May 10, 1949. G. THIMAN 2,469,484

VIBRATOR GRINDING MILL

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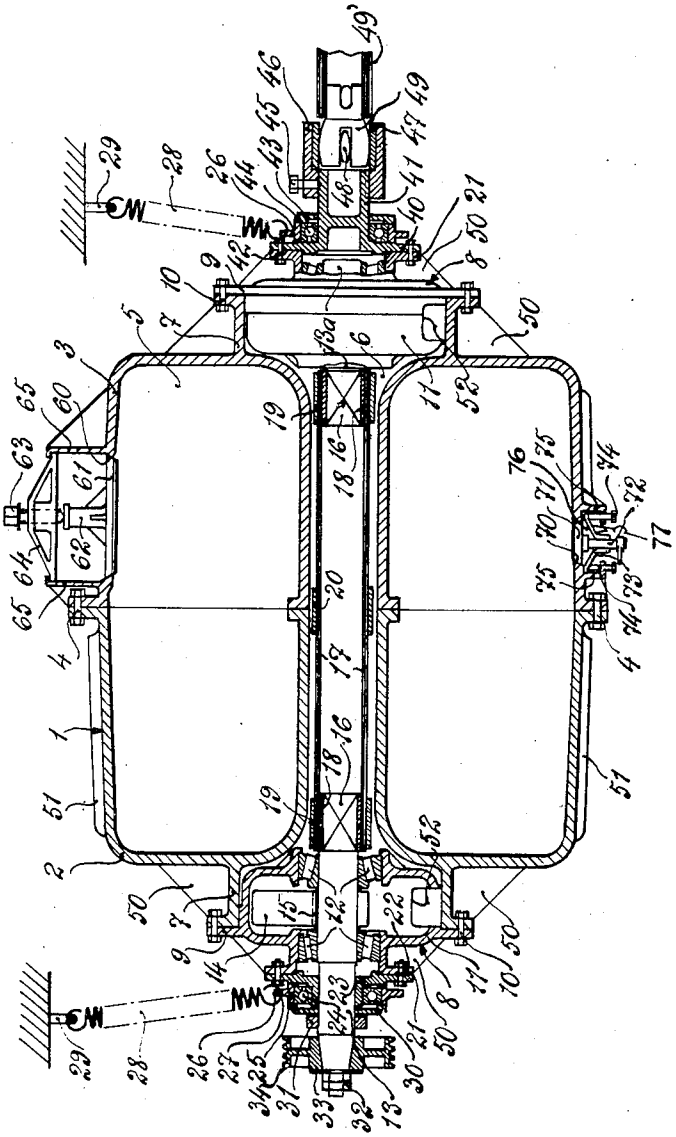


Fig. 1

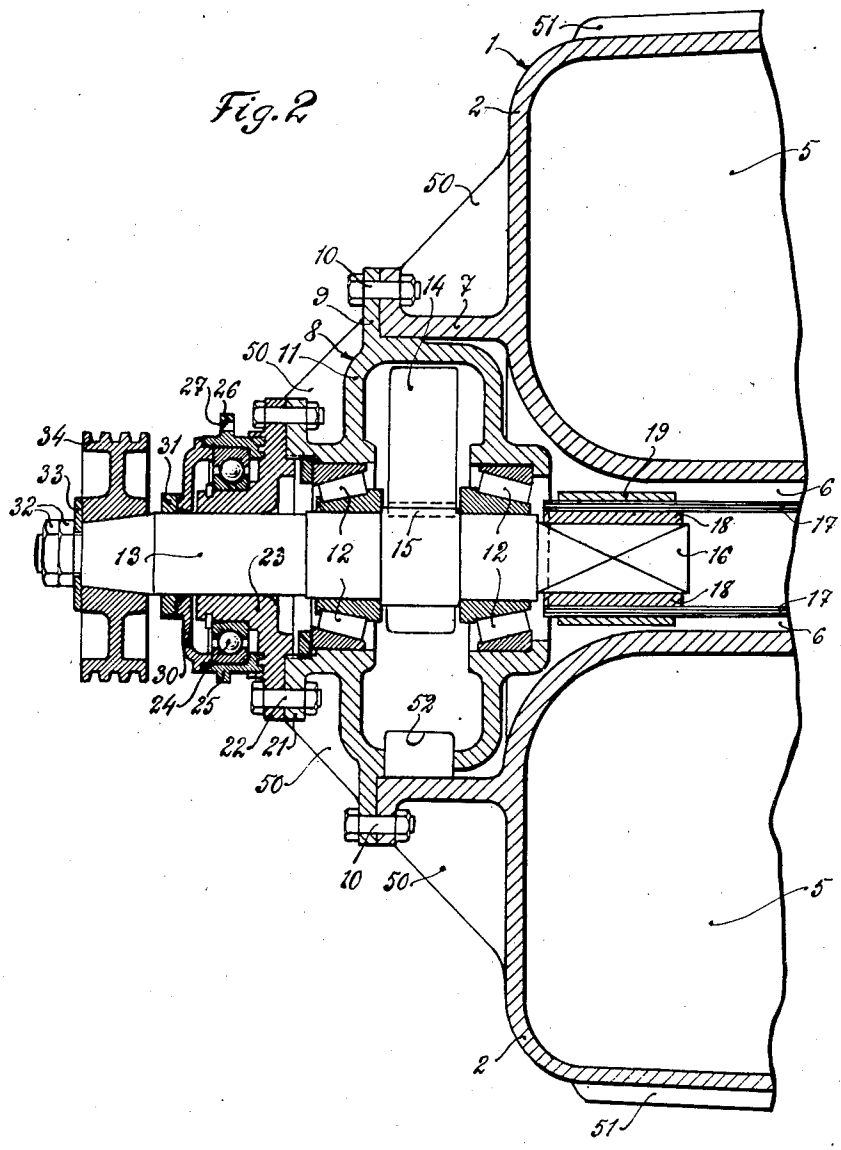
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Fig. 2



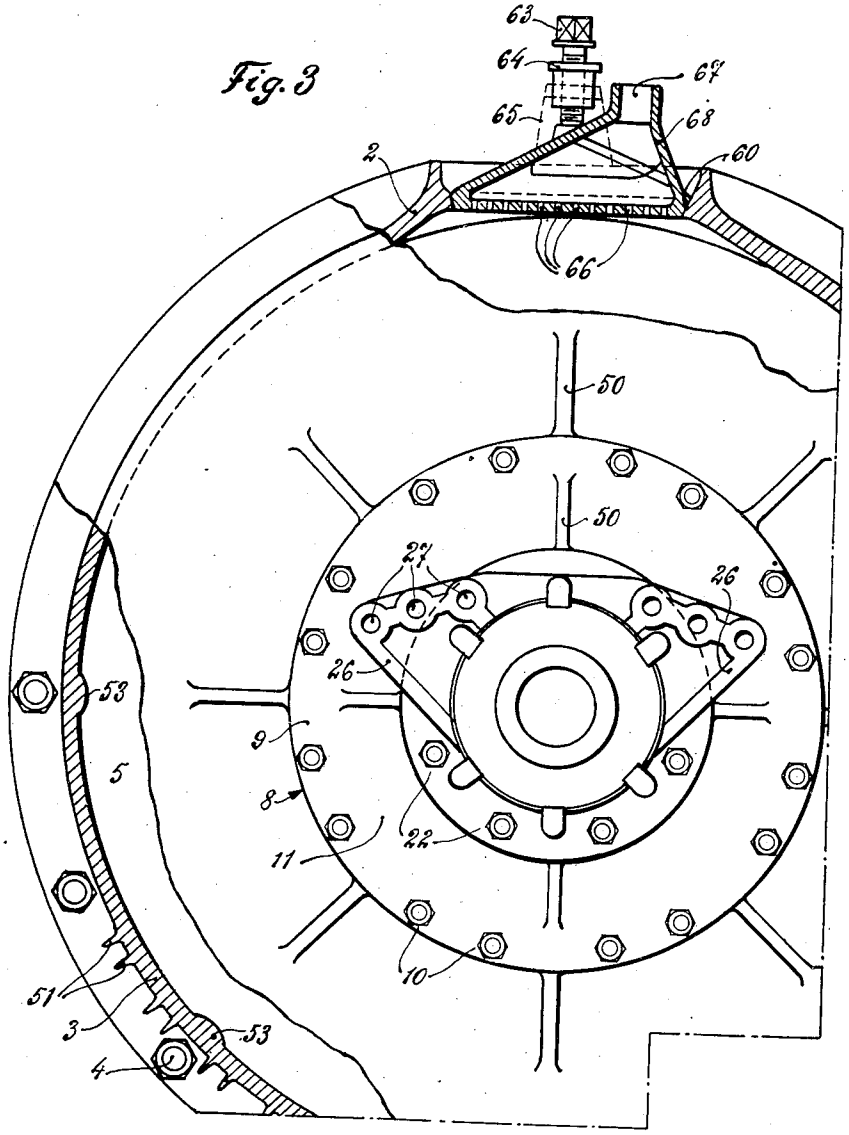
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Fig. 3



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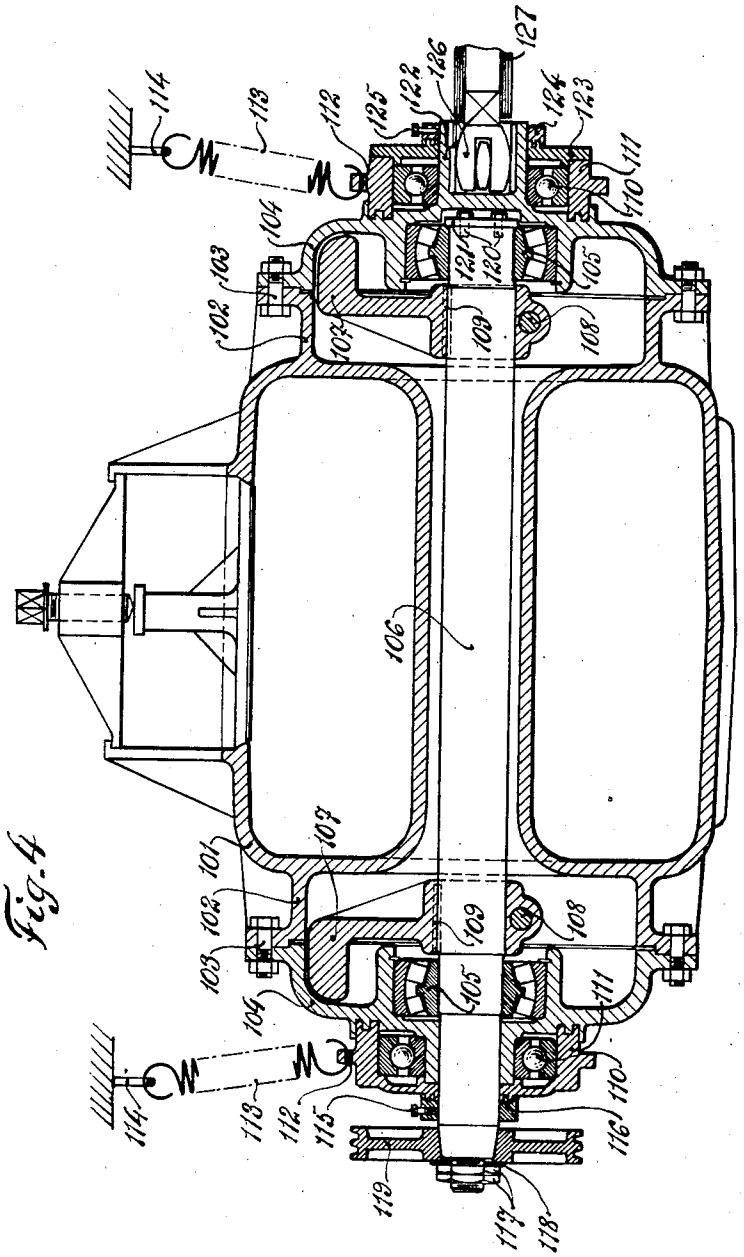


Fig. 4

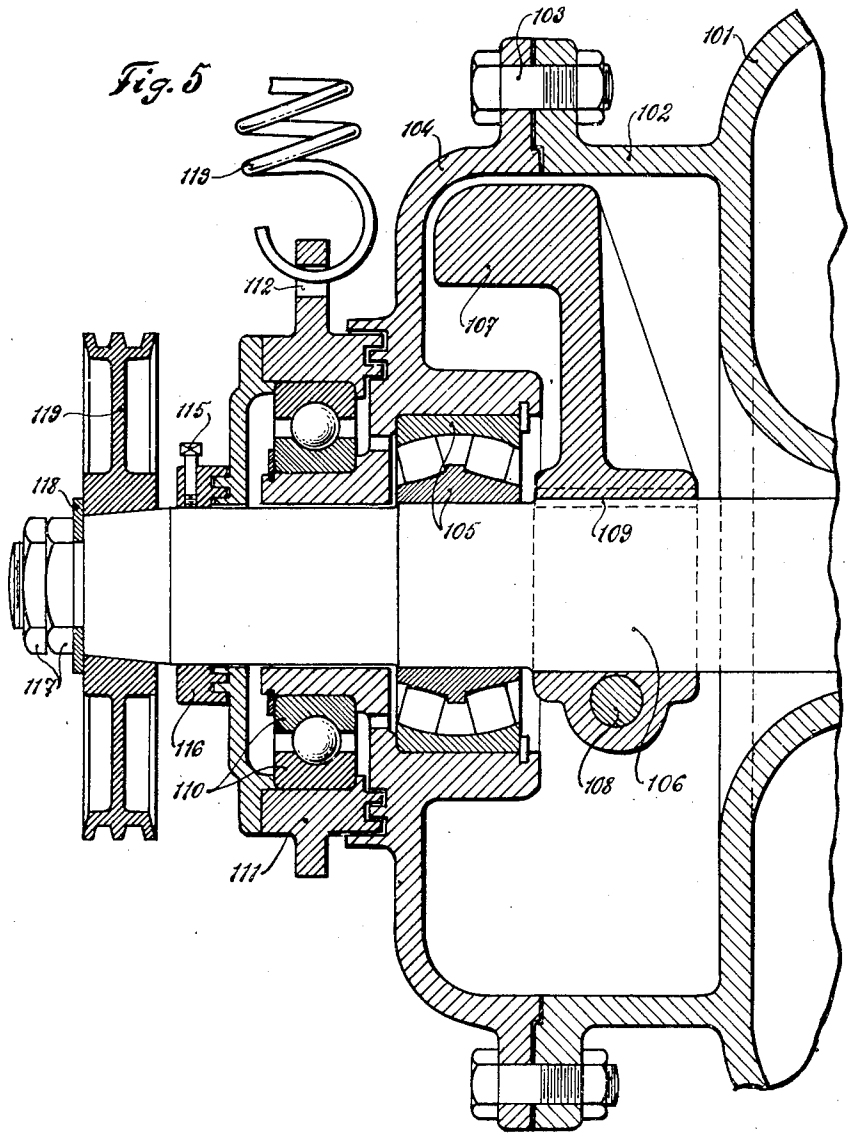
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Fig. 5



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UNITED STATES PATENT OFFICE

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VIBRATOR GRINDING MILL

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3 Claims. (Cl. 241—175)

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The invention relates to grinding mills of the type which comprise a container with balls or other comminuting bodies, means for elastically suspending the container and a vibrator associated with the container in such manner as to impart to the container a vibratory motion. One object of the invention is to provide a grinding mill of this type which in addition to the vibratory motion also has a rotary motion, in order to accelerate the grinding operation.

Two embodiments of the invention will be described in the following with reference to the accompanying drawings. Figs. 1–3 show the first embodiment and Figs. 4 and 5 the second.

Fig. 1 is an axial section of one form of mill,

Fig. 2 is an enlarged section of the left hand end of the mill of Fig. 1,

Fig. 3 is an elevation of the left hand end of the mill of Fig. 1 with portions broken away and in section,

Fig. 4 is an axial section of a second form of mill, and

Fig. 5 is an enlarged section of the left hand end of the mill of Fig. 4.

In the embodiment shown in Figs. 1–3 the numeral 1 denotes a cylindrical and annular container composed of two halves 2 and 3 held together by means of bolts 4. The container thus forms an outer, annular and closed chamber 5 which contains the comminuting bodies and in which the grinding takes place, and a central space 6 open at both ends.

At both ends the container is provided with annular flanges 7, and within these flanges are mounted vibrator units 8 having flanges 9 by means of which and with the aid of bolts 10 they are secured to the annular flanges 7. Each vibrator unit consists of a covering 11, roller bearings 12 mounted therein, shafts 13 and 13a respectively mounted in the bearings, and eccentric weights 14 mounted on and secured to the shafts by means of key and slot joints 15. The shafts 13, 13a have square inner ends 16 and are connected with each other by means of four leaf springs 17. Between the springs 17 and the square ends are disposed linings 18 of Phosphor bronze, and the springs are secured to the secured ends by means of square rings 19 forced thereon. A further square ring 20 is mounted on the springs at the middle thereof in order to

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prevent the springs from swinging out when the mill is in operation.

The coverings 11 are provided at the outer ends with flanges 21. To the flange 21 of the left covering is secured by means of bolts 22 an inner rotating bearing member 23 which is mounted by means of a ball bearing 24 in a non-rotatable bearing member 25. The bearing member 25 is formed with portions 26 (see Fig. 3) having holes 27 entered by six helical springs 28 by means of which the bearing member is suspended in hooks 29. Into the bearing member 25 is screwed a lid 30 sealed by means of a ring 31 fitted on the shaft 13.

At the outer end of the shaft 13 is mounted by means of nuts 32 and a washer 33 a pulley 34 driven by a motor not shown in the drawing and in its turn driving the eccentric weights 14, thereby causing the vibratory motion of the mill.

At the right end of the mill a shaft 41 having a flange 40 is secured by means of bolts 42 to the flange 21 of the vibrator covering 11 and rotatably mounted by means of a ball bearing 43 in a bearing member 44 which similarly to the bearing member 25 shown to the left in Fig. 1 is suspended in hooks 29 by means of springs 28.

To the shaft 41 is secured by means of a set screw 45 a socket 46 having secured inside thereof a ring 47 with a transverse key 48. A claw 49 fits over the key 48 and forms therewith a flexible coupling. The claw 49 is connected by means of a tube 49^1 with a motor not shown in the drawing by means of which the mill is made to rotate. The rotating motion is transferred from the tube 49^1 over the flexible coupling 49, 48, 47 to the shaft 41 which is rotatable in the non-rotatable bearing member 44 and is rigidly connected with the vibrator covering 11 which in turn is rigidly connected with the container 1.

In the figures 50 denotes reinforcing ribs, 51 cooling flanges, 52 openings for introducing the eccentric weights 14 into the coverings 11 and 53 (see Fig. 3) ribs on the inside of the annular container with the object of promoting rotation of the balls or other comminuting bodies with the container.

At the upper side of the container, in the position shown in Fig. 1, the container is provided with an opening 60 with a lid 61. The lid has a central post 62 against which presses a screw

63 positioned in a bridgelike member 64 held in position by two members 65 projecting from the container 1. As shown in Fig. 3 the lid 61 can be replaced by a hollow lid 68 having holes 66 and a discharge opening 67.

At the under side the container 1 has another opening 70 in which is disposed a lid 71. On the lid is rotatably mounted a screw 72 screwed into a conical plate 73. The plate 73 is secured to the container 1 by means of two bolts 74 mounted in two members 75 projecting from the container. By turning the screw 72 it is thus possible to open the lid 71 more or less. The plate 73 is provided with an opening 76 having a spout 77.

The mill operates in the following manner.

The container is brought into the position shown in Fig. 1, the lower valve 70, 71 being closed. The upper valve 60, 61 is opened and the material to be ground is filled into the annular chamber 5. The comminuting bodies are assumed already to be in the container. The valve 60, 61 is closed and the driving means connected to the pulley 34 and the tube 49[1] are started. The mill is thus made to rotate and at the same time is subjected to vibration. The combined effect of the vibration and rotation is to accelerate the grinding operation. When the grinding is finished the container is brought into the position shown in Fig. 1 and the valve 70, 71 is opened so as to let out the ground material without letting out the comminuting bodies. After the valve 70, 71 has been closed a new charge can be introduced through the valve 61.

It is, however, possible to use the upper valve 60, 61 also for the discharge of the ground material, and the lower valve may then be omitted. In this case the container, for discharging the ground material, is brought into the position shown in Fig. 1 and the lid 61 is removed and replaced by the device shown in Fig. 3. The container is then turned upside down and the charge is allowed to run out.

The vibrators are made as removable units in order to facilitate repair or exchange.

To remove, for example, the left vibrator in Fig. 1 the bolts 10 are removed and then the unit 8 together with the shaft 13, the eccentric weight 14 and the bearings 12, as well as all the parts to the left of the unit 8 can be withdrawn to the left. For this purpose the connection between the square end of shaft 16 and lining 18 is carried out as a slip joint connection. The vibrator unit can then easily be taken to pieces or a new one mounted on the shaft 13.

In the embodiment shown in Figs. 4 and 5 the annular container 101 is in one piece and as before provided with annular flanges 102 at the ends. Lids 104 are secured to the flanges 102 by means of bolts 103, and in the lids are mounted double row roller bearings 105 for the shaft 106 common to both vibrators. The eccentric weights 107 are clamped to the shaft by means of screws 108 and are secured against turning by means of key and slot joints 109. The lids are rotatably mounted by means of ball bearings 110 in non-rotatable bearing members 111 having holes 112 and suspended by means of helical springs 113 in hooks 114.

At the left end of the mill in Fig. 4 the non-rotatable bearing member 111 is sealed against the shaft 106 by means of ring 116 secured to the shaft by means of a screw 115. To the outer end of the shaft 106 a pulley 119 is clamped by means of nuts 117 and a washer 118.

At the right end of the mill in Fig. 4 the shaft

106 ends with a plate 121 for retaining the roller bearing 105 and secured by means of screws 120. The lid 104 is extended to the right to form a hub member 122 extending through the bearing 110, and to the non-rotatable member 111 is secured a lid 123 which by means of a packing ring 124 is sealed against the hub member 122. The packing ring 124 is secured to the hub member 122 by means of a screw 125. To the hub member 122 is connected a flexible coupling 126 the shaft 127 of which is connected to a motor not shown in the drawing which serves to rotate the mill.

In both of the embodiments shown the springs 28, 113 in which the mills are suspended are preferably arranged so as to be inclined to a plane through the axis of rotation of the mill in such a way that the upper ends of the springs are further from this plane than the lower ends thereof.

The invention is not limited to the specific forms shown and described, as many modifications may be made within the invention as defined by the claims.

What I claim is:

1. A vibrator grinding mill comprising in combination a cylindrical and annular container having a central channel, bearing members at each end of the container for rotatably supporting the container for rotation about its axis, means for elastically suspending the bearing members, a vibrator secured to the container at each end thereof for subjecting the container to vibration, a driving shaft connecting the vibrators through the central channel of the container, and means for rotatably supporting the shaft in the container, the shaft at one end of the container extending through the bearing member at that end and at the free end thereof being provided with means for driving the same, and the container at the other end extending through the bearing member at that end and at the free end being provided with means for the driving of the same.

2. A vibrator grinding mill comprising in combination a cylindrical and annular container having a central channel and annular flanges at both ends, a vibrator unit secured within the flange at each end of the container, and each having a shaft rotatably mounted in the unit and provided with an eccentric weight, bearing members for rotatably supporting the vibrator units for rotation of the container about its axis, tension springs for hanging suspension of the bearings, and a flexible shaft connecting the shafts of the vibrator units, one of the vibrator unit shafts extending through the bearing member at that end of the container and at the free end being provided with means for the driving thereof, and the vibrator unit at the other end of the container with a portion thereof extending through the bearing member at that end of the container and at the free end being provided with means for the driving of the same.

3. A vibrator grinding mill comprising in combination a cylindrical and annular container having a central channel, bearing members at each end of the container rotatably supporting the container for rotation about its axis, tension springs for hanging suspension of the bearing members, a shaft passing through the channel of the container and being rotatably mounted therein, and eccentric weights secured to the shaft at both ends of the container, the shaft at one end of the container extending through

the bearing member at that end and at the free end being provided with means for the driving thereof, and the container at the other end extending through the bearing member at that end of the container and at the free end being provided with means for the driving thereof.

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