

**Dec. 21, 1965**

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**3,224,839**

SYSTEM FOR COMMUNTING REFUSE

Filed April 6, 1961

2 Sheets-Sheet 1

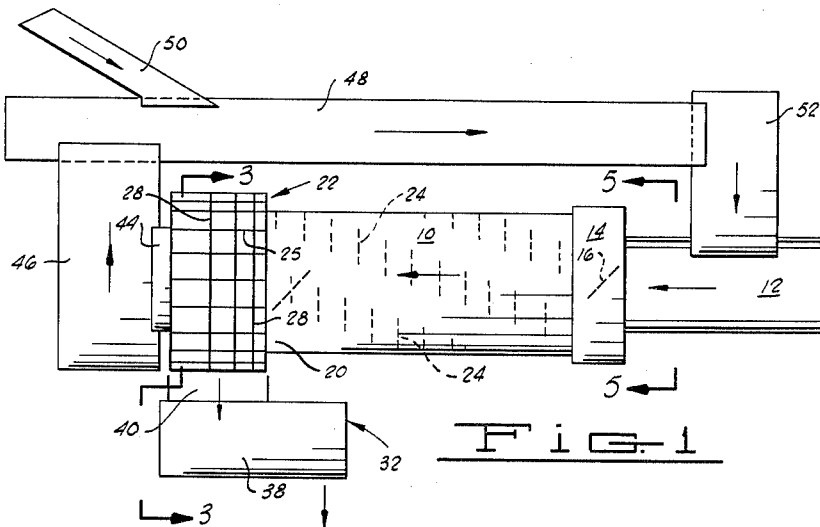
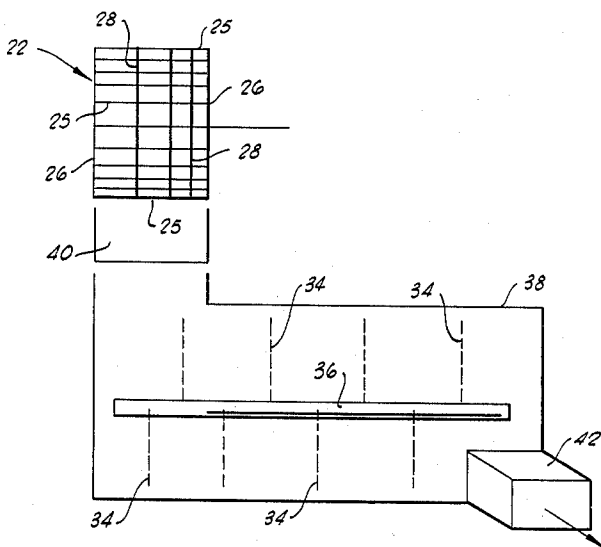


Fig. 2

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2 Sheets-Sheet 2

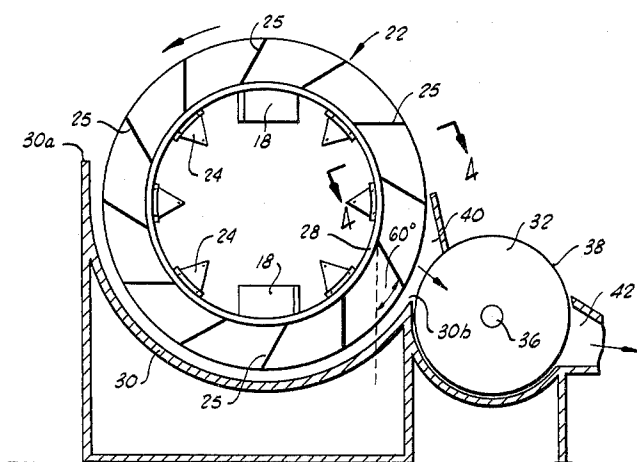


Fig. 3

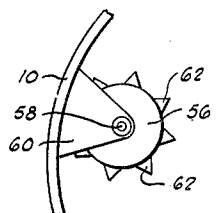


Fig. 7

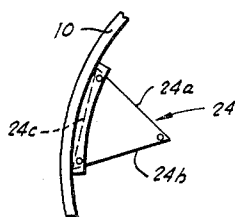


Fig. 6

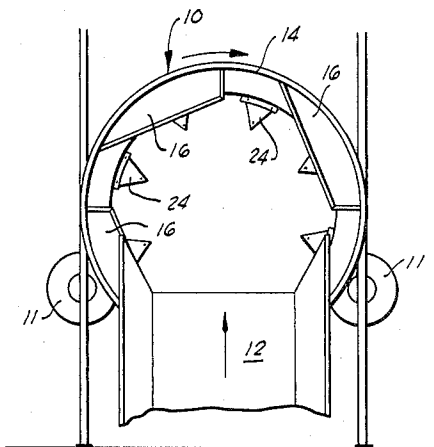


Fig. 5

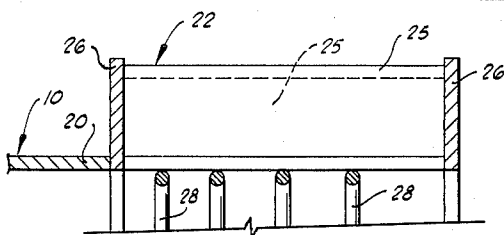


Fig. 4

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3,224,839

## SYSTEM FOR COMMINUTING REFUSE

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13 Claims. (Cl. 23-259.1)

This invention relates to a system for reducing the average particle size of a mixture of heterogeneous materials. More particularly, but not by way of limitation, the present invention relates to a system for pulverizing and grinding municipal refuse and analogous waste materials.

In the process of preparing a beneficial compost from municipal refuse by bacterial decomposition, it is necessary to treat the raw refuse in several ways prior to subjecting it to bacterial digestion in the final composting operation. Thus, the refuse must be homogenized and adjusted in moisture content prior to charging it to the digesting cells. In homogenizing the refuse, the refuse must be brought to a relatively uniform particle size, which particle size is substantially lower than the average particle size occurring in the raw refuse. Since the raw refuse, that is, the refuse in the form in which it is collected throughout the municipality, may contain relatively large and hard objects such as boards, pieces of sheet metal and chunks of glass as well as relatively small particulate matter and liquids, the problem of pulverizing or reducing the particle size of such a heterogeneous mass is one which requires special equipment. Such equipment must be capable of reducing the particle size of such objects as steel plates and panels of glass while also effectively functioning to reduce the particle size of relatively soft material such as cardboard boxes, newspapers, grapefruit rinds and the like.

The present invention contemplates a novel system for comminuting municipal refuse which, in its broadest and most basic aspect, comprises a large pulverizing device for effecting an initial particle size reduction in which the large, bulky, relatively hard materials are those which are primarily affected, a metering device for classifying according to particle size the material discharged from the pulverizing device, and a chain grinder for effecting the final particle size reduction and homogenization.

The pulverizing device comprises a large, horizontally mounted, rotatable drum having, in a preferred embodiment, a plurality of triangular-shaped blades mounted on the inner periphery of the drum for puncturing cans and cutting metal plates, fracturing glass, and otherwise, grinding, cutting and tearing large, bulky or hard objects into smaller pieces. The raw refuse material is fed into the pulverizing drum by means of a series of sweep blades located at the intake end of the drum and pitched with respect to the axis of rotation of the drum so that refuse fed into the drum is forced by the sweep blades into the interior of the drum. Similar sweep blades are located adjacent the discharge end of the drum so that material inside the drum which has been subjected to the action of the blades is swept out of the discharge end of the drum.

At the discharge end of the pulverizing device, a novel metering device is secured to the drum for rotation therewith and functions to classify the pulverized material discharged from the drum according to particle size. The metering device is constructed to allow the pulverized refuse which is of relatively smaller particle size to be discharged laterally from the metering device at a point which is closer to the drum than the point of discharge of those particles which are of relatively larger particle size. In other words, the latter particles are discharged laterally from the metering device at a point which is further removed from the discharge end of the drum in a direction measured along the axis of rotation of the drum.

2

Materials which have not been effectively pulverized by the blades within the drum, and which therefore remain of a size too large to be discharged laterally from the metering device, are passed through the metering device and discharged from one end thereof. At this point they are picked up by a suitable conveyor system and recycled to the intake end of the pulverizing drum.

The third major element of the system of the present invention is the chain grinding device which is located to one side of the metering device for receiving the lateral discharge of classified pulverized refuse therefrom. The chain grinder is oriented with respect to the metering device so that the particles of smaller size which are laterally discharged by the metering device are caused to enter the chain grinder at a point intermediate its length. Larger particles discharged from the metering device enter the end portion of the chain grinder and thus travel farther through the chain grinder than the smaller particles. They are therefore subjected to a substantially greater amount of grinding action than the smaller particles entering the grinder intermediate its length.

By virtue of this arrangement of the large pulverizing drum, the metering device and the chain grinder, along with the associated conveyor system for recycling certain materials through the pulverizing device, overloading of the chain grinder at any time is avoided. Moreover, the comminution of such difficultly grindable objects as rocks, tree limbs, metal plates, tin cans and bedsprings is effectively accomplished. The position of the grinder to one side of the metering device and pulverizing drum allows the comminuting system to be compactly and economically constructed. Also, in recycling a portion of the refuse discharged from the pulverizing drum back through the drum for one or more additional passes, incoming raw refuse may be partially inoculated with bacteria and spores which have had an opportunity for development and growth during the passage of the recycled refuse through the pulverizing drum and over the recycling conveyors. The recycling system also affords an opportunity to add a suitable inoculant to the recycled refuse material so that an enriched bacteria and fungus content may be developed in the refuse being comminuted in the system.

From the foregoing, it will be perceived that one of the important objects of this invention is to provide a comminuting system which is capable of effecting a substantial reduction in the average particle size of a mass of heterogeneous materials.

A further object of the present invention is to provide a comminuting system for utilization in homogenizing a mass of municipal refuse, which system, by its construction, allows such refuse to be inoculated with an inoculant containing beneficial bacteria during the process of particle size reduction.

An additional object of the present invention is to provide a two-stage particle size reduction apparatus in which the second stage reduction is enabled to proceed more economically and efficiently by the interposition of metering means between the two stages for classifying the discharge from the first stage according to particle size before such discharge is introduced to the second stage.

An additional object of the present invention is to provide a pulverizing device which may be more efficiently utilized for pulverizing a mass of heterogeneous materials of widely varying size and quality.

An additional object of the present invention is to provide a compact, ruggedly constructed system for effectively reducing the average particle size of raw municipal refuse.

An additional object of the present invention is to provide a system for pulverizing and grinding a mass of heterogeneous materials, which system is relatively eco-

nomical to construct, is characterized by the absence of complicated and delicate elements, and is characterized by a long and trouble-free operating life.

Other objects and advantages of the invention will be evident from the following detailed description when read in conjunction with the accompanying drawings which illustrate my invention.

In the drawings:

FIGURE 1 is a schematic plan view of the comminuting system of the present invention.

FIGURE 2 is an enlarged schematic view illustrating the relationship of the metering device of the invention to the chain grinder which is utilized to effect the final particle size reduction.

FIGURE 3 is a sectional view taken along line 3—3 of FIG. 1.

FIGURE 4 is a sectional view taken along line 4—4 of FIG. 3.

FIGURE 5 is a sectional view taken along line 5—5 of FIG. 1.

FIGURE 6 is a detail view illustrating the bladed plates secured to the inside of the pulverizing drum for the purpose of effecting an initial pulverization of waste material.

FIGURE 7 is a detail view illustrating the pulverizing cusped wheels utilized in a modified embodiment of the present invention.

Referring now to the drawings in detail, and particularly to FIG. 1, the initial comminution or particle size reduction of the raw refuse material is accomplished in a large, horizontal drum 10. The drum 10 is mounted upon a suitable drive mechanism 11 for rotation about a horizontal axis. A suitable inlet conveyor 12 is utilized to move the raw refuse into the intake end 14 of the drum 10. As shown in FIGS. 1 and 5, the intake end portion 14 of the drum 10 is of enlarged diameter in order to receive the discharge end of the conveyor 12, and to allow the drum to be utilized at full capacity. The enlarged end portion 14 of the drum 10 also provides an accommodation for a series of sweep blades 16 which are secured in circumferentially spaced relation around the inner periphery of the drum 10. As will also be perceived in referring to FIGS. 1 and 5, the sweep blades 16 are inclined or pitched with respect to the axis of rotation of the drum 10 so that the blades 16 on the upwardly moving side of the drum are inclined downwardly toward the discharge end of the drum whereby material entering the drum from the conveyor 12 will be moved by the sweep blades 16 toward the center of the drum. A similar set of sweep blades 18 is located at the discharge end 20 of the drum 10 and functions to move the pulverized refuse out of the drum and into a metering device, designated generally by reference character 22. Thus, the sweep blades 16 and 18 function to positively feed the raw refuse toward the center of the pulverizing drum 10 from the intake end 14 thereof, and to discharge pulverized refuse from the discharge end 20 of the drum, respectively.

In a preferred embodiment of the invention, pulverization of the refuse in the drum 10 is accomplished by means of a series of bladed members. The bladed members are triangular-shaped plates 24 having each of the three edges or sides 24a, 24b and 24c of each plate sharpened to a cutting edge as shown in FIG. 6. The plates 24 are preferably equilateral in configuration, and are provided with holes adjacent each vertex to allow the plates to be bolted to the inner periphery of the drum 10 with one of the vertices projecting inwardly toward the axis of rotation of the drum. When plates of this construction are utilized, the plates may be easily shifted to present a new cutting edge for contact with the refuse when the edges defining the radially projecting vertex become dulled. The plates 24 are arranged in rows which extend longitudinally of the drum 10 and each of the rows is preferably spirally or helically arranged with

respect to the axis of rotation of the drum as best shown in FIG. 1. The manner in which the bladed plates 24 accomplish pulverization of the refuse is more fully described below.

The metering device 22 is of generally annular configuration and is secured to the discharge end 20 of the drum 10 for rotation therewith. The metering device 22 comprises a plurality of elongated, flat paddles 25 secured between a pair of annular end plates 26. One of the end plates 26 is coaxially secured to the drum 10 at its discharge end 20 in the manner most clearly illustrated in FIG. 4. The second end plate 26 is spaced from the first end plate 26 along the axis of rotation of the drum 10 by a distance corresponding to the length of the paddles 25. Each of the paddles 25 is secured between the end plates 26 at an acute angle with respect to the peripheries of the end plates. The angles made by the paddles 25 with the peripheries of the end plates 26 are identical so that the distance between the outer edges of adjacent paddles 25 is greater than the distance between the inner edges of adjacent paddles. This construction prevents pulverized material from becoming packed between the paddles 25 and therefore becoming difficult to discharge from the metering device 22 in the manner hereinafter explained.

A plurality of spaced, annular bars 28 are disposed around the inner periphery of the metering device 22 and are secured to the inner edges of the flat paddles 25. It will further be noted that the bars 28 are disposed concentrically with respect to the axis of rotation of the drum 10, and that they are spaced from each other by distances which increase as the distance of adjacent bars from the discharge end 20 of the drum 10 increases. Stated differently, the spacing of the annular bars 28 is such that pulverized refuse discharged from the drum 10 will be classified according to particle size as it moves through the metering device 22 and is discharged between the paddles 25.

An arcuate, semicylindrical housing 30 is positioned beneath the metering device 22 in juxtaposition to the outer edges of the paddles 25. As shown in FIG. 3, the housing 30 is located with one of its longitudinal edges 30a positioned slightly above the horizontal plane occupied by the axis of rotation of the drum 10, and its other longitudinal edge 30b located below said plane on the other side of the metering device 22. Thus, when the drum 10 and metering device 22 are rotated in the direction indicated by the arrows in FIGS. 3 and 5, the housing 30 cooperates with the paddles 25 of the metering device 22 to move refuse through an arcuate path from the longitudinal edge 30a to the longitudinal edge 30b.

The refuse is laterally discharged from the metering device 22 over the longitudinal edge 30b of the housing 30 and enters a suitable grinding device 32 extending alongside the pulverizing drum and metering device. In the preferred embodiment of the invention illustrated by the accompanying drawings, the grinding device 32 employed is a chain grinder of the type disclosed in my U.S. Patent 2,965,320 issued December 20, 1960. The chain grinder 32 is characterized by a plurality of free-swinging chains 34 attached at one of their ends to a rotating shaft 36 which extends coaxially through the center of a generally cylindrical housing 38. In referring to FIGS. 2 and 3 of the drawings, it will be observed that the intake opening 40 of the housing 38 of the chain grinder 32 is aligned with the longitudinal edge 30b of the arcuate housing 30 to receive pulverized refuse discharged laterally from the metering device 22. It will also be noted that the larger particles of pulverized refuse discharged from the metering device 22 enter one end of the chain grinder 32 and travel through the entire length of the chain grinder, whereas relatively smaller particles enter the chain grinder intermediate its length and travel through only a portion of the grinder. The ground refuse is discharged through a discharge duct 42 located at the

opposite end of the chain grinder 32 from the intake opening 40.

In order to assure that none of the particles of pulverized refuse are carried upwardly past the edge 30b of arcuate housing 30 by the paddles 25, the paddles are inclined so as to make an angle of approximately 30 degrees with the vertical at the instant their outer edges move past the edge 30b. Thus, refuse will gravitate downwardly of the upper surface of the paddles 25 and into the chain grinder 32 when the paddles move upwardly past the longitudinal edge 30b of arcuate housing 30.

Some extremely difficultly grindable materials may not be sufficiently reduced in size by the pulverizing device to pass through the annular bars 28 and between the paddles 25 of the metering device 22. Such materials are moved axially through the metering device 22 and onto a discharge chute 44. From the discharge chute 44, this bulky overage material gravitates onto an overage conveyor 46 which extends transversely with respect to the metering device 22 and pulverizing drum 10. The overage conveyor 46 may be a simple belt-type conveyor, and functions to convey the overage material to a second conveyor 48 which extends alongside the drum 10 and metering device 22. A chute 50 extends over the conveyor 48 and facilitates the addition of composted material rich in beneficial bacteria to the overage material for purposes of preinoculation. The inoculated overage is then transmitted by a third conveyor 52 to the intake conveyor 12 for recycling through the pulverizing drum 10.

#### Operation

To summarize the operation of the comminuting system of the present invention, a mixture of heterogeneous materials, such as raw municipal refuse, is fed into the pulverizing drum 10 by the intake conveyor 12. The mass of refuse will contain such widely varying materials as metal plates, chunks of glass, tree limbs, bed-springs, cardboard boxes and garbage. These materials are positively fed into the central portion of the pulverizing drum 10 by the sweep blades 16 located at the intake end 14 of the drum. The action of the sweep blades 16 is such that the refuse material is picked up on the blades and then is allowed to gravitate downwardly toward the interior of the drum on the upper surface of the blades located on the upwardly moving side of the rotating drum.

As the waste material is moved toward the center of the pulverizing drum 10, it is subjected to the action of the bladed plates 24. The rate of rotation of the drum 10 is relatively slow so that materials become impaled upon the plates 24 at the bottom of the drum and are carried upwardly by the plates through an arc of rotation corresponding to about one third of the circumference of the drum 10. The weight of the refuse then causes it to become disengaged from the blades upon which it is impaled, and it gravitates downwardly upon those blades then at the bottom portion of the drum. The sharp, pointed blades thus pierce and cut into the waste material gravitated downwardly. Moreover, that material which has been resting upon the blades in the lower portion of the drum is subjected to the impact of the downwardly falling portion of material and is forced further upon the cutting edges of the blades. Also, shear forces of considerable magnitude are established in the mass of the refuse by the constant shifting induced by the rotating drum. The pulverizing action occurring inside the drum 10 may therefore be properly described as a grinding, piercing and cutting action.

As the raw refuse material continues to be introduced at the inlet end 14 of the drum 10, the pulverized refuse in the drum is constantly moved toward the discharge end 20 thereof. When the pulverized refuse reaches the discharge end 20 of the drum 10, it is picked up by the sweep blades 18 and moved out of the discharge end of

the drum by an action identical to that attributable to the sweep blades 16 located at the inlet end of the drum.

Pulverized refuse discharged from the drum 10 is received by the metering device 22. The purpose of the metering device 22 is to segregate or classify the discharged pulverized material according to particle size. As the metering device 22 is rotated, the pulverized material inside the metering device will gravitate outwardly through the annular bars 28 and the paddles 25. The varying spacing between the annular bars 28 (illustrated most clearly in FIG. 4) causes the pulverized material to be selectively classified according to particle size with smaller particles of material being passed between the paddles 25 at a point closer to the drum 10 than larger particles of material. Stated differently, the varying sizes of the openings between the annular bars 28 provide for a grading of the material discharged from the pulverizing drum 10, such that the finer materials are the first which are allowed to fall between the paddles 25, and the larger sizes of particles fall between the paddles 25 at progressively increasing distances from the discharge end 20 of the pulverizing drum 10. Those materials which have not been sufficiently reduced in size by the pulverizing action of the pulverizing drum 10 to pass through the bars 28 and paddles 25 pass instead through the metering device 22 in an axial direction and are discharged through the discharge chute 44 onto the overage conveyor 46.

The graded material which gravitates downwardly through the paddles 25 of the metering device 22 bears against the arcuate housing 30 and is thus moved by the action of the paddles 25 through an arcuate path to the edge 30b of the housing 30. At the edge 30b of the housing 30, the paddles 25 push the pulverized material into the intake opening 40 of the chain grinder 32 where a further reduction in particle size is effected.

In referring to FIG. 2, it will be perceived that the orientation of the chain grinder 32 with respect to the metering device 22 is such that the finer particles discharged from the metering device enter the grinder at a point which is closer to the discharge chute 42 of the grinder than the point of entry of the relatively larger pulverized materials. Thus, the smaller particles of pulverized material are caused to travel a shorter distance through the chain grinder 32, and the larger particles of pulverized material must pass through a longer path of travel through the chain grinder. The latter materials are therefore subjected to an increased period of grinding and the load on the chain grinder is reduced to a minimum. In order to assure that none of the pulverized material is carried upwardly past the inlet 40 of the chain grinder 32 by the paddles 25, each of the paddles is inclined to form an angle of approximately 30 degrees with the vertical at the instant when the paddle is opposite the longitudinal edge 30b of the arcuate housing 30. This relationship is illustrated in FIG. 3 of the drawings.

The large, bulky overage materials which have passed axially through the metering device 22 and come to rest upon the overage conveyor 46 are recycled to the inlet conveyor 12 by means of conveyors 48 and 52. While the overage material is on the conveyor 48, a portion of the refuse material which has been composted by operations occurring subsequent to the comminuting operation of the present invention is added to the overage material by means of a chute 50 extending into juxtaposition to the conveyor 48. This composted material is highly enriched in beneficial bacteria and spores, and its addition to the overage material from the pulverizing device accomplishes a valuable preinoculation of the overage material and the raw refuse with which it is mixed upon the inlet conveyor 12. The composted material which is added to the overage may conveniently be overage material derived from a final screening of the final compost product. On the other hand, it may, in some instances, be desirable to add bacteria-rich sewage to the overage

to effect the preinoculation. It may also be desirable to use a plurality of the rotatably mounted cusped wheels 56 (shown in FIG. 7) for pulverizing the refuse instead of the bladed plates 24. The cusped wheels 56 are journaled on shafts 58 which are in turn journaled in plates 60 secured to the inner wall of the drum 10. A series of cusps 62 are secured around the outer periphery of each of the wheels 56 so that as the wheel turns randomly, all of the cusps are exposed to equal wear.

From the foregoing description, it will be apparent that the comminuting system of the present invention provides a system which is peculiarly, though not exclusively, adapted to the preparation of raw municipal refuse for subsequent composting by bacteriological decomposition. The apparatus is relatively compact by virtue of the arrangement of the several components, and yet is capable of high-capacity operation. The two-stage particle size reduction operation permits a mixture of widely differing materials to be greatly reduced in average particle size and to be preinoculated preparatory to subsequent subjection to the decomposing action of bacteria.

Although this invention has been described with a certain degree of specificity, it is manifest that many changes may be made in the details of construction and the arrangement of components without departing from the spirit and scope of this disclosure. Accordingly, this invention should be considered as limited only by the scope of the appended claims.

I claim:

1. A system for reducing the average particle size of a mixture of heterogeneous materials comprising the combination of a rotatably mounted, horizontal drum having pulverizing means secured to the internal wall thereof for effecting an initial particle size reduction of said materials; metering means at one end of said drum for classifying pulverized material discharged from said drum according to particle size; and a grinding device positioned alongside said horizontal drum and metering device for receiving classified material discharged laterally in a generally horizontal direction from said metering device, said grinding device cooperating with said metering means to subject the material of relatively larger particle size discharged from said drum to more extensive grinding than the material of relatively smaller particle size which is discharged from said drum.

2. A particle size reducing system as claimed in claim 1 wherein said grinding device comprises a chain grinder, and wherein said metering means comprises a substantially annular plate coaxially secured to the discharge end of said drum for rotation with said drum; a second, substantially annular plate axially spaced from said first plate; a plurality of flat, axially extending, elongated paddles rigidly secured between said plates and circumferentially spaced from each other around said plates, said paddles being secured to said plates with their flat sides inclined at identical acute angles to the circumferences of said annular plates; and a plurality of annular bars secured to the inner edges of said paddles in coaxial relation to the axis of rotation of said drum with said bars being spaced increasing distances from each other along said axis of rotation from said first plate to said second plate; and wherein said system is further characterized to include an arcuate, semicylindrical housing immediately below said metering means and originating with one of its longitudinal edges located on one side of said metering means and above a horizontal plane containing the axis of rotation of said drum, and terminating with one of its longitudinal edges located below said plane on the other side of said metering means, said arcuate housing cooperating with the paddles of said metering means to move said discharged material through an arcuate path from the origin to the terminus of said housing for discharge therefrom.

3. A particle size reducing system as claimed in claim 1 and further characterized to include means for recycling to said drum overage material of a particle size too large

to be discharged to said grinding device by said metering means.

4. A particle size reducing system as claimed in claim 3 wherein said recycling means comprises a conveyor system for receiving said large particles from one end of said metering means and returning said particles to the intake end of said drum.

5. A particle size reducing system as claimed in claim 3 and further characterized to include means for inoculating said recycled, overage material with a material containing beneficial bacteria and spores prior to the reintroduction of said overage material to said drum.

6. A particle size reducing system as claimed in claim 1 wherein the diameter of said drum is enlarged at its end opposite said metering means to facilitate the introduction to said drum of the mixture to be pulverized; and further characterized to include means secured to the internal wall of said drum adjacent the ends thereof for positively feeding and discharging the mixture when said drum is rotated.

7. A particle size reducing system as claimed in claim 6 wherein said feeding means comprises a plurality of elongated sweep blades secured to the inner periphery of said drum in circumferentially spaced relation and pitched with respect to the longitudinal axis of said drum so that the blades on the upwardly moving side of said drum are inclined downwardly toward the discharge end of said drum whereby material in the bottom of said drum will be moved by said blades toward the center of said drum before pulverization and out of said drum after pulverization.

8. A pulverizing device for reducing the average particle size of raw, heterogeneous, unclassified refuse material comprising a horizontal, rotatably mounted drum; a plurality of elongated sweep blades secured to the inner periphery of said drum adjacent the inlet and discharge ends thereof in circumferentially spaced relation and pitched with respect to the longitudinal axis of said drum so that the blades on the upwardly moving side of said drum are inclined downwardly toward the discharge end of said drum whereby material at the bottom of said drum will be moved by said blades toward the center of said drum before pulverization, and toward the discharge end of said drum after pulverization; cutting, incising means comprising a plurality of axially extending rows of substantially equilateral triangular blades secured to the inner periphery of said drum between the inlet and discharge ends thereof, said equilateral triangular blades each having one of their vertices projecting radially toward the axis of rotation of said drum, and further having each of the three sides thereof sharpened to a cutting edge; and means for detachably securing said blades to said drum with one side of each of said blades coincident with a chord of said drum whereby said equilateral triangular blades may each be detached from said drum and rotated in the same plane through 120° so as to present new cutting edges and a new pointed vertex for contact with said raw, heterogeneous, unclassified refuse material when said detachable securing means is used to secure a second side of each of said blades to said drum coincident with the same chord thereof.

9. A pulverizing device for reducing the average particle size of raw, heterogeneous, unclassified refuse material comprising a horizontal, rotatably mounted drum; cutting, incising means in said drum for pulverizing material introduced to the interior of said drum; sweep blades secured to the inner periphery of said drum adjacent the inlet and discharge ends thereof in circumferentially spaced relation and pitched with respect to the longitudinal axis of said drum so that the blades on the upwardly moving side of said drum are inclined downwardly toward the discharge end of said drum whereby material from the bottom of said drum will be moved by said blades toward the center of said drum before pulverization and toward the discharge end of said drum after pulverization; a first substantially annular plate secured to the discharge end of

said drum for rotation with said drum; a second substantially annular plate axially spaced with said first plate; a plurality of flat, axially extending, elongated paddles rigidly secured between said plates and circumferentially spaced from each other around said plates; said paddles being secured to said plates with their flat sides inclined at acute, identical angles to the circumferences of said annular plates; and a plurality of annular bars secured to the inner edge of said paddles in coaxial relation to the axis of rotation of said drum with said bars being spaced increasing distances from each other along said axis of rotation from said first plate to said second plate whereby pulverized material of relatively small particle size is allowed to pass radially outward through said paddles relatively closer to said drum than pulverized material of relatively larger particle size.

10. A pulverizing device as claimed in claim 9 and further characterized to include an arcuate housing immediately below said metering means and originating on one side of said metering means above a horizontal plane containing the axis of rotation of said drum and terminating on the other side of said metering means below said horizontal plane, said arcuate housing cooperating with said paddles to move said discharged material through an arcuate path from the origin to the terminus of said housing for discharge therefrom.

11. A pulverizing device as claimed in claim 10 wherein each of said paddles extends downwardly from said annular bars at an angle of approximately 30 degrees to the vertical when said paddle is in juxtaposition to the terminus of said housing whereby pulverized material will gravitate from the flat upper surface of said paddles past said terminus in being discharged from said arcuate housing.

12. A pulverizing device for reducing the average particle size of raw, heterogeneous, unclassified refuse material comprising a horizontal, rotatably mounted drum; a plurality of elongated sweep blades secured to the inner periphery of said drum adjacent the inlet and discharge ends thereof in circumferentially spaced relation and pitched with respect to the longitudinal axis of said drum such that the blades on the upwardly moving side of said drum are inclined downwardly toward the discharge end of said drum whereby material from the bottom of said drum will be moved by said blades toward the center of said drum before pulverization and toward the discharge end of said drum after pulverization; a plurality of axially extending rows of wheels rotatably secured to the inner periphery of said drum between said inlet and discharge ends of said drum; and a plurality of sharp, pointed cusps

secured in circumferentially spaced relation around the periphery of each of said wheels.

13. A pulverizing device for reducing the average particle size of raw, heterogeneous, unclassified refuse material comprising a horizontal, rotatably mounted drum; cutting, incising means in said drum for pulverizing material introduced to the interior of said drum; a plurality of elongated sweep blades secured to the inner periphery of said drum adjacent the inlet and discharge ends thereof in circumferentially spaced relation and pitched with respect to the longitudinal axis of said drum so that the blades on the upwardly moving side of said drum are inclined downwardly toward the discharge end of said drum whereby material from the bottom of said drum will be moved by said blades toward the center of said drum before pulverization and toward the discharge end of said drum after pulverization; a generally cylindrical member having a plurality of axially extending openings therein secured to the discharge end of said drum for receiving pulverized material from said drum, the openings in said cylindrical member being graduated in areal size from the end of said cylindrical member adjacent the discharge end of said drum to the opposite end of said generally cylindrical member with the axially extending openings of smallest areal size adjacent the discharge end of said drum, and the axially extending openings of greatest areal size adjacent the end of said cylindrical member opposite the discharge end of said drum.

#### References Cited by the Examiner

##### UNITED STATES PATENTS

|           |         |                 |             |
|-----------|---------|-----------------|-------------|
| 813,903   | 2/1906  | Lindhard        | 241—78      |
| 843,466   | 2/1907  | Krickbaum       | 241—181     |
| 2,213,713 | 9/1940  | Maxson          | 241—181 XR  |
| 2,523,034 | 9/1950  | Lively          | 241—188 XR  |
| 2,721,035 | 10/1955 | Lankford et al. |             |
| 2,871,510 | 2/1959  | Sackett         | 23—259.1 XR |
| 2,948,593 | 8/1960  | Larson          | 23—259.1    |
| 2,965,320 | 12/1960 | Pierson         | 241—185     |
| 2,994,592 | 8/1961  | Scovel et al.   | 23—259.1    |

##### FOREIGN PATENTS

|           |        |                |
|-----------|--------|----------------|
| 1,224,230 | 6/1960 | France.        |
| 727       | 1884   | Great Britain. |
| 457,458   | 3/1950 | Italy.         |

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