United States Patent

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[72] Inventors **Victor Brown**
Elmhurst;
Ingvar G. Anderson, Wheaton, Ill.; Daniel Boscawin Vincent, Tampa, Fla.

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[73] Assignee **New Life Foundation**
a not-for-profit corporation of Illinois

[54] **APPARATUS FOR COMMINUTING COMPOST**
2 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **241/86**
[51] **Int. Cl.** **B02c 13/18**
[50] **Field of Search** ..... 241/73, 74, 86, 88, 188, 275, (Cursory); 24/191, 194

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Primary Examiner—Robert C. Riordon
Assistant Examiner—Donald G. Kelly
Attorney—Allegrette, Newitt & Witcoff

ABSTRACT: Apparatus is provided for comminuting town waste compost in the form of a vertically disposed foraminous cylinder within which a shaft having a plurality of radial shearing arms rotates rapidly for shearing the compost and forcing it through the perforations of the cylinder so that the resulting product consists of particles of substantially uniform size less than ¼-inch mean diameter. The cylinder is made from abrasion-resistant metal and has from about 50 percent to 65 percent of its surface area closed and the remainder of the surface open in the form of perforations.

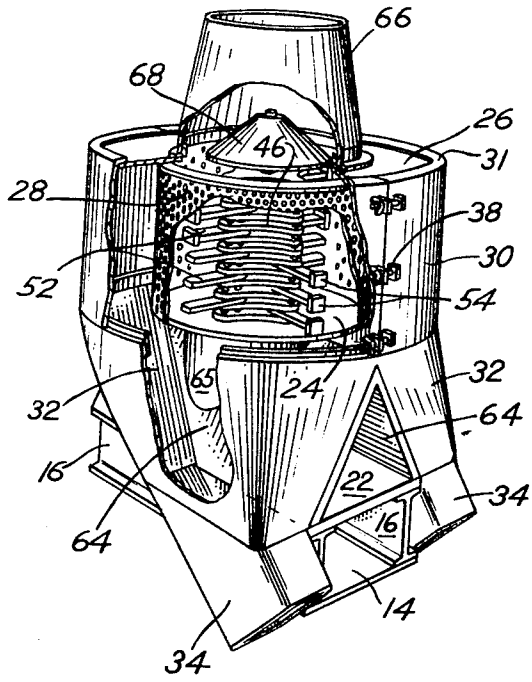


Fig. 1

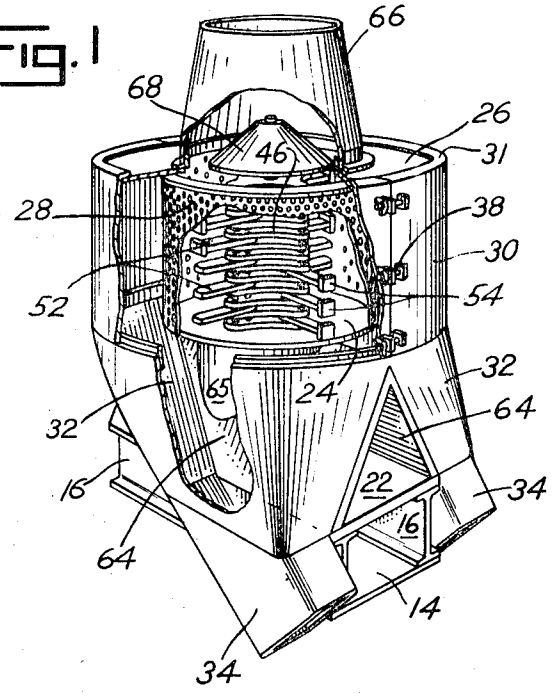


Fig. 2

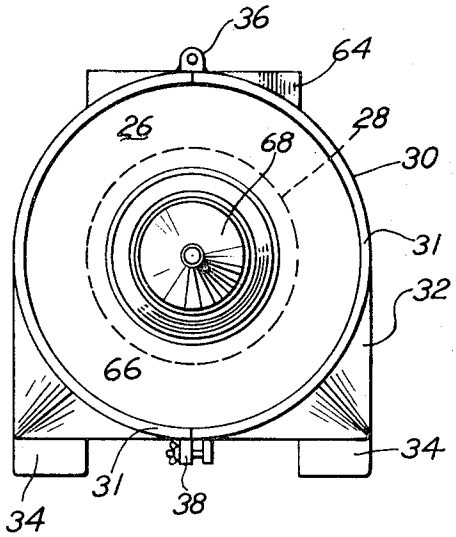


Fig. 3

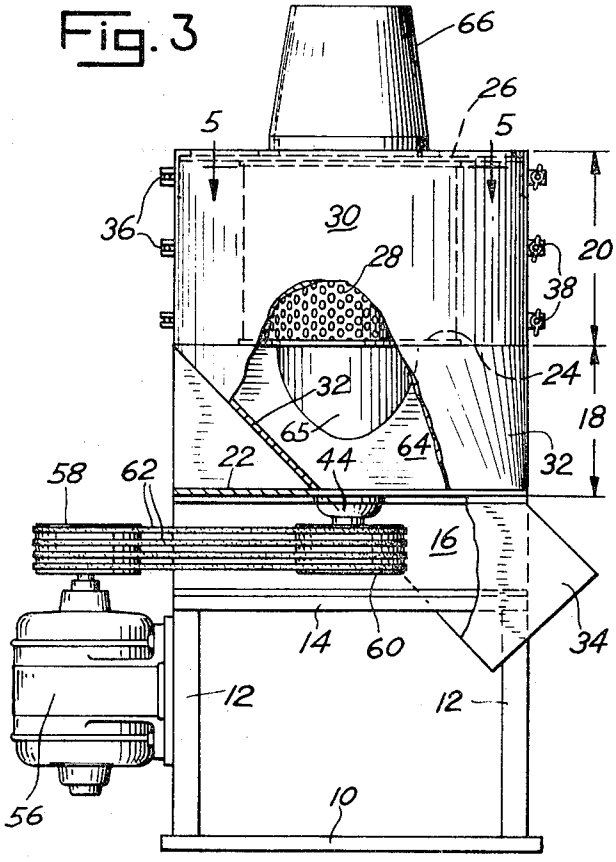
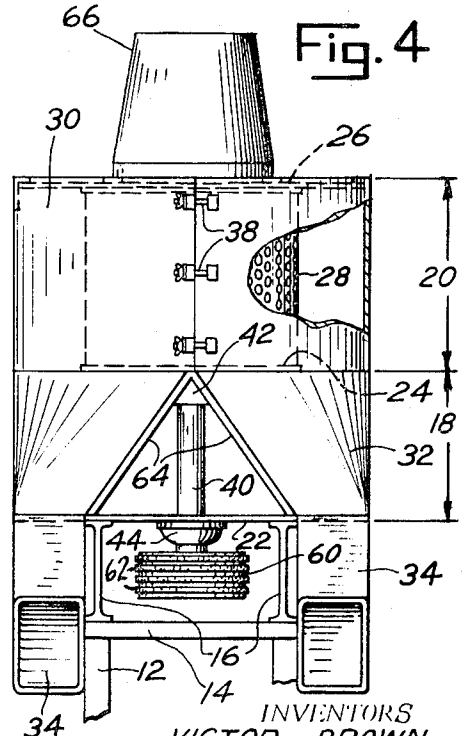


Fig. 4



INVENTORS
VICTOR BROWN,
INGVAR G. ANDERSON
& DANIEL B. VINCENT
by Bair, Freeman & Molinare
ATTORNEYS

Fig. 5

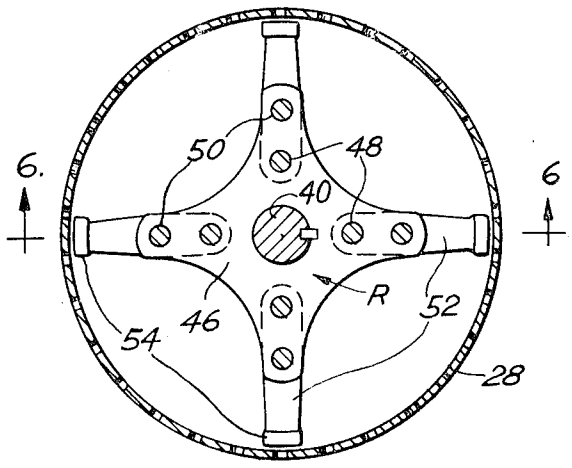


Fig. 6

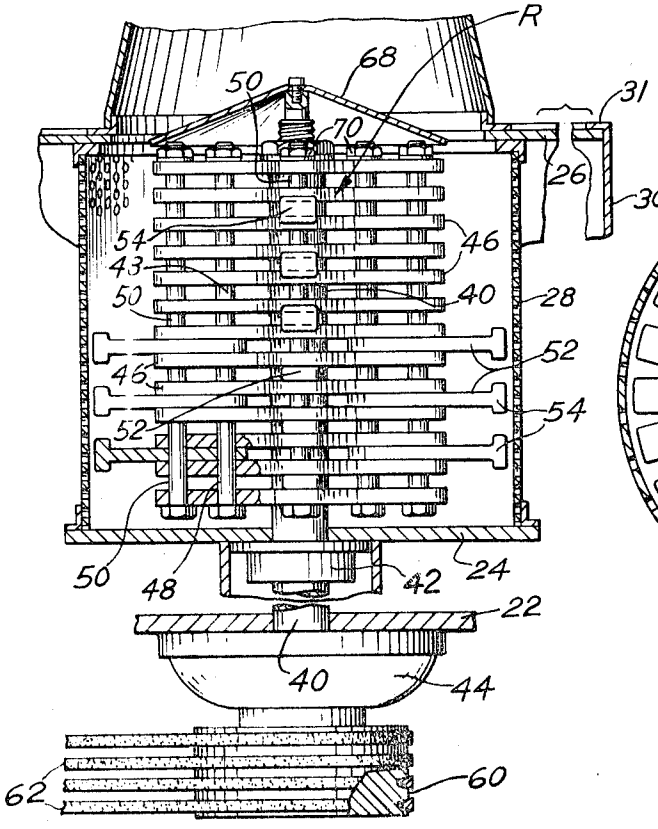
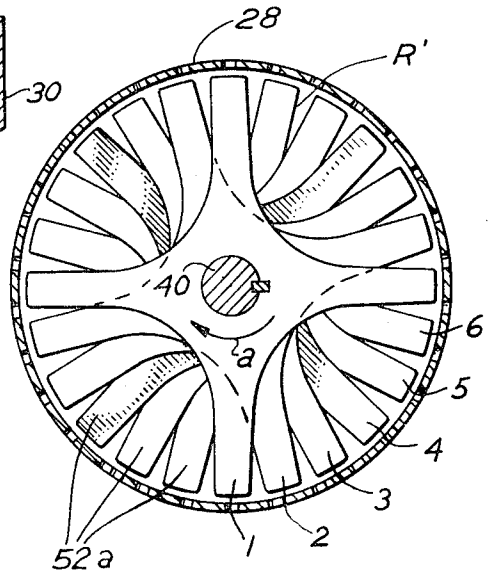


Fig. 7



INVENTORS
VICTOR BROWN,
INGVAR G. ANDERSON
& DANIEL B. VINCENT
by Bair, Freeman & Molinare
ATTORNEYS

APPARATUS FOR COMMINUTING COMPOST

One object of the invention is to provide an apparatus for comminuting compost which comprises a vertical foraminous cylinder surrounded by a collecting shroud and within which is mounted a rotor specially designed to coact with the foraminous cylinder to rapidly comminute large quantities of town waste compost.

Another object is to provide such apparatus designed for economical operation with great efficiency compared to the size of the apparatus.

Still another object is to provide a rotor for cooperation with a foraminous cylinder comprising a vertical stack of spiders to which shearing arms are rigidly secured and which extend to a diameter closely adjacent the innersurface of the foraminous cylinder to coact with the perforations thereof in shearing the compost and forcing it through the perforations.

An additional object is to provide a chute for collecting the comminuted compost after it is forced through the perforations of the foraminous cylinder.

Another additional object is to utilize the apparatus in an efficient manner which includes adjusting the moisture content of the compost to between 25 percent and 60 percent by weight and continuously feeding the compost into the foraminous cylinder wherein the rotor cooperates with the cylinder in effecting such feeding in the form of a vertically moving layer, the particles of which are sheared by the shearing arms of the rotor and forced through the perforations of the foraminous cylinder, issuing therefrom with a uniform size of less than ¼-inch mean diameter whereupon the comminuted compost may be collected and utilized as fertilizer.

Still another additional object is to provide apparatus which efficiently comminutes the compost by the cooperation of the shearing arms with a foraminous surface which is 35 percent to 50 percent open area.

With these and other objects in view our invention consists in the construction, arrangement and combination of the various parts of our apparatus for comminuting compost, and in the steps of the method involved, whereby the objects above contemplated are attained, as hereinafter more fully set forth, pointed out in our claims and illustrated in detail on the accompanying drawings, wherein:

FIG. 1 is a perspective view of an apparatus embodying my invention for comminuting town waste compost.

FIG. 2 is a plan view thereof.

FIG. 3 is a side elevation thereof with portions broken away and other portions shown in section.

FIG. 4 is a rear elevation thereof viewed from the discharge side of the apparatus.

FIG. 5 is an enlarged sectional view on the line 5–5 of FIG. 3.

FIG. 6 is a sectional view on the line 6–6 of FIG. 5, and

FIG. 7 is a plan view somewhat similar to FIG. 5 showing a modified form of rotor and the foraminous cylinder of the apparatus.

On the accompanying drawings we have used the reference numeral **10** to indicate a base, **12** to indicate uprights, **14** to indicate a plate and **16** to indicate I-beams which together form a supporting framework for our comminuting apparatus. A lower plate **22** is mounted on top of the I-beams **16** above which are a drive and chute assembly **18** and a comminuting section **20** as indicated in the space between FIGS. **3** and **4**. The lower plate **22** is located at the bottom of section **18** and an intermediate plate **24** is located at the junction between the sections **18** and **20** while an upper plate **26** is provided at the top of the comminuter section.

A foraminous cylinder **28** extends between the plates **24** and **26**. A cylindrical shroud **30** surrounds the cylinder **28**, is spaced therefrom and provides an enclosure in conjunction with the upper plate **26**. A transition shroud **32** which terminates at its lower end in a pair of discharge chutes **34** serves to interconnect the plates **22** and **24**. The shroud **30** is readily removable for replacement when required and for gaining access to the foraminous cylinder **28** and a rotor R within the cylinder as will hereinafter appear. For this purpose the shroud **30** is formed in two parts hinged together at **36** at one side and provided with clamp bolts **38** at the opposite side.

The rotor R comprises a shaft **40** supported in an upper bearing **42** and a lower bearing **34**. The latter includes a thrust bearing. A plurality of spiders **46** are keyed to the shaft **40** and have four arms as shown in FIG. **5** provided with inner and outer tie rods **48** and **50**. Shearing arms **52** are fixed to the spiders **46** by means of the tie rods **48** and **50** and some of the shearing arms may be provided with club heads **54**. After assembly, the rotor is carefully balanced for smooth, high-speed rotation and is of course rebalanced whenever necessary by reason of uneven wear on the arms **52** and their club heads **54**.

For rotating the shaft **40** and thereby the rotor R we provide a motor **56** such as one of electric type having a drive pulley **58** on the shaft thereof for driving a driven pulley **60** on the shaft **40** as shown in FIG. **3**. A plurality of V-belts **62** afford transmission of power from the pulley **58** to the pulley **60**.

Within the drive and chute section **18** a pair of sloping walls **64** are provided to deflect the comminuted material away from the shaft **40** and its bearings **42** and **44**. These walls also direct the material toward the discharge chutes **34**, and together with a tube section **65** serve to reinforce the transition shroud **32** and the plates **22** and **24**.

A feed chute **66** is provided for feeding the material to be comminuted to the interior of the foraminous cylinder **28**, and is preferably of truncated cone shape with its large end down to prevent any possibility of the material, which may be fed to the chute by a conveyor or the like, packing and therefore clogging the comminuting apparatus. A protective cone **68** is secured to the top of the shaft **40** for protecting the nuts **70** on the upper ends of the tie rods **48** and **50** from wearing away and thereby becoming weakened by the abrasive action of the material fed into the comminuter.

The foraminous cylinder **48** is preferably made from highly abrasion-resistant sheet metal and the perforations are such size and spacing as to provide approximately 35 percent to 55 percent openings compared to the area of the cylinder. It will be noted that 18 of the shearing arms **52** are illustrated in FIGS. **1** and **6** and that only some of them are provided with the club heads **54**. The number and disposition of the arms may be varied and also the number and disposition of the club heads. (Compare FIG. **6** with FIG. **1**).

The rotor R is so designed that there is considerable horizontal space between consecutive arms (see FIG. **5**) for the entrance for the material to become comminuted. Accordingly, the arms impact the material and tend by centrifugal force to provide a continuous feeding action of the material in a vertically downwardly moving layer on the inner surface of the foraminous cylinder **28**. By omitting some of the upper arms (having them 180° apart instead of 90°) more space is provided for the material as it enters the comminuter. Some of the material of course gravitates toward the lower arms and I find this arrangement produces a better distribution of the material within the cylinder and a more efficient operation than when the maximum (**24** arms) is used.

A suitable speed of rotation for the rotor R is 1,200 r.p.m. With a cylinder **28** some 3 feet in diameter this gives a speed relationship between the outer ends of the shearing arms **52** and the adjacent surface of the cylinder **28** about 11,000 feet per minute. Lower speeds are suitable however, even down to 8,000 feet per minute.

Experiment has shown that a suitable diameter for the perforations in the cylinder **28** is nine-sixteenths inches with about ½-inch spacing between adjacent edges of holes. This produces about 40 percent to 45 percent area of openings in relation to the total surface of the cylinder and this percentage may be varied both upwardly and downwardly to some extent and still secure satisfactory results.

In FIG. **7** we show a modified form of rotor R′ comprising spiders **46***a* having rigid shearing arms **52***a*. The spiders are so keyed to the shaft that the spiders and arms are spirally arranged within the foraminous cylinder **28**. Thus, the arms progress circumferentially as indicated by the reference nu-

merals 1, 2, 3, 4, 5 and 6 in spiral manner, the spider for the arms 2 being shown dotted below the spider for the arms 1. Thus, when the direction of rotation of the rotor R' is clockwise as indicated by the arrow *a*, the progressively downward moving body of material to be comminuted flows more readily and evenly into the rotor to be engaged by the successive shearing arms.

Town waste compost produced by the composting apparatus and method disclosed in the Victor Brown U.S. Pat. No. 3,294,491 has a moisture content approximately 60 percent which is suitable for comminution of the compost with the comminuting apparatus herein disclosed. The moisture content is to some extent critical and a range of 40 percent to 50 percent by weight is desirable as with that range we have obtained our best results. Our comminuting apparatus can operate with some sacrifice of efficiency down to 25 percent and up to 60 percent. It is therefore usually desirable and sometime necessary to reduce the moisture content from the 60 percent product of the apparatus in the patent, preferably to the range of 40 percent to 50 percent for satisfactory and efficient operation of the comminuting apparatus herein disclosed.

The compost material received from the composting apparatus of the Brown patent consists of pieces of paper, plastic and other material, about fines to 1 ½inches flat shredded aggregate. With 60 percent moisture such material has a 45° angle of repose. The material is composted sufficiently to result in substantially the same size of particles with an overall brown color.

We have tried hammer mills of the horizontal grinder type with both swinging and rigid hammers, also with knife hammers, but because of the fibrous material constituting part of the compost, the fibers were beaten and stretched with a churning action which rapidly wore out the hammers. After considerable experiment we found an apparatus substantially of the type herein disclosed the most satisfactory from the standpoint of producing the desired type of comminuted material with a minimum of power to operate the apparatus and comparatively great capacity for the size of the apparatus. A 3 -foot diameter foraminous screen was found to be capable of handling 5 tons of compost per hour at the specifications for surface speed and sizes of parts heretofore mentioned and when utilizing a **150 HP** motor **56**. These values may, of course, be proportionally changed for other capacities.

The design is such that the material can flow between the shearing arms and reach the foraminous cylinder where it is sheared by the cooperation of the outer ends of the shearing arms **52** and the club heads **54** thereon with the openings in the foraminous cylinder **28**. The arrangement produces a uniform application of force of the material against the foraminous cylinder equally distributed, and the speed determines how much space there is to permit entry of the compost into the rotor. Just the right amount of material within a somewhat narrow range must be on the foraminous cylinder and flow downwardly therealong. Using the club heads **54** resulted in the foraminous cylinder lasting longer as the wear was more evenly distributed. Also the screen can be inverted end-for-end after a certain amount of wear which affects the downstream edges of the perforations, and the life of the cylinder is thereby substantially doubled.

The apparatus is designed so that everything entering it must go through the perforations in the cylinder **28** with a cutting or shearing action as between the shearing arms and the edges of the perforations rather than an extrusion action. If the material is too dry it blows through the perforations and gets fuzzy. It must accordingly have at least 25 percent moisture to prevent blowing through. If the moisture exceeds about 60 percent, the material agglomerates in the angular space next to the inner surface of the cylinder and won't flow downwardly. The preferred range of moisture is 40 percent to 50 percent.

The material entering the apparatus is very abrasive and has a tendency to wear away the nuts **70** so that they lose their holding power. The protective cone **68** is therefore provided to deflect the material away from the nuts.

The hammers **52** and the cylinder **28** may be high-carbon steel, carburized or heat treated, or if desired the cylinder may be made of a high-carbon abrasive material.

The resulting comminuted product issuing from the discharge chutes **34** is a uniform compost, all of which is saleable, whereas prior methods and apparatus required leaving the compost dormant for as much as 12 months and then screening it to produce uniformity. Accordingly, some of the compost was discarded by these prior methods.

By having the axis of the foraminous cylinder vertical and the rotor and the rotating on a vertical axis, 360° of cutting or shearing surface is provided.

Some changes may be made in the construction and arrangement of the parts of our apparatus for comminuting compost without departing from the real spirit and purpose of our invention, and it is our intention to cover by our claims any modified forms of structure, use of mechanical equivalents or use of equivalent methods which may reasonably be included with their scope.

We claim:

1. Comminuting apparatus for comminuting highly abrasive town waste materials comprising a vertically disposed foraminous cylinder, said cylinder being made from abrasion-resistant metal and having from about 50 percent to about 65 percent of its cylindrical surface area closed and the remainder of said surface area open in the form of perforations, a vertical shaft mounted for rotation within said cylinder, a plurality of radial shearing arms rigidly secured to said shaft in vertical and circumferential array, said arms being balanced about said shaft for smooth, high-speed rotation, said arms terminating adjacent said cylinder, a portion of said arms terminates in enlarged heads and the remainder of said arms being without said enlarged heads, power means for rotating said shaft, and means surrounding said cylinder for collecting comminuted material which passes through said foraminous cylinder.

2. Comminuting apparatus in accordance with claim **1** wherein said radial shearing arms are rigidly secured to said shaft through spiders keyed to said shaft, said shearing arms are disposed in vertically staggered relationship to provide uniform shearing force between said shearing arms and said foraminous cylinder, and said shearing arms are circumferentially spaced to permit flow of said materials.