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MATERIAL REDUCING APPARATUS

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2 Sheets-Sheet 2

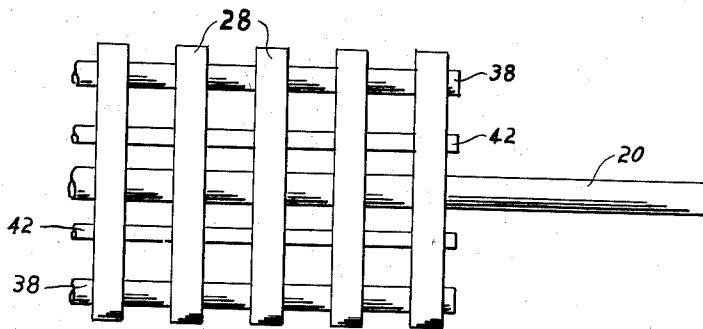


Fig. 3

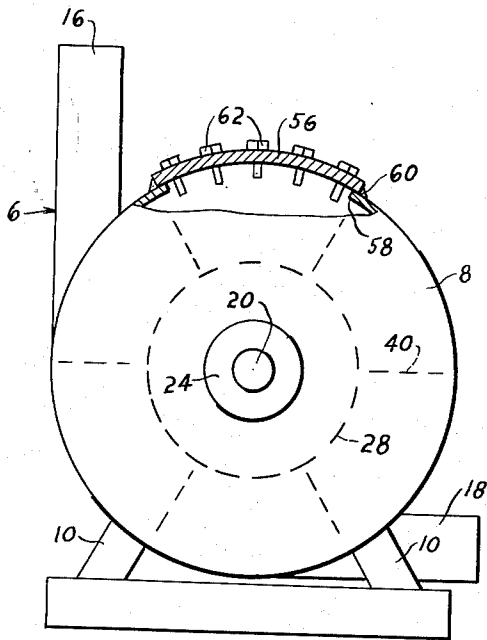


Fig. 2

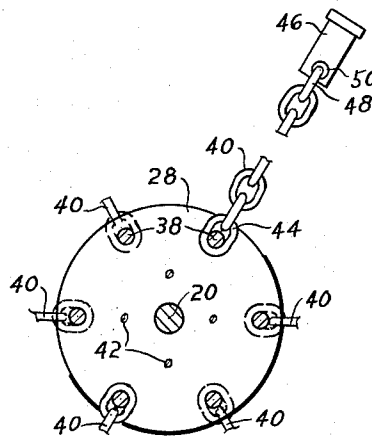


Fig. 4

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## MATERIAL REDUCING APPARATUS

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This invention relates generally to improvements in material reducing apparatuses, and more particularly, but not by way of limitation, to an improved chain-type grinder.

In the art of producing compost from municipal refuse, a great variety of materials are ordinarily ground together prior to composting the mixture. For example, municipal refuse may contain the usual animal and vegetable matter, or table scraps from a household, tree limbs, tin cans and glass bottles. Heretofore, no single material reducing apparatus has been effective in grinding and masticating this highly different group of materials in a single operation. Hammer mills are effective for grinding dry, rather brittle material, such as cattle feed and the like, but are ineffective for grinding wet and semi-plastic materials of the type contained in municipal refuse. On the other hand, previous chain-type grinders are usually effective only for grinding wet and a few semi-plastic materials. Furthermore, the usual chain-type grinder receives and discharges the material in substantially the same area of the grinder, whereby the material is subjected to the action of only one or two chain hammers.

The present invention contemplates a novel grinder, preferably of the chain hammer type, which may be effectively used to grind a great variety of materials in a single grinding operation, wherein the materials will be reduced to a desired maximum particle size and will be thoroughly mixed by the grinding operation. The hammers of the grinder are arranged in such a manner that the material is moved longitudinally through the grinder and is subjected to the action of a large number of the hammers prior to discharge of the material from the grinder. The present invention also contemplates the use of novel stripper means projecting into the housing of a chain grinder, whereby the action of the chain hammers will be facilitated and the material being ground will be reduced in a minimum of time. The present apparatus is particularly useful in grinding municipal refuse, without the necessity of segregating the refuse prior to the grinding operation.

An important object of this invention is to grind a great variety of types of material, such as are contained in municipal refuse, by a single instrumentality.

Another object of this invention is to provide a grinder wherein metal articles, such as tin cans, may be passed through the grinder without damage.

A further object of this invention is to provide a chain grinder wherein the beating action of the chain hammers will move the material longitudinally through the grinder.

Another object of this invention is to provide a novel stripper and chain hammer arrangement in chain grinders for reducing material to substantially any desired size.

A still further object of this invention is to provide a simply constructed chain grinder which may be economically manufactured.

Other objects and advantages of the invention will be evident from the following detailed description, when

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read in conjunction with the accompanying drawings, which illustrate my invention.

In the drawings:

Figure 1 is a plan view of my novel grinder, with a portion of the grinder shown in section to illustrate details of construction, and a portion of the grinder shown schematically to illustrate the arrangement of the chain hammers.

Figure 2 is an end view of the inlet end of the grinder, with a portion of the grinder shown in section to again illustrate details of construction.

Figure 3 is a detailed view of a portion of the driving shaft and chain supporting discs on the shaft, but without the chain hammers.

Figure 4 is a view of the driving shaft and one supporting disc taken at right angles to Fig. 3, illustrating the construction and connection of a chain hammer, with the chain hammer being enlarged for purposes of illustration.

Referring to the drawings in detail, and particularly Fig. 1, reference character 6 generally designates my novel chain-type grinder which comprises a hollow, cylindrically-shaped housing 8 supported on a plurality of suitable supports 10 in such a position that the longitudinal axis of the housing 8 extends substantially horizontally. The opposite ends of the housing 8 are enclosed by end members 12 and 14. An inlet 16 for the material to be ground is provided near the end 12 of the housing 8 and extends tangentially from the housing. The inlet 16 preferably extends vertically and may have any desired chute arrangement for feeding material to the housing 8. An outlet chute 18 extends tangentially from the opposite end of the housing 8 to discharge ground material from the grinder, as will be more fully hereinafter set forth. The outlet chute 18 may extend in substantially any direction from the housing 8; that is, the chute 18 may extend either horizontally, as shown, or vertically, depending upon the disposition to be made of the ground materials.

A drive shaft 20 extends longitudinally through the housing 8 along the longitudinal axis of the housing, and is rotatably supported in the opposite end members 12 and 14 by suitable bearing units 22. One end of the shaft 20 protrudes some distance from the respective bearing unit 22 to receive a pulley or sheave 24 which in turn receives an endless belt or chain 26 leading from a suitable power source (not shown). The belt or chain is driven by the power source to rotate the shaft 20 in the usual manner.

As shown in Fig. 3, a plurality of longitudinally spaced discs 28 are telescoped onto the drive shaft 20. Each disc 28 is suitably keyed (not shown) to the shaft 20, whereby each disc will rotate with the shaft. A plurality of circumferentially spaced bolts 38 extend through all of the discs 28 to support the chain hammers 40 (Fig. 4). Another series of longitudinally extending and circumferentially spaced bolts 42 may be extended through the discs 28 to further support the discs 28 and assure simultaneous rotation of all the discs. The bolts 38 and 42 are secured to the end discs 28 in any desired manner (not shown).

Each chain hammer 40 is secured on one of the bolts 38 between a pair of discs 28. The innermost link 44 of each chain hammer 40 is looped over the respective bolt 38 to provide a pivotal connection of the hammer to the bolt. A solid tip 46 is secured to the outermost link 48 of each chain hammer 40. It is preferred that each tip 46 have an aperture 50 through the inner end thereof to receive the outermost link 48 of the respective chain hammer 40, whereby the tips will be pivotally secured to the chain portions of the hammers. The tips 46 are formed out of a hard metal to provide the maximum service life for the tips. Each chain hammer 40 is

of a length to extend the respective tip 46 into close proximity with the inner periphery of the housing 8 when the hammer is extended radially outward from its respective bolt 38.

As indicated by the dotted circles in Fig. 1, the hammers 40 are secured in longitudinal rows along the shaft 20, with each row being substantially in the form of a helix. I prefer to secure two of the hammers 40 between each pair of the discs 28 in diametrically opposed relation as shown in Fig. 4. When viewed from the inlet end of the grinder 6, each succeeding diametrically opposed set of the hammers 40 will be circumferentially off-set, or spaced, in a clockwise direction from the preceding set of hammers. When the apparatus utilizes six of the bolts 38 as shown in Fig. 4, each succeeding set of hammers 40 will be disposed sixty degrees to the right of the preceding set, whereby each of the diametrically opposed, longitudinal rows of the hammers 40 will extend substantially in the form of a helix from the inlet end of the housing 8 to the last disc 28 on the shaft 20. Although I prefer to use only two diametrically opposed rows of hammers 40, more rows may be used if desired, depending upon the size of the grinder and the number of bolts 38 on which the hammers may be secured. The only requirement being, that each succeeding hammer of each row be circumferentially spaced with respect to the preceding hammer in a direction opposite to the direction of rotation of the supporting shaft. Thus, a hammer 40 could not be secured on each of the bolts 38, for then the hammers 40 would be disposed in longitudinal rows extending parallel to the axis of the supporting shaft 20.

A suitable blower 54 is secured on the shaft 20 to the rear of the last disc 28 in a position opposite the outlet chute 18. The blower 54 may take any desired form which will provide a discharge of air through the outlet chute 18 to blow the ground material from the housing 8, as will be more fully hereinafter set forth.

A novel stripper plate 56 (as shown in Figs. 1 and 2) is secured over a complementary opening 58 in the housing 8. The stripper plate 56 preferably extends longitudinally from adjacent the end 12 of the housing 8 to a point at least half way along the length of the housing 8, and circumferentially for about one fourth of the periphery of the housing 8. It will be understood, however, that the stripper plate 56 may be of a larger size if a finer grinding action is desired. The stripper plate 56 is suitably secured to the housing 8, as by welding 60, and has a plurality of threaded apertures therein to receive stripper bolts 62. The bolts 62 are of a length to extend into the interior of the housing 8 beyond the inner periphery of the housing 8, and are formed out of a hard metal to provide a long service life. As shown in Fig. 1, the bolts 62 are arranged in rows transverse to the longitudinal axis of the housing 8, with each transverse row being positioned between the paths of movement of longitudinally adjacent hammers 40.

In operation, the shaft 20 is rotated in a counterclockwise direction when viewed from the driving end or driving sheave 24, and the material to be ground is fed through the inlet 16 to the housing 8. The material entering the inlet 16 will be contacted by the hammers 40 positioned opposite the inlet, and the material will be carried counterclockwise around the inner periphery of the housing 8. It will be apparent that as the material is carried by the hammers 40 passed each bolt 62, the material will be ground and masticated between the hammer and bolt to reduce the particle size of the material. The material being ground will also be shredded over the bolts 62 and beaten by the hard metal tips 46 of the hammers 40 to thoroughly grind the material.

As the material is contacted by successive hammers 40, it will be forced around the inner periphery of the housing 8 and longitudinally through the housing from the inlet chute 16 toward the outlet chute 18, due to the

helical disposition of the hammers. The longitudinal velocity of the material may be increased, if desired, by tilting the housing 8 downwardly toward the outlet chute 18. However, I prefer to vary the speed of the material through the housing 8 by varying the helical disposition of the hammers 40. That is, the greater the angle of the helix, the faster the material will be moved through the housing 8 toward the outlet chute 18.

The ultimate particle size of the material being ground can be adjusted and controlled in various ways. For example, the greater the number of hammers 40, the greater the reduction in particle size of the material. Also, decreasing the angle of the helix increases the reduction in particle size of the material. Another controlling factor on particle size is the position and length of the bolts 62. As the number of bolts 62 increases, the greater the reduction in particle size. Similarly, the greater the length of the bolts 62, the greater the reduction in particle size of the material being ground. Still another controlling factor in the particle size of the finished material is the area covered by the stripper plate 56 and the stripper bolts 62. This factor naturally follows from the foregoing discussion relating to the number and size of the bolts 62. That is, the greater the area of the housing 8 covered by the stripper plate 56 and bolts 62, the greater the grinding action obtained, and the greater the reduction in particle size. Also, of course, the speed of rotation of the hammers 40 will effect the ultimate particle size.

The material being ground is carried, as previously stated, along the inner periphery of the housing 8 toward the outlet chute 18. The blower 54 will force the ground material out of the outlet chute 18 with any desired velocity, depending upon the design of the blower.

I have found that metal articles, such as tin cans, may be passed through the grinder 6 without apparent damage to either the hammers 40 or the stripper bolts 62. A tin can subjected to the action of the hammers 40 and bolts 62 is discharged through the outlet chute 18 in the form of a small ball, with the sides and ends of the can pressed closely together in haphazard fashion. I have also found that the present apparatus is particularly effective in disintegrating glass articles such as bottles and the like. A bottle dropped into the inlet chute 16 may be shattered into such fine particles as to be invisible to the naked eye when mixed with ground refuse discharging from the outlet chute 18. The size of material which may be fed to the grinder 6 will, of course, depend upon the physical dimensions of the grinder and the number of chain hammers 40 being utilized. I have found that when using a housing 8 substantially thirty-six inches in diameter, and when using forty-two chain hammers 40 disposed in diametrically opposed helically extending rows, the grinder effectively reduces general municipal refuse having initial dimensions of six inches by six inches. Such refuse may be reduced to at least a maximum particle size of one-fourth inches.

From the foregoing it will be apparent that the present invention provides a single instrumentality which may be used to grind a great variety of types of material, such as are contained in municipal refuse. Metal articles may be passed through the grinder without damage, and the beating action of the chain hammers will move the material longitudinally through the grinder, whereby the material will be subjected to the maximum beating action of the hammers. It will also be apparent that the present invention provides a novel stripper and chain hammer arrangement for chain grinders, whereby the maximum reduction in particle size may be obtained. Also, it will be apparent that the present apparatus is simple in construction and may be economically manufactured.

Changes may be made in the combination and arrangement of parts as heretofore set forth in the specification and shown in the drawings without departing from the spirit and scope of the invention as set forth in the follow-

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ing claims. For example, but by no means inclusive, I have shown and described only chain-type hammers, whereas other types of hammers may be used and beneficial results obtained in many grinding operations, even though the chain-type hammers are preferred.

What is claimed is:

1. A grinder, comprising a cylindrically-shaped hollow housing having an inlet at one end thereof and an outlet at the opposite end thereof, a power-driven rotatable shaft extending longitudinally through the housing, at least two longitudinal rows of chains secured to the shaft within the housing, each row of said chains being secured in a spiral arrangement around the shaft, a hard metal tip on the outer end of each chain positioned adjacent the inner periphery of the housing during rotation of the shaft and being of a size to form a hammer on the outer end of the respective chain, said chains being arranged to space adjacent hammers longitudinally along the shaft, a stripper plate interposed in the wall of the housing and having a contour corresponding substantially with the contour of the housing, and hard metal bolts secured in and extending through the stripper plate in positions to project into the housing between the paths of movement of said hammers.

2. A grinder as defined in claim 1 characterized further

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in that said stripper plate covers only a portion of the circumference of the housing and extends from opposite said inlet to a medial portion of the housing.

3. A grinder as defined in claim 1 characterized further in that said housing is positioned with its longitudinal axis extending substantially horizontally, and said stripper plate is arranged in the upper portion of said housing.

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