United States Patent [19]

Ferrara

[11] **3,802,129**

[45] **Apr. 9, 1974**

[54] **UNIVERSAL FINISHER AND SEPARATOR**

[76] Inventor: **Achille K. Ferrara,** 1030 Kendall Trl., Addison, Ill. 60101

[22] Filed: **Jan. 3, 1972**

[21] Appl. No.: **214,660**

[52] **U.S. Cl.** **51/163**

[51] **Int. Cl.** **B24b 31/06**

[58] **Field of Search** ..... 51/163, 7; 241/175, 179; 259/72, DIG. 42

[56] **References Cited**

UNITED STATES PATENTS

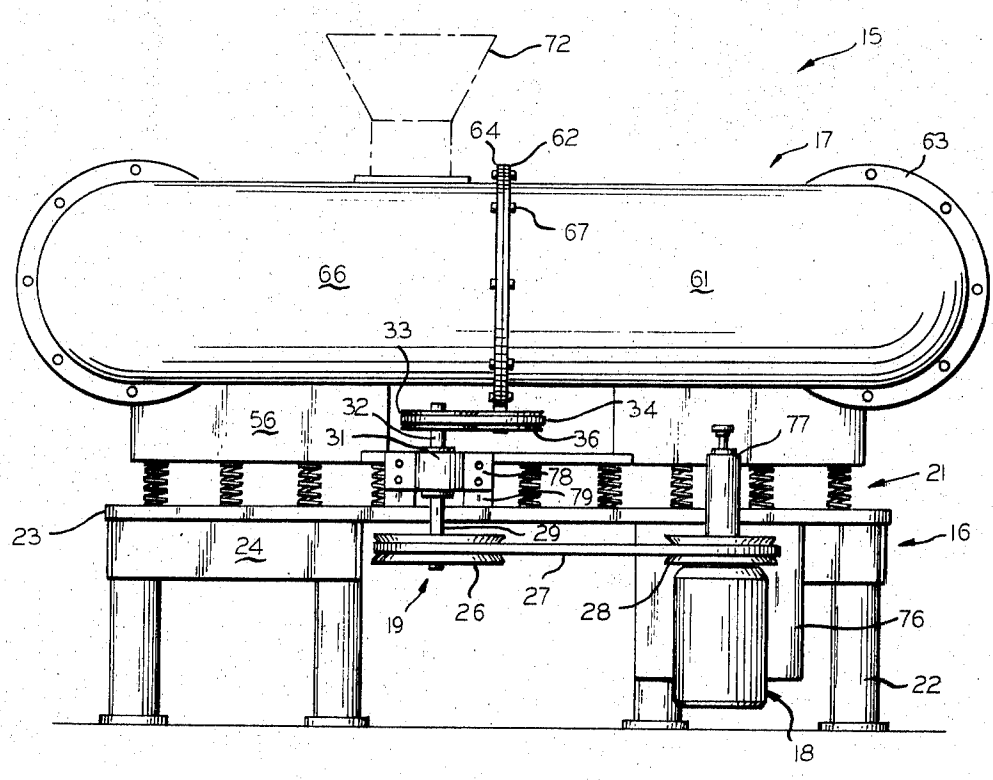
3,055,501	9/1962	Wood et al.	259/DIG. 42
3,100,088	8/1963	Podmore et al.	51/163 X
3,268,177	8/1966	McKibben	241/175
3,417,966	12/1968	Bodine	259/72
3,429,560	2/1969	Huber	51/163 X
3,465,974	8/1969	Eckert	259/72 X
3,514,907	6/1970	Strom	51/163
3,570,192	3/1971	Ferrara	241/175 X
3,606,702	9/1971	Balz	51/163
3,633,321	1/1972	Rise	51/163

Primary Examiner—Harold D. Whitehead
Assistant Examiner—Nicholas P. Godici
Attorney, Agent, or Firm—Alter, Weiss, Whitesel & Laff

[57] **ABSTRACT**

A vibrated toroid shaped enclosed chamber forces material therein to simultaneously progress spirally through the toroid and orbitally roll within the progressing spiral. The chamber is equipped to selectively deburr machined parts or to grind granular pieces. The vibrational mode of the finisher and grinder is readily varied because among other things, of the unique vibrator assembly and its location.

23 Claims, 13 Drawing Figures



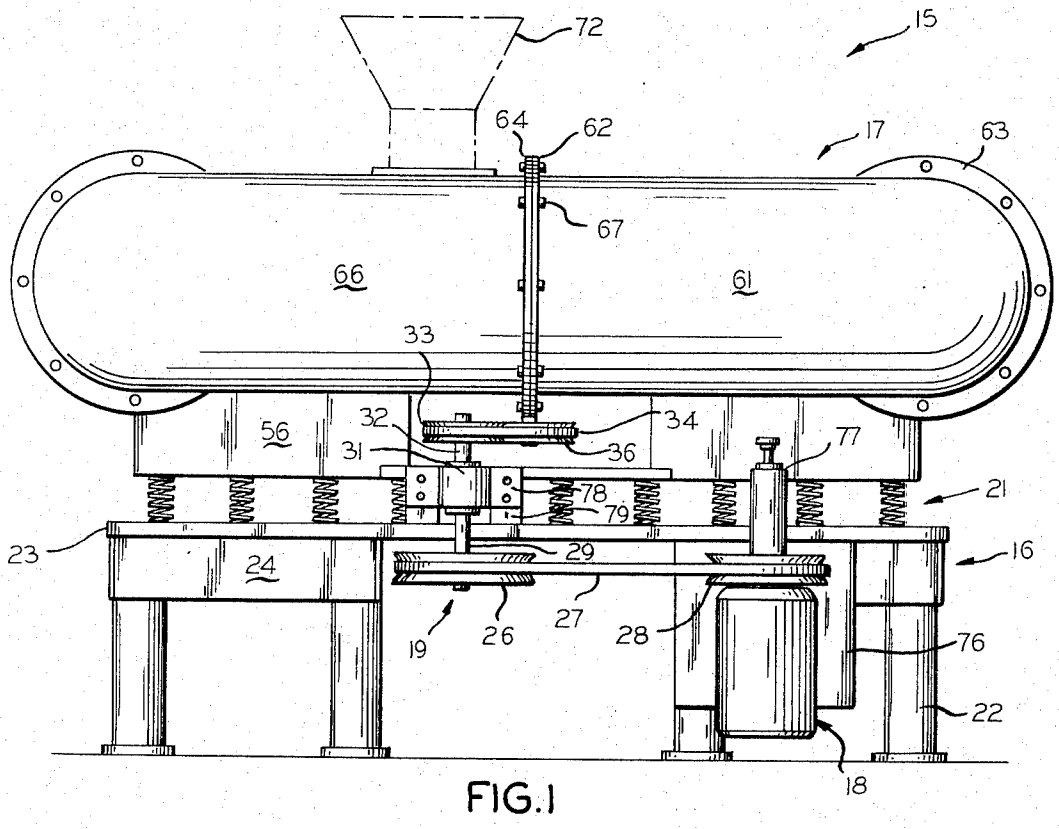

72
15
64
62
17
63
67
66
61
33
56
32
34
31
36
77
78
21
79
23
24
29
16
19
26
27
28
76
22
18

FIG.1

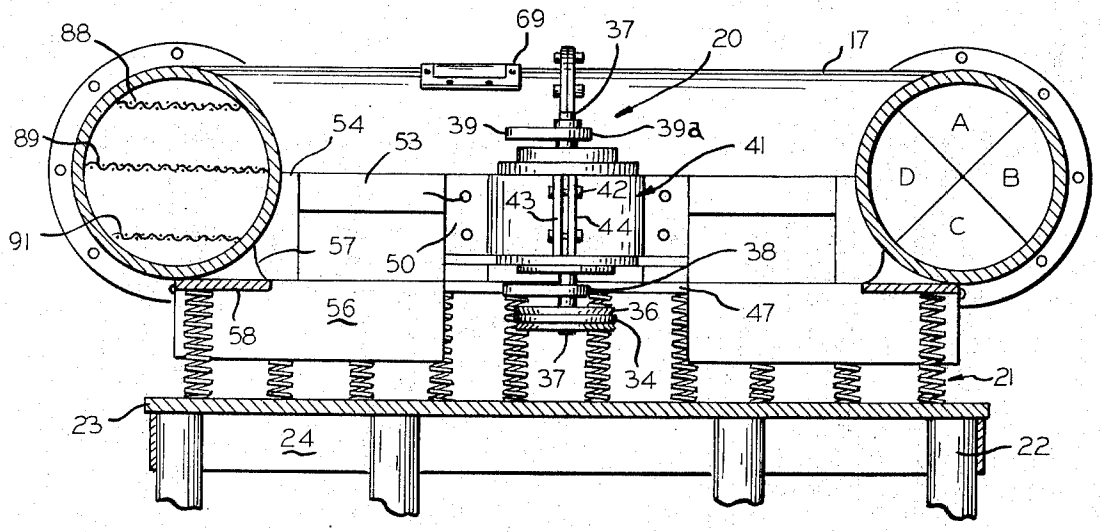

88
69
37
20
17
89
54
53
39
39a
41
A
D
B
C
43
42
44
91
57
50
38
56
58
36
47
37
34
21
23
24
22

FIG.2

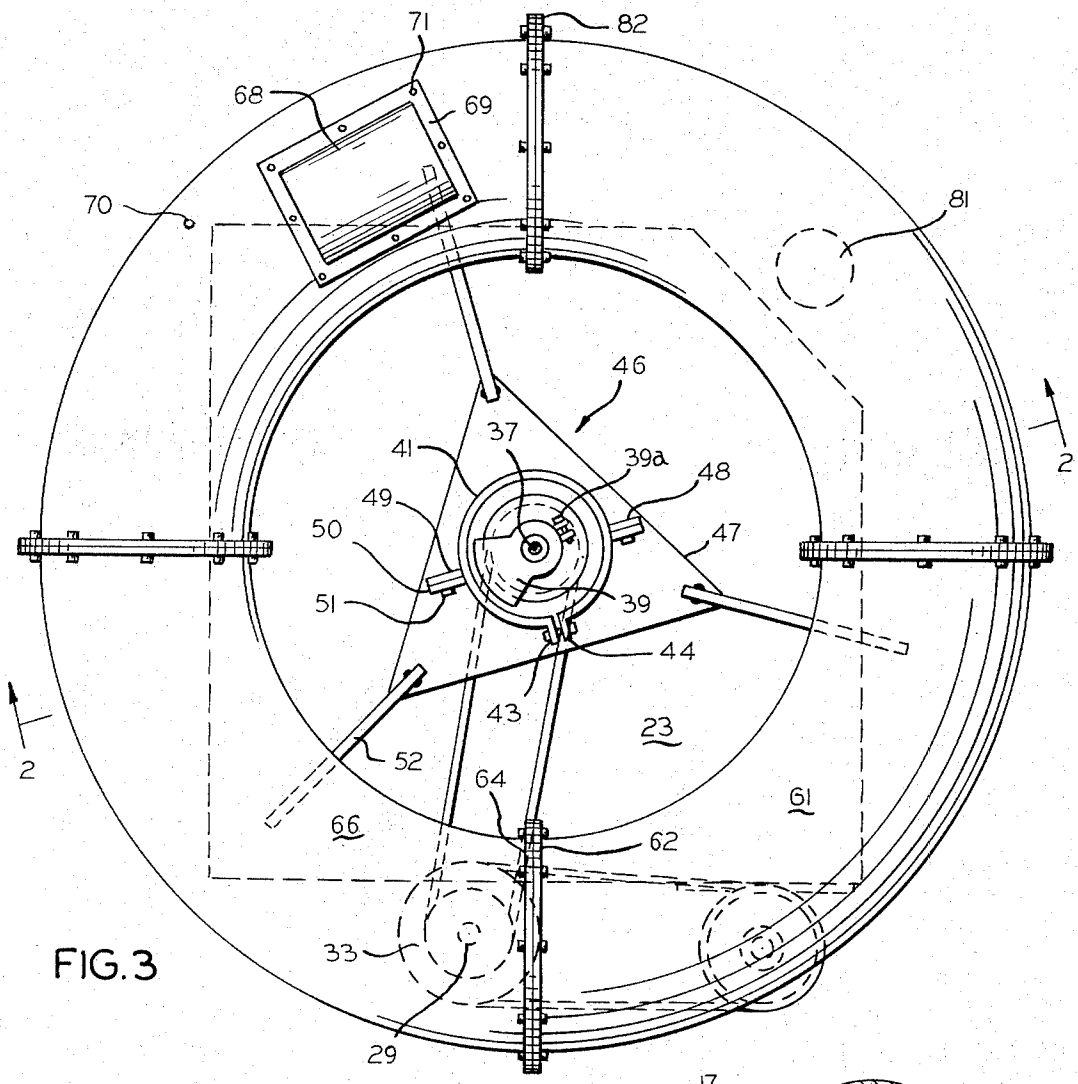


FIG. 3

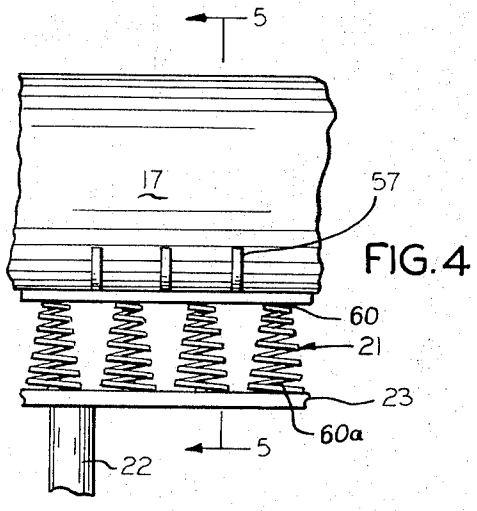


FIG. 4

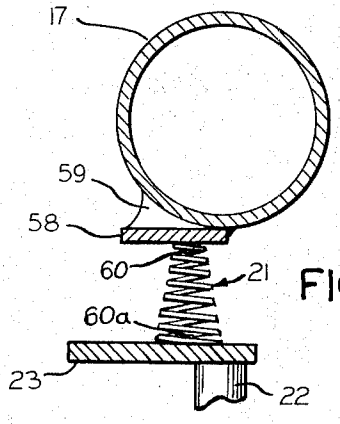


FIG. 5

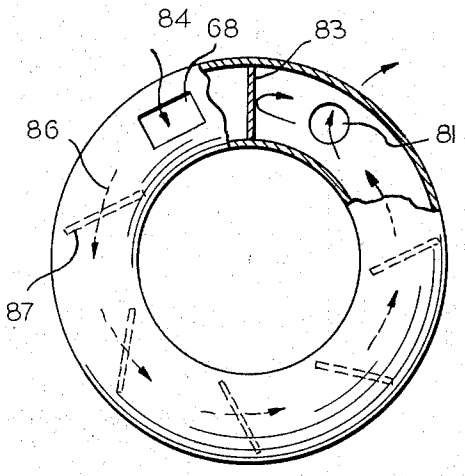


FIG.6

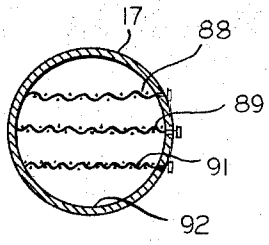


FIG.8

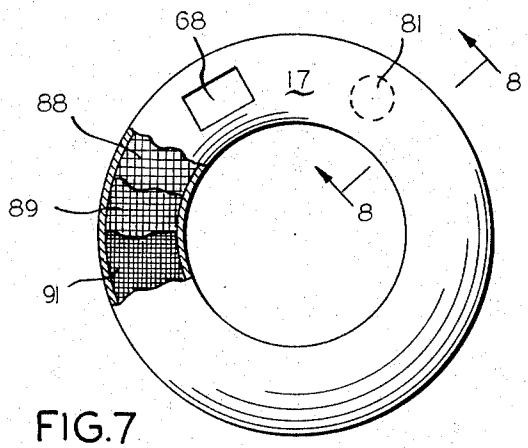


FIG.7

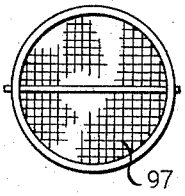


FIG.10

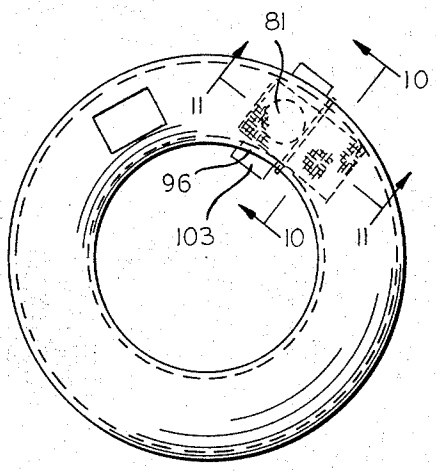


FIG.9

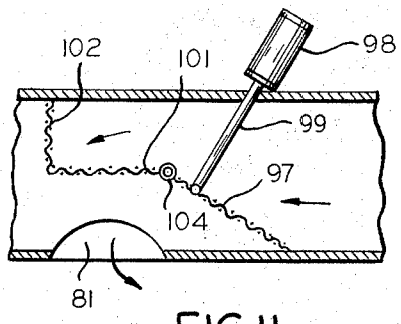


FIG.11

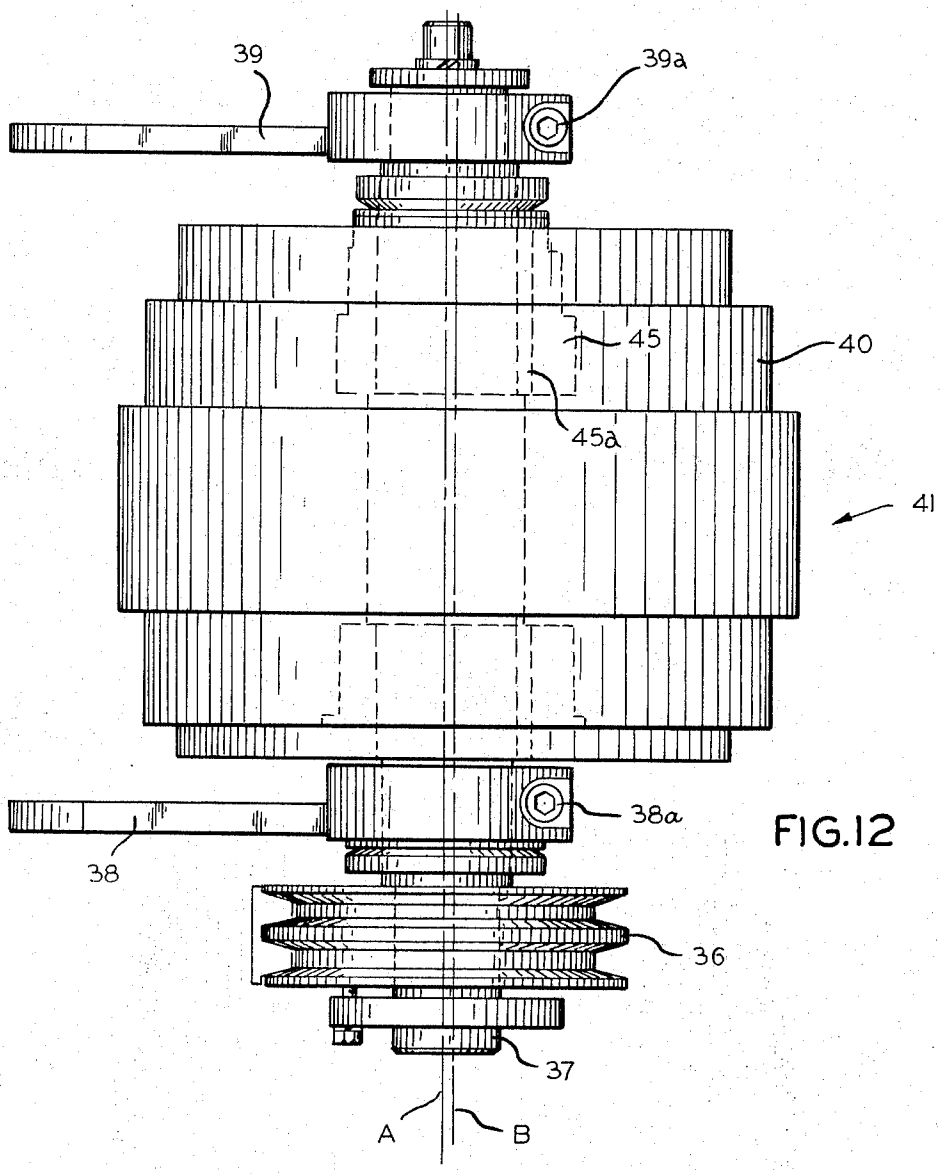


FIG.12

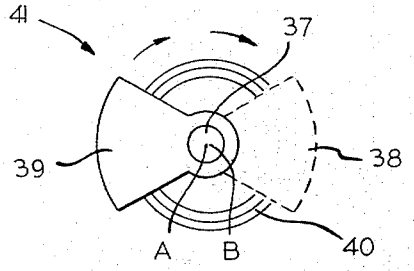


FIG.13

UNIVERSAL FINISHER AND SEPARATOR

This invention is related to process and finishing machinery and more particularly to such machinery utilizing vibratory methods.

Finishing equipment includes deburring equipment, grinders, blenders and separators. For a long time tumbling barrels were the major type of machinery used for deburring and grinding operations, and especially for the deburring operations. Later, it was discovered that vibrating abrading compartments more efficiently accomplished the deburring of many parts.

In the early equipment there were many areas of the vibrated abrading compartments that actually were not effected by the vibrations so that the media and the machined objects being finished were practically untouched by the vibrations while in those unvibrated areas and, consequently, were not properly finished. Thus, there has been a constant search for vibratory finishing equipment that uses all of the abrading compartment. There is available improved deburring equipment wherein the effective cross sectional area comprises at least three-fourths of the area. Even with such an improved compartment it was found possible to further increase the "effective" cross sectional area of the abrading compartment.

In addition, there has been a constant search for more efficient methods of effecting the vibration and of varying the vibrational modes. For example, originally the vibrator and motor were mounted on the same shaft. This was found to be deleterious to the life of the motor since the constant vibration of the motor adversely affected the life of the motor and its bearings. It was discovered that moving the motor away from the vibrator and coupling the motor to the vibrator unit with means such as belts or other shock insulation couplings increased the life of the motor and thereby added to the reliability of the vibrating finishing equipment.

In the past, the vibrational finishing equipment supplied to commercially interested users has been extremely specialized. Thus, the vibrating equipment was either for mixing, for deburring or for grinding. The modes of vibration have been fixed to the extent that a combination of these uses could not be effected by one single unit. Accordingly, an object of this invention is to provide new and more universal vibrating machinery.

A related object of this invention is to provide deburring equipment that effectively causes the media to deburr the piece parts in all portions of the abrading compartment.

Another object of the invention is to provide enclosed vibrational deburring equipment that practically eliminates nodal points in which the piece parts are "becalmed." Thus, the vibrating machine eliminates the undesirable scouring marks on the piece parts caused when the piece parts come into contact with each other; because irregular movement in the nodal points slow some of the piece parts enabling other of the piece parts to bump into and rub against the slowed piece parts.

Yet another object of this invention is to provide a universal vibrating machine that can be used for blending, grinding, deburring and separating, among other uses.

Still another object of this invention is to provide vibrating machines having an enclosed toroidally shaped abrading compartment for finishing piece parts and means therein for automatically separating them from the media after the finishing process has consumated.

Another object of the invention is to provide enclosed vibrational equipment enabling pressurization of the abrading compartment and the consequent utilization of lighter polishing agents.

Still another object of the invention is to provide vibrational deburring equipment that is much quieter in operation than presently available equipment.

In accordance with a preferred embodiment of this invention, the vibrating equipment comprises a torus shaped enclosed abrading compartment. Ingress of media and piece parts is accomplished through an aperture at the top portion of the toroidal abrading compartment. An aperture for removal of media is located at the bottom of the toroidal abrading compartment. A separate aperture is available for the automatic removal of the deburred piece parts.

The vibrator normally is centrally located along the axis of the toroidal unit and on the same plane therewith. Various means are simultaneously provided for altering the mode of vibration. For example, by moving the vibrator up and down along the axis of the toroid, the mode of vibration is altered. Similarly the vibrator assembly is equipped with a top and a bottom balance weight. The mode of vibration is varied by changing the relative positions of the top and the bottom balance weights. The motor which drives the vibrator is removed from the vibrator and coupled thereto with means such as a drive belt. The abrading unit "floats" on conically shaped springs which supplement and reinforce the vibrating motion provided by the vibrator.

Means are provided for grinding and grading material. More particularly, screen sections are horizontally positioned within the toroidal unit for grinding and grading material within the toroidal unit. The horizontal screen sections are placed therein with the screen having the least fine perforations at the top and the finest perforations at the bottom unit. The grinding media is larger than either the screen above and below. In addition the compartments are of a size such that in effect the screen above each compartment acts as a pressure plate to expedite the grinding process.

Means are provided for removing screens and the separated particles thereon from the toroid. Thus a variety of different sizes can be ground and graded from a mass of granular material.

A plurality of ribs are located at the bottom interior of the toroidal unit. The ribs cause gross mixing of the material or media within the toroidal unit when it is utilized for mixing.

The enclosed toroidal unit adds to the abrading process by causing the media to operate effectively in all quadrants including the quarter quadrant at the top of the toroidal unit. For example, if the toroidal unit is divided into quarter quadrants defined by biased lines 45° to the horizontal, then the topmost quadrant of the presently available abrading units does not effectively participate in the deburring operation, since any piece parts and media that are in that quadrant are too loosely packed for abrading purposes.

The enclosed toroidal unit keeps each piece part moving during the deburring process. Thus, scouring marks are eliminated since the piece parts do not come into contact with each other.

Other objects and features of this invention will now be explained with reference to the accompanying drawings, wherein:

FIG. 1 is a front elevational view of the universal grinder, finisher and separator;

FIG. 2 is a sectional view taken on a plane through line 2—2 and looking in the direction of the arrows 2, 2 of FIG. 3;

FIG. 3 is a top plan view of the universal blender, finisher and separator;

FIG. 4 is a front view of a portion of the universal blender, finisher and separator, particularly showing the mounting of the toroidal abrading compartment.

FIG. 5 is a view taken at a plane through the line 5—5 in FIG. 4 and looking in the direction of arrows 5,5;

FIG. 6 is a partial sectional plan view showing the direction of travel of the media in the toroidal abrading section when the abrading section is actuated by the vibrator;

FIG. 7 is a partial sectional plan view showing classification screens mounted in the interior of the toroid;

FIG. 8 is a sectional view taken on a plane going through the line 8—8 of FIG. 7 and looking in the direction of arrows 8, 8;

FIG. 9 is a top plan view of a toroidal abrading section showing the exit aperture at the bottom interior of the toroid and in particular the screen and baffling used to selectively direct the piece parts or media through the aperture;

FIG. 10 is a section view taken in the direction of the arrows 10, 10 of FIG. 9;

FIG. 11 is a sectional view showing the screening and baffling used for selectively directing the media or finished piece parts through the exit aperture at the bottom of the toroidal unit looking in the direction of arrows 11, 11 in FIG. 9;

FIG. 12 is a vertical view of the vibrator unit showing the eccentric weights mounted to the shaft internally and externally; and

FIG. 13 is a schematic top view showing various relative positions of the top and bottom weights of the vibrator assembly.

Turning to the drawings, it is noted that the universal grinder, grader, finisher and separator 15 comprises a base table assembly 16 supporting thereon a toroidally shaped enclosed abrading unit 17. Also shown are a drive motor assembly 18, coupled to a vibrator coupling assembly 19.

In FIG. 2 the abrading unit 17 is shown as having an enclosed hollow interior in which media and/or piece parts requiring finishing are placed.

The base table assembly 16 comprises support means such as legs 22 for supporting a horizontal table surface 23. A bracing skirt 24 surrounds most of the table and acts to brace the connection of the legs 22 to the horizontal surface 23. In one section the skirt is removed to leave room for a pulley unit making up the portion of the vibrator coupling assembly 19. The coupling assembly includes a pulley wheel 26 driven by belt 27 attached to motor pulley 28. The pulley wheel 26 is coupled to shaft 29 leading to bearing 31. The output shaft 32 of the bearing 31 drives attached pulley wheel 33. Pulley wheel 33 is belt-coupled through belt 34 to driven wheel 36 of the vibrator itself. The vibrator pulley is directly coupled to vibrator shaft 37.

Means for retaining the vibrator such as a vibrator unit 41 is shown in the form of an arcuate circumferential clamp member joined together at one end with fasteners such as bolt 42 attached through flanged plates 43 and 44. The clamp member is easily manipulated to enable moving the vibrator unit up or down as one means for varying the mode of the vibration.

The vibrator 41 comprises the shaft 37 which passes through the bearing mount 40. The shaft is coupled to cylindrical internal weights, such as weight 45 using means such as a key 45a. The weights are eccentric so that there is a greater mass on one side of the shaft. As shown particularly FIG. 12, the internal weight on the right side is larger than that of the left side and the right side is also closer to the center line "B" of the bearing. The center line of the shaft A and of the bearing B are nonconcentric. External balancing eccentric weights 38 and 39 are shown attached to the bottom and the top of the vibrator unit. The mode of vibration is also modified by changing the positions of the external weights relative to each other and to the internal weights as shown in FIG. 13. The position of these weights are varied by loosening the fastener which clamps the weight to the shaft, such as fasteners 38A and 39A.

The vibrator unit 41 is mounted to horizontal vibrator support unit 46. The support unit 46 comprises a horizontal plate 47 having attached thereto vertical attaching plates 48 and 49 to which unit 41 is removably attached using fasteners such as bolt 51.

Attached to plate 47 by any well-known means such as by welding are vertical support units such as vertical support unit 52. The support unit comprises an upper horizontal plate 53 which extends to a vertical plate 54 juxtaposed to the toroidal unit. A lower plate 56 also extends from plate 47 to the bottom of toroidal unit 17 and is there attached by welding or the like.

The entire toroidal unit 17 is supported by a series of coil springs 21 which resiliently hold the toroidal unit above the table surface 23. The springs act to supplement the vibratory action of the vibrator unit. In a preferred embodiment conical coil springs are used as shown in FIGS. 4 and 5 of the drawings. These springs provide a simultaneous "whipping" action in both the horizontal and vertical planes to reinforce the vibratory motion. Thus the springs aid in reducing the horsepower requirements, lowering the noise level and in eliminating nodal points in the media travel; i.e., increasing the uniformity of the spiral and rotating motion of the media.

The mounting of the coil springs to the toroidal unit is best seen in FIG. 4 and FIG. 5. As shown therein a spring brace unit 57 is attached to the bottom of the abrading unit 17. The brace supports comprise a horizontal bottom plate 58 having a series of vertical plates such as plate 59 attached thereto. The top of the vertical plate is arcuately shaped to match the external bottom portion of the toroidal section 17. The attachment is made by welding or the like. To bottom plate 58 there is attached a series of top nipples, such as nipple 60. Each top nipple is aligned with a bottom nipple such as nipple 60a on the table surface 23. The two nipples retain the springs 21 in position and keep them from being jarred out from between the toroidal unit 17

and the table top **23.** Thus, the toroidal unit **17** "floats" on the springs **21.**

In a preferred embodiment, the toroidal unit is made from a plurality of separate arcuate sections which are held together at the flanged ends of the sections. More particularly, a section representing a quadrant of the toroidal unit such as section **61** terminates in flanges **62** and **63.** Thus, the flange **62** attaches to the flange **64** of an adjacent toroidal section **66,** and are held together with fasteners such as bolt **67.** Of course, sealing means such as O-rings or gaskets are used between the flanges to prevent leakage through the flange connections.

Means are provided for inserting media and/or piece parts into the enclosed toroidal abrading unit. More particularly, an opening is provided at **68** on the upper side of the enclosed toroidal unit. The opening is closed during the working processes by a cover **69** which overlaps the aperture. The cover is attached by fasteners such as fastener **71** or any other well-known means. A chute such as chute **72** may also be provided to enhance the loading of toroidal unit.

Means such as air inlet valve **70** are provided for pressurizing the compartment as desired. The valve **70** is the readily available type, such as are used on pneumatic tires.

Means are provided for varying the rate of vibration of the vibrator unit. More particularly, the motor assembly **18** is connected to table **16** through support plate **76** in any well-known manner. A variable speed adjustment **77** is provided. This can be any well-known speed adjustment either for varying the actual speed of the motor or for varying the size of pulley **28.**

The means for attaching the motor to the actual vibrator is through the pulley arrangement **19** which has been previously described. The pulley arrangement **19** is attached to the table through a means such as flanged arcuate member **78** attached to upstanding standards such as standard **79** on the table top **23,** best seen in FIG. **1.**

Means are provided for emptying the toroidal abrading unit. More particularly, an exit aperture **81** is provided at the lower portion of the toroidal abrading unit. The exit aperture **81** is shown removed by at least 300° from the aperture **68** used for loading.

Ideally an impervious bulkhead or partition is placed between aperture **68** and aperture **81.** For example, in a preferred embodiment the partition is placed at flange **82** and is best shown in FIG. **6** as partition **83.** This assures that the media and piece parts are driven the long way around from the loading aperture to the unloading aperture. During vibrations the longitudinal travel of the media and piece parts is shown by arrows in FIG. **6,** such as arrows **84, 85** and **86.** Arrow **84** indicates media being loaded through aperture **68** into the toroid. Once in the toroid and during the operation of the vibrator, the media along with the piece parts is forced in the direction of the arrows such as arrow **86.**

Means such as rib **87** may be provided to induce blending or gross mixing during the travel of the media from aperture **68** to aperture **81.** The ribs are particularly useful when the device is used for blending different particles together into a single homogeneous mass.

Means are provided for grinding and/or separating different sized media in the toroidal unit. More particularly, as best seen in FIG. **8,** a portion of the interior of the toroidal unit is equipped to receive horizontally placed screens. Grinding media is located on top of each of the screens when they are used for grinding. The topmost screen such as screen **88** of FIGS. **7** and **8** has the largest perforations therein. Thus, only the larger dimensioned material is trapped by the topmost screen. Screen **89,** the next screen, is sized with perforations that are smaller than the perforations of screen **88.** Finally, the perforations of the bottom screen **91** are the smallest. The grinding media used in the compartment defined by screens **88** and **91** are larger than the perforations of even screen **88.**

When the screens are used for grading the large particles are trapped on the screen **88,** the medium sized particles on screen **89,** the small sized particles on screen **91,** and the smallest sized particles fall to the bottom **92** of toroidal unit **17.**

The screens are located so that material fed into aperture **68** falls onto the top screen. When used for grinding, the grinding media is actuated by the vibratory motion to grind up the large size material until it falls through the topmost screen. Then the grinding action occurs between the first and the second screen. Sufficient media is used so that the top screen acts as a pressure plate to expedite the grinding process.

The process continues until the material has been ground to the desired size. The final size is thus readily controlled by the number of screens used and the size of the perforations in the screens. While three screens are shown, it should be understood that fewer or more screens may be used.

Means are provided for removing the finished piece parts from the toroidal abrading unit, more particularly as shown in FIGS. **9, 10** and **11.** A combination of screens is used to separate the piece parts from the finishing media. The opening for the removal of the piece parts may be provided in the inner wall of the toroidal abrading chamber at **96.** A biased screen **97** is provided which can be changed from a lowered position to an elevated position by cylinder **98.** The cylinder **98** either may be manually, pneumatically or hydraulically operated to cause shaft or piston **99** to raise or lower the screen **97.** The screen **97** is sized so that the media used for finishing falls through, but the piece parts remain thereon. The piece parts on screen **97** are moved by the vibrational forces up to the horizontal screen **101.** They are stopped on screen **101** by the vertical screen **102.** As the vibrations continue, the piece parts are forced towards the side opening **96** and from there down chute **103** to a container (not shown) used to capture the finished piece parts. Screen **97** is lifted either manually through the use of cylinder **98** when it is desired to remove the media from the compartment through aperture **81.** Aperture **81** is also used to remove the ground material. Screen **97** pivots around point **104** when it is lifted and lowered.

Thus, it is seen that the universal finishing apparatus described herein can be used with equal facility for finishing piece parts as described, grinding material to a desired particle size, blending different sized medias to get a homogeneous mixture, and sizing particles obtained from the mixtures of varied sized particles.

For piece parts being finished, both piece parts and media are loaded into the loading aperture. Thw vibrator is operated so that the parts along with the media progress through the toroidal abrading compartment and also orbit in each of the cross-sectional quadrants

A, B, C and D shown in FIG. 2. With the shape of the toroidal compartment it has been found that orbiting and thus deburring occurs to a much greater degree in compartment D than as heretofore been possible with the deburring equipment presently available.

The toroidal abrading unit mounted on the springs as described herein with the vibrational unit centrally located as shown herein causes the media and accompanying piece parts to continuously move in combined rotating, spiral motion with practically no nodal points. Thus, less power is required and a more efficient, less noisy deburring operation is accomplished.

The mode of operation of the vibrator can be changed by varying the frequency of the vibration through the use of the speed adjuster 77 on motor 18, by varying the vertical position of the vibrator, and by changing the relative positions of the top and bottom balancing weights of the vibrator assembly. Thus, for example if the external weights are aligned, then the media is forced through a long spiral, when they are 180° out of phase, the media goes through a short spiral.

While the foregoing speaks of a preferred embodiment of the invention, it will be understood that other modifications will readily occur to those who are skilled in the art. Therefore, the appending claims are to be construed broadly enough to cover all equivalents falling within the scope and spirit of the invention.

I claim:

1. A universal finishing and separating machine, the combination comprising enclosed abrading compartment means, said abrading compartment means being a torus shaped compartment with a continuously curved surface,
- aperture means for loading and unloading material requiring finishing and media for acting on the material to be finished into and out of said compartment,
- vibrator means for vibrating said compartment to effect the finishing of said material, and
- means including said abrading compartment and said vibrator means for causing said material to continually move during the vibrating process.

2. The combination of claim 1 wherein said vibrator means is located along the central axis of said toroidally shaped compartment with arcuate top and bottom sections and substantially in the plane of the compartment.

3. The universal finishing and separating machine of claim 2 wherein said abrading compartment is mounted on resilient means that comprise conically shaped helical springs.

4. The universal finishing and separating machine of claim 2 including mounting means for supporting the vibrator means, said mounting means comprising enabling means for moving said vibrator means along said central axis to vary the mode of vibration.

5. The universal finishing and separating machine of claim 4 wherein said enabling means comprises an arcuate circumferential clamp member, said clamp member terminating in aligned spaced apart flange plates, and screw means for adjusting the distance between said flange plates to thereby enable moving said vibrating means within said circumferential clamp member.

6. The universal finishing and separating machine of claim 2 wherein said vibrator means comprises a shaft, internal eccentric weights surrounding said shaft, a bottom balance weight surrounding said shaft and a top balance weight surrounding said shaft, and means for moving said balance weights relative to said internal eccentric weights and relative to each other for thereby further varying the mode of vibration.

7. The universal finishing and separating machine of claim 6 wherein means are provided for varying the speed of rotation of the vibrator means and thereby vary the frequency of vibration and thus further vary the mode of vibration.

8. The universal finishing and separating machine of claim 1 wherein horizontal screens are provided, said screens mounted in said compartment in vertical layers, the topmost screen having the largest apertures therein and the bottommost screen having the smallest apertures therein whereby material loaded onto the topmost screen in said compartment is graded when the smallest of the material falls to the bottom and the largest held in the topmost screen.

9. The universal finishing and separating machine of claim 8, wherein media is provided on each of said screens for grinding material placed on said screens for grinding said material on each of the screens whereby said material is ground to a size determined by said bottommost screen.

10. The universal finishing and separating machine of claim 9 wherein the media between the screens is larger than the apertures of the upper and lower screens and wherein there is sufficient media between the screens whereby the upper screen acts as a pressure plate to expedite the grinding process.

11. A universal finishing and separating machine,
- the combination comprising an enclosed torus shaped compartment with a continuously curved surface,
- said compartment being mounted on resilient members to enhance vibrations,
- aperture means for loading and unloading material requiring finishing and media for acting on material to be finished into said compartment,
- vibrating means for vibrating said compartment to effect the finishing of said material,
- said vibrating means being substantially in the plane of said compartment,
- motor means for driving said vibrator means,
- said motor means and said vibrator means being nonconcentric, and
- said compartment shaped to surround said vibrating means so that said vibrating means is centrally located relative to said compartment but is accessible without opening said compartment.

12. The universal finishing and separating machine of claim 11 wherein mounting means are provided for supporting said vibrating means and wherein said mounting means enables moving said vibrator means along a vertical axis to vary the mode of vibration.

13. The universal finishing and separating machine of claim 12 wherein said mounting means comprises an arcuate circumferential clamp member surrounding said vibrating means, said clamp member terminating in aligned spaced apart flanged plates, means for adjusting the distance between the flanged plates to thereby enable moving said vibrating means vertically along said vertical axis.

14. The universal finishing and separating machine of claim 13 wherein said vibrating means comprises shaft

means, internal eccentric weights surrounding said shaft means, a top and a bottom balance weight surrounding said shaft means, means for moving the balance weights relative to each other and relative to said internal eccentric weights to further vary the mode of vibration.

15. The universal finishing and separating machine of claim **14** wherein means are provided for coupling said shaft to a drive motor, and means for changing the speed of said drive motor to vary the frequency of vibration and thereby further vary the mode of vibration.

16. The universal finishing and separating machine of claim **15** wherein solid means are provided for coupling said vibrator means to said enclosed compartment.

17. The universal finishing and separating machine of claim **16** wherein said aperture means comprises a lower egress aperture for removing said media and a side aperture for removing the finished material.

18. The universal finishing and separating machine of claim **17** wherein means are provided for separating said finished material from said media.

19. The universal finishing and separating machine of claim **18** wherein said aperture means comprises ingress means and egress means and wherein bulkhead means are provided for separating said ingress means from said egress means.

20. A universal finishing and separating machine,

the combination comprising an enclosed toroidally shaped compartment having an arcuate top and bottom,

said compartment being mounted on resilient members to enhance vibrations,

aperture means for loading and unloading material requiring finishing and media for acting on material to be finished into said compartment,

vibrating means for vibrating said compartment to effect the finishing of said material,

said vibrating means being substantially in the plane of said compartment,

motor means for driving said vibrator means and being non-concentric therewith,

said compartment shaped to surround said vibrating means so that said vibrating means is centrally located relative to said compartment but is accessible without opening said compartment,

said enclosed compartment resting on a plurality of conically shaped springs which acts to reinforce and support the vibrations of said vibrating means,

mounting means enabling the movement of said vibrator means along the vertical axis to vary the mode of vibration,

said mounting means comprising an arcuate circumfrential clamp member surrounding said vibrating means,

said clamp member terminating in aligned spaced apart flanged plates,

means for adjusting the distance between the flanged plates to thereby enable moving said vibrating means vertically along said vertical axis,

said vibrator means comprising shaft means,

internal eccentric weights surrounding said shaft means,

a top and a bottom balance weight surrounding said shaft means,

means for moving the balance weights relative to each other and relative to said internal eccentric weights to further vary the mode of vibration,

means for coupling said shaft to a drive motor,

means for changing the speed of said drive motor to vary the frequency of vibration and thereby further vary the mode of vibration,

means for coupling said vibrator means to said closed compartment,

said aperture means comprising a lower egress aperture for removing said media and a side aperture for removing the finished material,

means for separating said finished material from said media,

said aperture means comprising ingress means and egress means, bulkhead means for separating said ingress means from said egress means, said means for separating said media and said finished material comprises screen means,

said screen means comprising a bias screen, a horizontal screen, a vertical screen defining an edge of said horizontal screen,

the mesh on said screens being sufficiently large to enable said media to drop therethrough but sufficiently small to entrap said finished material,

said bias screen providing a path for said finished material to ride to said horizontal screen, and

said horizontal screen leading to said side egress aperture and said vertical screen entrapping said finished material to ensure that the finished material is forced through said side egress aperture.

21. The universal finishing and separating machine of claim **20** wherein means are provided for raising said biased screen to cause said material to avoid said side aperture.

22. The universal finishing and separating machine of claim **21** wherein said means for raising said bias screen comprises hydraulic cylinder means, shaft means extending from said hydraulic cylinder and attached to said bias screens for moving said bias screen responsive to the action of said hydraulic cylinder.

23. The universal finishing and separating machine of claim **1** wherein means are provided for pressurizing said abrading compartment.

* * * * *