Aug. 29, 1944. L. DOTZER 2,356,753

GRINDING MILL

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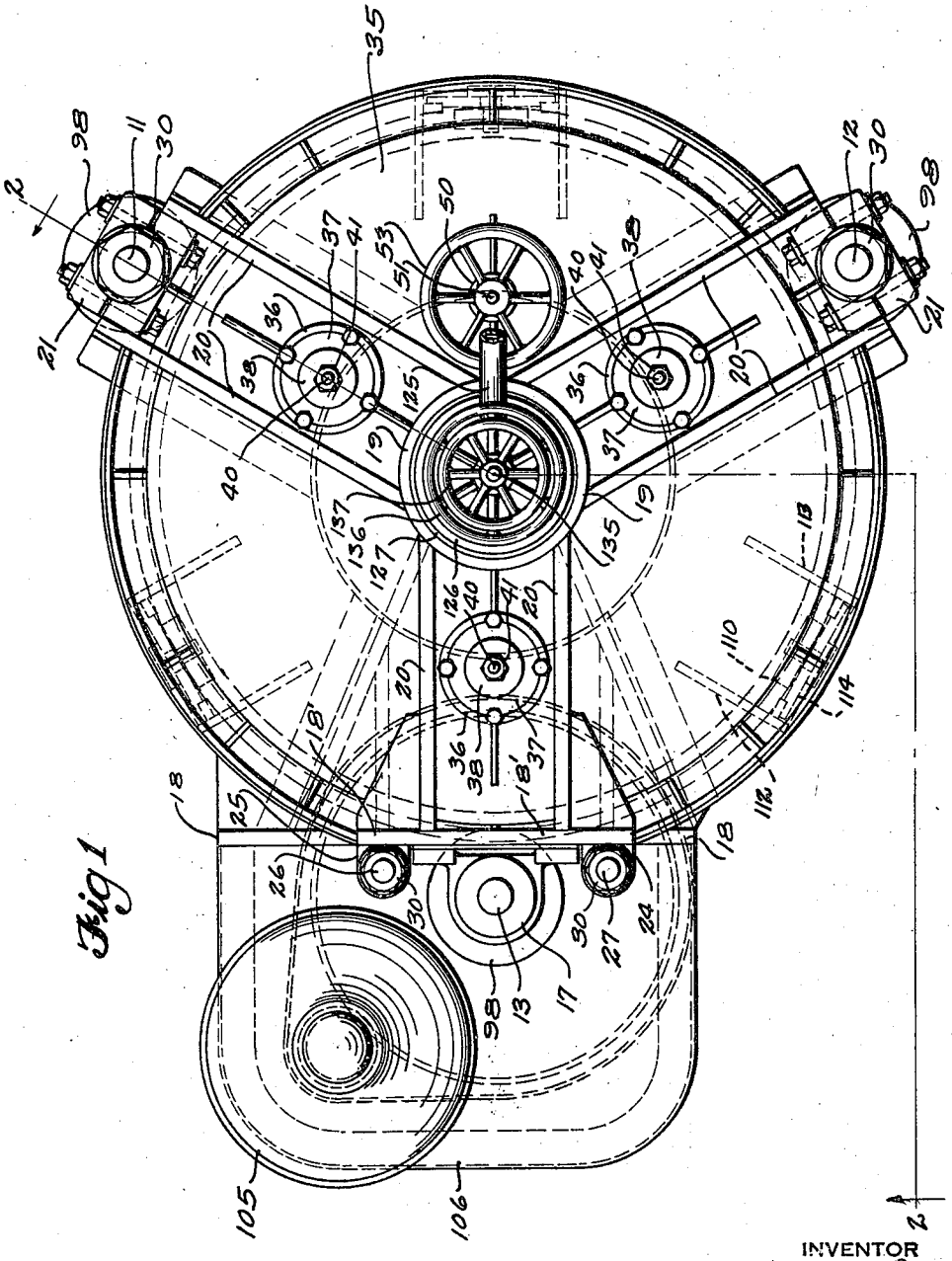


Fig 1

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GRINDING MILL

Filed Aug. 19, 1939 5 Sheets-Sheet 2

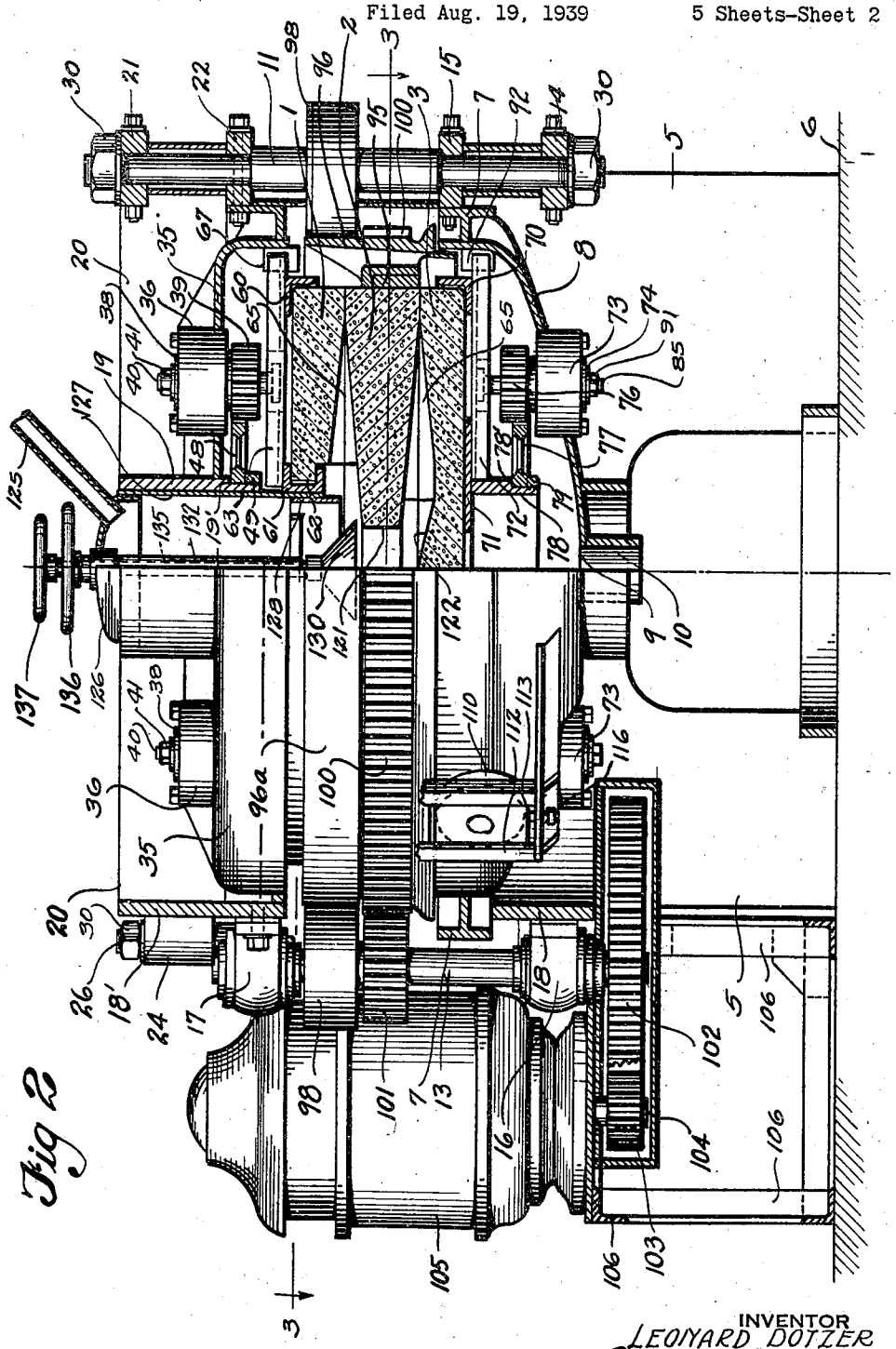


Fig 2

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GRINDING MILL

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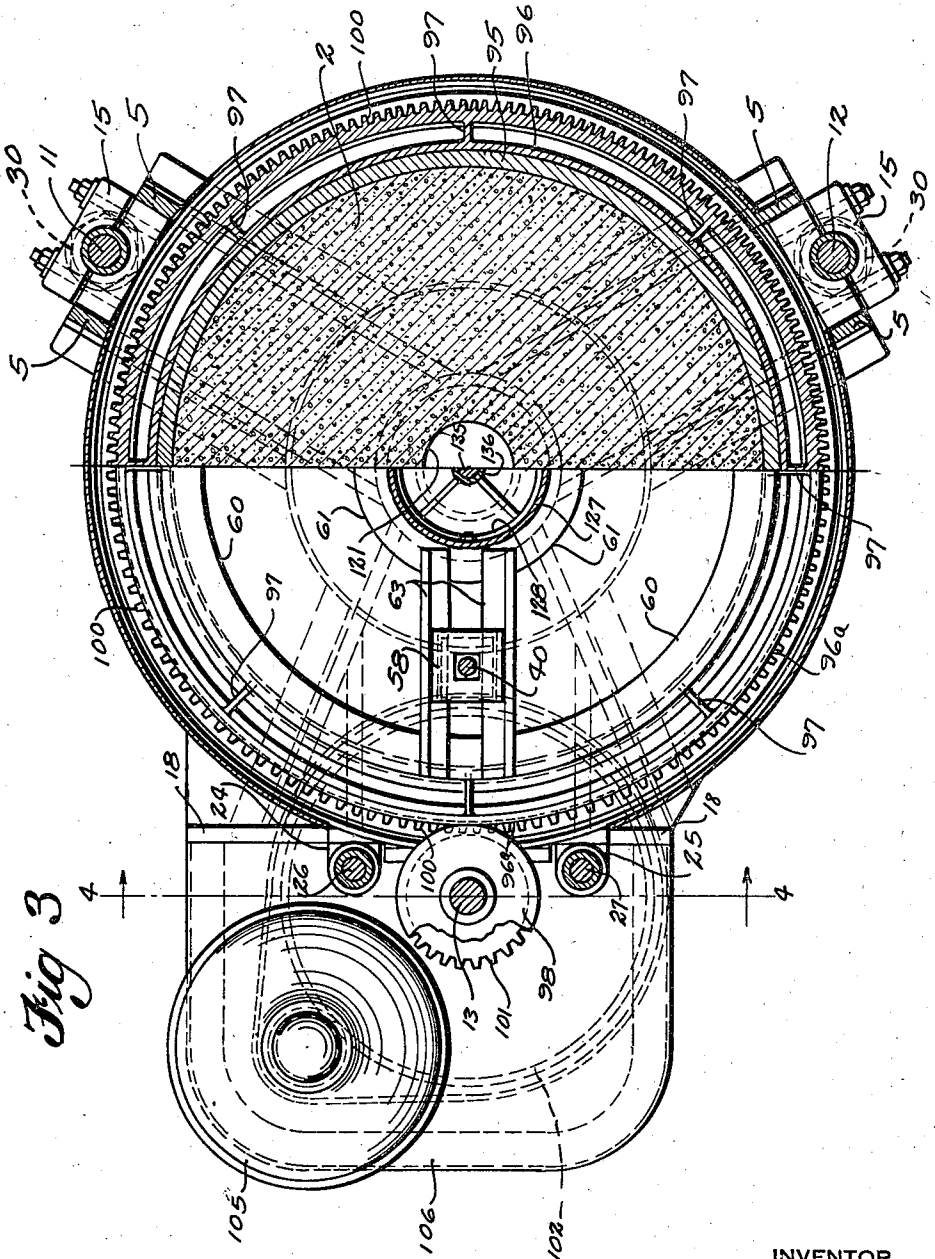


Fig 3

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Aug. 29, 1944. L. DOTZER 2,356,753

GRINDING MILL

Filed Aug. 19, 1939 5 Sheets-Sheet 4

Fig 5

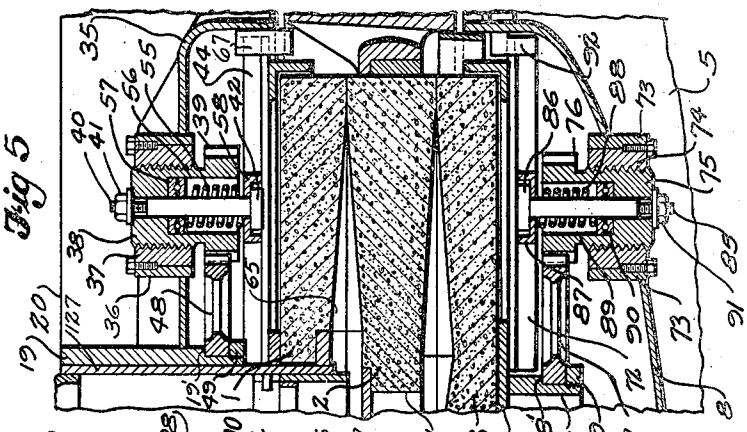
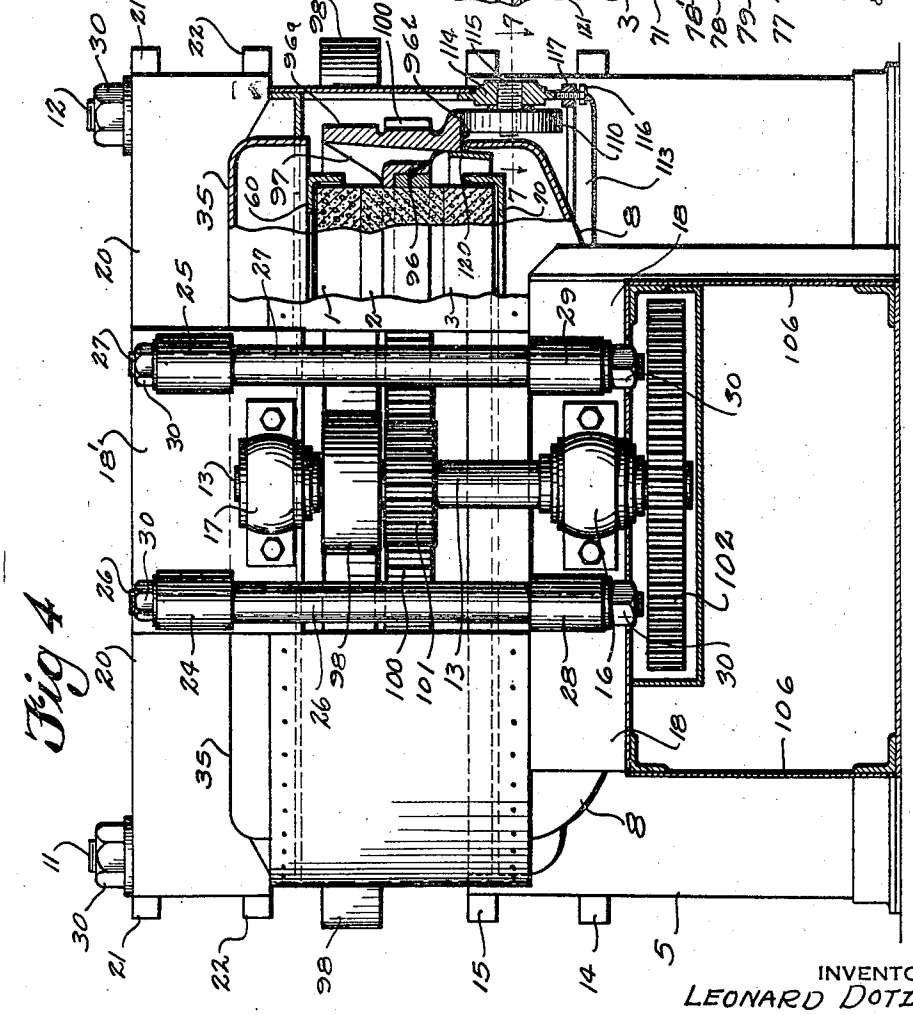


Fig 4



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Aug. 29, 1944. L. DOTZER 2,356,753

GRINDING MILL

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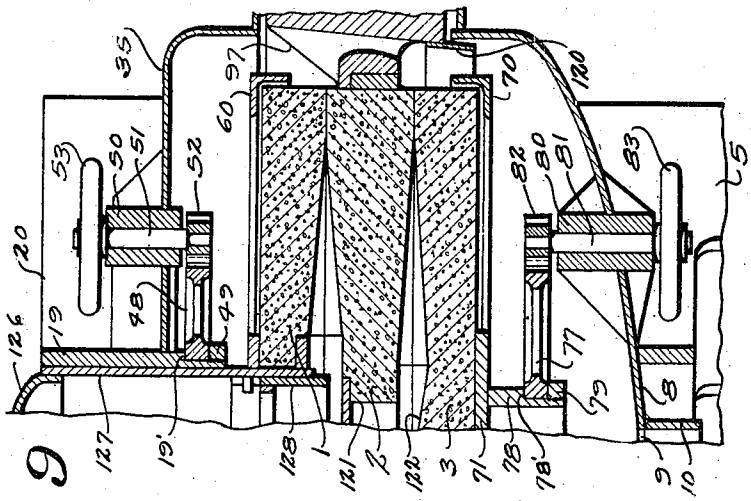


Fig 9

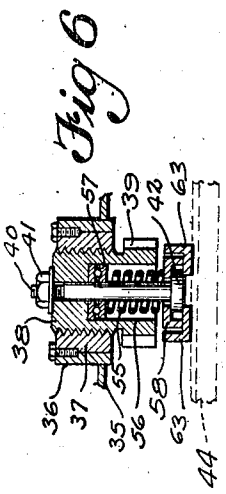


Fig 6

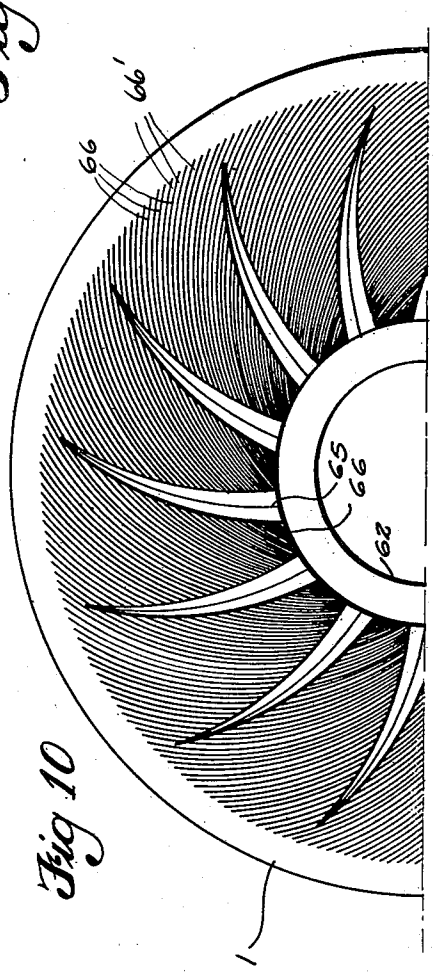


Fig 10

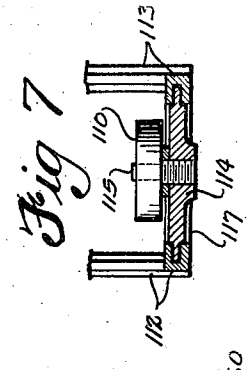


Fig 7

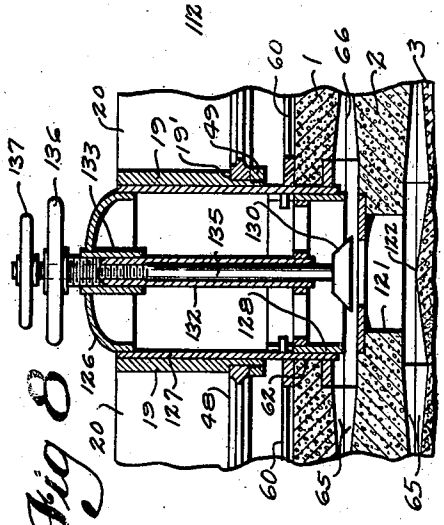


Fig 8

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2,356,753

# UNITED STATES PATENT OFFICE

2,356,753

## GRINDING MILL

Leonard Dotzer, Milton, Mass.

Application August 19, 1939, Serial No. 291,026

6 Claims. (Cl. 83—7)

This invention relates to improvements in grinding mills for the reducing of solid, semi-solid, paste-like, or even liquid substances of vegetable, mineral or of other origin.

More specifically stated, the present invention relates to machines designed for the reduction or grinding of cocoa nibs as used in the making of cocoa and chocolate products, although not limited to that particular use.

It is the principal object of this invention to provide a grinding mill, utilizing three or more stones, with improved means for driving, adjusting and supporting the stones without the use of a central axis or shaft, thus producing a better mill from the standpoint of construction and operation.

It is a further object of the invention to provide a tri-stone mill wherein the central stone, in a series of three, is "floating"; that is, it has no fixed supporting means, but is permitted to adjust itself in accordance with the feeding of the material to be ground, between the coacting surfaces of the stones. Also, provision is made therein whereby the feeding of material is to the center of the grinding surfaces through central openings in the upper and intermediate stones.

Still further objects reside in the details of construction or formation of the grinding stones, and their relationship.

In accomplishing these and other objects of the invention, I have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawings, wherein—

Fig. 1 is a top, or plan view of a grinding mill embodying the present invention.

Fig. 2 is a view of the mill partly in side elevation and partly in vertical section; the section being taken on line 2—2 in Fig. 1.

Fig. 3 is a horizontal section taken on the line 3—3 in Fig. 2, illustrating the stone driving means for this particular mill.

Fig. 4 is a sectional detail on the line 4—4 in Fig. 1, showing the disposition of the driving shaft and the gears mounted thereon, and one of the supporting rollers for the central grinding stone.

Fig. 5 is a sectional detail of means provided for adjusting the spacing of the two outer grinding stones of the mill of Fig. 2, and for retaining a yieldable pressure thereon.

Fig. 6 is a cross sectional detail on line 6—6 in Fig. 5.

Fig. 7 is a sectional detail, as seen on the line 7—7 in Fig. 4, of one of the central stone supporting rollers and its adjustable mounting.

Fig. 8 is an enlarged sectional detail of the adjustable devices for controlling the delivery of material to the grinding surfaces on the mill of Fig. 2.

Fig. 9 is a sectional detail of a mill in which is illustrated the means for the actuation of the gears which control the stone adjusting devices.

Fig. 10 is a partial plan of one of the grinding stones, particularly illustrating its furrow grooved grinding surface.

Referring more in detail to the drawings—

The mill that has been disclosed best in Figs. 1 to 4 inclusive, is what is referred to as a "floating stone type mill," embodying three stones which are designated respectively by the reference numerals 1, 2 and 3. In this mill, all stones are circular and arranged in coaxial relationship, disposed horizontally one above the other, and adapted to be adjusted in spacing to control the degree of fineness to which the material passed between them is ground, and also for clearing the machine of material.

In the structure shown in Figs. 1, 2 and 3, the means for supporting the mill stones and the various driving and stone adjusting devices, comprises a base structure embodying three equally spaced frames 5, extending radially from the vertical, central axis of the machine and designed to rest at their lower ends on a supporting base or surface 6. Mounted fixedly within the upper end of this frame structure is a ring 7 within which a heavy metallic basin or bowl 8 is rigidly supported. This bowl is of greater diameter than the stones and is arranged coaxial of and below the latter to serve, as presently understood, as a catch basin to receive the ground material as it is emitted from between the stones in the form of a more or less thick liquor, and flows downwardly from the peripheral surfaces of the stones. By reference to Fig. 2, it will be observed that the basin or bowl 8 is provided centrally with an opening 9 from which a delivery tube 10 extends for the discharge of the ground material into a suitable receptacle.

Arranged at the outer ends of these radial supporting frames 5, at equal intervals of spacing, as observed best in Figs. 1, 3 and 4, are vertical shafts 11, 12 and 13. The shafts 11 and 12 have their lower end portions fixedly mounted in vertically alined, spaced bearings 14 and 15, which, in turn, are fixed respectively to the frames 5 and to the outside of the frame ring 7, while the shaft 13, which is utilized, as presently described, in the means provided to drive the central stone, is revolubly mounted in vertically alined bearings

16 and 17, which are fixed to cross plates 18 and 18'; the plates, in turn, being fixed respectively to an upper frame structure disposed above the stones and presently described, and to the frames 5.

This upper frame structure, as observed best in Fig. 1, comprises a central, cylindrical housing 19, located coaxially of the series of stones, and from which housing, three equally spaced, frames 20 extend radially; these frames 20 being located respectively in the same vertical planes as the frames 5.

It will be observed by reference to Fig. 1, that two of these radial leg portions 20 are equipped at their outer ends with vertically alined, spaced bearings 21 and 22, which are mounted by the upper end portions of the shafts 11 and 12. Fixed to the plate 18', slightly above and at opposite sides of the bearing 17, are bearings 24 and 25, which mount therein the upper end portions of shafts 26 and 27, which shafts, as seen in Fig. 4, are fixedly mounted at their lower ends in bearings 28 and 29, fixed on the cross plate 18.

As a feature of this construction, it will be observed that the shafts 11 and 12, and also the shafts 26 and 27, are shouldered for solid abutment against their respective upper and lower end mounting bearings, so as to definitely space the upper and lower frames. Also, these shafts are equipped at upper and lower ends with nuts 30, which clamp and rigidly secure the relationships of the upper and lower frames.

The frame structure comprised by the central, cylindrical housing 19 and the three radial legs 20, supports from its under side, a horizontally disposed, circular, metal top housing 35 of inverted dish-like form. This metal top or head has a diameter somewhat greater than that of the stones, and it serves as the means from which the upper, or top stone of the set is operatively suspended and adjusted. The means for the suspension and adjustment of the upper stone from this top will now be described.

As seen in Figs. 1 and 2, there are three bearings, 36, mounted in the head 35 at equal spacings, and at equal distances from the axial line of the stones; these bearings being located within the radial frames 20 as noted in Fig. 1. In each of these bearings is a removably fixed bushing 37, as shown in Fig. 6, and into each bushing, a sleeve 38, is threaded; the lower end of each sleeve being equipped with a pinion gear 39, whereby it may be rotated. Mounted centrally of each sleeve is a bolt 40, having an adjusting and retaining nut 41 at its upper end and having a head 42 at its lower end extended beyond the lower end of the sleeve and fixed in a horizontal frame structure by means of which the upper stone, as presently understood, is operatively suspended.

The three pinion gears 39 are all in operative mesh with a central gear wheel 48 that is revolubly mounted on the lower end portion of the housing 19; being retained thereon between a downwardly facing shoulder 19' on the housing and a retaining nut 49 threaded onto the housing.

There is also mounted in the head 35, as seen in Figs. 1 and 9, a bearing 50 containing a vertical shaft 51 which, at its lower end, has a pinion gear 52 in mesh with the gear wheel 48, and at its upper end has a hand wheel 53 whereby it may be rotated to effect a rotatable adjustment of gear 48. It will be understood that, incident to rotation of gear 48, all gears 39 will be rotated, thus to cause a like rotation of the sleeves 38 and an upward or downward adjustment thereof to an equal extent, thus to effect a corresponding vertical adjustment of the upper stone.

A yielding, downward pressure may be applied against this stone through the mediacy of the bolts 40; each bolt being equipped with means as shown in Fig. 6, wherein 55 designates a coiled spring that is located about the stone suspending bolt 40 and contained in a socket 56 in sleeve 38 to bear at its upper end against a ball thrust bearing 57 seated in the base of the socket, and at its lower end against a housing 58 that encloses the bolt head 42 as a means of attaching the bolt to the stone suspending frame.

The function of the springs 55 is to normally retain the set adjustment of the upper stone, yet to permit an upward yielding sufficient to take care of any substance that is too coarse or hard to pass otherwise. The ball thrust bearings 57 permit easy rotation of the sleeves without causing wear or resulting in binding on the springs.

A feature of the structure illustrated in Fig. 6 is that the entire assembly, comprising the bushing 37, part 38 and gear 39, may be lifted out through the bearing part 36.

The horizontal frame structure by which the upper stone is fixedly suspended, is best disclosed in Figs. 2 and 3, and it comprises an angle iron ring 60 that encircles and is fitted to the top and outside peripheral surfaces of the stone, and a channel iron sleeve 61 that is fitted within the central opening 62 with which the stone is provided. Extended radially of the stone, across its top surface, are parallel angle iron bars 63, in pairs, fixed at their outer and inner ends, respectively, to the ring 60 and sleeve 61. Extended between the bars of each pair and fixed thereto by welding or in other suitable manner, are the housings 58 which contain the lower end heads 42 of the bolts 40.

The upper stone, in this case, has flat, parallel top and bottom surfaces and about the central opening 62, the stone is counter-bored upwardly from the under side to a substantial extent to provide a counter-sunk shoulder to receive the lower end flange of the inset sleeve 61. The under, or grinding surface of this stone is formed with a plurality of radially directed furrows 65 of substantial capacity, leading from the counterbore toward the outer periphery and gradually decreasing in width and depth, as understood by reference to Figs. 2 and 10. Formed intermediate the feed channels 65 are spirally directed, alternating ribs 66 and grooves 66', designed to facilitate the grinding operation, and the delivery of ground material to the periphery of the stone. This upper stone is held against rotation, but free for vertical adjustment, by reason of the outer ends of the radial frame bars 63 engaging with vertical guide lugs 67 that are fixed, as noted in Fig. 2, to the vertical side walls of the cover section.

The lower stone, 3 of this set is supported and adjusted by a means that is quite similar to that employed in connection with the upper stone, and this means will now be described: First, it will be understood, by reference to Fig. 2, that the lower stone 3 is solid; that is, it has no central opening as is the case of the upper and central stone. This stone rests within and is held against rotation by a frame structure comprising an angle iron ring 70, which has its flanges fitted respectively to the bottom surface and sides of the stone. A flat annular plate 71 is disposed against the under surface of the stone concentric thereof.

and this is joined by radial, angle iron bars 72, in pairs, with the ring 70.

Mounted in the bottom wall of the bowl 8, in symmetrical spacing relative to each other and about the stone axis, are bearings 73 in which bushings 74 are removably fixed. Threaded in each bushing, as seen in detail in Fig. 5, is a sleeve 75, and formed on the upper ends of these sleeves, are pinion gears 76, each operating in mesh with a gear wheel 77 that is mounted to revolve on the lower end portion of a cylindrical hub 78 that is fixed centrally in this stone supporting frame structure; the gear 77 being held between a downwardly facing shoulder 78' on the hub and a nut 79 threaded onto the lower end of the hub.

Also mounted in the bottom wall of the bowl 8, as seen in Fig. 9, is a bearing 80 containing a shaft 81 which, at its upper end, mounts a pinion gear 82 in mesh with gear 77, and at its lower end, below the bowl, is equipped with a hand wheel 83 whereby it may be rotated, thus to rotate gear 77 and the three gears 76, and cause all of the sleeves 75 to be simultaneously and equally adjusted upwardly or downwardly. Each sleeve 75 has a bolt 85 mounted centrally therein, which, at its upper end, has a head 86 fixed in a metallic housing 87, which, in turn, is fixed in the stone supporting frame. A coiled spring 88 surrounds the bolt, within a socket 89 in the sleeve, and yieldingly supports the stone. A ball thrust bearing 90 is disposed between the lower end of the spring and base of the socket for obvious reasons, as explained with reference to the upper stone, and a nut 91 is threaded on the lower end of the bolt 85 to limit the extent of lift of the stone by the expanding pressure of the spring. The function of each spring is to permit the stone to yield under unusual grinding strain or pressure.

In the case of both the upper and lower stones, the extent of their movement toward the center stone may be limited to an exact amount by the setting of the nuts 41 and 91 on the frame mounting bolts 40 and 85, and in each case, rotation of the stone is prevented through the mediacy of the stone mounting frames; it being explained here that the radial bars 72 of the lower frame extend beyond the stone into contact with guide lugs 92 fixed on the side walls of the bowl 8.

The central stone 2 is what I have referred to as a "floating" stone, in that it has no fixed adjustment, but may adjust itself vertically between certain narrow limits, to accommodate the outflow of material being ground. As will be observed best by reference to Figs. 2 and 3, this center stone 2 is coaxial of the upper and lower stones and is contained coaxially within an annular or cylindrical frame comprising a ring 95 that is fitted tightly to the stone, and an enclosing, cylindrical frame 96, of greater diameter than the stone and mounted solidly on the stone through the mediacy of a plurality of radial webs 97 that join the ring 95 and frame 96. This frame 96 is formed about its top portion with a smooth, cylindrical surface 96*a* serving as a guide track and against which track, guide rollers 98, which are mounted on the vertical shafts 11, 12 and 13, engage in rolling contact to retain this central stone against displacement from coaxial alinement with reference to the top and bottom stones.

Formed centrally about the frame 96 is a gear toothed surface 100 with which a stone driving pinion gear 101, fixed on shaft 13, travels in mesh. The shaft 13, in turn, has a driving gear 102, of relatively large diameter, fixed on its lower end, and this gear is adapted to be driven by a gear pinion 103 fixed on the lower end of the driving shaft 104 of a vertically disposed electric motor 105. The motor, as noted in Figs. 1, 2 and 3 is mounted on a supporting frame structure 106 located at one side of and securely attached to the base frame structure.

In order to limit the downward movement of the central stone when it is desired for any reason that the lower stone be held spaced therefrom, I have provided three supporting rollers 110, located at equally spaced intervals on radial, horizontal axes, as seen in Figs. 1, 2, 4 and 7. Each roller is in rolling and supporting contact with the lower end surface 96*b* of the cylindrical frame 96, and thus these rollers will operate to support the central stone when the lower stone is adjusted downwardly to a place beyond the usual spacing for grinding.

A detail of the manner of mounting the supporting rollers 110 is disclosed in Figs. 4 and 7, wherein it is seen that brackets 112 and 113 are fixed respectively to solid upper and lower frame members, and between these parts is supported a vertically adjustable slide 114 which mounts a stub axle 115 on which a roller 110 is mounted. Vertical adjustment of the slides 114 is effected by adjustment of set screws 116 that are adjustably threaded into bottom bracket 117 of each set and bear, at their ends, against the adjustable brackets 114.

Referring now to Fig. 2, it will be understood that ground material emitted from between the peripheral edges of the top and central stone will flow downwardly within the frame 96, and, with material likewise emitted from between the central and lower stone, will be delivered into the bowl 8 through the annular passage between the periphery of the lower stone and the enclosing side wall of the bowl 8. In order to prevent leakage of material, the lower edge of the frame 96 is equipped with a depending skirt 120 that projects down into the bowl as noted in Figs. 4 and 5.

It will be explained here that the central stone 2 is formed with a central passage 121 through which material to be ground may be delivered to the coacting surfaces of the central and bottom stones. The top and bottom surfaces of the central stone are flat and parallel and are grooved for a centrifugal delivery of material, as explained with reference to the top stone for distribution and proper grinding action. The bottom stone has a central, rather flat, conical rise 122 at the center whereby material entering from the opening 121 is diverted toward the periphery of the stone into the radial grooves 65 for distribution over the grinding surfaces.

Material that is to be ground is fed into the top of the machine through a supply tube 125, leading into a dome shaped cover 126 fitted to the upper end of a tube or lining sleeve 127 contained within the housing 19 and extending down into the central opening of the upper stone. Material, as fed by gravity, is controlled in its delivery to the grinding surfaces between the central and upper stones by the position of a vertically adjustable sleeve 128 extending, as seen best in Fig. 8, from the lower end of the tube 127 and adjustable manually to more or less restrict the outlet as provided thereby between the top surface of the center stone and the lower end of the sleeve.

The feed of material to the space between the lower and central stone is likewise regulated by adjustment of a conical damper 130 from or toward the opening 121 in the central stone

through which material must flow to the lower stone.

The means exterior of the mill for effecting the manual adjustments of these feed control devices comprises, for the sleeve 128, a tubular shaft 132 threaded downwardly through a central bearing 133 in the dome cover member 126, and for the conical member 130, a shaft 135, contained inside the tubular shaft 132 and extending from the lower end of that shaft where it is fixed to the damper 130, and threaded in the upper end of shaft 132. Shafts 132 and 135 are equipped at their upper ends respectively with hand wheels 136 and 137 for rotating the shafts in making the adjustments desired.

It will be here stated, as explanatory to the invention, that when the mill is not in operation, that is, while it is idling, the central stone in each series is supported free of contact from the surfaces of adjacent stones through the mediacy of the supporting rollers 110. Otherwise, the stones would burn.

After material has been admitted to the machine for grinding, the lower stone may be adjusted upwardly into proper grinding contact with the middle stone, and may then be raised as necessary to bring about the proper grinding pressure. This lifts the middle stone off the carrying rollers so that, in fact, it is a floating stone. The burning of the stones, however, will be prevented by reason of the film of ground material between them. Normally, the suspending device for the upper stone retains it spaced somewhat from the center stone, and prevents damage that would result to the stones directly contacting each other. It will be understood that after the material has been fed to the machine, the surfaces of the central and top stone will also be held in spaced relation and insured against damage by the film of material being ground between them.

Mills of the kind described are especially designed for the grinding of what are called liquids or semi-liquids, or "liquor." However, they may readily be adapted to the grinding of "solid" substances, each as cocoa nibs, by equipping them with crusher or foregrinder plates, as was disclosed in the application filed by George H. Hugo and myself on February 8, 1936 under Serial Number 62,952, said application maturing into Patent No. 2,176,892 of October 24, 1939. Such plates may be made of steel or the cutting edges might be formed directly in the stones.

No claim is made herein to the arrangement of a plurality of grinding disks forming separated grinding spaces on either side of an imperforate center disk, the disks being formed with opposed grinding surfaces restricting the outflow of material therefrom, and means for feeding material under predetermined pressure independently to each of the separate grinding spaces.

Having thus described my invention, what I claim as new therein and desire to secure by Letters Patent is:

1. A mill of the character described comprising a frame structure, a series of three stones arranged in the frame structure in face to face opposition and adapted for the reception of material between opposed surfaces for grinding, one of the outer stones and the central stone having central openings therein for the passage of material to the grinding surfaces, means for effecting an adjustment in spacing of the outside stones for a desired grinding clearance between stones of the series, means for retaining the outer stones against rotation, a rotating band encircling and fixed to the intermediate stone, means engaging the band for rotating the stone and guiding means mounted in the frame and engaging said driving band to retain the intermediate stone against eccentric shifting while permitting free floating action between the spaced outside stones.

2. A mill of the character described comprising a series of three axially alined stones arranged in opposed, face to face relationship and adapted for the reception of material between adjacent co-acting surfaces for grinding, one of the outer stones and the central stone having central openings therein for the passage of material to the grinding surfaces, means for retaining the outside stones of the series against rotation, a driving means for the intermediate stone comprising a driving band fixed circumferentially about and concentrically of the stone and having gear teeth thereon, a driving gear for the said band operable in driving mesh with the teeth thereof, means supporting the outside stones of the series with clearance for a free floating action of the intermediate stones between them, and for an outwardly yielding movement relative to the intermediate stone, and means engaging with the driving band to prevent any eccentric shifting thereof relative to the axial line of the series without interference to its free floating action.

3. A mill of the character described, comprising a series of three stones arranged horizontally in face to face opposition for the reception and grinding of material between them, means for effecting an adjustment in spacing of the top and bottom stones for a desired grinding action and permitting free floating of the intermediate stone between them during a grinding operation, means for retaining the outer stones against rotation, a supporting and driving band fixed circumferentially to the intermediate stone, means engaging the band to rotate the stone, guiding means in contact with the band retaining the stone against eccentric shifting without interference to its floating action, and supports engaged by the band to insure a protective clearance between the grinding surfaces of the intermediate stone and bottom stone and means for maintaining a yielding grinding pressure against the outside stones.

4. In a mill of the character described a series of three stones arranged horizontally in face to face relationship for the grinding of material between opposed, co-acting surfaces thereof, means for feeding material to be ground between the coacting surfaces of the stones, means for effecting an individual adjustment of the upper and lower stones of the series to establish a minimum spacing between them, and desired clearances between coacting grinding surfaces at the top and bottom side of the intermediate stone, pressure applying means acting against the top and bottom stones to yieldingly urge them toward the intermediate stone, and for establishing desired grinding pressures, means for rotating the intermediate stone, and vertically adjustable means for establishing an operating level for the intermediate stone and insure clearance for an idling operation.

5. In a mill of the character described, a stone supporting and adjusting means comprising in combination with a fixed bearing, a bushing threaded into the bearing and adapted for lon-

gitudinal adjustment therein by rotation, a bolt slidedly mounted in the bushing axially thereof and extended at one end beyond the bushing and having supporting connection at that end with the stone, means for limiting the movement of the bolt in the direction of the extended end, and a pressure spring disposed to act against the bushing and against the stone to yieldingly resist movement of the stone toward the bushing.

6. In a mill of the character described, a series of three stones in vertical axial alinement, means encircling the central stone, and supporting it for floating rotation, and limiting its movement in a downward direction, outwardly yieldable means supporting the outer stones at spaced intervals from the surfaces of the central stone, and retaining them against rotation, and means for delivering material for grinding under pressure between the stones; said central stone and one of said outside stones having a central opening for the feeding of material therethrough to opposed grinding surfaces.

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