by the time and temperature set by controlling the speed of the augers and the heating unit output. In a first aspect, a processor for waste organic material is provided. The processor comprises: a container having an opening on an upper side to admit the waste organic material and an outlet on a lower side to remove processed waste organic materials from the container; a first tray housed in the container to receive the waste organic material from the opening, the first tray comprising a first pair of screw augers to move the waste organic material along the first tray, the first tray terminating short of the first pair of screw augers; a second tray housed in the container to receive the waste organic material from the first tray, the second tray comprising a second pair of screw augers to move the waste organic material along the second tray in a different direction of movement in the first tray, the second tray terminating short of the second pair of screw augers; and a source of pressurized hot air provided to the

container travel along the first and the second trays to heat the waste organic material. The two trays convey the material in a zigzag fashion through heat.

**[0010]** In the processor, the hot air may enter at a bottom of the container, travelling in a direction opposite the waste organic material in the first tray and may exit through a top of the container. The air may be pressurized.

**[0011]** In the processor, the hot air may enter at a top of the container, travelling in a direction with the waste organic material in the first tray and may exit through a bottom of the container.

**[0012]** In the processor, the first pair of screw augers may be parallel to each other.

**[0013]** In the processor, the waste organic material in the second tray may move in an opposite direction of movement in the first tray.

**[0014]** The processor may include a controller to control the rate of input of the waste organic material.

**[0015]** In the processor, air in the container may be heated to a temperature to kill pathogens and mold spores in the waste organic material.

**[0016]** In the processor, the temperature may be less than approximately 450 Fahrenheit (F).

**[0017]** In the processor, at least one of the augers may include knives or cutting edges to remove lumps from the waste organic material.

**[0018]** In the processor, the first tray may be oriented to be horizontal.

**[0019]** In the processor, the container may comprise: a first sub-container for housing the first tray; a second sub-container for housing second first tray, the second sub-container mating with the first sub-container; and a lifting mechanism to lift the first sub-container from the second sub-container.

**[0020]** In a second aspect, a device for processing organic material is provided. The device comprises: a substantially closed container including an input opening and an output opening; a first tray to receive the organic material from the opening, the first tray comprising a first pair of screw augers to move the waste along the first tray, the first tray terminating short of the first pair of screw augers; a second tray to receive the organic material from the

first tray, the second tray comprising a second pair of screw augers to move the organic material along the second tray in an opposite direction of movement in the first tray, the second tray terminating short of the second pair of screw augers; and a heat source providing heat to remove pathogens, mold spores and odours from the organic material.

**[0021]** In the device, the waste organic material may be equine bedding.

**[0022]** In a third aspect, a method for processing waste organic material is provided. The method comprises: receiving said waste organic material to a container at an upper end to a first tray housed in said container; conveying said waste organic material along said first tray by a first pair of screw augers; depositing by gravity said waste organic material from said first tray to a second tray housed in said container, said second tray located below said first tray and oriented to transport said waste organic material in a different direction of movement in said first tray; conveying said waste organic material along said second tray by a second pair of screw augers; and injecting hot air into to said container to travel along said first and said second trays to heat said waste organic material.

**[0023]** In the method, the hot air may enter at a bottom of said container, travelling in a direction opposite said waste organic material in said first tray and may exit through a top of said container.

**[0024]** In the method, said hot air may enter at a top of said container, travelling in a direction with said waste organic material in said first tray and may exit through a bottom of said container.

**[0025]** In the method, a temperature of said hot air may be less than approximately 450 F.

**[0026]** In other aspects various combinations and subsets of the above noted aspects may be provided.

#### Brief Description of the Drawings

**[0027]** Embodiments of the present disclosure will now be described, by way of example only, with reference to the accompanying drawings, in which:

**[0028]** Figure 1 is a block diagram of a waste processing system, including a processing device having an infeed hopper and material exit airlock, according to an embodiment;

- [0029]** Figure 2A is a block diagram of the main processing device having trough trays, screw augers, sections, hydraulic lifting pistons, locking devices, intake hopper distribution arms, a bucket elevator, an infeed hopper, a material discharge airlock, a moist air exhaust and a hot air intake fan of the waste processing system of Fig. 1, according to an embodiment;
- [0030]** Figure 2B is a block diagram of a portion of the main processing device of Fig. 2A, according to an embodiment;
- [0031]** Figure 3 is a block diagram of side view of a trough tray of the main processing device of Fig. 2A, showing screw augers showing rotation direction, where each pair of screw augers rotates towards each other and up against a solid cutting surface and heat surrounds the troughs and augers, according to an embodiment;
- [0032]** Figure 4 is a block diagram of an end view the trough tray of Fig. 3, showing three trays of screw augers and a discharge screw auger to gather processed material prior to entry into an airlock below according to an embodiment;
- [0033]** Figure 5 is an exploded upper perspective view of components of a screw auger of Fig. 4, showing blades or knives with bearings and drive, mounted on fins of the screw auger;
- [0034]** Figure 6 is another block diagram of the waste processing system including the device of Fig. 1 according to an embodiment; and
- [0035]** Figure 7 is a flow chart of a process for the waste processing system of the device of Fig. 1 according to an embodiment.

### **Detailed Description of Embodiments**

**[0036]** The description which follows and the embodiments described therein are provided by way of illustration of an example or examples of particular embodiments of the principles of the present disclosure. These examples are provided for the purposes of explanation and not limitation of those principles and of the present disclosure. In the description which

follows, like parts are marked throughout the specification and the drawings with the same respective reference numerals.

**[0037]** Briefly, an embodiment processes used waste organic material materials for animals, such as equine waste organic material. Clean bedding is generally composed mostly of wood products such as a combination of wood shavings, woodchips, sawdust, waste hay and other fibrous materials. Approximately 90% of waste organic material consists of wood product, 6% is waste hay dropped by the animal while eating and 4% is animal feces/urine.

**[0038]** Waste organic material may contain diseases or pathogens deposited into the bedding by feces, urine or expectorant from the horses. In order to prevent the spreading of such diseases, an embodiment further heats the waste organic material for a period of time in a containment apparatus to kill and remove microbes from the waste organic material. Feces/urine in the waste organic material frequently is accompanied with noxious odours. An embodiment heats ammonia in the waste organic material from urination to such a degree as to vaporize the nitrogen and hydrogen in the ammonia, removing it to reduce and / or eliminate the related odours. In a similar manner, odours that may be present in the feces deposited in the bedding and removed from the stalls can be dried sufficiently to turn the feces into a fine powder that is captured later in the dust collection system, thus eliminating any odours from this source.

**[0039]** Also, mold spores may be in "clean" bedding that is subsequently provided into an animal's stall after soiled bedding is removed. Although not usually evident, if the sawdust/wood shavings have been stored outside or are damp, these mold spores may begin to grow within the pile or in the stalls. Horses like to eat with their heads down and can very easily inhale these microscopic mold spores, potentially causing respiratory problems. This disclosure eradicates pathogens and mold spores from the waste organic material during processing to provide the recycled material to be reused as horse bedding.

**[0040]** An embodiment provides processing of animal waste organic material to decontaminate it and to reduce its weight, volume and odour content. One aspect of an embodiment reclaims wood components from the waste organic material. The processed waste organic material can be recycled /reused as fresh bedding material. The processed waste organic material may also be used as a bio-fuel.

**[0041]** The term “waste organic material” is used herein to refer to material provided as input to the waste processing system of an embodiment. Waste organic material includes, but is not limited to, waste bedding, waste material, clean bedding, manure, sawdust, particulate and / or other loose materials, woodchips, grains, minerals, seeds, liquefied manure, slurries, liquids and liquids containing waste material. The amount of actual waste in such waste organic material may be minimal. The term “processed waste organic material” is used herein to refer to materials that have been processed by an embodiment and / or the resulting output of an embodiment. Materials that are being processed by an embodiment may be referred to as “waste organic material” and / or “processed waste organic material”. It will be appreciated that an embodiment can process any transportable material, having any of waste and / or organic material therein or not. Embodiments described herein can process a wide variety of organic products that may require drying and / or decontaminating.

**[0042]** Through a series of conveyors and augers in a container, an embodiment exposes the waste organic material to high temperatures to reduce the moisture in the waste organic material and / or kill pathogens therein. An embodiment also agitates the waste organic material during heating process to allow the heat to reach all areas in the waste organic material.

**[0043]** An embodiment also provides a series of cutting blades or knives attached to one or more levels of augers to cut the waste organic material as it is processed into manageable particles as the hay in the waste organic material has a tendency to ball up and plug augers.

**[0044]** The embodiment also provides a sizing system for particles and can reduce lumps that may be present in the waste organic material being processed.

**[0045]** Upon leaving the container, the processed waste organic material which is gathered from an exit conveyor can be tested for desired qualities, sent to a storage bin or sent to be pelletized by a pellet mill and/or bagging system. Waste organic material can be processed to meet criteria for animal bedding and can be packaged and sold as such in either loose or pellet form. Processed waste organic material can be processed and sized to meet specifications for bio-mass fuel in either loose or pellet form and can be packaged or sold in bulk to such industries as greenhouse growers for boiler fuel, stove pellets for home and industrial heating systems or a number of other applications.

**[0046]** With reference to Figures 1-6, a waste processing system according to an embodiment is generally shown, that includes processing device 10. Device 10 includes a base unit 11 that can be mounted with bolts onto a concrete pad that rests upon the floor of a processing plant and supports the various components of device 10. Some aspects of processing device 10 include a plurality of horizontal screw augers 16 mounted inside troughs 15 located in a container. For an embodiment, waste organic material is introduced into the top of the container and carried horizontally by augers 16 in a zig-zag path, cascading towards the bottom of the container for discharge from device 10. As the waste organic material travels through augers 16, cutting edges or knives located on some of the augers chop the waste organic material into smaller lumps. Heat from an external source is introduced to the bottom of the container and travels upwardly, counter-current to the waste organic material, vaporizing moisture and in the waste organic material, killing pathogens and mold spores, as well as removing noxious odours from the waste organic material.

**[0047]** Referring to Figure 1, device 10 has a rectangular container that is divided vertically into one or more separate sections. Device 10 has three vertically arranged sections 10a, 10b and 10c. Other embodiments can provide more or less sections. Waste organic material flows downward through device 10 and is conveyed horizontally in the sections by augers 16 as indicated by solid arrows 40. As such, the waste organic material moves in a cascading manner from one section to another lower section through device 10. Each lower section transports the material in a different direction than its upper section. In one embodiment, the direction of conveyance of the lower section is opposite to the direction of the upper section. This allows for a compact layout of multiple sections. Airflow, which is preferably heated, flows countercurrent to the waste organic material flow, per arrows 42, and travels upward and around all augers 16. The air may be pressurized. A lower pressure area may be provided at the exit point for the air to assist in air flow management in the container. It will be seen that such an arrangement of sections provides space savings and increased throughput. Also, there are efficiencies in heat transfer into the waste organic material and the ability to reuse the heat over and over from section to section.

**[0048]** In one embodiment, the container for device 10 is generally rectangular in shape and sized to contain augers 16 with minimal lateral spacer on the sides of the augers. Exterior dimension can be approximately 6 feet wide by 6 feet tall by 12 feet long. Different sizes for any dimension can be provided. Access doors and ports may be provided along the sides

and / or ends of the container to allow a user to access the augers and sections for maintenance and repairs.

**[0049]** Waste organic material provided from infeed hopper 3 is augured along section 10a and then at the end of section 10a, falls to section 10b. In section 10b, the waste organic material is augured to the end of section 10b, and then the waste organic material falls to section 10c. In section 10c, the waste organic material is augured to the end of section 10c, and then the waste organic material falls to the discharge auger. In one embodiment, all sections are housed within a single container. Per Figure 2B, in another embodiment, each section is housed in a separate sub-container, with each section and separate sub-container fitting with the section below. The interface between the adjacent sections is sealed with a high temperature sealing gasket 12. Each sub-container can be lifted and moved by a lifting mechanism to allow access to its components. In one embodiment, a lifting mechanism comprises hydraulic lifting pistons 14a and 14b provided and located at the ends of each section 10, which can be electronically operated to lift each of the top two sections (10a & 10b) either separately or together to provide an opening between the sections for access to the components within the section. Other lifting mechanisms, such as winches, pulley, hydraulics and or other systems can be provided.

**[0050]** Inside each section of device 10 is a tray of troughs 15a, 15b and 15c. For each section, its troughs are joined horizontally. The number of troughs is determined by the number of screw augers 16 that are installed in each section. Each tray, generally referred to as 15, is supported from the sides of each section and by stiffeners 17 that attach to the sides of each section and run below the trays. Stiffeners can be I-beam structures placed under each trough.

**[0051]** In one embodiment, each tray is sized to be short of the length of the screw augers, such that the screw augers extend past the tray to open area 44, providing a drop zone for material to drop down to the next tray below via gravity. Open area 44 also provides a path for hot air to travel from section to section, per arrow 42. A filtering screen or grates (not shown) can be placed around open area 44 to prevent oversized materials from being provided to lower trays. In other embodiments a tray may have one or more openings in its bottom to allow material to fall down to the next lower tray. The openings can be of different

sizes to allow different sized materials to fall through. Such openings can be provided in addition to or instead of the drop zone described herein.

**[0052]** Each tray is oriented within the container to be horizontal. However, any one or more trays (or augers) can be inclined upward or downward, as design and processing parameters require.

**[0053]** Screw augers 16 can be constructed in any length and diameter required for the desired throughput of device 10. In one embodiment the augers are provided in pairs of two, with no less than two in parallel and no more than ten in one section. Each pair of augers in the tray rotates towards each other (per arrows 46, Fig. 3) with a solid surface 48 between them to use as a cutting surface, while transporting the waste organic material to the same end. As such, the augers provide a sizing mechanism for particles and to reduce the size of lumps that may be present in the waste organic material. In other embodiments a series of non-paired, single augers can be provided for a section.

**[0054]** Referring to Figure 5, screw augers 16 comprise core 21 that is attached to bearing 22 at one end and a driving (turning) device 23 at the other end. The screw auger as shown is rotated by the motor in a counter clockwise direction and material is conveyed from the right to the left end of the auger. Fins 24 are attached to the core in a helical pattern that allows for waste organic material to be transported from one end of the screw auger to the other. Augers work in pairs in order to project the waste organic material towards each other as the material passes the length of the auger. In one or more sections, augers will have sharp blades or knives 25 attached as shown that cut the loose hay and other long strands in the waste organic material and break up any lumps in the waste organic material into smaller sizes for ease of movement and for later use. Blades or knives use the narrow gap between the auger fins and the trough as a cutting surface. Blades or knives may require sharpening or replacing from time to time. Kicker 50 is a bar running along core 21 that is attached from a bottom side of a blade of auger 16 to its adjacent top side. Kicker 50 is provided to "kick up" material being conveyed. This action further aerates the waste organic material, exposing more of it to the heated airflow. The kicking action may eject the waste organic material outwardly from core 21 approximately one inch above the radius of auger 16 as the auger turns. Other features can be provided to auger 16 to kick up the conveyed

material. Auger can be made of steel, metal, stainless steel or other compounds depending on the durability and heat requirements for the augers of device 10.

**[0055]** Augers are driven by motors which are controlled by variable speed controllers 23 that regulate the increase or decrease the rotational speed of the augers. The speed of paired augers may be controlled together or separately. The speed of augers one or more different layers may be controlled together or separately. Generally, the speed of the augers in the troughs increases from the top layer to the bottom layer. The speed of an auger in a lower section may be at least as fast as or faster than the speed of its adjacent upper section. For example, augers in section 10a may operate at 10 rotations per minute (rpm); augers in section 10b may operate at 20 rpm; and augers in section 10c may operate at 30 rpm. These speeds are exemplary – other values and ranges can be provided. Speeds may increase arithmetically, step-wise, geometrically and / or exponentially per section. An embodiment can set the speeds of the augers in the sections to provide proper material flows through device 10, where increasing speeds of augers between sections ensures that a lower section does not become jammed with an overflow of material from its adjacent upper section, since the lower section operates at a higher speed than the upper section. The motors may be electrically powered. One embodiment uses three-phase motors.

**[0056]** In other embodiments other conveying devices may be provided for device 10 which can be used instead of or in addition to augers as shown. Exemplary conveying devices include auger, conveyors, belts, buckets and other transport mechanisms.

**[0057]** Referring to Figure 2A, material distribution system 5 is located at infeed 3 on the top of device 10. This system distributes the incoming waste organic material evenly from one side of the first level of augers to the other. Distribution arms (not shown) move back and forth to accomplish this task. A limit switch (not shown) controls the level of waste organic material in a distribution hopper of infeed 3, to prevent overloading of material from the bucket elevator or similar conveyor (not shown) to device 10. An infeed hopper (not shown) receives the wet waste organic material as it is loaded by a loading machine (not shown). Heated air generated from an external heat source is introduced into the bottom of device 10 through opening 30 and is propelled into device 10 by electrically-driven fan 31. A temperature probe 32 determines the temperature of this hot air at intake and relays this information back to a control panel (not shown). One embodiment provides air heated to a

temperature of less than 450 F (230 °C); the temperature may be below 400 F. The heated air temperature should be set to be high enough to kill pathogens present in the waste organic material, having regard for the time that the waste organic material will be present in device 10, and low enough to not char the cellulose and wood fiber material present in the waste organic material. In one embodiment, a temperature below about 450 F is used to not char the bedding materials.

**[0058]** For waste organic material that is wet waste bedding, it on average contains approximately 45% moisture. The actual moisture content depends on many factors, including on how the bedding was stored and whether waste piles were covered or not. By heating the waste bedding, an embodiment can produce processed waste bedding having moisture content of between approximately 12 and 14%. If the processed bedding has moisture content of below approximately 10%, then it may be too dry and may not form into a consistent pellet, instead crumbling. If moisture level in the processed waste bedding material is too low, some moisture may be re-added to the processed bedding to bring the moisture content to an acceptable level. For example, if the processed waste bedding has a moisture content of below approximately 10%, then moisture may need to be re-added to allow proper pellets to be made.

**[0059]** Cross screw auger 35 working from each side of the bottom tray directs the processed waste organic material into airlock 34. Airlock 34 prevents hot air from leaving device 10 at the bottom and can force air to travel upward through device 10. A control panel for device 10 can automatically set the incoming hot air temperature to a desired setting by throttling the external heat source either up or down as required, using cool air to reduce temperature and removing cool air to increase temperature. Hot air at the desired temperature travels across the bottom of the lowest auger tray trough, heating it by contact. Heat can be then transferred by induction indirectly to the material being transported by the augers in that trough tray. Hot air also travels to the open end at the bottom of the next trough level and penetrates through the dropping material, adding heat as it surrounds the particles, releasing moisture in the material being tumbled and carried by the augers. In the process, heat contacts the underside of the next tray of troughs above and this process is repeated. This process can be then repeated for all levels of trays in device 10, with hot air being utilized to heat material both directly and indirectly from tray to tray.

**[0060]** In other embodiments, separate heaters and air transport systems can be provided for one or more sections in device 10. In another embodiment, heated air can be injected at the top of the container and can flow concurrently with the direction of movement of the waste organic material downwards to the bottom of the container and can be exhausted at the bottom tray. In other embodiments different gases (e.g. nitrogen) and / or chemicals (e.g. fungicides) can be injected into the air stream for mixing and contacting the waste organic material as it is conveyed through device 10.

**[0061]** During this heating process, moisture released from the wet waste organic material in each section passes upwards to the top tray where it is captured by outlet fan 33 and directed to a moisture separator or a scrubber (not shown) to remove water if it is desired that the heat be reused in another part of the over all system, or this moist air with fine dust particles is directed to the system dust collection system (not shown) where the fine dust is captured and removed from the air stream and the moist air exits the system through an exhausting system (not shown) to atmosphere. Preferably, exhausted air emissions are provided to meet or exceed regulatory air emissions requirements. During the heating process pathogens, mold spores and / or other contaminants are released from the waste organic material through the release of the moisture. These contaminants become airborne and can then be destroyed by the hot air. This destruction is based on a "time and temperature" formula as determined by pathogen/contaminant/mold spore eradication tables known to those of skill in the art and available from laboratories, universities or regulatory bodies.

**[0062]** The system has the capability to regulate the hot air temperatures and control the speed of the material traveling through device 10 to assure compliance with eradication requirements.

**[0063]** During the heating process and pathogen eradication as described above, when the waste organic material is waste organic material, the incoming wet waste organic material is dried to a desired level for either loose animal bedding or for pelletizing into pellets for use as either animal bedding or fuel pellets. The percent of the moisture removed can be controlled in a similar fashion as described above for pathogen eradication. One embodiment processes wet manure that originally has a moisture content of less than approximately 60% and produces an output material that has a moisture content of

approximately 14%. For wet material that has over approximately 60% moisture, the wet material can be windrowed in a storage area for pre-drying using natural airflow (wind).

**[0064]** Processed material that has passed through the entire processing system of device 10 exits device 10 through airlock 34, located at the drop zone of the bottom auger tray. The airlock prevents hot air from escaping device 10 with the processed waste organic material on exit. Airlock 34 in one embodiment is a rotary valve that allows solid material into rotating paddles with little airflow through it. The air can then be directed where needed. The processed waste organic material then enters a conveyor (not shown) and is conveyed to other processes of the over all system where further drying may take place if required. Test samples can be removed from test port 35 for laboratory testing.

**[0065]** The throughput of device 10 is determined by several parameters, including: (i) number of sections or levels of augers in device 10; (ii) number of augers/auger troughs in each tray level; (iii) diameter of the augers; (iv) length of the augers; (v) speed of auger rotation during operation; and (vi) desired level of dryness required. Adjusting any one of these parameters may greatly or minimally impact the throughput and the moisture content of the end product. Aside from structural changes to the components, speeds and temperatures and even inclines may be controlled through a control panel or manually. Embodiments have provided processing times of approximately 10 wet tonnes per hour.

**[0066]** Referring to Figure 6, more elements of a waste processing system according to an embodiment are shown. Device 10 is the main element that processes the waste organic material. Prior to receiving waste organic material at device 10, belt conveyor 60 conveys the raw waste organic material to mixer unit 60. Mixer unit 60 provides an initial churn of the waste organic material and provides a coarse cutting of same. From mixer unit 60, conveyor 64 conveys the churned waste organic material to device 10. Device 10 processes the waste organic material as described above. Power for motors for device 10 may be provided from an electrical source, such as an electrical grid or a generator. Natural gas may be used as an energy source to heat the air provided to device 10. Heated exhaust air from device 10 may be re-cycled to the input hot air stream for device 10. The processed waste organic material provided at the output of device 10 may still require some further processing, if for example, its moisture content is still too high for an intended purpose. If so, the processed waste organic material from device 10 can be provided to a secondary processing stage.

The secondary processing stage may be another device 10 (not shown). Alternatively or additionally, the secondary processing stage may be one or more cyclone heaters 66, which may also have a dust collector 69. Heat for device 10 and cyclones 66 is supplied by heating unit 62. It has been noted that generally device 10 uses less energy to dry materials than cyclonic processes. From heaters 66, the dryer processed waste organic material is provided to intermediate storage silos 68. From silos 68, the processed waste organic material can be provided to pellet mill 70 for extrusion and compression into pellets. The finished pellets may be stored in silos 72 and eventually may be further processed with chemicals and / or heat and may then be used as recycled pellet materials.

**[0067]** For the system, hydraulics may be used to control some operations. Electrical power for the system can be provided from the power grid or be derived from using a natural gas or diesel generator. When a generator is used, heat from the exhaust and radiator of the generator can be reclaimed and directed to various components of the system where heat is needed.

**[0068]** Sources of heat for the air for device 10 can be provided from electrical heaters or a multi-fueled burner with a heat distribution box. Fuel for a burner may be natural gas, diesel, waste oil or bio-fuel, including bio-fuel produced from the waste organic material processed by the system.

**[0069]** The system may be operated by manual controls or through a master control panel with partial or full automation. Automatic responses from various functions of the system may be sent to a master control panel and any necessary production adjustments may be automatically made to improve performance.

**[0070]** Referring to Figure 7, detail is provided on an exemplary waste organic material processing method according to an embodiment.

**[0071]** In block 80, waste organic material is provided to a container at an upper end to a first tray housed in the container. Then, per block 82, the material is conveyed along the first tray by a first pair of screw augers, which churn the material. From after the conveying, at block 84, the method deposits, preferably by gravity, the waste organic material from the first tray to a second tray housed in the container, where the second tray located below the first tray and is oriented to transport the waste organic material in a different direction from movement in the first tray. Next at block 86, the waste organic material is conveyed along

the second tray by a second pair of screw augers, which continue to churn the material. At some instance during the process (e.g. at the beginning, after the beginning and / or at one or more instances after the beginning), hot air is injected into the container to travel along the first and the second trays to heat the waste organic material. For the purpose of illustration and not limitation, the heating process is shown at the end per process 88. It may be initiated at the beginning of the process and operate independently of the conveying processes. Alternatively, the heating process may dynamically change the airflow and heat temperature depending on conditions detected of the processed material in the process.

**[0072]** In the method, the hot air may enter at a bottom of the container, travelling in a direction opposite the waste organic material in the first tray and may exit through a top of the container. Alternatively, the hot air may enter at a top of the container, travelling in a direction with the waste organic material in the first tray and may exit through a bottom of the container.

**[0073]** It will be appreciated that the devices and embodiments described herein relate to processing waste organic material. Other embodiments may process other materials, such as woodchips, grains, minerals, seeds, etc. Other embodiments may be provided to process liquids. In such liquid processing systems, waterproofing of trays may be provided. Different conveying speeds for device 10 and different heating temperatures may be provided to accommodate the characteristics of the processed material.

**[0074]** As used herein, the wording “and / or” is intended to represent an inclusive-or. That is, “X and / or Y” is intended to mean X or Y or both.

**[0075]** In this disclosure, where a threshold or measured value is provided as an approximate value (for example, when the threshold is qualified with the word “about”), a range of values will be understood to be valid for that value. For example, for a threshold stated as an approximate value, a range of about 25% larger and 25% smaller than the stated value may be used. Thresholds, values, measurements and dimensions of features are illustrative of embodiments and are not limiting unless noted. Further, as an example, a “sufficient” match with a given threshold may be a value that is within the provided threshold, having regard to the approximate value applicable to the threshold and the understood range of values (over and under) that may be applied for that threshold.

**[0076]** Although a preferred embodiment has been disclosed for purposes of illustration, it should be understood that various changes and modifications and substitutions could be made in the preferred embodiment without departing from the spirit of the invention as defined by the claims which follow.

## Claims

1. A processor for waste organic material, comprising:
  - a container having an opening on an upper side to admit said waste organic material and an outlet on a lower side to remove processed waste organic materials from the container;
  - a first tray housed in said container to receive said waste organic material from said opening, said first tray comprising a first pair of screw augers to move said waste organic material along said first tray, said first tray terminating short of said first pair of screw augers;
  - a second tray housed in said container to receive said waste organic material from said first tray, said second tray comprising a second pair of screw augers to move said waste organic material along said second tray in a different direction of movement in said first tray, said second tray terminating short of said second pair of screw augers; and
  - a source of hot air provided to said container travel along said first and said second trays to heat said waste organic material.
2. The processor as in claim 1, wherein:
  - said hot air enters at a bottom of said container, travelling in a direction opposite said waste organic material in said first tray and exits through a top of said container.
3. The processor as in claim 1, wherein:
  - said hot air enters at a top of said container, travelling in a direction with said waste organic material in said first tray and exits through a bottom of said container.
4. The processor as in claim 1, wherein said first pair of screw augers are parallel to each other.

5. The processor as in claim 1, wherein said waste organic material moves said in second tray in an opposite direction of movement in said first tray.
6. The processor as in claim 5, including a controller to control the rate of input of said waste organic material.
7. The processor as in claim 5, wherein said hot air provided to said container is heated to a temperature to kill pathogens and mold spores in said waste organic material.
8. The processor as in claim 7, wherein said temperature is less than approximately 450 Fahrenheit.
9. The processor as in claim 5, wherein at least one of said augers includes knives or cutting edges to remove lumps from said waste organic material.
10. The processor as in claim 3, wherein:  
said first tray is oriented to be horizontal.
11. The processor as in claim 3, wherein said container comprises:  
a first sub-container for housing said first tray;  
a second sub-container for housing second first tray, said second sub-container mating with said first sub-container; and  
a lifting mechanism to lift said first sub-container from said second sub-container.
12. A device for processing organic material, comprising:  
a substantially closed container including an input opening and an output opening;

a first tray to receive said organic material from said opening, said first tray comprising a first pair of screw augers to move said waste along said first tray, said first tray terminating short of said first pair of screw augers;

a second tray to receive said organic material from said first tray, said second tray comprising a second pair of screw augers to move said organic material along said second tray in an opposite direction of movement in said first tray, said second tray terminating short of said second pair of screw augers; and

a heat source providing heated air to said container to remove pathogens, mold spores and odours from said organic material.

13. The device for recycling material as claimed in claim 12, wherein the waste organic material is equine bedding.

14. A method for processing waste organic material, comprising:

receiving said waste organic material to a container at an upper end to a first tray housed in said container;

conveying said waste organic material along said first tray by a first pair of screw augers;

depositing by gravity said waste organic material from said first tray to a second tray housed in said container, said second tray located below said first tray and oriented to transport said waste organic material in a different direction of movement in said first tray;

conveying said waste organic material along said second tray by a second pair of screw augers; and

injecting hot air into to said container to travel along said first and said second trays to heat said waste organic material.

15. The method for processing waste organic material as claimed in claim 14, wherein:

said hot air enters at a bottom of said container, travelling in a direction opposite said waste organic material in said first tray and exits through a top of said container.

16. The method for processing waste organic material as claimed in claim 14, wherein:  
said hot air enters at a top of said container, travelling in a direction with said waste organic material in said first tray and exits through a bottom of said container.
17. The method for processing waste organic material as claimed in claim 16 wherein:  
a temperature of said hot air is less than approximately 450 Fahrenheit.

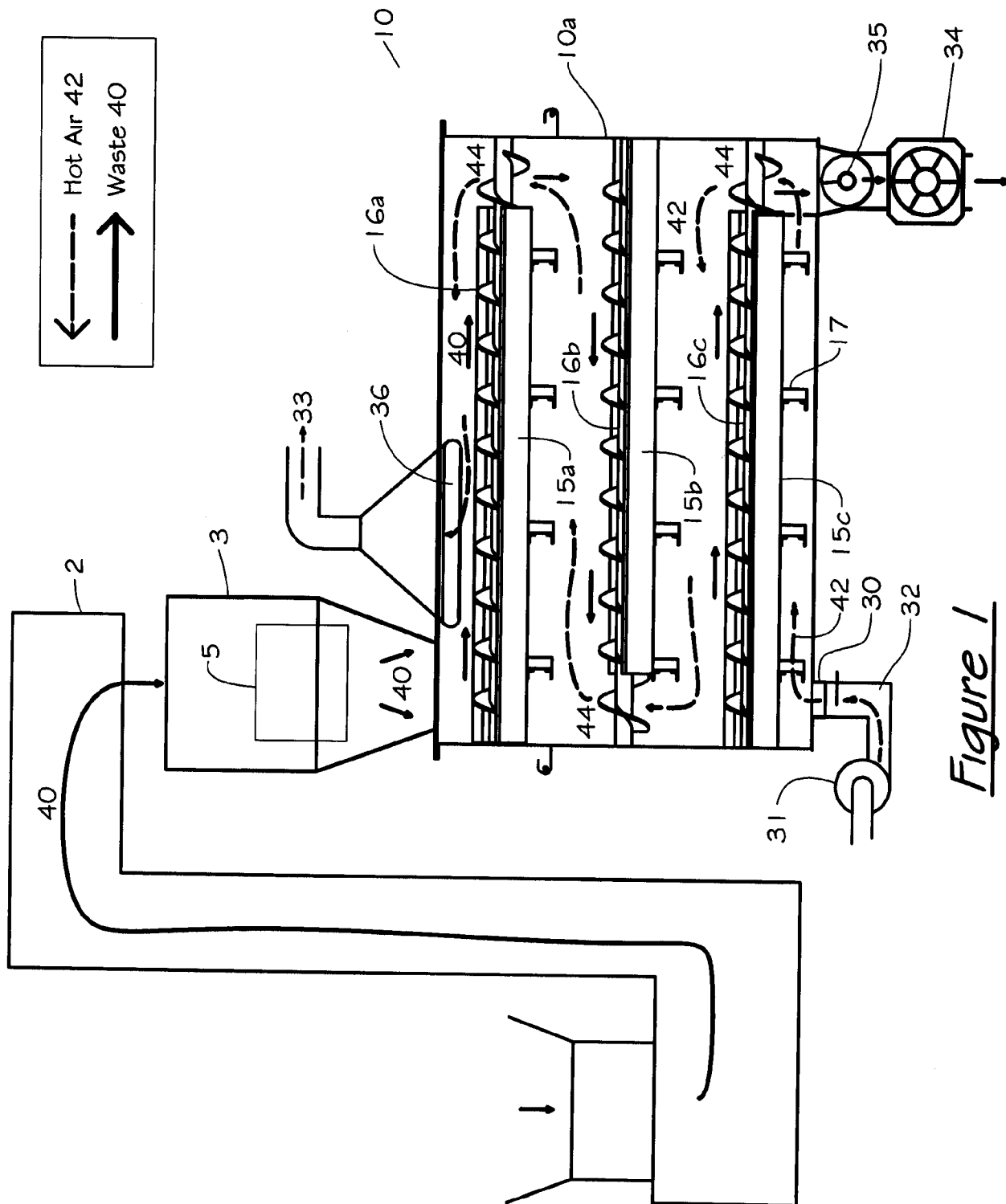
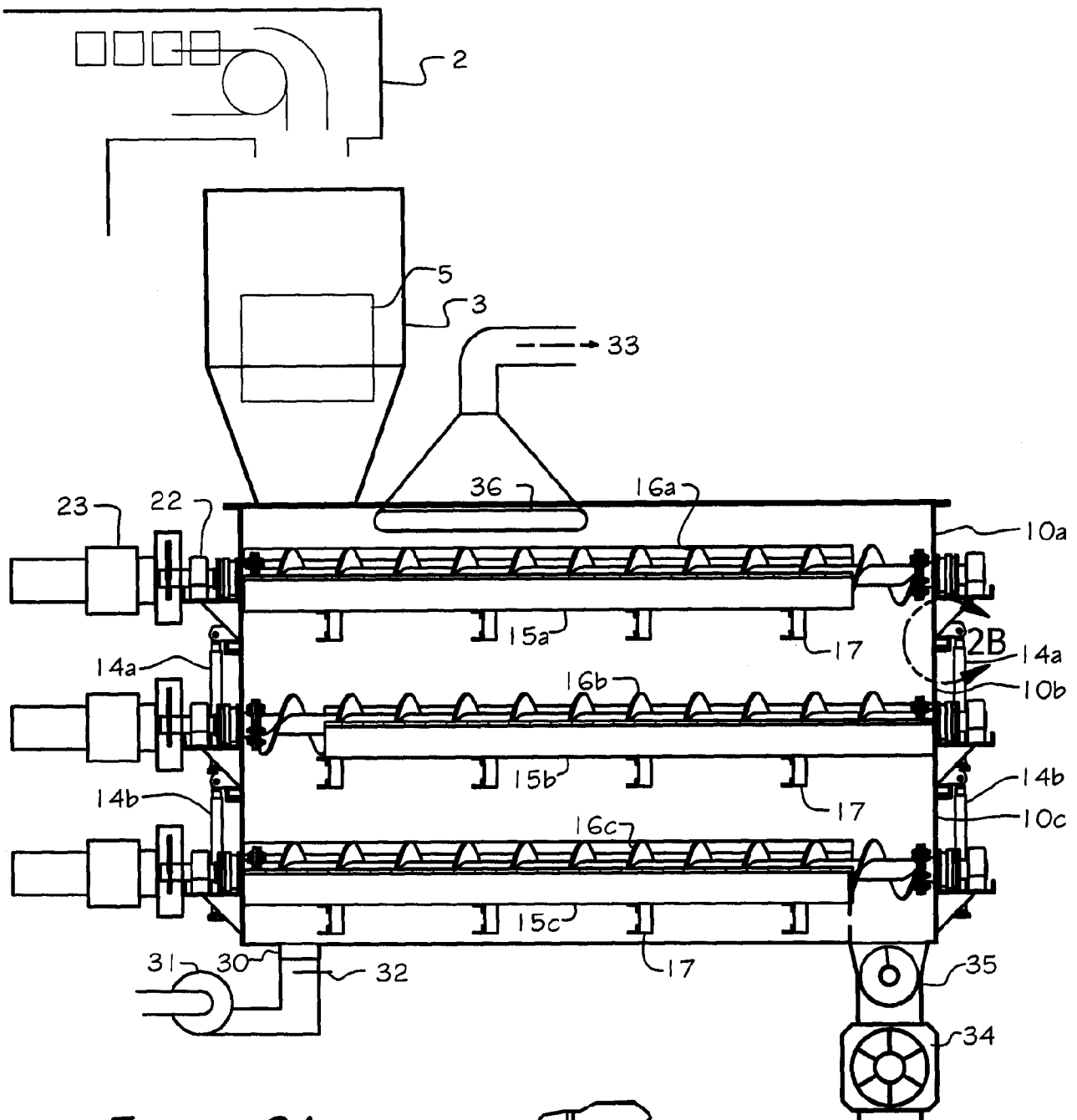
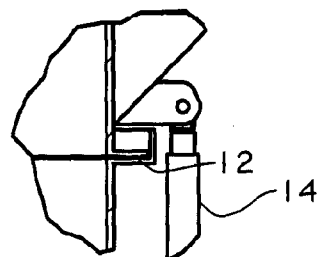


Figure 1

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Figure 2AFigure 2B

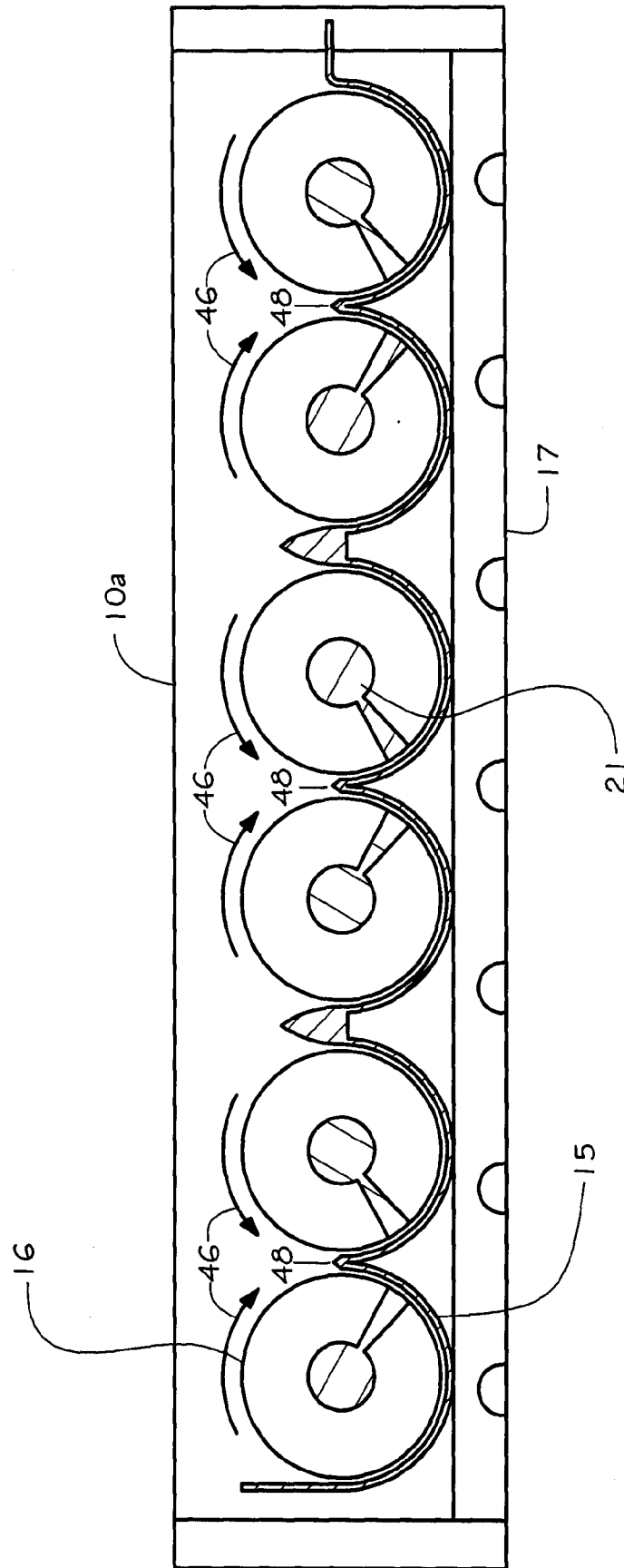


Figure 3

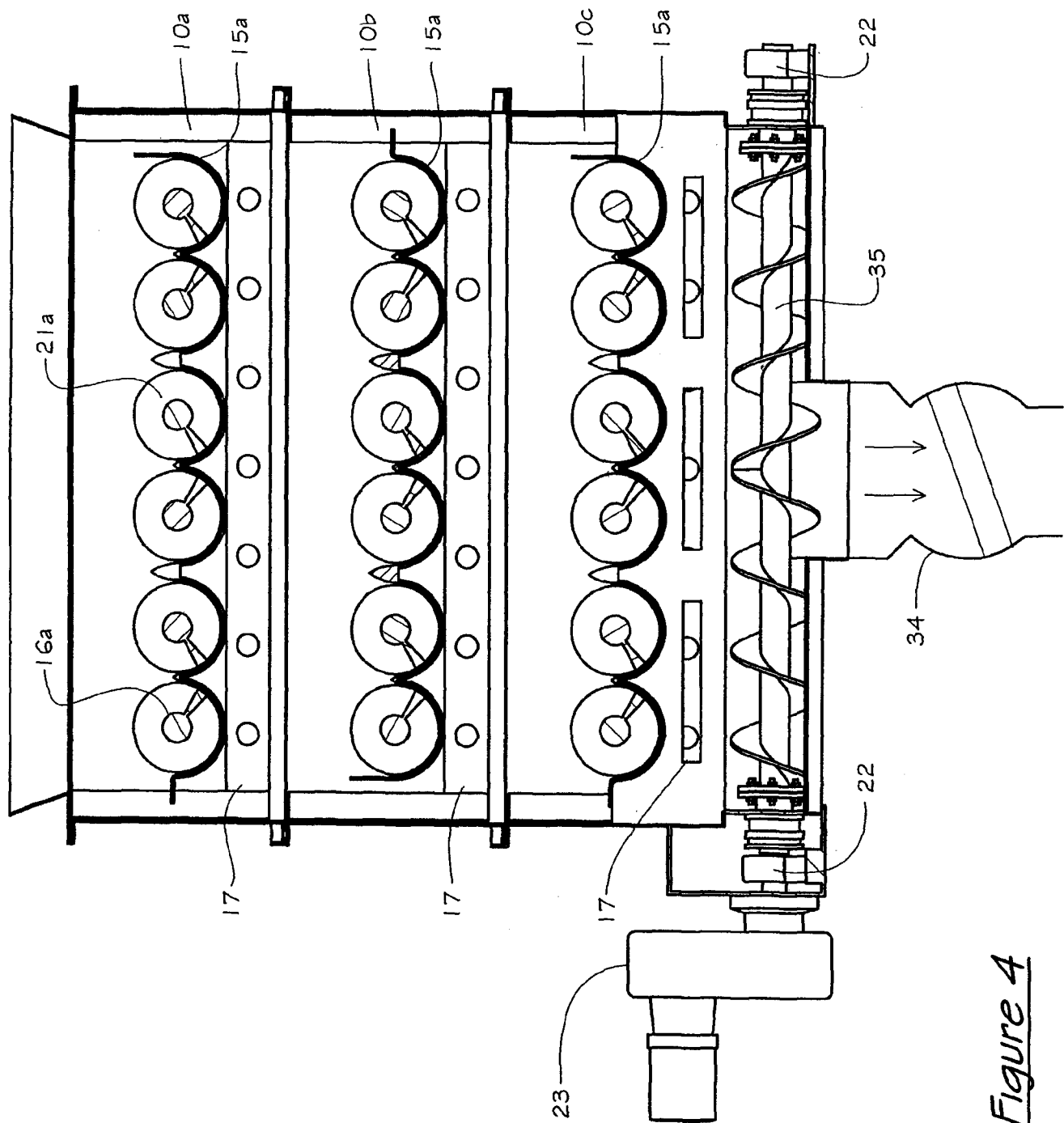


Figure 4

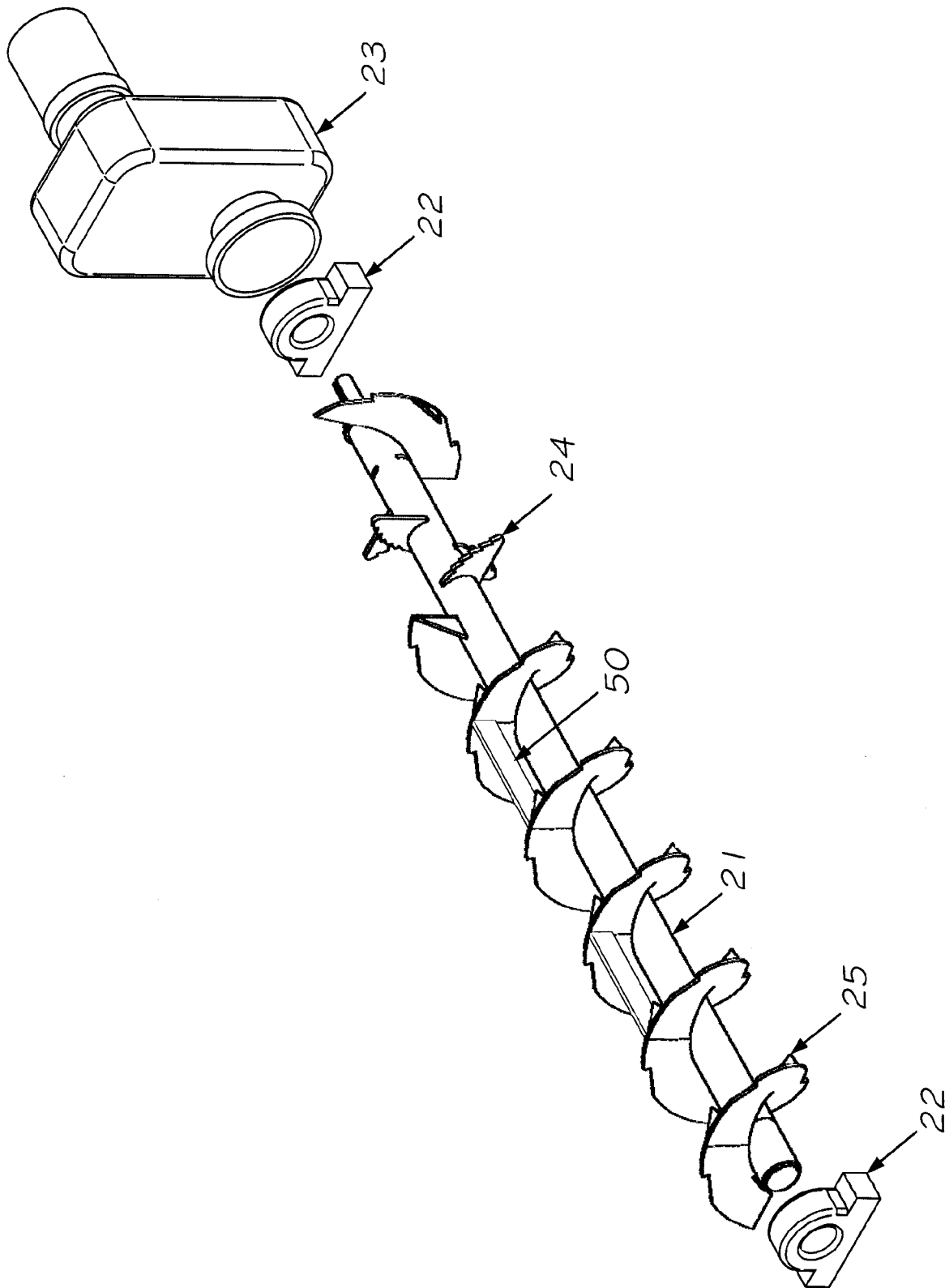
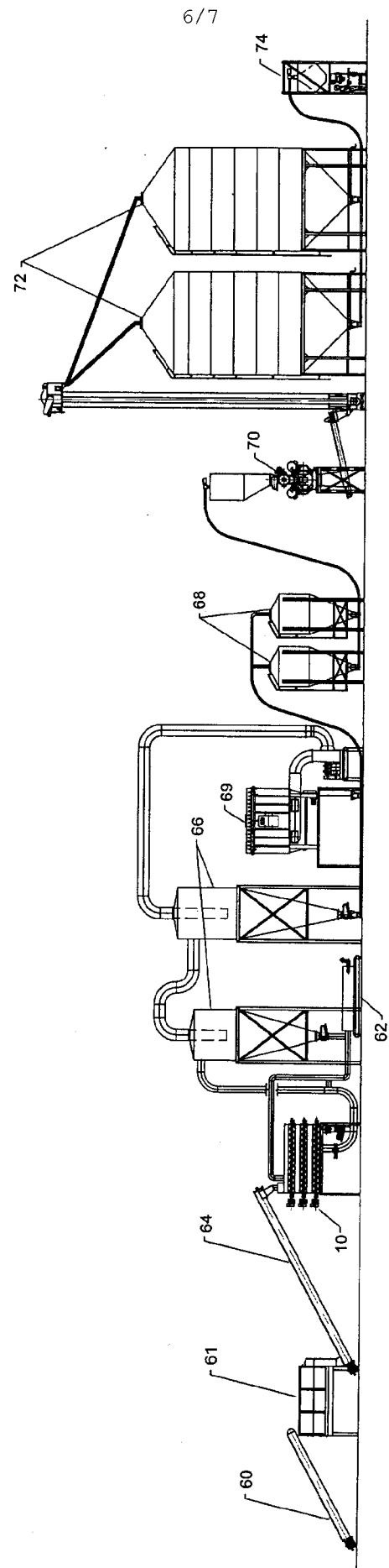


Figure 5:

Fig 6



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Figure 7