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Fahey et al.

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[54] **VIBRO-GYRATORY MILLS**

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[52] **U.S. Cl.** **241/69,** 241/78, 241/97

[51] **Int. Cl.** **B02c 9/04**

[58] **Field of Search** 241/69, 70, 74, 78, 80, 241/81, 96, 97

[56] **References Cited**

UNITED STATES PATENTS

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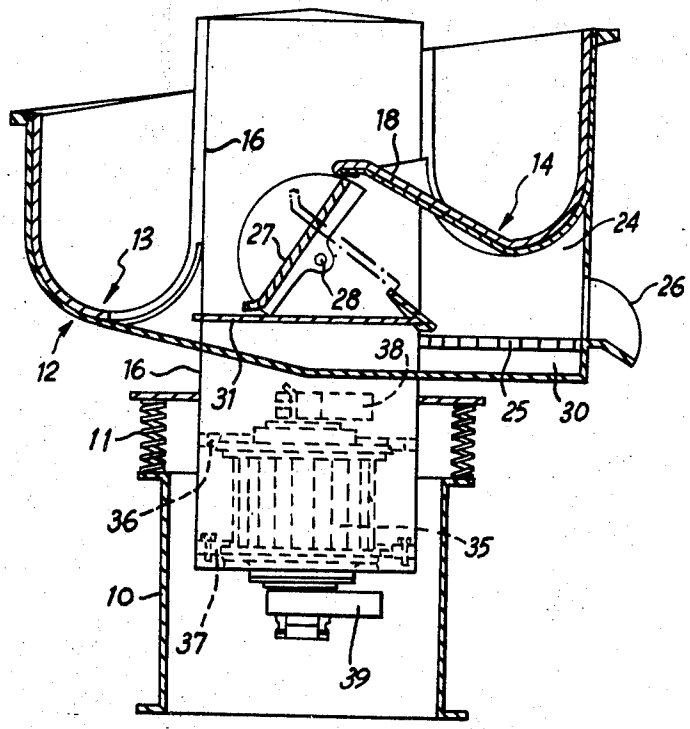
Assistant Examiner—DeWalden W. Jones
Attorney, Agent, or Firm—Breitenfeld & Levine

[57] **ABSTRACT**

Vibro-gyratory mills for grinding or finishing purposes having a process chamber of annular shape in plan with a spiral floor and a separating chamber located beneath the upper end of the floor, there being a deflector member pivotally mounted at the region where the upper and lower ends of the floor meet, the deflector member being pivotally movable between a recirculating position in which it forms a chute extending between the upper and lower ends of the floor and a discharge position in which it forms a chute directing the charge from the upper end of the floor to said separating chamber.

9 Claims, 2 Drawing Figures



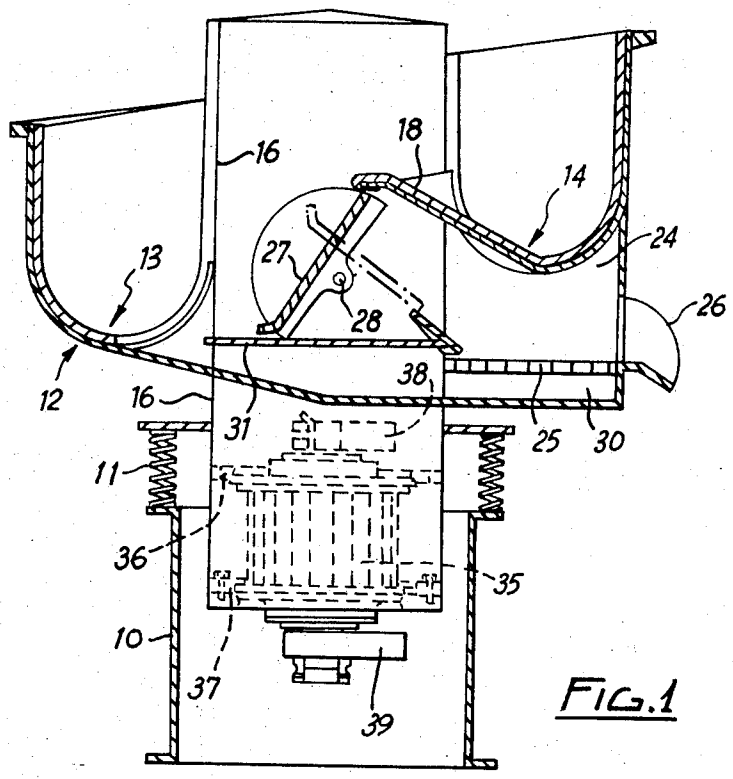

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FIG. 1

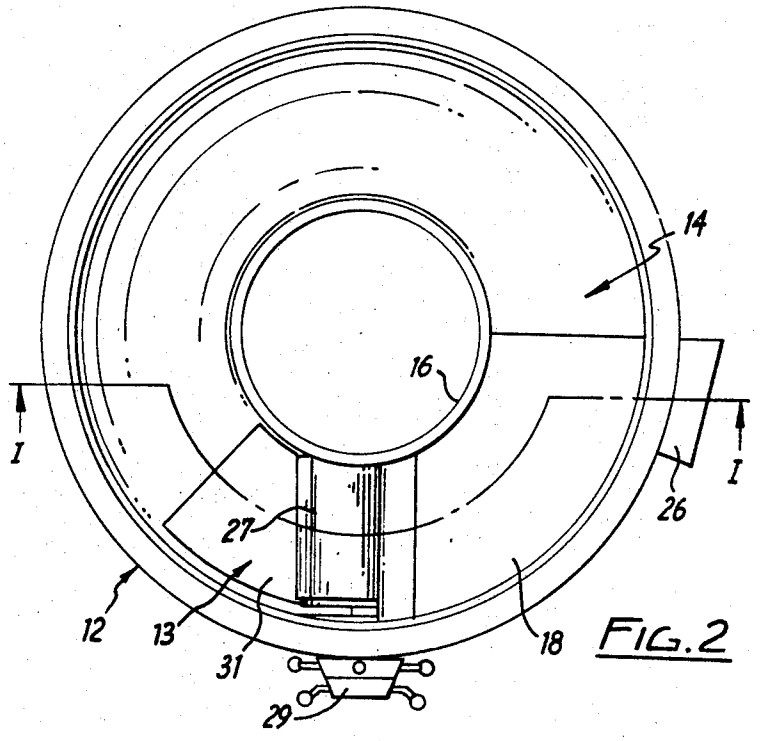
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FIG. 2

VIBRO-GYRATORY MILLS

The invention relates to vibro-gyratory mills which may be used for grinding, polishing, de-burring or similar finishing operations and which effect such operations by means of a vibratory action in the form of a high frequency rotary oscillation about a vertical axis with an upward and downward component in the movement, such action being applied to a charge of workpieces or material, usually mixed with discrete finishing media, contained in the mill.

The term "workpieces" used hereinafter should be construed as referring not only to components to be polished, de-burred or otherwise finished but also to materials which require to be ground or powdered.

The invention provides a vibro-gyratory mill having a processing or treatment chamber which is of annular shape in plan and has an upward slope in the floor, a vibratory mechanism serving to promote progression of a charge of workpieces and media around said chamber, a separating chamber including a horizontal separating screen at a level below that of the upper end of the floor of the treatment chamber and having an outlet through which, after screening, separated workpieces can be discharged from the machine, means for returning the media to the lower end of the floor of said treatment chamber, and a deflector member pivotally movable between a recirculating position in which it forms a chute extending between the upper and lower ends of the floor of the treatment chamber, and a discharge position in which it forms a chute directing the charge from the upper end of said floor to said separating screen.

Preferably said deflector member is pivotally mounted between its ends on an axis extending parallel to the upper edge of said floor and disposed at a level between that of the upper end of the floor and said separating screen.

Preferably also the floor of said treatment chamber is of helical form with a step connecting the upper and lower ends of the heliz, said separating chamber being disposed beneath the upper end of said helix within the confines of the annular treatment chamber. The separating screen is preferably disposed at or below the level of the lower end of the sloping floor of the treatment chamber.

An embodiment of the invention will now be described, by way of example only, and partly with reference to the accompanying drawings, in which:

FIG. 1 is a fragmentary vertical cross-section through one form of machine according to the invention taken approximately on the line I—I in FIG. 2; and

FIG. 2 is a plan view of the machine shown in FIG. 1.

Referring to the drawings, there is shown the upper portion of a vibratory mill comprising a generally cylindrical base portion **10** on which is supported, by a series of coil springs **11**, a treatment chamber or bowl **12** of annular shape in plan. The major portion of the floor of the chamber is of shallow helical form rising from a low level zone **13** to a high level zone **14**. The floor of the chamber is of arcuate cross-section and the spaced, parallel walls of the chamber are provided with a rubber or other suitable lining.

The treatment chamber surrounds a central sleeve **16**, also supported on the springs **11**, and within which a vibratory unit is located. This comprises a motor **35** carried by upper and lower support rings **36** and **37** and having a vertical shaft which projects from both ends of the motor casing. Eccentric weights **38** and **39** are carried by the respective ends of the motor shaft and are relatively angularly displaceable to control the motion imparted by the motor to the treatment chamber **12**. By virtue of the provision of the eccentric weights and the resilient mounting of the motor and the treatment chamber on the springs, rotation of the motor imparts to the treatment chamber a high frequency rotary oscillation about the central axis of the chamber having an upward and downward component in the movement. This movement causes a charge of workpieces and media in the chamber to undergo generally orbital movement in substantially vertical planes while moving up and around the chamber from the low level to the high level zones. During the movement the media act upon the workpieces to effect a grinding, finishing or like action which can be varied depending on the speed of rotation and the relative angular displacements of the eccentric weights.

A short ramp **18** extends upwardly from the high level zone **14** at a steeper angle than the remainder of the chamber floor, and below this ramp is a separating chamber **24** housing a separating sieve or screen **25** leading to a discharge opening **26** in the outer wall of the chamber. A deflector plate or flow control gate **27** is pivotally mounted about a transverse horizontal axis **28** at a level between the upper end of the ramp and the separating screen. This deflector plate may be moved by any suitable manual or automatic means such as the knob **29** (FIG. 2) between a discharge position shown in broken lines and a recirculating position shown in full lines.

In the discharge position the charge falling from the upper end of the ramp **18** is intercepted and directed down the plate **27** into the chamber **24** and on to the screen **25**, one component of the charge being retained by the screen and delivered from the machine by way of the discharge opening **26**, and the other component falling through the screen into a collecting chamber **30** from whence it is returned to the main chamber **12** by virtue of the vibratory movement imparted to the machine. Where parts are being finished, the parts will generally be larger than the media so that the parts will be discharged from the outlet **26** and the media returned through the screen **25** and chamber **30** for reuse. In the case of material which is being ground or powdered or where parts to be finished are smaller than the media, an additional collecting tray or the like would berequired to receive the material passing through the screen for delivery to a discharge outlet, the media falling from the end of the screen into the collecting chamber and returning from hence to the main chamber **12**.

When the deflector plate **27** is in its recirculation position the charge of workpieces and media slides down the deflector plate on to a floor plate **31** level with and forming part of the bottom of the main chamber **12** to which the charge is thus returned for recirculation without separating. This can be effected as often as desired and the movement of the deflector plate may be arranged to be effected automatically after the charge has been recirculated a desired number of times.

It should be noted that in this recirculation position the deflector plate forms a chute extending between the upper and lower levels of the floor of the main

chamber **12.** During recirculation the charge slides down this chute and does not fall directly from the top end to the bottom end of the floor. As a result of this feature the machine can be used for fine polishing since the surfaces of the parts are not scratched or otherwise damaged during recirculation.

The provision of the relatively gentle incline between the regions **13** and **14** followed by the relatively steep incline of the ramp improves progression of the charge round the chamber compared with machines having a uniform spiral chamber floor. This is so because in climbing the slope the workpieces, being generally heavier than the media, tend to slow down and thereby move closer together. Consequently to maintain adequate spacing of the workpieces after several circulations, their initial spacing when introduced must be increased and the throughput of the machine is thereby reduced. By virtue of the use of a long shallow incline followed by a short steep incline we have found that this problem is reduced and greater throughput can be attained.

A further advantage arises from the location of the separating screen at a low level beneath the upper end of the chamber floor. This provides a compact arrangement and renders the chamber accessible from above throughout its entire annular length. Separation takes place below the level of the lower end of the chamber floor and return of media to the chamber is effected by the vibratory movement which constrains the media to travel up the inclined path connecting the collecting chamber **30** with the low level end of the main chamber **12.** It should also be noted that the charge is transferred to the separating zone using gravity. Previously proposed machines have utilised a high level separating zone to which the charge must climb, and this arrangement imposes restrictions on the extent to which the vibratory mechanism may be adjusted. By using gravity to transfer the charge for separating, the restrictions on the settings of the motor and weights are removed and a wider range of vibratory movements can therefore be applied to the apparatus.

Various modifications may be made without departing from the invention and it is envisaged that the chamber floor could be level for most of its length and then provided with a steep ramp from which the charge may either fall back into the chamber or be deflected into the separating chamber.

We claim:

1. A vibro-gyratory mill having a processing or treatment chamber which is of annular shape in plan and has an upward slope in the floor, a vibratory mechanism serving to promote progression of a charge of workpieces and media around said chamber, a separating chamber including a horizontal separating screen at a level below that of the upper end of the floor of the treatment chamber and having an outlet through which, after screening, separated workpieces can be discharged from the machine, means for returning the media to the lower end of the floor of said treatment chamber, and a deflector member pivotally movable between a recirculating position in which it forms a chute extending between the upper and lower ends of the floor of the treatment chamber, and a discharge position in which it forms a chute directing the charge from the upper end of said floor to said separating screen.

2. A vibro-gyratory mill according to claim **1** wherein said deflector member is pivotally mounted between its ends on an axis extending parallel to the upper edge of said floor and disposed at a level between that of the upper end of the floor and said separating screen.

3. A vibro-gyratory mill according to claim **2** wherein the floor of said treatment chamber is of helical form with a step connecting the upper and lower ends of the helix, said separating chamber being disposed beneath the upper end of said helix within the confines of the annular treatment chamber.

4. A vibro-gyratory mill according to claim **3** wherein said separating screen is disposed at or below the level of the lower end of the sloping floor of said treatment chamber.

5. A vibro-gyratory mill according to claim **4** wherein said means for returning the media to said treatment chamber comprises an upwardly sloping ramp having its lower end located beneath said separating screen and its upper end communicating with the lower end of the floor of said treatment chamber, the media discharged through the screen travelling up said ramp under the influence of the vibratory movement.

6. A vibro-gyratory mill according to claim **5** wherein the floor of said treatment chamber rises gently over most of its annular length and terminates in a relatively steep ramp portion.

7. A vibro-gyratory mill according to claim **5** wherein the floor of said treatment chamber is of arcuate cross-section and has upstanding side walls.

8. A vibro-gyratory mill according to claim **7** wherein said treatment chamber is resiliently mounted on a fixed base by an annular series of coil springs.

9. A vibro-gyratory mill according to claim **8** wherein said vibratory mechanism comprises a motor carried by said chamber and having a vertical shaft fitted with eccentric weights.

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