

Jan. 21, 1969

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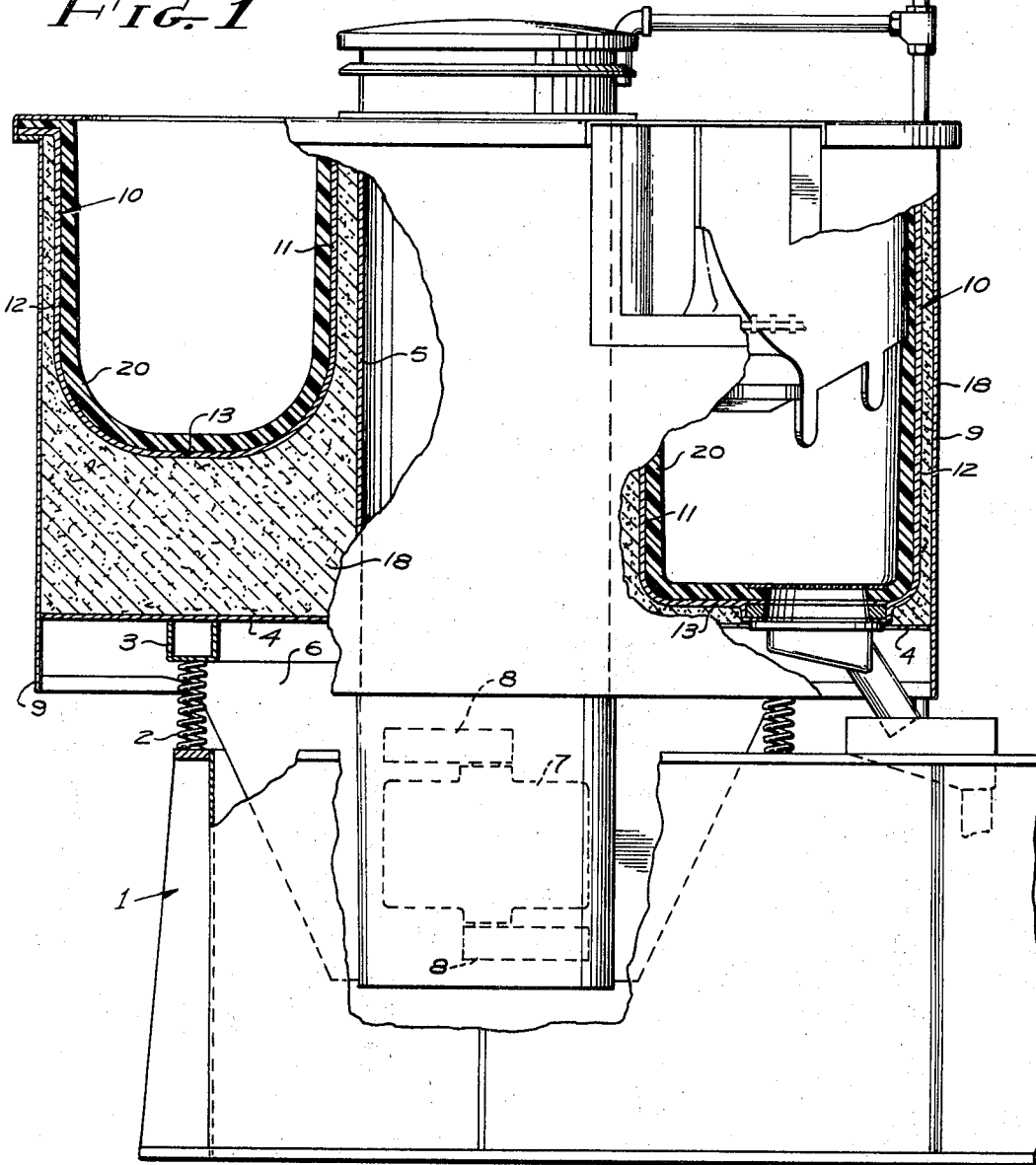
3,422,577

SELF-DISCHARGING FINISHING MILL

Filed Feb. 7, 1966

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Fig. 1



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FIG. 2

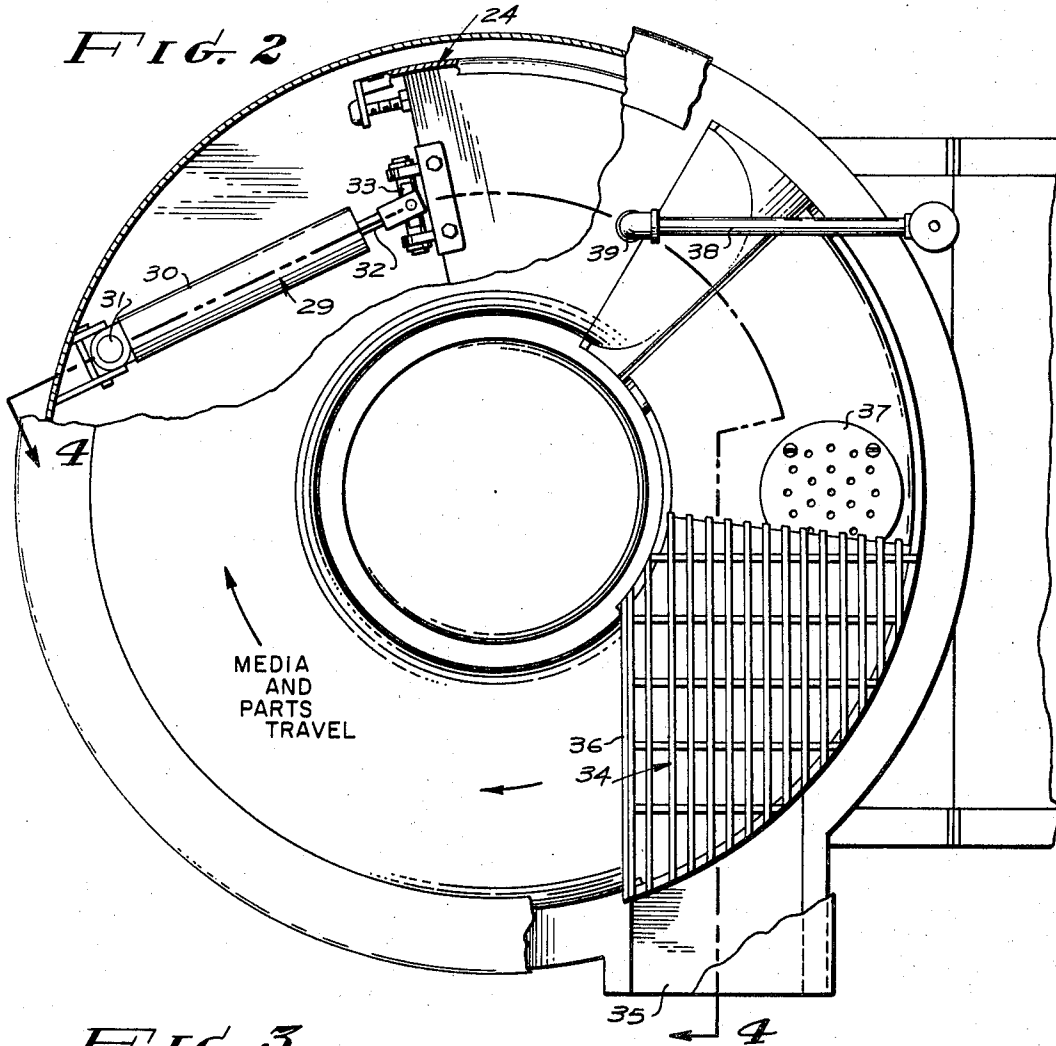
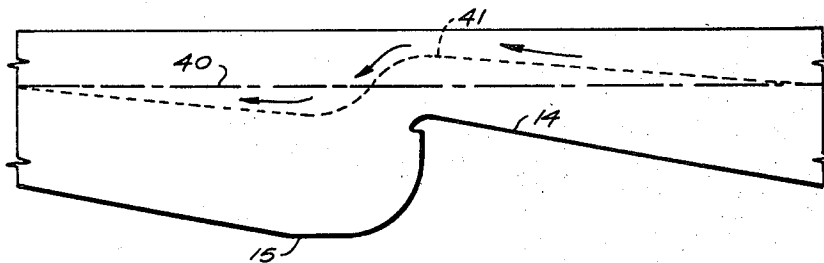


FIG. 3



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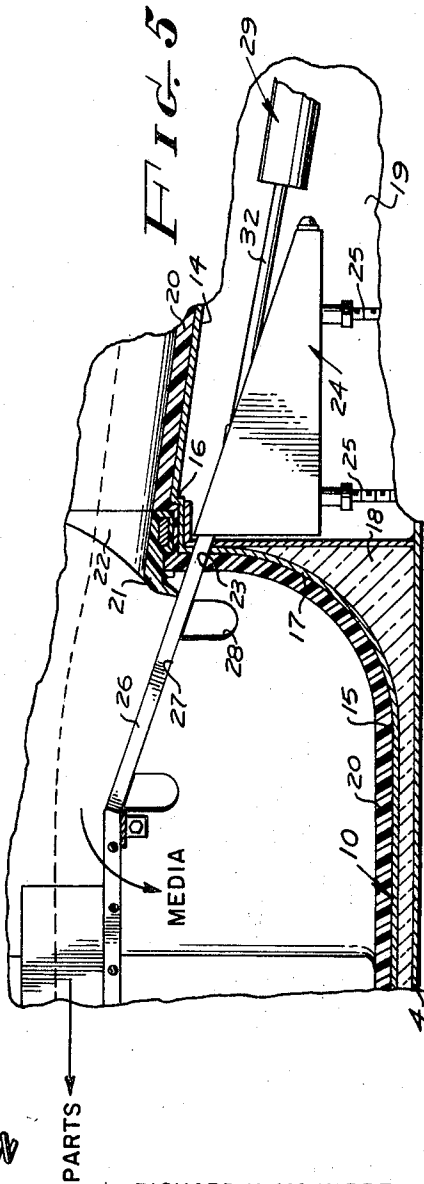
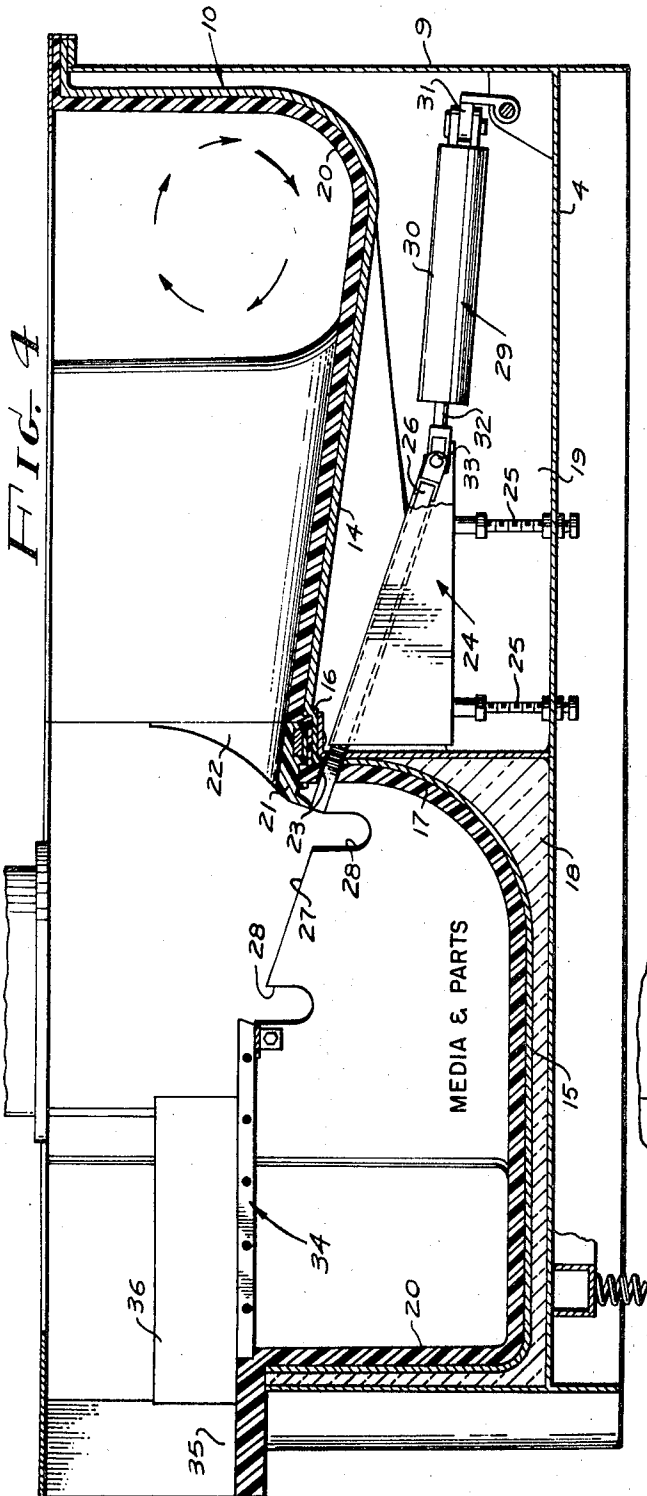
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SELF-DISCHARGING FINISHING MILL

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U.S. Cl. 51-163

8 Claims

Int. Cl. B24b 31/00; B02c 17/08; B01f 11/00

ABSTRACT OF THE DISCLOSURE

A vibratory mill having an annular container and means for vibrating the container. The bottom of the container includes a ledge, and a ramp is extensible from the ledge to convey media and work pieces beyond the ledge for enabling discharge of at least the work pieces.

This invention relates to self-discharging finishing mills, more particularly, to the type of mill utilizing a vibrating unit such as the mill disclosed in U.S. Patent No. 3,100,088, issued Oct. 20, 1961, to Henry L. Podmore. Included in the objects of this invention are:

First, to provide a vibratory finishing mill which includes a toroidal container having a helical bottom terminating in a ledge over which the finishing media and work pieces cascade during the finishing operation and which incorporates a novel travelling ramp capable of helical movement in a path continuing from the ledge and adapted to bridge between the ledge and a separator grid for conducting the media and work pieces to the grid to discharge the work pieces and return the media to the container.

Second, to provide a vibratory finishing mill and method of finishing wherein the mill is initially filled to a level above the ledge separating the upper and lower ends of the helical bottom. The mill is then vibrated in such a manner that the media and work pieces move toroidally, and advance circumferentially up the helical bottom and cascade over the ledge; the vertical depth of the mass decreasing toward the upper end of the helical bottom and the rate of progression increasing so as to minimize the difference in level of the mass above the upper and lower levels of the helical bottom and protect the work pieces as they move over the ledge.

Third, to provide a vibratory finishing mill and method of finishing wherein vibration of the mill is utilized to facilitate extension of the traveling ramp through the cascading mass of media and work pieces, thereby permitting automatic discharge of the work pieces after a predetermined interval.

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

FIGURE 1 is a side view of the finishing mill with portions broken away and in section.

FIGURE 2 is a plan view thereof with portions broken away and in section.

FIGURE 3 is a diagrammatical developed view corresponding to the mid-line of the annular chamber and indicating the surface of the contents prior to and during operation of the mill.

FIGURE 4 is a fragmentary sectional view taken through 4-4 of FIGURE 2 showing the travelling plate or ramp in its retracted position.

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FIGURE 5 is a fragmentary sectional view similar to FIGURE 4 showing the ramp in its extended position.

The finishing mill includes a base 1 on which is mounted a ring of springs 2 joined at their upper ends to a mounting ring 3.

Secured to the mounting ring 3 is an annular bottom plate 4 through which extends a central tube 5. The tube 5 extends below the bottom plate 4 and is rigidly supported relative thereto by gussets 6. Mounted in the lower extended portion of the tube 5 is a motor 7 having eccentric weights 8 at opposite ends thereof.

The central tube 5 also extends above the bottom plate 4 and the periphery of the bottom plate supports an outer shell 9 which forms with the central tube 5 an annular space. Fitted within the annular space is an annular container 10 having a radially inner wall 11 and a radially outer wall 12 and a helical bottom 13.

The helical bottom is provided with an upper end 14 and a lower end 15 joined by a ledge 16. The lower part of the ledge forms a curved transition portion 17.

The major portion of the space between the annular container 10 and the walls formed by the central tube 5, bottom plate 4 and outer shell 9 is filled with a vibration transmitting packing 18 which may be a rigid foamed plastic material. The space under the upper portion of the helical bottom 13 extending backward from the ledge 16 is free of packing and forms a compartment 19.

The inner surface of the annular container 10 is covered with a wear-resistant liner 20. Cast polyurethane has been found satisfactory, but other materials, preferably having elastomeric qualities, may be used.

Above the ledge 16, there is provided a wear-resistant lip 21 which is preferably arranged so that it may be removed. The lip overhangs the upper portion of the ledge and terminates in lateral margins 22 fitted onto the inner and outer walls of the wear resistant liner 20.

Underneath the lip 21, the ledge 16 is provided with a guide slot 23 extending the width of the container and communicating with the compartment 19. Mounted within the compartment adjacent the ledge 16 is a guide frame 24 which is arcuate in plan conforming to the curvature of the container 10. The guide frame is supported on suitable posts 25 which are adjustable. The guide frame 24 supports an arcuate travelling plate or ramp 26 which is adapted to project circumferentially from the ledge 16.

Formed in the liner covering the radially inner and outer walls 11 and 12 of the container is a pair of arcuate guide ledges 27 which form a continuation of the guides formed by the guide frame 24 so that when the travelling plate or ramp 26 is extended, its lateral sides are supported. It has been found desirable to provide clearance slots 28 in the guide ledges 27 immediately beyond the lip 21 and immediately before grid 34.

Mounted in the compartment 19 is a drive unit 29 for advancing and retracting the travelling blade 26. The drive unit comprises a cylinder 30 supported within the compartment by a universal bracket 31. A thrust shaft 32 extends from the cylinder and is joined by a universal connection 33 to an inner end of the traveling blade 26.

The travelling blade is preferably formed of the same wear-resistant material from which the liner 20 is formed and may be a solid piece of such material or may contain suitable reinforcing.

Beginning at a point circumferentially displaced from the ledge 16 and joined to the terminal ends of the arcuate

ledges 27 is a grid or separator 34 which extends essentially horizontally and circumferentially to a workpiece discharge chute 35. The grid 34 is provided with a wall 36 so that workpieces on the grid are deflected toward the chute 35.

The lower end of the helical bottom 13 beyond the ledge 16 is provided with a drain 37 which may be equipped with a shut-off valve, not shown. A fluid supply pipe 38 overhangs the container 10 and is provided with a discharge nozzle 39. Other spray means, not shown, may be located over the grid 34.

The method of finishing material utilizing the finishing mill is as follows:

Suitable finishing media is placed in the container until the container is filled to a level 40 substantially above the upper end 14 of the helical bottom, as indicated by broken lines in FIGURE 3. The parts or workpieces to be finished are added to the media. The container is then vibrated by means of the motor 7 and weights 8.

The motor and its weights may be adjustable vertically as a unit so as to be located at the best level with respect to the center of gravity of the container and its contents and the circumferential relationship of the two weights are so adjusted that the contents comprising media and workpieces tend to advance or progress clockwise as viewed in FIGURE 2; that is, from the lower end to the upper end of the helical bottom 13.

In addition, the media and parts churn in a toroidal pattern; that is, they move upwardly at the radially outer side of the container, then radially inward across the top, then downward along the radially inner side of the container and finally, radially inward as indicated by the arrows in FIGURE 4.

Due to the helical shape of the bottom 13, the center of mass of material comprising the media and parts, is located eccentrically with respect to the center of the container; that is, the center of mass is displaced toward the lower end of the helical bottom 13. As a result, the amplitude of the vertical component of vibration tends to increase in a direction toward the upper end 14 of the helical bottom 13. It seems from observation of the machine in operation, that this increase in amplitude of the vertical component tends to accelerate the material. In any case, the vertical depth of the material decreases toward the upper end 14 of the helical bottom 13. Consequently, the difference in level of the material overlying the upper end 14 and the material overlying the lower end 15 is substantially less than the vertical height of the ledge 16 so that the media and workpieces cascade over the ledges in such a manner that the workpieces are fully supported and are not subject to damage which might be the case if the workpieces were to fall freely. The characteristic outline of the upper surface of the material during operation of the finishing mill is illustrated by dash-lines 41.

The material is vibrated and circulated around the container 10 until the workpieces are properly finished, whereupon, the drive unit 29 is activated to thrust the traveling blade 26 circumferentially until its extended end engages or overlies the grid 34. This movement is accomplished while the finishing mill remains in operation.

Vibration of the finishing mill is continued, causing the workpieces and media to pass onto the grid. The workpieces are delivered to the discharge chute 35, while the media is returned to the lower end 15 for recirculation. After the workpieces have been discharged, the traveling blade 26 is retracted and additional workpieces are added to the media. This may be accomplished without stopping operation of the finishing mill.

The term "finishing" has here been employed in the broadest sense; that is, it is intended to include deburring, polishing, coating, or the like and the media may vary substantially. It may comprise ceramic or metal pieces, wood, plastic particles, sand or other grit. Furthermore,

the operation may be performed dry or with water or water plus detergents or various other materials.

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

I claim:

1. A vibratory finishing mill, comprising:

- (a) an annular container having, at least in part, a helical bottom terminating in a ledge;
- (b) means for vibrating said container to cause media and work pieces contained therein to progress upwardly along said helical bottom and cascade over said ledge;
- (c) means forming a discharge chute in a wall of said container spaced from said ledge;
- (d) a grid partially bridging the space between said chute and ledge and overlying the bottom of said container, said grid dimensioned to transfer work pieces to said chute and pass media to the bottom of said container;
- (e) and a ramp disposed under said helical bottom and movable outwardly from said ledge to bridge the gap between said ledge and said grid thereby to convey media and work pieces to said grid.

2. A vibratory finishing mill according to claim 1, wherein:

- (a) said ramp forms a segment of a helix;
- (b) helical track means are provided to guide said ramp;
- (c) and a drive means for thrusting and retracting said ramp is disposed under the helical bottom of said container.

3. A vibratory finishing mill, comprising:

- (a) an annular container having, at least in part, a helical bottom terminating in a ledge;
- (b) means for vibrating said container to cause media and work pieces contained therein to progress upwardly along said helical bottom and cascade over said ledge;
- (c) a helical ramp disposed under said bottom and extensible from said ledge to convey media and work pieces beyond said ledge;
- (d) and means for discharging at least the work pieces from said container positioned to receive media and work pieces from said ramp when said ramp is extended.

4. A vibratory finishing mill according to claim 3, wherein:

- (a) means is provided to introduce liquid into the mass of media and work pieces;
- (b) and a drain is provided in the bottom of said container beyond said ledge.

5. A vibratory finishing mill according to claim 3, wherein:

- (a) a lip is provided at said ledge and overhangs the upper portion of said ledge.

6. A vibratory mill, comprising:

- (a) a container having, at least in part, a helical bottom terminating in a ledge;
- (b) means for vibrating said container to cause media and work pieces contained therein to progress upwardly along said helical bottom and cascade over said ledge, said means including a motor having eccentric weights mounted thereon;
- (c) a ramp, said ramp being movable to extend from said ledge to convey media and work pieces beyond said ledge;
- (d) and means for discharging at least the work pieces from said container positioned to receive media and work pieces from said ramp when said ramp is extended.

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7. A vibratory mill according to claim 6, wherein:
 (a) said ramp forms a segment of a helix, and track means are provided on said container to guide said ramp;

(b) and a drive means for moving said ramp is coupled thereto. 5

8. A finishing mill according to claim 6, wherein:

(a) said ramp is helical and is disposed under said bottom of said container, said ledge including an opening therein through which said ramp may be extended; 10

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(b) and said ledge including an overhanging lip above said opening.

References Cited

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OTHELL M. SIMPSON, *Primary Examiner*.

U.S. Cl. X.R.

241—175; 259—29, 72