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(54) **COORDINATED SOFT-TOUCH CASE PACKER**

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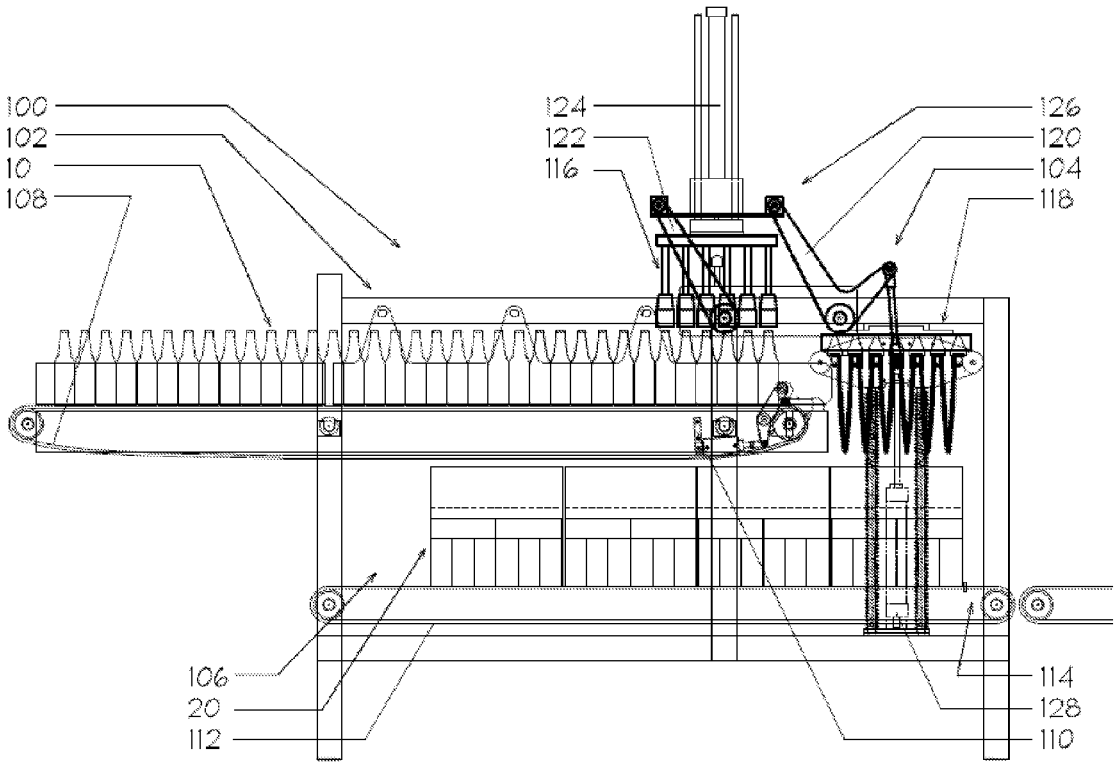
USPC **53/244**

(57) **ABSTRACT**

Disclosed is a product case packing system with a gripping head assembly and a packaging grid assembly linked by a coordination arm that synchronizes the delivery of the product to be packaged and with the positioning of the grid assembly into the packaging container. The system includes a gripper head assembly extension control module, capable of controlling multiple travel distances of the gripper head assembly in a single packing cycle, a product assembly detection module, and a packaging release control element for subtle separation of individual packed containers.



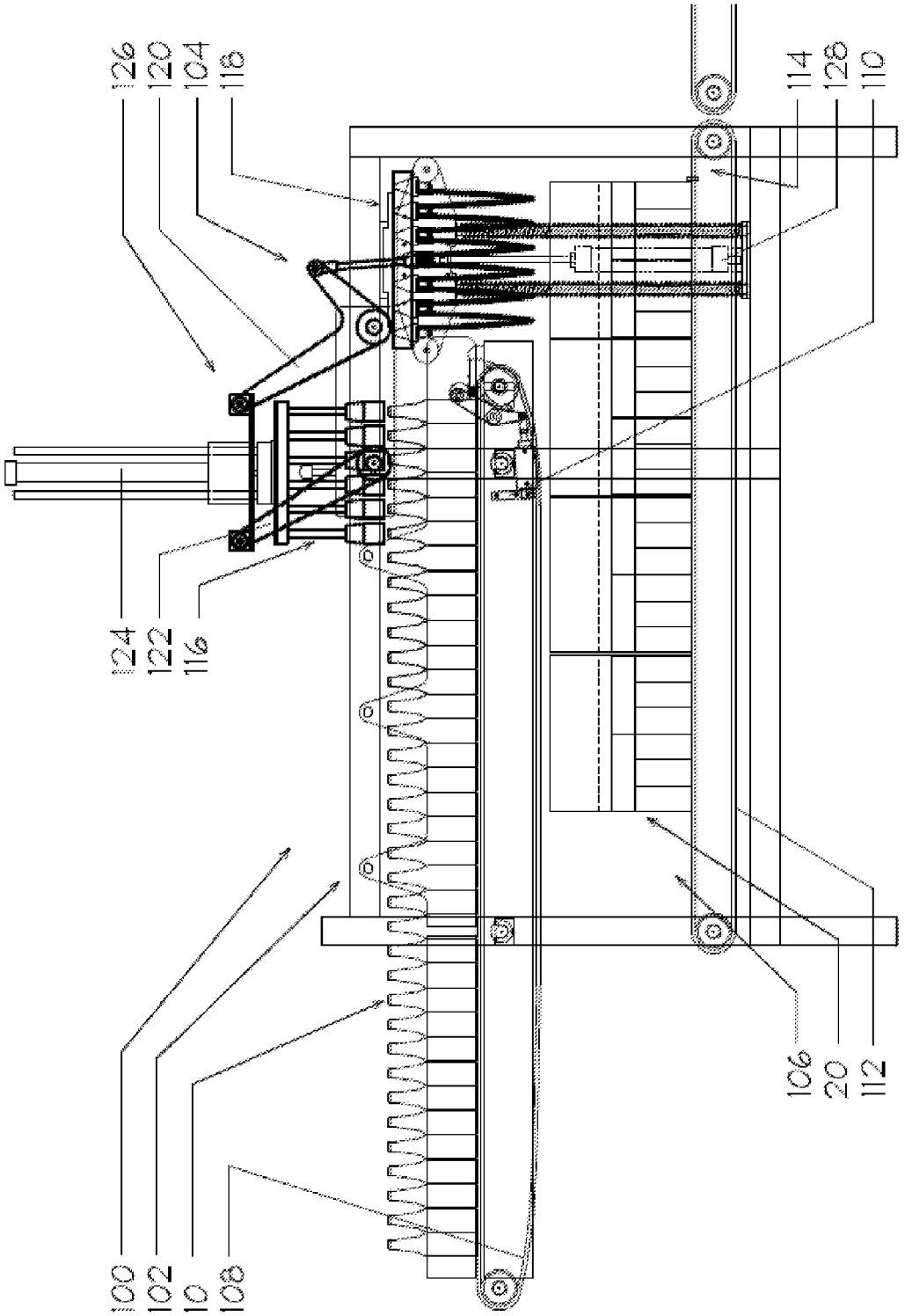


FIG. 1

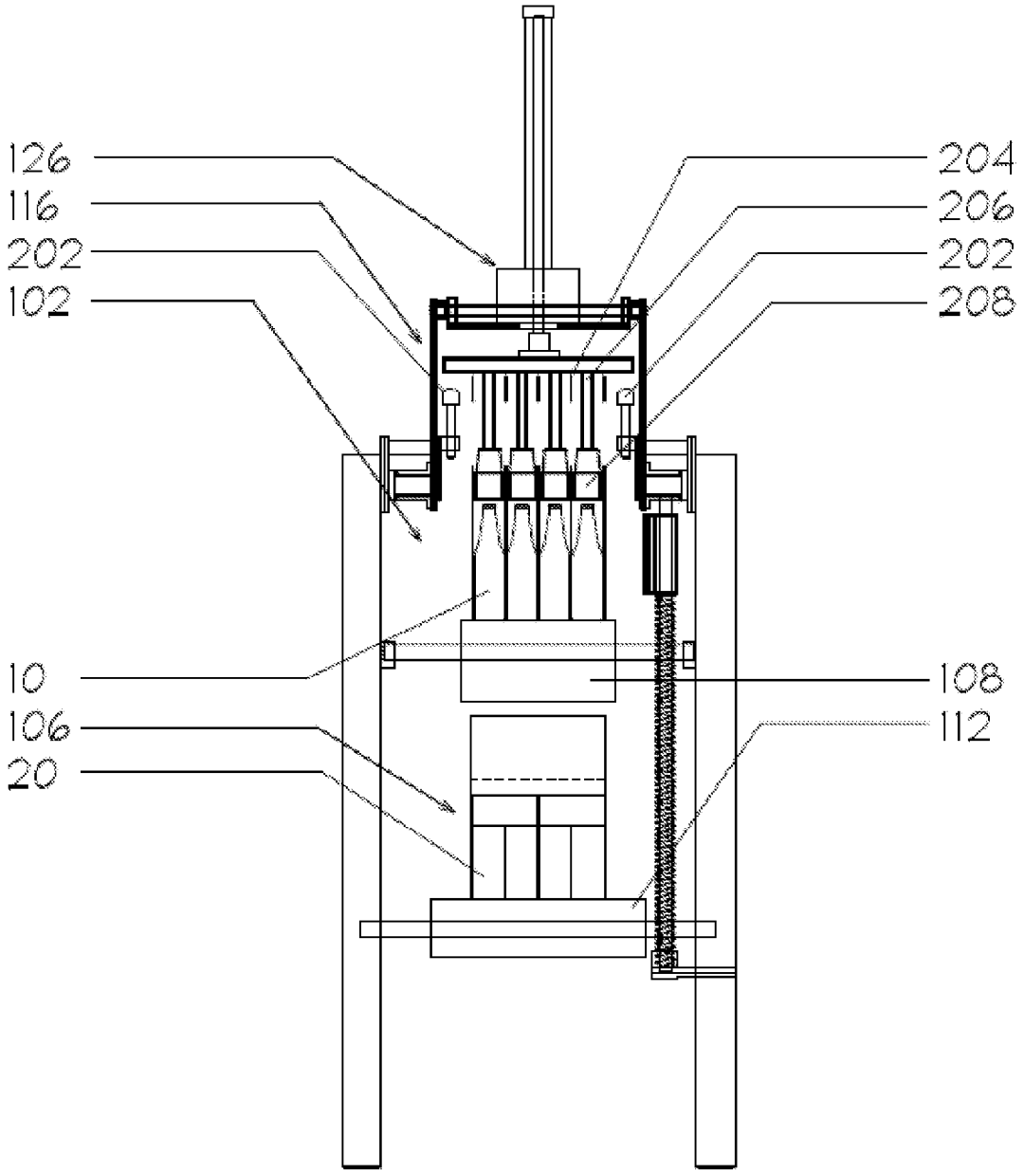


FIG. 2

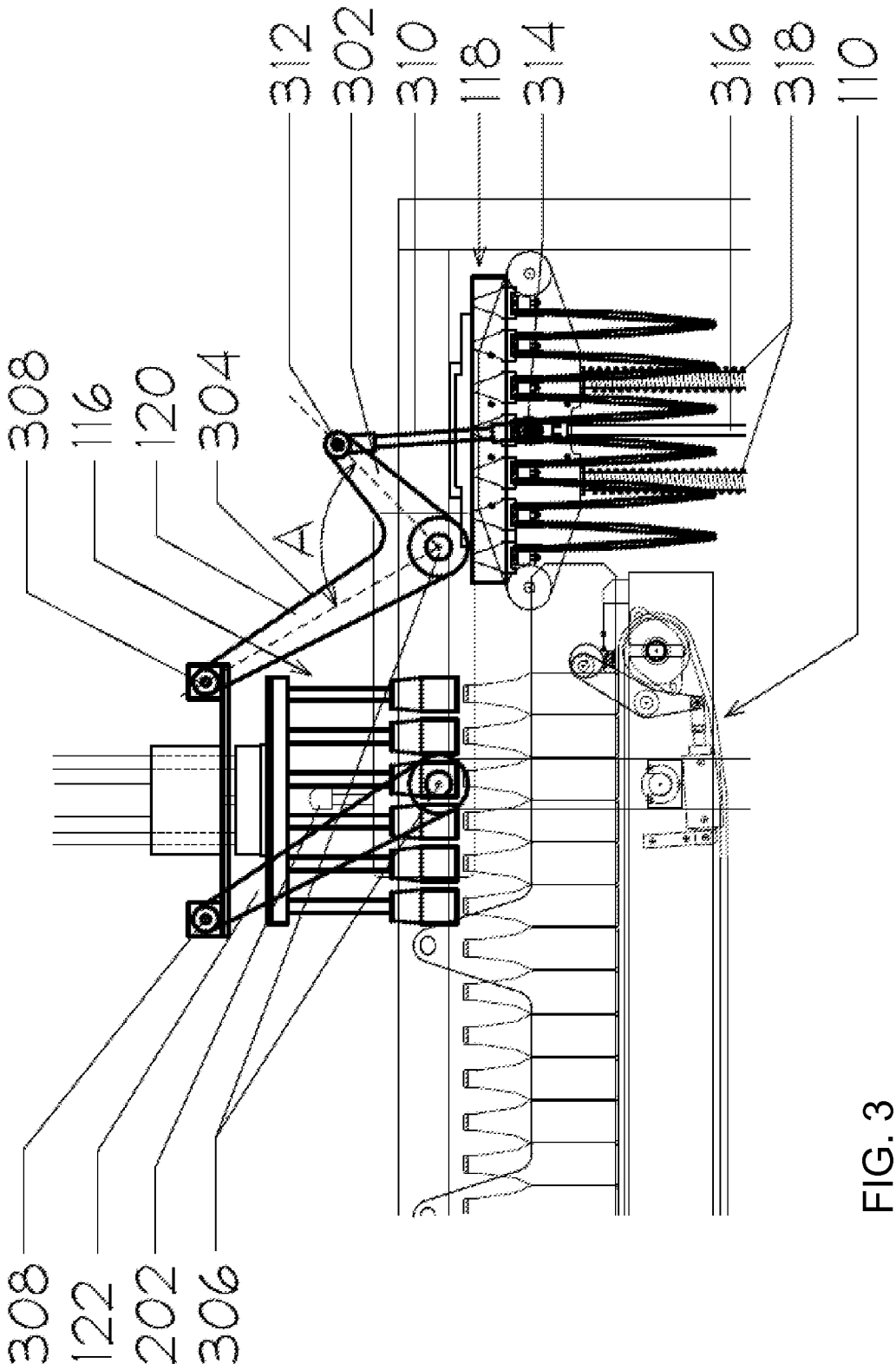


FIG. 3

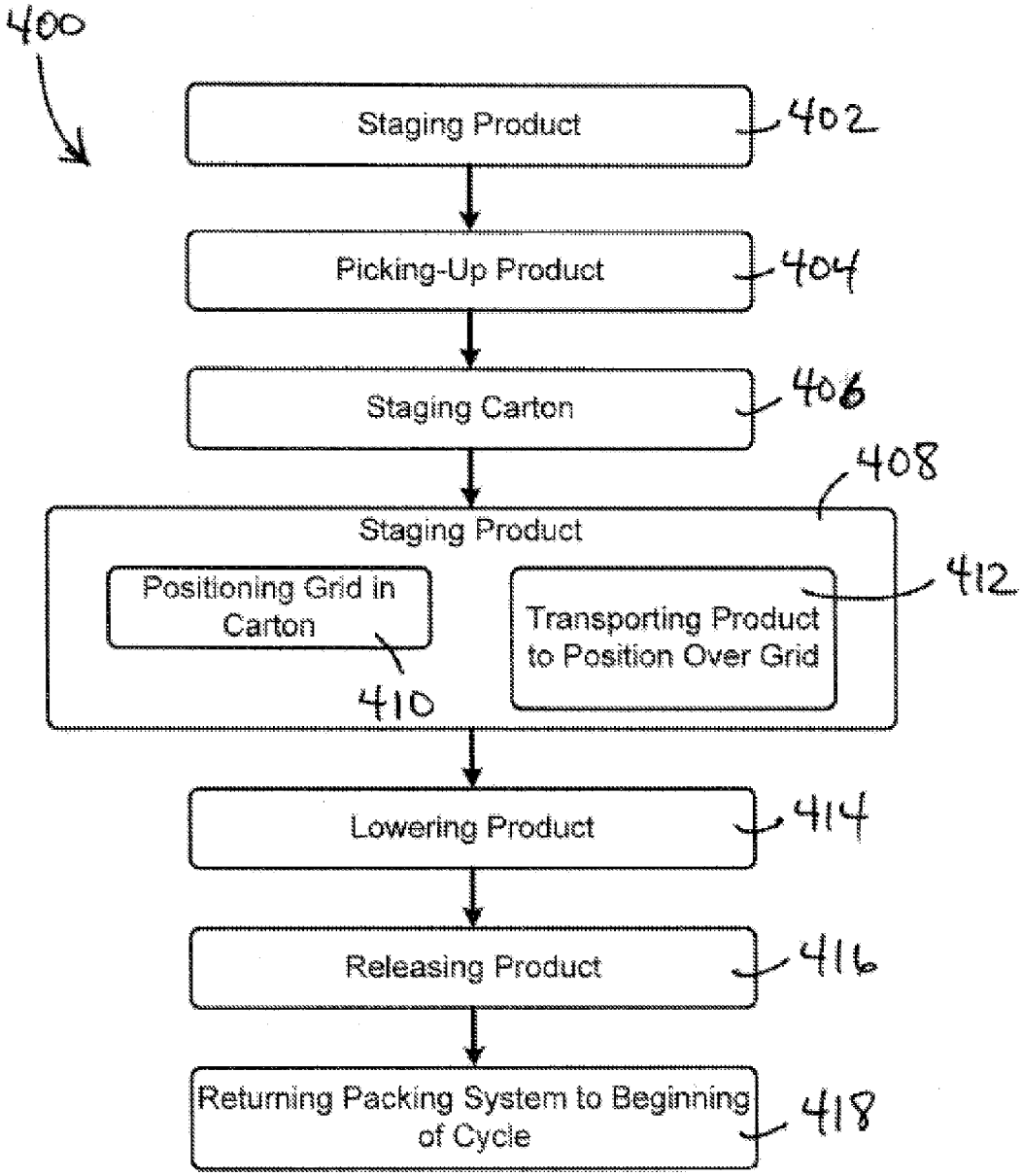

400
Staging Product
402
Picking-Up Product
404
Staging Carton
406
408
Staging Product
Positioning Grid in Carton
410
Transporting Product to Position Over Grid
412
Lowering Product
414
Releasing Product
416
Returning Packing System to Beginning of Cycle
418

FIG. 4

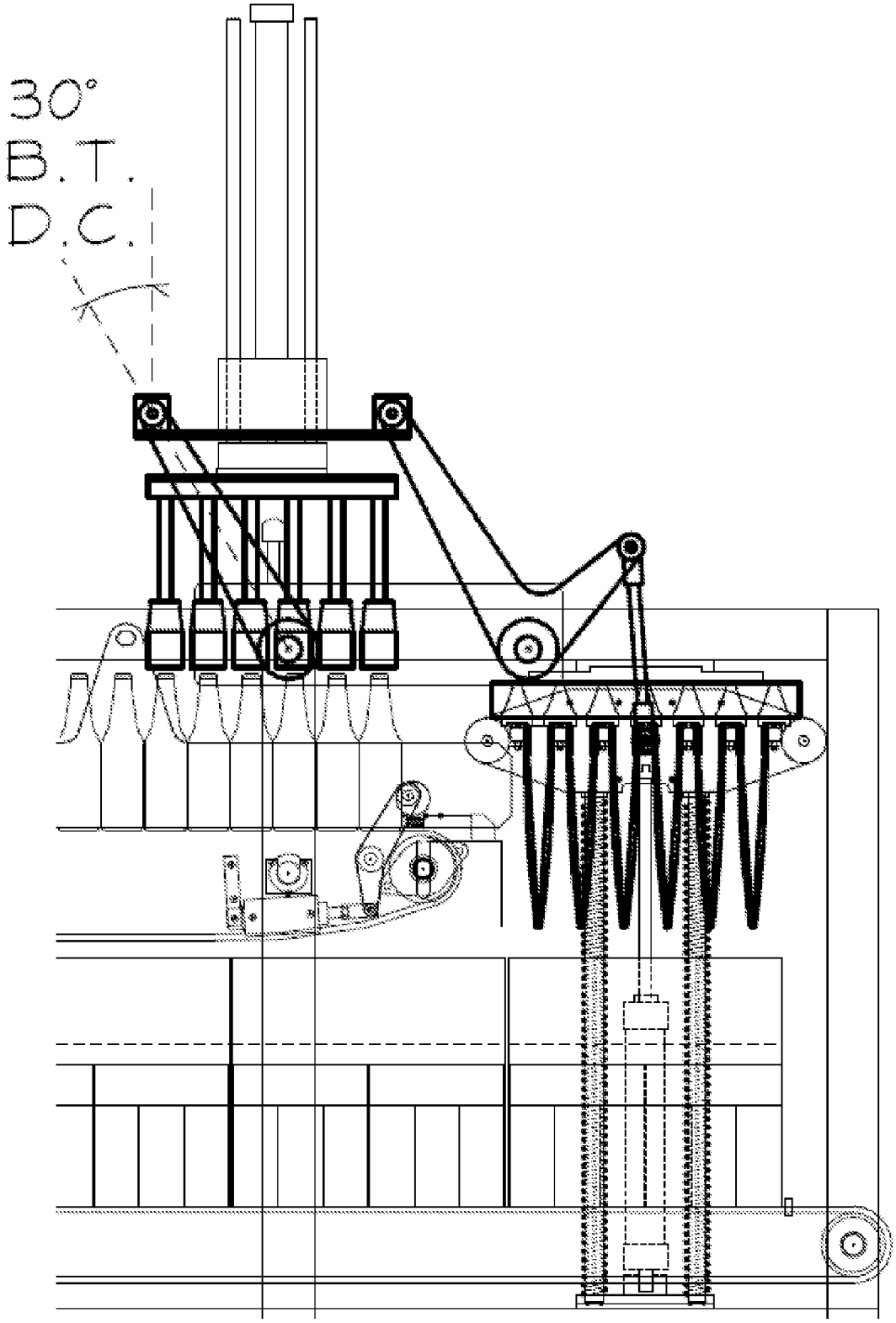


FIG. 5

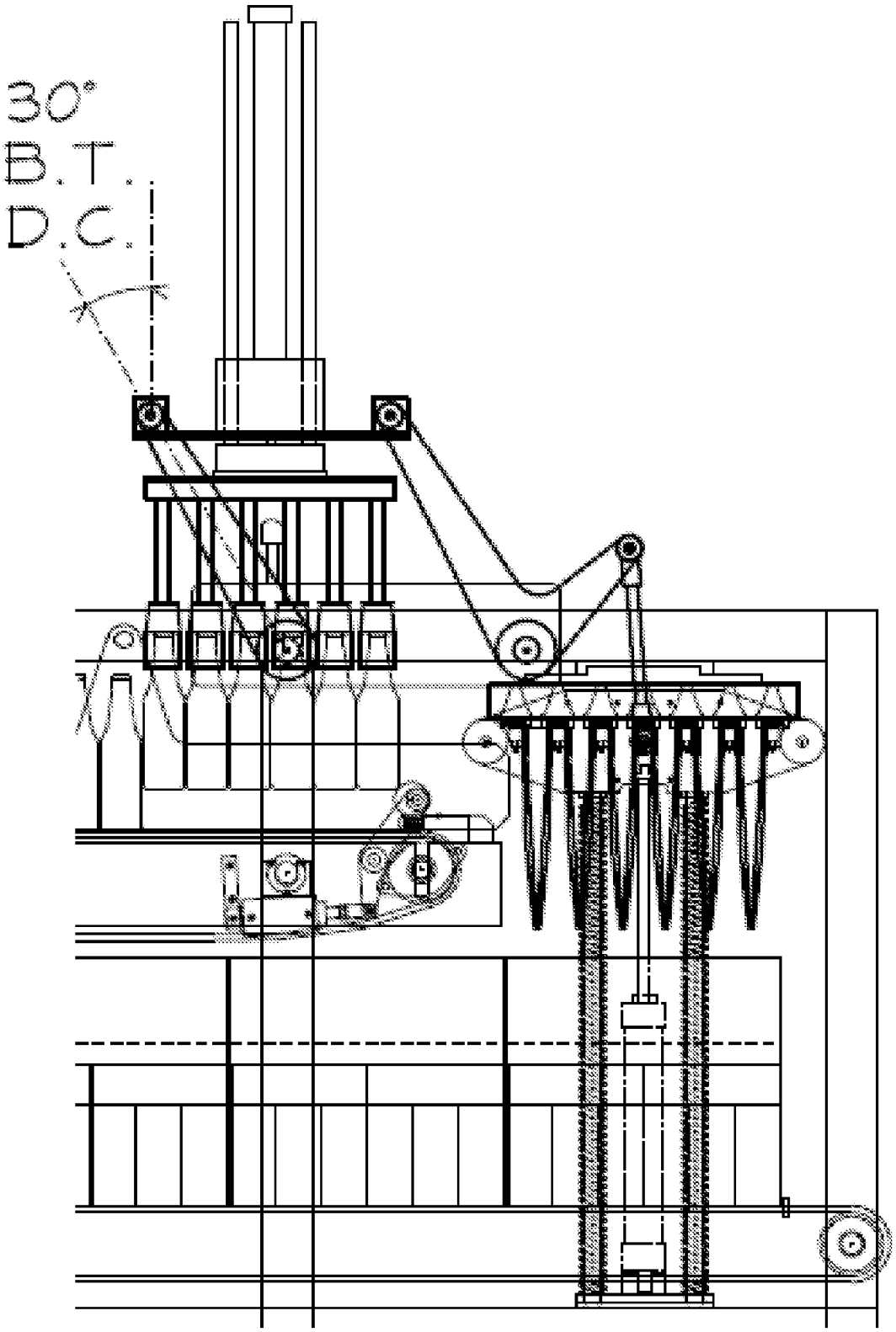


FIG. 6

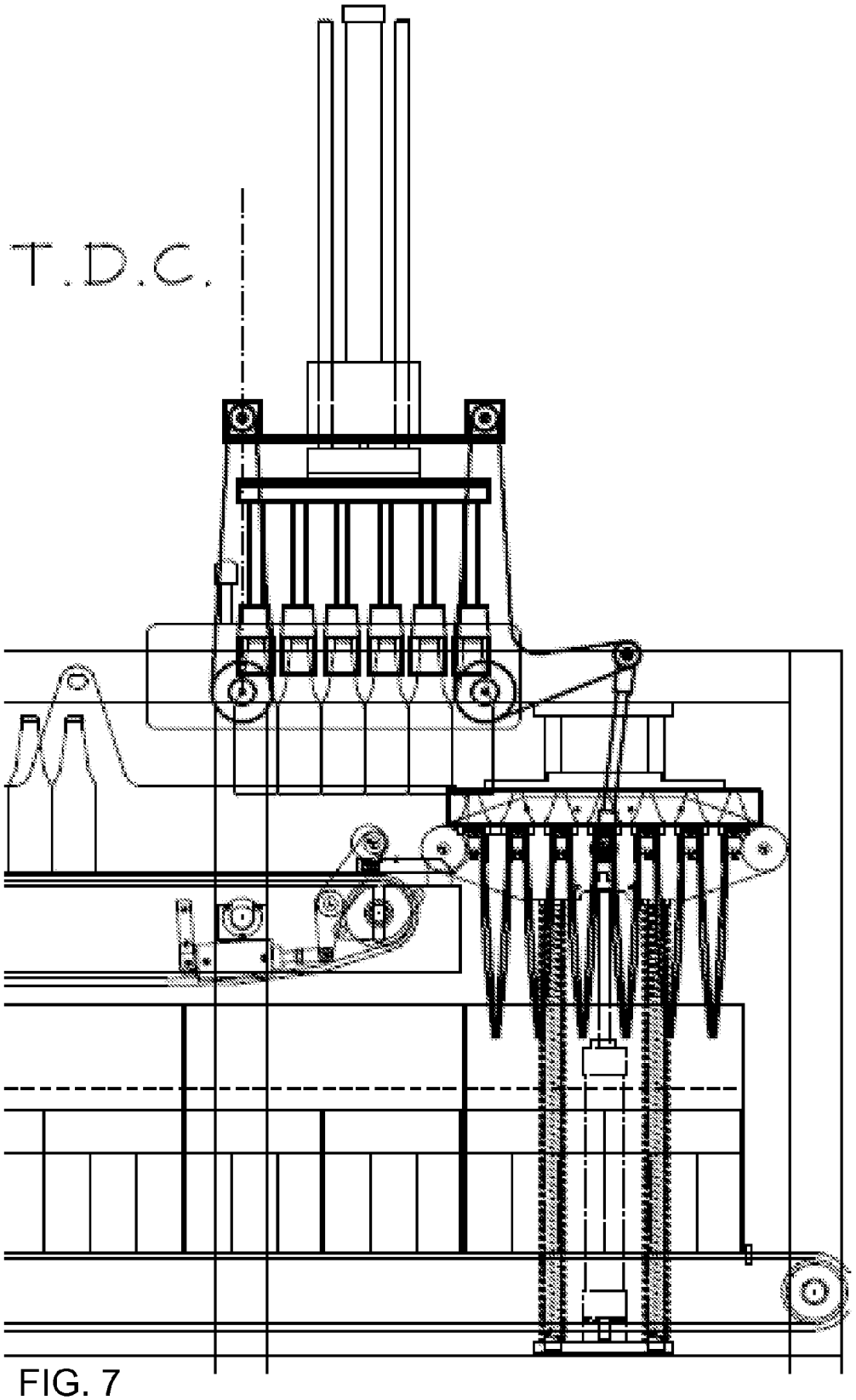


FIG. 7

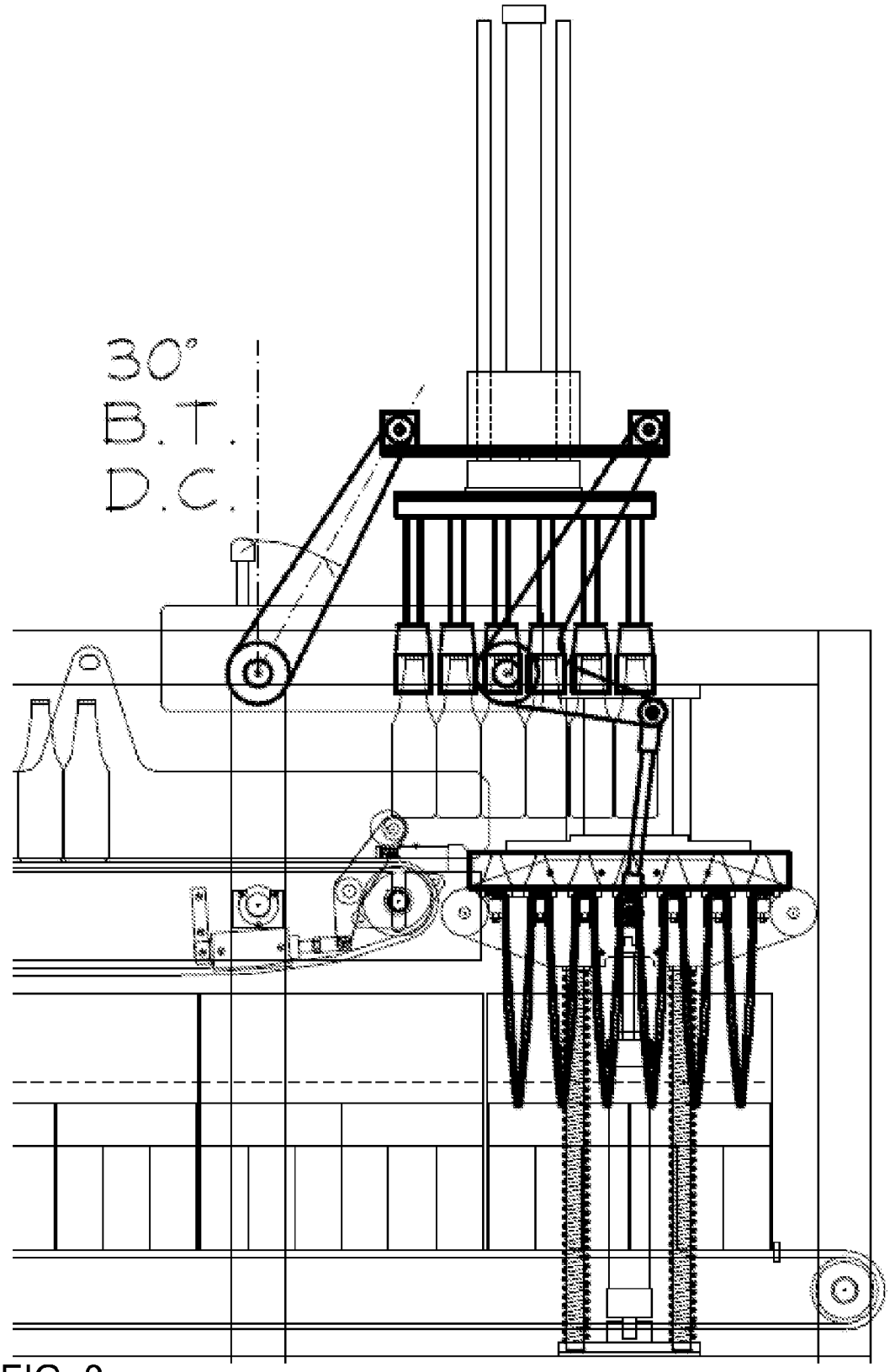


FIG. 8

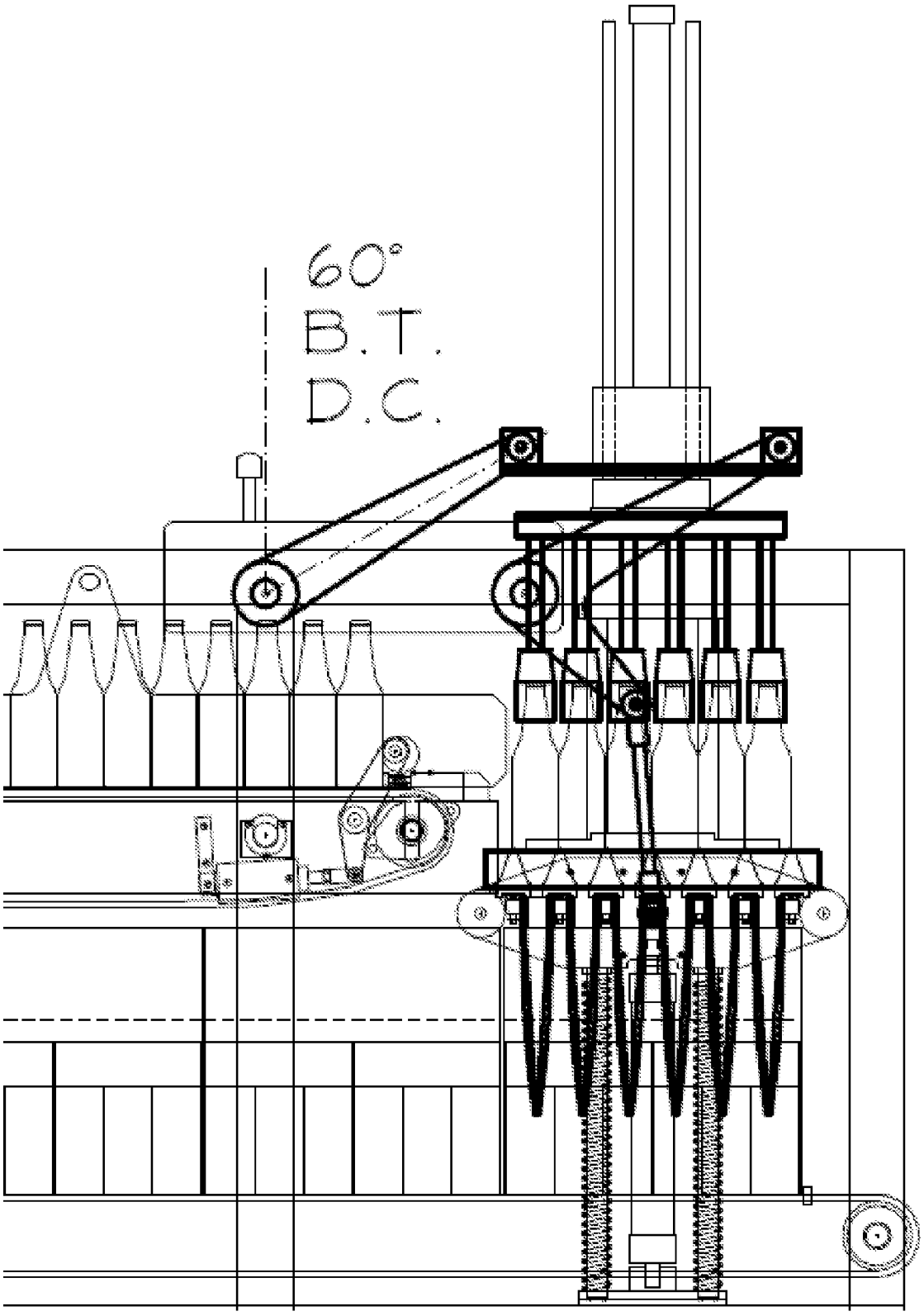


FIG. 9

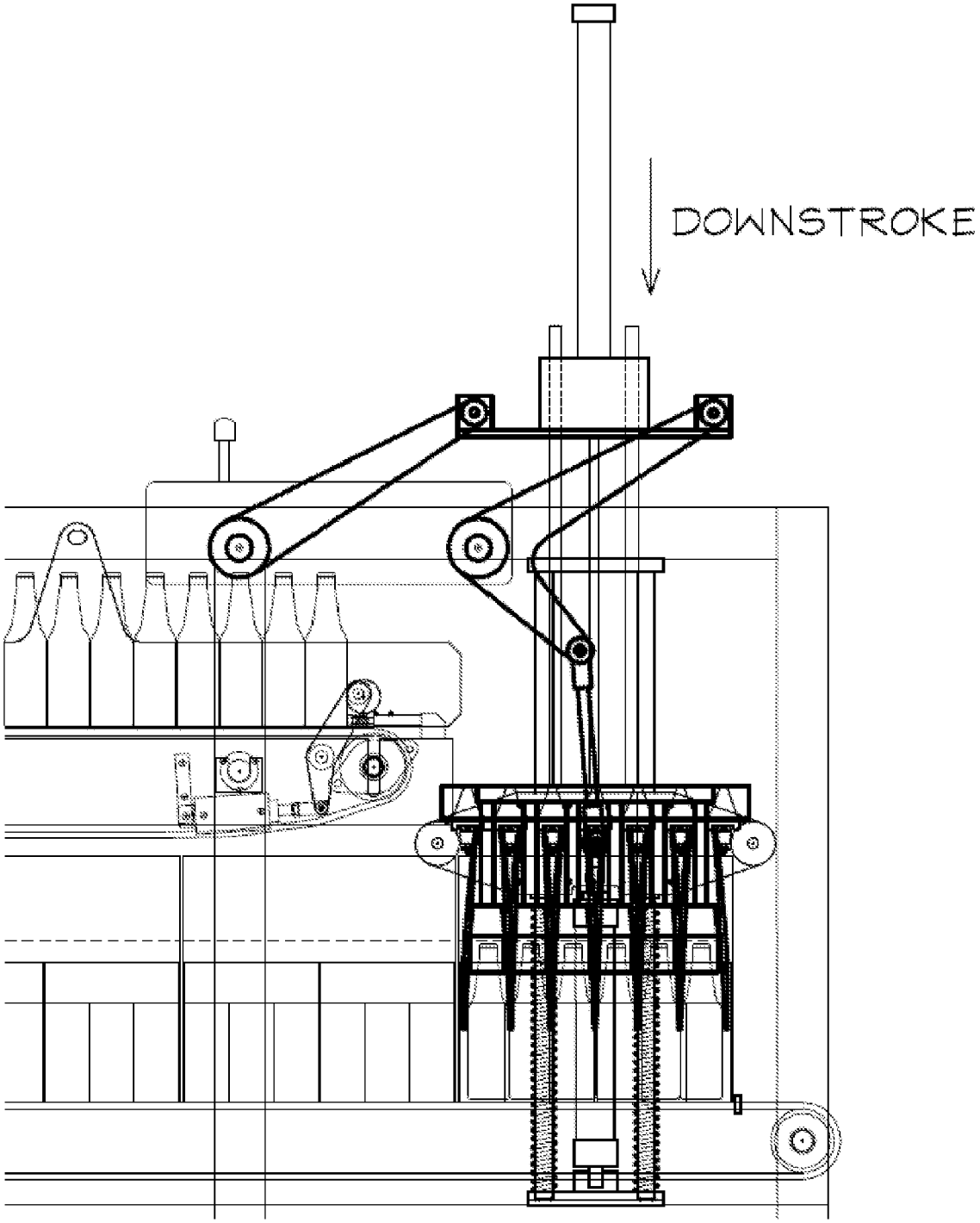


FIG. 10

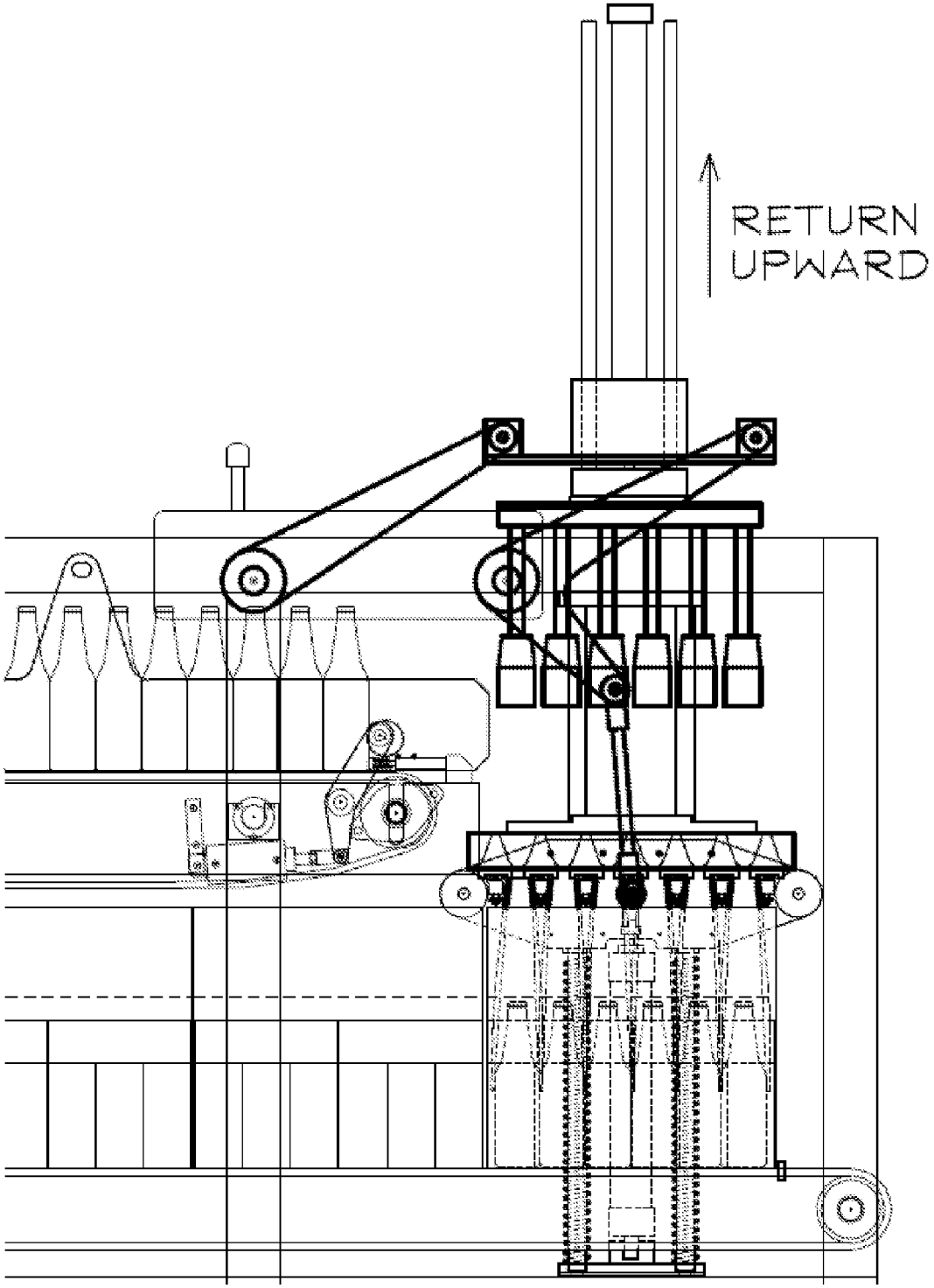


FIG. 11

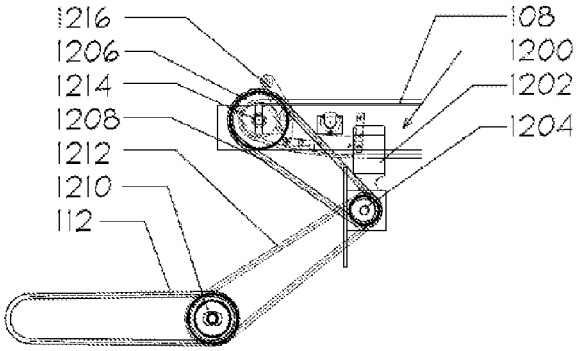


FIG. 12

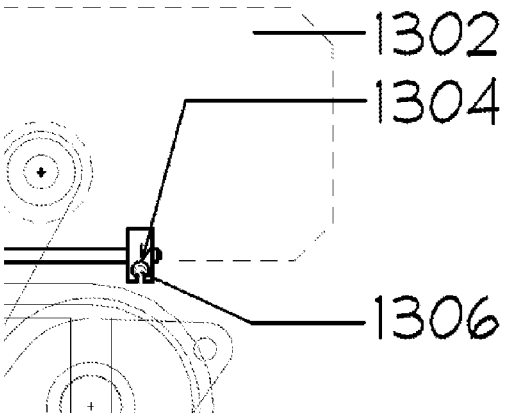


FIG. 13

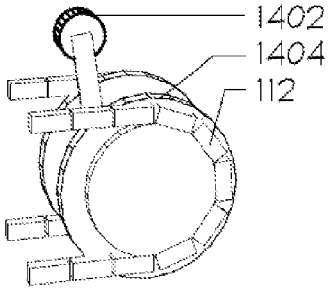


FIG. 14

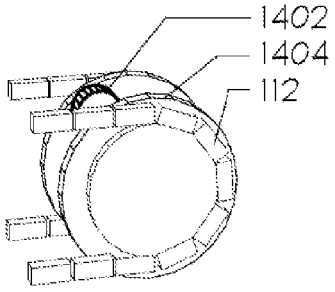


FIG. 15

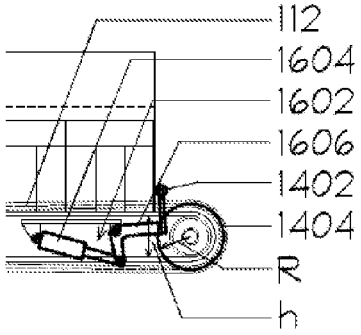


FIG. 16

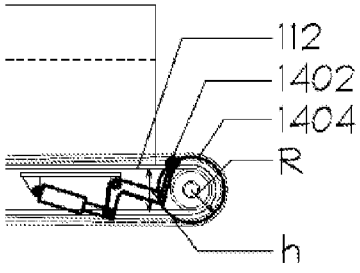


FIG. 17

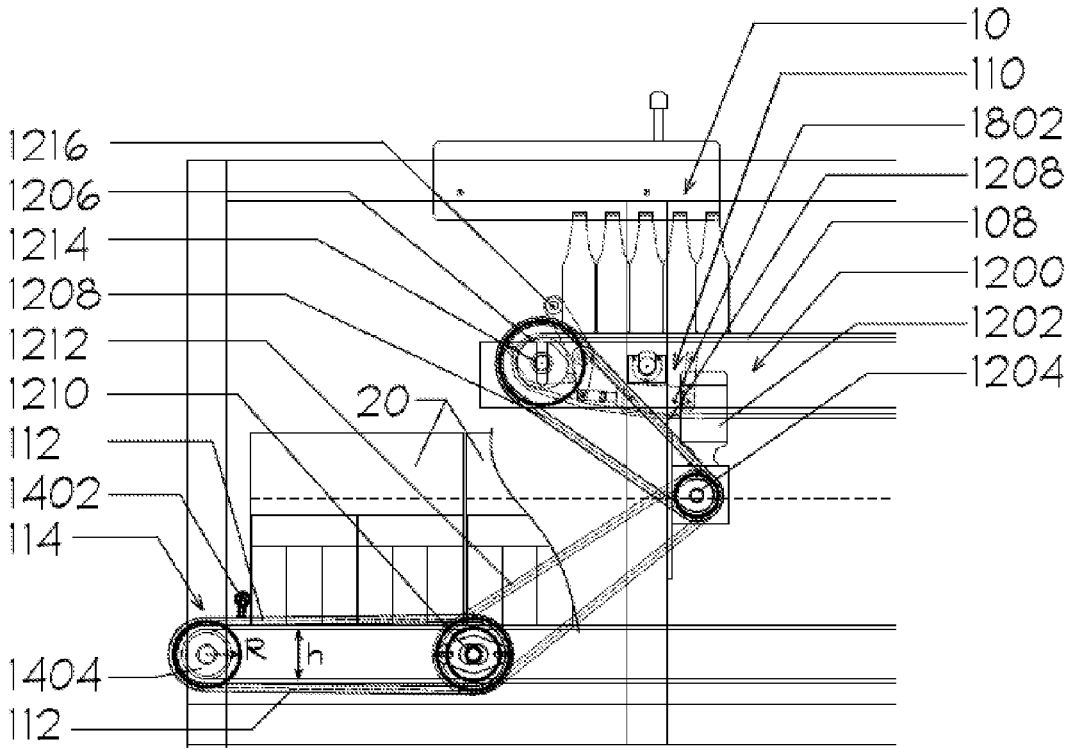


FIG. 18

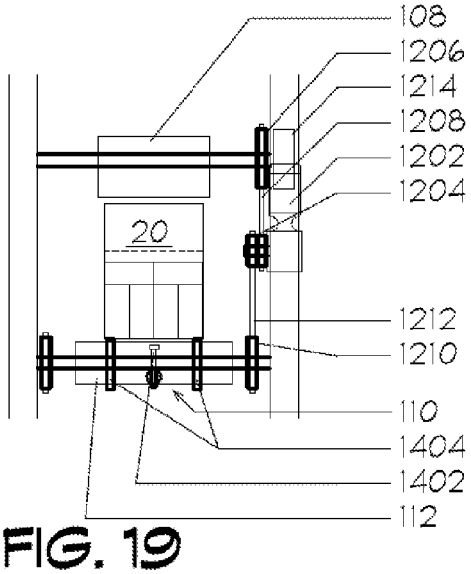


FIG. 19

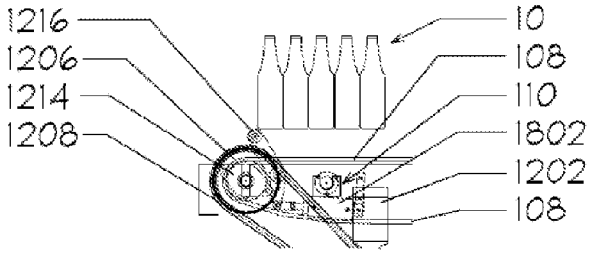


FIG. 20

COORDINATED SOFT-TOUCH CASE PACKER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of provisional patent application No. 61/621,442, filed 6 Apr. 2012 by the present inventors, J. Raudat and L. Dennison.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

BACKGROUND OF THE INVENTION

[0003] This invention relates generally to automated packaging machines, and, more particularly, this invention relates to improvements a coordinated movement of the gripper and grid sections for automatically packaging of groupings of distinct product items.

[0004] The field of automated packaging addresses the process of combining multiple distinct product units into a bulk container, to aid in storage and transportation for distribution, in a variety of ways. One common automated packaging machine may be seen to divide up the product and drop it into a box or case. Another machine stages the product as it flows, and captures a grouping of the product to relocate that grouping of product into the packaging box, or other suitable item, such as a carton, container, case, tray, or shell. These types of packaging machines can be seen to consist of a product feed section, a carton feed section, a load section, and an operator interface section. A quantity of product suitable for the capacity of a particular carton may be enough product to fill the carton, or enough to fill multiple cartons, or enough to fill a carton with multiple cycles of the packaging machine.

[0005] The operator interface section controls the system and allows the operator to manage the operation of the machine. It typically consists of a series of pushbuttons activators, along with read-out lights or displays, which enable the operator to start, stop, or alter the performance of the machine, and locate/correct any fault conditions.

[0006] The product feed section of the packaging machine includes a conveyor belt that transfers the product generally from an up stream process such as filling or labeling to the load section of the machine. The conveyor belt urges the product into lanes that align the product into a plurality of rows, and into the load section.

[0007] While the feed section fills the load section with product, the case feed section delivers empty boxes, cartons, or cases to the lift section via a conveyor. U.S. Pat. No. 3,353,331 issued to Rowekamp on 21 Nov. 1967, U.S. Pat. No. 3,561,189 issued to Raudat on 9 Feb. 1971, U.S. Pat. No. 2,921,425 issued to Seval on 19 Jan. 1960, U.S. Pat. No. 3,589,094 issued to Pearson on 29 Jun. 1971, U.S. Pat. No. 3,744,213 issued to Pearson on 10 Jul. 1973, U.S. Pat. No. 3,832,826 issued to Ullman on 3 Sep. 1974, and U.S. Pat. No. 4,457,121 issued to Johnson and Raudat on 3 Jul. 1984, demonstrate that the prior art teaches a variety of ways to deliver the grouped individual products into the cartons, once they are in the load section. However, none of these systems achieve the simplicity and compact footprint of the current system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The invention will be explained in conjunction with an illustrative embodiment shown in the accompanying drawings, in which:

[0009] FIG. **1** is an elevation side view of an exemplary embodiment of a combined packing system, including a product feed section, a carton feed section, and a packing unit, of the current invention;

[0010] FIG. **2** is an elevation output-end view of the packing system of FIG. **1**;

[0011] FIG. **3** is an elevation side view of the exemplary embodiment of the packing unit of the current invention depicted in FIG. **1**;

[0012] FIG. **4** is a flow diagram of the exemplary packing system operational process;

[0013] FIG. **5** is an elevation side view of the system depicted in FIG. **1**, with the coordination arm positioned at 30-degrees before top dead center before product pick-up;

[0014] FIG. **6** is an elevation side view of the system depicted in FIG. **1**, with the coordination arm positioned at 30-degrees before top dead center after product pick-up;

[0015] FIG. **7** is an elevation side view of the system depicted in FIG. **1**, with the coordination arm positioned at 30-degrees before top dead center;

[0016] FIG. **8** is an elevation side view of the system depicted in FIG. **1**, with the coordination arm positioned at 30-degrees after top dead center;

[0017] FIG. **9** is an elevation side view of the system depicted in FIG. **1**, with the coordination arm positioned at 60-degrees after top dead center and the gripper head assembly raised with holding product;

[0018] FIG. **10** is an elevation side view of the system depicted in FIG. **1**, with the coordination arm positioned at 60-degrees after top dead center and the gripper head assembly lowered;

[0019] FIG. **11** is an elevation side view of the system depicted in FIG. **1**, with the coordination arm positioned at 60-degrees after top dead center and the empty gripper head assembly raised;

[0020] FIG. **12** is a perspective side view image of an exemplary dual-conveyor drive motor assembly;

[0021] FIG. **13** is a perspective side view an exemplary product assembly sensor;

[0022] FIG. **14** is a perspective view image of an exemplary package management mechanism configured to assemble cartons;

[0023] FIG. **15** is a perspective view image of an exemplary package management mechanism configured to release the carton;

[0024] FIG. **16** is a perspective view image of an exemplary package management mechanism configured to assemble cartons;

[0025] FIG. **17** is a perspective view image of an exemplary package management mechanism configured to release the carton;

[0026] FIG. **18** is an elevation side view of an exemplary embodiment of a dual-conveyor drive motor system, coupled with a product feed section, and a carton feed section;

[0027] FIG. **19** is an elevation output-end view of the dual-conveyor drive motor system of FIG. **18**; and

[0028] FIG. **20** is an elevation side view of the exemplary embodiment of the assembly unit of the current invention depicted in FIG. **18**.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

[0029] Now, referring to FIG. **1**, the exemplary embodiment of the current packing system **100** is shown to comprise a product feed section **102**, a packing unit **104**, and a carton feed section **106**. The product feed section **102** is configured to assemble and position multiple distinct product units **10** into an orderly configuration for coordinated delivery into a bulk container. A product conveyor **108** transports the individual product units **10**, also referred to as product, into a product assembly unit **110** that detects proper configuration and permits product units **10** to be conveyed by the packing unit **104**. The packaging feed section **106** is configured to assemble and position multiple distinct carton units **20**, also simply referred to as cartons, into an orderly configuration for receiving groupings of product units **10** from the packaging unit **104**. A package conveyor **112** transports the cartons **20** into the carton management unit **114**, where the cartons **20** receive the coordinated product units **10** from the packaging unit **104**, and then are released to be assembled for bulk distribution.

[0030] The packing unit **104** transports the product **10** from the vicinity of the product assembly unit **110** to the cartons **20** positioned in the vicinity of the carton management unit **114**. The exemplary packing unit **104** is comprises a gripper head assembly **116**, a grid assembly **118**, a coordination arm **120**, three parallel arms **122**, and a gripper head elevator **124**. The gripper head assembly **116** and the gripper head elevator **124** are components of the exemplary pick-up assembly **126**. The grid assembly **118** may also be simply referred to as the grid, and the gripper head elevator **124** may also be simply referred to as the elevator. The coordination arm **120** and the parallel arm **122** are shown on one side of the gripper head assembly **116**. Each of the shown exemplary coordination arm **120** and the parallel arm **122** has a paired parallel arm on the opposite side of the gripper head assembly **116**. The rigidity of the exemplary packing unit **104** permits the exemplary design to forego placing an additional coordination arm **120** on the opposite side. In the exemplary embodiment, the gripper head assembly **116** is supported by the coordination arm three parallel arms **122**.

[0031] The exemplary packing unit **104** additionally comprises a coordination actuator **128** that affects the coordinated motion of the pick-up assembly **126** and the grid **118**. The coordination actuator **126** functions to create coordinated motion through repeatable cycles, where in each full cycle a full carton **20** of product **10** is transported from the vicinity of the product assembly unit **110** to the carton **20** in the vicinity of the package management unit **114**.

[0032] A suitable exemplary grid assembly **118** is described in U.S. Pat. No. 4,075,819, issued to John L. Raudat et al., on 28 Feb. 1978, and U.S. Pat. No. 4,448,009, issued to John L. Raudat (the current inventor), on 15 May 1984, which patents are both incorporated herein by reference to provide a detailed description of exemplary grid assemblies **118** and their function.

[0033] Referring now to FIG. **2**, the exemplary packing system **100** has a lower stop **202** positioned in the vicinity of the product assembly unit **110**. The lower stop **202** interrupts the full potential downward stroke of the gripper head elevator **124** at the precise level above the product **10**. The elevator **124** has the potential for a long stroke, useful in delivering the product **10** into the carton **20**. Separate short-stroke and long-stroke elevators may be employed as an alternative, but the lower stop **202** permits the use of a single elevator to facilitate both product **10** pick-up from the product assembly unit **110**, and delivery to the carton **20** in vicinity of the package management unit **114**. In the exemplary embodiment, packing system **100** has a right side and left side lower stop **202**, in order to engage on two sides of the gripper plate **204**, and more effectively distribute the forces at the stop point.

[0034] The exemplary gripper head assembly **116** comprises a gripper plate **204**, gripper tubes **206**, and grippers **208**. In the exemplary embodiment there is a specific gripper tube **206** and gripper **208** for each product unit **10** to be picked up by the gripper head assembly **116** in each cycle. A suitable exemplary gripper head assembly **116** is described in U.S. Pat. No. 7,522,570, issued to John L. Raudat et al., on 30 Jun. 2009, which patent is incorporated herein by reference to provide a detailed description of an exemplary gripper head assembly **116** and its function. A suitable exemplary gripper **208** is described in U.S. Pat. No. 2,873,996, issued to Charles J. Mchugh et al., on 17 Feb. 1959, which patent is incorporated herein by reference to provide a detailed description of an exemplary gripper **208** and its function.

[0035] In the present exemplary embodiment, the gripper head assembly **116** is raised and lowered in a straight line by the elevator **124**. When positioned in the vicinity of the product assembly unit **110**, the downward stroke of the gripper head assembly **116** is interrupted by the gripper plate **204** contacting the lower stop **202**. The exemplary lower stop **202** is designed to absorb the impact of the downward motion of the gripper head assembly **116**. The exemplary lower stop **202** is a rigid steel rod, with a resilient elastomeric cap that contacts the gripper plate **204**, and cushions the impact.

[0036] Components of the exemplary packing unit **104** are shown in greater detail in FIG. **3**. The exemplary coordination arm **120** is shown to have a lead arm **302** and a follow arm **304**. The lead arm **302** is shorter than the follow arm **304**, and measures slightly over half the length of the follow arm **304**. The exemplary angle A between the centerline of the lead arm **302** and the follow arm **304** is 75 degrees, with angles from 70 degrees to 80 degrees believed to be operational. The coordination arm **120** and the parallel arms **122** are attached to the packing system **100** frame at frame pivot points **306**, and to the pick-up assembly **126** at pick-up pivot **308**. Frame pivot points **306** and pick-up pivot **308** for the coordination arm **120** and the parallel arms **122** are spaced an equal distance apart. Since the pick-up point may change as the characteristics of the particular product and carton vary, so the lengths of the lead arm **302**, follow arm **304**, and angle A can be adjusted to adapt to the particular product and carton dimensions.

[0037] The grid **118** is linked to the pick-up assembly **126** through rigid coordination arm **120** and grid link rod **310**. Grid link rod **310** is attached to the lead arm **302** at link rod pivot **312**, and the grid **118** at grid pivot **314**. Grid link rod **310** is a rigid material that maintains a set distance between the link rod pivot **312** and the grid pivot **314**, thereby coordinating the movement of the pick-up assembly **126** and the grid **118**. By adapting the lengths of the lead arm **302** and the follow arm **304**, as well as the grid link rod, other angles for angle A, between 85 degrees and 95 degrees, may be operational.

[0038] The grid **118** is attached to the coordination actuator **128** by grid drive rod **316**, which also attaches to the grid **118** at grid pivot **314**. Though grid drive rod **316** and grid link rod **310** both attach to grid **118** at grid pivot **314**, they may be attached independently. Grid drive rod **316** is a rigid material that imparts motion directly from the coordination actuator

128 to the coordinated components of the pick-up assembly **126**. In the exemplary embodiment, grid **118** travels along a part of the length of grid guides **318**. Exemplary grid guides **318** are straight, parallel, rigid rods that are housed within compressible springs, so that the grid guides **318** direct the travel of the grid into a precisely positioned carton **20**, and the springs assist the coordination actuator **128** to lift the grid **118** during part of the packing system **100** packing cycle.

[0039] Referring now to FIG. **4**, the exemplary packing system **100** coordinatedly moves through a packing cycle **400**, that has an infinite number of positions to accomplish the steps of **402** staging product **10**, **404** picking up product **10**, **406** staging a carton **20**, **408** staging product, which in the exemplary embodiment includes simultaneously **410** positioning the grid **118** in the carton **20** and **412** transporting product **10** to a position over the grid **118**, **414** lowing the product **10** to the grid **118**, **416** releasing the product **10** through the grid **118**, and **418** returning the packing system **100** to the beginning of the packing cycle **400** to pick up another grouping of product **10** and repeat the process as appropriate.

[0040] Referring now also to FIGS. **5** through **11**, the exemplary cycle **400** starts with product appropriately positioned by the product assembly unit **110**, and the gripper head assembly **116** in a raised position. The position of the coordination arm **120** in this example is referenced from the relative position of the pick-up pivot **308** of the follow arm **304** with respect to its path of travel in an arc around its frame pivot point **306**. So referenced, exemplary step **404**, picking-up product, is accomplished at 30 degrees before top dead center ("TDC").

[0041] Step **404**, picking-up product, is accomplished by elevator **124** lowering gripper head assembly **116** until the gripper plate **204** rests on the lower stop **202**. At this point grippers **208** are each positioned over a product **10**, and an air supply is applied to the interior bladder of gripper **208** through gripper tube **206**, holding each product **10** in a respective gripper **208** firmly enough to affect the lifting and transport of the product **10**. Lifting is affected by elevator **124**, while transporting is affected by coordination actuator **128**, which rotates coordination arm **120** around its frame pivot point **306** through the linkage of the grid drive rod **316**, to the grid **118**, to the grid link rod **310**, to the coordination arm **120**.

[0042] While the gripper head assembly **116** secures the product **10**, the packaging feed section **106** performs step **406**, staging a carton **20** in the vicinity of the package management unit **114**. Once the carton **20** is in position, the packing system **100** may perform step **408**, staging product, which includes step **410**, positioning the grid **118** in the carton **20**, and step **412**, transporting product **10** to a position over the grid **118**. Packing system **100** performs steps **410** and **412** simultaneously, because of the geometric linkage of the pick-up assembly **126** and the grid **118** through the coordination arm **120**. Exemplary step **410** occurs as the coordination arm **120** rotates from 30 degrees before TDC, to TDC, to 30 degrees after TDC, and then to 60 degrees after TDC. During this rotation the grid **118**, which is attached to the shorter lead arm **302**, travels distance from a raised position above carton **20**, to a lowered position within a carton **20**. At the same time, exemplary step **412** occurs, since the coordination arm **120** links the grid **118** to the gripper head assembly **116**. During the rotation the gripper head assembly **116**, which is attached to the relatively longer follow arm **304**, travels a distance greater than the grid **118**, and moves from a position over the product assembly unit **110** to a position over the grid **118**.

[0043] In the exemplary embodiment, at 60 degrees after TDC the grid **118** stops a short distance from the bottom of the carton **20**. In this situation a short distance is a distance at which the grid **118** can controllably route the individual product **10** into the carton **20** from the gripper head assembly **116** without damage to the product **10** or carton **20**. Additionally, at 60 degrees after TDC the gripper head assembly is directly over the grid, but at a slightly too great of a distance to safely deliver the product **10** through the grid **118**.

[0044] In the exemplary embodiment, with the coordination arm **120** at 60 degrees after TDC, the packing system **100** performs step **414**, lowing the product **10** to the grid **118** by activating elevator **124** to complete a full downstroke, uninterrupted by lower stop **202**, which is only located on the frame over the product assembly unit **110**. In this position, at 60 degrees after TDC, and the gripper head assembly **116** lowered to within an effective distance of the grid **118**, the packing system **100** can perform step **416**, releasing the product **10** through the grid **118**, by releasing the vacuum applied to the product **10** through the gripper head assembly **116**.

[0045] In step **418**, the packing system **100** returns to the beginning of the packing cycle **400** to pick up another grouping of product **10**. The packing system **100** returns the gripper head assembly **116** to a raised position by activating elevator **124** to its full upward stroke. Additionally, in the exemplary embodiment, coordination actuator **128** operates to push the grid **118** to its upward position, in turn driving the coordination arm **120** through the return arc from a position of 60 degrees after TDC, to 30 degrees TDC, to TDC, and on to 30 degrees before TDC, so that the pick-up assembly **126** is once again positioned over the product **10** assembled by the product assembly unit **110**.

[0046] Referring now to FIG. **12**, an exemplary dual-conveyor drive motor assembly **1200**. The exemplary embodiment has a motor sprocket **1204** capable of driving multiple drive belts. In the exemplary embodiment, motor sprocket **1204** is configured to drive product drive belt **1208**, which in turn drives product sprocket **1206**, and package drive belt **1212**, which in turn drives package drive belt **1210**. The exemplary product sprocket **1206** includes a selective drive mechanism **1214** capable of permitting the product sprocket **1206** to stop, while the product drive belt **1208** continues to move. An exemplary suitable selective drive mechanism **1214** may be clutch **1214**, which may be controllably engaged and disengaged through a pressurized air supply used to control other components of the packaging system. Alternatively, the selective drive mechanism **1214** could be an electrically driven clutch. An assembly arm **1216** is shown in a raised position to restrain the product **10** in the vicinity of the product assembly unit **110**. An exemplary product assembly unit **110** is shown and discussed in greater detail in FIGS. **18** through **20**, below.

[0047] Referring now to FIG. **13**, an exemplary product assembly bumper **1302** includes individual components that sense the appropriate presence of product **10** in the vicinity of the product assembly unit **110**. The exemplary product feed section **102** assembles the product **10** into individual lanes. A plurality of assembly bumpers **1302** may be arranged so that each lane has a bumper **1302**. The exemplary bumpers **1302** are slightly spring loaded, to cause a bumper **1302** to move into a particular position when the respective product lane is filled with product **10**. Each bumper **1302** includes a body

through which is a formed a sight channel **1304**. The exemplary embodiment employs a light source **1306** on one side of the bumper array, and sensor (not shown) on the other side of the array, to detect when the sight channels **1304** of the entire array of bumpers **1302** align, permitting the light source **1306** to shine light on the sensor (not shown).

[0048] Referring now to FIGS. **14** through **17**, an exemplary package management unit **114** is shown to have a package stop **1402**, which is part of a package stop assembly **1602**. The exemplary package stop **1402** has a raised position, shown in FIGS. **14** and **16**, and a lowered position, shown in FIGS. **15** and **17**. Stop assembly **1602** may include a package stop **1402**, a stop actuator **1604** and a stop arm **1606**. The exemplary package stop **1402** is operatively attached to the stop actuator **1604** through stop arm **1606**.

[0049] An additional component of the exemplary embodiments of FIGS. **14** through **17** is a kicker wheel **1404**. Where the inside surfaces of the package conveyor **112**, which doubles back against itself, are separated by a distance h, the exemplary kicker wheel **1404** has a radius R, which is greater than ½ h. The greater radius means that the surface of the kicker wheel **1404** is raised slightly above the outer surface of the package conveyor. Additionally, the greater radius means that the surface of the kicker wheel **1404** moves at a greater circumferential velocity than the package conveyor **112**. The greater velocity results in giving a filled package **20**, which has been released by the stop **1402**, a slight boost of speed relative to the subsequent packages **20**. The boost of speed creates separation, permitting the stop **1402** to be raised after the filled packages **20** passes, just in time to stop the next package **20** to be filled.

[0050] Referring now to FIGS. **18** through **20**, an exemplary product assembly unit **110** assembles the product **10** for pick-up by the pick-up assembly **126**. An exemplary product sprocket **1206** is operatively attached to product conveyor **108** to effect movement of the product units **10** thereon. Though a limiter bar (not shown) spanning between assembly arms **1216** on each side of the product conveyor **108** may effectively inhibit product **10** from going off the end of the product feed section **102**, the exemplary embodiment employs a selective drive mechanism **1214** to permit the product sprocket **1206** and product conveyor **108** to stop, while the drive motor **1202** continues to run to move packages **20** into position to fill, and on after being filled.

[0051] In operation, the product conveyor **108** moves product **10** into position to be picked-up by the pick-up assembly **126**, while the package conveyor **112** moves packages **20** into position to be filled by the pick-up assembly **126**. When each lane of product **10** is appropriately filled with product **10**, the array of bumpers **1302** permit the light source **1306** to activate the sensor (not shown), which in turn engages the clutch **1214**, stopping the movement of the product conveyor **108**. With the product conveyor stopped, the product assembly unit **110** can lower the assembly arms **1216** with assembly actuator **1802**. Lowering assembly arms **1216** lowers the attached limiter bar (not shown), so that product **10**, lifted by the pick-up assembly **126**, can clear the limiter bar without requiring greater lifting from the product conveyor **108**. Lowering the limiter bar additionally permits step **408**, staging product, which includes step **412**, transporting product **10** to a position over the grid **118**, to more rapidly follow step **404**, picking-up product, since the product **10** need only be lifted a short distance to clear the lowered limiter bar.

[0052] In the exemplary embodiment, the sensor attached to the bumpers **1302** engages the clutch **1214**, but does not disengage the clutch **1214**, since it would do so as soon as the product **10** is lifted from the product conveyor **108**, if not when the product conveyor **108** stops. A subsequent sensor disengages the clutch **1214** and starts the product conveyor **108** once the step **412**, transporting product **10** to a position over the grid **118**, moves the product **10** being packed out of the way. The exemplary embodiment uses a sensor that detects a position of the coordination arm **120** or parallel arm **122** that indicates the product **10** being picked-up are out of the way of the incoming product **10**.

[0053] Referring back to FIGS. **3**, **12**, **13**, **18** and **20**, exemplary step **404**, picking-up product, is accomplished at 30 degrees before top dead center ("TDC"), but a range between 25 degrees and 35 degrees may be adaptably suitable. Initiating step **404** with coordination arm **120** at a slightly greater degree off TDC, for example 31 degrees or 32 degrees, up to 35 degrees, or even greater, will create a steeper angle of ascent of the product **10** off product conveyor **108**, permitting the bottom of product **10** to more quickly clear the product assembly unit **110**, specifically the limiter arm (not shown) that extends perpendicular across the product conveyor **108**.

[0054] Various adjustments may then be made within the scope of the teachings of this disclosure to compensate for this additional angle during either or both lowering product step **414** and releasing product step **416**. The exemplary initiation of staging the product step **408** occurs as the coordination arm **120** rotates from 30 degrees before TDC, to TDC, to 30 degrees after TDC, and then to 60 degrees after TDC. Ranges between 25 degrees and 35 degrees before and after TDC may be adaptably suitable, and ranges between 55 degrees and 65 degrees after TDC may be adaptably suitable. The range of the range of motion of the staging the product step **408** may be adjusted by the travel length of the stroke of the coordination actuator **128** and the length of both the grid drive rod **316** and the grid link rod **310**. Any combination of a longer extension of the coordination actuator **128**, grid drive rod **316** and the grid link rod **310** will expand the before TDC angle at the picking-up product step **404** and the initiation of staging product step **408**. Any combination of a shorter extension of the coordination actuator **128**, grid drive rod **316** and the grid link rod **310** will expand the after TDC angles at the end of the staging the product step **408**. The total travel distance of coordination actuator **128** may be set to have staging product step **408** start at an angle of about 31 degrees or 32 degrees before TDC, and have staging product step **408** end at an angle of about 61 degrees or 62 degrees after TDC.

[0055] However, since angle A would remain the rigid the product **10** drop distance from when the product **10** is released from the gripper head assembly **116** until it is interfaces with grid assembly **118** to be controllably deposited into a carton **20**, barring any other geometric changes, would remain the same. In an alternate exemplary embodiment, coordination arm **120** may be lockably hinged, permitting the infinite adjustment of the angle A.

[0056] The foregoing disclosure and description is illustrative and explanatory thereof. Any present invention should only be limited by the allowed claims and their legal equivalents. The allowed claims should be given their broadest interpretation, given the reasonable meanings of the words used herein, combined with the reasonable interpretation of one having ordinary skill in the art of automated packaging machines. The inventor trusts and relies on these legal prin-

ciple, in order to avoid being unnecessarily repetitive and verbose. Various changes in the details of the illustrated construction may be made within the scope of the appended claims by one having ordinary skill in the art without departing from the spirit of the invention and scope of the claims.

I claim:

1. A coordinated motion packaging machine for packaging product assembled in a product feed section in a bulk package assembled in a carton feed section, the packaging machine comprising:

a gripper head assembly, a coordination arm, and a grid assembly;

the gripper head assembly capable of simultaneously lifting a plurality of product and transporting the plurality of product to a position over the grid assembly and the bulk package;

the grid assembly having fingers for guiding the product into the bulk package; and

the coordination arm linking motion of the grid assembly to simultaneous motion of the gripper head assembly.

2. The packaging machine of claim **1**, further comprising:

the coordination arm having a lead arm, a follow arm, and a frame pivot point;

the lead arm operatively linked to the grid assembly, and the follow arm operatively linked to the gripper head assembly;

an angle at the frame pivot point between the lead arm and the follow arm is 75 degrees.

3. The packaging machine of claim **1**, further comprising:

the coordination arm having a lead arm, a follow arm, and a frame pivot point;

the lead arm operatively linked to the grid assembly, and the follow arm operatively linked to the gripper head assembly;

an angle at the frame pivot point between the lead arm and the follow arm is between 70 and 80 degrees.

4. The packaging machine of claim **1**, further comprising:

the coordination arm having a lead arm, a follow arm, and a frame pivot point;

the lead arm operatively linked to the grid assembly, and the follow arm operatively linked to the gripper head assembly;

an angle at the frame pivot point between the lead arm and the follow arm is rigidly fixed.

5. The packaging machine of claim **1**, further comprising:

the coordination arm having a lead arm, a follow arm, and a frame pivot point;

the lead arm operatively linked to the grid assembly, and the follow arm operatively linked to the gripper head assembly;

an angle at the frame pivot point between the lead arm and the follow arm is lockably adjustable.

6. A coordinated motion packaging machine for packaging product assembled in a product feed section in a bulk package assembled in a carton feed section, the packaging machine comprising:

a gripper head assembly, a coordination arm, and a grid assembly;

the gripper head assembly capable of simultaneously lifting a plurality of product and transporting the plurality of product to a position over the grid assembly and the bulk package;

the grid assembly having fingers for guiding the product into the bulk package;

the coordination arm linking motion of the grid assembly to simultaneous motion of the gripper head assembly;

the coordination arm having a pick-up pivot to operatively link to the gripper head assembly, a link rod pivot to operatively link to a grid pivot on the grid assembly, and a frame pivot point around with the pick-up pivot and ling rod pivot may rotate;

the link rod pivot positioned above the grip pivot in a range of between 45 degrees to the left and right of a point directly above the grid pivot, as measured at the grid pivot; and

the pick-up pivot moveable from an initiation point toward the product feed section from a point directly above the frame pivot point, to an interruption point on the other side of the point directly above the frame pivot point;

the initiation point and the frame pivot point form an initiation line, the interruption point and the frame pivot point form an interruption line, and the frame pivot point and the point directly above the frame pivot point forming a TDC line; and

the interruption line is a greater angle from the TDC line than the initiation point is from the TDC line.

7. The packaging machine of claim **6**, further comprising:

the angle from the TDC line to the initiation line is within 5 degrees of half the angle from the TDC line to the interruption line.

8. The packaging machine of claim **6**, further comprising:

the angle from the TDC line to the initiation line is half an angle in the range between the angle from the TDC line to the interruption line minus 5 degrees and the angle from the TDC line to the interruption line plus 5 degrees.

9. A packing cycle for packing a bulk package with an plurality of products comprising:

staging product in a product feed section of a packaging machine;

picking up a quantity of product suitable to the capacity of a carton;

staging a carton in a carton feed section of a packaging machine;

staging product, said staging product including simultaneously positioning a grid assembly in a carton and transporting product to a position over the grid assembly; wherein

a coordination arm linking motion of the grid assembly to simultaneous motion of a gripper head assembly; and

the gripper head assembly capable of lifting a plurality of product and transporting the plurality of product to a position over the grid assembly and the carton;

lowering the product to the grid assembly;

releasing all the product through the grid assembly; and

returning the packing system to the beginning of the packing cycle.

10. The packing cycle of claim **9**, wherein staging product further comprising:

the coordination arm comprising a lead arm, a follow arm, and a frame pivot point;

the lead arm operatively linked to the grid assembly, and the follow arm operatively linked to the gripper head assembly; and

moving the following arm in a direction of the lead arm around the frame pivot point.

11. The packing cycle of claim **9**, wherein lowering the product further comprising:

a pick-up assembly comprises the gripper head assembly and a gripper head elevator;

the gripper head elevator is operatively connected to raise and lower the gripper head assembly; and

lowering the gripper head assembly toward the grid assembly with the gripper head elevator.

12. The packing cycle of claim **9**, wherein staging product further comprising:

the coordination arm having a following arm with a pick-up pivot to operatively link to the gripper head assembly, a link rod pivot to operatively link to a grid pivot on the grid assembly, and a frame pivot point around with the pick-up pivot and ling rod pivot may rotate;

the link rod pivot positioned above the grip pivot in a range of between 45 degrees to the left and right of a point directly above the grid pivot, as measured at the grid pivot; and

the pick-up pivot moveable from an initiation point toward the product feed section from a point directly above the frame pivot point, to an interruption point on the other side of the point directly above the frame pivot point;

the initiation point and the frame pivot point form an initiation line, the interruption point and the frame pivot point form an interruption line, and the frame pivot point and the point directly above the frame pivot point forming a TDC line; and

the interruption line is a greater angle from the TDC line than the initiation point is from the TDC line; and

moving a following arm from a position along the interruption line, through a position along the TDC line, to a position along the interruption line.

13. The packing cycle of claim **9**, wherein staging product further comprising:

the coordination arm having a following arm with a pick-up pivot to operatively link to the gripper head assembly, a link rod pivot to operatively link to a grid pivot on the grid assembly, and a frame pivot point around with the pick-up pivot and ling rod pivot may rotate;

the link rod pivot positioned above the grip pivot in a range of between 45 degrees to the left and right of a point directly above the grid pivot, as measured at the grid pivot; and

the pick-up pivot moveable from an initiation point toward the product feed section from a point directly above the frame pivot point, to an interruption point on the other side of the point directly above the frame pivot point;

the initiation point and the frame pivot point form an initiation line, the interruption point and the frame pivot point form an interruption line, and the frame pivot point and the point directly above the frame pivot point forming a TDC line; and

the angle from the TDC line to the initiation line is within 5 degrees of half the angle from the TDC line to the interruption line; and

moving a following arm from a position along the interruption line, through a position along the TDC line, to a position along the interruption line.

14. The packing cycle of claim **9**, wherein staging product further comprising:

the coordination arm having a following arm with a pick-up pivot to operatively link to the gripper head assembly, a link rod pivot to operatively link to a grid pivot on the grid assembly, and a frame pivot point around with the pick-up pivot and ling rod pivot may rotate;

the link rod pivot positioned above the grip pivot in a range of between 45 degrees to the left and right of a point directly above the grid pivot, as measured at the grid pivot; and

the pick-up pivot moveable from an initiation point toward the product feed section from a point directly above the frame pivot point, to an interruption point on the other side of the point directly above the frame pivot point;

the initiation point and the frame pivot point form an initiation line, the interruption point and the frame pivot point form an interruption line, and the frame pivot point and the point directly above the frame pivot point forming a TDC line; and

the angle from the TDC line to the initiation line is half an angle in the range between the angle from the TDC line to the interruption line minus 5 degrees and the angle from the TDC line to the interruption line plus 5 degrees; and

moving a following arm from a position along the interruption line, through a position along the TDC line, to a position along the interruption line.

15. The packing cycle of claim **9**, wherein staging product further comprising:

the coordination arm comprising a lead arm, a follow arm, and a frame pivot point;

the lead arm operatively linked to the grid assembly, and the follow arm operatively linked to the gripper head assembly;

an angle at the frame pivot point between the lead arm and the follow arm is 75 degrees; and

moving the following arm in a direction of the lead arm around the frame pivot point.

16. The packing cycle of claim **9**, wherein staging product further comprising:

the coordination arm comprising a lead arm, a follow arm, and a frame pivot point;

the lead arm operatively linked to the grid assembly, and the follow arm operatively linked to the gripper head assembly;

an angle at the frame pivot point between the lead arm and the follow arm is between 70 and 80 degrees; and

moving the following arm in a direction of the lead arm around the frame pivot point.

17. The packing cycle of claim **9**, wherein staging product further comprising:

the coordination arm comprising a lead arm, a follow arm, and a frame pivot point;

the lead arm operatively linked to the grid assembly, and the follow arm operatively linked to the gripper head assembly;

an angle at the frame pivot point between the lead arm and the follow arm is rigidly fixed; and

moving the following arm in a direction of the lead arm around the frame pivot point.

18. The packing cycle of claim **9**, wherein staging product further comprising:

the coordination arm comprising a lead arm, a follow arm, and a frame pivot point;

the lead arm operatively linked to the grid assembly, and the follow arm operatively linked to the gripper head assembly;

an angle at the frame pivot point between the lead arm and the follow arm is lockably adjustable; and

moving the following arm in a direction of the lead arm around the frame pivot point.

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