Nov. 1, 1966 G. S. ANDERSON 3,282,024

PACKAGING APPARATUS FOR TETRAHEDRON-SHAPED CONTAINERS

Filed March 27, 1963 7 Sheets-Sheet 1

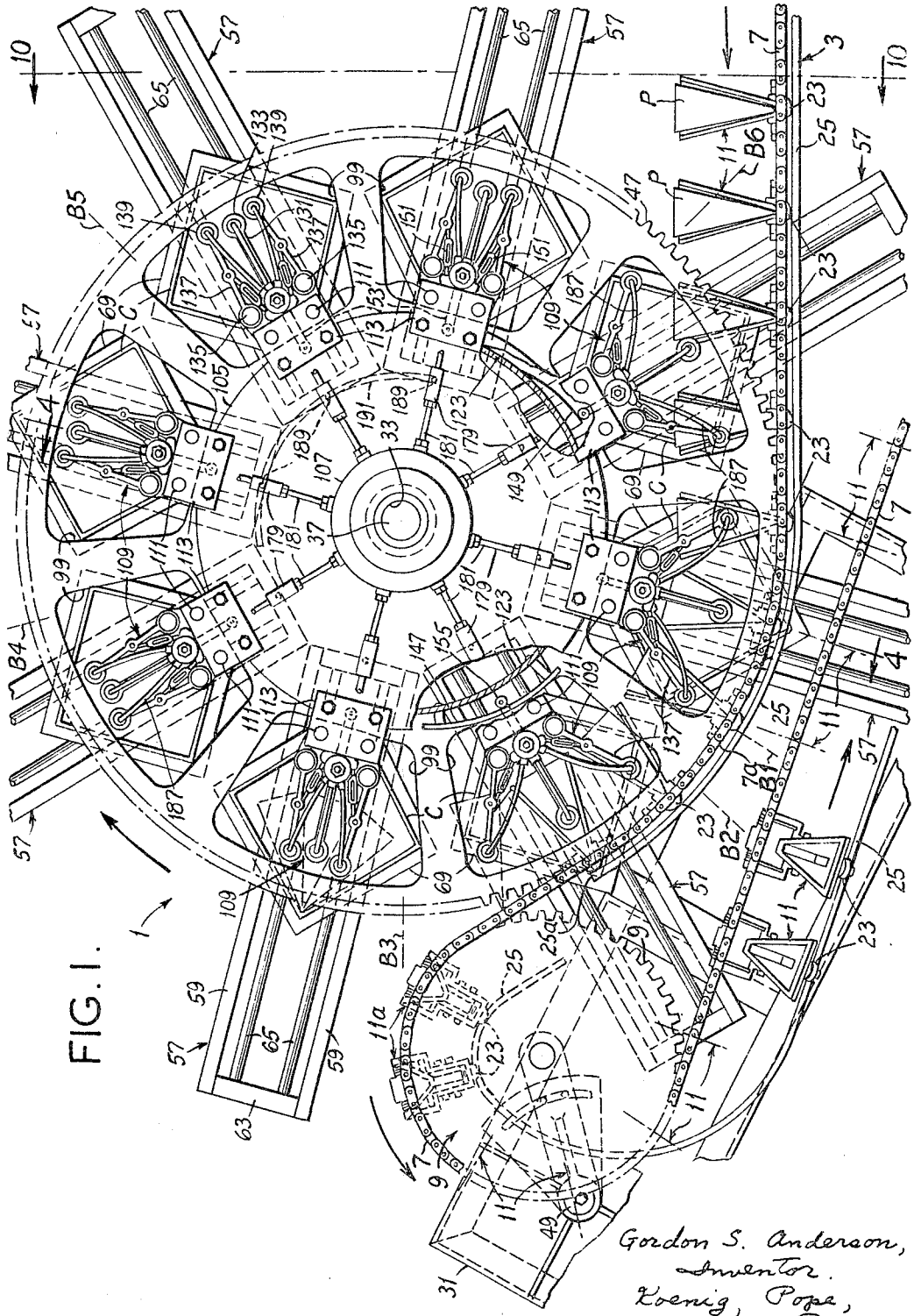


FIG. 1.

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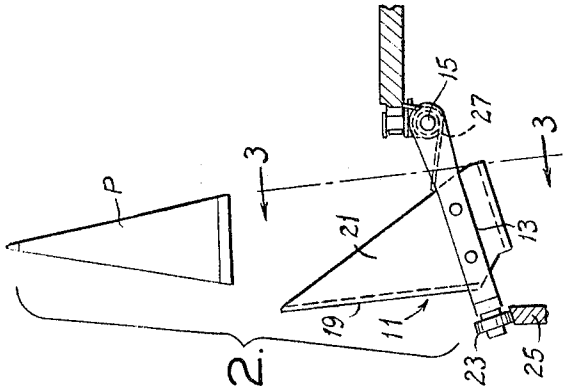


FIG. 2.

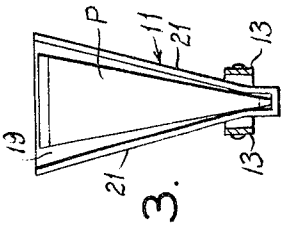


FIG. 3.

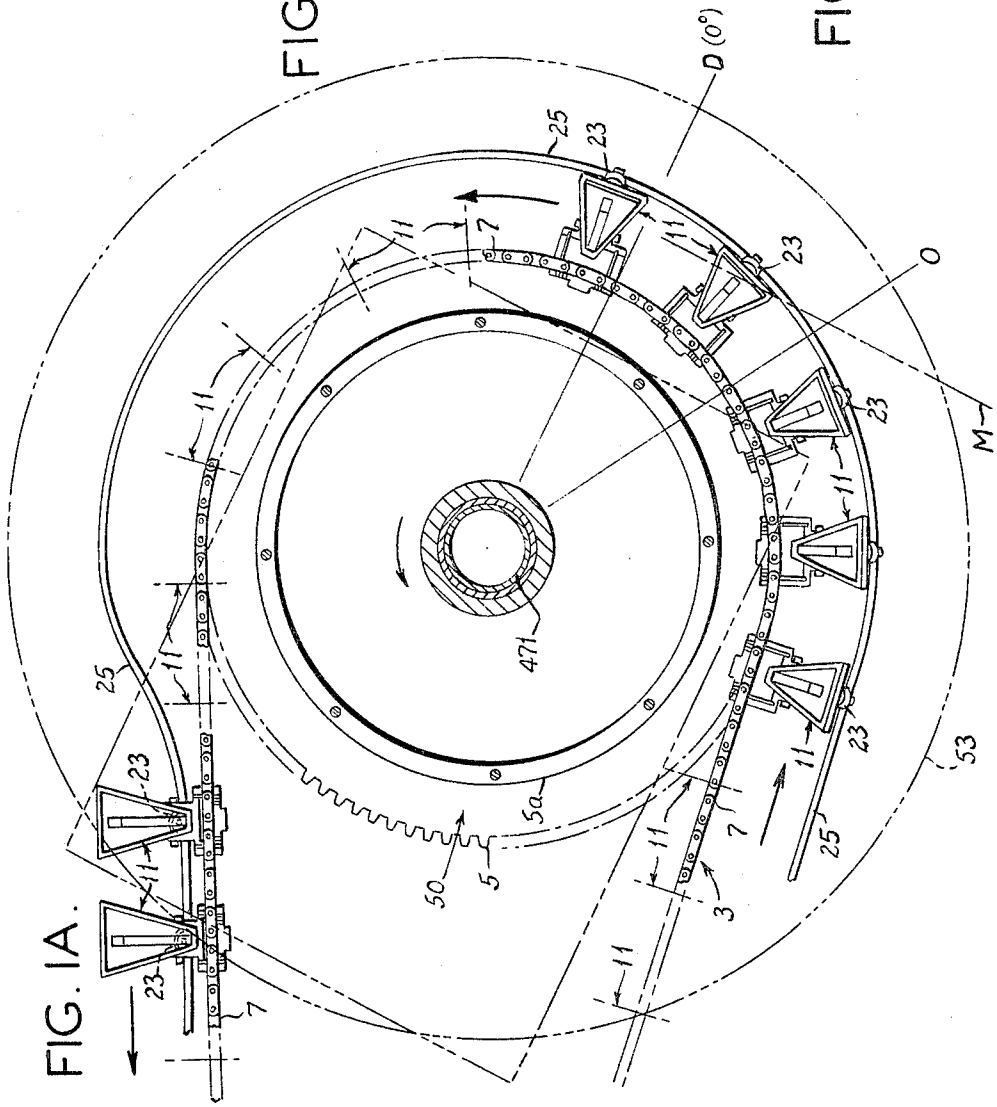


FIG. 1A.

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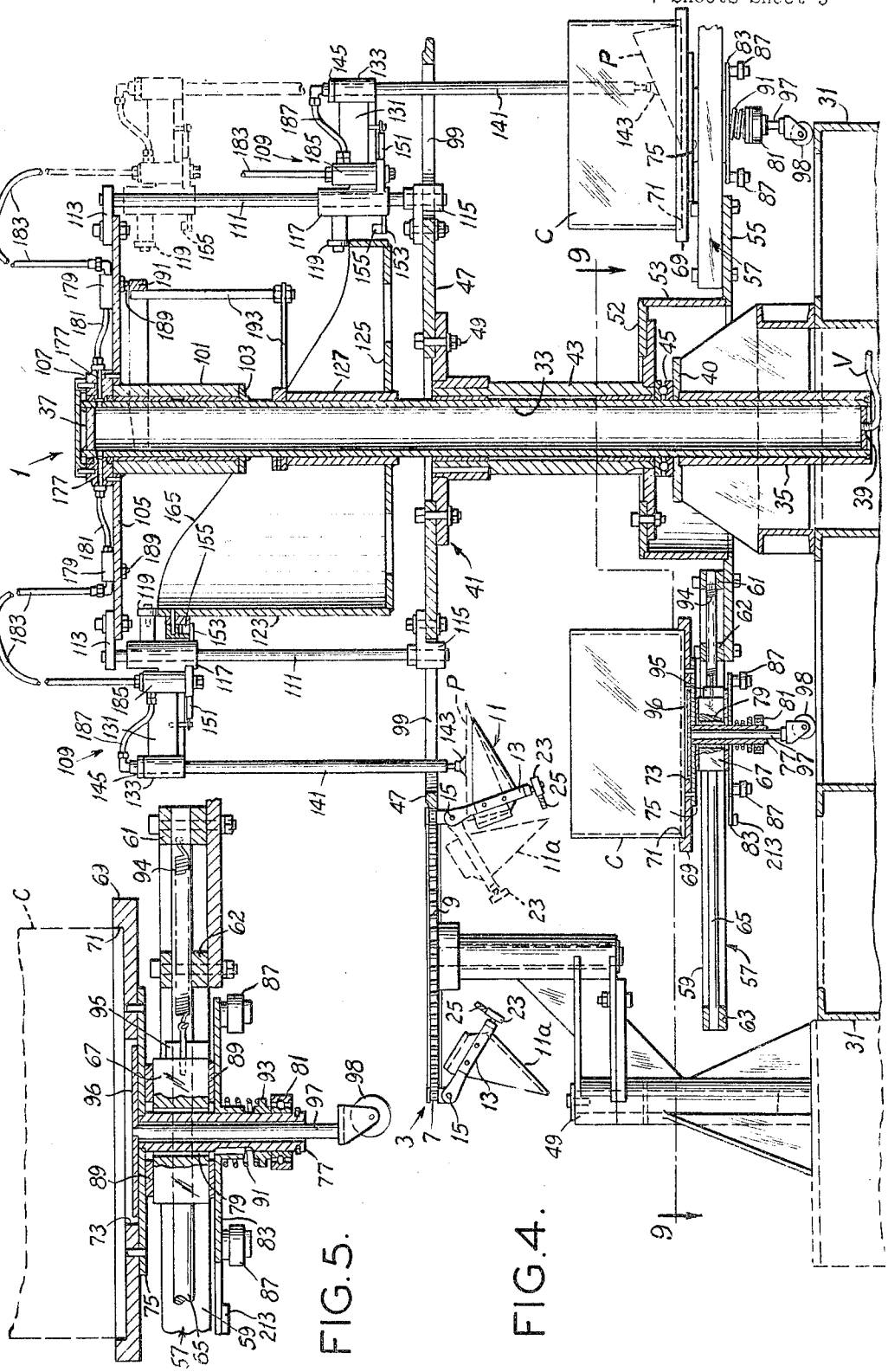


FIG. 4.

FIG. 5.

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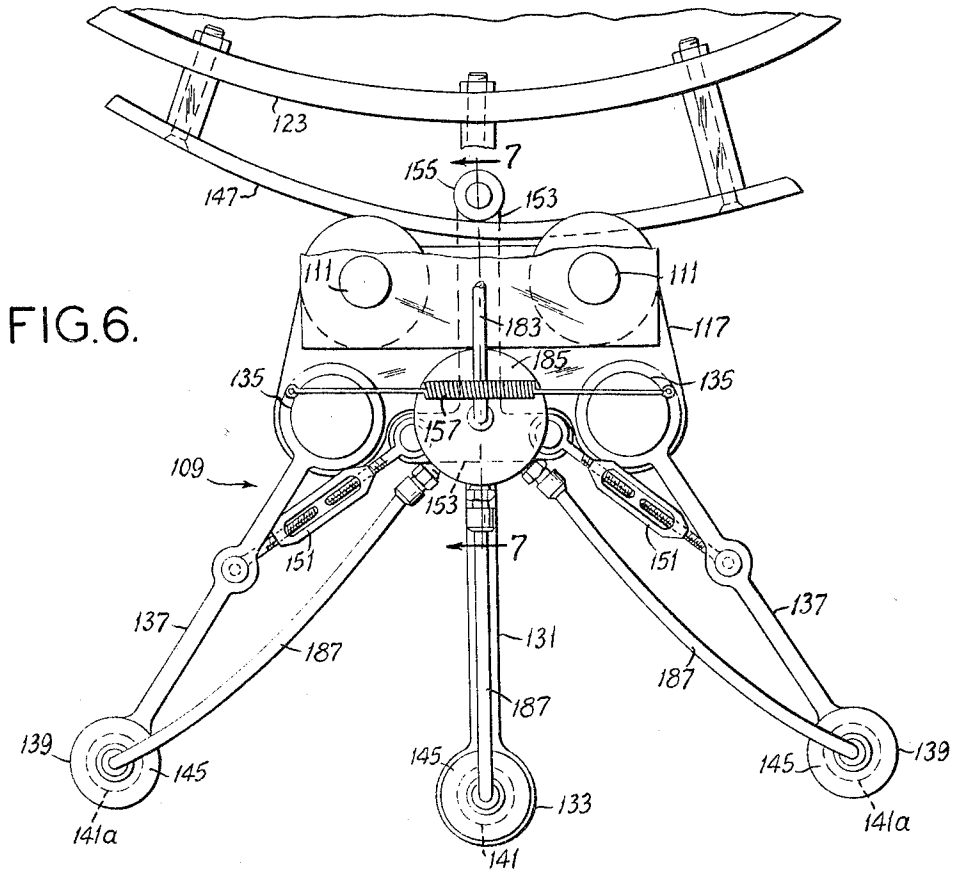


FIG.6.

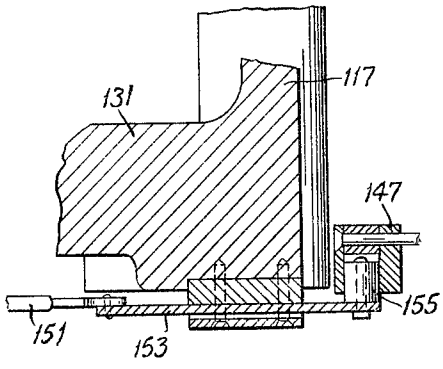


FIG.7.

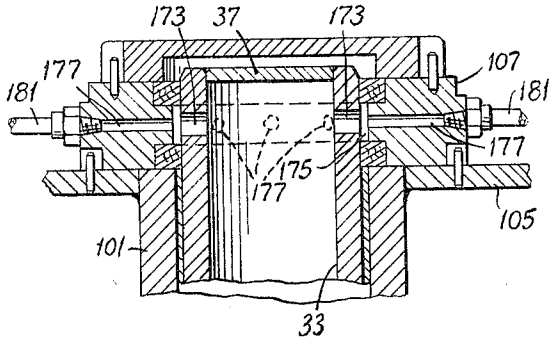


FIG.8.

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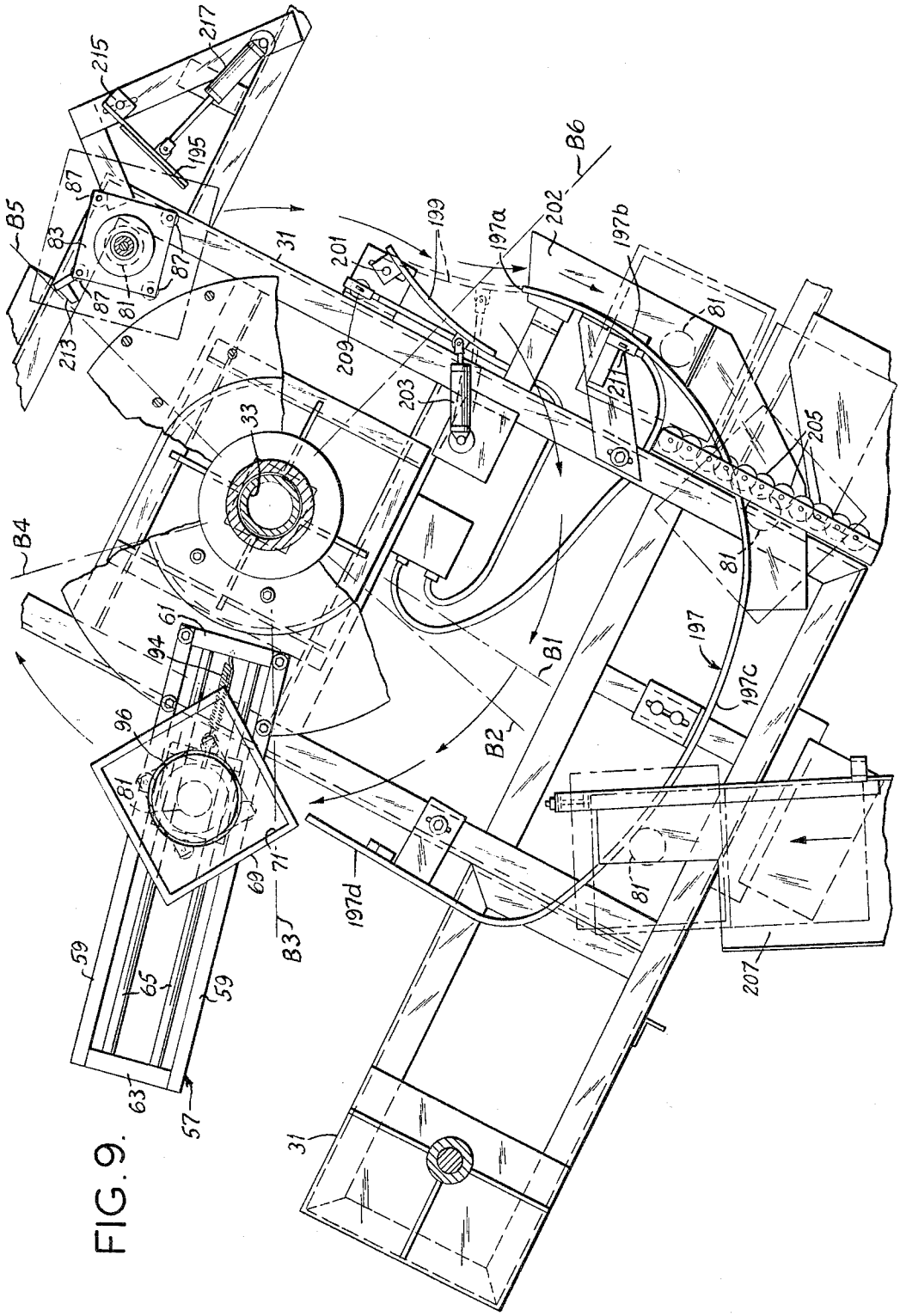


FIG. 9.

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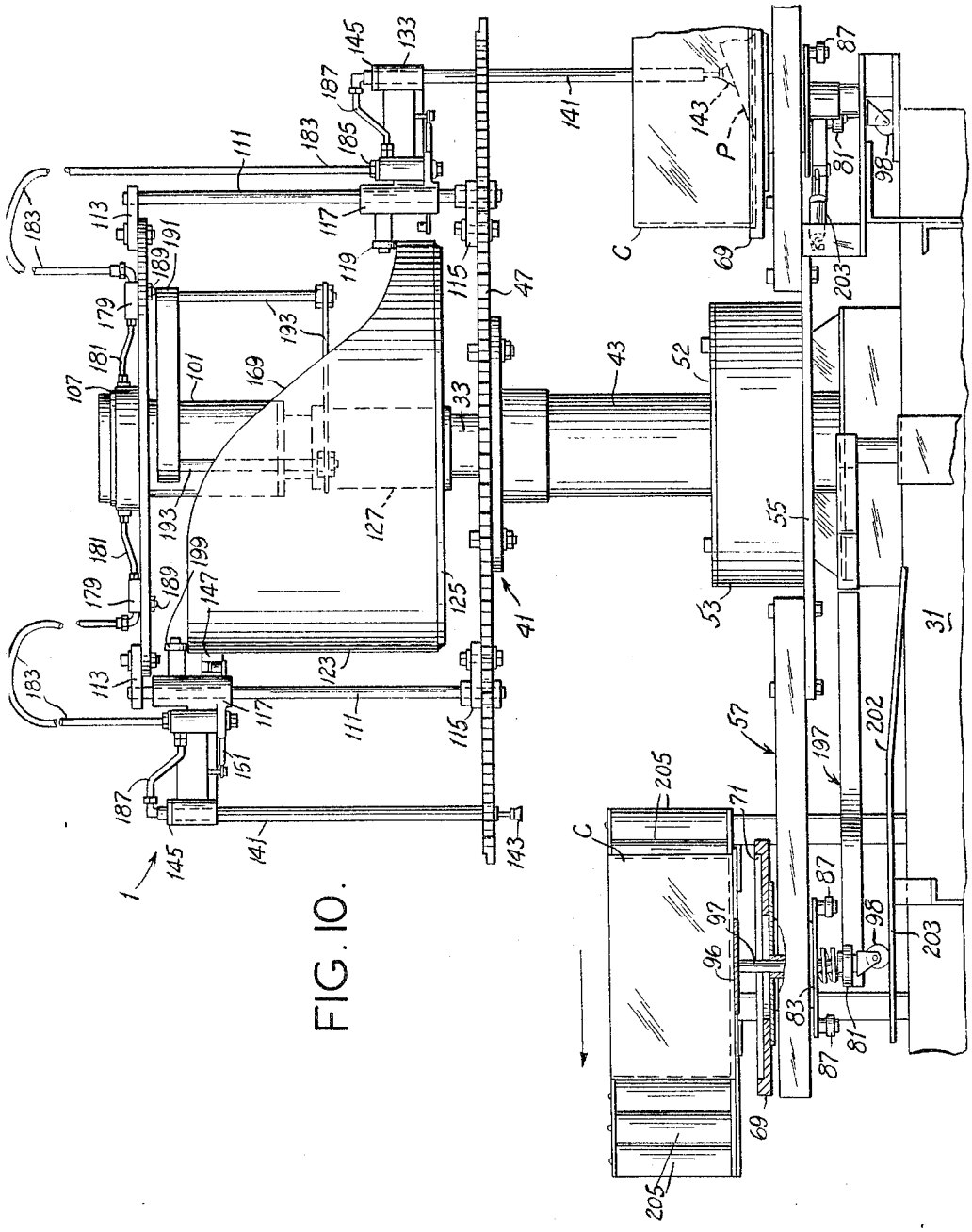


FIG. 10.

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PACKAGING APPARATUS FOR TETRAHEDRON-SHAPED CONTAINERS

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FIG. 11.

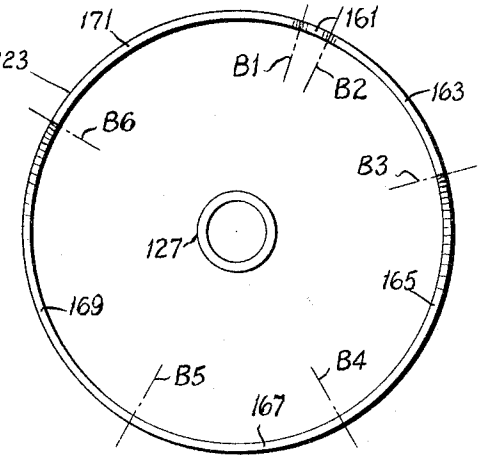
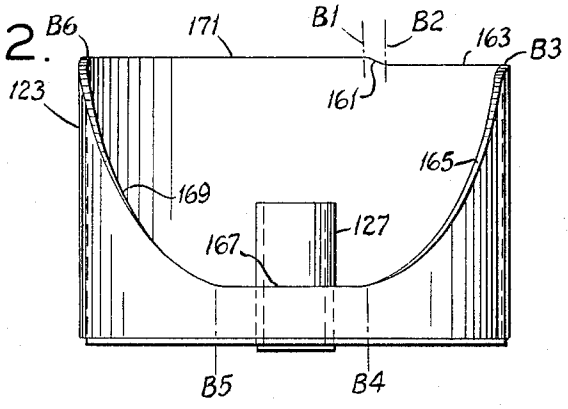


FIG. 12.



United States Patent Office 3,282,024 Patented Nov. 1, 1966

3,282,024

PACKAGING APPARATUS FOR TETRAHEDRON-SHAPED CONTAINERS

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Filed Mar. 27, 1963, Ser. No. 268,265
23 Claims. (Cl. 53—247)

This invention relates to the containerization of tetrahedron-shaped packages, and more particularly to apparatus for automatically packing tetrahedron-shaped packages in rectangular containers.

The invention is particularly concerned with the containerization of tetrahedron-shaped packages produced by a machine such as shown in the copending coassigned Wagner et al. U.S. patent application Serial. No. 261,795, filed February 28, 1963, issued as U.S. Patent 3,236,021, February 22, 1966. Packages are produced at relatively high speed by the machine shown in said application (packages may be produced at the rate of three hundred per minute, for example), and it is desirable that apparatus be provided for automatically packing the packages in cartons or boxes. One type of pack which has been found suitable for tetrahedron-shaped containers is a type that may be referred to as the fan-pack, in which a rectangular container (more particularly an open-top cardboard carton or tray of square outline in plan) is packed with packages, the latter being arranged in sets each shaped like a fan, each set consisting of a plurality of packages with one end of each package in the set at the apex of the fan and the other ends of the packages in the set constituting the outer edge of the fan, a first set being positioned in the container with its apex at a first corner of the container, a second set being positioned in the container overlying the first set with its apex at a second corner of the container, a third set being positoned in the container overlying the second set with its apex at a third corner of the container, and a fourth set being positioned in the container overlying the third set and with its apex at the fourth corner of the container. Among the several objects of this invention may be noted the provision of apparatus for automatically effecting such fan-packing of tetrahedron-shaped packages, capable of receiving packages produced by a high-speed package-forming machine such as shown in said U.S. Patent 3,236,021 and fan-packing them in rectangular containers at a rate corresponding to the package production rate. In general, the apparatus comprises means for supporting a container for indexing rotation about a central vertical axis, means for rotatably indexing the container around said axis successively to present different corners of the container in a loading position, and loading means for holding a fan-shaped set of packages and lowering the set into the corner of the container which is in loading position with the apex of the fan at that corner. More particularly, the loading means is adapted to grip a plurality of tetrahedron-shaped packages delivered thereto by a delivery conveyor and, after gripping the packages, to arrange them into a fan prior to loading them into the container. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

FIG. 1 is a plan, with parts broken away and parts shown in section, showing a containerization apparatus constructed in accordance with this invention;

FIG. 1A is a continuation of FIG. 1;

FIG. 2 is a detail illustrating a tetrahedron-shaped package dropping into a bucket on a delivery conveyor of the apparatus;

FIG. 3 is a view taken on line 3—3 of FIG. 2 showing the package in the bucket;

FIG. 4 is a vertical section taken generally on line 4—4 of FIG. 1;

FIG. 5 is an enlarged fragment of FIG. 4, showing details of a carriage carrying a rotary table;

FIG. 6 is an enlarged fragment of FIG. 1;

FIG. 7 is a vertical section taken on line 7—7 of FIG. 6;

FIG. 8 is an enlarged fragment of FIG. 4, showing the detail at the top of a center post;

FIG. 9 is a horizontal section taken generally on line 9—9 of FIG. 4, with parts broken away;

FIG. 10 is a view taken generally on line 10—10 of FIG. 1, with parts omitted;

FIG. 11 is a plan of a barrel cam per se of the apparatus; and

FIG. 12 is an elevation of the barrel cam shown in FIG. 11.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to the drawings, there is generally indicated at 1 a containerization unit constructed in accordance with this invention, and there is generally indicated at 3 an endless conveyor for conveying a succession of packages to the containerziation unit from a package-forming machine such as shown in said U.S. Patent 3,236,021.

By reference to said U.S. Patent 3,236,021, it will be understood that the package-forming machine comprises a turret 50 which is rotary on a vertical post 471. The turret 50 and the post of the package-forming machine are indicated in FIG. 1A of the drawings herein. It will also be understood that the turret 50, which rotates continuously in counterclockwise direction as viewed in FIG. 1A, has sixteen operating stations (designated 55 in said copending application) spaced at equal intervals therearound, means being provided at each station for holding an open-ended tube in upright position, sealing the lower end of the tube, filling the tube and then sealing its upper end to form a filled and sealed tetrahedron-shaped package. Each package, after completion, is released and drops out through a respective drop-out opening (designated 63 in said copending application) in the lower turret plate (designated 53 in said copending application). Position D shown in FIG. 1A corresponds to position D shown in said copending application (the 0° position). The drop-out position is indicated at O in FIG. 1A. At M in FIG. 1A is indicated the position of the mandrel of the package-forming machine.

For purposes of the present invention, a sprocket 5 is incorporated in the turret 50 of the package-forming machine for rotation therewith about the turret axis. This sprocket is mounted below the lower plate 53 of the turret. It may be fastened, for example, to the bottom of the ring gear indicated at 497 in said copending application and has a central opening 5a somewhat larger in diameter than the internal diameter of said ring gear. Sprocket 5 constitutes part of conveyor 3, the latter further comprising an endless chain 7 trained around sprocket 5 and also around an idler sprocket 9 (see FIGS. 1 and 4). Sprocket 5, which rotates with turret 50, constitutes a drive sprocket for chain 7. The latter travels continuously in the direction indicated by the arrows in FIGS. 1 and 1A.

Chain 7 carries a series of buckets 11. These are spaced at equal intervals along the chain, the spacing corresponding to the spacing of the dropout openings 63 referred to above. The chain with buckets 11 thereon is phased so that the buckets will underlie the drop-out openings. Each bucket is mounted in a yoke 13 which

is pivotally mounted as indicated at 15 on the chain. The arrangement is such that each bucket is adapted not only for movement along with the chain in a closed circuit corresponding to the path of the chain, but is also adapted for swinging movement relative to the chain about pivot 15. For simplification of the drawings, many of the buckets have been omitted, the positions of the omitted buckets being indicated by lines 11.

Each bucket comprises what may be termed a base wall 19 generally of triangular shape corresponding to the shape of a triangular face of the tetrahedron-shaped package P which the bucket is to receive, and generally triangular side walls 21 on the long sides of the base wall 19. It is open at the wide end of the base wall 19 and open between the side walls 21.

As to each bucket, the yoke 13 therefore carries a cam follower roller 23. These cam follower rollers 23 ride on a cam rail 25 which follows the closed-circuit path of the buckets. Rail 25 is so formed as to hold the buckets in what may be termed a package-receiving or loading position (see FIGS. 1A, 2 and 3) as the buckets travel around sprocket 5. In this loading position, each bucket opens upward to a respective drop-out opening, so that each package, dropping down through a drop-out opening as illustrated in FIG. 2, falls into a bucket as illustrated in FIG. 3. Each bucket-yoke assembly includes a torsion spring 27 which biases the yoke in the direction for engagement of the follower roller 23 with the cam rail 25.

Containerization unit 1 comprises a base designated in its entirety by reference numeral 31 (see FIGS. 4 and 10). Extending upward from the base is a cylindric center post 33. This post is a tubular post, having its lower end received wtihin a socket 35 provided on the base. It is fixed with respect to the base, and has closures 37 and 39 at its upper and lower ends to constitute it as a vacuum chamber. At the upper end of the socket 35 is a bearing plate 40. A turret designated in its entirety by the reference numeral 41 is rotatable around the post on the axis of the post. This turret includes a quill 43 rotatable on the post above plate 40 with a thrust bearing 45 between the lower end of the quill and bearing plate 41. Quill 43 has a sprocket 47 secured on its upper end concentric with the post. This sprocket is at the same level as the conveyor idler sprocket 9. Chain 7 has an arcuate portion 7*a* in mesh with sprocket 47. Arcuate portion 7*a* trails the idler sprocket 9. The latter is mounted on a support such as indicated at 49 associated with the base 31. Chain 7, via its meshed engagement with sprocket 47, drives turret 41. Rotation of the turret is clockwise as viewed from above (and as viewed in FIG. 1). Vacuum is drawn in post 33 via a vacuum line V (see FIG. 4) connected to a vacuum pump (not shown).

As previously mentioned, cam rail 25 is formed to hold the buckets 11 in upright package-receiving position as the buckets travel around sprocket 5 so that each package formed by the package-forming machine drops into a bucket. Cam rail 25 is also formed so that each bucket, after deposit of a package therein and as the bucket travels away from the package-forming machine, is allowed to swing downward to bring the bucket to a generally horizontal position extending laterally outward from the chain (see the buckets at the upper left of FIG. 1A and the buckets traveling toward containerization unit 1 in FIG. 1). This laterally extending position of each bucket may be referred to as its transfer or unloading position, since, in this position of the bucket, the package therein is positioned for being transferred from the bucket by the containerization unit 1 as will appear. It will be observed that when the bucket is in its stated transfer position, its base wall 19 is at the bottom, its side walls 21 extend upward, and the open side of the bucket between the side walls 21 is up. The package which is cradled in the bucket has one of its triangular faces exposed at the top for being gripped by a vacuum gripper of the containerization unit, as will be later described, and this exposed face of the package is generally horizontal.

The buckets 11 travel in their transfer position, each carrying a package P, from the package-forming machine to the containerization unit 1. Upon reaching the unit 1, they travel in their transfer position along an arcuate path centered in the vertical axis of turret 41 corresponding to the path of travel of the arcuate portion 7*a* of chain 7 in mesh with sprocket 47. The cam rail 25 has a gap starting at 25*a* as indicated in FIG. 1 to permit each bucket to swing down to a position such as indicated at 11*a* in FIG. 4 as the bucket approaches the idler sprocket 9. This occurs after the package which was carried by the bucket has been transferred to the containerization unit, as will appear, and clears the bucket from the package to enable the transfer. Then, as regards the return reach of chain 7, cam rail 25 is formed to return the buckets to their FIG. 2 package-receiving or loading position so that they are ready to receive packages in the package-forming machine as they travel around sprocket 5.

On the lower end of quill 43 is a plate 52 having a depending skirt 53. This skirt has an annular outwardly extending horizontal flange plate 55 at its lower end. Extending radially outward from plate 55 and spaced at equal angular intervals around plate 55 are frames each designated in its entirety by the reference numeral 57. As herein illustrated there are eight such frames spaced at 45° intervals around the turret 41. Each frame has side members 59, inner end members 61 and 62 and an outer end member 63. A pair of rails 65 of circular cross section extends from end-to-end of the frame. A carriage 67 is slidable on the rails 65.

Each carriage 67 carries a rotary container or table 69. Each carrier or table 69 has a rectangular recess 71 in the top. This recess is of a size corresponding to the size of containers C to be packed. The carrier 69 also has a circular center hole 73. It is mounted on a support plate 75 which is fixed on the upper end of a tubular stem 77. This stem extends down through and is rotatable in a central vertical hole 79 in the carriage 67. On the lower end of the stem is a cam follower roller 81. A plate 83 is vertically slidable on stem 77 below the carriage, but keyed to the stem so that it is non-rotatable on the stem. Plate 83 carries four follower rolls 87 angularly spaced at 90° intervals. Friction pads 89 are interposed between plate 75 and the top of the carriage and between plate 83 and the bottom of the carriage. A coil compression spring 91 reacts from a collar 93 on the stem against plate 83 to provide frictional engagement between the pads, plates 75 and 83 and the carriage for frictional resistance to rotation of the carrier 69. A tension spring 94 is provided for biasing the carriage to an inner retracted position relative to the track assembly determined by engagement of the carriage with a stop 95. Center hole 73 of carrier 69 accommodates a circular lift plate 96 on the upper end of a push rod 97 extending down through tubular stem 77. Rod 97 is slidable in stem 77 and has a caster 98 on its lower end.

Sprocket 47 has a plurality of relatively large holes 99, one directly above each frame 57. With eight frames 57 as shown herein, there are eight holes spaced at 45° intervals around the sprocket. A quill 101 is rotatable on post 33 at the upper end of the post, bearing on a collar 103 on the post. At the upper end of quill 101 is a circular upper turret plate 105 and a ring 107. Plate 105 and sprocket 47 carry a plurality of loading units, one associated with each carrier 69, and each designated in its entirety by the reference numeral 109. With eight frames 57 and eight container carriers 69 as herein illustrated, there are eight such loading units 109, spaced at 45° intervals around the upper part of the turret 41.

Each loading unit 109 comprises a pair of vertical

guide bars 111 having their upper ends mounted in a bracket 113 at the periphery of the upper turret plate 105 and their lower ends mounted in a bracket 115 on sprocket 47 at the inner edge of a respective hole 99 in the sprocket. The respective pairs of bars 111 are spaced at 45° intervals around the turret and rotate with the turret. As to each loading unit, a carriage 117 is slidable on bars 111 and carries a cam follower roller 119 which bears on the upper edge of a fixed barrel cam 123. This barrel cam has a bottom plate 125 secured to a sleeve 127 fixed on the center post 33. It does not rotate. The barrel cam is formed to provide for up and down sliding movement of each carriage 117 on its guide bars 111 as will appear.

Each carriage 117 has an arm 131 extending radially outward therefrom in the central radial plane of the carriage. This arm is fixed with respect to the carriage (it may be integral therewith) and has a vertical tubular guide 133 at its outer end. Two pivot pins 135 extend upward from the carriage, one on each side of fixed arm 131 at its inner end. Two arms 137 are pivoted at their inner ends on pins 135 and extend outward from the carriage on opposite sides of the fixed central arm 131. Each pivoted arm 137 has a vertical tubular guide 139 at its outer end.

Associated with each carriage 117 is a set of three grippers, each gripper being constituted by a vertical tubular rod having a vacuum-grip cup at its lower end. One of these rods, designated 141, extends through the guide 133 at the outer end of the arm 131, having an easy sliding fit therein. The other two rods, each specially designated 141*a*, extend through the guides 139 at the outer ends of pivoted arms 137, having an easy sliding fit therein. Rods 141*a* are identical to rods 141, and vacuum-grip cup at the lower end of each rod is designated 143. Each of rods 141 and 141*a* has a collar 145 at its upper end to prevent it from sliding downward out of its respective guide 133, 139, these collars being engageable by the upper ends of the guides 133 when the carriage 117 rises vertically to lift the rods 141 and 141*a*.

As to each carriage 117, the pivoted arms 137 are swingable on the vertical pivot pins 135 toward and away from the central fixed arm 131 to swing the two outer vacuum pick-up rods or grippers 141*a* toward and away from the central vacuum pick-up rod or gripper 141. Arms 137 are adapted to occupy an open or spread position, angled outward and away from arm 131 in which the rods 141 and 141*a* are adapted to pick up three tetrahedron-shaped packages P from the buckets 11 on conveyor chain 7, and to swing inward from this open or spread position toward arm 131 to what may be referred to as a closed position to swing the two packages picked up by rods 141*a* toward the package picked up by rod 141 and thereby form the three packages into a fan.

Referring to FIG. 1, the pivoted arms 137 of the three carriages 117 at the lower part of the figure are shown in their open or spread position, and the arms 137 of the remaining five carriages are shown in their closed position. As to each carriage, as it rotates around with the turret, arms 137 are closed by a fixed closing cam 147, remain closed for somewhat more than 180° of travel around with the turret, and are then opened by a fixed opening cam 149. These cams are mounted on the cylindric wall of the barrel cam 123. The two pivoted arms 137 on each carriage 117 are linked by turnbuckles 151 to a T-shaped slider 153 carrying a cam follower 155 at its outer end. This slider is radially slidable relative to the carriage. When it slides in, arms 137 close. When it slides out, arms 137 open. In the course of rotation of each carriage 117 around the axis of turret 41, follower 155 engages the opening cam 149. This pushes slider 153 outward to open the arms 137. Then follower 155 engages the closing cam 147. This pulls the slider 153 inward to close the arms 137. These actions occur with the carriage 117 at the top of its vertical stroke. An overcentering tension spring 157 in FIG. 6, with its ends secured to the hub of arms 137, maintains arms 137 in their open position. Conversely, when arms 137 are caused to pivot to their closed position, overcentering spring 157 applies slight positive pressure to assure that position until re-opened.

The barrel cam 123 (see FIGS. 11 and 12) is formed to provide a slight fall 161 starting at a position designated B1 and ending at a position designated B2. Following this fall, the barrel cam has a horizontal dwell 163 extending from position B2 to position B3. Following the dwell 163, there is a steep fall 165 from position B3 to position B4. Following the steep fall, there is a lower horizontal dwell 167 from position B4 to position B5. Following the dwell 167, there is a steep rise 169 from position B5 to B6. Following the rise 169 there is an upper horizontal dwell 171 from B6 back to B1. Position B1 is located in the zone where each set of three gripper rods 141 and 141*a*, carried by a respective carriage 117 traveling around with turret 51, come into position above three packages P in buckets 11 on the conveyor chain 7, and trails the closing cam 147. In traveling from position B1 to B2, the carriage 117 falls a short distance on account of the fall 161 of the barrel cam 123. The three gripper rods 141 and 141*a* move down along with the carriage, and the cups 143 at the lower ends of the rods engage the three packages.

Upon such engagement of the cups 143 with the three packages, vacuum is drawn in the rods 141 and 141*a* as will appear so that the packages are gripped to the lower ends of the rods. The buckets then drop away, and the packages remain gripped to the lower ends of the rods. Closing cam 147 then effects closure of the pivoted arms 137 to swing rods 141*a* toward rod 141 thereby to form the three packages into a fan. This occurs while the carriage cam follower 119 is on the dwell 163. Then, starting at position B3, the carriage 117 descends to lower the rods carrying the fan of three packages thereby to lower the fan into the corner of the container which is in loading position below. The vacuum grip is then released. Then, starting at position B5, the carriage rises, pulling the rods upward. After the carriage and the rods have been raised, the opening cam 149 effects opening of the pivoted arms 137.

The vacuum system for rods 141 and 141*a* is serviced from the vacuum chamber constituted by the post 33. The post 33 has ports 173 adjacent its upper end which provide for communication between an annular groove 175 in ring 107 and the interior of the post. Ring 107 has eight radial ports 177. Associated with each loading unit 109 is a vacuum control valve 179. These valves are mounted in a circular series on top of the upper turret plate 105. Connections such as indicated at 181 are made between these valves and ports 177 in ring 107. Flexible connections as indicated at 183 are made between these valves and a vacuum manifold 185 on each carriage 117. Flexible connections as indicated at 187 are made between each manifold 185 and the upper ends of the respective three rods 141 and 141*a*. Each valve 179 has an operating button 189 which extends down through a hole in plate 105 for engagement with a fixed valve-actuating cam 191. The latter is mounted as indicated at 193 on post 33 and is or arcuate form, following an arc centered in the turret axis and on a radius corresponding to the radius of the circular series of valves 179. Cam 191 extends around the turret axis from a point slightly past position B4 to a point between position B5 and position B6. When the button 189 of any given valve 179 is off the cam 191, the valve is set for drawing a vacuum in the respective three rods 141 and 141*a*. When the button is riding on the cam, the respective three rods 141 and 141*a* are vented and blocked off from the vacuum chamber in post 33.

Each container carrier or table 69, when in its radially inner position determined by engagement of the respec-

tive carriage 67 with stop 95, is adapted to be rotatably indexed around the axis of its stem 77 through an angle of 90° once each revolution of the turret successively to present each of the four corners of a container C carried by the carrier 69 in the recess 71 thereof in a loading position for reception of a fan of packages with the apex of the fan at the corner which is in loading position. In each indexed position of a carrier 69, it lies in diamond relation with respect to the respective frame 57 (see FIG. 1), and presents the radially outer corner of the container in the stated loading position.

Rolls 87 constitute part of a means for so rotatably indexing each carrier 69, this means further comprising a striker plate 195 (see FIG. 9) carried by the base frame 31. This striker plate is engageable by the radially outermost roll 87 to effect 90° rotation of plate 83, stem 77 (which is keyed to plate 83) and carrier 69 as the rotation of the turret brings the carrier around to the striker plate. The frictional resistance imparted by pads 89 prevents overtravel of the carrier.

When any given carriage 67 and the associated container carrier or table 69 have made four circuits around with the turret 41 to complete the loading of four fans of packages in the four corners of the container on the carrier, the carriage and carrier are moved radially outward on the rails 65 of the respective track assembly and the container is lifted out of the recess 71 for discharge of the filled container. For this purpose, there is provided on base 31 a cam track 197 adapted for engagement by the follower roller 81 at the lower end of stem 77. The trailing end 197*a* of this track is located somewhat past position B6 and outward of the circular path described by rollers 81 when the carriages 67 are in their radially inner retracted position. Track 197 has an initial rise 197*b* which curves outward away from the axis of turret 41, a dwell 197*c* on an arc centered in the turret axis, and a fall 197*d* which recedes back inward toward the turret axis. A curved gate 199 is pivoted for swinging movement on a vertical axis at 201 on base 31. This gate is movable from the retracted open position in which it is shown in solid lines in FIG. 9 to the closed position in which it is shown in dotted lines in FIG. 9 by an air cylinder 203. When the gate is in its retracted position, rollers 87 can pass on between the trailing end of track 197*a* and the gate. When the gate is in its operative position, a roller 81 coming around with turret 41 is deflected by the gate onto the outside of track 197. As the roller continues its movement with the turret 41, it is cammed outward by rise 197*b* of the track and this slides the associated carriage 67 outward. As the carriage slides outward, caster 98 rides up a ramp 202 (see FIG. 10), and this lifts rod 97 to lift the lifter plate 96 so as to lift the container C out of the recess 71 in carrier 69. Container C engages a bank of wipe-off rollers 205 which causes it to be discharged from the turret 41. As roller 81 continues on around the outside of dwell 197*c* of track 197, the respective carriage 67 is maintained in its outer position for application of another container C to the respective carrier 69 at a container-delivery station 207.

For operating the air cylinder 203 to open and close the gate 199, two switches 209 and 211 are provided on base 1, switch 209 being a closing switch and switch 211 being an opening switch. The indexing plate 83 associated with each carriage 67 carries a wiper 213 at one corner thereof. This wiper is adapted to engage and actuate switches 209 and 211 one after the other when the plate 83 (and the associated carrier 69) has made four revolutions with the turret 41 and has been indexed four times by striker plate 195. On actuation of switch 209, a solenoid valve (not shown) is actuated to cause cylinder 203 to close the gate, and on actuation of switch 211 the valve is deactuated to cause cylinder 203 to open the gate.

Operation is as follows:

Turret 41 of the containerization unit 1 is continuously driven by chain 7 at a speed related to the speed of the turret of the package-forming machine, since the drive for chain 7 is via the sprocket 5 on the turret of the package-forming machine and chain 7 meshes with sprocket 47 on turret 41 of the containerization unit. Chain 7 continuously delivers packages P contained in buckets 11 on the chain to the containerization unit. Buckets 11, approaching the containerization unit, are in their transfer position, to enable the suction cups 143 at the lower ends of vacuum gripper rods 141 and 141*a* to grip the packages. Since chain 7 has arcuate portion 7*a* traveling around sprocket 47, the buckets are carried along in the zone of arcuate portion 7*a* along an arcuate path centered in the axis of turret 41, and three buckets come into register with the three gripper rods 141 and 141*a* of a respective loading unit 109 (the two rods 141*a* of the loading unit then being in their open position). These three buckets carry a triad of packages P (three packages) in side-by-side spaced relation, such that when the three packages of the triad are gripped at the lower ends of the three rods 141 and 141*a*, the two outside packages of the triad may be swung into position engaging the sides of the center package of the triad to form a fan of three packages.

Container carriers 69 and loading units 109 rotate continuously around with turret 41. Tracing a cycle of operation in respect to any given carrier 69 and its related loading unit 109 (the operation in respect to all eight carriers and loading units being the same), the cycle may be regarded as commencing when the carrier 69 and its related loading unit 109 pass the container-delivery station 207. Here the carrier 69 is in its radially outer position (as determined by cam track 197). A container C is applied to the carrier 69 seated in the recess 71 of the carrier. As the carrier 69 continues moving around with turret 41 away from station 207 (clockwise as viewed in FIGS. 1 and 9) it is pulled in to its retracted position by the action of spring 94 on carriage 67 as permitted by the fall 197*d* of cam track 197. In the meantime, the three gripper rods 141 and 141*a* of the respective loading unit 109 have gripped three packages P delivered thereto by buckets 11 as previously described, and rods 141*a* have swung toward rod 141 to form the three packages into a fan. This swinging of rods 141*a* to form the packages into a fan is caused by the closing cam 147 (see FIG. 1).

Carrier 69 is moved completely back to its retracted position in the vicinity of position B3. The container C carried by the carrier 69 is then in position for reception in its radially outer corner of the fan of three packages now gripped to the lower ends of the three rods 141 and 141*a*. In this respect, it will be observed that carrier 69 and container C carried thereby are in diamond relation with respect to the frame 57 (i.e., in diamond relation with respect to a radial plane of the turret 41 passing through the center of the carrier 69) to present the radially outer corner of container C in loading position.

At position B3, the carriage 117 of the loading unit 109 starts to descend, the follower roller 119 on the carriage riding down fall 165 of the barrel cam 123. Rods 141 and 141*a* carrying the fan of three packages descend with the carriage 117, and lower the fan into the radially outer corner of container C with the apex of the fan at this corner. After the fan has been lowered into the container, the valve 179 for the respective loading unit 109 is actuated by cam 191 to vent the three rods 141 and 141*a*. This releases the grip on the packages so that, on raising of the rods, the packages remain in the container. Then, at position B5, carriage 117 starts to rise, thereby lifting rods 141 and 141*a* and the lifting of the rods is completed at position B6. Somewhat past position B5, the button 189 of the valve 179 rides off cam 191 and a vacuum is again drawn in the rods for gripping the next triad of packages. The opening cam 149 causes rods 141*a* to swing away from rod 141.

As the container carrier 69 passes position B5, the radially outer roller 87 associated therewith strikes the striker plate 195. This effects 90° indexing rotation of

the carrier to bring the second corner of the container C carried by the carrier into loading position. Gate 199 is open at this time, and follower roller 81 passes between the gate and the trailing end 197a of cam track 197 so that the carrier 69 remains in its retracted position. The carrier 69 then makes a second circuit around with the turret 41 for loading of a fan of three packages into the second corner of the container. After the second fan has been loaded into the second corner of the container, the carrier 69 is indexed 90° by engagement of the then radially outer roller 87 with striker plate 195 to bring the third corner of the container into loading position. Gate 199 still remains open, so that carrier 69 remains in its retracted position. The carrier then makes a third circuit around with the turret for loading of a fan of three packages into the third corner of the container. After the third fan has been loaded into the third corner, carrier 69 is indexed 90° by engagement of the then radially outer roller 87 with striker plate 195 to bring the fourth corner of the container into loading position. Gate 199 still remains open, so that carrier 69 remains in its retracted position. The carrier then makes a fourth circuit around with the turret for loading of a fan of three packages into the fourth corner of the container. After the fourth fan has been loaded into the fourth corner, carrier 69 is indexed 90° by engagement of the then radially outer roller 87 with striker plate 195 to bring the carrier back to position for start of the next container loading cycle. This brings wiper 213 into position for wiping switch 209 to close the gate 199. Follower roller 81 rides out along gate 199 and then along the outside of cam track 197 to move the carrier 69 outward and lift the lifter plate 96 for discharge of the filled container C from the turret 41 by engagement of the container with the bank of wipe-off rollers 205. This completes a container-loading cycle, and the cycle is repeated every four revolutions of the turret 41. When wiper 213 wipes switch 211, gate 199 opens.

Striker plate 195 is shown as pivoted at 215 on base 31 and controlled by an air cylinder 217. The latter is adapted to swing the striker plate 195 from its operative position wherein it is in the path of the radially outer roller 87 to a retracted position clear of said path in the event of failure of any set of three gripper rods 141, 141a to pick off three packages. This enables the respective carrier 69 to make one or more additional circuits around with the turret to insure complete filling of a container C (i.e., loading of four complete fans of three packages each into the container). Cylinder 217 may be operated by any suitable means for sensing failure of any set of three rods 141, 141a to pick off three packages. This sensing means may, for example, comprise a vacuum sensor associated with each valve 179, and controlling a solenoid valve for controlling operation of cylinder 203. In the event of failure of any rod in any set of three rods to pick off a package, that rod remains open at its lower end to atmosphere so that no vacuum is drawn therein, and the vacuum sensor will sense this to actuate cylinder 203.

As previously noted, rods 141 and 141a have an easy sliding fit in guides 133 and 139. This enables each carriage 117 to continue its downward movement when downward movement of the respective three rods 141 and 141a is arrested upon deposit of the fan of packages gripped to the lower ends of these rods in a container C. Connections 187 are flexible to permit such relative movement of the rods and carriages 117.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. Apparatus for packing tetrahedron-shaped packages in multicornered open-top containers with the packages arranged in sets like a fan, with each set consisting of a number of packages with one end of each package in the set at the apex of the fan and the other ends of the packages in the fan constituting the outer edge of the fan, and with said sets positioned in the container with their apices at different corners of the container and with one fan overlying another, said apparatus comprising a plurality of container carriers, means for transporting said carriers along a predetermined path, each carrier being carried by said transport means for indexing rotation about a central vertical axis, means for rotatably indexing each carrier around said axis successively to present different corners of a container carried thereby in a loading position, and loading means for holding and lowering a fan-shaped set of packages into each corner of each container as said corners are successively indexed to loading position with the apex of each fan at the corner.

2. Apparatus as set forth in claim 1 wherein said transport means transports said carriers around an endless path.

3. Apparatus as set forth in claim 2 wherein said loading means comprises a plurality of sets of grippers, one for each carrier, each set of grippers being adapted to grip said number of packages, said sets of grippers being movable with said transport means, and each carrier being indexed once each circuit thereof around said endless path.

4. Apparatus as set forth in claim 3 wherein the grippers of each set are movable relative to one another for forming the packages gripped thereby into a fan.

5. Apparatus as set forth in claim 3 further comprising a conveyor for delivering packages to said sets of grippers, each set of grippers being adapted to grip said number of packages as delivered thereto by said conveyor.

6. Apparatus as set forth in claim 5 wherein the conveyor is adapted to deliver packages one after another in spaced side-by-side relation, and the grippers of each set are movable relative to one another between an open position for gripping said number of packages as delivered by the conveyor and a closed position for forming the packages gripped thereby into a fan.

7. Apparatus for packing tetrahedron-shaped packages in multicornered open-top containers with the packages arranged in sets like a fan, with each set consisting of a number of packages with one end of each package in the set at the apex of the fan the other ends of the packages in the fan constituting the outer edge of the fan, and with said sets positioned in the container with their apices at different corners of the container and with one fan overlying another, said apparatus comprising a turret rotatable on a vertical axis, a series of container carriers spaced at equal intervals around the turret and rotatable with the turret, each carrier being carried by the turret for indexing rotation relative to the turret about a central vertical axis, means for rotatably indexing each carrier around its said axis upon each revolution of the turret successively to present different corners of a container carried by the carrier in a loading position on successive revolutions of the turret, a plurality of sets of grippers, one set for each carrier, spaced at equal intervals around the turret and rotatable with the turret, the number of grippers in each set corresponding to the number of packages in a fan, the grippers in each set being vertically movable relative to the turret and adapted to hold said number of packages in fan-shaped array, and means for effecting lowering and then raising of each set of grippers upon each revolution of the turret, each set of grippers upon lowering thereof during a revolution of the turret being adapted to lower a fan-shaped set of packages held thereby into that corner of the container carried by the respective carrier which is in loading position on that revolution, with the apex of the fan-shaped set of packages at said corner.

8. Apparatus as set forth in claim 7 wherein the grippers of each set are movable relative to one another for forming packages gripped thereby into a fan.

9. Apparatus as set forth in claim 7 further comprising a conveyor for delivering packages to said sets of grippers, each set of grippers being adapted to grip said number of packages as delivered thereto by said conveyor.

10. Apparatus as set forth in claim 9 wherein the conveyor is adapted to deliver packages one after another in spaced side-by-side relation, and the grippers of each set are movable relative to one another between an open position for gripping said number of packages as delivered by the conveyor and a closed position for forming the packages gripped thereby into a fan.

11. Apparatus as set forth in claim 10 wherein each carrier is movable radially inward and outward relative to the turret, each carrier normally occupying a radially inner position, and wherein means is provided for moving each carrier radially outward to a container discharge position when the turret has completed a number of revolutions such as to complete the packing of the container on said carrier.

12. Apparatus for packing tetrahedron-shaped packages in multicornered open-top containers with the packages arranged in sets like a fan, with each set consisting of a number of packages with one end of each package in the set at the apex of the fan and the other ends of the packages in the fan constituting the outer edge of the fan, and with said sets positioned in the container with their apices at different corners of the container and with one fan overlying another, said apparatus comprising a turret rotatable on a vertical axis, a series of container carriers spaced at equal intervals around the turret and rotatable with the turret, each carrier being carried by the turret for indexing rotation relative to the turret about a central vertical axis, means for rotatably indexing each carrier around its said axis upon each revolution of the turret successively to present different corners of a container carried by the carrier in a loading position on successive revolutions of the turret, a plurality of carriages, one over each carrier, spaced at equal intervals around the turret and rotatable with the turret, means mounting each carriage for vertical movement relative to the turret, means for effecting lowering and raising of each carriage upon each revolution of the turret, a set of vertically extending rods carried by each carriage, each rod having vacuum grip means at its lower end for gripping a package, the number of said rods in each set corresponding to the number of packages in a fan, each set of rods being adapted for gripping at their lower ends said number of packages in fan-shaped array and for lowering said array into a corner in loading position of the container carried by the respective carrier upon lowering of the respective carriage.

13. Apparatus as set forth in claim 12 for packing rectangular containers with fans of three packages at each of the four corners of each container wherein said indexing means indexes each carrier 90° upon each revolution of the turret, and wherein each set of rods comprises three rods, a central rod and two outer rods on opposite sides of the central rod, the outer rods of each set being carried by the respective carriage for swinging movement away from an open position toward the central rod to a closed position for forming the three packages gripped thereby into a fan, and means for closing said outer rods to form a fan prior to lowering of the packages into a container and for opening said outer rods after deposition of the fan in the container.

14. Apparatus as set forth in claim 13 wherein each carrier is movable radially inward and outward relative to the turret, each carrier normally occupying a radially inner position, and wherein means is provided for moving each carrier radially outward to a container discharge position when the carrier has completed four revolutions with the turret.

15. Apparatus for packing tetrahedron-shaped packages in multicornered open-top containers with the packages arranged in sets like a fan, with each set consisting of a number of packages with one end of each package in the set at the apex of the fan and the other ends of the packages in the fan constituting the outer edge of the fan, and with said sets positioned in the container with their apices at different corners of the container and with one fan overlying another, said apparatus comprising means for moving a container successively to present different corners thereof in a loading position, and loading means for holding a fan-shaped set of packages and lowering said set into the corner of the container which is in loading position with the apex of the fan at that corner, said loading means comprising a set of grippers for gripping said number of packages, said grippers being movable relative to one another for forming the packages gripped thereby into a fan.

16. Apparatus for packing tetrahedron-shaped packages in multicornered open-top containers with the packages arranged in sets like a fan, with each set consisting of a number of packages with one end of each package in the set at the apex of the fan and the other ends of the packages in the fan constituting the outer edge of the fan, and with said sets positioned in the container with their apices at different corners of the container and with one fan overlying another, said apparatus comprising means for moving a container successively to present different corners thereof in a loading position, loading means for holding a fan-shaped set of packages and lowering said set into the corner of the container which is in loading position with the apex of the fan at that corner, and a conveyor for delivering packages to said loading means, said loading means being adapted to grip packages delivered thereto by said conveyor, said loading means comprising a set of grippers for gripping said number of packages as delivered by said conveyor, said grippers being movable relative to one another for forming the packages gripped thereby into a fan.

17. Apparatus for packing tetrahedron-shaped packages in multicornered open-top containers with the packages arranged in sets like a fan, with each set consisting of a number of packages with one end of each package in the set at the apex of the fan and the other ends of the packages in the fan constituting the outer edge of the fan, and with said sets positioned in the container with their apices at different corners of the container and with one fan overlying another, said apparatus comprising means for supporting a container for indexing rotation about a central vertical axis, means for rotatably indexing the container around said axis successively to present different corners of the container in a loading position, and loading means for holding a fan-shaped set of packages and lowering said set into the corner of the container which is in loading position with the apex of the fan at that corner, said loading means comprising a set of grippers for gripping said number of packages, said grippers being movable relative to one another for forming the packages gripped thereby into a fan.

18. Apparatus for packing tetrahedron-shaped packages in multicornered open-top containers with the packages arranged in sets like a fan, with each set consisting of a number of packages with one end of each package in the set at the apex of the fan and the other ends of the packages in the fan constituting the outer edge of the fan, and with said sets positioned in the container with their apices at different corners of the container and with one fan overlying another, said apparatus comprising means for supporting a container for indexing rotation about a central vertical axis, means for rotatably indexing the container around said axis successively to present different corners of the container in a loading position, loading means for holding a fan-shaped set of packages and lowering said set into the corner of the container which is in loading position with the apex of the fan at that corner, and a conveyor for delivering packages to said loading means, said loading means being adapted to grip packages delivered thereto by said con-

veyor, said loading means comprising a set of grippers for gripping said number of packages as delivered by said conveyor, said grippers being movable relative to one another for forming the packages gripped thereby into a fan.

19. Apparatus for packing tetrahedron-shaped packages in multicornered open-top containers with the packages arranged in sets like a fan, with each set consisting of a number of packages with one end of each package in the set at the apex of the fan and the other ends of the packages in the fan constituting the outer edge of the fan, and with said sets positioned in the container with their apices at different corners of the container and with one fan overlying another, said apparatus comprising a plurality of container carriers, means for transporting said carriers along a predetermined path, means for moving each carrier relative to said transport means successively to present different corners of a container carried thereby in a loading position, and loading means for holding and lowering a fan-shaped set of packages into each corner of each container as said corners are successively presented in loading position with the apex of each fan at the corner, said transport means transporting said carriers around an endless path, said loading means comprising a plurality of sets of grippers, one for each carrier, each set of grippers being adapted to grip said number of packages, and said sets of grippers being movable with said transport means, the grippers of each set being movable relative to one another for forming the packages gripped thereby into a fan.

20. Apparatus for packing tetrahedron-shaped packages in multicornered open-top containers with the packages arranged in sets like a fan, with each set consisting of a number of packages with one end of each package in the set at the apex of the fan and the other ends of the packages in the fan constituting the outer edge of the fan, and with said sets positioned in the container with their apices at different corners of the container and with one fan overlying another, said apparatus comprising a plurality of container carriers, means for transporting said carriers along a predetermined path, means for moving each carrier relative to said transport means successively to present different corners of a container carried thereby in a loading position, and loading means for holding and lowering a fan-shaped set of packages into each corner of each container as said corners are successively presented in loading position with the apex of each fan at the corner, said transport means transporting said carriers around an endless path, said loading means comprising a plurality of sets of grippers, one for each carrier, each set of grippers being adapted to grip said number of packages, and said sets of grippers being movable with said transport means, and a conveyor for delivering packages to said sets of grippers, each set of grippers being adapted to grip said number of packages as delivered thereto by said conveyor, the conveyor being adapted to deliver packages one after another in spaced side-by-side relation, and the grippers of each set being movable relative to one another between an open position for gripping said number of packages as delivered by the conveyor and a closed position for forming the packages gripped thereby into a fan.

21. Apparatus for packing tetrahedron-shaped packages in multicornered open-top containers with the packages arranged in sets like a fan, with each set consisting of a number of packages with one end of each package in the set at the apex of the fan and the other ends of the packages in the fan constituting the outer edge of the fan, and with said sets positioned in the container with their apices at different corners of the container and with one fan overlying another, said apparatus comprising means mounting a container for movement successively to present different corners thereof in a loading position, and means for forming a number of said tetrahedron-shaped packages into a fan-shaped set of said packages and transferring the fan-shaped set of said packages into the corner of the container which is in loading position with the apex of the fan at that corner.

22. Apparatus as set forth in claim 21 further comprising a conveyor for delivering tetrahedron-shaped packages to said forming means.

23. Apparatus as set forth in claim 22 wherein said forming means comprises a set of grippers for gripping said number of tetrahedron-shaped packages.

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