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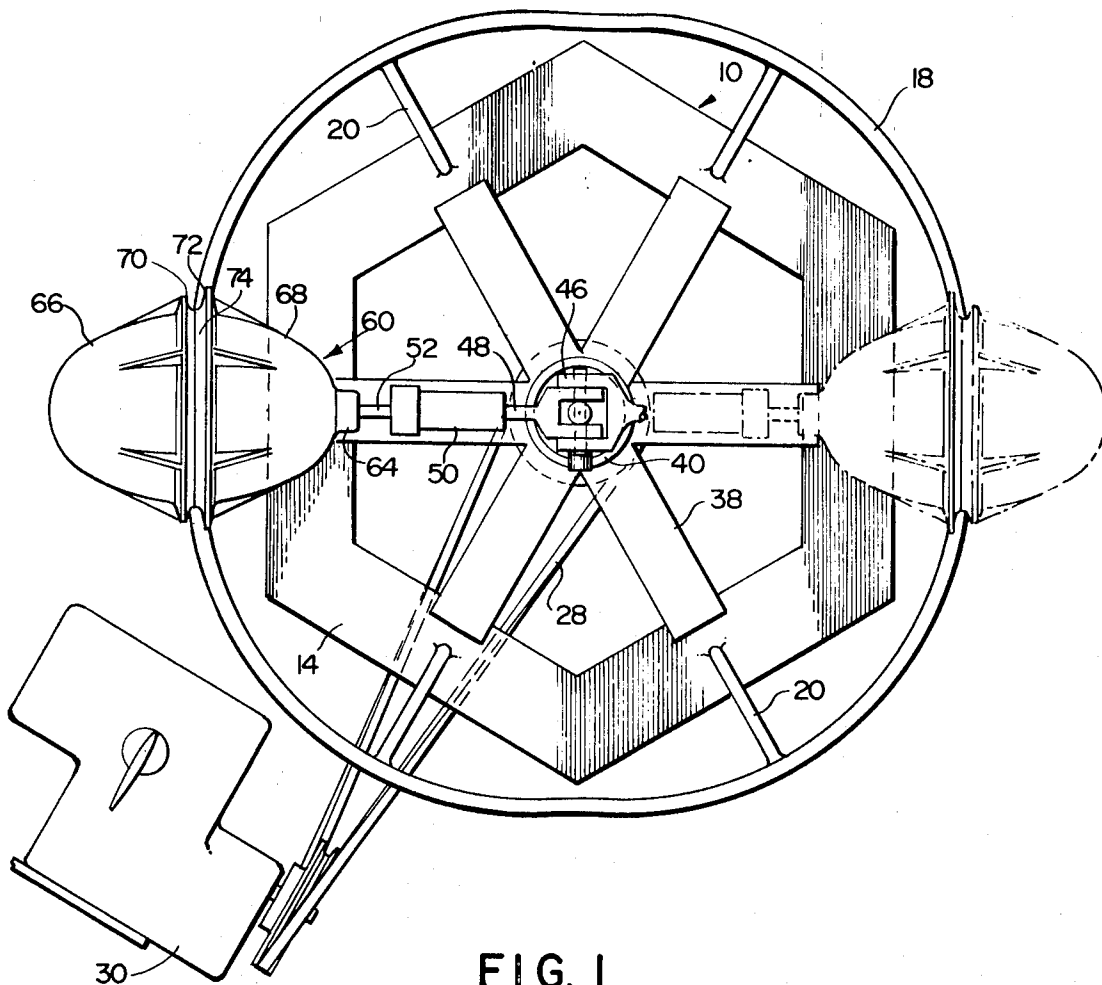
C. A. FOSTER ET AL

3,609,921

TUMBLING MILL

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2 Sheets-Sheet 1



INVENTORS.
CECIL A. FOSTER
GEORGE W. BOOTH

BY

Moss, Altman & Oster

ATTORNEYS

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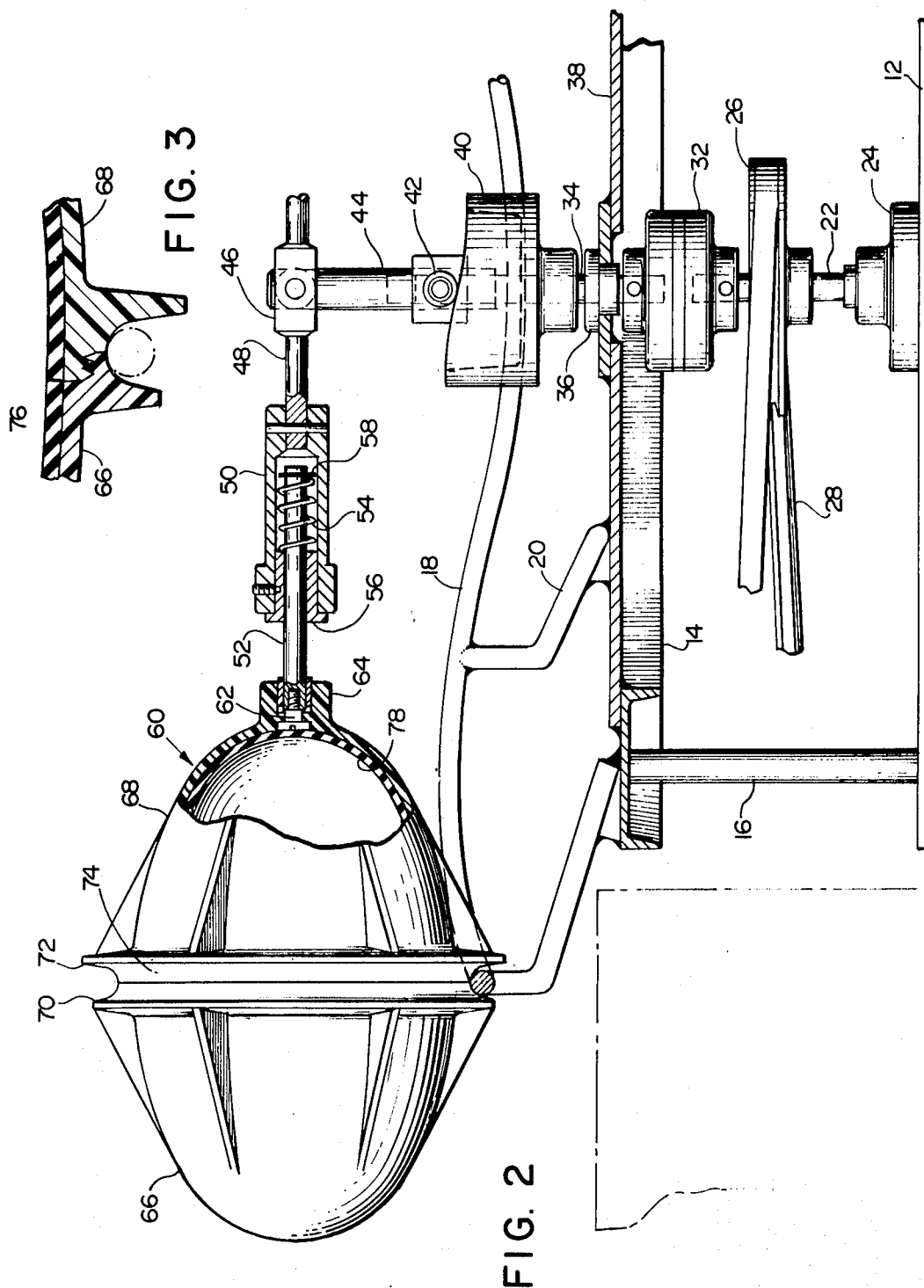


FIG. 2

FIG. 3

INVENTORS.
CECIL A. FOSTER
GEORGE W. BOOTH

BY *Morse, Altman & Orth*

ATTORNEYS

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TUMBLING MILL

Cecil A. Foster, 25 Fairmount Ave., Johnston, R.I. 02919, and George W. Booth, West Main St., West Barnstable, Mass. 02630

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8 Claims

ABSTRACT OF THE DISCLOSURE

A tumbling mill is provided for use in grinding, pulverizing and polishing various materials. The mill is adapted to generate a multiplicity of motions. A mill chamber rotates about a horizontal axis around a closed, undulating track, moving radially in and out with respect to a vertical driving axis, which driving axis itself reciprocates vertically causing the chamber to tilt about its horizontal axis.

BACKGROUND OF THE INVENTION

(1) Field of the invention

This invention relates generally to tumbling mills and more particularly is directed towards a tumbling mill of improved design and efficiency having a multiplicity of motions from a single rotary drive.

(2) Summary of the prior art

Tumbling mills generally are comprised of a shell or drum rotating about a horizontal axis. Whatever material is to be reduced in size is fed into one end of the mill along with a charge of a suitable grinding medium such as iron balls or the like. As the mill rotates the material and the grinding medium tumble against one another in a cooperating action which grinds, polishes or pulverizes the material. Mills of this type customarily have very limited motions and as a result require a relatively long period of operation in which to achieve the desired grinding action.

Accordingly, it is an object of the present invention to provide improvements in tumbling mills. Another object of this invention is to provide a simple, low cost tumbling mill having a multiplicity of motions adapted to increase the grinding, speed and efficiency of the apparatus.

SUMMARY OF THE INVENTION

This invention features a tumbling mill comprising a vertical drive shaft axially reciprocating a pivoted, telescoping horizontal rod connected to the vertical drive shaft and to a chamber mounted for rotation about the horizontal axis on an undulating, generally circular closed track. A variable speed motor is connected to the drive shaft causing the chamber to rotate about a horizontal axis, cyclically tilting about that axis while moving upwardly, downwardly and radially in and out as it operates.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a tumbling mill made according to the invention,

FIG. 2 is a fragmentary sectional view in side elevation thereof, and,

FIG. 3 is a detailed sectional view showing the connection between the chamber portions.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, the reference character 10 generally indicates a base for a tumbling mill, the base being comprised of a lower bed plate 12 supporting a

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platform 14 by means of upright posts 16. The platform, in turn, supports a closed track 18 in the form of a cylindrical rod, which in top plan view as shown in FIG. 1, is in the form of a distorted circle somewhat flattened on four sides and which undulates in a vertical plane as best shown in FIG. 2. The track 18 is supported on the platform 14 by means of spaced ribs 20.

Extending up through the center of the base and platform is a drive assembly comprised of a drive shaft 22 rotatably mounted in a lower bearing 24 fixed to the bed plate 12. The shaft 22 drivingly engages a pulley 26 connected by a belt 28 to a variable speed motor and reduction gear assembly 30 located to the side of the unit. The shaft 22 engages a coupling 32 which in turn engages a drive shaft 34 rotatably mounted in a bearing 36 supported by cross pieces 38 to the platform 14. Drivingly connected to the shaft 34 is a cam 40 engaging a follower 42 mounted to a shaft 44 telescoped over the shaft 34. Thus, as the shaft 22 is rotated by the variable speed motor, shaft 44 will also rotate about the vertical axis while at the same time undergoing vertical reciprocation as a result of the interaction between the cam and follower 40 and 42.

Mounted to the top of the shaft 24 is a hinge coupling 46 engaging the inner end of a connecting rod 48 normally disposed in the horizontal plane and provided at its outer portion with a tubular member 50 telescoped over the inner end of a tie rod 52. The tie rod 52 is provided with a coil spring 54 trapped between a bushing 56 secured to the member 50 and an annulus 58 on the inner end of the tie rod 52. The arrangement provides a spring-loaded sliding connection between the rods 48 and 52 which also permits the rod 52 to rotate freely with respect to the rod 48.

Mounted to the outer end of the tie rod 52 is a rotatable chamber 60 secured to the rod in the illustrated embodiment by means of a screw 62 passing through an opening in the end wall of the chamber and is threaded to the tapped end of the rod 52. A boss 64 is formed at the end of the chamber for reinforcement thereof at the connecting joint.

The chamber 60, in the preferred embodiment, has an ovoidal configuration and is comprised of a pair of separable sections 66 and 68 connected to one another at the center. The chamber sections 66 and 68 are circular in cross section and each is formed with cooperating contoured flanges 70 and 72 which come together to form annular groove 74 adapted to fit over and roll about the track 18. The flanges on either side of the groove extend out for some distance from the chamber walls to encompass the track 18 and to insure that the chamber remains on the track even at high rotational speeds. The chamber halves detachably connect to one another by means of cooperating threads 76 formed at the center line behind the annular groove 74. Other locking arrangements obviously may be provided to permit the chamber to be opened and closed for easy loading and unloading of the charge of material and the grinding medium.

In the illustrated embodiment, the interior walls of the chamber 60 are lined with a stratum 78 of rubber or other resilient material which not only lowers the noise level of the unit in operation but also aids in the grinding action since it enhances the bouncing of loose material within the chamber. The grinding action may be further enhanced by adding abrasive material to the liner 78. The abrasive can be coated over the surface of the resilient liner as by spraying the same together with a binder onto the liner. Also, abrasive inserts may be set into the resilient layer with the outer portions of the inserts either flush with the surface of the liner or protruding therefrom to interact with the charge of ma-

terial in the chamber. Also, polishing agents may be placed in the chamber either in the form of dry material or suspended in a liquid as best suited for the particular task.

The hinge mounting of the rod 48 permits the chamber 60 to be raised from the horizontal position illustrated into a vertical or nearly vertical position for loading and unloading purposes. When loading, the chamber is raised to the vertical position, the chamber section 66 is unscrewed from the section 68 and the charge of material as well as the grinding medium are deposited in the raised section 68. The section 66 is then screwed back into position and the chamber lowered to the horizontal position with the groove 74 placed over the track, the weight of the chamber together with its charge being sufficient frictional force to insure rotation of the chamber as it moves about the track. The chamber not only will rotate but will tilt about its axis by reason of the cam and follower 40 and 42 and the undulating rail 18. Furthermore, the chamber will move radially in and out to add another motion component by reason of the flattened configuration of the track. The added motions enhance the polishing and grinding action and speed up the processing on the charge. The operation can be further accelerated by speeding up the motor drive as required.

Having thus described the invention what we claim and desire to obtain by Letters Patent of the United States is:

1. A tumbling mill, comprising:

- (a) a container adapted to receive a charge of material,
- (b) an irregularly contoured generally horizontal closed track adapted to support and guide said container,
- (c) an annular member mounted to said container for rolling engagement with said track,
- (d) a vertical drive shaft extending centrally through said track,
- (e) an extensible member connecting said shaft to said

container whereby said chamber will be rolled about said track upon rotation of said shaft, and

(f) drive means engaging said shaft.

2. A tumbling mill according to claim 1 including means for axially reciprocating at least a portion of said drive shaft to cause said container to tilt about its axis upon rotation thereof.

3. A tumbling mill according to claim 1 wherein said extensible member is pivoted to said drive shaft.

4. A tumbling mill according to claim 1 wherein said track is in the form of an undulating flattened circle.

5. A tumbling mill according to claim 1 including a stratum of resilient material over the inner walls of said container.

6. A tumbling mill according to claim 5 including an abrasive medium bonded to said stratum.

7. A tumbling mill according to claim 1 wherein said extensible member includes a pair of relatively rotatable, spring-loaded elongated members telescopically connected to one another.

8. A tumbling mill according to claim 1 wherein said container is of ovoidal configuration comprised of a pair of matching cooperating half-sections detachably connected to one another.

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HAROLD D. WHITEHEAD, Primary Examiner

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