Aug. 16, 1966 R. K. McKIBBEN 3,266,739

ROLLER-ACTUATED VIBRO-ENERGY MILL

Filed Aug. 23, 1963 3 Sheets-Sheet 1

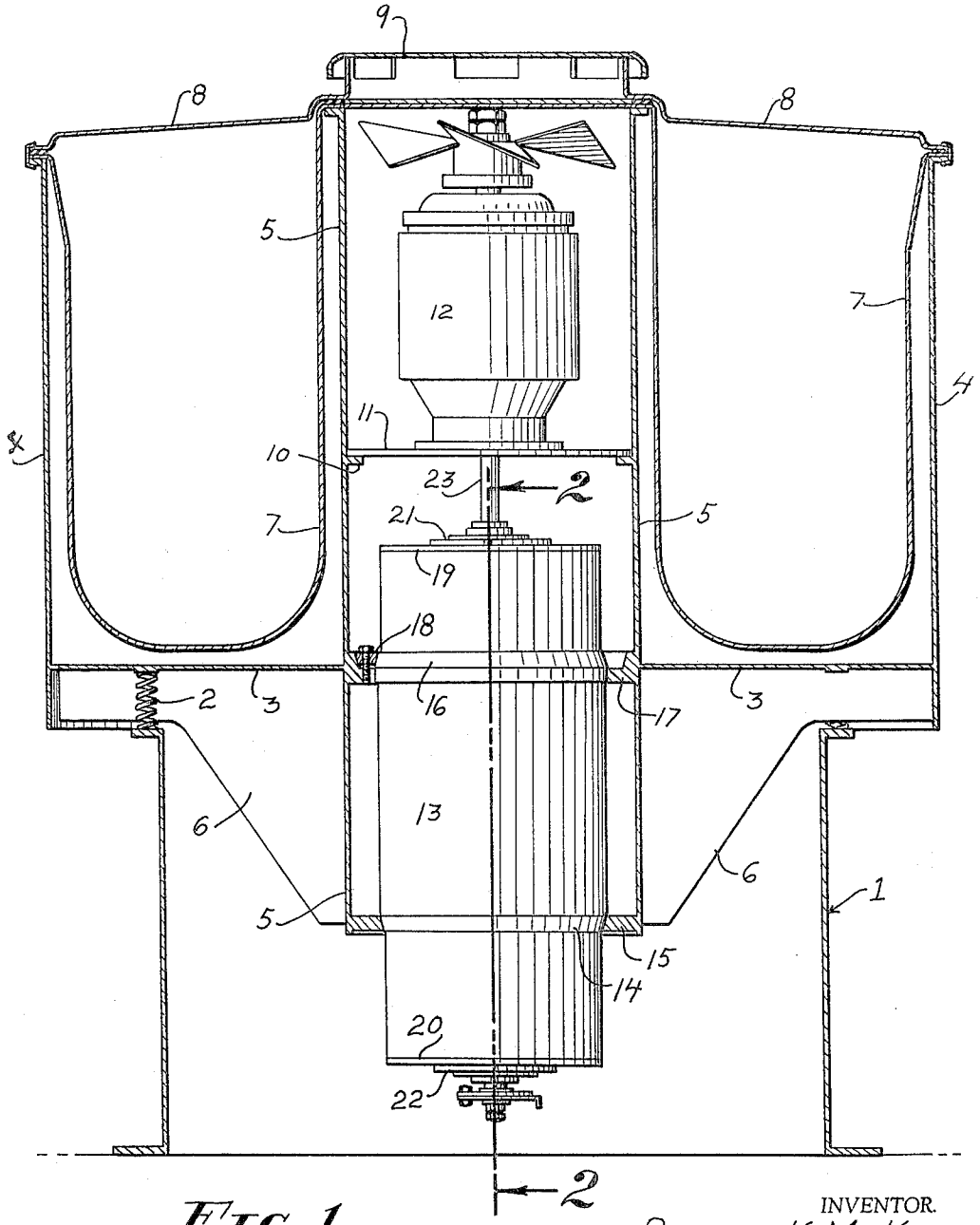


FIG. 1

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Filed Aug. 23, 1963 3 Sheets-Sheet 2

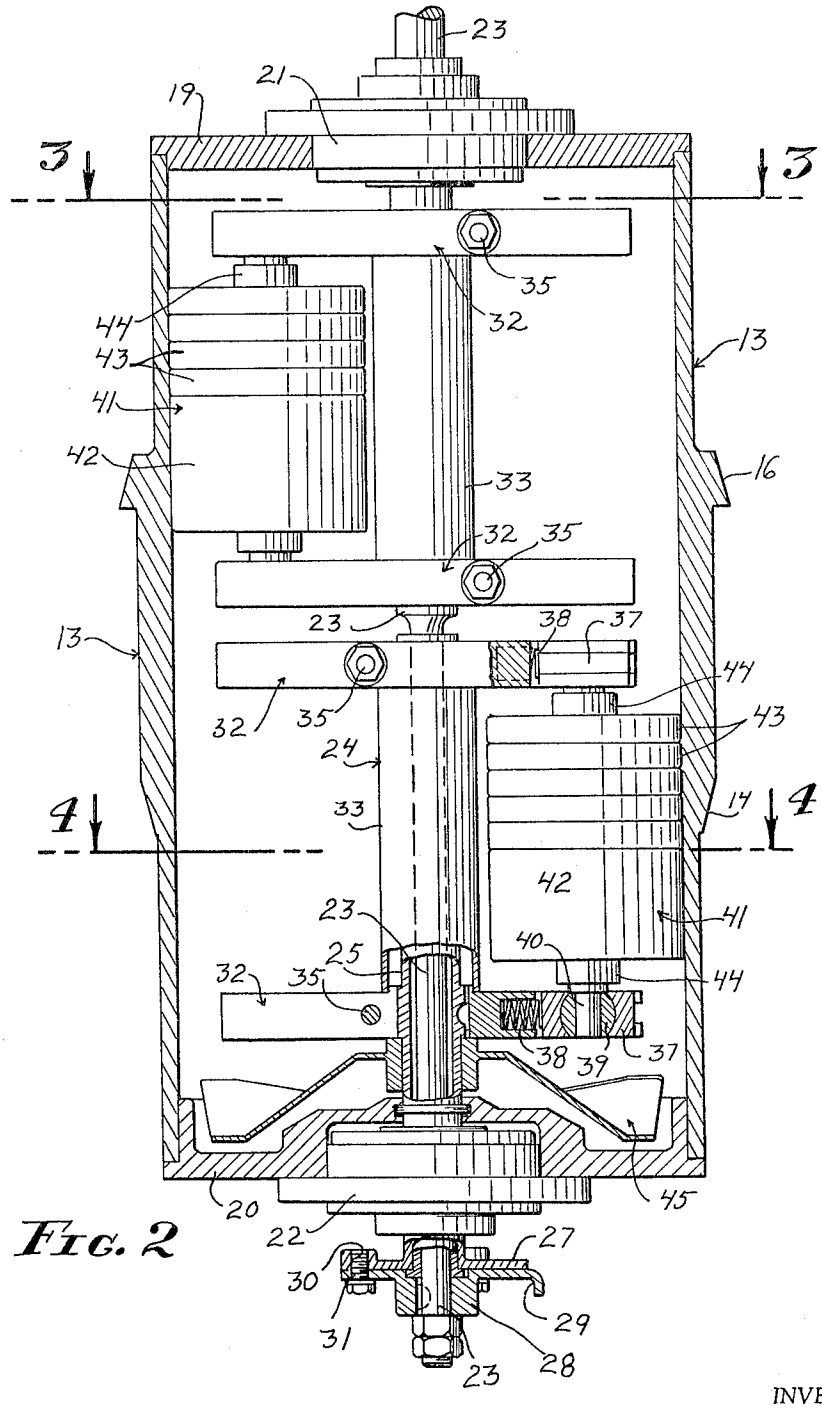


FIG. 2

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Filed Aug. 23, 1963 3 Sheets-Sheet 3

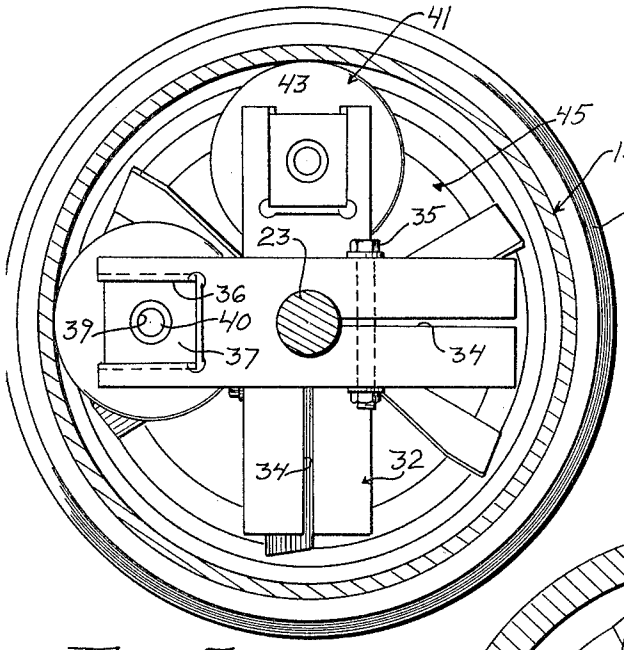


FIG. 3

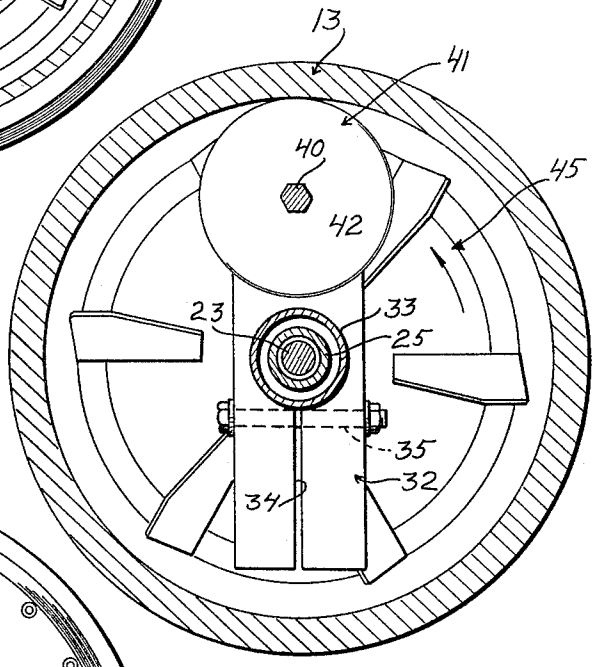


FIG. 4

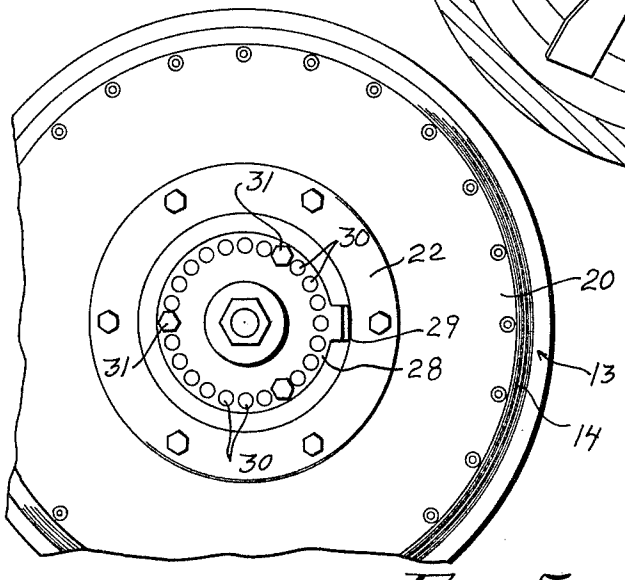


FIG. 5

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ROLLER-ACTUATED VIBRO-ENERGY MILL

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4 Claims. (Cl. 241—175)

This invention relates to roller-actuated, vibro-energy mills; that is, to vibro-energy mills wherein rollers are caused to roll on the internal surface of a cylindrical cage to generate high frequency vibrations. Included in the objects of this invention are:

First, to provide a vibro-energy mill of the annular, vertical axis type wherein shaft and bearing-supported eccentric weights are eliminated, and instead axially offset rollers are rotated at high speed about a vertical axis and urged by centrifugal force against the walls of a surrounding cylindrical cage, to produce high frequency vibrations in a mill supported as a unit with said cage.

Second, to provide a vibro-energy mill of this type which incorporates means for permitting relative, circumferential displacement of the rollers so that the character of the vibrations produced may be varied to meet various conditions of operation.

Third, to provide a vibro-energy mill wherein the bearings of the vibration-producing means are not subject to excessive loads, so that not only is bearing wear minimized but also the mass and rotation speed of the rollers may be increased to permit construction of larger mills or to increase the capacity thereof.

Fourth, to provide a roller-actuated, vibration-producing means which is adapted for use in grinding, deburring, polishing, and finishing mills, as well as separators.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawings in which:

FIG. 1 is a longitudinal, sectional view of a vibro-energy mill incorporating the invention, with portions shown in elevation;

FIG. 2 is an enlarged, longitudinal, fragmentary, sectional view taken through 2—2 of FIG. 1 showing the vibro-energy producing means, with portions being shown in elevation;

FIG. 3 is a transverse, sectional view taken through 3—3 of FIG. 2;

FIG. 4 is a transverse, sectional view taken through 4—4 of FIG. 2;

FIG. 5 is a bottom view of the vibro-energy producing means.

The vibro-energy mill includes a cylindrical base frame 1 having an upper flange on which is mounted a ring of supporting springs 2. A bottom plate 3 rests on and is secured to the upper ends of the springs 2.

Secured to the periphery of the bottom plate 3 is a cylindrical shell 4, and centered within the bottom plate 3 is a central tube 5. The tube 5 extends below the bottom plate 3 and is provided with radiating gusset plates 6 which are also secured to the underside of the bottom plate 3.

The shell 4 and central tube 5 form a toroidal chamber in which is mounted a toroidal jacket 7 open at its upper end and adapted to receive a cover 8. A vent 9 overlies the central tube 5. Within the upper portion of the central tube 5 there is provided an internal flange 10 which supports a plate 11 on which is mounted a motor 12.

Fitted in the lower portion of the tube 5 is a cylindrical case 13 which contains the vibro-energy producing means. Externally, the case 13 is provided with a lower tapered seat 14 which rests within a lower seat ring 15 in the

form of an internal flange, forming a part of the central tube 5. Near its upper end the case 13 is provided with an upper seat 16 tapered oppositely to the lower seat 14. The seat 16 is disposed within a ring 17 and is secured thereto by means of locking wedges 18. The ends of the case 13 are covered by upper and lower cover plates 19 and 20 which are mounted in bearings 21 and 22.

A motor shaft 23 extends downwardly from the motor 12 through the upper bearing 21. The lower portion 24 of the motor shaft 23 is reduced in diameter and is provided with a sleeve 25 supported at its ends by bushings 26. The sleeve 25 and lower portion 24 of the motor shaft 23 protrude through the lower bearing 22.

The lower end of the sleeve 25 is provided with an end flange 27, and the lower reduced extremity of the motor shaft 23 is provided with a collar 28 having a flange 29 confronting the end flange 27. The collar flange 29 is provided with a ring of bolt holes 30. Bolts 31 fit into appropriate bolt holes 30 so that the flanges 27 and 29 may be circumferentially adjusted, and consequently the sleeve 25 may be circumferentially adjusted with respect to the motor shaft 23.

The sleeve 25 and the upper portion of the motor shaft 23 within the case 13 are essentially identical in diameter, and each is adapted to receive a pair of roller impelling arms 32 which are separated by spacer sleeves 33. The impelling arms 32 are disposed diametrically, their central portions being bored to receive the sleeve 25 or the upper portion of the motor shaft 23.

One extremity of each impelling arm 32 is provided radially with a slot as indicated by 34, and is also provided with a clamp bolt 35. The opposite extremity of each arm 32 is provided with a radially extending, bearing block slot 36 having guideways so as to receive a bearing block 37.

The bearing blocks 37 are capable of radial displacement and are urged radially outward by springs 38. Each bearing block 37 contains a self-aligning bearing 39. The bearings associated with each pair of impelling arms 32 support therebetween a roller shaft 40, which may be polygonal in shape.

Each roller shaft 40 receives a roller assembly 41 which may comprise a main roller disk 42 and a set of auxiliary roller disks 43. The roller disks may be retained between collars 44. By adding or subtracting the roller disks, the total mass of the roller disk assembly may be changed.

The lower cover plate 20 seals the lower end of the case 13 and internally forms an oil sump. Mounted on the sleeve 25, below the lowermost impelling arm 32, is a multiple blade oil slinger 45 arranged to drive lubricant upwardly along the internal walls of the case 13.

Operation of the roller-actuated, vibro-energy mill is as follows:

As shown in FIG. 2, a pair of roller assemblies 41 are provided which are axially displaced from each other. The roller assemblies 41 may also be circumferentially displaced by adjustment of the end flanges 27 and 29. Inasmuch as the bearing blocks 37 are free to move radially, the roller assemblies 41 ride against the inner surface of the case 13.

When the roller assemblies 41 are idle, the springs 38 maintain the roller assemblies in nominal contact with the case 13. When the motor 12 is operated, the impelling arms 32 rotate the rollers about the axis of the motor shaft 23 and sleeve 25, causing the roller assemblies 41 to rotate on their own axes as they are urged by centrifugal force against the case 13 and ride on the internal surface thereof.

The roller assemblies 41 form eccentric masses which set up vibration in the case 13, the frequency of which is

dependent upon the speed of rotation. This vibration is transmitted to the parts of the mill supported on the springs **2**. The mill jacket **7** imparts vibration to its contents. In practice the mill jacket **7** contains grinding, deburring, or polishing material and the product to be ground or workpieces to be deburred or polished.

By reason of the fact that the roller assemblies **41** are free of radial restraint with respect to the impelling arms **32**, the bearings **21** and **22** are not subjected to excessive loads; that is, the loads caused by eccentric rotation of the rollers are transmitted directly to the internal wall of the case **13**. As a consequence, the total energy which may be imparted to the case **13** and to the mill itself is not limited by the strength of the bearings **21** and **22**. In addition, heavier masses may be used than is feasible if the masses must be supported against radial displacement by the rotating shaft.

In the operation of the mill, it is quite important that the angular relation of the roller assemblies or eccentric masses be adjusted. This adjustment may vary with the weight and type of material being treated as well as the type of treatment to be given. Such adjustment may be readily made by reason of the fact that the flanges **27** and **29** are exposed and readily accessible.

It should be observed that while the vibro-energy unit is disposed below the motor **12**, the vibro-energy unit may be inverted and the motor placed below. Also if desired, the case **13** may be elongated to increase the axial displacement between the eccentric masses to meet the various needs of the mill and the materials to be treated.

While a particular embodiment of this invention has been shown and described, it is not intended to limit the same to the exact details of the construction set forth, and it embraces such changes, modifications, and equivalents of the parts and their formation and arrangements as come within the purview of the appended claims.

What is claimed is:

1. A vibro-energy mill, comprising:
(a) an annular mill structure;
(b) a ring of supporting springs therefor;
(c) a cylindrical roller case centrally located in said mill structure;
(d) a drive shaft extending axially through said case;
(e) a sleeve fitting a portion of said drive shaft and extending therewith from an end of said case;
(f) means for effecting relative circumferential displacement of said drive shaft and sleeve;
(g) axially displaced sets of roller-impelling arms carried respectively by said drive shaft and sleeve;
(h) axially offset rollers carried by said arms and radially movable into engagement with the inner surface of said case for rotation thereabout;
(i) and a drive for said shaft to rotate said rollers, thereby to cause said rollers to be urged by centrifugal force into rolling engagement and vibration-producing contact with said case.

2. A vibro-energy mill, comprising:
(a) an annular mill structure;
(b) a ring of supporting springs therefor;
(c) a cylindrical roller case centrally located in said mill structure and having bearings at its axial ends;
(d) a drive shaft structure extending axially through said roller case and journaled in said bearings;

(e) axially displaced pairs of roller-impelling arms carried by said shaft structure for rotation therewith;
(f) an opposed pair of radially movable bearing units carried by each pair of arms;
(g) a roller journaled between each pair of bearing units and freely movable radially into engagement with the inner surface of said roller case to form, on rotation of said shaft structure, an eccentric mass imparting vibration to said roller case and mill structure;
(h) and means for rotating said shaft structure.

3. A vibro-energy mill, comprising:
(a) an annular mill structure;
(b) a ring of supporting springs therefor;
(c) a cylindrical roller case centrally located in said mill structure and having bearings at its axial ends;
(d) a drive shaft, a sleeve at one end thereof, said drive shaft extending through and journaled at one end of said roller case, said drive shaft and sleeve extending through and journaled at the other end of said roller case and terminating in exposed ends;
(e) means connecting the common exposed ends of said drive shaft and sleeve for effecting relative circumferential adjustment;
(f) a first pair of roller-impelling arms carried by said drive shaft within said roller case;
(g) a second pair of roller-impelling arms carried by said sleeve within said roller case;
(h) an opposed pair of radially movable bearing units carried by each pair of arms;
(i) and a roller journaled between each pair of bearing units and freely movable radially into engagement with the inner surface of said roller case to form, on rotation of said shaft and sleeve, an eccentric mass imparting vibration to said roller case and mill structure.

4. A vibro-energy mill, comprising:
(a) an annular, spring-supported, mill structure;
(b) a centrally located, cylindrical roller case carried by said mill structure;
(c) axially displaced means forming eccentric masses urged, when rotated within said roller case, by centrifugal force into contact with said roller case, to impart vibration thereto and to said mill structure;
(d) supporting and impelling means for each of said eccentric masses;
(e) means for effecting relative circumferential adjustment of said supporting and impelling means, thereby to effect relative circumferential displacement of said eccentric masses;
(f) and drive means for rotating said supporting and impelling means thereby to cause rotation of said eccentric masses.

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