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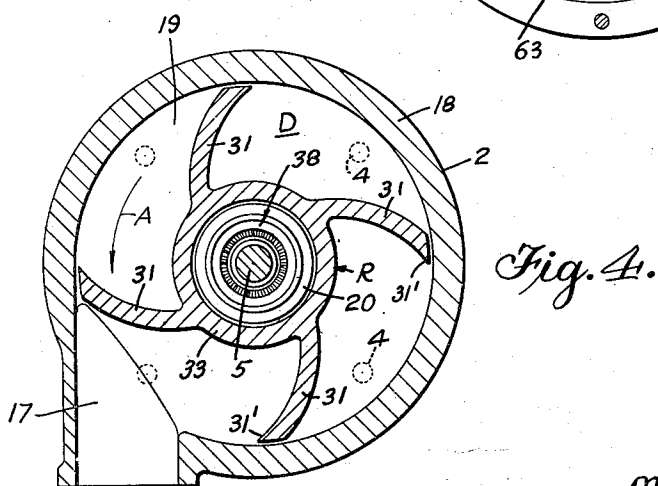
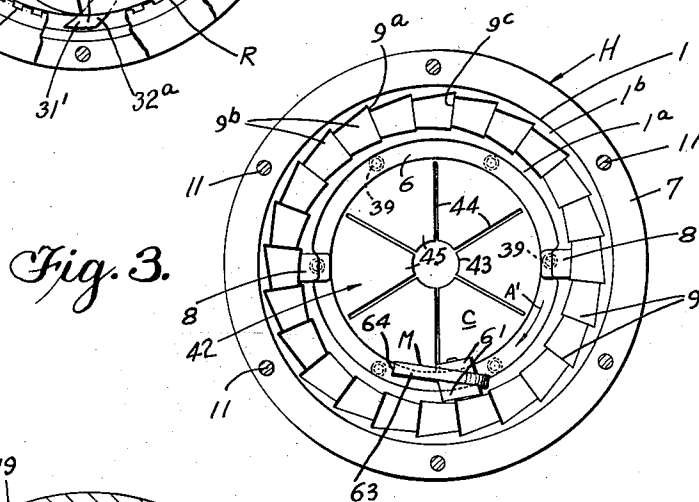
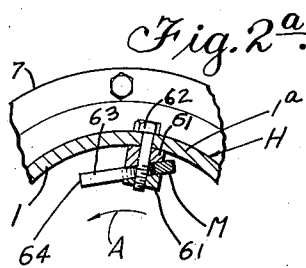
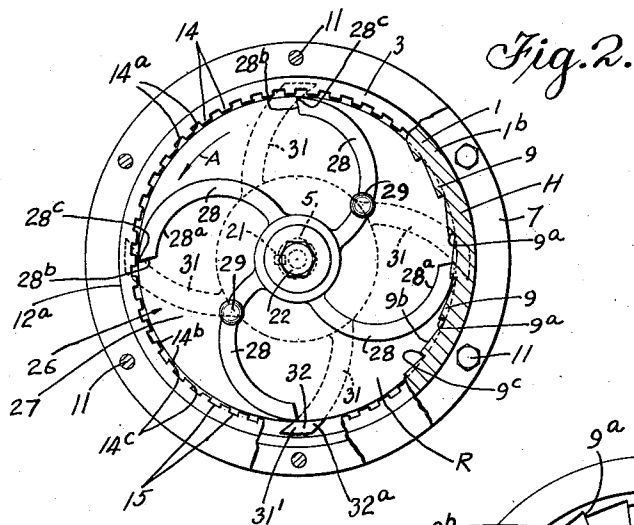
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COMMUNUTING APPARATUS-GARBAGE GRINDER

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2 Sheets-Sheet 2



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COMMUNUTING APPARATUS—GARBAGE GRINDER

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20 Claims. (Cl. 241—46)

This invention relates to apparatus for comminuting solid materials, and more particularly to a comminuting apparatus of the wet type, in which the material is subjected to comminuting action in the presence of liquid such as water, which may be introduced into the apparatus along with the solid material or may be partly or wholly contained in the solid material as introduced.

The principal object of the invention is to provide for rapid and effective comminution or disintegration of solid materials in the presence of liquid, without clogging or jamming of the machine by the material being treated.

The apparatus of my invention is useful in the wet comminution of various kinds of materials. It is especially useful in the disposal of kitchen waste or garbage, in which the garbage or waste material is comminuted and discharged in a stream of water. Accordingly, it is an important object of the invention to provide a waste disposal apparatus that will effectively comminute or disintegrate all types of food wastes or other kitchen waste materials without clogging or jamming and without injury or damage to the apparatus.

The apparatus utilizes a comminuting rotor in combination with fixed comminuting means. A particular object of the invention is to provide an advantageous rotor construction which prevents clogging or jamming of the rotor by material that is not properly comminuted, which sometimes occurs with other machines of this general type, particularly when the machine is started with a load of material on the rotor.

Another particular object of the invention is to so design and construct both the comminuting rotor and the fixed comminuting means as to provide for the rapid and effective disintegration or comminution of many different types of materials including practically all types of kitchen waste materials.

Another object is to provide a comminuting apparatus having a high capacity for disintegrating and discharging material for a given power input and without jamming.

A further object of the invention is to provide a rotor that acts both as a rotary comminuting means cooperating with the fixed comminuting means to disintegrate material, and also as an efficient impeller or pump for forcibly and positively discharging the comminuted material.

Another object is to provide a device that is simple and inexpensive to construct, efficient and economical in operation, and very resistant to wear so as to have a long life even under heavy loads and with materials that are difficult to disintegrate.

A further object is to provide a fixed comminuting or grinding ring that is so mounted that it may be easily removed and replaced when necessary.

Another object is to provide advantageous means for trapping pieces of magnetic material introduced into the apparatus, in such manner as to prevent them from clogging or jamming the rotor or causing damage to the rotor or the fixed comminuting means.

Other objects and advantages of the invention will be pointed out hereinafter or will be apparent from the fol-

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lowing description, with reference to the accompanying drawings in which:

Fig. 1 is a partly sectional side elevation of a form of apparatus embodying my invention;

Fig. 2 is a horizontal section on line 2—2 in Fig. 1;

Fig. 2a is a fragmentary horizontal section on line 2a—2a in Fig. 1;

Fig. 3 is an inverted horizontal section on line 3—3 in Fig. 1;

Fig. 4 is a horizontal section on line 4—4 in Fig. 1;

Fig. 5 is a partly sectional side elevation of the fixed grinding ring in the form of apparatus shown in Fig. 1;

Fig. 6 is a side elevation of the rotor in the form of apparatus shown in Fig. 1;

Fig. 7 is a partly sectional side elevation of a modified form of fixed grinding ring; and

Fig. 8 is a partial side elevation of a modified form of rotor.

The apparatus comprises a fixed vertically extending annular housing structure H which is shown as including an upper section 1 and a lower section 2. A fixed grinding ring 3 is secured in tight fitting relation between the upper and lower housing sections, and preferably also forms part of the housing structure.

The driving means preferably comprises an electric motor E disposed below the housing H and secured to the lower housing section 2 as by means of the bolts 4. The motor E is provided with a drive shaft 5 extending upward within the housing H and carrying at its upper end a rotor R. The axis of rotation of shaft 5 and rotor R is substantially vertical and extends centrally of the housing H.

The motor E, when energized, rotates shaft 5 and rotor R in one direction about the central vertical axis thereof.

For purposes of illustration and description, it will be assumed herein that the shaft and rotor are rotated in a counterclockwise direction as indicated by the curved arrows at A in Figs. 2, 2a and 4, and certain elements of the rotor and of the fixed comminuting means or other fixed parts of the apparatus described hereinafter are accordingly designed for operation with that direction of rotation. It will be understood, however, that these elements may be designed for operation with either direction of rotation of the rotor. In describing some of the elements of the rotor or of fixed parts of the apparatus, certain terms such as "forward" and "rearward," or "leading" and "trailing" will be used with reference to the relative motion thereof with respect to each other. For example, a forward or leading portion or element of the rotor is one that is disposed forwardly in the direction of rotation of the rotor, assumed herein to be in a counterclockwise direction, while a forward or leading portion or element of the fixed comminuting means or other fixed part of the apparatus is one that is disposed forwardly in the direction of relative movement thereof with respect to the rotor. This direction of relative movement is opposite to the direction of rotation of the rotor and is therefore assumed herein to be clockwise. It will be seen that the fixed portions or elements so disposed can properly be designated as "forward" or "leading," since they are disposed so as to face or be directed toward the forward or leading portions or elements of the rotor as the latter approach the fixed portions or elements during rotation of the rotor.

The upper housing section 1 is open at its upper and lower ends, and has an annular side wall of circular cross section including an upper portion 1a of relatively great depth or vertical extent, and a lower portion 1b of relatively small depth or vertical extent. The housing section 1 is also provided with an inwardly projecting mounting flange 6 at its upper end and an outwardly projecting flange 7 at its lower end.

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The upper side wall portion 1a extends approximately vertically, but the inner surface thereof is preferably flared outward and downward at a slight angle to the vertical, as shown. It is also preferably provided with a plurality of angularly spaced inwardly projecting ribs 8, extending downward in generally vertical directions through substantially the entire height of the upper wall portion 1a. In this case I have shown two such ribs spaced 180° apart, each of generally rectangular cross-sectional shape as shown in Fig. 3.

The lower side wall portion 1b of housing section 1 is flared outward and downward at a greater angle to the vertical than the upper portion 1a, the inner surface thereof sloping preferably at an angle of about 45° to the vertical. The inner surface thereof is of notched or serrated configuration to provide a plurality of angularly spaced teeth 9. The shape of these teeth is shown in Figs. 1, 2 and 3. Since Fig. 3 is taken looking upward, the relative direction of rotation of the rotor appears to be clockwise, as indicated by the curved arrow at A' in this figure.

Each of the teeth 9 has an inwardly extending leading or forward surface 9a facing in a clockwise direction, that is opposite to the direction of rotation of the rotor, and an inwardly facing rearward surface 9b that is inclined outward in said direction of rotation to meet the outer edge of the forward face 9a of the next tooth. The front and rear faces 9a and 9b of each tooth meet to form an angular cutting edge 9c extending downward and outward along the slope of the inner surface of wall portion 1b throughout substantially the entire height of said sloping surface.

The fixed grinding ring 3, which is preferably formed as a single casting, is clamped tightly between the upper housing section 1 and the lower housing section 2, as by means of bolts 11 engaging the flange 7 on the upper section and threadedly engaging the side wall of the lower section 2. The interengaging surfaces of members 1, 2 and 3 are preferably of complementary stepped shape so as to provide outwardly facing annular shoulders 12a and 12b on the member 3 engaging inwardly facing annular shoulders 13a and 13b on members 1 and 2 respectively, in order to position and hold the member 3 in centered relation with respect to the axis of the housing.

The grinding ring 3 is of generally cylindrical shape, with the upper end of its inner surface disposed adjacent the bottom of the teeth 9. It is provided at its inner surface with a plurality of angularly spaced teeth 14 projecting inwardly and separated by grooves or slots 15. The teeth 14 and slots 15 extend downward from the top to the bottom of the inner surface of ring 3. The individual teeth 14 are of considerably less circumferential width and spacing than the teeth 9. They are preferably of substantially rectangular profile, with their side faces 14a extending substantially radially and their inner faces 14b lying substantially in a cylindrical surface about the axis of the housing. In the form of apparatus shown in Figs. 1 through 6, the teeth 14 and slots 15 are inclined downward and forward in the counterclockwise direction of rotation of the rotor R, as best seen in Fig. 5. The slots 15 between said teeth are preferably of downwardly increasing circumferential width, as also shown in Fig. 5. This prevents clogging of these slots by accumulation of material therein during operation. Also, when the ring 3 is formed by casting, it is of advantage in permitting easy withdrawal of the pattern from the mold.

The upper housing section 1 and grinding ring 3 serve to define and enclose therewithin a material receiving and comminuting chamber C. The lower housing section 2 is formed to provide an annular discharge compartment D below the chamber C, and an outlet passage 17 communicating with said compartment at one side thereof and extending outward therefrom substantially

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tangentially in the counterclockwise direction of rotation of the rotor R.

Said lower housing section has a circular outer side wall 18, a bottom wall 19 which preferably slopes upward slightly toward the center, and an annular inner wall 20 of less height than side wall 18 but extending upward a substantial distance above the bottom of the discharge compartment D. The internal diameter of side wall 18 is somewhat greater than that of grinding ring 3 so that the teeth 14 of said ring project inwardly of said side wall and the slots 15 open freely at their lower ends into the discharge compartment B. Preferably, the upper end of the discharge compartment B is of greater diameter than the circle defined by the bases of slots 15.

The inner wall 20 surrounds an opening extending vertically through the bottom of the housing, through which extends the rotor drive shaft 5 and in which are mounted suitable bearing and sealing means as described hereinafter.

The rotor R is preferably formed as a single casting which is secured removably to the upper end of drive shaft 5 for rotation therewith, as by means of key 21 and bolt 22. Said rotor comprises a hub portion 23 having a bore 24 fitting closely on the shaft 5, and a generally disc shaped head portion 26 whose upper surface 27 is preferably somewhat convex so as to slope downwardly from the central portion toward the periphery thereof. The head portion 26 of the rotor is disposed within the lower portion of the material receiving and comminuting chamber C and above the discharge compartment D. It is shown as disposed within the grinding ring 3.

The circumferential or outer face of rotor head 26 is of less height than the grinding ring 3, and the bottom edge of said face is preferably disposed at approximately the same level as the bottom of the teeth 14 of said grinding ring. Thus, the periphery of the upper surface 27 of the rotor head is a substantial distance below the top of the teeth 14 so that the upper portion of said teeth, and preferably the major portion of their height, is exposed for direct engagement with material thrown outwardly from the top of the rotor head by centrifugal force. The circumferential face of the rotor head is spaced very close to the inner faces of teeth 14 so as to provide a close running fit between the rotor head and the grinding ring teeth, the clearance therebetween being preferably less than twenty thousandths of an inch.

The rotor has a plurality of angularly spaced blades 28 projecting upward from the head 26 and preferably formed integrally therewith. Each of the blades 28 extends outward from the central portion of the head 26 to the periphery thereof. The upper surface of each blade 28 is shown as sloping upward from its inner end to its outer end. At its inner end, the upper surface of each blade is only slightly above the upper surface 27 of head 26. The height of each blade 28 above the rotor head increases progressively toward the outer end thereof, due both to the upward inclination of the blade and the downward inclination of the top surface of the rotor head. At its outer end, the top surface of each blade 28 is preferably at approximately the same level as the top of the teeth 14 of grinding ring 3.

In the apparatus shown, there are four such blades 28, spaced 90° apart. These blades are of forwardly concave curvature and are curved outward and forward in the counterclockwise direction of rotation of the rotor. Each blade starts at its inner end approximately along a radial line drawn from the axis of the rotor, and is inclined at a progressively greater angle away from such radial line, in the direction of rotation, until, at its outer end, each blade is almost tangent to the periphery of the rotor head. The side walls 28a of blades 28 are shown extending substantially vertically. In the form of apparatus shown in Figs. 1 through 6, the outer end faces 28b of said blades also extend substantially

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vertically. Said outer end faces face forward in the direction of rotation of the rotor and extend transverse to the forward direction of the outer end portions of the blades, and are preferably inclined slightly forward toward their outermost edges 28c, as shown in Fig. 2. Said outer edges 28c of the blades 28 extend upward from the circumferential face of the rotor head to approximately the level of the upper ends of teeth 14 of the grinding ring, and are preferably spaced close to the inner faces 14b of said teeth.

The rotor R is also provided with a plurality of upwardly projecting members 29 intermediate, and preferably approximately midway between, the axis and the periphery thereof, at such angular positions about the axis as to provide running balance during rotation. In the example shown, I have provided two such members 29 located 180° apart and formed as circular posts or fingers extending upward from two of the blades 28 a short distance outward from the inner ends of said blades. The head portion 26 of the rotor and the upwardly extending blades 28 and fingers 29 constitute rotary comminuting means cooperating with the above described fixed comminuting means disposed around the comminuting chamber C.

The rotor R is also constructed to act as a pump for effecting positive discharge of water and ground material from the discharge compartment D. For this purpose, it is provided with a plurality of angular spaced impeller blades 31 secured to and preferably formed integrally with the head 26 and extending downward therefrom within the discharge compartment. Four such blades 31 are shown, spaced 90° apart. Said impeller blades extend fairly close to the walls of the discharge compartment D, the outer and lower edges of the blades being preferably shaped to conform approximately with the curved shape of side wall 18 and bottom wall 19 of said compartment. Each of said blades is preferably curved outward and rearward with respect to the direction of rotation of the rotor, as best shown in Fig. 4, so as to force the water and entrained material out through the tangential outlet 17 by a positive pumping action somewhat similar to that of a centrifugal pump.

It will be noted that the impeller blades 31 project outward beyond the periphery of the rotor head 26 and beneath the inner portion of grinding ring 3. They extend outward beneath and preferably somewhat beyond the teeth 14 and slots 15 of said grinding ring, as shown in Fig. 1 and also in Fig. 2 in which a portion of the grinding ring 3 is broken away to show the outwardly projecting portion 31' of one of the blades 31. The upper faces 32 of these projecting portions of the blades are spaced very close to the bottom of the grinding ring 3 and the teeth 14 thereof, the clearance therebetween being preferably less than ten thousandths of an inch, so that the blades 31 cooperate with the lower ends of teeth 14 to exert a cutting or shearing action on material leaving the lower ends of slots 15.

The rotor R is preferably also provided with an annular baffle or skirt 33 extending downward from the head 26, inside the impeller blades 31, the lower portion of said annular baffle being disposed outwardly of and close to the inner wall 20 of the discharge compartment and extending downward a substantial distance below the upper end of said inner wall 20, so as to prevent or minimize access of water to the sealing means described below and also prevent any stringy material that may enter the discharge compartment from coming in contact with the drive shaft 5 or with said sealing means.

The portion of drive shaft 5 extending upward from motor E to rotor R is journaled in anti-friction bearing means such as a ball bearing 36 mounted in a recess 37 in the wall 20, it being understood that the lower end of said shaft is also journaled in suitable bearing means, not shown, at the lower end of motor E, which also takes the end thrust on said shaft due to the weight of the shaft

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and rotor and to vertical loads imposed thereon during operation. A suitable sealing gland 38 is also provided between the shaft 5 and the inner housing wall 20, above the bearing means 36, to prevent leakage of water or other material.

The apparatus may be mounted and supported in any desired manner. It is ordinarily supported by securing the upper end of the housing H to a suitable support member which may also serve as a means for facilitating introduction of kitchen waste or other material, and water, into the comminuting chamber C through the open upper end of the upper housing section 1. In Fig. 1, the mounting flange 6 at the upper end of said housing section 1 is shown as secured by bolts 39 to the open lower end of a funnel shaped receptacle or hopper of which only the lower portion is shown at 41. This arrangement may be employed in mounting units of relatively large size for use in restaurant kitchens or the like. For ordinary domestic use, smaller size units are used and may be similarly secured to a kitchen sink at the drain opening thereof. A suitable gasket and guard member 42 of synthetic rubber or other flexible resilient material is preferably also provided at the upper end of housing H. Said member is shown as comprising a disc whose outer marginal portion is clamped by bolts 39 between the receptacle 41 and the mounting flange 6. Said disc is formed with a small central opening 43 and a plurality of radial slots 44 extending from the inner edge of flange 6 inward to said opening, so as to provide a plurality of resiliently displaceable sector-shaped flaps 45 between said slots. The flaps 45 normally extend inward to obstruct the major portion of the open upper end of housing H, but are free to yield downward so as to form an opening at the upper end of the housing H of sufficient size to permit forcible introduction of material from the receptacle 41 into the comminuting chamber C.

In using the apparatus for the disposal of waste material or garbage, the motor E is energized to cause rapid rotation of rotor R, and the waste material and water are introduced through the upper end of the housing into the comminuting chamber C. Material falling upon the rotor R is thrown outward by centrifugal force. Large pieces of material are thrown against the side wall of the upper housing section and strike the vertically extending ribs 8. Smaller pieces may fall further downward and be forced or thrown into engagement with the teeth 9 on the outwardly sloping wall portion 1b or the teeth 14 of grinding ring 3. Pieces that are too large to enter the outwardly contracting space between the upper face of rotor head 26 and the sloping wall portion 1b will continue to be battered about between the rotor and the ribs 8 until they are reduced sufficiently to be brought into engagement with the teeth 9 or 14.

The upwardly projecting blades 28 of the rotor have several important functions. They provide more positive engagement and impact against pieces of material falling on the rotor and impart rotary motion thereto, causing them to be thrown outward with considerable velocity by centrifugal force. They also cooperate with the outwardly sloping wall portion 1b and its teeth 9 to prevent pieces of too large size from entering, and becoming jammed in, the space between the rotor head 26 and the grinding ring 3. It will be seen that the outer end portions of said blades 28 extend outward below the outwardly sloping teeth 9, and are spaced only a short distance below the lower outer portions of said teeth, so as to strike any large pieces that enter this region and subject them to further disintegration by impact and by bringing them into forcible engagement with said teeth. The forwardly facing end faces 28b of blades 28, whose outer edges 28c are disposed close to the inner faces of teeth 14 of the grinding ring, also act to bring the solid material into forcible disintegrating engagement with said teeth.

The blades 28 have another advantageous function due

to their being inclined outward and at a progressively increasing angle forwardly in the direction of rotation. If material is introduced into the apparatus before the motor is energized, and the motor is then started with a load of material already on the rotor, these blades tend to retain the material on the rotor during the period of acceleration thereof to full running speed and prevent such material from being delivered from the rotor until it attains sufficient speed for effective comminuting action. It has been found that this is of great advantage in preventing pieces of material that have not been properly comminuted or reduced in size from getting caught between the rotor and the fixed comminuting elements such as teeth 9 or 14 before the rotor has attained proper operating speed and thus causing it to jam or stall under these conditions.

The upwardly projecting posts or fingers 29 act to spear and tear up large objects or pieces of waste material by direct impact and to strike such objects and throw them against the housing and the ribs 8, and also act to break up large pieces of material that are engaged between them and the ribs 8 or teeth 9.

If water is introduced along with the material, it will also be thrown outward by the rotor and will be discharged between the rotor and the grinding ring 3. When the material is sufficiently reduced in size it is also discharged by passing down through the slots 15 in the grinding ring or between the peripheral face of the rotor and the inner faces of teeth 14. This movement of material from the comminuting compartment into the discharge compartment D is effected partly by gravity and partly by the entraining or flushing action of the water.

In moving downward between the rotor and the grinding ring 3 materials are subjected to further comminuting action either by grinding or attrition between the periphery of the rotor head 26 and the teeth 14, or by cutting or shredding action of the projecting portions 31' of impeller blades 31 that revolve beneath said teeth. Since the upper faces 32 of these projecting blade portions are spaced very close to the lower ends of teeth 14 and slots 15, they act to cut or shear pieces of material as they are discharged from said slots or between the teeth and the periphery of the rotor.

The comminuted material and water entering the discharge compartment D are subjected to rapid whirling motion so that centrifugal force keeps them in the outer portion of said compartment, away from the central shaft 5 and its bearing means, and causes them to be discharged by positive pumping action through the tangential outlet passage 17, which may be connected by suitable piping to a sewer system or other place of disposal.

In addition to its utility as a garbage disposer, the apparatus may also be used for comminuting other materials. For example, it may be used for comminuting or grinding vegetable products, such as chili peppers or citrus fruit peel. In such cases, it may not be necessary to separately introduce water into the apparatus if the material to be treated contains sufficient water to form, upon grinding, a pulp that is sufficiently fluid to be discharged from the apparatus.

In the form of apparatus described above, the outer end faces 28b of the upwardly projecting rotor blades 28 face forwardly in the direction of rotation of the rotor and the leading outer edges 28c thereof extend substantially vertically, while the teeth 14 of the grinding ring are inclined downward and forward in said direction of rotation. It will be seen from Fig. 5 that the leading inner edge 14c of each tooth 14 is inclined downward and forward in the direction of rotor rotation, at a small angle to the vertical, not only by reason of the above mentioned inclination of the teeth but also because of the downwardly increasing circumferential width of the slots. Thus, any material thrown or forced outward by the rotor or by the blades 28 and engaging the leading faces of teeth 14 tends to be deflected in a downward

direction due to the inclination of said faces, promoting the downward movement of material through the slots. The downwardly increasing circumferential width of the slots 15 also promotes such downward movement and eliminates any tendency of the material to clog said slots or accumulate therein.

A modified form of grinding ring is shown at 53 in Fig. 7. It is generally similar to the grinding ring 3 described above, except that the teeth 54 and slots 55 extend substantially vertically instead of being inclined downward and forward in the direction of rotation of the rotor. This modified form of grinding ring may be substituted for the ring 3 in the apparatus described above. Preferably, as before, the teeth 54 are of downwardly decreasing circumferential width, and the slots 55 are of downwardly increasing circumferential width, so that in this case also the leading face and leading inner edge 55c of the teeth are inclined downward and forward at a slight angle to the vertical so as to promote the downward movement of material.

The modified form of rotor shown at R' in Fig. 8 is generally similar to the rotor R described above, except that the outer end faces 58b and leading outer edges 58c of the blades 58 are inclined downward and rearward with respect to the direction of rotation, said blades being otherwise like the blades 28 described above. This form of rotor may be substituted for the rotor R in Figs. 1 and 2, and may be used in combination with either of the above described forms of grinding ring 3 or 53. The operation is substantially the same as before, except that the downward inclination of the outer end faces 58b serves to impart a downward component of motion to pieces of material that are struck and thrown outward thereby, thus promoting the downward movement of the material.

It will be noted that when either of the rotors R or R' is used in conjunction with either of the grinding rings 3 or 53, the leading outer edges 28c or 58c of the rotor blades 28 or 58 are inclined relative to the leading inner edges 14c or 54c of the grinding ring teeth 14 or 54. Due to this inclined relationship and the close spacing between these cooperating leading edges, these edges exert a progressive shearing action on material engaged thereby, and the inclined relationship between these cooperating edges serves to distribute the load imposed on the rotor more uniformly throughout the rotation of the rotor than would be the case if these edges were parallel to each other. For the same reasons, an advantageous shearing action and more uniform distribution of load on the rotor result from the fact that, due to the curvature of the impeller blades 31 as seen in Figs. 2 and 4, the leading upper edges 32a of the outwardly projecting portions 31' of said blades, which are spaced very close to the lower ends of the grinding ring teeth 14 and 54, are inclined relative to the leading lower edges 14d or 54d of said teeth.

The upwardly projecting rotor blades 28 or 58 are preferably equally spaced from each other, so that the leading outer edges 28c or 58c of said blades are spaced at substantially equal angular intervals about the periphery of the rotor R or R'. Similarly, the downwardly projecting impeller blades 31 are preferably spaced equally from each other, so that the leading upper edges 32a of the outwardly projecting portions 31' of these blades are also spaced at substantially equal angular intervals around the periphery of the rotor. The grinding teeth 14 or 54 and their leading inner and lower edges 14c or 54c and 14d or 54d are preferably also spaced at equal angular intervals. The spacing between the grinding ring teeth is relatively small compared with the spacing between the blades of the rotor, so that the number of teeth 14 or 54 is substantially greater than the number of blades 28 or 58 and of blades 31. Furthermore, the number of teeth 14 or 54 on the grinding ring is preferably relatively prime to the number of blades 28 or 58, and is preferably

also relatively prime to the number of blades 31, that is, the number of grinding ring teeth and the number of either set of blades on the rotor have no common divisor other than unity.

With this preferred arrangement, the leading outer edge 28c or 58c of any one blade 28 or 58 is brought into a given relative position of registration with respect to the leading inner edge 14c or 54c of each successive tooth at a different instant of time than any other one of said blades, and the leading upper edge 32a of the outwardly projecting portion of any one blade 31 is brought into a given relative position of registration with the leading lower edge 14d or 54d of each successive tooth at a different instant of time than any other one of said blades. This further serves to maintain the load on the rotor more nearly uniform and to prevent excessive and irregular instantaneous loads such as would occur if all the rotor blades registered with the grinding ring teeth at the same time.

For example, with four blades 28 or 58 and four blades 31 on the rotor, as shown, the number of teeth 14 or 54 on the grinding ring 3 or 53 may be any number that is relatively large compared to four and that is also relatively prime to four, such as forty-seven or forty-nine. It will be understood that the same advantageous relationship may be provided with other numbers of blades and teeth. Thus, if the rotor were provided with three blades 28 or 58 and three blades 31, the number of teeth on the grinding ring might be, for example, forty-seven, forty-nine or fifty, since each of these numbers is relatively prime to three. If the number of blades 28 or 58 is different from the number of blades 31, the number of teeth 14 or 54 is preferably relatively prime to the number of each of these blades.

The above described relationship between the number of rotor blades and the number of grinding ring teeth is particularly advantageous when the coacting leading edges thereof extend approximately parallel or are only slightly inclined with respect to each other; for example, in case the leading outer edges of the upwardly projecting rotor blades and the leading inner edges of the grinding ring teeth both extend substantially vertically, as shown for example at 28c in Fig. 6 and at 54c in Fig. 7. It will be apparent from the foregoing discussion that both the relative inclination and relative spacing of the coacting leading edges of the rotor blades and the grinding ring teeth are of advantage in providing continuity of cutting or shearing action and uniformity of loads imposed on the rotor, and these effects are believed to contribute substantially to the demonstrated ability of the apparatus to effectively disintegrate relatively large quantities of material for a given power input, without jamming or stalling of the rotor.

As a further feature of the present invention, the apparatus is preferably provided with magnetic means for attracting and trapping bottle caps or other objects of steel or other magnetic metal that may be inadvertently introduced along with the waste or other solid material. For this purpose, I have shown in Figs. 1, 2a and 3a permanent magnet M mounted within the upper section 1 of housing means H at a position between the open upper end thereof and the rotor R. The magnet M is shown as being of the well-known horseshoe shape, and may be of steel or of a suitable magnetic alloy having a high magnetic retentivity and a high coercive force. It is shown as being clamped tightly between blocks 61 which are preferably of non-magnetic material such as brass or certain types of stainless steel of low magnetic permeability. Magnet M and blocks 61 may be secured to the housing by bolt 62 threadedly engaging the inner clamping block.

The two arms or elongated pole members 63 of the horseshoe magnet M extend within the material receiving and comminuting chamber C, adjacent but somewhat inward from the wall of housing section 1. The elongated

pole members 63 extend approximately tangent to a circle about the vertical axis of the housing H and rotor R, and in the general direction of counterclockwise rotation of the rotor, so as to provide at their free ends 64 closely spaced magnet poles of opposite polarity. The ends of the pole members face forwardly in the counterclockwise direction of rotation of the rotor and are located adjacent but somewhat inward from the annular side wall of housing section 1.

If an object such as a bottle cap formed of steel or other magnetic metal, is inadvertently introduced into the chamber C along with kitchen waste or other material to be disintegrated, it is generally battered about within the chamber, between the upwardly projecting rotor blades or the posts 29 and the side wall or ribs 8 of the housing until it either hits one of the pole members of magnet M or comes close enough to be attracted and held thereby. The above described disposition of the pole members 63 and their ends 64 is of particular advantage in trapping and holding such magnetic objects and preventing them from being dislodged and carried away by impact of other objects. If a magnetic object is attracted to and held by one or both of the pole members 63 at the forwardly facing ends 64 or at the outer side thereof facing the housing wall, it will be protected by the pole members against dislodging by impact of other objects. If it is first attracted to the magnet at the inner side of one or both pole members, where it is more exposed to impact of other objects, such impact tends to move the attracted object forwardly along the pole member or members until it reaches the end 64 thereof, and thereby simply displace it into a more protected position at the forwardly facing end of the magnet or between the magnet and the side wall of the housing, instead of dislodging it. The magnet will therefore, in many cases at least, trap and hold such magnetic objects before they are reduced in size sufficiently to reach the space between the rotor and the grinding ring and thus tend to jam or stall the rotor.

Although a magnet of horseshoe shape having two elongated pole members whose opposite poles are close together is particularly effective, it will be understood that other forms of magnet may be used. For example, a simple bar magnet might be mounted in a similar manner, with an elongated pole member extending in the position described above so as to have one end thereof facing forwardly in the direction of rotation of the rotor, and providing one magnet pole at that end thereof.

It will also be understood that any desired number of such magnets may be provided and may be mounted at any suitable location or locations within the housing, between the open upper end thereof and the rotor.

I claim:

1. In an apparatus for the wet comminution of solid materials comprising vertically extending annular housing means enclosing a material receiving and comminuting chamber, the combination with housing means of a rotor mounted for rotation about a vertical axis, and means for rotating said rotor in one direction, said rotor having a generally disc shaped head and a plurality of angularly spaced blades projecting upward from said head and extending outward from the central portion to the periphery thereof, each of said blades being curved outward and forward in said one direction and being of forwardly concave curvature so that the forward inclination of each blade increases progressively toward the outer end thereof.

2. In an apparatus for the wet comminution of solid materials, the combination as set forth in claim 1, in which the upper surface of the rotor head is upwardly convex and slopes downward and outward, and the height of each blade above said head increases progressively from the central portion of the head to the periphery thereof.

3. In an apparatus for the wet comminution of solid materials, the combination of a rotor mounted for rotating about a vertical axis, and means for rotating said rotor in one direction, said rotor having a generally disc shaped

head and a plurality of angularly spaced blades projecting upward from said head and extending outward from the central portion to the periphery thereof, each of said blades being curved outward and forward in said one direction and being of forwardly concave curvature so that the forward inclination of each blade increases progressively toward the outer end thereof, in which the outer end portion of each blade extends in a forward direction almost tangent to the periphery of the rotor head and is provided with an outer end face facing forward in the direction of rotation of the rotor and extending transverse to the forward direction of the outer end portion of the blade.

4. In an apparatus for the wet comminution of solid materials, the combination as set forth in claim 3, in which said end faces of the blades extend substantially vertically.

5. In an apparatus for the wet comminution of solid materials, the combination as set forth in claim 3, in which said end faces of the blades are inclined downward and rearward with respect to the direction of rotation of the rotor.

6. In an apparatus for the wet comminution of solid materials, the combination as set forth in claim 3, in which said outer end face of each blade is inclined slightly forward toward its outermost edge.

7. In an apparatus for the wet comminution of solid materials comprising: vertically extending annular housing means enclosing a material receiving and comminuting chamber and provided with fixed comminuting means disposed around said chamber; said fixed comminuting means including a grinding ring formed to provide at its inner surface a plurality of angularly spaced inwardly projecting teeth separated by slots; a rotor mounted for rotation about a vertical axis and having a generally disc shaped head disclosed in the lower portion of said chamber within said grinding ring, with its periphery spaced close to the inner faces of said teeth; and means for rotating said rotor in one direction; said rotor also having a plurality of angularly spaced blades projecting upward from said head and extending outward from the central portion to the periphery thereof, each of said blades being curved outward and forward in said one direction and being of forwardly concave curvature so that the forward inclination of each blade increases progressively toward the outer end thereof.

8. An apparatus for the wet comminution of solid materials comprising: vertically extending annular housing means enclosing a material receiving and comminuting chamber and provided with fixed comminuting means disposed around said chamber; a rotor mounted for rotation about a vertical axis and having a generally disc shaped head disposed in the lower portion of said chamber; and means for rotating said rotor in one direction; said fixed comminuting means including a grinding ring formed to provide at its inner surface a plurality of angularly spaced inwardly projecting teeth separated by slots, said teeth and slots extending downward from the top to the bottom of said grinding ring; said rotor head being disposed within said grinding ring and having a circumferential face spaced close to the inner faces of said teeth.

9. An apparatus as set forth in claim 8, in which the slots between the teeth of said grinding ring are of downwardly increasing circumferential width.

10. An apparatus as set forth in claim 8, in which the teeth of said grinding ring are of substantially rectangular profile, with their side faces extending substantially radially and their inner faces lying substantially in a cylindrical surface about the axis of the rotor.

11. An apparatus as set forth in claim 8, in which the teeth of said grinding ring are inclined downward and forward in the direction of rotation of the rotor.

12. An apparatus as set forth in claim 8, in which the teeth of said grinding ring extend substantially vertically.

13. An apparatus as set forth in claim 8, in which the circumferential face of the rotor head is of less height than the teeth of said grinding ring and is disposed within the lower portion of said teeth; said rotor being provided with a plurality of angularly spaced blades projecting upward from the rotor head and extending outward from the central portion to the periphery thereof; the upper surface of each blade sloping upward and outward; and the outer edge of each blade extending upward from the circumferential face of the rotor head to approximately the level of the upper ends of said teeth and being spaced close to the inner faces of said teeth.

14. An apparatus for the wet comminution of solid materials comprising: vertically extending annular housing means enclosing a material receiving and comminuting chamber and provided with fixed comminuting means disposed around said chamber and including a grinding ring formed to provide at its inner surface a plurality of inwardly projecting teeth extending downward and separated by slots; a rotor mounted for rotation about a vertical axis and having a generally disc shaped head whose circumferential face is of less height than the teeth of said ring and is disposed within the lower portion of said grinding ring and spaced close to the inner faces of said teeth; said rotor being also provided with a plurality of angularly spaced blades projecting upward from the rotor head and extending outward from the central portion to the periphery thereof; and means for rotating said rotor in one direction; the leading outer edges of said blades being spaced at substantially equal intervals around the periphery of the rotor head and extending upward from said circumferential face thereof in closely spaced relation to the inner faces of said teeth; the leading inner edges of said teeth being spaced at substantially equal intervals, and the number of said teeth being considerably greater than and relatively prime to the number of said blades.

15. An apparatus for wet comminution of solid materials comprising vertically extending annular housing means enclosing a material receiving and comminuting chamber; a comminuting ring disposed at the lower end of said chamber; a rotor mounted for rotation about a vertical axis and having a generally disc shaped head with impeller means thereon disposed within said comminuting ring with its outer circumferential face spaced close to said comminuting ring; and means for rotating said rotor in one direction; said housing means including an annular wall whose inner surface is located above the outer portion of said rotor head; the lower portion of said inner surface sloping downward and outward at a greater angle to the vertical than the upper portion thereof, from a position above the rotor head and inwardly of the periphery of said head to a position approximately above said periphery; said lower portion of said inner surface being formed to provide a plurality of angularly spaced teeth having angular inner edges extending downward and outward throughout substantially the entire height of said lower portion and cooperating with the impeller means on said rotor.

16. An apparatus as set forth in claim 15, in which said comminuting ring is provided with a plurality of angularly spaced inwardly projecting teeth extending downward from a position adjacent to lower ends of the first mentioned teeth, with the lower portions of their inner faces surrounding and spaced close to the outer circumferential face of said rotor head and having the teeth of said comminuting ring spaced closer together than said first mentioned teeth.

17. An apparatus for the wet comminution of solid materials comprising: vertically extending annular housing means enclosing a material receiving and comminuting chamber and a discharge compartment below said chamber; a rotor mounted for rotation about a vertical axis and having a generally disc shaped head disposed in the lower portion of said chamber and a plurality of angularly spaced impeller blades extending downward from said

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rotor head and within said discharge compartment; and means for rotating said rotor in one direction said housing means being provided with a grinding ring formed to provide at its inner surface a plurality of angularly spaced inwardly projecting teeth separated by slots, said teeth and slots extending downward from the top to the bottom of said grinding ring; said rotor head being disposed within said ring and having a circumferential face spaced close to the inner faces of said teeth; the outer end portions of said impeller blades projecting outward beyond said circumferential face of the rotor head, below and in close proximity to the lower ends of said teeth and slots; said grinding ring teeth having side faces extending substantially radially with respect to said vertical axis; and said impeller blades being curved outward and rearward with respect to the direction of rotation of the rotor so that the leading upper edges of said projecting end portions of the blades are inclined relative to the leading lower edge portions of said teeth.

18. An apparatus for the wet comminution of solid materials comprising: vertically extending annular housing means provided with a grinding ring having at its inner surface a plurality of inwardly projecting teeth extending downward and separated by slots, said housing means enclosing a discharge compartment below said grinding ring; a rotor mounted for rotation about a vertical axis and having a generally disc shaped head disposed within said grinding ring in closely spaced relation to said teeth; said rotor being also provided with a plurality of angularly spaced blades extending downward from said head within said discharge compartment and having portions projecting outward beyond the periphery of the rotor head, below and in close proximity to the lower ends of said teeth; and means for rotating said rotor in one direction; the leading upper edges of said projecting portions of the blades being spaced at substantially equal intervals from each other; the leading lower edges of said teeth being spaced at substantially equal intervals from each other, and the number of said teeth being considerably greater than and relatively prime to the number of said blades.

19. An apparatus for the wet comminution of solid materials comprising: vertically extending annular housing means enclosing a material receiving and comminuting chamber and provided with fixed comminuting means disposed around said chamber and an opening at the upper end of said chamber for introduction of solid material into the chamber; a rotor mounted for rotation about a vertical axis located centrally of said housing means and having a generally disc shaped head disposed in the lower

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portion of said chamber with its periphery in closely spaced relation to said fixed comminuting means; means for rotating said rotor in one direction; and a permanent magnet mounted on said housing means and having at least one elongated pole member extending within said chamber at a position between said opening and said rotor, said pole member extending approximately tangent to a circle about said vertical axis and in the general direction of rotation of said rotor and having an end providing a magnet pole and facing forward in said direction and positioned adjacent but somewhat inward from said housing means.

20. An apparatus for the wet comminution of solid materials comprising: vertically extending annular housing means enclosing a material receiving and comminuting chamber; annular comminuting means disposed at the lower end of said chamber; a rotor mounted for rotation about a vertical axis and having a generally disc shaped head disposed in the lower portion of said chamber adjacent said comminuting means; a plurality of upwardly projecting blades extending arcuately inwardly from the periphery of said disc shaped head; and means for rotating said rotor; said housing means including an annular wall whose inner surface is located above the outer portion of said rotor head; the lower portion of said inner surface sloping downward and outward at a greater angle to the vertical than the upper portion thereof, from a position above the rotor head and inwardly of the periphery of said head to a position approximately above said periphery thereby militating against the passage of large pieces of material from reaching the zone defined by said comminuting means and said rotor.

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U. S. DEPARTMENT OF COMMERCE

PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,824,702

Mark W. Lee

February 25, 1958

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 19, for "may me" read -- may be --; column 8, line 54, for "14 and 54" read -- 14 or 54 --; column 9, line 42, for "substantially" read -- substantially --; column 11, line 36, for "disclosed" read -- disposed --.

Signed and sealed this 17th day of June 1958.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents