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Hoyt

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[54] **ORBITAL AGITATING APPARATUS**

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[52] **U.S. Cl.** **51/163;** 51/164; 259/72

[51] **Int. Cl.** **B24b 31/04**

[58] **Field of Search** 51/163, 164, 7; 259/72

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Attorney, Agent, or Firm—Thomas H. Olson

[57] **ABSTRACT**

A machine for agitating an article such as a container of small parts and an abrasive medium as employed in deburring or otherwise finishing the small parts. The container is rigid with a platform having a circular periphery and is driven by a flexible torque transmission element secured centrally of the circular periphery. The periphery rests on a table that has a central opening for the torque transmission element, and the point of contact between the circular periphery and the table makes an orbital path around the opening. The height of the table is adjustable in order to vary the configuration of the orbital path. The torque transmission has an eccentric element whereby the orbital path can be adjusted to be eccentric of the opening thus affording variation of the degree of agitation to which the container and contents are subjected.

13 Claims, 10 Drawing Figures

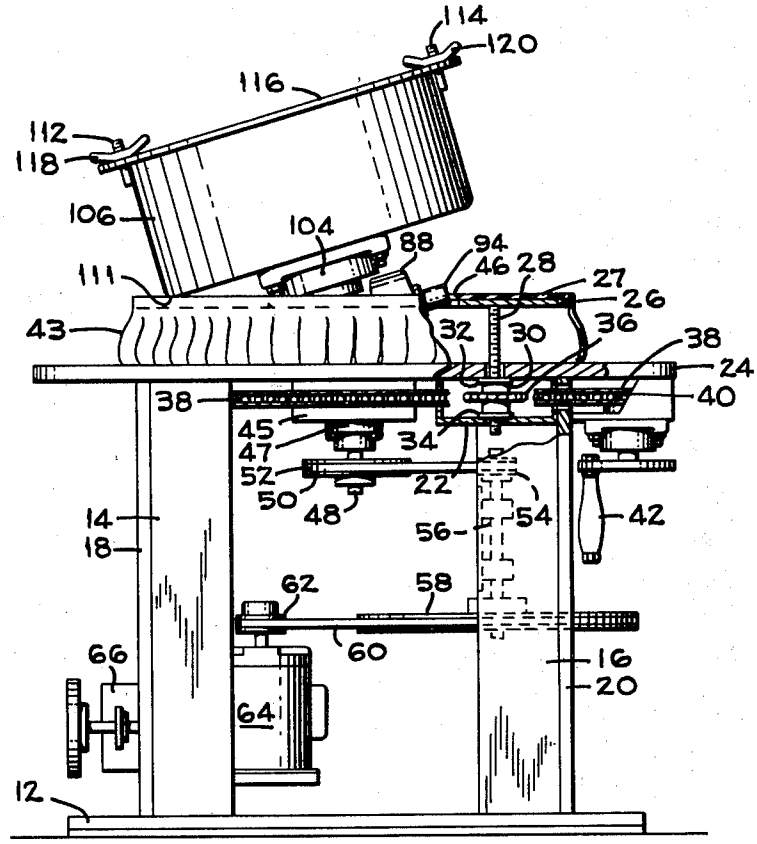

Fig_2

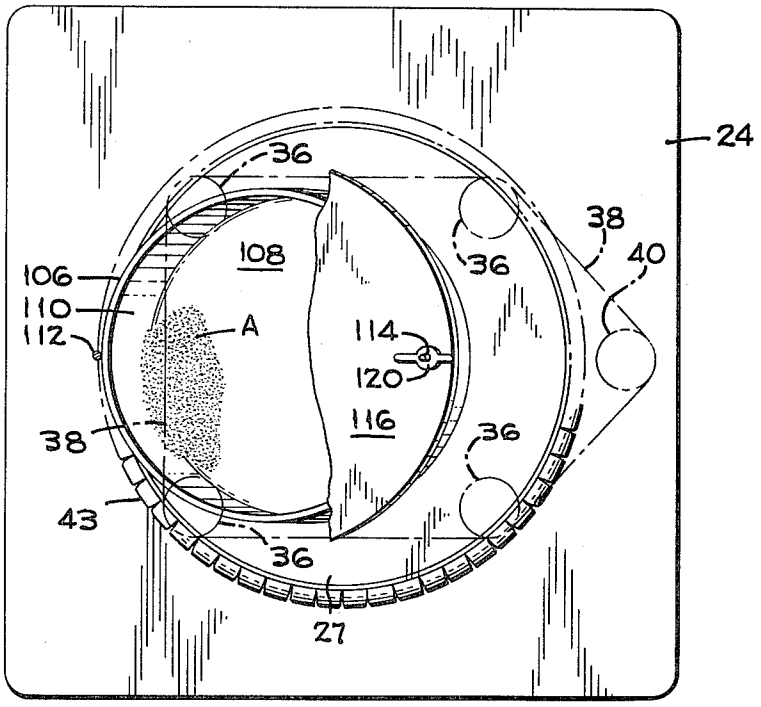
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Fig_1

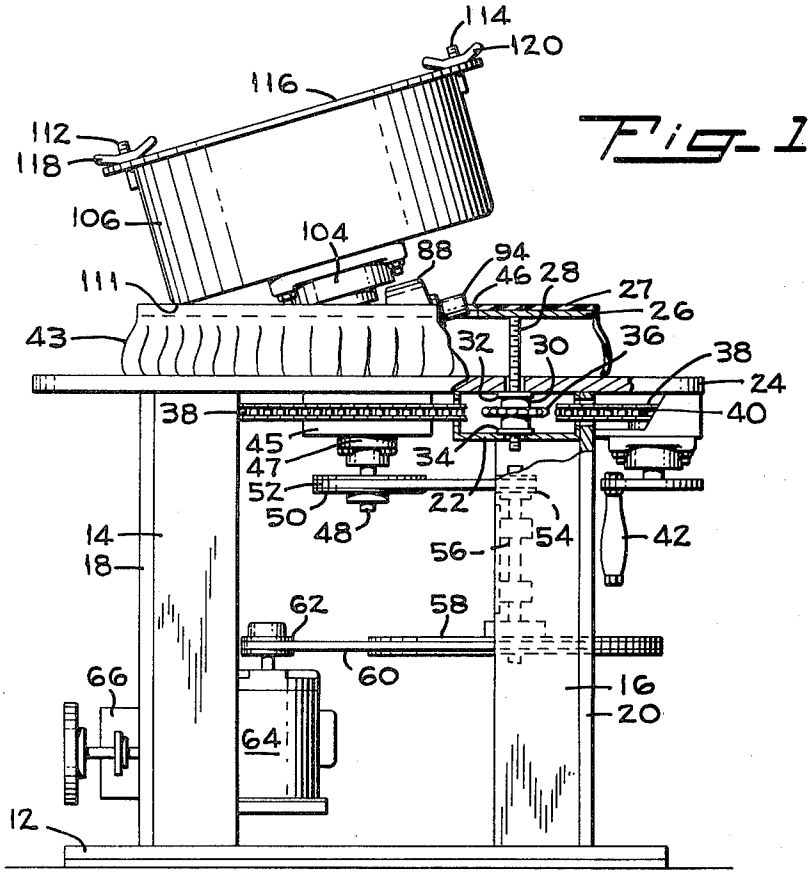
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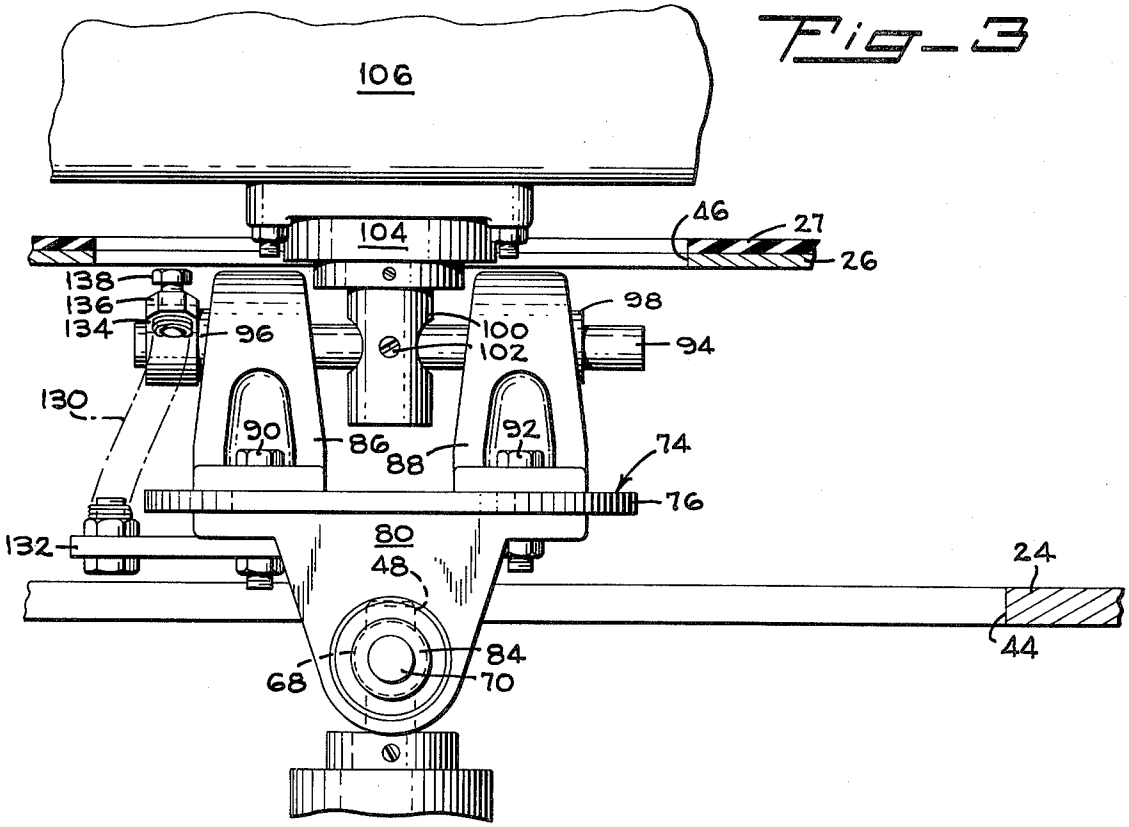
Fig_3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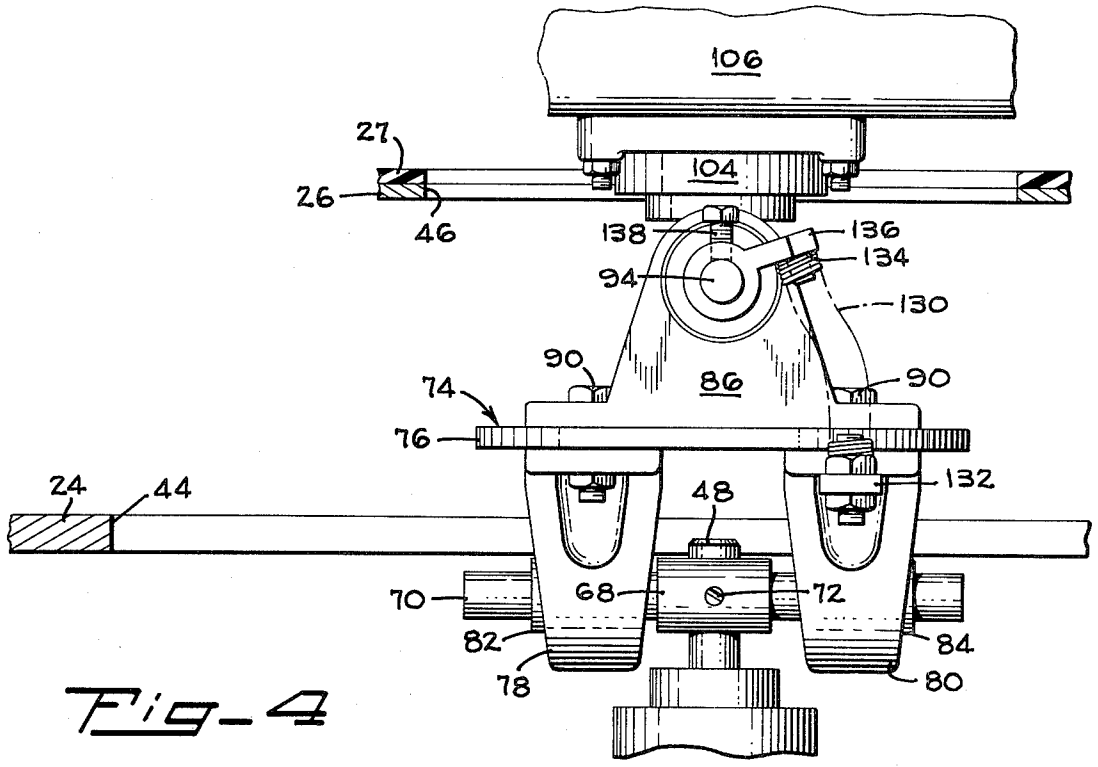
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Fig_4

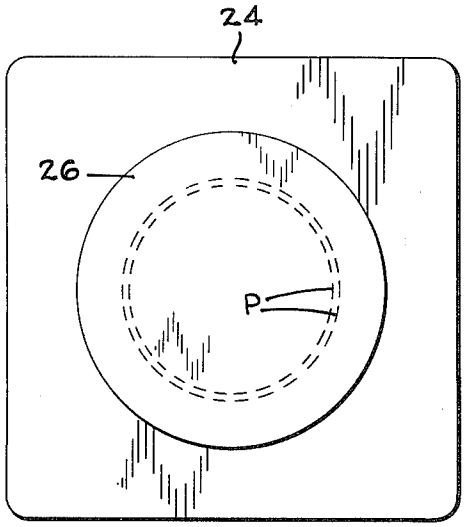


Fig_5A

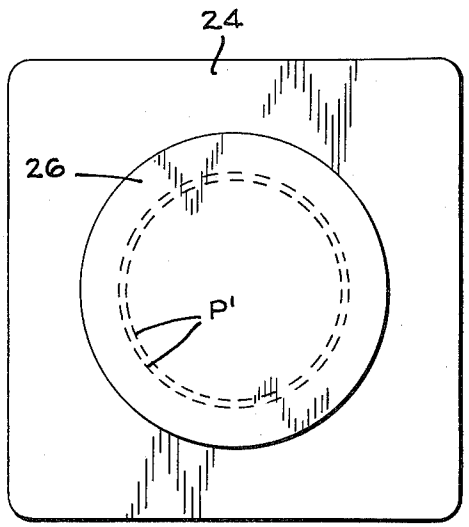


Fig_6A

Fig_5

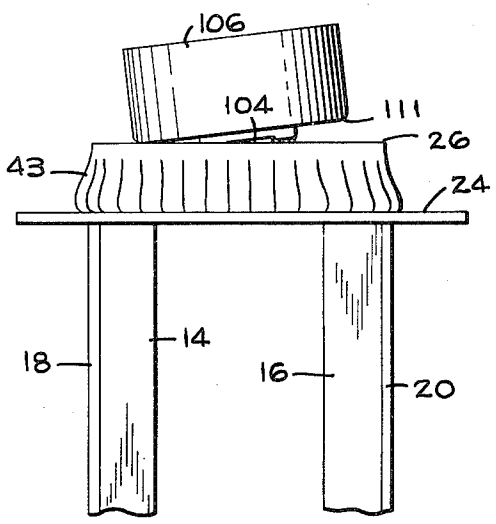


Fig_6

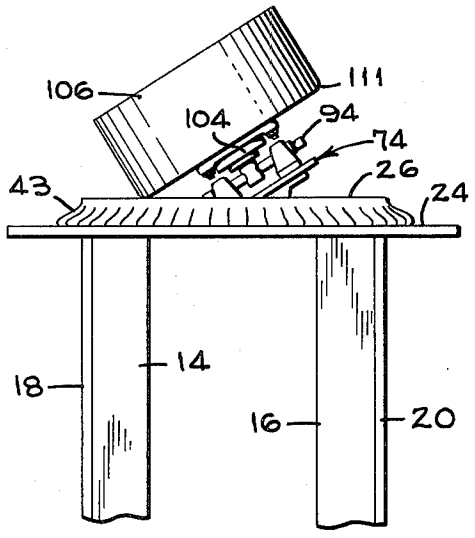
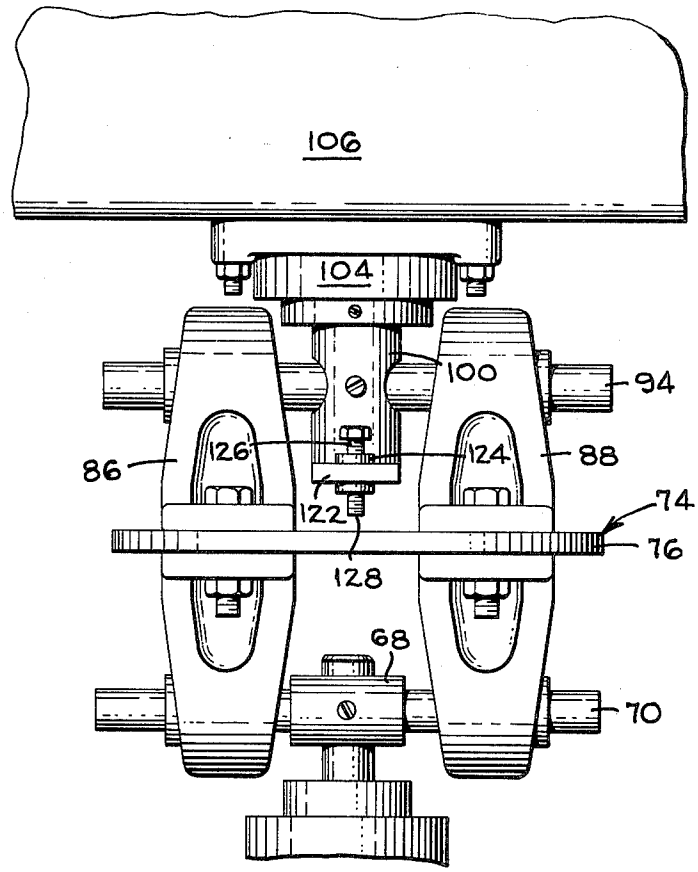


Fig-7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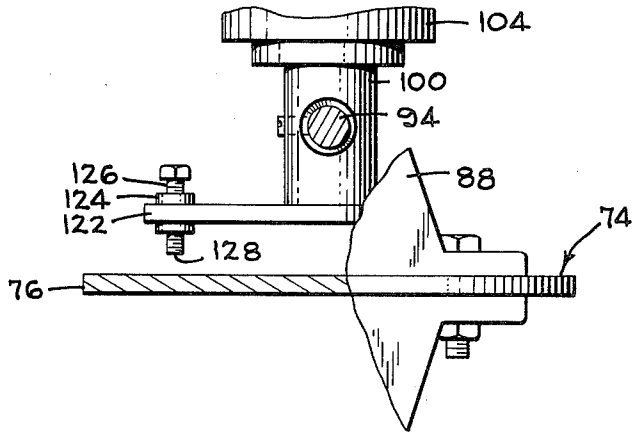
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Fig-7A

ORBITAL AGITATING APPARATUS

FIELD OF THE INVENTION

The invention relates to a machine for agitating an article, and more particularly, to a machine for agitating a container adapted to receive a plurality of small parts and an abrasive or like surface finishing medium. The machine is exemplified hereinafter by a finishing machine for small parts.

DESCRIPTION OF THE PRIOR ART

Known existing finishing machines include those employing a cylindric barrel which is simultaneously rotated about two or more axes and finishing machines that are vibratorily driven to effect relative movement between the parts and the finishing medium therein. Although such prior art machines have been used satisfactorily, they tend to be overly complex and expensive and under certain conditions do not effect efficient treatment of the parts placed therein.

SUMMARY OF THE INVENTION

The present invention subjects the article mounted to it, e.g., a container for parts and finishing medium, to a compound rocking orbital motion which effects efficient movement of the parts relative the finishing medium without subjecting the parts to unnecessary impact.

An object of the invention is to provide a device of the type referred to above in which the degree of agitation to which the parts are subjected is adjustable. Adjustability permits the machine to be operated at an optimum mode so that the parts are not subjected to undue impact but are moved with sufficient vigor that the requisite surface finishing is achieved. Adjustability of the degree of agitation is achieved in two ways, one by the speed of rotation of the orbiting container and secondly, by the angle through which the container is rocked in traversing the orbital path.

Another object is to provide a machine of the type referred to above that subjects the article to forces and/or motions in a plurality of directions. This object is achieved because the present invention agitates the article in a compound mode that includes rotation, which produces centrifugal forces, and rocking motion which produces oscillatory forces on the article. It has been found that a machine according to the present invention has a much higher production rate than prior art machines of equivalent power rating.

The foregoing, together with other objects, features and advantages will be more apparent after referring to the following specification and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation view of an agitating machine according to the present invention.

FIG. 2 is a top view of the machine in FIG. 1.

FIG. 3 is a front elevation view of one satisfactory form of flexible torque transmitting structure according to the present invention, the structure being shown in an upright position for clarity.

FIG. 4 is a side elevation view of FIG. 3.

FIG. 5 is a partially diagrammatic front elevation of the device in one mode of operation.

FIG. 5A is a top view of FIG. 5.

FIG. 6 is a partially diagrammatic front elevation of the device in another mode of operation.

FIG. 6A is a top view of FIG. 6.

FIG. 7 is a front elevation view of an alternate form of a torque transmitting element according to the present invention.

FIG. 7A is a fragmentary side view of FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring more particularly to the drawing, reference numeral 12 indicates a lower base plate on which the frame for the machine of the invention is supported. Extending upward from base plate 12 are four rigid legs, two of which are indicated in FIG. 1 at 14 and 16. One or more cover panels such as indicated at 18 and 20 in FIG. 1 can be installed in spanning relation of the legs in order to enclose the volume circumscribed by the legs. Mounted on top of legs 14 and 16 and their counterparts at the rear of the machine is a top 24 which is secured, such as by welding to the top of the legs. Overlying table 24 in substantial parallel relation thereto is a plate 26 which defines a generally horizontal upper surface. Plate 26 has a high friction layer thereon, such as a layer of rubber 27.

Plate 26 is arranged for vertical movement toward and away from table 24. To achieve this mode of operation there are secured to the lower surface of plate 26 four screws 28 (only one being shown in FIG. 1) which are arranged in a square pattern on the lower surface of plate 26 in alignment with legs 14 and 16 and their counterparts at the rear of the machine. With reference to FIG. 1, each screw 28 is threadedly engaged by a collar 30 which is captured between the lower surface of table 24 and the web of U-shaped member 22. Thrust washers 32 and 34 confine collar 30 against vertical movement and afford rotation of the same. Rigid with collar 30 and secured exterior thereto is a sprocket 36 which is engaged by a roller chain 38. Roller chain 38 engages each of the four sprockets associated with each of the four screws 28. Thus movement of roller chain 38 effects simultaneous rotation of all collars 30 and effects corresponding vertical movement of screw 28 and plate 26. Exterior of plate 20 is a drive sprocket 40 that is engaged with roller chain 38; drive sprocket 40 is driven by a hand crank 42 so that upon rotation of the hand crank, plate 26 moves up or down with respect to table 24. A flexible rubber skirt 43 is provided between table 24 and plate 26 as a safety measure to prevent access to the space therebetween.

Table 24 and plate 26 define central openings 44 and 46, respectively. Aligned with the openings and journalled for rotation in a bearing 47, which is fixed to a bearing support 45 on the base, is a shaft 48. On the lower end of shaft 48 is a sheave 50 which through a V-belt 52 and a sheave 54 receives power from a countershaft 56. On the lower end of countershaft 56 is a large sheave 58 which is driven through a V-belt 60 from a motor pulley 62 of a motor 64. A speed controller 66 is provided for controlling the speed of rotation of motor 64 and therefore of shaft 48.

At the upper end of shaft 48 is a collar 68 which joins shaft 48 to a pivot shaft 70. A set screw 72 fixes collar 68 to pivot shaft 70.

Pivot shaft 70 is carried in a rigid body 74 that forms a part of the flexible torque transmission means of the present invention. Body 74 includes a plate 76 to which

are rigidly connected bearing housings **78** and **80** which at their lower extremities support pivot shaft **70** for pivotal movement relative to the bearing housings. Collars **82** and **84** engage pivot shaft **70** to inhibit axial movement of the pivot shaft; the collars are adjustable, however, along pivot shaft **70** so that shaft **48** and collar **68** can be positioned symmetrical of bearing housings **78** and **80** or asymmetrical thereof.

To the upper surface of plate **76** are secured similar bearing housing members **86** and **88**, bolts **90** and **92**, serving to secure both the upper and lower pairs of bearing housings to plate **76**. At the outer extremities of bearing members **86** and **88** is supported for rotation relative to the bearing members an upper pivot shaft **94**, collars **96** and **98** being secured to the shaft to inhibit axial movement thereof. Collars **96** and **98** are identical to collars **82** and **84** in that they are adjustable in order that the longitudinal midpoint of pivot shaft can be positioned symmetrically or asymmetrically of bearing members **86** and **88**. Secured to the midpoint of pivot shaft **94** is a shaft **100**, there being a set screw **102** which engages pivot shaft **94** to retain shaft **100** to the midpoint of the pivot shaft. The upper end of shaft **102** terminates in a bearing assembly **104**, one portion of which is secured to the article to be agitated, here exemplified by a cylindric container or tub **106**. Bearing assembly **104** affords rotation of container **106** relative to shaft **100**, but inhibits axial and tilting movement of the container relative to the shaft. The cylindric container includes a circular bottom wall **108** and a cylindrical side wall **110**. Bottom wall **108** can be thought of as a platform having a circular rim **111**, a portion of which is in contact with the upper surface of layer **27** on plate **26**. Fixed to the upper margin of cylindric wall **110** is a pair of threaded studs **112** and **114**. A cover plate **116** is provided, there being holes for registry with threaded studs **112** and **114** in order that the cover plate can be installed to close the container. The cover plate is maintained in position by wing nuts **118** and **120** threaded on threaded studs **112** and **114**, respectively. Container **106** and cover plate **116** are typically lined with rubber to avoid damaging the parts under treatment and to enhance transmission of motion to the finishing medium within the container.

The operation of the apparatus of the invention is as follows:

A plurality of small parts and finishing compound are placed in container **106** as indicted at A in FIG. **2**. Cover plate **116** is placed onto the container and wing nuts **118** and **120** are engaged with the protruding portions of threaded studs **112** and **114** to secure the cover in place. The weight of container **106** and its contents causes the container to tilt so that the lower circular rim **111** of bottom wall **108** engages the upper surface of plate **26** at a limited peripheral region of the bottom wall or lower rim of the container. The flexible torque transmission affords this condition by pivotal movement of body **74** about the axis of pivot shaft **70** and/or pivotal movement of pivot shaft **94** with respect to the body. Motor **64** is then activated so that shaft **48** and body **74** of the flexible torque transmission means are rotatively driven. In response to such rotation shaft **100** is rotated and in turn the lower rim **111** of container **106** in contact with plate **26** rolls on the upper surface of the plate to describe an orbital path, such path being indicated in FIG. **5A** by reference character P. The friction afforded by layer **27** causes the container to roll but the force of friction is not so great as to inhibit sliding or slipping movement of rim **111** on layer **27**, such as occurs when the vertical position of plate **26** is effected. Accordingly, container **106** is rolled around the surface of plate **26** and is subjected to both orbital and tilting oscillatory motion. The circumference of rim **111** of container **106** is different from a submultiple of the length of the path P on plate **26** over which the rim rolls, in consequence of which the container rotates relative to drive shaft **48**. More specifically, as viewed in FIG. **5**, clockwise rotation of shaft **48** causes counter clockwise rotative motion of container **106**. Such motion is transmitted to the contents A of the container so that the action necessary for surface finishing is effected. In FIG. **5A** it will be noted that the path P is represented by two broken lines. The two broken lines indicate the extremities of the orbital path. The radial distance between the two extremities is determined by the eccentricity of collar **68** on pivot shaft **70** and/or the eccentricity of shaft **100** on pivot shaft **94**.

Comparison of FIGS. **5A** and **6A** indicates that the mean diameter of path P is determined by the vertical position of plate **26**. Thus when the plate is relatively high (see FIG. **5**) container **106** is tilted to a slight degree and the diameter of the orbital path is relatively small. When, however, plate **26** is relatively low (see FIG. **6**) the angle of tilt of container **106** is relatively steep and the diameter of the radial path P′ is relatively large. Morever, the rate of reverse rotation of container **106** relative to shaft **48** is less when plate **26** is relatively high (FIG. **5**) than when the plate is relatively low (FIG. **6**). Thus the degree of agitation to which container **106** and contents A are subjected can be adjusted by rotation of crank **42** to raise or lower plate **26**. Through speed controller **66**, the speed of motor **64** and therefore of shaft **48** can also be adjusted. Thus the invention affords a wide degree of adjustment of agitation forces and speed according to the nature, weight and size of the article being agitated. Because both crank **42** and speed controller **66** can be adjusted while container **106** is rotating, it is possible to adjust or "tune" the degree of agitation in accordance with observation of the motion of the article.

The weight of container **106** and the contents A thereof is ordinarily sufficient to maintain a portion of rim **111** in contact with layer **27** on plate **26** and to assure adequate friction therebetween. Additional force can be produced, however, by a compression spring **130**. The lower end of compression spring **130** is fixed to plate **76** by a connection **132**. The upper end of the spring is secured at **134** to a lever arm **136** which is clamped around pivot shaft **94** by a clamping screw **138**. The force of spring **130** biases pivot shaft **94** in a counter clockwise direction as viewed in FIG. **4** so as to resiliently urge a region of rim **111** into contact with layer **27** on plate **26**.

FIG. **7** shows a modification of the flexible torque transmission according to the present invention. The individual parts of FIG. **8** are substantially identical to those described in connection with FIGS. **4** and **5**, the principal difference being that bearing housings **86** and **88** are installed so that pivot shafts **94** and **70** are parallel to one another. In order to maintain container **106** in a tilted position so that only a limited peripheral region of rim **111** is in contact with the surface of layer **27** on plate **26**, there is a rigid arm **122** secured to the

lower end of shaft **100** and extending outward from the central axis thereof. At the outer end of arm **122** is an interiorly threaded bushing **124** in which is threadedly engaged a bolt **126.** The lower end of bolt **126,** indicated at **128,** bears against the upper surface of plate **76** to limit the angular movement of shaft **100** on pivot shaft **90** so as to maintain container **106** in the requisite tilted position.

The operation of the embodiment of the invention of FIG. **8** is substantially identical to that described hereinabove in that actuation of motor **64** effects rotation of shaft **48** and body **74.** Body **74** tilts so that a limited peripheral region of rim **111** of container **106** contacts the upper surface of plate **26.** Further downward movement of the container is inhibited when bearing surface **128** of screw **126** contacts the upper surface of plate **76.** Container **106** is thus rolled around the surface of plate **26** in an orbital path, the nature of the path being controllable by the vertical adjustment of plate **26** and by the degree of eccentricity of collar **68** along pivot shaft **70.**

Although the invention has been described hereinabove in connection with a surface finishing machine, it is to be understood that the invention is useful for agitating virtually any type article. For example, a clamping mechanism for a paint can can be installed on bearing assembly **104** so that the paint can be readily mixed by use of the invention. Additionally, the invention may be employed in gravity separation process such as separating relatively dense gold from relatively light weight sand. These examples are not exhaustive of the nature of articles that can be agitated according to the present invention.

Thus it will be seen that the present invention provides an agitating machine which subjects the article to agitation in several directions or motions. This is achieved by a structure that is relatively simple and that can be adjusted over a wide range of degrees of agitation so that optimum results can be achieved.

Although two embodiments of the invention have been shown and described, it will be obvious that other adaptations and modifications can be made without departing from the true spirit and scope of the invention.

What is claimed is:

1. A machine for agitating an article comprising means defining a generally horizontal substantially planar non-rotatable surface, said surface defining means having an opening therein, flexible torque transmission means extending through said opening, an article supporting platform and means for attaching said platform to said torque transmission means above said surface, said attaching means including means for affording rotation of said platform relative said torque transmission means, said platform having a generally circular rim generally concentric with said rotation affording means, said flexible torque transmission means flexing to permit a peripheral region of said circular rim to bear on said surface, means below said surface for driving said torque transmission means so that said peripheral region of said circular rim describes a closed path on said surface around said opening, and means for securing the article to said platform.

2. A machine according to claim **1** including means for adjustably raising and lowering said surface defining means relative to said torque transmission means so as to vary the configuration of said closed path.

3. A machine according to claim **1** wherein said torque transmission means comprises a rigid body, upper and lower pivot shafts journalled in said body at spaced apart locations thereon, means for operatively connecting said driving means to said lower shaft so that said body is rotated by said driving means, and means for operatively connecting said rotation affording means to said upper shaft.

4. A machine according to claim **3** wherein said upper and lower shafts reside in respective upper and lower spaced apart planes.

5. A machine according to claim **4** wherein said upper and lower shafts are disposed so that their respective longitudinal axes are substantially perpendicular to one another.

6. A machine according to claim **4** wherein said upper and lower shafts are disposed so that their respective longitudinal axes are substantially parallel to one another.

7. A machine according to claim **3** wherein the axis of said lower pivot shaft is offset from the axis of said upper shaft so that said path is eccentric of said surface opening.

8. A machine according to claim **7** including means for adjusting the position of said lower shaft connecting means along the lower pivot shaft so as to afford adjustment of the degree of eccentricity of said path relative said opening.

9. A machine according to claim **3** including means for rotatively resiliently biasing said upper pivot shaft relative said rigid body to resiliently urge said peripheral region of said circular member into contact with said surface.

10. A machine according to claim **1** wherein said article securing means includes a rigid impervious container, said container having an access opening for affording introduction of parts and surface finishing material into said container.

11. A machine according to claim **10** in combination with a closure member for said opening and means for removably securing said closure member in sealing relation to said opening.

12. A machine according to claim **1** wherein said torque transmission driving means includes means for adjusting the rotative speed of said driving means to afford adjustment of the force of agitation on the article.

13. A machine according to claim **1** wherein said horizontal surface forming means includes a resilient high friction layer laminated thereto.

* * * * *