United States Patent [19]

Eisenberg

[11] **3,903,941**

[45] **Sept. 9, 1975**

[54] **MACHINE AND METHOD FOR FILLING CONTAINERS TO A PREDETERMINED LEVEL**

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[73] Assignee: **Solbern Corporation,** Fairfield, N.J.

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[52] **U.S. Cl.** **141/78;** 141/171; 222/367

[51] **Int. Cl.**[2] **B65B 1/04;** B65B 1/22

[58] **Field of Search** 141/1, 11, 12, 69, 71, 141/72, 73, 74, 78, 79, 80, 131, 163, 164, 168, 171, 256, 270, 283, 324, 118, 124; 221/211; 222/167, 367; 259/DIG. 24, 3; 198/55, 158

[56] **References Cited**

UNITED STATES PATENTS

2,324,824	7/1943	Chilson et al.	221/211 X
2,937,670	5/1960	Eisenberg	141/78
3,217,760	11/1965	Eisenberg	141/12
3,298,404	1/1967	Eisenberg	141/1

Primary Examiner—Richard E. Aegerter
Assistant Examiner—Frederick R. Schmidt
Attorney, Agent, or Firm—Kenyon & Kenyon Reilly Carr & Chapin

[57] **ABSTRACT**

A container filling machine of the type in which containers are conveyed in a line through an open-ended rotating drum having circumferentially spaced shelves around the inside with pivoted gates for raising the product to a discharge point above the containers, includes the following improvements for reducing product damage and contamination and increasing versatility and adjustability: wedge-shaped shelf gates, drum support rollers above the drum axis, a pin-type drum drive with solid pins on the drum and roller bushings on the drive pinion, a frusto-conical product return section at the exit end of the drum, a circumferentially adjustable cam track for selectable bucket discharge location, an extendable shaker pan with infinitely adjustable position and slope for delivering discharged product to the containers, remotely adjustable tilt angle for containers by means of circular yoke support members held by automatically releasable clamps, and a container shaking mechanism with adjustable amplitude. An improved method for filling containers with relatively uniform spherical product includes tilting and shaking the containers as they are being filled, rather than after filling, to minimize overfilling and excessive product return.

23 Claims, 10 Drawing Figures

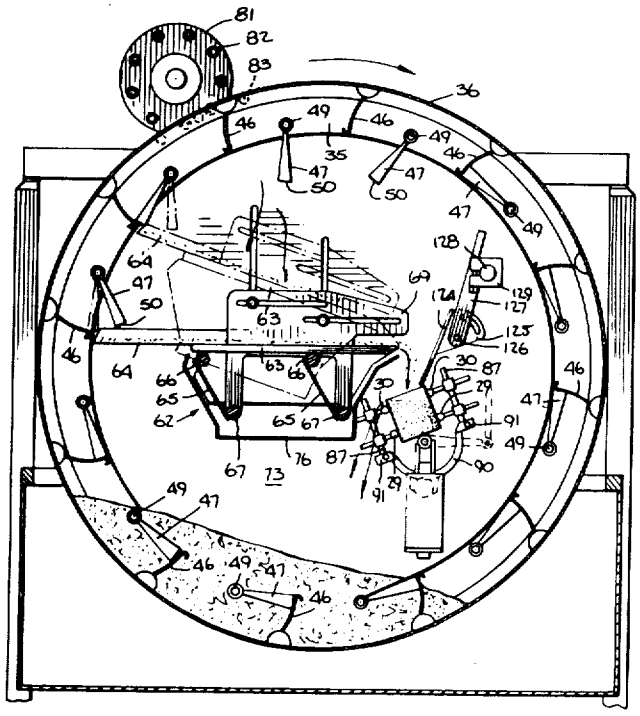
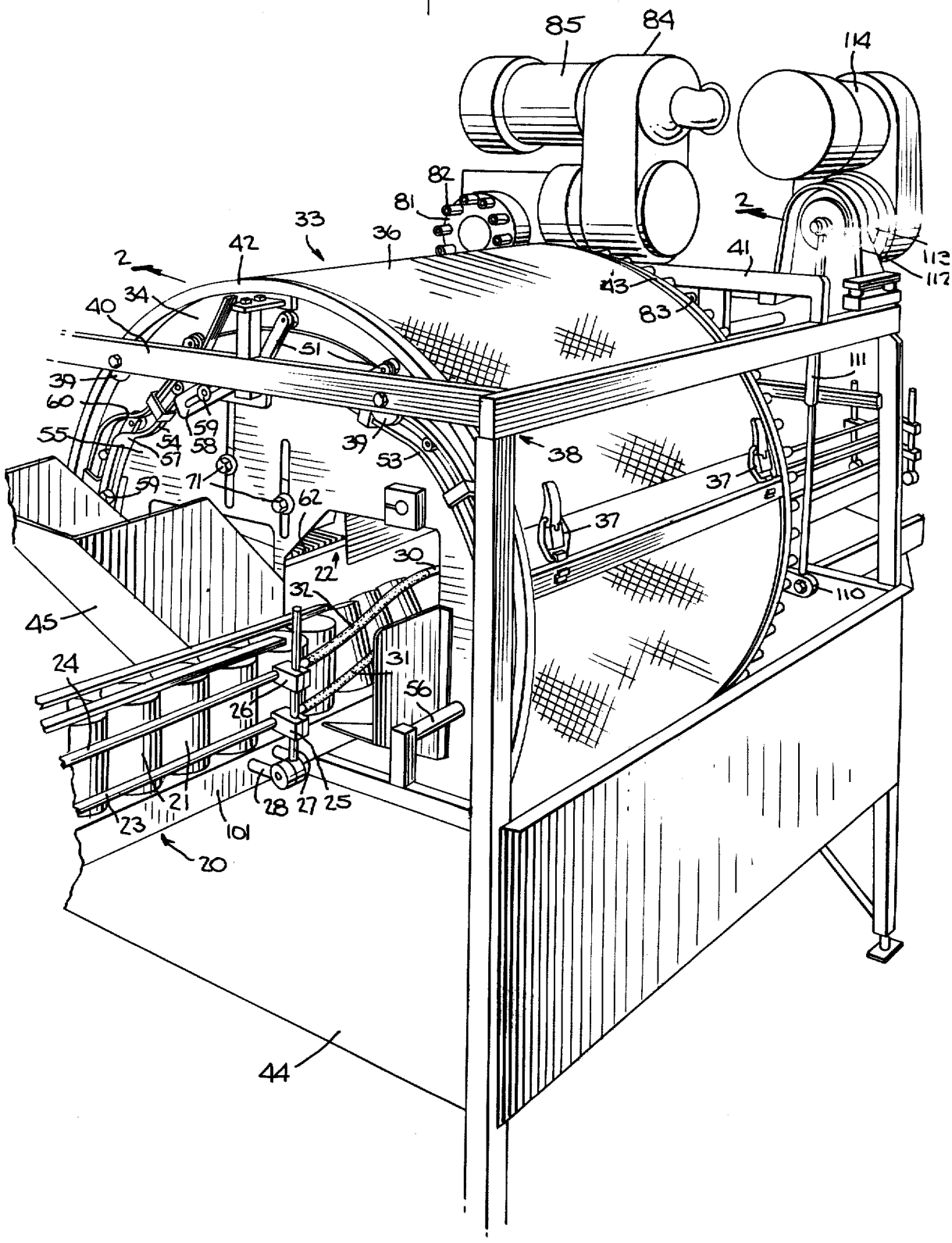


Fig. 1.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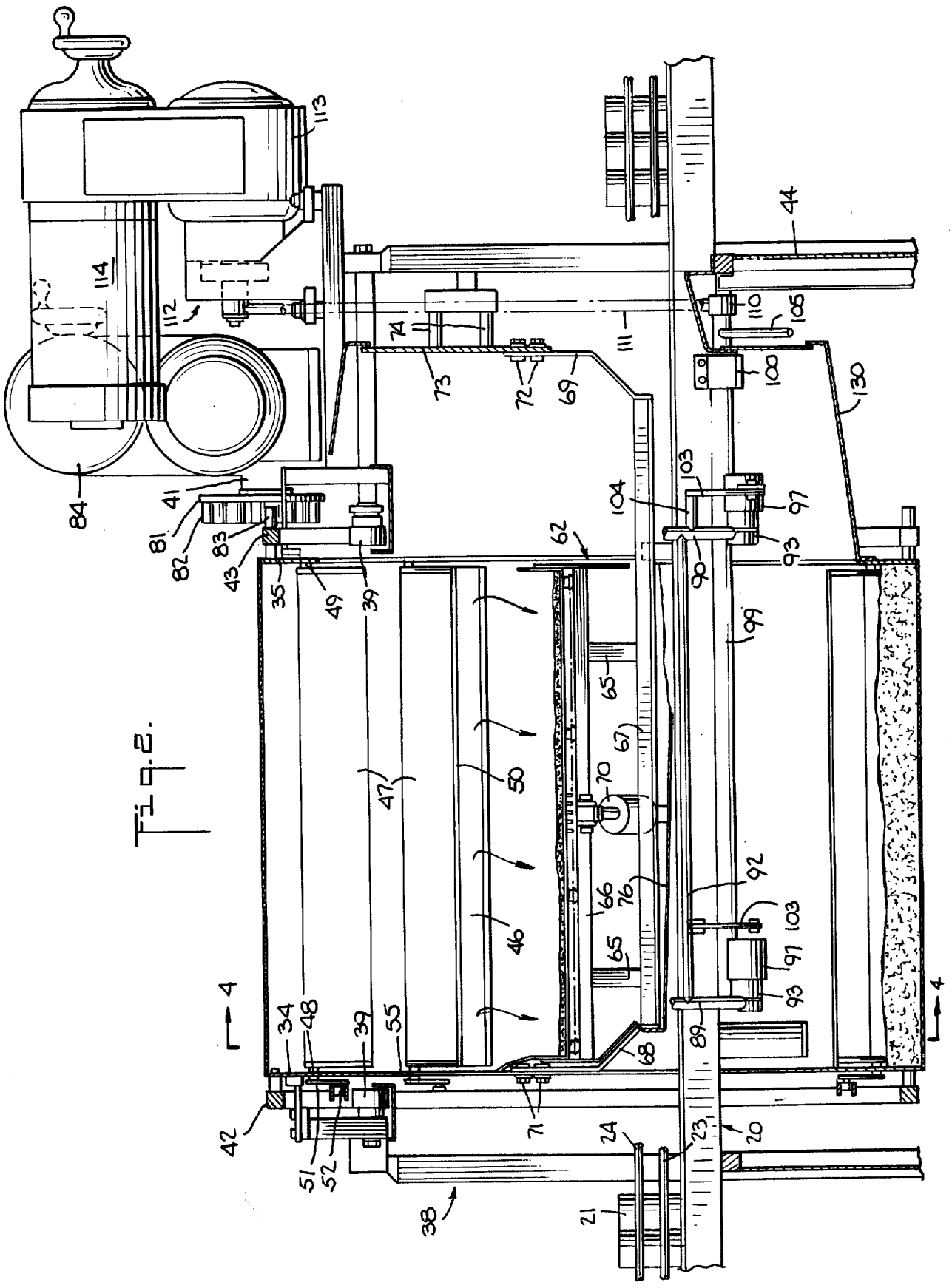
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FIG. 2.

Fig. 5.

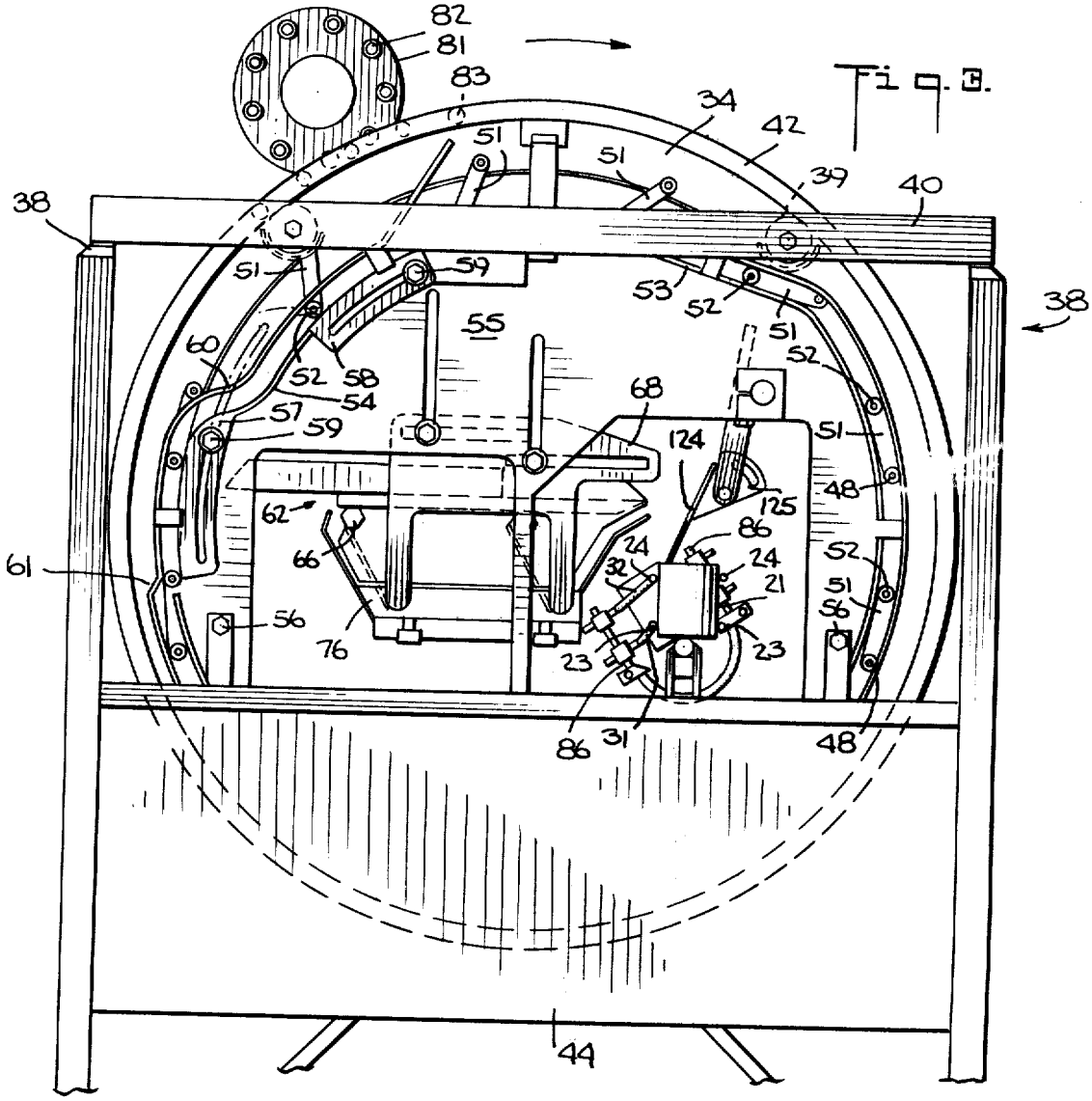
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Fig. 6.

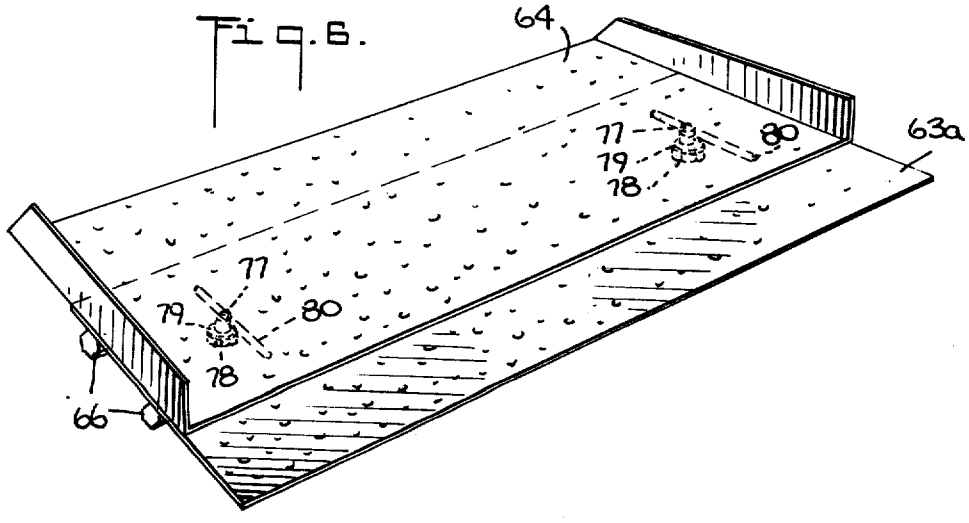
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Fig. 4.

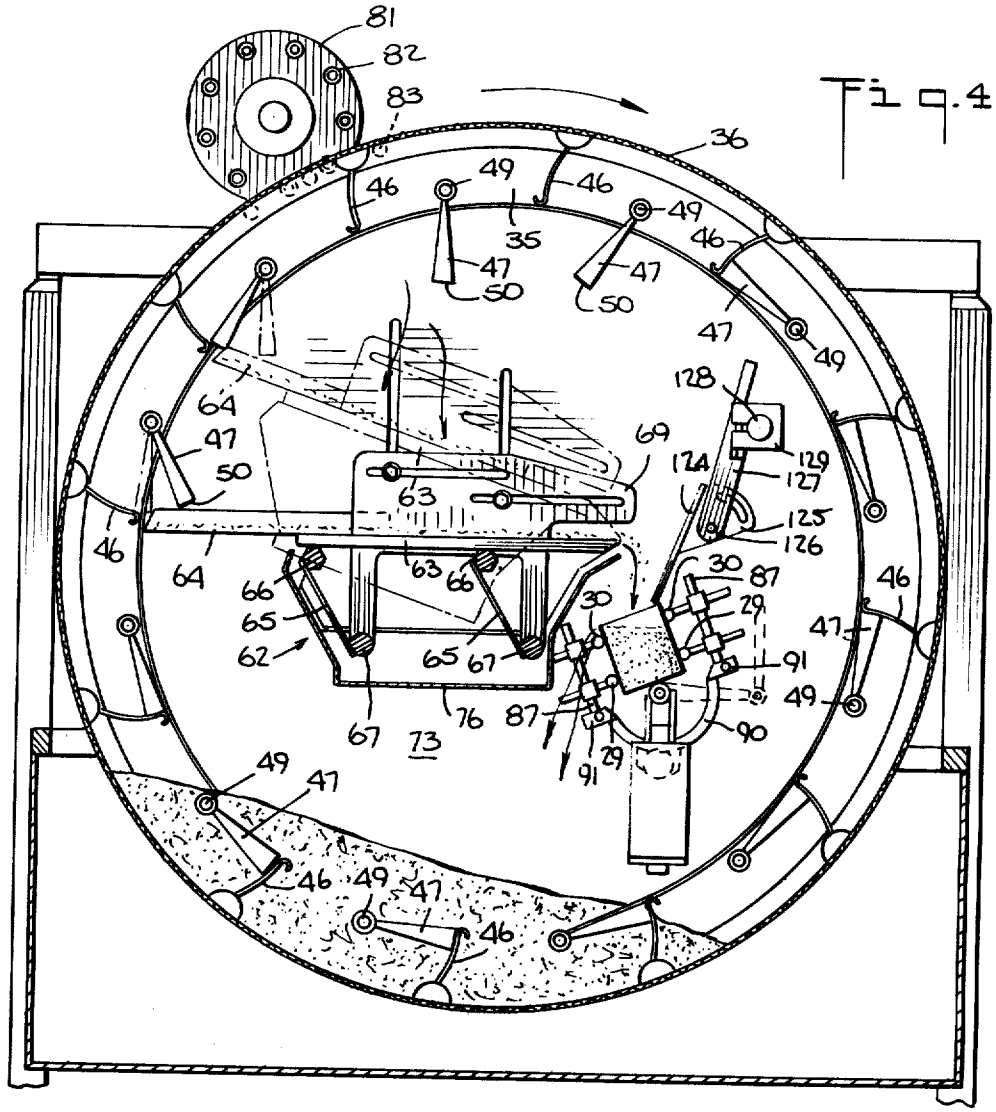
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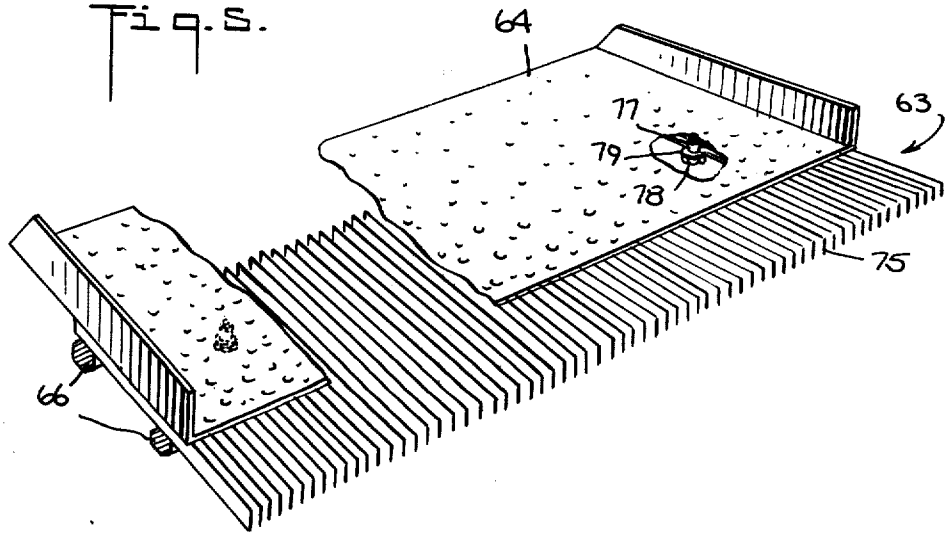
Fig. 5.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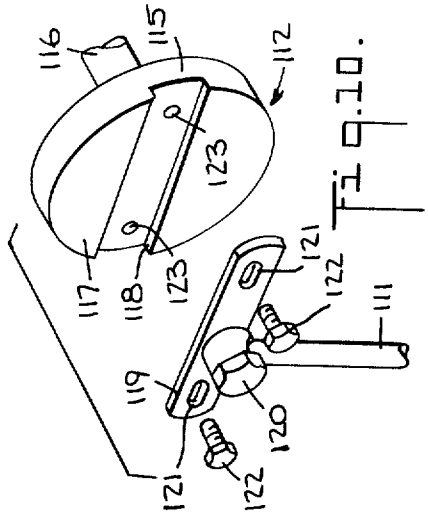
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Fig. 10.

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Fig. 7.

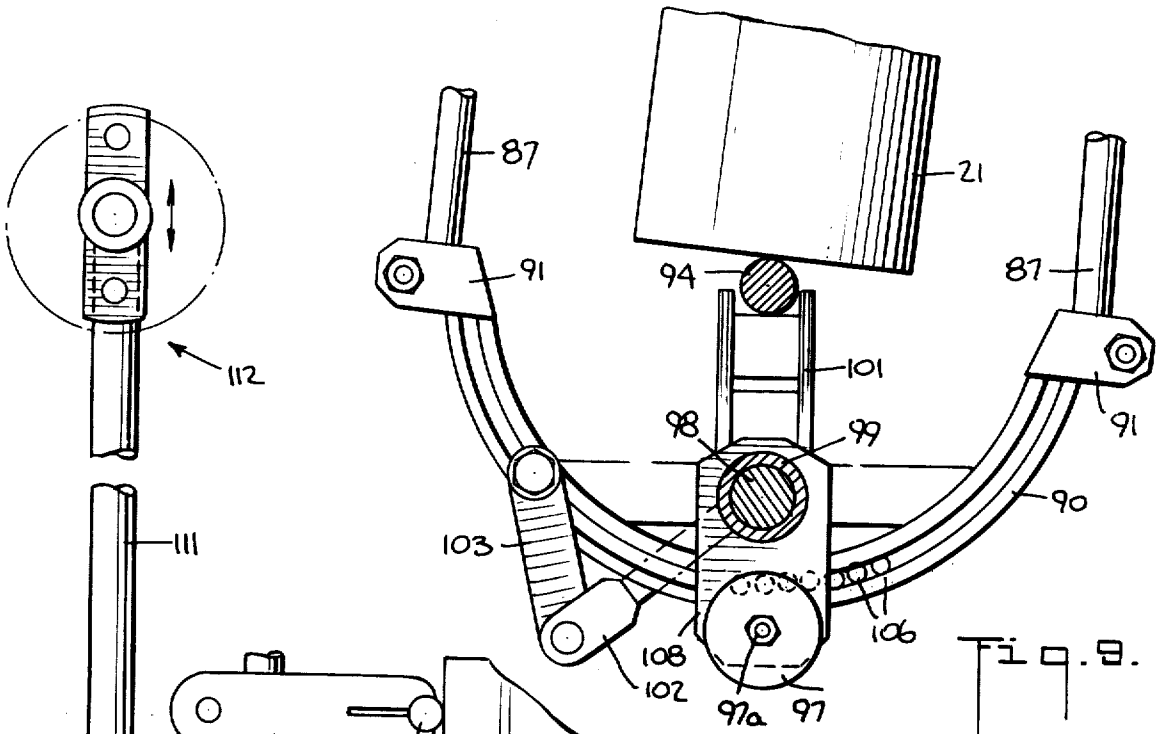
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Fig. 9.

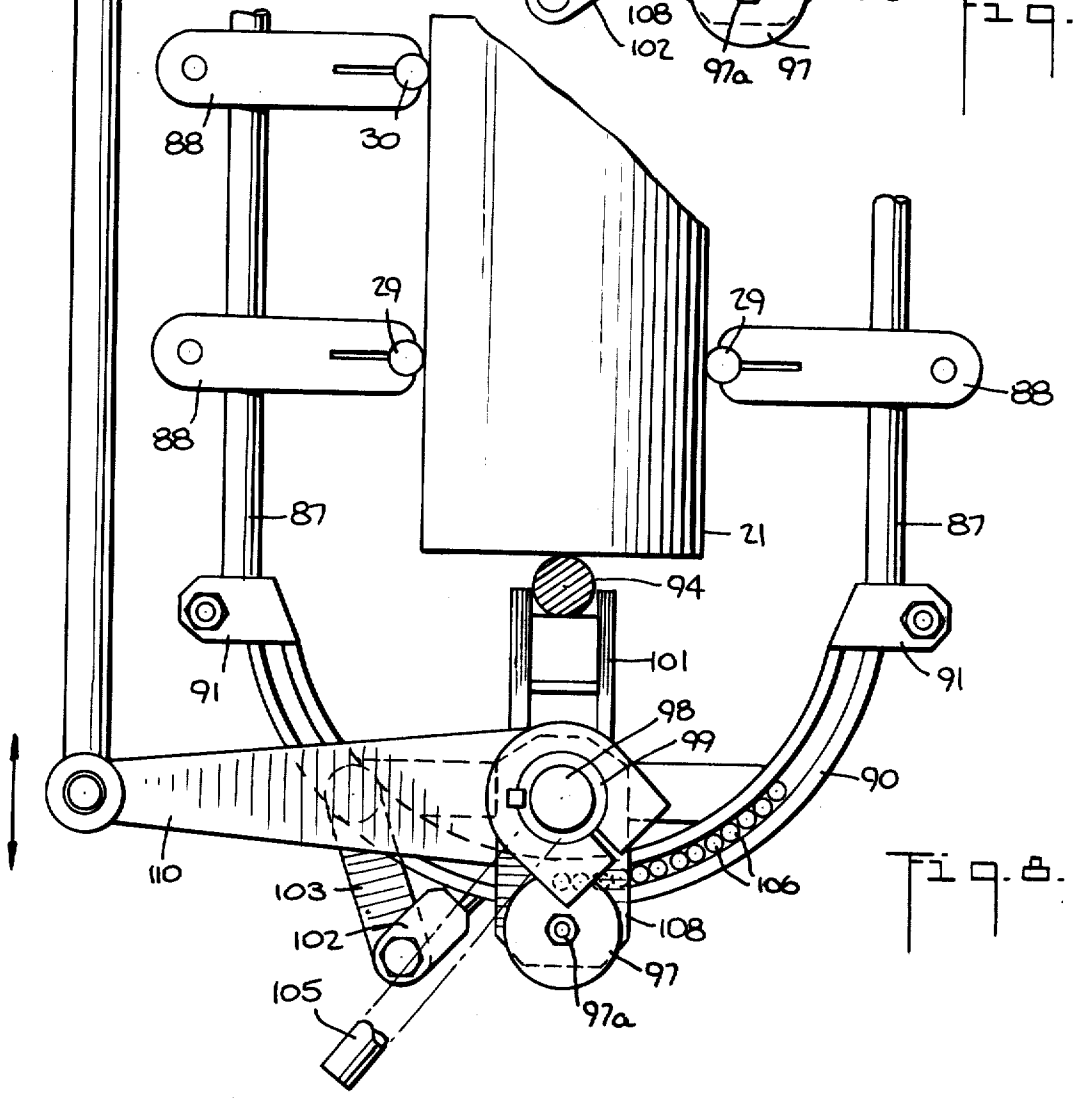
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Fig. 8.

MACHINE AND METHOD FOR FILLING CONTAINERS TO A PREDETERMINED LEVEL

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to machines and methods for filling containers and more particularly to machines and methods for compactly filling containers with relatively small pieces of material to a predetermined level within each container.

2. Description of the Prior Art

My previous U.S. Pat. Nos. 2,937,670, issued May 24, 1960; 3,217,760, issued Nov. 16, 1965; and 3,298,404, issued Jan. 17, 1967, disclose container filling machines of the type of which the present invention is an improvement, and their disclosures are incorporated herein by reference.

In these prior machines, empty containers such as cans or jars are placed on an elongated conveyor for transport past a material delivery location. The materials usually handled are small food items such as fruit, cut or sliced vegetables, and so forth. These materials are delivered by a chute to the interior of an open-ended drum surrounding the conveyor, with the drum axis extending generally in the direction of the path of travel of the containers on the conveyor. The drum is supported for rotation about its axis and is rotated by means of a suitable drive. Buckets or scoops spaced circumferentially around the inside of the drum pick up portions of the material in the bottom of the drum as it rotates and carry the portions to the top of the drum where the material is released into a shaker tray for delivery into the containers.

The machines in the patents cited above include means for agitating the containers to pack the materials more closely in the containers and to shake out any material in excess of the desired amount. These agitating means include guide rails positioned along either side of a portion of the line of containers. The guide rails are supported by members that are mounted for rotation through a limited angle about an axis parallel to the conveyor line. The axis may be either above or below the level of the conveyor surface. These support members are oscillated within a small angle about their mounting axis, and this motion is transferred to the guide rails which, in turn, swing or rock the containers back and forth in an arc transverse to the linear path of the conveyor.

If the axis of the support members is above the containers, the resulting centrifugal force is downward and tends to pack the material more tightly in the containers. If the axis is below the bottoms of the containers, the resulting centrifugal force is directed upward and tends to eject excess material from the upper portions of the containers. At the same time, the containers in these machines are given a translatory lateral shaking motion because the axis of rotary oscillation is either above or below the support surface of the conveyor. This lateral shaking motion aids in settling the materials in the containers in each case, that is, whether the swinging axis is above or below the bottoms of the containers.

In addition to the transmitting swinging motion to the containers, the guide rail support members in some of my prior machines also can be adjusted to tilt the containers to a selected angle with respect to the vertical after the filling step to shake out material in excess of

that required for a preselected fill level. See, for example, FIGS. **4–6** in U.S. Pat. No. 3,298,404 and the accompanying text col. 4, line 41 - col. 5, line 41. This technique is suggested as being useful when filling containers with relatively small pieces of material, a specific example being mushrooms. Alternatively, my U.S. Pat. No. 2,937,670 teaches (FIG. 7 and text col. 6, lines **65–74**) that the containers may be tilted during the filling step to facilitate filling with elongate or sliver form material, such as french cut stringbeans.

Although the machines disclosed in these prior patents provided uniform container filling for a wide range of products, operating experience has revealed a number of drawbacks which the improvements of the present invention are intended to correct. For example, the tilt angle of the guide rail supports shown in FIGS. **4–6** of U.S. Pat. No. 3,298,404 is adjustable only by means of individual screw clamps, and the adjustment cannot be made without shutting down the machine and going through a series of trial and error changes. Furthermore, although some control over the amount of agitation is permitted by varying the speed of the shaker motor, there are many times when it would be desirable also to change the amplitude of agitation. Such a change is not possible in the machines as disclosed in these prior patents.

In the prior scoop design for lifting material from the bottom to the top of the drum, fixed shelves as attached at an angle to the inner wall of the drum, and pivotally mounted gates cooperate with the shelves to form scoops or buckets for carrying material to near the top of the drum as it rotates. Near the top of the path of travel for each scoop the gates open by means of a crank and cam follower traveling in a circular cam track mounted at one end of the drum. A problem with the previous scoop design is that materials collect on the ledge formed by a portion of each fixed shelf that extends like a lip beyond the gate when the gate is in the closed position. This material drops back to the bottom of the drum before the gate opens, and if the material is a delicate product, it can be damaged by the fall.

Another problem encountered with the prior machines results from the manner of supporting and driving the drum. The drums are typically supported on roller wheels near their bottoms on either side of their vertical center lines. Since, for many food products, the lower part of the drum may be immersed in a water or syrup bath, the support wheels necessarily also are immersed in their bath, causing problems of lubrication, sanitation, and bearing seal leakage.

The prior drums are typically driven by an electric motor and reduction drive through a sprocket pinion wheel that engages circumferentially spaced steep pins mounted on a circular flange at one end of the drum. In order to reduce wear, the pins preferably carry roller bushings, but the periodic immersion of these bushings in the liquid bath also causes lubrication and sanitation problems.

In addition, it has been found that the technique of overfilling containers followed by tilting and shaking them to eject the excess causes damage to delicate products as the result of the product recycling and that the damage is increased by spiral vances spaced around the inner surface of the drum at its exit ends to return the material to the bucket section. The spiral vanes also create pulsations in product flow to the buckets, and

these pulsations adversely affect the uniformity of filling.

These and other problems have been solved by the machine and method of the present invention as will become apparent from the detailed description of the preferred embodiment in connection with the drawings.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved machine for filling containers on a conveyor line by having means for remotely adjusting the tilt angle of containers as they are being filled to maintain a preselected fill level with products of variable uniformity.

It is another object of the invention to provide a filling machine having a container shaking means in which the amplitude of shaking movement is adjustable.

Another object of the invention is to provide a container filling machine of the rotating-drum type that is particularly suitable for handling delicate food products such as cherries, mushrooms, olives, peaches, and so forth in which the product handling means are fully adjustable for optimum delivery rates with minimized product recycling and product injury.

A further object of the invention is to provide a rotary-drum filling machine in which product contamination from the drum supporting means and the drum driving means is eliminated.

An additional object of the invention is to provide an improved method for filling open-top containers to a preselected level without first overfilling and then ejecting excess material.

These and other objects are accomplished by a machine for filling containers conveyed by a conveying support member in a line past a material delivery station. Improved means for supporting the containers to permit adjustment of container tilt angle comprise means for guiding the containers past the material delivery station, means for supporting the container guiding means for rotation within predetermined angular limits about an axis approximately coincident with the centerline of the conveying support member, and means for remotely adjusting the supporting means for the container guides to position the guides at an angle corresponding to a preselected fill level.

By having the container guide support means rotatable about an axis coincident with the conveying member, which is preferably of elongated cylindrical form, the containers are always centrally supported on the conveying member regardless of the tilt angle.

The preferred container supporting and tilting means comprises at least one pair of parallel side rails, at least one circular yoke for supporting the guide rails along each side of the line of containers, and a remotely releaseable clamp for holding the yoke concentric with the centerline of the conveying member. When the clamp is released, the yoke can be slidingly adjusted relative to the clamp by means such as a crank and connecting link arrangement mounted adjacent to the yoke on one end of a rotatable shaft, with the yoke being maintained concentric with the centerline of the conveying member as it slides in the clamp.

In a preferred arrangement, the clamp is mounted on a hollow shaft concentric with the first-mentioned shaft, and the hollow shaft is oscillated about its axis, preferably by a motor-driven eccentrically mounted journal through a connecting rod and lever, to transmit a lateral shaking motion to the containers through the yoke and guide rails. The shaking amplitude can be adjusted by varying the eccentricity of the journal relative to the motor shaft.

The filling machine of the invention preferably includes a rotary-drum type device having improved means for delivering a variety of materials to the containers in optimum fashion with minimum product recycling and resultant damage to delicate products such as food items. These improved delivery means comprise the following:

- wedge-shaped pivoted gates cooperating with concave shelves spaced circumferentially around the inside of the rotating drum to form variable capacity buckets for raising material from the bottom of the drum to a discharge location above the containers, the wide edge of each wedge-shaped gate slidably engaging the corresponding concave shelf without exposing a shelf lip that would otherwise tend to pick up material and subsequently drop it at a point other than the desired discharge point;
- means for opening the bucket gates that can be shifted angularly to adjust the discharge point from the buckets, the opening means comprising a cam track segment mounted adjacent to one end of the drum, the cam track engaging cam followers on the free ends of cranks connected to each bucket gate, the cam track segment being angularly shiftable within the range of desired bucket discharge locations;
- a shaker pan for conveying material from the bucket discharge position to the containers, the pan comprising a main section and an extension section which is extendable in an infinite number of steps between minimum and maximum pan lengths determined by the selected bucket discharge location and the position of the line of open-top containers;
- means for mounting the shaker pan for infinite adjustment between every possible bucket discharge location and every possible container position within the limits of the machine, the mounting means preferably comprising a pair of end plates attached to the shaker pan support, each end plate having at least one elongated slot; a pair of stationary support plates, one plate of the pair positioned at each end of the drum in flat contact with the adjacent end plate of shaker pan support and having at least one elongated slot extending in a direction transverse to the slot in the end plate, and a fastening device passing through both slots to permit infinite adjustment vertically, horizontally and angularly to the limits of the slots; and
- a frusto-conical product return section, preferably formed from dimpled sheet metal, for gently and continuously returning excess material that has been ejected from the filled containers or has fallen between them.

All the foregoing elements combine to provide maximum versatility in a single machine as well as optimum product handling with lowest possible spoilage.

Finally, the improved filling machine of the invention includes drum support trunnions that contact the inner surfaces of circular rings fastened to each end drum, the points of contact being above the drum axis and thereby completely avoiding contact with and contamination of material in the bottom of the drum, and the

drive pins for the drum that are spaced circumferentially around one of the circular trunnion rings are in one piece for easy cleaning, likewise to reduce product contamination.

In addition, the improved method of the invention comprises the steps of tilting and shaking a line of containers simultaneously with their being filled so that a preselected fill level is obtained without first overfilling and then shaking out and possibly damaging the excess material.

The advantages of these and other components of the improved filling machine and method of the present invention will be readily apparent from the following description of the preferred embodiment in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the improved rotary-drum container filling machine of the invention.

FIG. 2 is a section view in elevation along lines 2—2 of FIG. 1.

FIG. 3 is a view of the entrance end of the machine of FIG. 1.

FIG. 4 is an end view in section taken at the material delivery station of the filling machine along lines 4—4 of FIG. 2.

FIG. 5 is a perspective of one preferred embodiment of the shaker pan of the invention.

FIG. 6 is an alternate embodiment of the shaker pan.

FIG. 7 is a side view, partially cut away, of the container tilting and shaking mechanism of the machine of FIG. 1.

FIG. 8 is an end view along lines 8—8 of FIG. 7 of the container tilting and shaking mechanism with the containers in the vertical position.

FIG. 9 is an end view along line 9—9 of FIG. 7 of a portion of the mechanism of FIG. 6 with the containers in a tilted position.

FIG. 10 is an exploded view of the preferred variable eccentricity shaker drive mechanism of the machine of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, FIG. 1 shows a perspective view looking at the entrance end of the preferred embodiment of a filling machine according to the invention. An elongated conveyor, generally designated by 20, carries a line of open-top containers, such as cans 21, in a linear path past a container filling station 22 located above the open containers and extending along a portion of the linear path.

The cans are guided on the conveyor to the filling station by two pairs of guide rails 23 and 24, one rail of each pair extending along each side of the line of containers. Guide rails 23, 24 are adjustable in height by clamps 25 and 26 mounted on an upright bar 27. A horizontal bar 28 permits lateral adjustment between the rails for different size cans.

For at least a portion of the path past the container filling station guide rails 23, 24 are replaced by pairs of tiltable guide rails 29 and 30 (see FIGS. 4 and 7–9). Tiltable rails 29, 30 are connected to the guide rails 23, 24 by flexible tubing 31 and 32; so that the cans have continuous support as they travel along the linear path of the conveyor.

A means for delivering material to the container filling station includes an open-ended rotary drum 33 made of annular end plates 34 and 35 (see also FIG. and a cylindrical porous shell 36 wrapped around end plates 34, 35 and fastened with latches 37. The arrangement of the interior of the drum will be discussed in connection with FIGS. 2 and 4 below.

Drum 33 is supported within a rectangular frame 38 for rotation about its axis on two pairs of rollers 39, one pair of rollers mounted at each end of the drum on frame members 40 and 41. Each pair of rollers 39 contact the inner surface of a circular track 42 or 43 attached to the corresponding annular end plate 34 or 35. The roller contact points are above the drum axis and equidistant from a vertical plane bisecting the drum lengthwise. This mounting location is an improvement over the below-axis trunion mounting common with rotary-drum equipment because the rollers are more accessible and do not contaminate material in rectangular tank 44 which surrounds the lower portion of the drum.

Material to be filled into the containers is delivered into the bottom of the drum through a chute 45. A typical application for the machine of FIG. 1 is to fill cans or other containers with delicate food products, such as fruit, that are packed in a syrup or juice. Tank 44 provides a reservoir for the liquid portion, which has easy access to the interior of the drum through the porous shell 36. The porous shell is preferably made of smoothly perforated sheet metal to reduce product abrasion, but wire screening may also be used.

Referring to FIGS. 2 and 4 for further details of the drum design, a number of shelves 46 are attached to the inner surface of the drum. Each shelf has a concave surface facing the direction of drum rotation (as indicated by the arrow in FIG. 4). A wedge-shaped gate 47 is associated with each shelf. Each gate is attached at its ends to a pair of shafts 48 and 49, the shafts being rotatably mounted on end plates 34 and 35, respectively, coincident with the axis of curvature of the corresponding shelf surface. The wide edge 50 of each gate mates with the corresponding concave shelf surface to form a bucket for picking up a portion of the material in the bottom of the drum as the drum rotates, as shown in FIG. 4. The gates are actuated to close the buckets on the downward travelling side of the drum before they enter the material at the bottom and then to open the buckets at preselected discharge points in the upper quadrant of upward travel.

As shown in FIG. 3, the means for actuating the bucket gates includes arms 51 having one end attached to the outer end of each shaft 48 for swinging the associated gate 47. The free end of each arm 51 carries a cam follower 52 that engages a stationary cam track 53 for the portion of travel from approximately the 12 o'clock position to the 9 o'clock position and an adjustable cam track 54 for the remaining quadrant.

Cam track 53 is bolted directly to a stationary circular end plate 55 which, in turn, is attached to rectangular frame 38 by spacer bolts 56. Adjustable cam track 54, on the other hand, is attached to circular end plate 55 by means of slotted mounting plates 57 and 58 and bolts 59, the slots in mounting plates 57 and 58 permitting circumferential shifting of an inflection point 60 between a lower limit (shown in solid lines) to an upper limit (shown in dashed lines). The location of inflection point 60 determines the gate opening location for each

bucket, according to the dictates of container size and type of product being handled, as shown more clearly in FIG. 4, where the solid and dashed line positions correspond to the same positions in FIG. 3.

The wedge shape of the bucket gates provides an important advantage in delivering delicate products that can be damaged by too much handling. After each bucket has been filled from the reservoir of material in the bottom of the drum, it is desirable to swing the gate outward a slight amount to increase the bucket capacity so that the top layer of material will not fall out when the bucket tilts as it travels through the upper quadrant to the discharge point. This slight swinging action is accomplished by an additional inflection point 61 (FIG. 3) in cam track 54 ahead of the discharge inflection point 60. The shift caused by inflection point 61 is illustrated in FIG. 4 by the dashed line position of the bucket gate at the 10 o'clock position. It is apparent that the wedge shape of the gate provides sealing contact with the shelf of the bucket both before and after inflection point 61 without creating an exposed lip of the shelf to collect material which will subsequently drop off before reaching the bucket discharge point.

At either extreme gate opening location, as well as any desired intermediate position, the material in each bucket in turn is delivered to a shaker pan assembly 62 which includes a chute 63 with an adjustable extension 64. Chute 63 is pivotally mounted on legs 65 by means of upper hinge pins 66 attached to the under side of chute 63 and lower hinge pins 67 attached to end plates 68 and 69. By this arrangement, shaker pan assembly 62 can be given a substantially longitudinal vibration by a drive means such as a pneumatic piston and cylinder assembly 70 (FIG. 2) to assist in delivering the product discharge from buckets uniformly to the line of containers.

End plate 68 has a pair of parallel slots by which it is attached to stationary end plate 55 by means of bolts 71 through a complementary pair of parallel slots in end plate 55 that extend in a direction transverse to the direction of the slots in end plate 68. End plate 69 is attached in a similar manner by bolts 72 to a stationary circular end plate 73; similar to end plate 55 and mounted at the other end of the drum to frame 38 by spacer bolts 74 (see FIG. 2).

As shown most clearly in FIG. 4, the arrangement of complementary slots in end plates 68, 69 of shaker pan assembly 62 and stationary end plates 55, 73 permits continuous adjustment of both the height and the angle of the shaker pan assembly between upper and lower limits corresponding to the upper and lower limits of bucket discharge location. At the same time, chute extension 64 can be infinitely adjusted to properly relate to every bucket discharge location between the upper and lower limits permitted by adjustable cam track 54. In this way, a large range of container sizes can be accommodated and the optimum chute angle obtained for a variety of products.

Referring to FIGS. 5 and 6, two alternate versions of the shaker pan assembly can be provided, depending on the material being handled and the type of pack desired. In the embodiment of FIG. 5, chute 63 is made up of a plurality of elongated flat bars 75 arranged on edge in spaced parallel relation and welded to upper hinge pins 66. The parallel bars 75 allow liquid to drain back to the drum through a sump 76 while serving as guides for products moving forward from adjustable extension 64, which is shown as fabricated from dimpled sheet metal and is fastened by studs 77 welded to its underside and extending between adjacent bars 75, which act as a slot to allow continuous adjustment between the limits imposed by hinge pins 66. At any desired position between these limits, extension 64 can be clamped to chute 63 by a nut 78 on each stud bearing against a washer 79 in contact with the lower edges of the adjacent bars 75.

In cases where no drainage is desired, the alternate embodiment of FIG. 6 substitutes a chute 63*a* of dimpled sheet metal having slots 80 for the spaced bars of FIG. 5.

Another improvement of the present invention is the drum drive means shown in FIGS. 1–4. As mentioned in the description of the prior art, previous machines of this type used a sprocket and pin drive, with the pins being mounted on a ring at one end of the drum. It was found that plain steel pins tended to wear rapidly; so the pins were equipped with nylon sleeves or roller bushings to reduce wear, but these created crevices that were difficult to clean and created a source of contamination that was unsatisfactory in a machine for handling food products. In the present embodiment, the sprocket pinion has been replaced by a pin-type driving member 81 carrying rollers 82 that are circumferentially spaced for meshing engagement with pins 83 mounted on circular track 43. Driving member 81 is itself driven by a conventional variable speed reduction drive 84 powered by an electric motor 85.

The improved pin-to-pin drive works smoothly and well. It retains the advantage of having roller bushings for minimum wear, but by allowing the rollers to be placed on the driving member, the pins on the drum can be perfectly plain for maximum sanitation.

In FIGS. 7 through 9, the improved container tilting and shaking assembly is shown in detail. This assembly includes, as mentioned earlier, pairs of tiltable guide rails 29 and 30 for supporting the containers for at least a portion of their travel past the material delivery station at any desired angle within predetermined limits as the containers are being filled. Each pair of guide rails is mounted on two pairs of upright posts 86 and 87 by clamps 88. The lower ends of posts 86, 87 are fastened to arcuate yokes 89 and 90, respectively, by clamps 91. Yokes 89 and 90 are joined as a unitary structure by an assembly swing rail 92, and each yoke is releasably held by means such as clamps 93 at a distance from the centerline of a conveying support member 94 for containers 21 equal to the radius of the yoke arc. Conveying support member 94 preferably has a circular cross section so that the containers will make only line contact at every tilt angle.

Each clamp 93 is biased in the closed position by a spring 95 acting against the back of a piston 96 in a pneumatic cylinder 97. Air supplied under pressure from a remote valve (not shown) to fittings 97*a* at each cylinder releases clamps 93 when it is desired to change the support angle of yokes 89, 90. When clamps 93 are released, the yokes can be slidably moved relative to the clamps by means that permit remote adjustment of tiltable guide rails 29, 30. These means include a shaft 98 extending generally parallel to the direction of the path of travel of the containers and supported for rotation about its longitudinal axis within an additional hollow shaft 99 which is supported in bearings 100 from structure 101 of elongated conveyor 20.

Crank arms **102** extend radially from shaft **98** near each yoke and are connected at their ends through links **103** to yokes **89** and **90** by way of swing rail **92** and an extension stub **104**, respectively, so that rotation of shaft **98** by a radial handle **105** results in sliding movement of the yokes relative to the clamps, as shown in FIGS. **8** and **9**. Handle **105** is located at the outer end of shaft **98** outside of the drum structure (see FIG. **2**) so that the yokes can be adjusted easily and safely while the drum is rotating merely by actuating the remote air valve (not shown) to release clamps **93** and then swinging handle **105** until the yokes are shifted to produce the desired tilt angle for containers **21**.

It will be noted that, because of their arcuate construction, yokes **89** and **90** will remain substantially concentric with the centerline of conveying support member **94** throughout their range of adjustment with respect to clamps **93**. This insures that with only a single remote adjustment (i.e. movement of handle **105**), the containers can be tilted through a predetermined angular range while the container bottoms remain substantially centered on the conveying support member for maximum stability.

If the machine is intended for relatively long term operation with a fixed tilt angle, yokes **89, 90** can be locked with respect to clamp assemblies **93** at any of a finite number of positions within the limits of yoke adjustment, each finite position being determined by a countersunk hole **106**, by means of setscrews **107** (see FIG. **7**).

It should be noted further from FIGS. **8** and **9** that to achieve the indicated range of adjustment the lengths of crank arms **102** and connecting links **103** are chosen so that each connecting link exerts a force on the yoke in response to rotation of shaft **98** that has a substantial component tangent to the curve of the yoke at the clamping assembly **93** for all of the selectable points in the range. This tangential component is necessary to cause the yoke to slide relative to the clamp in response to swinging the handle **105**.

Although the crank and link arrangement is both a simple and effective way to adjust the tilt angle of yokes **89, 90**, other means, such as arcuate rack and pinion or motor-driven worm and gear arrangements, could be used to accomplish the same result of remotely adjusting the yokes with respect to their clamps while maintaining them substantially concentric with conveying support member **94**.

The double shaft arrangement described above also permits angular shaking of the tiltable guide rail assembly at any angular position of the assembly. This is accomplished by locking each clamp **93** to hollow shaft **99** by means of a clamp **108** and tapered locking pin **109**. At the outer end of shaft **99** is a crank arm **110** connected through a telescopically adjustable connecting rod **111** to an eccentric drive member **112** which can be rotated at selectively variable speeds by means of a conventional variable speed reduction unit **113** driven by an electric motor **114**.

In operation, electric motor **114** rotates eccentric drive member **112** at selectively variable speed through reduction unit **113**. Eccentric drive member **112** converts rotation into longitudinal reciprocation of connecting rod **111** which, in turn, converts to rotary oscillation of crank arm **110**. This rotary oscillation is transmitted through outer shaft **99** and clamps **108** and **93** to the yoke assembly.

From inspection of FIG. **8** it is apparent that the angular shaking motion is centered about the axis of shaft **99**, which is displaced from the centerline of conveying support member **94**. Therefore, the shaking action on containers **21** will not be a pure rocking motion but will include lateral translation as well. The rocking component of the shaking action exerts a centrifugal force on the contents of the containers that tends to eject material at and near the top. The lateral translation component, on the other hand, tends to shake the contents below the top down to fill up any voids and make a solid and more uniform pack while ejecting any overfill above the top edge of the containers.

FIG. **10** shows an exploded view of the assembly of eccentric drive unit **112** that permits adjustment of the eccentricity to selectively vary the shaking amplitude within predetermined limits. Eccentric drive unit **112** consists of a coupling **115** attached to the end of an output drive shaft **116** from variable speed reduction unit **113**. Coupling **115** has a flat end face **117** perpendicular to the axis of drive shaft **116**, with a diametral groove **118** in the end face. A bar **119** mates with groove **118** for sliding motion therein. A stub journal **120** extends from the center of bar **119** for rotatably mounting the upper end of connecting rod **111**.

Bar **119** also includes two elongated slots **121** to permit limited longitudinal movement of the bar in groove **118** when attached to coupling **115** by two cap screws **122** threaded into mating holes **123** in the base of groove **118**. In this way the eccentricity of drive member **112** can be adjusted within the limits of slots **121**.

The operation of the improved container filling machine of the present invention thus includes the steps of conveying the containers in a linear path on a moving conveyer line past the material delivery station **22**, tilting the line of containers in a portion of the linear path extending along the end of discharge chute **63** about an axis substantially coincident with the centerline of conveying support member **94** to an angle that corresponds to a preselected fill level, filling the tilted containers with items delivered from chute **63**, and shaking the tilted containers as they are being filled with a combined rocking and lateral translatory motion of adjustable frequency and amplitude to simultaneously pack the material uniformly in the containers and eject any overfill.

By tilting and shaking the containers as they are being filled rather than after the filling step, overfill and subsequent shakeout are minimized, with resulting reduction in product damage due to the additional handling that occurs during recycling.

My prior U.S. Pat. Nos. 2,937,670 and 3,217,760 disclose a procedure for tilting containers while they are being filled with elongated objects, slivers or the like, to avoid obstruction of the container openings, but there is no suggestion of tilting while filling to avoid excessive overfill and subsequent spillback, which can damage delicate products.

As shown in FIG. **4**, the possibility of product damage is further reduced by providing a deflection plate **124** attached to a sector plate **125** for pivotal adjustment about a pin **126** connecting the sector plate to a support arm **127** which is adjustably fastened to a shaft **128** by a clamp **129**. Shaft **128** is held at each end by suitable attachments to stationary end plates **55** and **73**. Deflector plate **124** is positioned to shield the product delivered from the end of chute **63** from the sharp

upper edges of tilted containers **21** so that only the smooth inner sides of the containers contact the product flow.

Additional product protection is provided by a truncated cone **130** of dimpled sheet metal attached to the exit end of drum **33.** Materials tipped or shaken from the containers into cone **130** as the containers leave the filling location slide gently back into the drum bucket filling area rather than being moved back by spiral vanes on the inside of the drum surface, as in previous designs. This provides still further gentle product handling action. Cone **130** also permits the use of a shorter drum, thereby reducing the amount of product required as a reservoir within the drum. Less product within the drum means less opportunity for product damage.

The improvements in drum-type container filling machines described above therefore provide both individually and in combination greater flexibility of operation and better product handling with reduced possibility of damaging delicate products. For example, the wedge-shaped bucket gates **47** eliminate the possibility of product dropback into the drum reservoir with the attendant opportunity for bruising or other damage to delicate products. The adjustable cam track **54** in conjunction with fully adjustable shaker pan assembly **62** produces a gentle, sliding product transfer from drum buckets to shaker pan for a wide variety of container sizes. The height of the pan can be adjusted to match the height of the containers, the angle of the shaker pan can be adjusted to the proper slide angle for a smooth, continuous flow for a variety of products, and the length of the shaker pan can be extended to match the discharge location of the drum buckets for full sliding product transfer. All these adjustable elements combine, therefore, for gentle, positive, damage-free product handling from the drum reservoir to the containers.

Furthermore, the arcuate shape of the support yokes for the tiltable container guide rails permit remote adjustment of the container tilt angle by insuring that the yokes are maintained substantially concentric with the conveying support member for all tilt angles so that the containers are not shifted to one side or the other as the tilt angle is changed but are kept safely centered on the conveyor.

By arranging the tiltable portion of the guide rails to extend along the width of the discharge end of the shaker pan so that tilting and shaking occur during the entire filling process, improved fill density control is achieved with less overfill and subsequent spillback. This arrangement, together with the truncated cone drum exit section, permit a much shorter drum because the major part of such product spill back as does occur takes place in the filling region. The result, as stated above, is a reduced product inventory requirement in the drum reservoir with less recycling and opportunity for product damage.

The ability of the disclosed apparatus to vary container shaking amplitude as well as shaking frequency allows the shaking motion to be optimally selected for the container size and product handled. This minimizes or eliminates any further opportunity for product damage inside the containers and during spilloff and maximizes control of product density and desired headspace in the filled containers.

Finally, the improved pin-to-six drum drive above-axis trunnion mounts minimize product contamination and permit fast cleanup and visual inspection.

What is claimed is:

1. In a machine for compactly filling containers with material to a preselected level of the type that includes an elongated support member for conveying containers in a linear path, means for delivering material into the containers from a location above a portion of the linear path, means for tilting the containers to an angle corresponding to the preselected fill level, and means for agitating the containers to pack the material closely in the containers and to eject excess material, the improvement wherein the means for tilting the containers to a predetermined angle comprises:

means for guiding the containers in the portion of the linear path below the material delivery location including

at least one pair of side rails positioned in spaced relation parallel to the portion of the linear path, one rail of each pair being in sliding engagement with one side of each container being conveyed, and the other rail being in sliding contact with the opposite side of each container;

means for supporting the guide means for rotation within predetermined angular limits about an axis approximately coincident with the centerline of the conveying support member including

at least one yoke in the form of a circular arc subtending an angle equal to at least the predetermined angular limits of rotation, means for connecting each end of the yoke respectively to one and the other of each pair of side rails, and

means located at a distance from the centerline of the conveying support member approximately equal to the radius of the circular arc formed by the yoke for holding the yoke at any selectable point between its ends that lies in an arc subtending an angle corresponding to the predetermined angular limits of rotation; and

means for remotely adjusting the container guide supporting means within the predetermined angular limits to position the container guiding means at the angle corresponding to the preselected fill level, the holding means permitting sliding movement of the yoke relative to the holding means from one of the selectable points to another in response to actuation of the remote adjusting means, the yoke when held at any of the selectable points being approximately concentric with the centerline of the conveying support member.

2. The machine of claim **1** wherein the means for holding the yoke comprises:

releasable clamp means located at a distance from the centerline of the conveying support member approximately equal to the radius of the circular arc of the yoke and

a remotely controlled device for selectively releasing the clamp means to permit sliding movement of the yoke relative to the clamp.

3. The machine of claim **2** wherein the remotely controlled device for selectively releasing the clamping means comprises a device actuated by pressurized fluid.

4. The machine of claim **1** wherein

the means for remotely adjusting the container guide supporting means within the predetermined angular limits comprises:

a shaft extending in the general direction of the path of travel of the containers and supported for rotation about its longitudinal axis;

means connected to the shaft and engaging the yoke for slidably moving the yoke relative to the holding means in response to rotation of the shaft; and

means connected to the shaft at a point remote from the holding means for controllably rotating the shaft by an amount sufficient to slide the yoke relative to the holding means to the selectable point corresponding to the desired container tilt angle.

5. The machine of claim **4** wherein

the means for moving the yoke relative to the holding means comprises:

a crank arm attached at one end to the shaft and

a connecting link having one end pivotally connected to a point on the yoke that is circumferentially spaced from the selectable holding points and having the other end pivotally connected to the other end of the crank arm, the lengths and relative angular positions of the crank arm and connecting link being chosen so that the connecting link exerts a force on the yoke in response to rotation of the shaft that has a substantial component tangent to the curve of the yoke at all of the selectable points, whereby the yoke can be adjustably positioned to all of the selectable points by sliding motion relative to the holding means in response to rotation of the shaft.

6. The machine of claim **4**, wherein

the means for agitating the containers to pack the material closely in the containers and to eject excess material comprises:

an additional shaft extending substantially parallel to the centerline of the conveying support member;

means for mounting the additional shaft for rotary oscillation about its longitudinal axis;

means for connecting the yoke holding means to the additional shaft for rotary oscillation therewith; and

means for oscillating the additional shaft about its axis with selectable frequency and amplitude about a mean position in which the yoke is substantially concentric with the centerline of the conveying support member.

7. The machine of claim **6** wherein the additional shaft comprises a hollow shaft, and the first-mentioned shaft is mounted concentrically inside the additional shaft.

8. The machine of claim **7** wherein the axis of the first-mentioned shaft and the additional shaft intersects a line between the centerline of the conveying support member and the mean position of the yoke holding means.

9. The machine of claim **6** wherein the means for oscillating the additional shaft about its axis with selectable frequency and amplitude comprises:

drive means having a rotatable drive shaft;

means for selectively controlling the speed of the drive shaft;

an eccentric journal coupled to the drive shaft;

means for selectively changing the eccentricity of the journal with respect to the axis of rotation of the drive shaft;

a connecting rod having one end mounted for rotation on the eccentric journal; and

means coupled to the additional shaft and to the other end of the connecting rod for converting reciprocal motion of the connecting rod to rotary oscillation of the additional shaft.

10. The machine of claim **9** wherein the means for selectively changing the eccentricity of the journal comprises:

a coupling attached to the end of the drive shaft, the coupling having a flat end face perpendicular to the drive shaft axis with a diametral groove in the face;

a bar mating with the groove for sliding motion therein, the journal being mounted on the sliding bar and extending parallel to the axis of the drive shaft when the bar is in the groove; and

means for clamping the bar at selected longitudinal positions relative to the groove, whereby the eccentricity of the journal axis relative to the drive shaft axis can be selectively established.

11. The device of claim **10** wherein the bar has at least one elongated slot extending for a portion of its length; the coupling has at least one threaded hole, the axis of the hole in the coupling intersecting the longitudinal axis of the slot in the bar; and the means for clamping the bar at selected longitudinal positions relative to the groove comprises:

a threaded fastener passing through the slot in the bar and engaging the threads of the hole in the coupling for permitting relative sliding movement between the bar and the coupling when the threaded fastener is loosened and for preventing relative movement between the bar and the coupling when the threaded fastener is tightened, whereby the eccentricity of the journal with respect to the drive can be selectively adjusted within the limits of the slot in the bar.

12. The machine of claim **9** wherein the connecting rod comprises:

means for selectively adjusting the length of the rod for providing additional adjustment of the tilt angle of the containers.

13. In a machine for filling containers to a predetermined level of the type that includes means for conveying containers in a linear path, an open-ended drum surrounding a portion of the conveying means with the drum axis extending substantially in the direction of the linear path, means for supporting the drum for rotation about its axis, means for rotating the drum on the support means, means for delivering to the interior of the drum material to be placed in the containers, means spaced circumferentially around the inside of the drum for raising portions of the material in the drum to a preselected discharge point above the line of containers, and means for directing material discharged from the raising means to the containers as they are conveyed to the linear path, the improvement wherein

the means spaced circumferentially around the inside of the drum for raising portions of the material in the drum to a discharge point near the top of the drum comprises:

a plurality of shelves attached to the inner surface of the drum, each shelf having a surface that faces in the direction of drum rotation and forms a concave cylindrical arc about an axis spaced radially inwardly from the inner surface to the drum;

a wedge-shaped gate for each shelf, each gate being mounted at its narrow edge for pivoting movement about the axis of curvature of the corresponding shelf surface, and the wide edge of each gate mating with the shelf surface to form a bucket for picking up a portion of the material in the bottom of the drum as the drum rotates; and

means for pivoting each gate to a closed position with respect respect to its corresponding shelf before each bucket passes through the material at the bottom of the drum and to an open position at a preselected discharge point above the containers, the wide edge of the gate providing a range of closed bucket volumes, departing on the fraction of gate edge engaging the shelf, without exposing the shelf lip for picking up unwanted material outside of the bucket.

14. The machine of claim **13** wherein the means for pivoting each gate to a closed position with respect to its corresponding shelf before each bucket passes through the material at the bottom of the drum and to an open position at a preselected discharge point comprises:

a crank for pivotally rotating the gate, the crank having

a shaft connected to the gate and extending to an outer end outside one end of the drum and

a lever arm with one end fixed to the outer end of the crank shaft;

a cam follower mounted on the other end of the lever arm;

a first cam track segment mounted adjacent to the end of the drum for engaging the cam follower over a first angular portion of its travel for closing the gate; and

a second cam track segment mounted adjacent to the end of the drum for engaging the cam follower over a second angular portion of its travel for opening the gate, the second cam track segment being angularly shiftable for varying the angular location at which the bucket gates will open, thereby varying the preselected discharge point.

15. The machine of claim **13** wherein the means for directing material discharged at the preselected discharge point from the raising means to the containers as they are conveyed in a linear path comprises:

a chute leading from the discharge point to the open upper portions of the containers;

a frame for supporting the chute; and

means for supporting the frame inside the drum to provide an infinite selection of horizontal, vertical and angular settings of the chute within predetermined limits.

16. The machine of claim **15** wherein the means for supporting the frame inside the drum to provide an infinite selection of horizontal, vertical and angular settings of the chute within predetermined limits comprises:

a pair of stationary end plates, one plate mounted adjacent to each end of the drum;

a pair of end plates attached one at each end of the frame, the frame end plates being spaced apart such that their outer surfaces contact the inner surfaces of the stationary end plates, one of each frame end plate and the contiguous stationary end plate having at least one laterally extending slot and the other plate having at least one slot extending in a direction transverse to the first-mentioned slot; and

at least one threaded fastener passing through the at least one lateral slot of one end plate and the at least one transverse slot of the contiguous end plate at each end of the drum, thereby permitting an infinite selection of horizontal, vertical and angular settings within the limits of the slot lengths.

17. The machine of claim **15** further comprising:

means for shaking the chute with respect to its supporting frame for increasing the flow of materials through the chute from the preselected discharge point of the raising means to the line of containers.

18. The machine of claim **15** wherein the chute comprises:

a main portion having a length corresponding to the shortest possible distance between a preselected discharge point and a line of containers within the adjustment limits of the machine and

an extension portion slidably mounted with respect to the main portion for extending the chute length in continuous increments to the longest possible distance between a preselected discharge point and a line of containers within the adjustment limits of the machine.

19. The machine of claim **18** wherein the main portion of the chute comprises:

a plurality of elongated flat bars extending in spaced relation parallel to the direction of material flow through the chute, the bars being cantilevered for a portion of their lengths, the free ends of the cantilevered bars defining the end of the chute adjacent to the line of containers, whereby liquid material will drain freely between the bars, leaving primarily solid material to be directed into the line of containers, and the free ends of the bars insure against unsanitary material retention surfaces.

20. The machine of claim **13** further comprising:

a frusto-conical exit section attached to the end of the drum from which the filled containers leave for returning excess material falling from the containers to the bottom of the drum.

21. The machine of claim **20** wherein the frusto-conical exit section comprises a dimpled inner surface for returning excess material to the bottom of the drum by gentle tumbling action.

22. In a machine for filling containers of the type that includes means for conveying containers in a linear path, an open-ended drum surrounding a portion of the conveying means with the drum axis extending substantially in the direction of the linear path, means for supporting the drum for rotation about its axis, means for rotating the drum on the support means, means for delivering to the interior of the drum material to be placed in the containers, means spaced around the inside of the drum for raising portions of the material in the drum to a preselected discharge point above the line of containers, and means for directing material discharged from the raising means to the containers as they are conveyed in the linear path, the improvement wherein:

the means for rotating the drum on the support means comprises:

a plurality of fixed pins attached in a circle to one end of the drum in spaced circumferential relation;

a drive means having a rotary drive shaft;

a circular drive member attached to the rotary drive shaft for rotation thereby;

a plurality of roller bushings arranged on the circular drive member in a circle concentric with the rotary drive shaft, the rollers being equally spaced circumferentially by a distance equal to the circumferential spacing of the fixed pins attached to the drum, the drive means being positioned so that the circle of roller bushings on the circular drive member engages the circle of fixed pins on the end of the drum for transmitting tangential driving force to rotate the drum on the support means.

23. The machine of claim **22** wherein the axes of the fixed pins attached to the end of the drum, the axes of the roller bushings mounted on the circular drive member, and the axis of the rotary drive shaft of the drive means are all parallel to the axis of drum rotation, and the circle of fixed pins on the end of the drum is tangent to the circle of roller bushings on the circular drive member.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,903,941 Dated September 9, 1975

Inventor(s) Bernard C. Eisenberg

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 28, after "fixed shelves", change "as" to --are--.

Column 2, line 50, after "immersed in" change "their" to --this--.

Column 2, line 54, after "spaced", change "steep" to --steel--.

Column 2, line 64, change "vances" to --vanes--.

Column 6, line 3, change "(see also Fig.)" to --(see also Fig. 2)--.

Column 12, line 1, change "pin-to-six" to --pin-to-pin--.

Column 14, line 56, change "to the linear path" to --in the linear path--.

Column 15, line 9, change "respect respect" to --respect--.

Column 15, line 14 change "departing" to --depending--.

Signed and Sealed this

sixth Day of *January 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks