Oct. 23, 1951 J. NIETHAMER 2,572,373

GRINDING DISK OR PULVERIZER

Original Filed Feb. 28, 1946 4 Sheets-Sheet 1

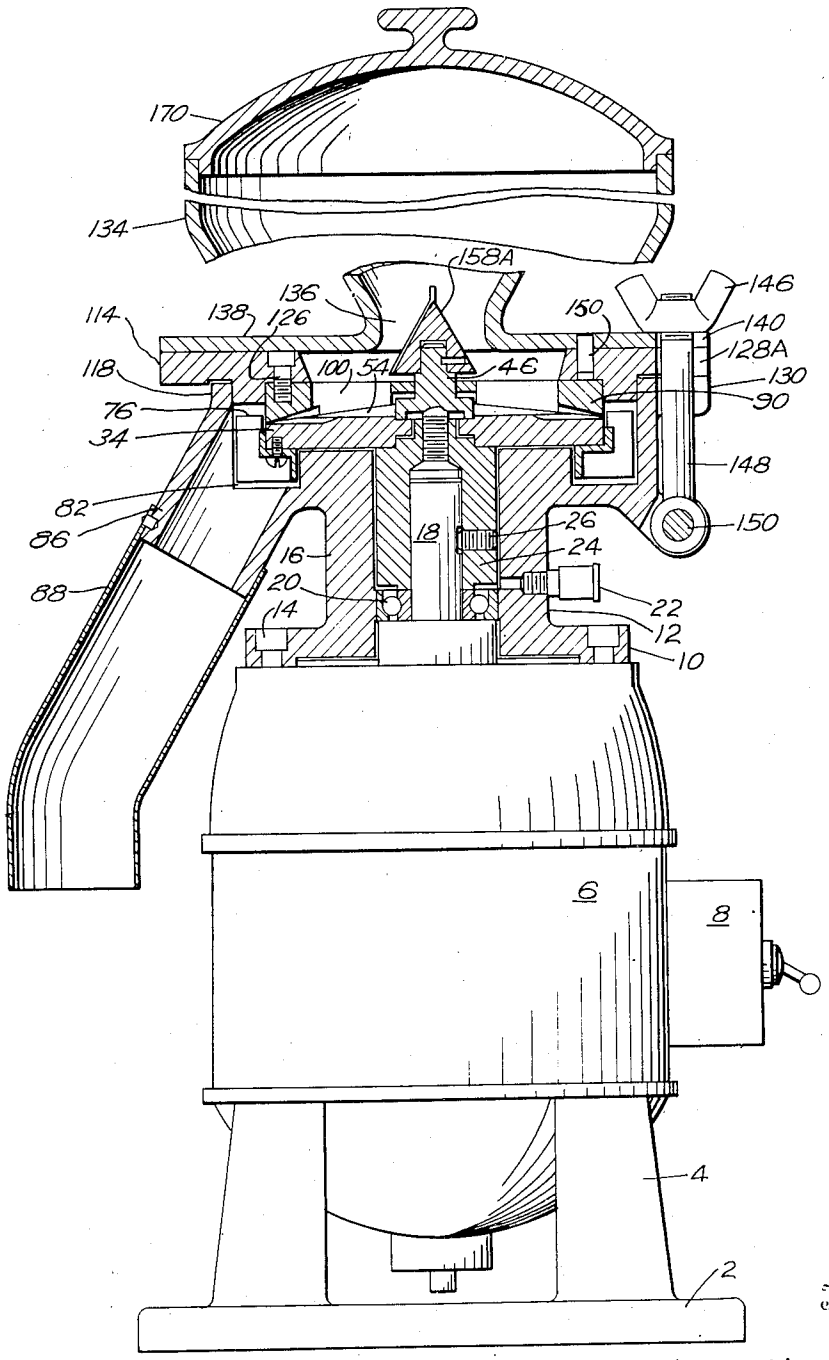


Fig. 1

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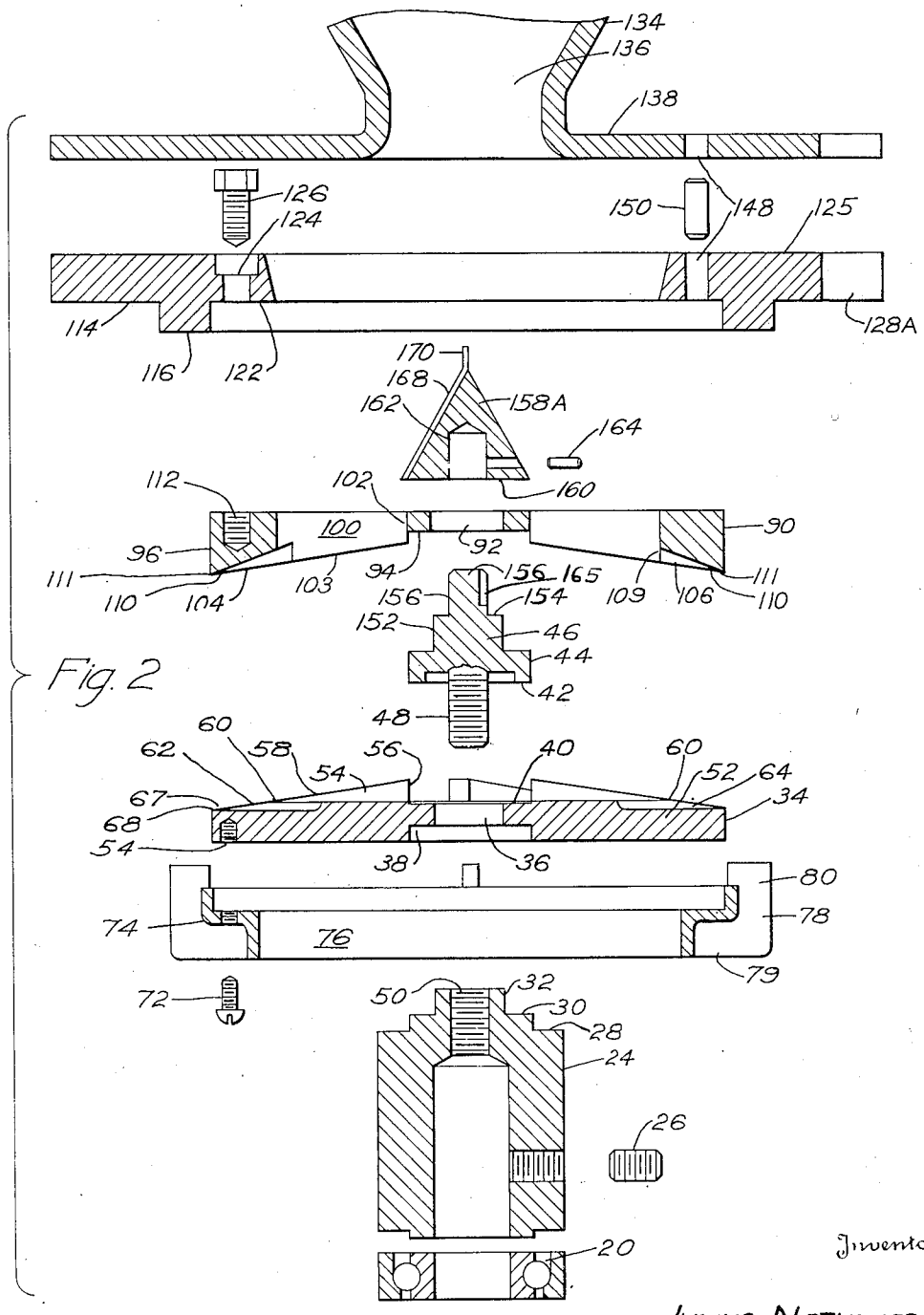


Fig. 2

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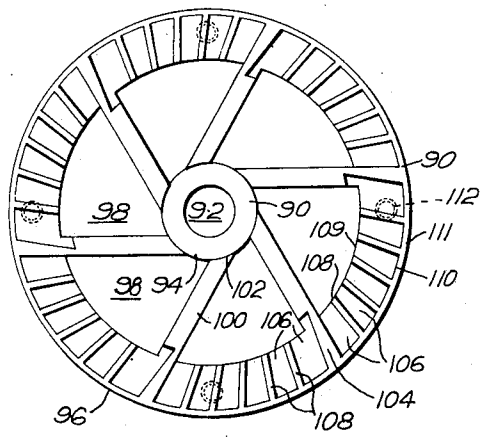


Fig. 3

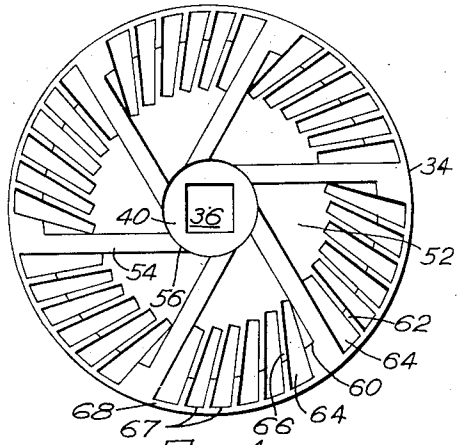


Fig. 4

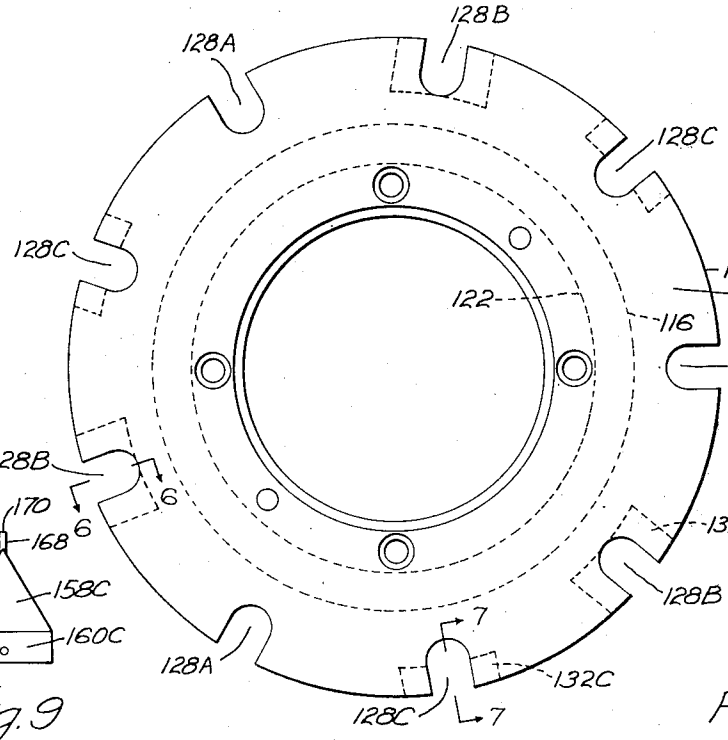


Fig. 9

Fig. 5

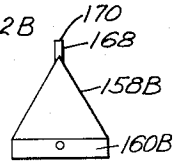


Fig. 8

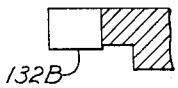


Fig. 6

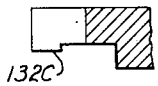


Fig. 7

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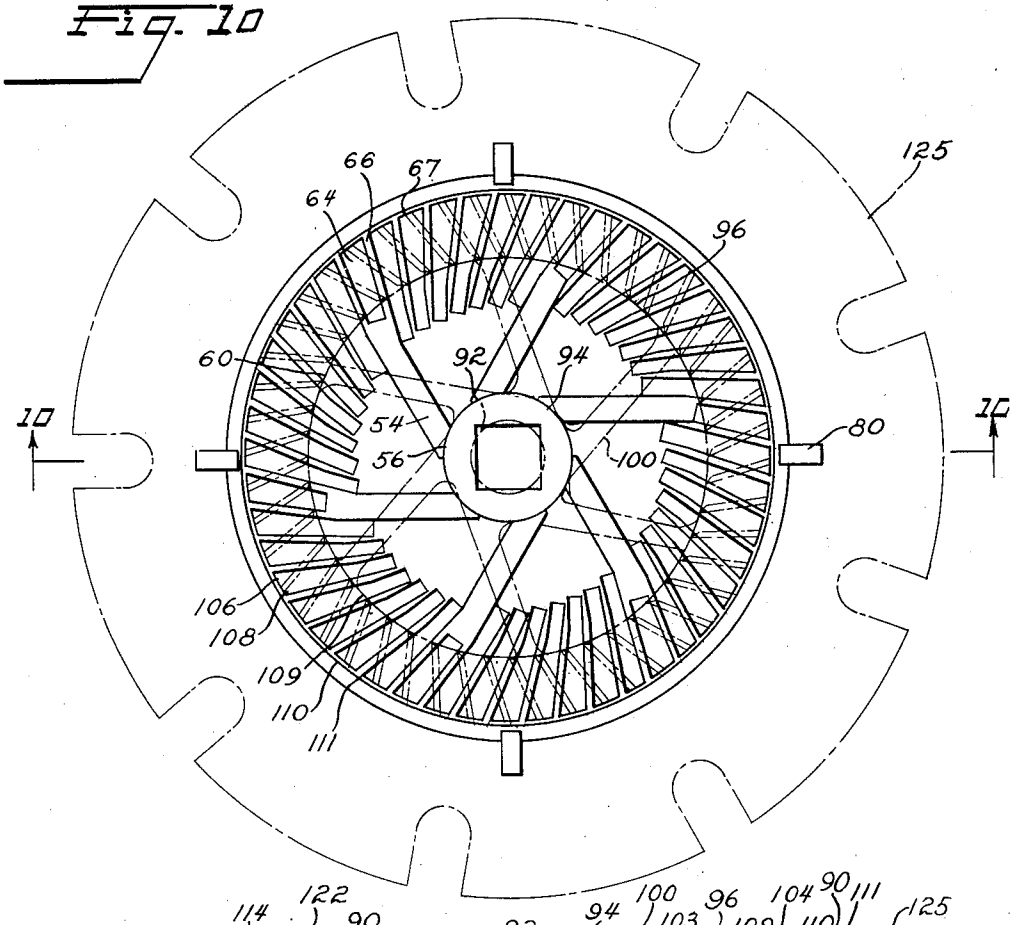
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Fig. 10



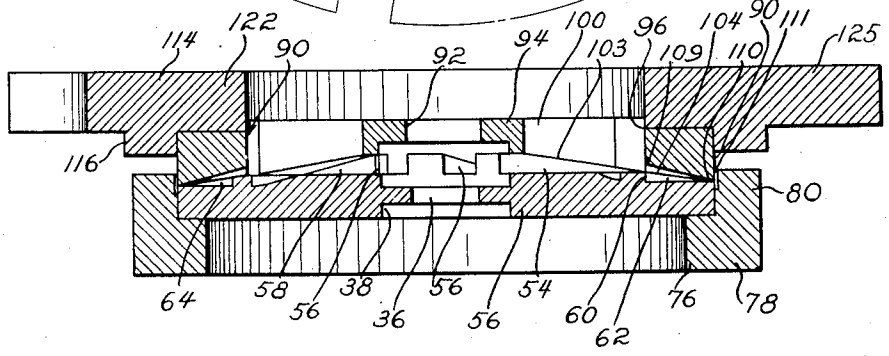


Fig. 11

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GRINDING DISK OR PULVERIZER

Julius Niethamer, Whitestone, N. Y.

Original application February 28, 1946, Serial No. 650,890. Divided and this application June 20, 1949, Serial No. 100,197

3 Claims. (Cl. 241—260)

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This invention relates to pulverizers and, more particularly, to a rotary disk pulverizer having a grinding and shearing action on the material worked upon. The application is a division of my co-pending application entitled Pulverizers, Ser. No. 650,890, filed February 28, 1946, now Patent 2,478,937 of August 16, 1949.

The primary object of the invention is to provide a pulverizer of the type which includes a disk rotatable about a vertical axis and having an upwardly disposed working face cooperating with the downwardly disposed working face on a stator disposed thereabove. Working faces on the rotor and stator are intended to be formed with sets of teeth which pulverize first by a rough shearing action to break up the material being worked upon, then by finer shearing action to cut the material into substantially uniform particles, and finally by grinding the material. It is further intended to perform the successive steps of pulverization in separate zones progressing radially outward from near, but not at, the centers of the rotor and stator to the peripheries thereof, and to dispose the teeth on the working faces of the rotor and stator at such angles as to exert on the material a positive outward force as well as a centrifugal force so as to feed the material through the successive working zones.

More specifically, it is an object to provide a rotor having a generally flat face, but with a set of large elongated, upstanding teeth which extend out from near the center of the rotor to the periphery thereof, these teeth being highest at their inner ends and sloping downwardly and outwardly so as to merge into disk face well inside the disk periphery. It is intended that these large teeth be relatively widely spaced from one another, for instance 60°, and that they be non-radial, or skewed, as seen in plan view so that their inner ends are offset counter-clockwise of radii intersecting their outer ends. In addition to the large upstanding teeth, it is now proposed to provide sets of smaller, similarly skewed teeth intermediate the larger and about half as long, these smaller ones extending inwardly from near the disk periphery and being formed by cutting slots in the disk face so that their top edges lie flush with the face. By leveling the portion of the disk face adjacent its periphery at an angle corresponding to the slope of the large teeth, a grinding zone is formed near the disk edge.

Another object is to provide a stator having a working face generally complementary with the complex rotor face in that the lower edges of the

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stator teeth are inclined downwardly from their inner to their outer ends. It is intended that the stator teeth, like those on the rotor, be skewed but that they be arranged so that their inner ends are offset clockwise from radii intersecting their outer ends.

Another object is to provide a stator formed of spaced inner and outer concentric rings of hard abrasive material integrally connected by large, skewed teeth in the manner of non-radial spokes, with open spaces between the large teeth so that material may be fed therethrough into the working zones. More specially, it is intended that the inner ring be flat, and shallower in its axial dimension than the large teeth. The outer ring, which is deeper than the inner, is to be formed with its lower, working face beveled downwardly and outwardly so as to merge and be flush with the lower edges of the large teeth. Slots, wedge-shaped in cross section, are to be provided in the lower face of the outer ring so as to form teeth therebetween, these teeth being of greatest depth at the inner periphery of the outer ring and merging into the ring face adjacent the outer periphery so as to form an outer grinding zone mating with the grinding zone on the stator.

These and other objects will be apparent from the following specification and drawings, in which:

Fig. 1 is an elevation, partially in vertical section of the assembly;

Fig. 2 is an exploded view showing the inner parts in vertical section;

Fig. 3 is a plan view of the stator in inverted position;

Fig. 4 is a plan view of the rotor;

Fig. 5 is a plan view of the adjustment ring;

Figs. 6 and 7 are detailed sections along lines 6—6 and 7—7, respectively, of Fig. 5.

Figs. 8 and 9 are elevations showing feed control cones.

Fig. 10 is a phantom plan view looking down on the stator and rotor removed from the grinder showing the relationship of the teeth; and

Fig. 11 is a cross section taken along the line 10—10 of Fig. 9.

Referring now to the drawings, in which like reference numerals denote the same or similar elements, the machine as a whole is shown in Fig. 1 wherein there is shown a flat base 2 having legs 4 projecting upwardly to support the casing 6 of an electric motor controlled by an off-on switch 8 connected to a suitable source of electricity, not shown. The flat top of motor casing 6 supports the base 10 of a housing 12 secured on by bolts 14.

Housing 12 includes an upstanding, hollow cylindrical portion 16, the base of which accommodates the drive shaft 18 of the motor enclosed in casing 6. Ball bearings 20 rotatably support shaft 18 near the lower end of housing 12 and a grease cup 22 and passage therefrom is provided in the wall of cylindrical portion 22 for bearing lubrication.

A tubular rotor drive shaft 24 closely engaged over motor drive shaft 18 and held in non-rotating engagement thereon by a set screw 26 extends upwardly into an enlarged cylindrical portion of housing 12, the upper end of the rotor drive shaft being provided with annular, inwardly flanged shoulders 28 and 30 and terminating in a rectangular boss 32, as best seen in Fig. 2 for supporting and non-rotatably fitting with a rotor 34 complementarily formed with a rectangular central opening 36 which non-rotatably fits on rectangular boss 32, and an annular recess 38 in its bottom arranged to nest with shoulders 28 and 30. A shallow annular recess 40 surrounding central opening 36 is formed in the top wall of disk 34 for receiving the depending rim 42 of an outwardly flanged skirt 44 on a combined lock screw and feed control support 46, the screw portion 48 of which threads downwardly into an inwardly threaded axial bore 50 in the top of rotor drive 24.

Of particular importance is the arrangement of and form of teeth on the upper, working face of the substantially flat, disk-shaped body 52 of rotor 34, these teeth being as seen best in Figs. 2, 9 and 10 and consisting of two sets integrally formed with disk body 52 both of which sets are skewed so that their inner ends lie counter-clockwise of radii respectively intersecting their outer ends, as seen in plan view. The teeth 54 comprising the larger set terminate at their highest, inner ends 56 flush with the edge of recess 40 and have straight top edges 58 sloping downwardly towards their outer ends so, in effect, as to merge with the upper face of the body 52 of disk 34 at the point designated 60. It should be further noted that a circumferential portion 62 of the upper face of disk 34 is beveled from point 60 to its outer periphery, the bevel of portion 62 being at the same angle of slope as the top edges 58 of teeth 54 so as to form a continuation thereof. Actually, teeth 54 continue from point 60 almost to the outer periphery of body 52, being there defined by slots 64 in the upper face of body 52. Slots 64 are angularly spaced from one another so as to define small teeth 66 therebetween, these small teeth being skewed somewhat more than the larger ones 54. The depth of slots 64 is such that their bottoms interset at point 67 with the plane of beveled portion 62 so that, at point 67, all teeth 54 and 66 dwindle away, thus leaving a smooth grinding surface 68 immediately adjacent the outer periphery of disk 34.

The underside of rotor 34 is tapped at several points for threadedly receiving bolts 72 which hold on the Z-sectioned ring 74 of turbine 76, the L shaped blades 78 of which are welded or otherwise rigidly secured to ring 76 with their surfaces radially disposed. Turbine blades 78 each comprise a foot 79 which underlies the lower edge portion of rotor 34 and a leg 80 which extends higher than the upper peripheral edge of the rotor so as to overlap the gap between the rotor and stator described below, the turbine running in an annular recess 82 in the body 84 of housing 12. An outlet chute 86 extending from housing body 84 communicates with turbine recess 82 and, preferably, an outlet tube 88 is connected on outlet chute for removing the ground material.

A stator 90 affixed above rotor 34 is formed with an annular central opening 92 surrounding the central boss 152 of lock screw and feed control support 46 so as to allow rotation of the latter therein. While stator 90 is preferably formed of one integral piece, it may be considered as comprising an inner ring 94, an outer ring 96, and cut-away portions 98 leaving spoke-like large teeth 100 therebetween. All of the teeth of stator 90 are skewed in the manner of those on rotor 34 but, in the case of stator 90 the inner ends of the teeth lie clockwise of radii intersecting their outer ends, as seen in plan. In Fig. 3 the stator is shown inverted. Otherwise, stator 90 is somewhat complementary with rotor 34 in that large teeth 100 are narrowest, from top to bottom, at their inner ends 102 and have lower edges 103 inclined outward and downwardly, these edges preferably being beveled so as to present a knife-like edge.

The outer ring portion 96 of stator 90 has its lower face beveled as indicated at 104 so that the portions at the outer ends of the spoke-like large teeth 100 form a continuation thereof, and spaced slots 106, which are wedge-shaped in cross-section, define small teeth 108. In detail, slots 106 are deepest at their inner ends 109 so that the effective height of small teeth 108 is there greatest whereas the slots terminate at 110 so as to leave a substantially smooth grinding surface 111 adjacent the periphery of stator 90 to mate with the corresponding surface 68 on rotor 34.

Stator 90 is provided with four holes 112 for attachment by four screws 126 to an adjustment ring 114. Adjustment ring 114 is generally T-shaped in cross-section and comprises a depending ring portion 116 rotatably fitting in the cylindrical side wall 118 of housing 12, and an inwardly extending flange 122 drilled and countersunk at 124 for the screws 126 which affix it to stator 90. An outwardly extending flange 125 on adjustment ring has its periphery notched. In Fig. 5 it will be observed that there are three spaced sets of notches 128A, 128B, and 128C, these sets being selectively engageable over three pairs of ears 130 extending outwardly from housing 12, each pair being 120 degrees from the next. While the lower surface of ring 114 is flat at the outer corners of notches 128A, as illustrated in Figs. 2, 6, and 7 depending feet 132B and 132C extend downwardly from adjacent the outer corners of notches 128B and 128C, respectively, so that when ring 114 is rotated to bring the three notches 128A in registry with the three pairs of ears 130, ring 114 supports stator 90 above the position which it would occupy where notches 128A registered with ears 130 and, of course, below the position which it would occupy were notches 128C so registered.

A hopper 134 having at its lower end a reduced throat 136 and an outwardly flanged flat base 138 also having nine notches 140 at its outer edge spaced to register with notches 128A, 128B, and 128C fits flatwise over adjustment ring 114, the ring 114 and hopper base 138 being held in position by three bolts 148 pivoted at 150 to housing 12 so that they may be swung up between ears 130 and into slots 128A, 128B, or 128C, depending upon the position selected for adjustment ring 114, and also into slots 140, there being wing nuts 146 on bolts 142 for holding the top assembly down. If desired, the inner flange

122 of adjustment ring 114 and the flat base 138 of hopper 134 may be suitably drilled, as at 148, for drift pins 150.

The combined lock screw and feed control support 46 is formed with an annular central boss 152 which rotates within annular central opening 92 of stator 90, as denoted above. The top wall of boss 152, which lies just higher than the upper surface of rotor inner disk 94, is formed as an inwardly flanged shoulder 154 and projecting upwardly from the shoulder is an axial post 156 on which fits a feed control cone 158A, 158B, or 158C. Each of the cones is provided with a flat base 160 which rests on shoulder 154, and axial bore 162 extending upwardly from the base for fitting over post 156. A pin 164 is press fitted in a suitable opening through the side wall of each cone, the inner end of the pin engaging an L-shaped bayonet slot 165 which has a vertical portion and a foot portion extending clockwise therefrom so that a cone may be fitted down on post 156, given a slight turn, and locked in place. On the side of each cone, a stiff wire 168 is soldered so as to lend a slight stirring motion to material fed therepast, the upper end of the wire extending above the cone apex and terminating in a tip 170.

In operation, wing nuts 146 are loosened so as to allow bolts 148 to be pivoted out from the position shown in Fig. 1 so that hopper 134 can be removed for installing the selected feed control cone 158A. Then, either before or after the hopper is replaced, adjustment ring 114 is rotated to bring the desired set of slots 128A, 128B, or 128C in registry with ears 130 so as to provide the desired spacing between stator 90 and rotor 34. By adjustment of ring 114, a coarse, medium, or fine pulverization can be obtained. Then, with hopper 134 in place, bolts 148 are returned to their Fig. 1 position, wing nuts 146 are tightened, cover 170 is removed, the material to be pulverized is placed in hopper 134, and switch 8 is closed to start motor 6. Assuming that a fine pulverization and a fast feed is desired, the raw material will drop through hopper throat 136, the rotation of the cone 158A serving to stimulate material flow therepast. From throat 136, the material passes down through the spoke-like teeth 100 of stator 90, immediately after which it is sheared by the cooperating large teeth 54 and 100 on the rotor and stator. As rotor 34 turns, counterclockwise as seen in plan, the angularly skewed disposition of its teeth is such that the inner ends lead the outer, thereby forcing the material outwardly as it is roughly sheared. The effect of the angular disposition of stator teeth 100 is likewise such that material forced there-against by the rotor will be wedged outwardly. These driving actions, together with centrifugal force, feed the roughly sheered material to the zone between small rotor teeth 66 and small stator teeth 108 (at which points large teeth 54 and 100 have become small) where the roughly sheared material is sheared into small particles. As these small particles are fed outwardly, they are then ground between smooth surfaces 68 and 111. When the particles have been ground sufficiently to pass out between the adjacent peripheries of the rotor and stator, they are then engaged by the blades 78 of turbine 76 and impelled to outlet chute 86. In addition to its functions in grinding per se, the design of the rotor and turbine is such as to eliminate heat, as is particularly desirable in dry grinding.

The invention described above is not limited to the specific disclosures, but covers all modifications and equivalents within the scope of the following claims.

I claim:

1. In a pulverizer, a pair of substantially disk-shaped pulverizing members coaxially disposed with working faces adjacent one another, one of said members having a plurality of upstanding teeth thereon, the other of said members comprising spaced inner and outer rings of rigid material and a plurality of rigid teeth integral with said rings and extending spoke-like therebetween, the outer ring having a plurality of slots in the working face thereof, said slots tapering inwardly from adjacent the periphery of the ring and being spaced from one another to define divergent teeth therebetween.

2. The combination claimed in claim 1, the free edges of said spoke-like teeth merging into the material of said outer-ring adjacent the periphery thereof.

3. In a pulverizer, a pair of grinding disks having opposed, frusto-conical respectively concave and convex mating faces each having an outer peripheral zone and an inner zone, the outer zone of the concave disk being formed of a ring of solid material having an annular series of regularly spaced wedge-shaped slots therein, said slots being skewed with respect to radii of the disk and having their shallower ends merging into the outer periphery of the disk and defining therebetween a plurality of skewed teeth having free edges lying along a relatively shallow frusto-cone and with said teeth increasing in height above the material of said ring, said concave disk also having a plurality of relatively widely spaced, large spoke-like teeth extending inwardly from said ring, said spoke-like teeth having open spaces therebetween and being joined at their inner ends and having free edges lying along the surface of said frusto-cone, the outer peripheral zone of said convex disk having an annular series of relatively small upstanding, regularly spaced skewed teeth with their outer ends merging into the material of the disk and with the outer portions of their free edges lying along the surface of said frusto-cone, and a plurality of relatively widely spaced large teeth upstanding from the surface of said disk and extending inwardly from said outer peripheral zone and also having their free edges lying along said frusto-cone.

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