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Wagner

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(54) **MANUAL GRINDER FOR GRAIN FOOD PRODUCTS**

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PCT Pub. Date: **May 18, 2000**

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(52) **U.S. Cl.** **241/169.1**; 241/30
(58) **Field of Search** 241/30, 168, 169.1, 241/258, 259

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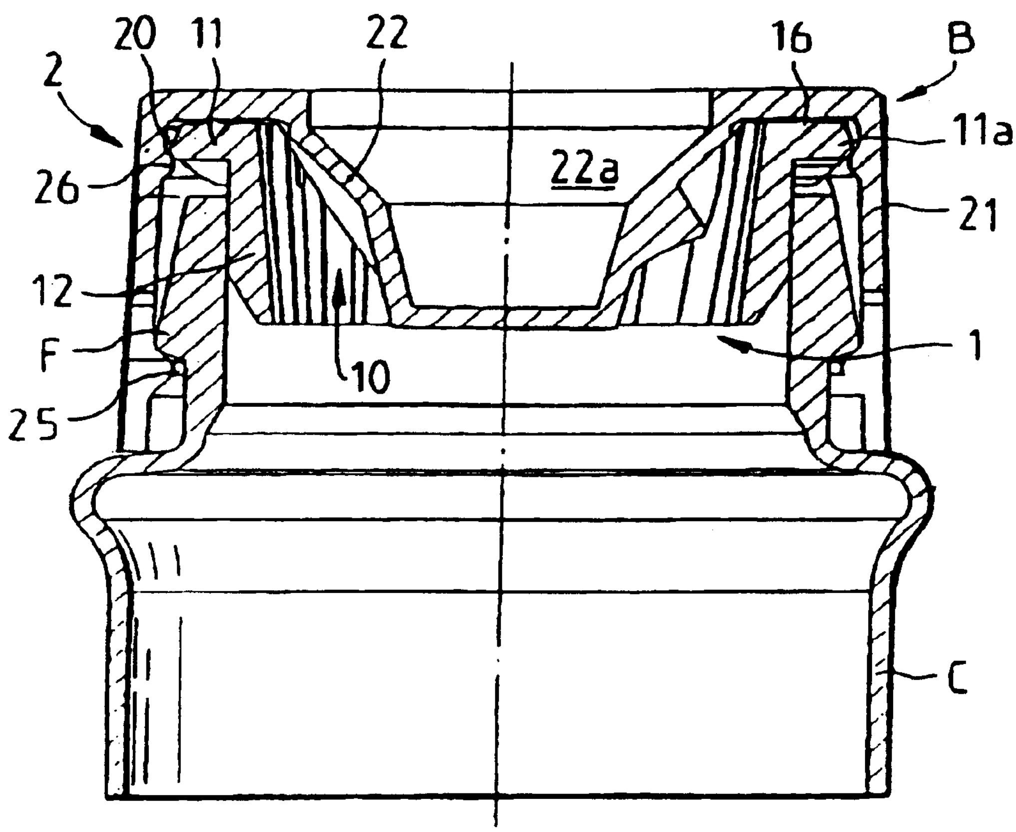
(57) **ABSTRACT**

The invention relates to a manual grinder for mounting on the neck (C) of a receptacle for foodstuffs in the form of grains, the grinder being characterized in that it comprises firstly a fixed ring (**1**) provided with a flange (**11**) for supporting it on the receptacle, which flange is downwardly extended by an inner sleeve (**12**) that is engaged in said neck (C) and that presents a toothed inner side wall (**12***a*), and secondly a cap (**2**) rotatably mounted on said neck (C) covering said ring (**1**) and including a peripheral skirt (**21**) radially connected to a central bushing (**22**) having a toothed outer side wall (**22***a*) that is engaged coaxially in said sleeve (**12**), so as to define between them a peripheral grinding zone (**10**).

11 Claims, 4 Drawing Sheets



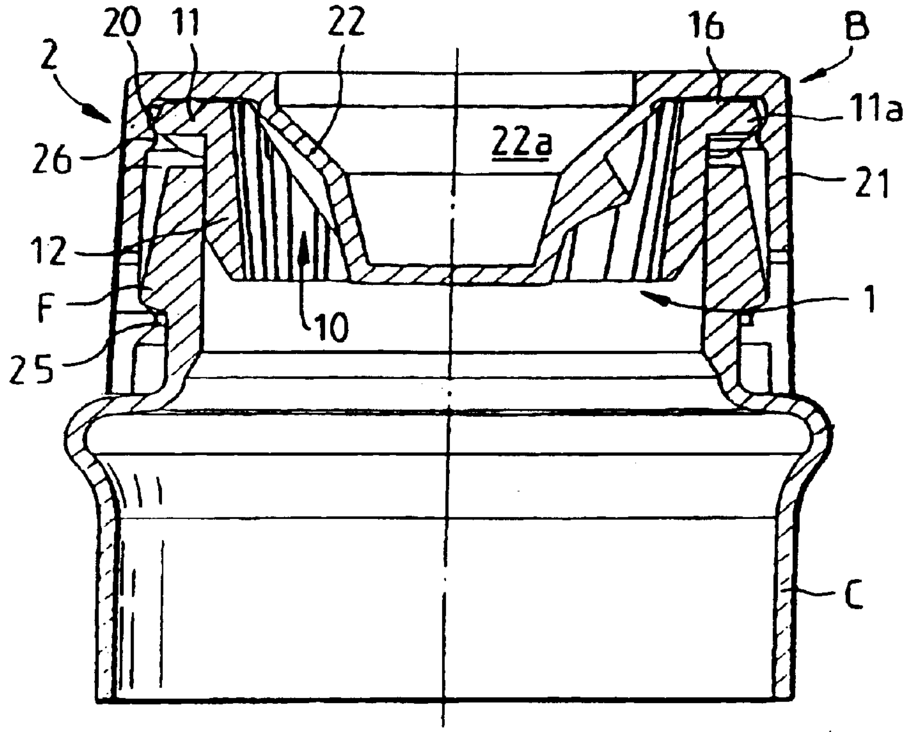

20
11
22
16
B
2
11a
22a
26
21
12
F
10
1
25
C

FIG.1

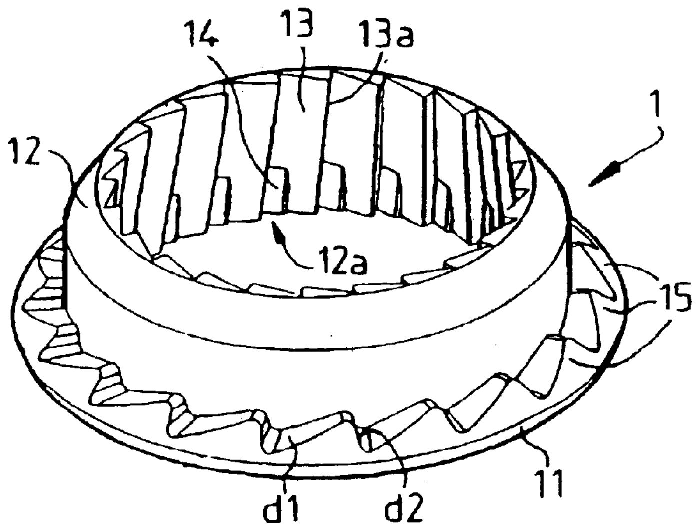

14
13
13a
1
12
12a
15
11
d1
d2

FIG.2A

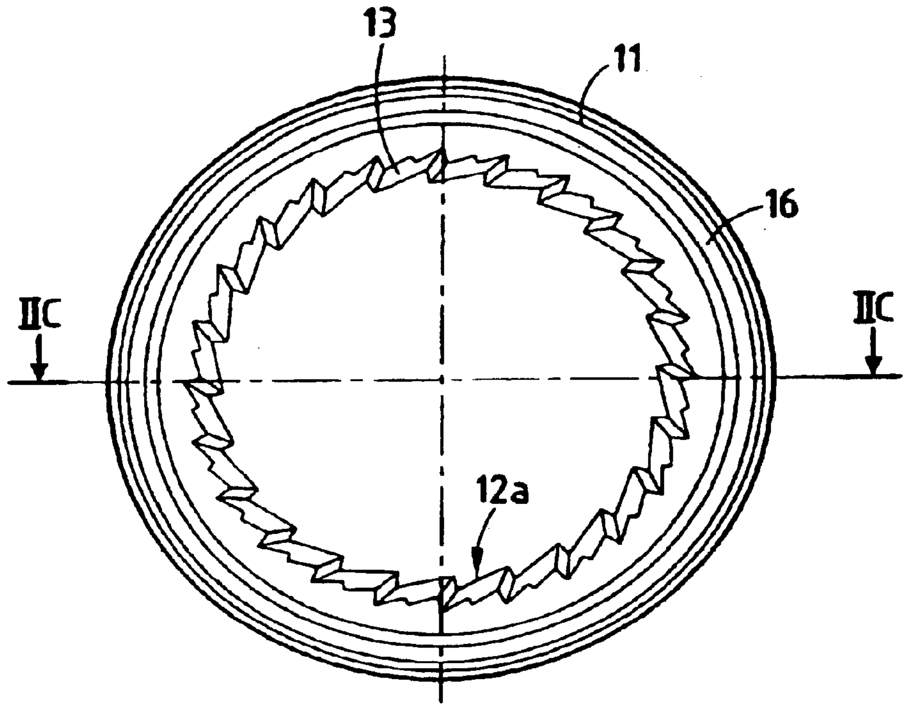


FIG.2B

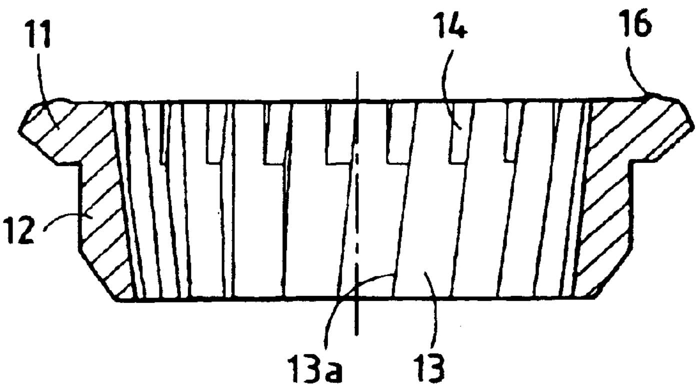


FIG.2C

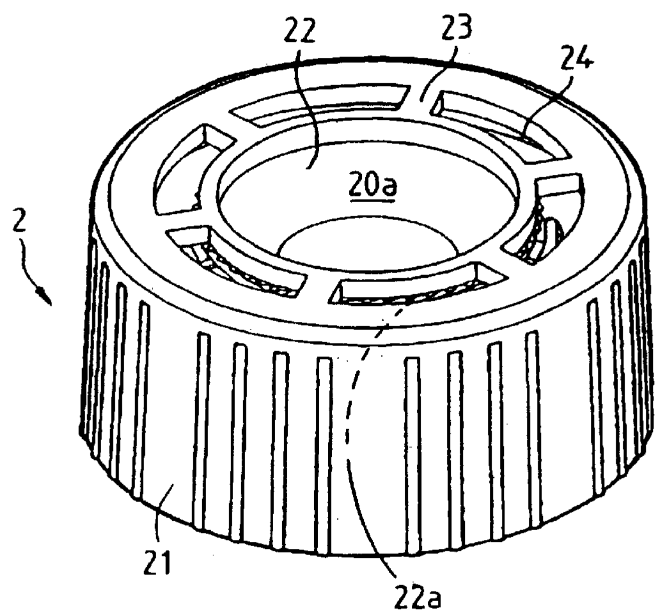


FIG.3A

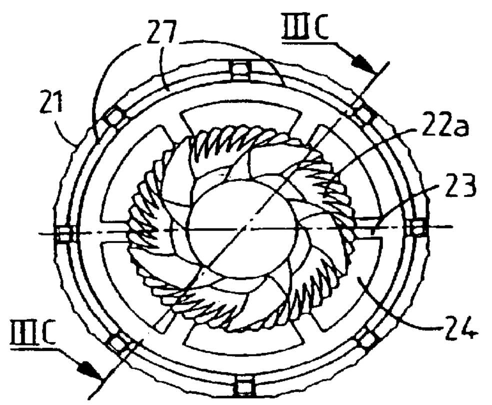


FIG.3B

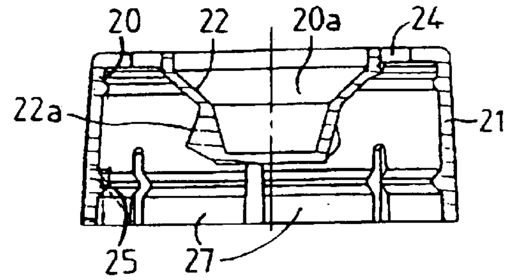


FIG.3C

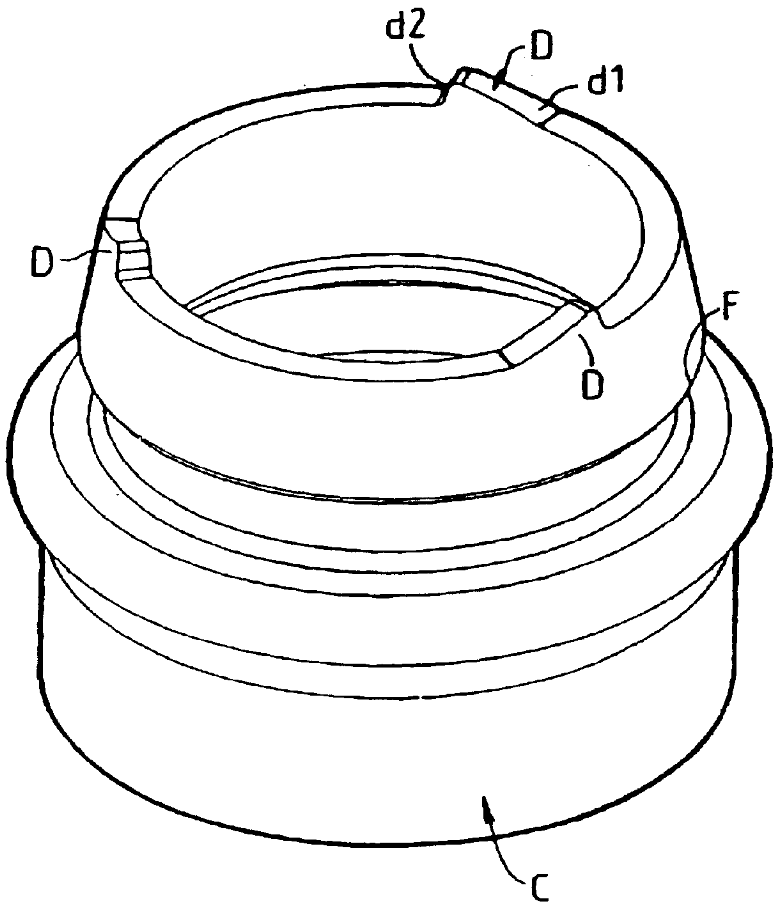


FIG.4A

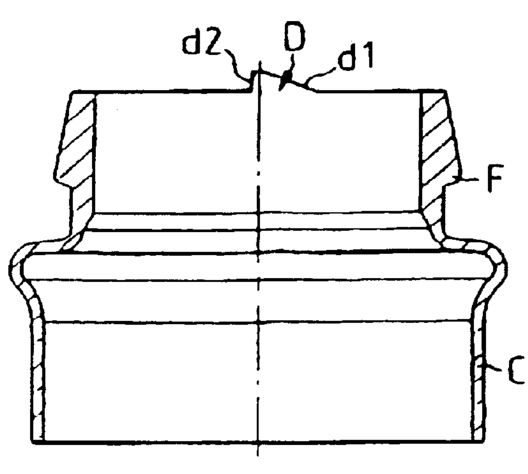


FIG.4B

MANUAL GRINDER FOR GRAIN FOOD PRODUCTS

The present invention relates to a manual grinder for foodstuffs in the form of grains, such as spices.

Grinders or mills already exist that are designed to be mounted on the necks of receptacles that have been previously filled with grains in order to form a method of packaging and distribution ready for use.

However, those grinders are made in the form of at least two independent parts which need to be assembled together in a specific order before or after being mounted on the receptacle, thus implying manufacturing operations that are laborious and thus expensive.

Also, the operation of positioning the two moving parts that perform grinding relative to each other is awkward and difficult to check, and if it is not done correctly, there can arise serious problems in operation.

Furthermore, the fineness and thus the quality of grinding depends mainly on the narrowness of the intermediate zone between these two parts, which means that the assembly must be fitted together accurately and it is difficult to achieve this in automatic and reproducible manner on assembly and packaging lines.

An object of the present invention is to resolve these technical problems in satisfactory manner.

According to the invention, this object is achieved by means of a manual grinder for mounting on the neck of a receptacle for foodstuffs in the form of grains, the grinder being characterized in that it comprises firstly a fixed ring provided with a flange for supporting it on the receptacle, which flange is downwardly extended by an inner sleeve that is engaged in said neck and that presents a toothed inner side wall, and secondly a cap rotatably mounted on said neck covering said ring and including a peripheral skirt radially connected to a central bushing having a toothed outer side wall that is engaged coaxially in said sleeve, so as to define between them a peripheral grinding zone

According to an advantageous characteristic, said skirt is radially connected to said bushing by means of bridges leaving between them outlet orifices for the ground foodstuff.

Preferably, said bridges lie in the plane of the top face of said cap.

According to another characteristic, said peripheral skirt is provided with snap-fastening members for cooperating with complementary members carried by the neck of the receptacle.

In order to improve the flexibility of the skirt, it is possible also to provide local thinning of its wall thickness.

According to another characteristic, said support flange has locking members for locking it in rotation and designed to co-operate with complementary members carried by the neck of the receptacle.

In a particular variant, said locking members are constituted by a continuous series of teeth carried by the bottom face of said flange and designed to become locked on at least one complementary tooth formed on the top rim of the neck.

Preferably, each of said teeth of the flange and of the neck is constituted by a sloping face for absorbing rotary forces, and by a steeper face for transmitting said forces.

In another variant, said sleeve is radially clamped against the inner wall of said neck.

According to other characteristics, said rotary cap has an annular guide groove slidably receiving the peripheral edge of said flange, and the top face of said flange is provided with an annular rib that comes into sliding contact with the bottom face of the cap.

The grinder of the invention makes it possible automatically to obtain proper relative positioning of the moving cap and the fixed ring without it being necessary to provide indexing of these two parts relative to each other.

Furthermore, the ring is locked against rotation on the receptacle without sliding, thus providing good mechanical efficiency.

In addition, grinding quality is guaranteed by forces being transmitted automatically from the receptacle (which is rotated while in an upside-down position) to the toothed sleeve of the inner ring which then moves slightly closer to the toothed bushing of the cap which is held stationary by the user.

The grinder of the invention is thus constituted by only two parts which are easy to fabricate and to assemble and which can be installed quickly and securely on the receptacle while providing the assembly with an overall shape that is very ergonomic and compact.

The invention will be better understood on reading the following description accompanied by the drawings, in which:

FIG. **1** is an overall section view of an embodiment of the invention;

FIGS. **2**A, **2**B, and **2**C are detail views respectively in perspective, from above, and in section on AA of the ring in FIG. **1**;

FIGS. **3**A, **3**B, and **3**C are detail views respectively in perspective, from above, and in section on DD of the cap in FIG. **1**; and

FIGS. **4**A and **4**B are detail views respectively in perspective and in section of a variant embodiment of a receptacle neck suitable for the FIG. **1** embodiment of a grinder.

The grinder B shown in FIG. **1** is for mounting on a neck C of the receptacle containing a foodstuff in the form of grains (pepper, . . .) and for being actuated manually by the consumer.

The component parts of the grinder are assembled together prior to being delivered to the packager of the foodstuff who subsequently installs the grinder directly on the receptacle after it has been filled.

Consequently, the grinder is installed in such a manner that the receptacle is not intended to be refilled and is intended to be discarded after the foodstuff has been consumed.

The grinder comprises firstly a fixed ring **1** that is held stationary on the neck C of the receptacle, and secondly a covering cap **2** that is movable in rotation relative to said ring and said receptacle while being retained axially on said neck.

When the receptacle is placed head-down with its neck C at its bottom end, the cap **2** is held stationary by the user and the receptacle is then rotated relative to the cap **2**, thereby driving the ring **1** so as to grind the grains which are suitable for penetrating into the intermediate zone and then dispense the resulting powder under gravity.

As can be seen more precisely in FIGS. **2**A to **2**C, the ring **1** is provided with a flange **11** for supporting it on the rim of the neck C.

The flange **11** is extended downwards by an inner sleeve **12** which is engaged in the neck C, preferably with radial clamping, the sleeve and the flange together defining a shoulder. The flange **11** has members for preventing it from rotating by co-operating with complementary members carried on the rim of the neck C.

In the embodiment shown in FIG. **2**A, the bottom face of the flange **11** carries a series of teeth **15** suitable for locking on at least one complementary tooth D, and in FIG. **4**A on three complementary teeth, formed on the top edge of the neck C.

Each of the teeth D and the teeth **15** is constituted by a sloping positioning face d**1** and a steeper face d**2** for providing rotary locking and guidance (see FIGS. **2**A, **4**A, and **4**B).

This configuration makes it possible, merely by pressing on the cap **2**, to wedge the teeth D on the neck C between the teeth **15** of the flange **11**.

The inner side wall of the sleeve **12** has teeth extending up its full height. The edges **13***a* of the teeth **13** slope relative to cylindrical or frustoconical generator lines.

In their top portions, where they join the flange **11**, the main faces of the teeth **13** are provided with sharp-edged fins **14**.

The rotary cap **2** has a peripheral skirt **21** radially connected to a central bushing **22**.

The outside of the skirt **21** is provided with fluting that makes it easier to hold.

The central bushing **22** is of tapering profile and it is engaged coaxially in the sleeve **12** so that its toothed outer side wall **22***a* faces the toothed inner side wall **12***a* of the sleeve **12**, defining between them a peripheral grinding zone **10** of tapering profile.

The inclined face d**1** serves to absorb excessive force imparted to the sleeve **12** when rotating the cap **2**. The steep face d**2** enables such forces to be transmitted from the receptacle to the sleeve **12** via the flange **11**, thereby reducing the size of the grinding zone **10**.

The bushing **22** has a flat-bottomed top cavity **22***a*.

The skirt **21** is connected to the bushing **22** by means of bridges **23** leaving between them orifices **24** for delivering the ground foodstuff. In this case, the bridges **23** lie in the plane top face of the cap **2**.

The skirt **21** is provided with snap-fastening members such as a bead **25** for co-operating with complementary members carried by the neck C and implemented in this case in the form of an annular thread F (see FIGS. **1** and **4**B).

When the cap is made out of a rigid material (such as a thermoplastic), the flexibility of the skirt **21** for snap-fastening purposes can be improved by local thinning **27** of its wall thickness (see FIGS. **3**B and **3**C) Thus.

Thus merely pressing on the cap **2** so as to hold the ring **1** captive serves simultaneously to snap-fasten the skirt **21** on the neck C and to lock the sleeve **12**, thereby improving automatic positioning of the flange **11** that it is prevented from rotating.

The tendency of the ring **1** to move away from the neck C during rotation of the cap **2** is countered by cooperation between the snap-fastening members and the locking members.

The cap **2** also has an annular groove **20** for providing guidance in rotation which slidably receives the peripheral edge **11***a* of the flange **11**.

The groove **20** is upwardly defined by the top face of the cap and downwardly defined by an annular protection **26** formed on the inner wall of the skirt **21**.

The top face of the flange **11** is also provided with an annular rib **16** that comes into sliding contact with the bottom face of the cap, thereby forming a spacer.

What is claimed is:

1. A manual grinder for mounting on a neck of a receptacle for foodstuffs in the form of grains, the grinder comprising:

a fixed ring provided with a flange for supporting it on the receptacle, wherein the flange extends toward the receptacle by an inner sleeve that is engaged to the neck, wherein the ring presents a toothed inner side wall, and

a cap rotatably mounted on said neck covering said ring and including a peripheral skirt radially connected to a central bushing having a toothed outer side wall that is engaged coaxially in said sleeve, so as to define between them a peripheral grinding zone.

2. A grinder according to claim **1**, wherein said skirt is radially connected to said bushing by means of bridges leaving between them outlet orifices for the ground foodstuff.

3. A grinder according to claim **2**, wherein said bridges lie in the plane of the top face of said cap.

4. A grinder according to claim **1**, wherein said peripheral skirt is provided with snap-fastening members for co-operating with complementary members carried by the neck of the receptacle.

5. A grinder according to claim **1**, wherein said support flange has locking members for locking it in rotation and designed to co-operate with complementary members carried by the neck of the receptacle.

6. A grinder according to claim **5**, wherein said locking members are constituted by a continuous series of teeth carried by the bottom face of said flange and designed to become locked on at least one complementary tooth formed on the top rim of the neck.

7. A grinder according to claim **6**, wherein each of said teeth of the flange and of the neck is constituted by a sloping face for absorbing rotary forces, and by a steeper face for transmitting said forces.

8. A grinder according to claim **1**, wherein said sleeve is radially clamped against the inner wall of said neck.

9. A grinder according to claim **1**, wherein said rotary cap has an annular guide groove slidably receiving the peripheral edge of said flange.

10. A grinder according to claim **1**, wherein the top face of said flange is provided with an annular rib that comes into sliding contact with the bottom face of the cap.

11. A grinder according to claim **1**, wherein said peripheral skirt includes local thinning of its wall thickness.

* * * * *

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(12) **United States Patent**
Kelsey

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(45) **Date of Patent: *Jul. 20, 2004**

(54) **GRINDING MILL**

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(73) Assignee: **EDI Rail PTY Limited**, Queensland (AU)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **10/097,299**

(22) Filed: **Mar. 15, 2002**

(65) **Prior Publication Data**

US 2002/0088882 A1 Jul. 11, 2002

Related U.S. Application Data

(63) Continuation of application No. 09/486,374, filed as application No. PCT/AU98/00692 on Aug. 28, 1998, now Pat. No. 6,375,101.

(30) **Foreign Application Priority Data**

Aug. 29, 1997 (AU) P08835
Apr. 9, 1998 (AU) PP3025

(51) **Int. Cl.**[7] **B02C 17/00**
(52) **U.S. Cl.** **241/30**; 241/172; 241/176
(58) **Field of Search** 241/30, 172, 176, 241/1, 301

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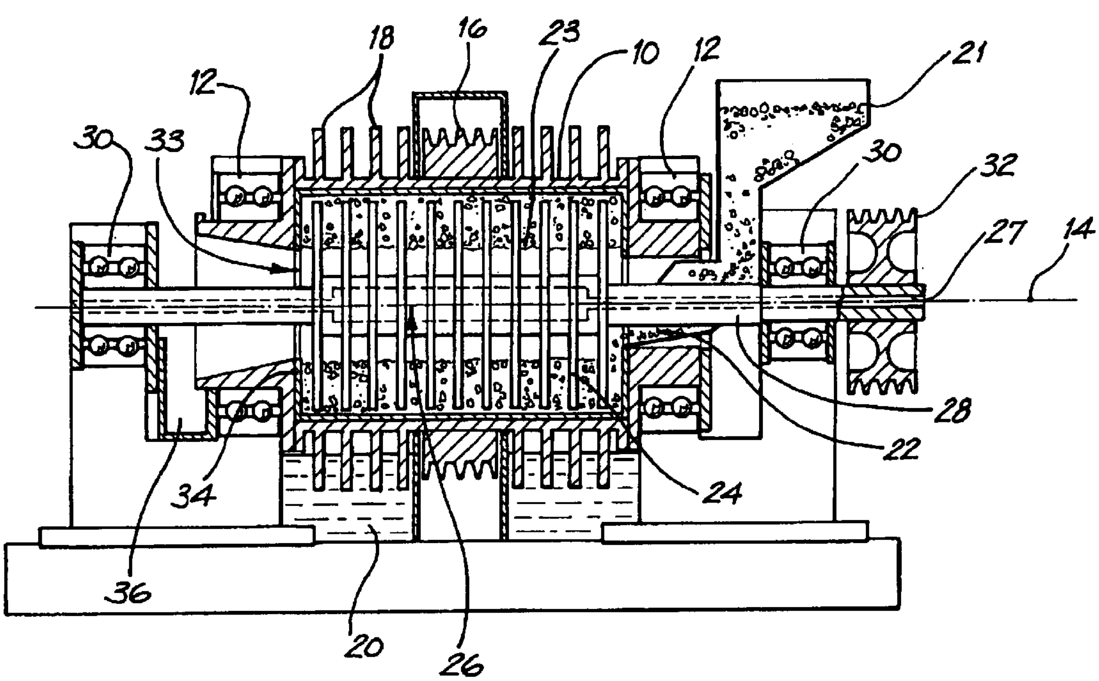
(74) *Attorney, Agent, or Firm*—Smith, Gambrell & Russell

(57) **ABSTRACT**

A grinding mill has a rotating container **(40)** into which particulate material is fed. The container is rotated above critical speed to form a layer which is retained under high pressure against the container inner surface. Shearing discs **(58)** mounted inside the container induce shearing of the layer to promote particle fracture by shearing and abrasion in the pressurized layer. Fine ground material travels axially to the container discharge end **(64)**. In one form of the invention, the container is rotated at sufficient speed to form a series of solidified zones **(70)** alternated with stirred zones **(72)** next to non-rotating shearing discs **(58)**. These solidified zones act as solid discs rotating with the container.

28 Claims, 3 Drawing Sheets



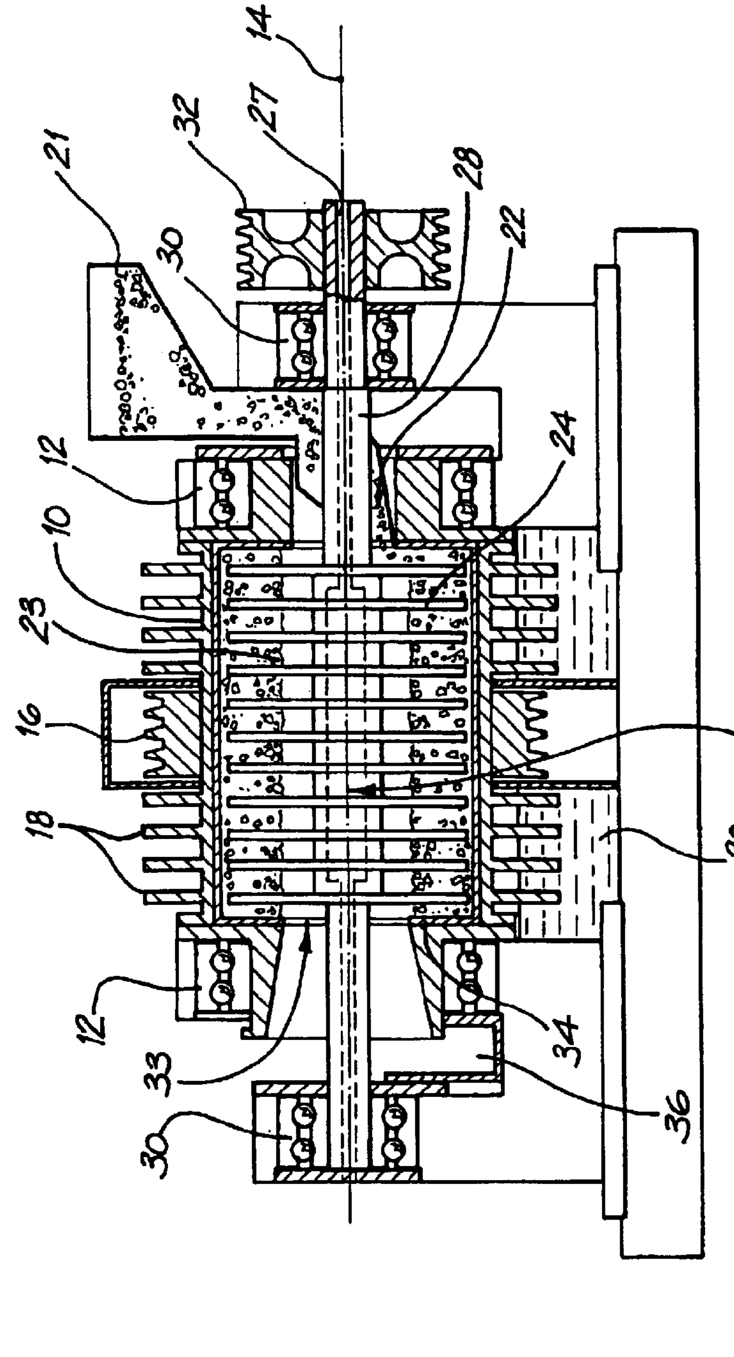


FIG. 1

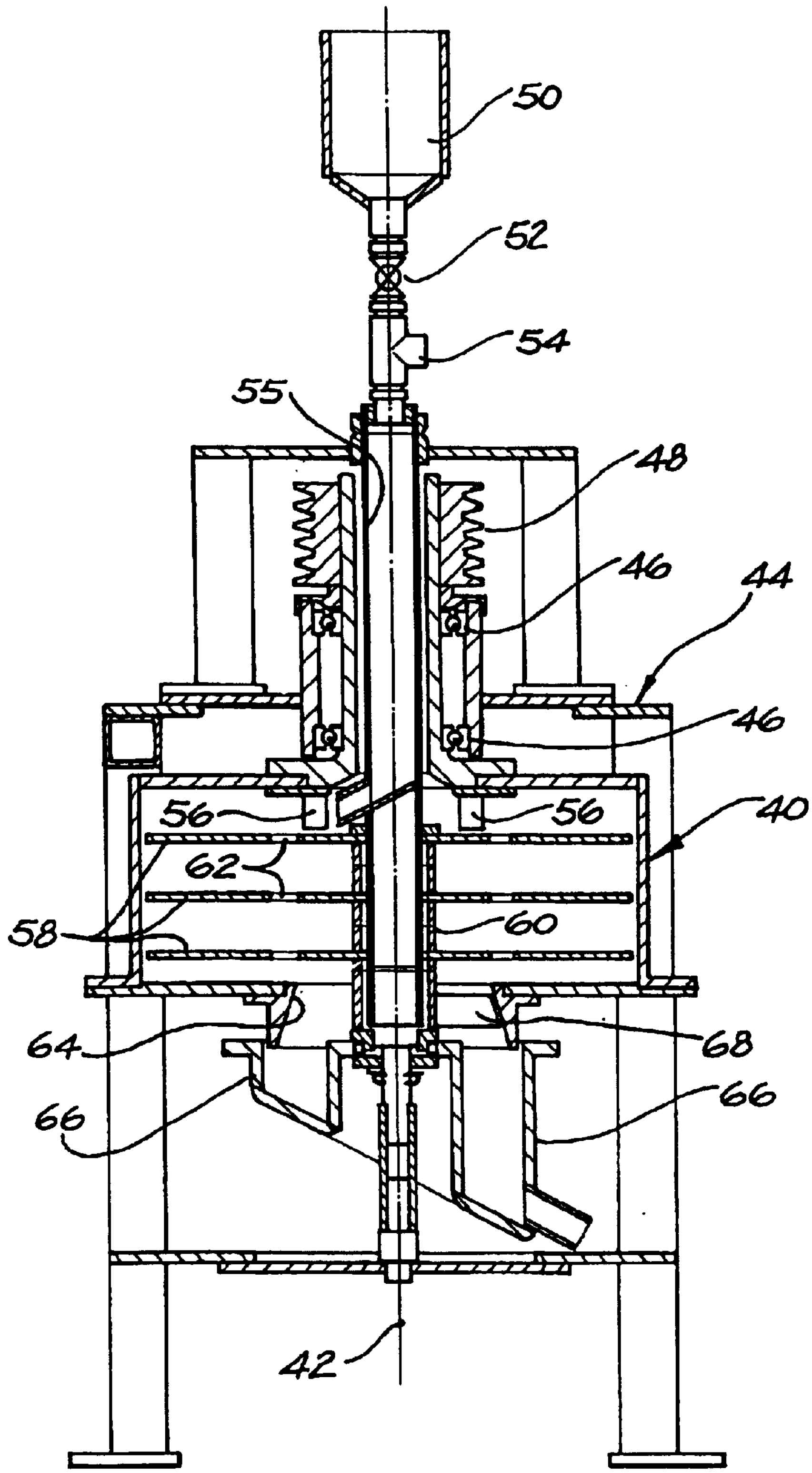


FIG. 2

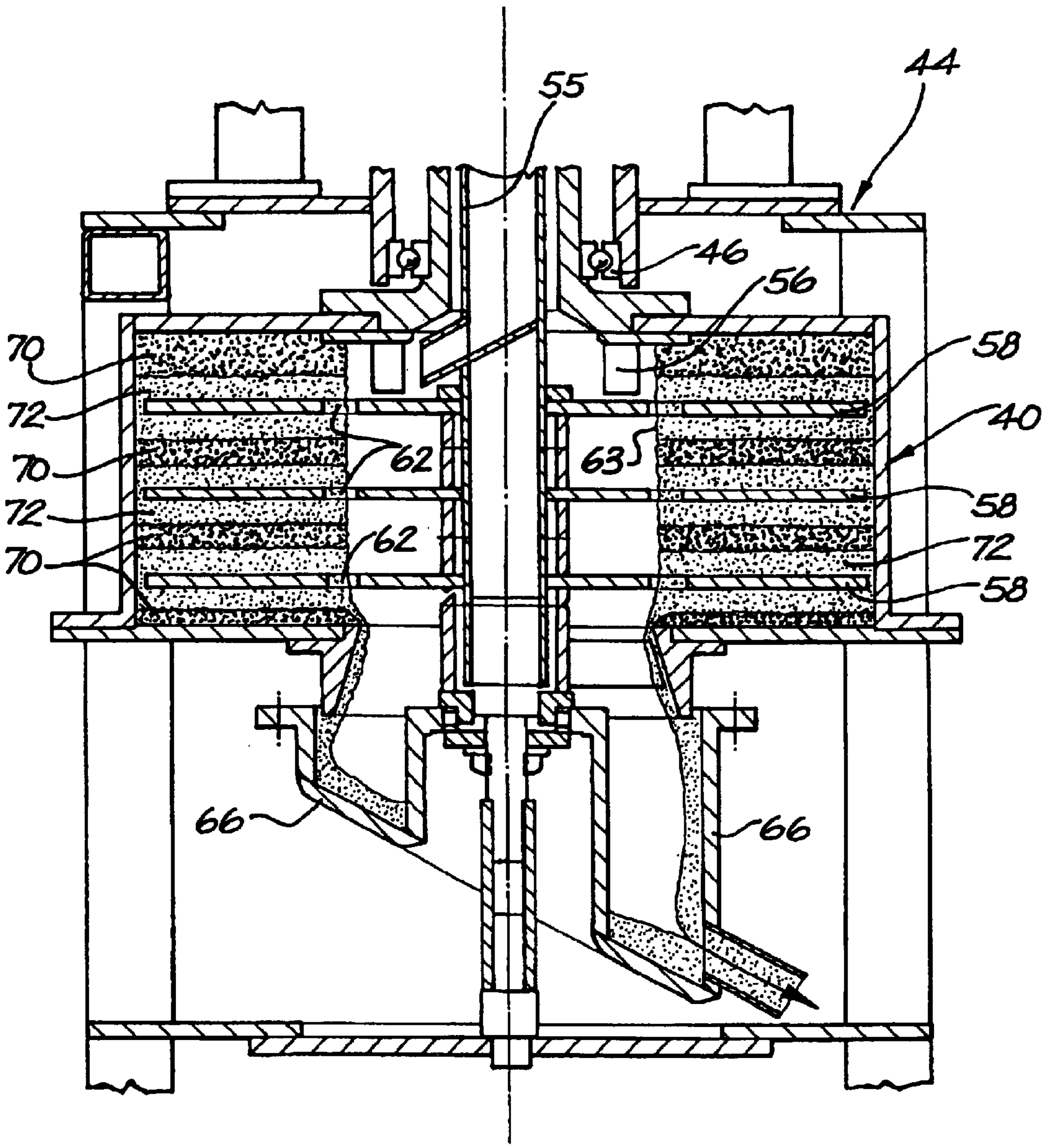


FIG. 3

GRINDING MILL

The present application is a continuation of Ser. No. 09/486,374, filed Feb. 28, 2000, issued as U.S. Pat. No. 6,375,101, which is a 371 of PCT/AU98/00692, filed Aug. 28, 1998, which prior applications are incorporated herein by reference.

BACKGROUND OF INVENTION

The invention relates to a rotary grinding mill for size reduction of particles such as ceramics, minerals and pharmaceuticals.

Prior art rotary mills include a cylindrical drum rotated about a generally horizontal axis. The rotating drum is fed with particulate material such as a slurry or powder, the rotation of the drum being at one half to three quarters of the "critical speed" (i.e. the minimum speed at which material at the inner surface of the drum travels right around in contact with the mill). This causes a tumbling action as the feed and any grinding media travels part way up the inner wall of the drum then falls away to impact or grind against other particles in the feed. Size reduction of the particles is thus achieved principally by abrasion and impact.

In conventional rotary mills, the energy requirements of the mill increases steeply with increasing fineness of grind. For applications where a fine grind is required, the use of stirred mills, in which a body of the particulate material is stirred to create shearing of particles and numerous low energy impacts, may be used to ameliorate this problem to some extent. However, the present application of stirred mills is constrained by reduction ratio boundaries imposed by both upper feed size limits and energy transfer inefficiencies at ultra fine sizes. These constraints, together with throughput limitations and media/product separation difficulties due to viscosity effects at ultra fine sizes, restricts the practical and economic scope for applying that technology.

SUMMARY OF THE INVENTION

The present invention aims to provide an alternative grinding mill construction.

The invention, in one form, provides a grinding mill for particulate material, including a rotary container having an inner surface, feed means for feeding the particulate material to the container, means rotating the container at a sufficiently high speed that the particulate material forms a layer retained against the inner surface throughout its rotation, and shear inducing means contacting said layer so as to induce shearing in said layer.

In non-vertical mills, the minimum rotational speed at which the particulate material rotates around in contact with the container is known as the "critical speed." That term is used herein with reference to both vertical and non-vertical mills as referring to the minimum rotational speed at which the particulate material forms a layer retained against the container inner surface throughout its rotation.

The invention also provides a grinding method in which particulate material is fed to a container rotated at above critical speed, so as to form a layer retained against the container throughout its rotation and inducing shear in said layer by shear inducing means contacting the layer.

Preferably, the shear inducing means is mounted inside and rotates relative to the container.

In a first embodiment, the shear inducing means rotates in the direction of rotation of the container, but at a different speed. In a second embodiment, the shear inducing means counterrotates relative to the container.

Alternatively, the shear inducing means can be non-rotational, relying on relative rotation with the container to induce shearing of the material layer.

Preferably also, the mill rotates at least three times, more preferably at least ten times, critical speed.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments will now be further described with reference to the accompanying drawings, in which:

FIG. **1** is a schematic sectional elevation of a first embodiment;

FIG. **2** is a schematic sectional elevation of a second embodiment; and

FIG. **3** is an enlarged sectional elevation of the grinding chamber of the FIG. **2** mill during operation, showing the creation of alternate stirred and dead zones within the chamber.

DESCRIPTION OF PREFERRED EMBODIMENTS

The mill shown in FIG. **1** has a cylindrical outer drum **10** mounted on bearings **12** for rotation about its central axis **14**, driven by means of drum drive pulley **16** attached to its outer surface. The drum outer surface also carries cooling fins **18** which pass through a cooling water trough **20** below the drum.

A feed of flowable particulate material, for example a slurry or powder, is introduced to one end of the drum from a feed hopper **21** via feed inlet **22** and is flung outwards to form a layer **23** against the inner surface of the drum. The drum is rotated sufficiently above critical speed that the entire mill charge, and any grinding media, travels right around in contact with the drum rather than the sub-critical tumbling operation of prior art mills. The drum is preferably rotated at least three times critical speed, most preferably at least ten times, so that the mill charge layer is at high pressure, compressed by the high centrifugal force. The magnitude of the compressive forces applied can be varied by varying the speed of rotation of the outer drum.

The charge layer is mobilised by disc or finger projections **24** of the counterrotating shear inducing member **26** inside the drum, mounted on a central shaft **28** supported in bearings **30**. This shaft is rotated by means of a shaft drive pulley **32**. A cooling water passage **26** extends through shaft **28**.

For maximum shearing, the shaft is rotated rapidly in the opposite direction to drum **10**. Alternatively, the shaft may be rotated in the same direction as the drum but at a differential speed. This latter arrangement eliminates a 'dead' locus within the charge layer at which the rotational "G" force is zero, and reduces energy requirements of the mill.

The particles in the charge layer are subjected to intense interparticle and/or particle to media shear stresses generated by the stirring action of the projections **24** rotating through the compressed charge layer. The high pressure due to rotation of the charge layer enhances energy transfer from the projections to the charge, thus transferring a relatively large proportion of the available input energy directly to the particles as fracture promoting stress.

The shearing of the compressed solids layer causes both shearing and abrasion fracture of the particles, with sufficient energy to cause localised stressing and fracture applied simultaneously to a large proportion of the total particle population within the mill. The net result is a high distribution of very fine particles, with the capacity to sustain effective fracture by this mechanism at high particle population expansion rates within the mill.

In addition to abrasion fracture, particles may also fracture due to compressive force of the media and sold particle bulk pressure, due to the exaggerated "gravitational" force within the mill. The magnitude of this compressive force and the particle/particle and particle/media packing densities may be varied. It is believed that some fracture by shatter and attritioning of particle surfaces resulting from higher velocity impacts also occurs, but to a lesser degree than abrasion fracture.

The discharge end **33** of the mill drum **10** has an annular retaining plate **34** extending radially inwards from the drum inner surface. The greater centrifugal force acting on the heavy media particles causes the media to be retained within the mill radially outwards of the retaining plate **34** and therefore kept within the mill while the fine product is displaced by the incoming feed and passes radially inwards of the retaining plate and into a discharge launder **36**.

FIGS. **3** and **4** illustrate a vertical mill constructed in accordance with a second embodiment, including non-rotating shear members.

The rotating drum **40** of the mill is mounted on a vertical rotational axis **42**, supported on frame **44** by bearings **46**, and is rotated at high speed via the drum drive pulley **48**.

The mill is charged initially with a mix of grinding media, fed from media hopper **50** via ball valve **52**, and a feed powder or slurry fed through feed port **54**. The charge passes down stationary feed tube **55** into the drum. Feed impellers **56** attached to the rotating drum impart rotary motion to the charge, which forms a highly compressed layer retained against the drum inner surface.

In the embodiment of FIGS. **2** and **3**, the shear inducing member inside the drum is stationary, consisting of one or more radial discs **58** attached to a fixed shaft **60**. The discs have apertures **62** in the region of the inner free surface **63** of the charge layer to allow axial movement of fine ground material through the mill to the discharge end. If fingers or other projections are used instead of discs **58**, the apertures **62** are not required.

After the initial charge is introduced, no further grinding media is added but a continuous stream of feed is fed via feed port **54**. The mill is adapted to receive feed slurries of high solids content, for example 50–90% solids, typically 55–75%, depending on the feed material and the size reduction required.

The grinding media and larger particles in the charge layer will tend not to move axially through the mill due the high compressive forces on the charge. Instead radial migration of particles occurs, wherein larger particles introduced in the feed slurry migrate radially outwards through the charge due to the high centrifugal force and are subject to grinding and fracturing by the efficient mechanisms discussed above with reference to FIG. **1**. As the particle size reduces, the smaller particles migrate radially inwards until they reach the inner free surface of the charge layer, which equates to a zero (gauge) pressure locus.

The fine particles reaching the free surface may then move axially through the mill, through apertures **62** in the discs, pass radially inwards of the discharge ring **64** and into discharge launder **66**. A scraper blade **68** may be affixed to stationary shaft **60** to keep the material flowing freely through the discharge ring.

The applicant has found that, at the very high rotational speeds at which this mill is operated, preferably at least 100 times gravity, for example up to 200 times gravity, zones in the charge away from the shearing discs **58** pack solid and rotate at one with the rotating drum. This can be used to advantage by spacing the shearing discs apart by a sufficient distance to create solid 'dead' zones of charge between successive discs and adjacent the end faces of the rotating drum. These dead zones **70**, shown by the darker shading in FIG. **3**, effectively act as solid discs extending inwards from the inner wall of the drum, parallel to and rotating at high speed relative to the discs. This creates an extremely high shear rate in the stirred charge regions **72** (shown in lighter shading in FIG. **3**) adjacent the discs, while protecting the end surfaces of the drum against excessive wear.

The minimum disc spacing required to create this stirred zone/dead zone phenomenon will vary dependent on the rotational speed and charge material used, but in cases of extremely high G force and high solids content may be as little as 50 mm.

Compared to the FIG. **1** embodiment, the embodiment of FIGS. **2** and **3** has the advantage of lower power requirement as it is not necessary to drive the shear-inducing member. The power requirement of the mill may be further reduced by reducing the length of the grinding chamber and employing only a single shearing disc. The high "gravity" environment within the mills according to the invention extends the practical and economic boundaries of conventional stirred mill comminution with respect to the feed top size, reduction ratios, energy efficiency and throughput.

While particular embodiments of this invention have been described, it will be evident to those skilled in the art that the present invention may be embodied in other specific forms without departing from the essential characteristics thereof. The present embodiments and examples are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed is:

1. A grinding mill for particulate material, including a rotary container having an inner surface a feed inlet for feeding the particulate material to the container, a rotary drive rotating the container at sufficiently high speed that the particulate material forms a layer retained against the inner surface throughout its rotation, and a shear inducing member contacting said layer so as to induce shearing in said layer, said shear inducing member including one or more radial members extending into the particulate layer, wherein the rotary drive is adapted to rotate the container at a sufficiently high speed to cause one or more substantially solidified zones in particulate material layer.

2. A grinding mill according to claim **1**, wherein the rotary drive is adapted to rotate the container at sufficient speed to induce a force of at least one hundred times gravity on the particulate material layer.

3. A grinding mill according to claim **1**, wherein the shear inducing member creates one or more stirred zones in the particulate material layer, said stirred zones being located between the shear inducing member and the solidified zones.

4. A grinding mill according to claim **1**, wherein a plurality of shear inducing members is spaced axially along said container so as to create alternate solidified and stirred zones.

5. A grinding mill according to claim **1**, wherein the shear inducing member includes radial members extending into the particulate material layer to create said one or more stirred zones.

6. A grinding mill according to claim 1, wherein said rotary drive is adapted to rotate said container sufficient speed that said one or more substantially solidified zones rotates with said container.

7. A grinding mill according to claim 1, wherein said rotary drive is adapted to rotate said container a sufficient speed that said one or more substantially solidified zones rotates with said container co-operates with said shear inducing member to induce said shear.

8. A grinding mill according to claim 1, wherein said shear inducing member is non-rotational.

9. A method of grinding particulate material, including feeding the particulate material to container which has an inner surface, rotating the container at a sufficiently high speed that the particulate material forms a layer retained against the inner surface throughout its rotation, and contacting the layer with a shear inducing member to induce shear in said layer, wherein the container is rotated at a sufficiently high speed to cause one or more substantially solidified zones in the particulate material layer.

10. A method according to claim 9, wherein the container is rotated at sufficient speed to induce a force of at least one hundred times gravity on the particulate material layer.

11. A method according to claim 10, wherein the shear inducing member creates one or more stirred zones in the particulate material layer, said stirred zones being located between the shear inducing member and the solidified zones.

12. A method according to claim 11, wherein a plurality of shear inducing members are spaced axially along said container so as to create alternate solidified and stirred zones.

13. A method according to claim 11, wherein the shear inducing member includes radial members extending into the particulate material layer to create said one or more stirred zones.

14. A method according to claim 11, wherein said one or more substantially solidified zones rotate with said container.

15. A method according to claim 9, wherein said one or more substantially solidified zones rotates with said container and co-operates with said shear inducing member to induce said shear.

16. A method according to claim 9, wherein said shear inducing member is non-rotational.

17. A grinding mill for particulate material, including a rotary container having an inner surface, feed inlet for feeding the particulate material to the container, a rotary drive rotating container at sufficiently high speed that the particulate material forms a layer retained against the inner surface throughout its rotation, a shear inducing member contacting said layer so to induce shearing in said layer, said shear inducing member including one or more radial members extending into the particulate layer, wherein said shear inducing member is non-rotational.

18. A grinding mill according to claim 17, wherein the rotary drive is adapted to rotate the container at least ten times the minimum speed at which the particulate material forms a layer retained against the container inner surface throughout its rotation.

19. A grinding mill according to claim 18, wherein rotary drive is adapted to rotate the container at sufficient speed to cause one or more substantially solidified zones in the particulate material layer.

20. A grinding mill according to claim 17, wherein the rotary drive is adapted to rotate the container at sufficient speed to cause one or more substantially solidified zones in the particulate material layer.

21. A grinding mill according to claim 20, wherein the shear inducing member is arranged to create one or more stirred zones in the particulate material layer, said stirred zones being located between the shear inducing member and the solidified zones.

22. A grinding mill according to claim 21, wherein a plurality of shear inducing members is space axially along said container so as to create alternate solidified and stirred zones.

23. A method of grinding particulate material, including feeding the particulate material to a container which has an inner surface, rotating the container at sufficiently high speed that the particulate material forms a layer retained against the inner surface throughout its rotation, an contacting the layer with a shear inducing member to induce shear in said layer, wherein said shear inducing member includes one or more radial members extending into the particulate material layer, wherein said shear inducing member is non-rotational.

24. A method according to claim 23, wherein the container is rotated at least ten times the minimum speed at which the particulate material forms a layer retained against the container's inner surface throughout its rotation.

25. A method according to claim 24, wherein the container is rotated at sufficient speed to induce a force of at least one hundred times gravity on the particulate material layer.

26. A method according to claim 23, wherein the container is rotated at sufficient speed to cause one or more substantially solidified zones in the particulate material layer.

27. A method according to claim 26, wherein the shear inducing member creates one or more stirred zones in the particulate material layer, said stirred zones being located between the shear inducing member and the solidified zones.

28. A method according to claim 27, wherein a plurality of shear inducing members is spaced axially along said container so as to create alternate solidified and stirred zones.

* * * * *

(12) **United States Patent**
Lassota

(10) **Patent No.: US 6,783,089 B2**
(45) **Date of Patent: Aug. 31, 2004**

(54) **FOOD INGREDIENT GRINDER ASSEMBLY AND METHOD**

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(65) **Prior Publication Data**

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(52) **U.S. Cl.** **241/30**; 241/34; 241/36; 241/100
(58) **Field of Search** 241/36, 37.5, 34, 241/100, 30

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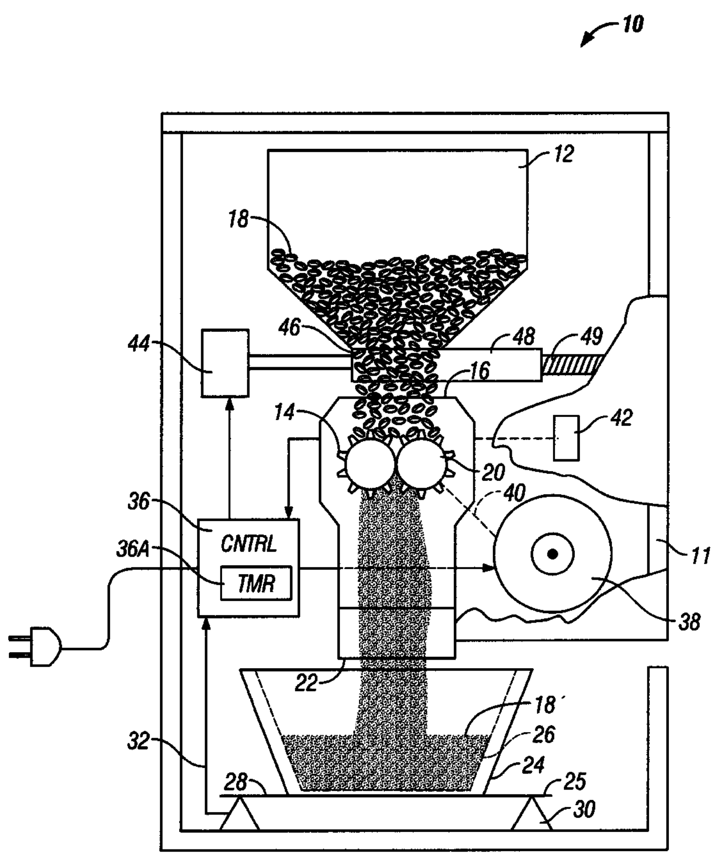
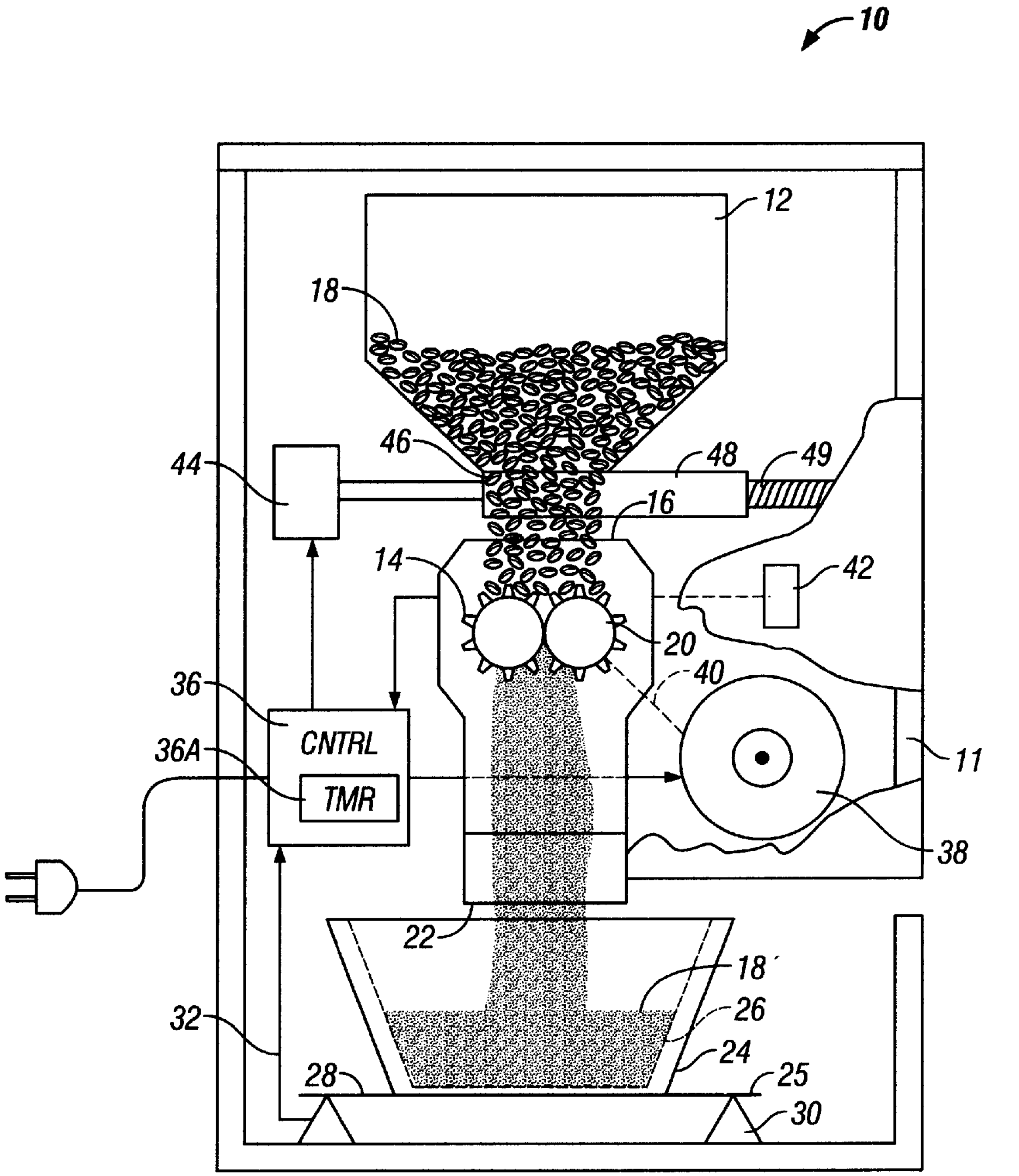
(74) *Attorney, Agent, or Firm*—James W. Potthast; Potthast & Associates

(57) **ABSTRACT**

A food ingredient grinder assembly (**10**) having ingredient hoppers (**12**) and grinding blades (**20**) for grinding ingredient upon receipt within grinding chamber (**14**) has a controller that maintains a motor (**38**) operating after the ingredient in the grinding chamber has been depleted to vibrate and blow away residual ground ingredient from interior surfaces of the grinder assembly to reduce contamination of different type of ingredient subsequently ground in the same grinding chamber and passed to a brew basket (**24**) through the same outlets and manifold (**50**). In one embodiment the grinding blades are controlled according to a preselected time period and in another embodiment the control is based on the net weight of the ground ingredient within the brew basket (**24**) which is measured through use of strain gages (**30**).

24 Claims, 8 Drawing Sheets

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12
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CNTRL
36A
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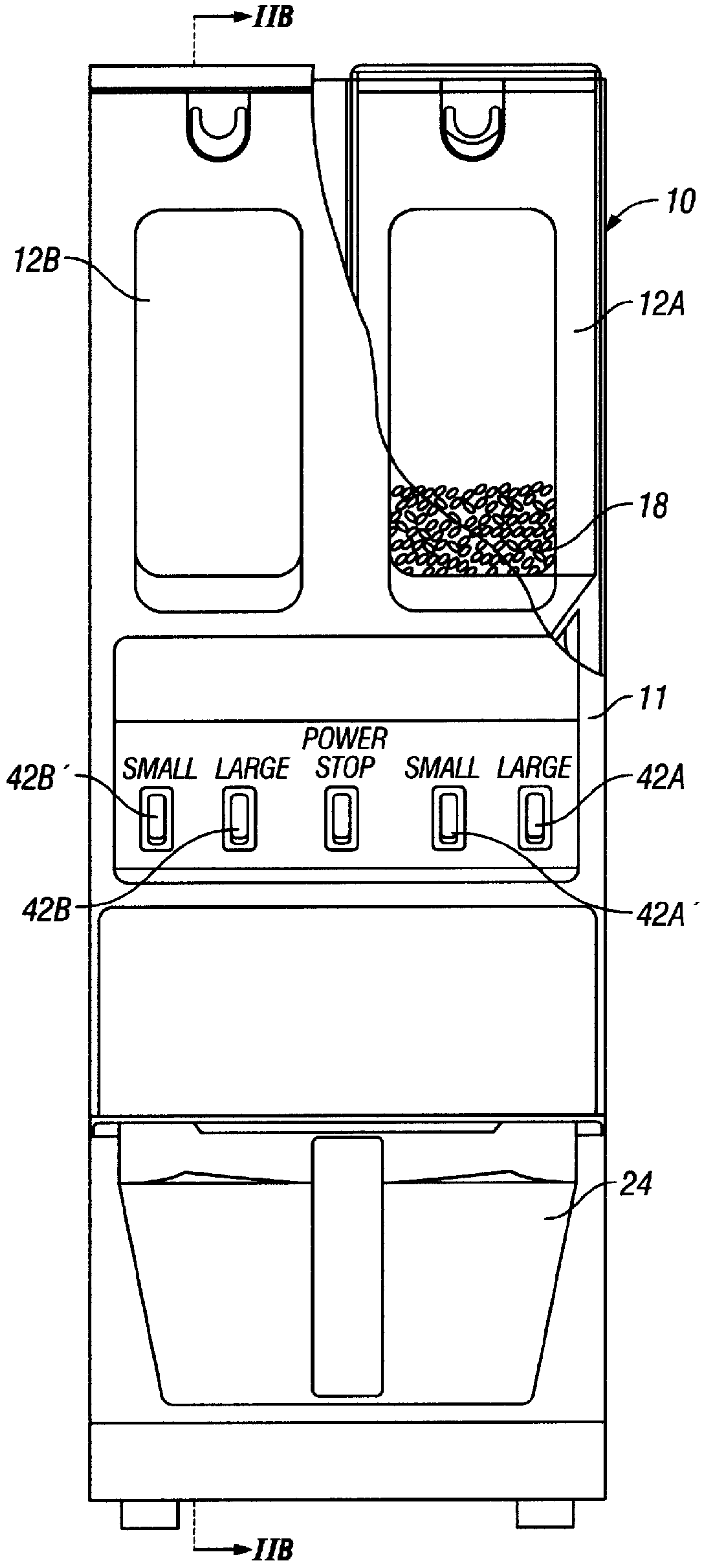
FIG. 1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12B
12A
18
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LARGE
STOP
SMALL
LARGE
42B´
42A
42B
42A´
24
IIB

FIG. 2A

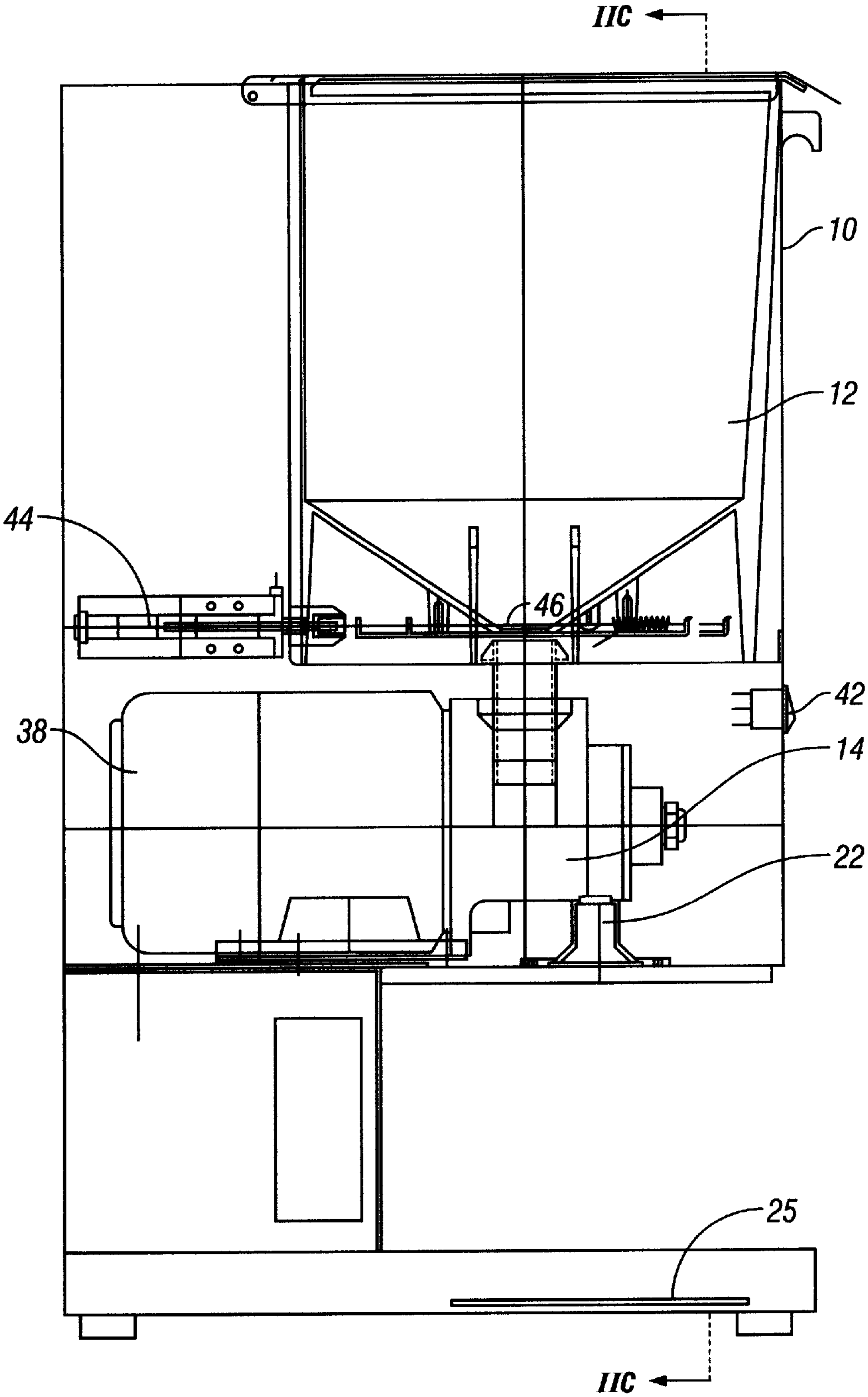

FIG. 2B