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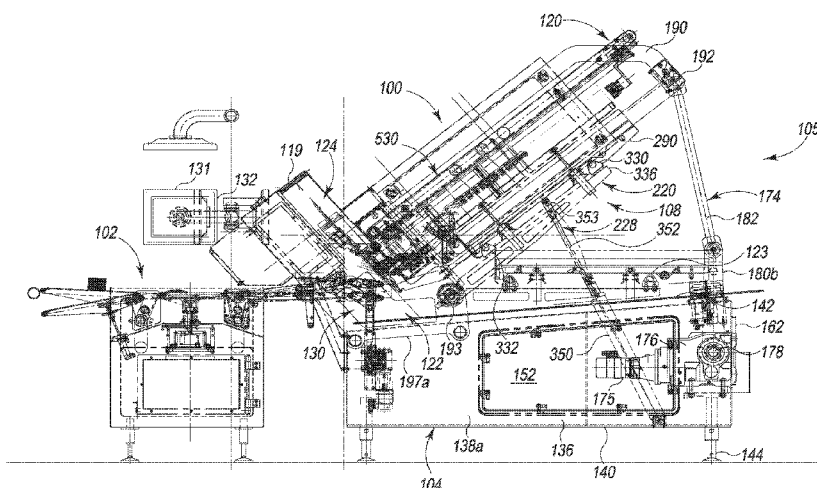


Fig. 1

(57) Abstract: A high speed food article slicing machine with a slicing station, a moveable frame supporting a food article feed mechanism frame, a food article gate, and a safety guard system for detecting an intrusion into the machine. Food articles are loaded onto a lift tray and raised to a staging position where food articles are in contact with a food article gate. The lift tray is located inline with the food article feed paths such that lateral shifting of food articles into the feed paths is not needed. Food article grippers, individually driven along feed paths by an overhead conveyor, move food articles over the food article gate towards the slicing station. The food article gate functions to assist in removal of food article end portions. The slicing machines utilizes a horizontally radiating laser intrusion detector to shut down systems when an unwanted intrusion is sensed.



HIGH SPEED SLICING MACHINE

This application claims the benefit of U.S. Provisional Application No. 61/343,551, filed May 1, 2010.

5 BACKGROUND OF THE INVENTION

Many different kinds of food articles or food products, such as food slabs, food bellies, or food loaves are produced in a wide variety of shapes and sizes. There are meat loaves made from various meats, including ham, pork, beef, lamb, turkey, and fish. The meat in the food loaf may be in large pieces or may be thoroughly comminuted. These meat
10 loaves come in different shapes (round, square, rectangular, oval, etc.) and in different lengths up to six feet (183 cm) or even longer. The cross-sectional sizes of the loaves are quite different; the maximum transverse dimension may be as small as 1.5 inches (4 cm) or as large as ten inches (25.4 cm). Loaves of cheese or other foods come in the same great ranges as to composition, shape, length, and transverse size.

15 Typically the food loaves are sliced, the slices are grouped in accordance with a particular weight requirement, and the groups of slices are packaged and sold at retail. The number of slices in a group may vary, depending on the size and consistency of the food article and the desire of the producer, the wholesaler, or the retailer. For some products, neatly aligned stacked slice groups are preferred. For others, the slices are shingled or folded
20 so that a purchaser can see a part of every slice through a transparent package.

Food articles can be sliced on high speed slicing machines such as disclosed in Published Patent Document WO 2010/011237 A1 or U.S. Patents 5,628,237 or 5,974,925; or as commercially available as the Power Max 4000™ and FX180® slicers available from Formax, Inc. of Mokena, Illinois, USA.

The FX180® machine can be configured as an automatically loaded, continuous feed machine, or an automatically loaded, back-clamp or gripper type machine.

For an automatically loaded, continuous feed machine, side-by-side upper and lower conveyor pairs drive food articles into the cutting plane. A gate is located in front of the conveyors. The initial food articles are loaded with leading ends abutting the gate. The gate is lowered and the food articles proceed into the conveyors. When the initial food articles are sliced to the extent that the trailing ends of the food articles clear the gate, the gate is raised and new food articles are loaded in the feed paths, held back by the gate. Shortly thereafter the gate is lowered and new food articles slide down to where lead ends of the new food articles abut trailing ends of the initial food articles being sliced. The new food articles are driven into the cutting plane trailing the initial food articles. Food articles are sequentially and continuously loaded in this manner, lead end-to-trailing end, in abutting contact with the preceding food articles.

U.S. Patent 5,628,237 and European patent EP 0 713 753 describe a back-clamp or gripper type slicing machine. According to this type of slicing machine, food articles are loaded onto a lift tray and the lift tray is raised to a ready-to-sweep position. Loaf grippers are retracted after the previous food articles are sliced. During retraction of the loaf grippers, loaf-to-slicing blade gate doors are closed and ends of the previous food articles are dropped through a loaf end door. After the grippers have reached the retracted position or “home position” remote from the slicing blade, a loaf sweep mechanism is activated, moving the food articles laterally together into the slicing position. A spacing mechanism moves down and spaces the food articles apart. The grippers then advance after it has been determined that the loaf sweep mechanism has moved the food articles to the slicing position. The grippers have onboard sensing mechanisms that are triggered by contact with the food

articles. After sensing and gripping the food articles, the food articles are retracted slightly, and the loaf-to-slicing blade gate doors are opened and the food articles are advanced to the slicing plane of the slicing blade. The loaf sweep mechanism retracts and the loaf lift tray lowers, ready for the next reload cycle. According to this design, in practice, the reload cycle is accomplished in about eight seconds. In a high volume slicing operation, reload cycle time can be a significant limitation to optimum production efficiency.

The machine disclosed in WO 2010/011237 A1 provides an automated, food article tray loading method and apparatus wherein food articles can be loaded into the lift tray into designated and separated lanes which automatically assume a preload condition, and after the food articles are loaded, food article separation is maintained on the lift tray. A food article transfer receives the food articles on the lift tray in their separated positions and transfers the food articles into the slicing feed paths while maintaining the separated positions. A food article end disposal system utilizes a transport that laterally moves end portions outside of the feed path and ejects the end portions as the transport is moved back into the feed path to receive the subsequent end portions. The machine utilizes food article grippers that are fixed onto conveyor belts which support and drive the food articles in the feed paths.

The present inventors have recognized that it would be desirable to slice plural food articles with independent feeding and weighing capabilities, with hygienic and operational enhancements.

SUMMARY OF THE INVENTION

The invention provides a mechanism and method for slicing multiple food articles with independency of feed rate and the ability to weigh each product group from each food article respectively to achieve optimal weight control and yield of each food article.

The present invention provides a high speed slicing apparatus and a weighing and classifying conveyor combination that provides plural advantages in machine cost, productivity, food hygiene, and operation.

The invention provides a lift tray that is located in line with the food article feed paths and is lowered to receive food articles and raised into the feed paths. There is no need for lateral shifting of food articles into the feed paths. Food article grippers are driven along the feed paths by an overhead conveyor. A laser food article end detection system is employed in each feed path to detect the terminal end of the food article to control the positioning of the gripper for that path.

The invention provides the use of an automatic debris or scrap removal conveyor that also provides for end portion removal.

The invention provides an automated cleanup position wherein the elevated food article feed mechanism can be collapsed to a more convenience plane or maintenance position, and the blade cover is automatically pivoted to a cleanup position.

The combination provides for enhanced portion control and yield. A food article feed mechanism ensures accurate feeding by the use of servo driven and controlled feed belts and grippers. The slicing mechanism includes three independent drives for slicing multiple food articles simultaneously.

An improved food article stop gate is provided that also serves as a door for the removal of food article end portions.

A horizontally radiating laser intrusion detector is used to shut down systems when an unwanted intrusion by an operator is detected.

An automated, food article tray loading method and apparatus is provided wherein food articles can be loaded into the lift tray into designated and separated lanes which

automatically assume a preload condition, and after the food articles are loaded, food article separation is maintained on the lift tray.

Numerous other advantages and features of the present invention will become readily apparent from the following detailed description of the invention and the
5 embodiments thereof, and from the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a near side elevational view of a slicing machine and a weighing and classifying conveyor combination of the present invention;

10 Figure 1A is an enlarged fragmentary view taken from Figure 1;

Figure 1B is a perspective view of the slicing machine of Figure 1 in a clean-up configuration;

Figure 2 is a plan view of the combination of figure 1 with some panels and parts removed or made transparent illustrating some underlying components;

15 Figure 2A is a bottom perspective view of a portion of Figure 2;

Figure 3 is a sectional view taken generally along line 3-3 of Figure 2 with some panels and parts removed or made transparent and underlying components revealed;

Figure 4 is a schematic, sectional view taken generally along line 4-4 of Figure 6 with some panels and parts removed or made transparent and underlying components revealed;

20 Figure 5 is a schematic, sectional view taken generally along line 5-5 of Figure 6 with some panels and parts removed or made transparent and underlying components revealed;

Figure 6 is a sectional view taken generally along line 6-6 of Figure 3 with some panels and parts removed or made transparent and underlying components revealed;

Figure 7 is a fragmentary elevational view taken generally along line 7-7 of Figure 2 with some panels and parts removed or made transparent and underlying components revealed;

Figure 7A is a fragmentary perspective view of a portion of Figure 7;

5 Figure 7B is an enlarged fragmentary view of a portion of Figure 7A;

Figure 7C is an enlarged rear perspective view of a portion of Figure 7;

Figure 7D is a top perspective view of a portion of Figure 7;

Figure 7E is an enlarged fragmentary view of a portion of Figure 7;

10 Figure 7F is an enlarged fragmentary view of an alternate embodiment of a lower conveyor.

Figure 8 is a fragmentary rear perspective view of the apparatus of Figure 1;

Figure 9 is a far side perspective view of the apparatus of Figure 1 with a lift tray in a lowered position;

15 Figure 10 is a top perspective rear view of the lift tray of Figure 9 with a tray platform removed;

Figure 11 is an enlarged, fragmentary near side perspective view of a portion of the slicing machine of Figure 1;

Figure 12 is an enlarged, fragmentary far side perspective view with a door removed to show underlying components;

20 Figure 13A is a schematic diagram of the loaf feed apparatus in a first stage of operation;

Figure 13B is a schematic diagram of the loaf feed apparatus in a second stage of operation;

Figure 13C is a schematic diagram of the loaf feed apparatus in a third stage of operation; and

Figure 13D is a schematic diagram of the loaf feed apparatus taken generally along line 13D-13D of Figure 13C.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

While this invention is susceptible of embodiment in many different forms, there are shown in the drawings, and will be described herein in detail, specific embodiments thereof with the understanding that the present disclosure is to be considered as an exemplification
10 of the principles of the invention and is not intended to limit the invention to the specific embodiments illustrated.

Published Patent Application No. WO 2010/011237 and U.S. Patent 5,628,237 are herein incorporated by reference.

Overall Description

15 Figures 1-3 illustrate a high speed slicing apparatus 100 and a weighing and classifying conveyor or output conveyor 102 according to a preferred embodiment of the invention. The slicing apparatus 100 includes a base section 104, a collapsible frame 105, an automatic food article loading apparatus 108 that receives food articles 110 to-be-sliced, a food article feed apparatus 120, a food article end and scrap removal conveyor 122 (Figures
20 13C and 13D), a laser safety guard system 123, a slicing head apparatus 124, and a slice receiving conveyor 130. The slicing head apparatus includes a slicing blade 125 that defines a slicing plane and a orifice plate or slicing block 126 that guides food articles into the slicing plane, the blade cutting closely to the orifice plate. The slicing apparatus also includes a

computer display touch screen 131 that is pivotally mounted on and supported by a support 132.

Base Section

The base section 104 includes a compartment 136 having side walls 138a, 138b, a
5 bottom wall 140, and an inclined top wall 142. The apparatus 100 is supported on four adjustable feet 144. The compartment 136 has a tapered side profile from back to front wherein the top wall 142 slants down from back to front. The slanted orientation of the top wall 142 ensures water drainage off the top of the compartment 136. The compartment is supported on adjustable feet 144.

10 The compartment 136 includes a near side door 152, a far side door 156 (Figure 9), and a rear door 162 that permit access into the compartment or to modules normally held within the compartment 136. The compartment 136 typically affords an enclosure for a computer, motor control equipment, a low voltage supply, and a high voltage supply and other mechanisms as described below. The compartment may also include a pneumatic
15 supply or a hydraulic supply, or both (not shown).

Collapsible Frame and Elevated Housings

The base section 104 supports the collapsible frame 105 as shown in Figs. 1, 1B and 9. The collapsible frame 105 includes a foldable support mechanism 174 that supports a food article feed mechanism frame 190.

20 The foldable support mechanism 174 includes a servomotor 175 that drives a gear reducer 176 having a drive shaft 178 that extends out of far side of the compartment 136 (Figure 9). The drive shaft 178 is rotationally fixed to parallel levers 180a, 180b which swing out with a turning of the drive shaft 178. The levers 180a, 180b are pivotally connected to a

column 182 via a rotary connection 184. The column 182 is pivotally connected at a pivot connection 192 to the frame 190 which supports the food article feed apparatus 120.

For cleaning and maintenance purposes, the collapsible frame 105 is collapsed down by actuating the servomotor 175 and gear reducer 176 to rotate the levers 180a, 180b, which
5 draws down the column 182 as shown in Figure 1B. The frame 190, and all equipment supported thereby, is lowered for more convenient maintenance and cleaning as illustrated in Figure 1B. In some cases this eliminates the need for ladders or platforms when servicing the slicing apparatus 100.

The slicing head 124 is covered by a guard 119 that is attached to the frame 190 such
10 that when the frame is pivoted down as shown in Figure 1B, the guard 119 is pivoted away from a slicing head base 117 to expose the slicing blade 125 and internals for cleaning and maintenance.

Additionally, the elevation of the food article feed apparatus can be adjusted by using the servomotor to selectively pivot the columns 180a, 180b and lower the rear of the frame
15 190. At a front, the frame 190 is supported on a cross shaft 193 that is eccentrically fixed at each end to a round cam 194 (Figure 1A). The cam is journaled in a round opening 195 in side supports 197a, 197b and the cam is fixed for non rotation to the respective side support by fasteners 199. The far side is shown in Figure 1A, with the understanding that the near side is mirror image identical across the longitudinal vertical center plane of the machine. As
20 shown in Figure 1A, because the dimension "a" is smaller than the dimension "b", the shaft ends can be temporarily loosened by removing the fasteners and the shaft and cams can be rotated 180 degrees about a centerline of the shaft, and the cams can be re-fastened to be fixed to the side supports. The elevation will be different between the two 180 degree

adjustable positions. Thus, the machine will accommodate two different height settings for different types of food articles.

Food Article Feed Apparatus

An upper conveyor assembly 530 of the food article feed apparatus 120 is shown in Figure 2. The conveyor assembly 530 includes three independently driven endless conveyor belts 802, 804, 806. Each belt 802, 804, 806 is identically driven so only the drive for the belt 802 will be described.

The belt 802 is wrapped around a toothed front drive roller or pulley 812 and a back idler roller or pulley 816. The belt 802 preferably has teeth that engage teeth of the two rollers 812, 816. Each drive roller 812 includes a toothed outer diameter 812a and a toothed, recessed diameter 812b.

An endless drive belt 820 wraps around the recessed diameter 812b. The drive belt 820 also wraps around a drive roller 824 that is fixed to a drive shaft 828. The drive shaft 828 extends transversely to the belt 802 and is journaled for rotation within a bearing 830 mounted to a near side frame member 836.

The drive shaft 828 penetrates a far side frame member 838 and extends to a bearing 843, coupled to a gear reducer 842 mounted to a support frame 854. The gear reducer 842 is coupled to a servomotor 850 that is mounted to the support frame 854.

The servomotor 850 drives the drive shaft 828 which turns the roller 824 which circulates the belt 820 which rotates the roller 812 which circulates the belt 802.

Three servomotors 850 are mounted to the support frame 854 and all are located within an upper compartment 855 that is supported by the frame 190.

The idler rollers 816 are provided with a pair of mirror image identical adjustable cam belt tension adjustment mechanisms 882a, 882b. As shown in Figure 7A, each

mechanism 882a, 882b includes a fork 885 that is braced from the respective side frame member 836, 838 by an adjustable cam 883. The fork 885 is guided by upper and lower pins 886a, 886b so as to slide rearward and forward and has an end 891 that captures an axle 889 that rotationally supports the idle rollers 816. For adjustment, the cam fastener 883a is
5 loosened so as to be rotatable on the respective side frame member 836, 838, rotated to achieve the desired belt tension, and then the cam fastener is tightened to hold the cam fixed.

Figure 7B illustrates a gripper 894 used in cooperation with the belt 802. The gripper 894 is mounted to a bottom run of the belt 802 and is translated along the food article path
10 by the belt 802. The gripper 894 is clamped to a belt joint and guide assembly 896 by a fixture 901 that engages the assembly 896 and is fixed thereto by a clamping set screw 897. The assembly 896 comprises a pair of upper members 899 and a lower member 900. The upper members 899 can include teeth 899a that mesh engage the teeth of the belt 802 once the members 899, 900 are fastened together to splice the free ends 802e, 802f of the belt 802
15 (Fig. 7D). For clamping, fasteners 902, 904 (Figure 7D) are provided which are inserted from above the members 899 through plain holes in the members 899 and tightly threaded into threaded holes in the member 900.

The block 900 includes guides 906, 907 that contain slide bearings 906a, 907a composed of friction reducing material. The slide bearings 906a, 907a partly surround
20 longitudinal rails 912, 913 that are in parallel with, and straddle the belt 802. The rails 912, 913 support the gripper along its working path from a retracted position to a fully forward position near to the slicing plane.

For each gripper there are two rails 912, 913 to support and guide that gripper. Thus, there are two rails that straddle the belt 804 and two rails that straddle the belt 806.

The gripper 894 is connected to the fixture 901 by a front plate 920 having a predominant lateral face and a rear plate 922 having a predominant longitudinal face. Each gripper 894 is provided with two air lines 930, 932 for two way pneumatic gripper open-and-close operability.

5 The air lines 930, 932 are guided through lower rings 940 and upper rings 942 to an air tube storage area 950 above the food article feed apparatus 120 (Figure 7D). The air tube lines are routed around weighted rollers or slides 951 that are guided by longitudinal slots 952 and extend to a source of pressurized air. Thus, the movement of the rollers or slides along the slots under force of gravity, will take up slack in the air tubes when the
10 grippers 894 are moving toward, and when in, the retracted position.

The gripper 894 travels from the retracted home position shown in Figure 7A to the advanced, forward position approaching the slicing plane.

The grippers 894 are as described in Published Patent Application No. WO 2010/011237, herein incorporated by reference.

15 Lower Conveyor

As illustrated in Figures 3, 6, 7, and 7E at a front end of the food article feed apparatus 120, are three lower feed conveyors 992, 994, 998, having endless belts 1002, 1004, 1008, respectively. The endless belts 1002, 1004 1008 are independently driven and are directly opposed to pressure plates 1003, 1005, 1007 respectively.

20 Figure 6 shows the conveyor 992 has a drive roller 1010 having a central hub 1012 with a center bore 1014. The drive roller 1010 has tubular stub axles 1016, 1018 extending from opposite ends of the central hub 1012. The tubular stub axles 1016, 1018 are journaled for rotation by bearings 1020, 1022 that are fastened to carrier blocks 1023a.

The conveyor 994 includes a drive roller 1038 having a central hub 1042 with a bore 1044. The drive roller 1038 has tubular stub axles 1046 and 1048 extending from opposite ends of the central hub 1042. The tubular stub axles 1046, 1040 are journaled by bearings 1050, 1052 respectively that are attached to carrier blocks 1023b.

5 A motor housing 1054, including a baseplate 1054b and a cover 1054a, is mounted to an end of an upper conveyor support bar 1056. The base plate 1054b of each side of the machine is fastened to a linear actuator, such as a pneumatic cylinder 1055a and 1055b respectively. The cylinders 1055a, 1055b are connected together by the support bar 1056. Each cylinder slides on a fixed vertical rod 1057a, 1057b respectively. Thus, controlled air to
10 the cylinders 1055a, 1055b can be used to uniformly raise or lower the near side housing 1054 and the far side housing 1054 uniformly.

A spindle 1060 extends through the motor housing 1054, through a sleeve 1064, through a coupling 1065, through the tubular stub axle 1016, through the central bore 1014, through the tubular stub axle 1018, through the tubular stub axle 1046, and partly into the
15 bore 1044. The spindle 1060 has a hexagonal cross-section base region 1070, a round cross-section intermediate region 1072, and a hexagonal cross-section distal region 1074. The hexagonal cross-section base region 1070 is locked for rotation with a surrounding sleeve 1071 to rotate therewith.

The intermediate region 1072 is sized to pass through the sleeve 1064, through the
20 tubular stub axle 1016, through the central bore 1014, and through the tubular stub axle 1018 to be freely rotatable therein. The distal region 1074 is configured to closely fit into a hexagonal shaped central channel 1078 of the tubular stub axle 1046 to be rotationally fixed with the tubular stub axle 1046 and the drive roller 1038.

The sleeve 1064 includes a hexagonal perimeter end 1064a that engages a hexagonal opening 1065a of the coupling 1065. The coupling 1065 includes an opposite hexagonal opening 1065a that engages a hexagonal perimeter end 1016a of the tubular stub axle 1016. The coupling 1065 couples the sleeve 1064 and the stub axle 1016 for mutual rotation such
5 that the sleeve 1064 and the drive roller 1010 are locked for rotation together, i.e., turning of the sleeve 1064 turns the drive roller 1010.

Within the motor housing 1054 are two servomotors 1090, 1092 mounted to the housing by fasteners. As shown in Figures 4 and 6, the servomotor 1090 has a vertically oriented output shaft 1096 that rotates about a vertical axis connected to a worm gear 1098
10 that is in mesh with and drives a drive gear 1100 that rotates about a horizontal axis. The drive gear 1100 drives the sleeve 1071 that drives the region 1070 of the spindle to rotate the spindle 1060. Rotation of the spindle 1060 rotates the drive roller 1038 via the hexagonal cross-section distal end region 1074.

Adjacent to the servomotor 1090 is the servomotor 1092. The servomotor 1092 is
15 configured substantially identically with the servomotor 1090 except the worm gear 1098, as shown in schematic form in Figure 5, of the servomotor 1092 drives a drive gear 1100 that drives the sleeve 1064 to rotate. The sleeve 1064 rotates independently of the round cross-section region 1072 of the spindle 1060, and drives a stub axle 1016 to rotate, which rotates the drive roller 1010.

20 The sleeves 1071 and 1064 are journaled for rotation by bearings. The drive gears 1100, 1100 are fastened to the respective sleeve 1071, 1064 using fasteners 1116.

Each conveyor belt 1002, 1004, 1008 is wrapped around the respective drive roller and a front idle rollers 1134, 1135, 1136 that is supported by respective side frames 1131, 1132.

Also, as shown in Figures 7, 7E, and 13A-13C, the underside of the support bar 1056 carries pneumatic cylinders 1130. Each pneumatic cylinder 1130 is supplied with a preselected air pressure to extend a piston rod 1013, 1015, 1017 to press down on pressers 1003, 1005, 1007 to lightly press down on a top of the product below, clamping the food article between the pressers 1003, 1005, 1007 and the belts 1002, 1004, 1008. Piston rods 1013a, 1015a, 1017a in their extended position and pressers, in their depressed position 1003a, 1005b, 1007a are illustrated in Figure 7E. The conveyor belts 1002, 1004, 1008 drive the food articles through corresponding orifices in the slicing block and into the slicing plane.

Figure 7F illustrates an alternate embodiment of the lower conveyor. The same reference signs indicate similar parts as described above. In the embodiment illustrated in Figure 7F, the lower conveyor 992a, 994a, 998a is pivotable about an axis A parallel to the central axis of a drive roller 1010a. Each conveyor belt 1002, 1004, 1008 is wrapped around the respective drive roller and a front idle rollers 1134, 1135, 1136 that is supported by respective side frames 1131, 1132. Side frames 1131, 1132 may be connected to a transverse bottom surface or bar 1133 which provides at least a region of contact for at least one piston rod 1137 disposed below the top surface of the conveyors. A support bar 1058 below the lower conveyors carries one or more pneumatic cylinders 1139, such as three pneumatic cylinders, supplied with a pre-selected air pressure, each of which extends a piston rod to pivot the lower conveyor about the pivot axis. Extension of the piston rods tilts the lower conveying surface towards presser plates 1003, 1005, 1007 to provide pressure in grasping the food product between the presser plates and the lower conveyor 992a, 994a, 998a. The tilt or pivot of the lower conveyor can be adjustable over a variable angular distance, such as 7 degrees. The lower conveyor 992b, 994b, 998b is illustrated in is lowered position.

The drive roller 1010a can be driven by a hexagonal shaft 1011 connected to a motor (not shown in Figure 7F). Hexagonal shaft 1011 comprises a circular channel 1014 which allows the hexagonal shaft, and accordingly the drive roller 1010a, to pivot about the axis A of the circular channel 1014. A combination of multiple concentric hexagonal shafts with a circular channel for coupling about a circular shaft can be used to drive adjacent lower conveyors.

Side frames 1131, 1132 comprises an opening 1021 in the shape of an arc, which accommodates the cross-sectional dimensions of a support or alignment bar 1019, which can extend across the span of lower conveyors and intersect the side frames of each lower conveyor. The angular angle of the arc corresponds to the degree of angular movement of the lower conveyor.

Feed Paths

The illustrated apparatus provides three feed paths, although any number of paths are encompassed by the invention. The near side feed path is defined by the gripper 394 driven by the belt 802 which feeds the near side food article into the space between the conveyor belt 998 and presser 107. The middle feed path is defined by the gripper 394 driven by the belt 804 which feeds the middle food article into the space between the conveyor 994 and the presser 105. the far side fed path is defined by the gripper 394 driven by the belt 806 which feeds the far side food article into the space between the conveyor 992 and the presser 103.

Food Article Loading Apparatus

As illustrated in Figure 1, the automatic food article loading apparatus 108 includes a lift tray assembly 220, and a lift tray positioning apparatus 228. The lift tray assembly 220 receives food articles to-be-sliced. The tray positioning apparatus 228 pivots the tray

assembly 220 to be parallel with, and below the food article feed apparatus 120 in a staging position.

Lift Tray Positioning Apparatus

Figures 8-10 illustrate the food article lift tray assembly 220 includes a frame 290 that supports movable food article support tray 302. The tray 302 is removed in Figure 10. The frame 290 includes an end plate 291. Food article are loaded onto the tray 302 until they abut the end plate 291. The tray 302 includes four spaced-apart guard rails 303 that define three lanes corresponding to three feed paths for the slicing machine.

As illustrated in Figures 1 and 10, the frame 290 is connected by a rear connection 330 and a front connection 332 to a lever 336. The lever 336 is pivotally mounted onto the shaft 193.

The mechanism 228 includes a pneumatic or hydraulic, extendable cylinder 350 that has a rod 352 pivotally connected to the lever 336 or the frame 290 at a connection 353, and a cylinder body 354 pivotally connected to the floor 140 at a connection 356. Extension or retraction of the rod 352 pivots the lever 336 and frame 290 about the connection 342.

Lift Tray Assembly

As shown in Figure 10, an inner frame 375 supports the tray 302 within the frame 290. The inner frame 375 is movable vertically with respect to the frame 290. The inner frame 375 is liftable by pneumatic cylinders 380 to an elevated position above the staging position below the feed paths to lift the food articles to be in the food paths and to be gripped by the grippers. The cylinders 380 have rods connected to cross members of the frame 375 and cylinder bodies fastened to cross members of the frame 290. In the elevated position, the tray top surface 302a is just above the top of the end plate 291 so the food articles can be moved longitudinally off the tray 302.

Food Article Gate

As illustrated in Figure 13A-13D a food article gate 2020 is operable to be used as a gate, to be used as a floor for supporting the food article, and to be used as a trap door to drop a food article remainder end through the trap door against a baffle 2022 and onto a scrap conveyor 122. The scrap conveyor 122 is also located below the cutting plane to dispose of shaving scrap caused by the blade on the food article during idle dwell periods.

The scrap conveyor 122 can be continuously circulated by use of a drum motor on one of the rollers. The conveyor delivers scrap to a discharge chute 2030 (Figures 13D and 9) where the scrap can be collected in a bucket or other means.

The gate 2020 can be operated to be positioned according to Figure 13A-13C by a linear actuator such as a servomotor actuator or a pneumatic cylinder, as shown in Figures 11 and 12. A servomotor actuator 2036 is pivotally connected to the cabinet 855 at a pivot point 2038 and has an actuator rod 2040 pivotally connected to a lever 2042 which is fixedly connected to an axle rod 2044. The axle rod 2044 sealingly penetrates through the cabinet wall as shown in Figure 11. The axle rod 2044 is fixed to the gate 2020. The axle rod 2044 is journaled at an opposite end to a bracket 2048. By extension or retraction of the rod 2044 the gate 2020 can be selectively pivoted. By machine control.

Laser Detectors

A separate food article end detector is used for each of the three illustrated food paths. Preferably, the detectors are laser distance sensors 2002, 2004, 2006. Once the food articles are pivoted by the apparatus 228 to the staging position below the feed paths, the sensors 2002, 2004, 2006 sense the ends of each food article in the three lanes on the tray 302, and communicate that information to the machine control. The machine control uses

this information to control the servomotors 850 to control the positioning of the grippers to the ends of each food article and also controls the actuation of each gripper. By knowing the exact end of the food article the grippers know when to be activated to seize the food article.

5 Slicing Head Section

The slicing head section is as described in WO 2010/011237, herein incorporated by reference.

The slicing block with orifices is also as described in WO 2010/011237, herein incorporated by reference.

10 The jump conveyor can also be configured as described in U.S. Serial 11/449,574 filed 6/08/2006 or WO 2010/011237, herein incorporated by reference.

Laser Safety Guard System

The laser safety guard system 123 is illustrated in Figures 1 and 8. The system comprises a central sensor 123 that projects a horizontal fan beam approximately 360
15 degrees or as much of an angle as needed. If an obstruction is sensed, such as an operator's arm, one or more machine operations are halted by the machine control. The machine operations, such as the lift tray positioning apparatus, may be halted by machine controls when an obstruction in the fan beam is sensed. Other operations such as the slicing
20 movement of the slicing blade, or the food article feeding apparatus, may also be halted with the laser safety guard system.

From the foregoing, it will be observed that numerous variations and modifications may be effected without departing from the spirit and scope of the invention. It is to be understood that no limitation with respect to the specific apparatus illustrated herein is intended or should be inferred.

The Invention Claimed Is:

1. A food article slicing machine comprising:
 - a slicing station comprising a knife blade and a knife blade drive driving the blade along a cutting path in a cutting plane;
 - 5 a food article feed apparatus disposed over a food article loading apparatus, said food article feed apparatus having an upper conveyor assembly with independently driven endless conveyor belts, each belt connected to a food article gripper for moving a food article along a food article feed path.
- 10 2. The food article slicing machine of claim 1, wherein the food article feed path comprise lanes within a lift tray.
3. The food article slicing machine of claim 1, wherein a food article gate disposed upstream of the slicing station forms a portion of the food article feed path.
- 15 4. The food article slicing machine of claim 3, wherein the food article loading apparatus includes a lift tray assembly moveable between a staging position and an elevated position, said elevated position being a position wherein the food articles
20 disposed within the lift tray assembly are in the food article feed path;
and wherein the food articles are supported in position along the food article feed path by at least the food article gate when the lift tray assembly is moved from its elevated position.

5. The food article slicing machine of claim 1, wherein the food article feed path feeds the food article between a front lower conveyor and upper presser plate upstream of the slicing station
- 5 6. A food article slicing machine comprising:
a slicing station comprising a knife blade and a knife blade drive driving the blade along a cutting path in a cutting plane;
a base section supporting a moveable frame, said moveable frame supporting a food article feed mechanism frame; and
10 a safety guard system for detecting an intrusion into the machine.
7. The food article slicing machine of claim 6 wherein the safety guard system comprises a laser source.
- 15 8. The food article slicing machine of claim 7 wherein the laser source projects an arc shaped beam.
9. The food article slicing machine of claim 8 wherein the laser source is oriented such that the arc is horizontal.
- 20 10. The food article slicing machine of claim 8 wherein the fan beam is adjustable to produce an arc of up to 360 degrees.

11. The food article slicing machine of claim 8 wherein the arc covers at least a portion of the slicing machine.

12. The food article slicing machine of claim 8 further comprising a sensor for detecting an intrusion into the arc.

13. The food article slicing machine of claim 12 wherein the sensor communicates an intrusion to a slicing machine control which halts at least one aspect of machine operations when an intrusion is sensed.

10

14. The food article slicing machine of claim 13 wherein the area swept out by the arc shaped beam is horizontal.

15. The food article slicing machine of claim 8 wherein the arc shaped beam sweeps out an area covering at least a portion of the region between the base section of the slicing machine and the collapsible frame.

16. A food article slicing machine comprising:

20 a slicing station comprising a knife blade and a knife blade drive driving the blade along a cutting path;

a food article feed apparatus moving one or more food articles for movement along a corresponding food article path intersecting the cutting path; and

a food article loading apparatus having

25 a lift tray assembly for receiving food articles, and

a lift tray positioning apparatus for moving the lift tray between a lowered position where food articles are loaded onto the lift tray, and a raised position where food articles are moved into a staging position.

5

17. The food article slicing machine of claim 16 wherein the lift tray assembly comprises a frame that supports a moveable food article support tray.

18. The food article slicing machine of claim 17 wherein the moveable food article
10 support tray comprises guard rails that define at least one lane for moving food article towards the cutting path.

19. The food article slicing machine of claim 18 wherein the moveable food article
15 support tray comprises four guard rails to define three lanes for conveying three food articles simultaneously towards the cutting path.

20. The food article slicing machine of claim 17 wherein the frame comprises an end plate on the end of the tray closest to the slicing station.

20 21. The food article slicing machine of claim 20 wherein the frame further comprises an inner frame for supporting the moveable food article support tray, said inner frame moveable vertically with respect to the frame.

22. The food article slicing machine of claim 21 wherein vertical movement of the inner frame elevates the moveable food article support tray.

23. The food article slicing machine of claim 22 wherein the vertical movement of the inner frame is actuated by pneumatic cylinders having rods connected to cross members of the inner frame, and cylinder bodies of the pneumatic cylinders fastened to cross members of the frame.

24. The food article slicing machine of claim 22 wherein the moveable food article support tray in its elevated position has a tray top surface that is just above the top of the end plate to allow for longitudinal movement of food article from the moveable food article support tray over the top of the end plate.

25. The food article slicing machine of claim 17 wherein the lift tray positioning apparatus comprises a lever connected to the frame on a bottom surface of the frame.

26. The food article slicing machine of claim 25 wherein the lever pivots about a shaft on the end of the frame closest to the slicing station, allowing the frame to be tilted towards and away from the slicing station.

27. The food article slicing machine of claim 26 wherein the lift tray positioning apparatus comprises an extendable cylinder connected to the frame such that extension of the cylinder causes the lever to pivot about the shaft.

28. The food article slicing machine of claim 27 wherein the cylinder is connected to the frame by being connected to the lever.
- 5 29. The food article slicing machine of claim 27 wherein the extendable cylinder is a pneumatic cylinder.
30. The food article slicing machine of claim 27 wherein the extendable cylinder is a hydraulic cylinder.
- 10 31. The food article slicing machine of claim 27 wherein the extendable cylinder is connected to the base section of the slicing apparatus.
32. The food article slicing machine of claim 27 wherein the extendable cylinder further
15 comprises a rod, the extension of which causes the lever to pivot about the shaft.
33. The food article slicing machine of claim 27 wherein the extension of the extendable cylinder tilts the lift tray assembly towards a staging position.
- 20 34. A method of loading food articles for slicing in a food slicing machine having a slicing blade comprising the steps of:
- providing food articles to be loaded;
 - providing a moveable food article support tray on a lift tray assembly, said lift tray assembly having an outer frame and an inner frame, said inner frame disposed

within the outer frame, the inner frame supporting the moveable food article support tray;

loading food articles onto the moveable food article support tray;

tilting the lift tray assembly into a staging position;

5 elevating the moveable food article support tray to move the food articles into a secondary staging position;

gripping the ends of the food articles; and

moving the food articles from the food article support tray towards the slicing blade.

10

35. The method of loading food articles of claim 34 wherein the step of tilting the lift tray assembly comprises the step of:

pivoting the lift tray assembly about a shaft connected to a lever on the bottom surface of the lift tray assembly.

15

36. The method of loading food articles of claim 34 wherein the step of loading food article onto the support tray comprises the step of

moving food articles into individual, adjacent lanes in the support tray, each lane being part of a food article path.

20

37. The method of claim 34 wherein the step of tilting the lift tray assembly into a staging position comprises abutting one end of the food articles against an endplate of the outer frame.

38. The method claim 37 wherein the step of elevating the food article support tray comprises the step of:

moving the inner frame relative to the outer frame to an elevated position wherein the surface of the movable food article support tray is just above the top of the endplate.

5

39. The method of claim 38 wherein the step of moving the inner frame relative to the outer frame comprises the step of :

extending at least one pneumatic cylinder disposed between the inner frame and outer frame such that extension of the pneumatic cylinders raises the inner frame and the moveable food article support tray.

10

40. The method of claim 36 wherein the step of elevating the food article support tray comprises the step of

sliding food articles under the force of gravity over the top of the endplate to allow food articles to come in contact with a food article gate.

15

41. The method of claim 40 wherein the step of sliding food articles comprises the step of:

maintaining at least a portion of the food articles within the food article path defined by the lanes.

20

42. The method of claim 40 wherein the step of gripping the ends of the food articles occurs when the end opposite the gripped end is in contact with the food article gate.

5 43. The method of claim 34 further comprising the step of identifying the location of the food article ends.

44. The method of claim 43 wherein the step of identifying the location of the food article ends comprises the step of:

10

using a laser sensor to determine the distance from the laser sensor to the end of the food article.

15 45. The method of claim 34, wherein the step of loading food articles onto the support tray comprises the step of moving food articles into individual, adjacent lanes in the support tray, each lane being part of a food article path; and

20

further comprising the step of using a plurality of laser sensors, one laser sensor for each food article in a lane, to determine the distance from the laser sensor to the end of the food article.

25

46. The method of claim 41 wherein the step of moving the food articles from the food article support tray towards the slicing blade comprises the step of pivoting the food article gate downwards such that the food article gate is parallel with the top surface of the moveable food article support tray, said food article gate in its downwards position being part of the food article path.

47. A food article slicing machine comprising:

a slicing station comprising a knife blade and a knife blade drive driving the blade along a cutting path;

5 a food article feed apparatus supporting food articles for movement along food article paths intersecting the cutting path;

a food article gate for separating the slicing station from the food article feed apparatus, said food article gate positionable into a closed position, wherein the gate in a closed position is located transverse to the food article path and is located between the slicing station and the food article feed apparatus.

10

48. The food article slicing machine of claim 47 wherein the food article feed apparatus comprises a conveyor belt located upstream of the slicing station, said conveyor belt for conveying food articles into the cutting path, the gate positionable in a food article support position, wherein the gate in a food article support position is within the same plane as the food article path and wherein the food article gate in a food support position spans at least a portion of the distance from the feed apparatus to the conveyor belt located upstream of the slicing station.

15

49. The food article slicing machine of claim 48, the gate positionable in a discard position wherein the gate in the food article support position is moved to be downwardly inclined from the food article path and spans a least a portion of the distance from the feed apparatus to a scrap removal conveyor belt located below the slicing station.

20

50. The article slicing machine of claim 47, the gate further positionable in a discard position wherein the gate in the discard position is moved to be downwardly inclined from the food article path and spans a least a portion of the distance from the feed apparatus to a scrap removal conveyor belt located below the slicing station.

5

51. The food article slicing machine of claim 47 wherein the position of the gate is adjustable about a pivot axis to various angular positions.

52. The food article slicing machine of claim 51 wherein the pivot axis is the axis of an axel rod fixed to the bottom of the gate, said axel rod is fixedly connected to a lever for pivoting the gate.

10

15

53. The food article slicing machine of claim 52 wherein the position of the food article gate is adjusted by a linear actuator having an actuator rod pivotally connected to the lever.

54. A food article end disposal system for a food article slicing machine, comprising:
a slicing station comprising a knife blade and a knife blade drive driving the blade along a cutting path within a cutting plane;
a food article feed apparatus supporting one or more food articles for movement along food article paths intersecting the cutting path;
a food article gate movable from a feed position to a discard position;
a transport mechanism for conveying the food article ends away from the slicing machine.

20

55. The food article end disposal system of claim 54 wherein the transport mechanism comprises a conveyor system located beneath the food article path.
- 5 56. The food article end disposal system of claim 55 wherein the conveyor system comprises a scrap conveyor located below the cutting plane.
57. The food article end disposal system of claim 56, wherein in the discard position, the food article gate is downwardly inclined from the plane of the food article path to
10 allow transfer of food article ends from the feed path upstream of the food article gate, to the scrap conveyor.
58. The food article end disposal system of claim 57 wherein the food article ends are directed to the scrap conveyor by a baffle.
- 15 59. The food article end disposal system of claim 54 wherein in the feed position, the food article gate forms part of the food article path.
60. The food article end disposal system of claim 54 wherein in the discard position, the
20 food article gate diverts the food article ends from the food article path.
61. The food article end disposal system of claim 60 wherein the food article ends are diverted to a position below the food article path.

62. The food article end disposal system of claim 61 wherein the food article ends are diverted to a path intersecting the cutting plane at an angle.

5 63. The food article end disposal system of claim 54 wherein the food article gate spans at least a portion of each food article path.

64. A method of disposing food article ends in a food slicing machine, comprising the steps of:

10 retracting a gripper releaseably gripping a food article end from a slicing plane;
positioning a food article gate from a feed position to a discard position;
releasing the food article end from the gripper; and
transporting the food article end away from the slicing machine.

15 65. The method of claim 64 wherein the step of retracting a gripper comprises the step of retreating the gripper along a food article feed path such that the food article end is upstream of at least a portion of the food article gate in its feed position, said feed position being a position where the food article gate comprises part of the food article feed path.

20 66. The method of claim 64 wherein the step of positioning the food article gate comprises pivoting the food article gate along a pivoting edge in a downward incline such that the food article gate is located below the plane of the food article path.

67. The method of claim 66 wherein the step of retracting a gripper comprises the step of retracting the gripper such that it is upstream of the pivoting edge of the food article gate.
- 5 68. The method of claim 64 wherein in the discard position, the food article gate is tilted below the food article path.
69. The method of claim 64 wherein the step of transporting the food article end away from the slicing machine comprises diverting the food article end from the food article path by having the released food article end move freely along a portion of the food article path and the food article gate.
- 10
70. The method of claim 69 wherein the food article gate in the discard position directs the food article end towards a scrap conveyor located below the cutting plane.
- 15
71. The method of claim 70 wherein a baffle is located along a discard pathway comprising the food article gate in its discard position, and the scrap conveyer, said baffle located between the food article gate and the scrap conveyor.
72. An arrangement for minimizing slack in pneumatic tubing for pneumatically operated grippers in a slicing machine comprising:
- 20
- a weighted roller moveable along a longitudinal guide slot, said weighted roller in contact with pneumatic tubing;
 - a guide frame through which the pneumatic tubing is routed in contact with the weighted roller.

73. The arrangement of claim 72 wherein the pneumatic tubing is routed around the weighted rollers.

5 74. The arrangement of claim 72 wherein at least a portion of the movement of the weighted roller along the longitudinal guide slot is due to the force of gravity.

75. The arrangement of claim 74 wherein the movement of the weighted roller due to the force of gravity is in a direction that reduces slack to the associated pneumatic
10 tubing.

76. A method for minimizing slack in pneumatic air tubes for a pneumatically operated gripper in a slicing machine comprising the steps of:

routing air tube lines of the gripper to at least one weighted roller such that the movement of the roller due to the weight of the roller under the force of gravity
15 causes the roller to move in a direction that reduces slack in the air tube lines.

77. The method of claim 76 wherein the at least one weighted roller is moveable along a pair of guide slots.

20 78. The method of claim 77 wherein the guide slots are located on either end of the weighted roller.

79. The method of claim 77 wherein the rollers move within a plane parallel to the direction of travel of the grippers.

80. The method of claim 78 wherein the rollers and grippers move in opposite parallel directions.

5 81. The method of claim 79 wherein a movement of the gripper in one direction causes the rollers to move a corresponding distance in the opposite direction.

82. The method of claim 76 wherein the step of routing comprises guiding air tubes through at least one stationary frame.

10

83. The method of claim 81 wherein the step of routing comprises guiding a pair of air tubes associated with each gripper through an individual stationary frame.

15

20

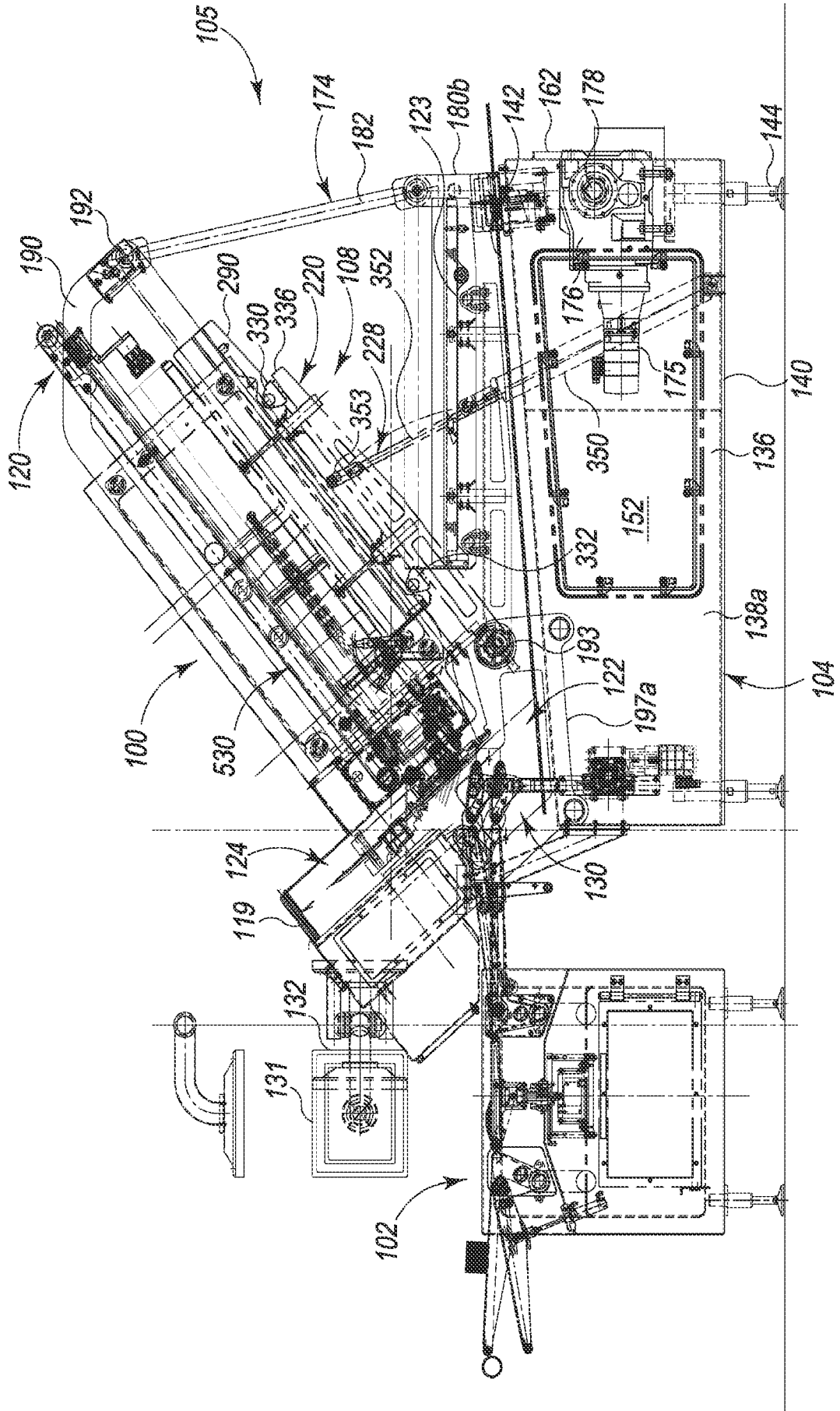


Fig. 1

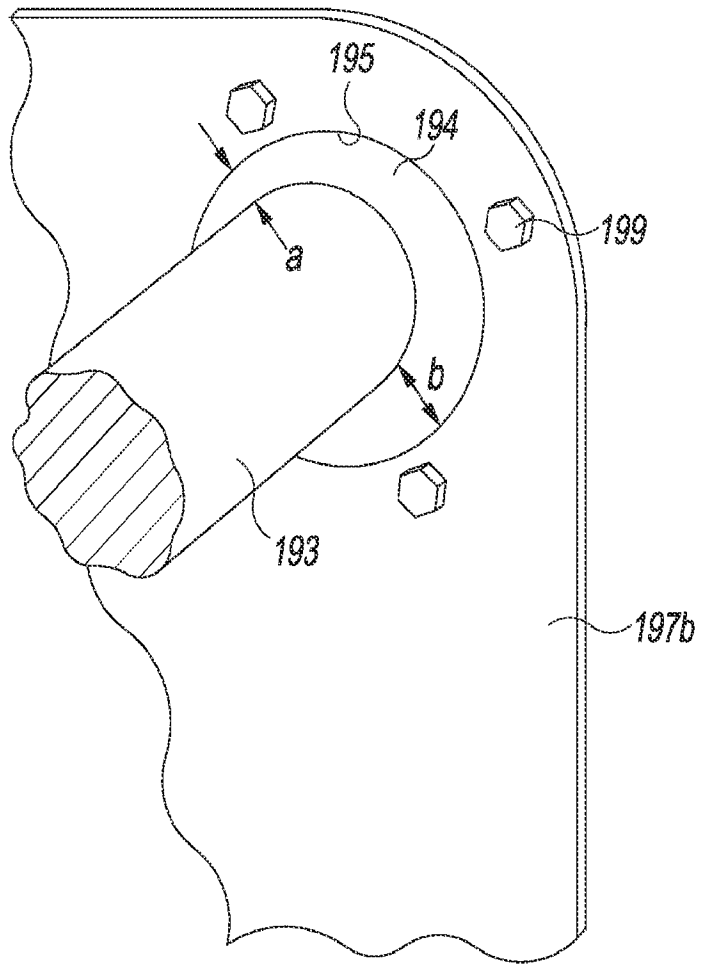


Fig. 1A

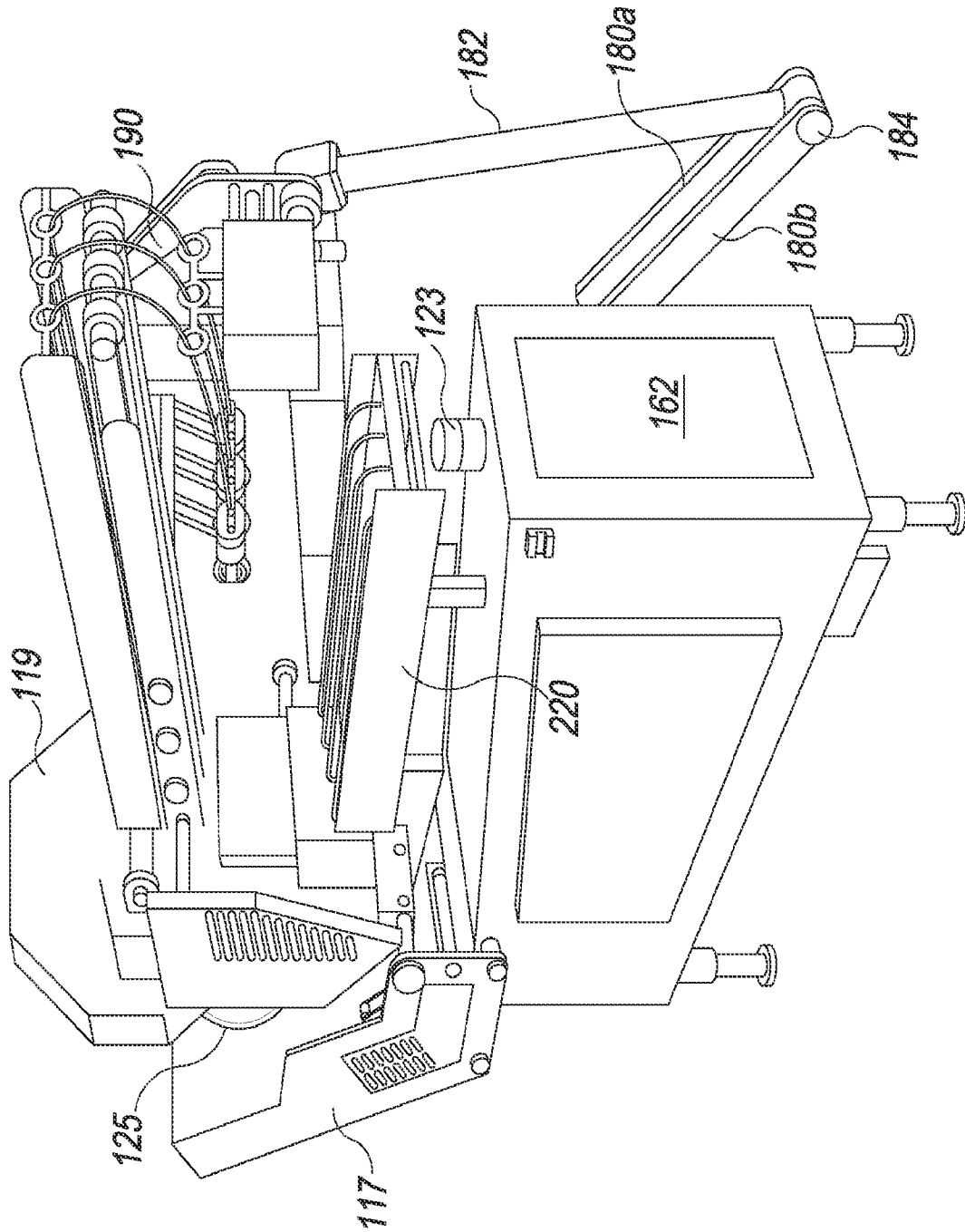


Fig. 1B

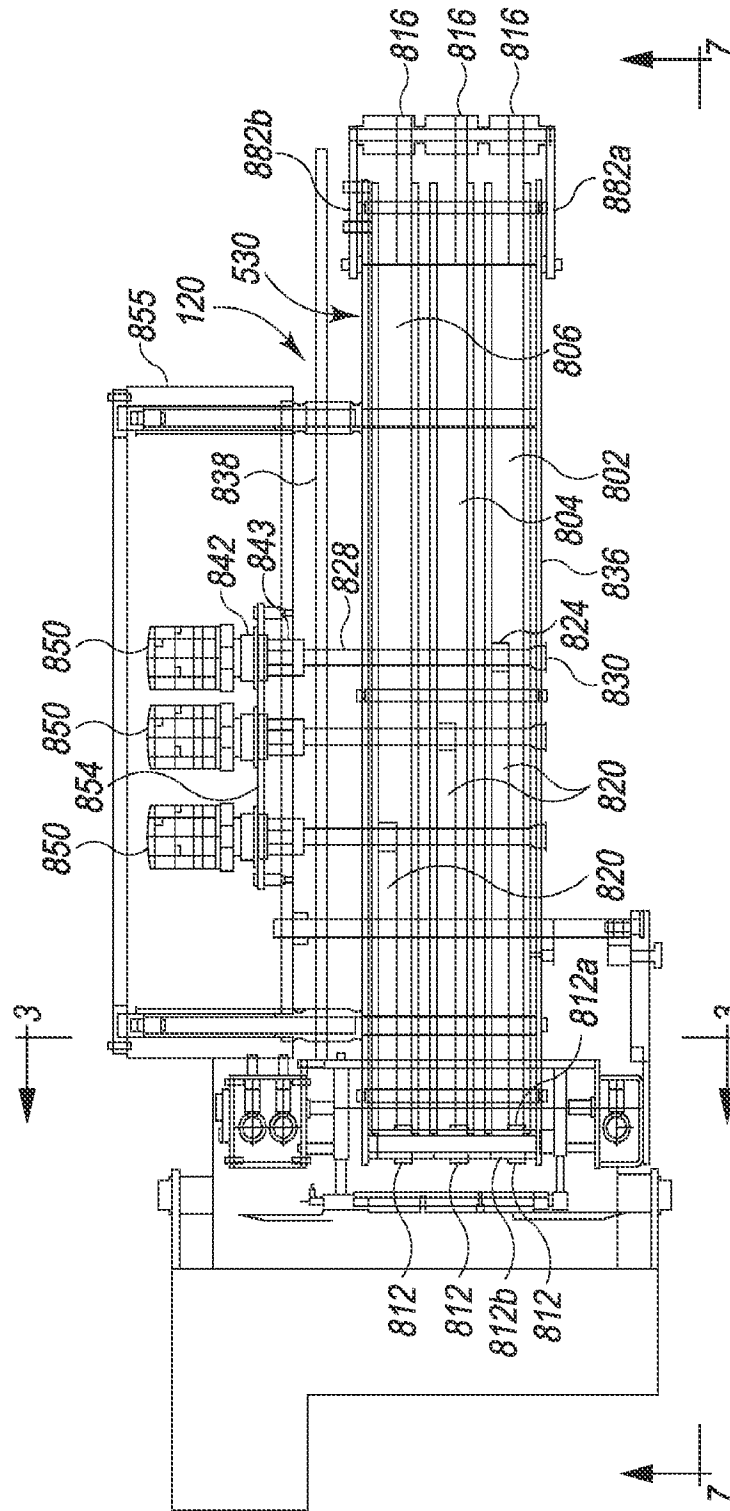


Fig. 2

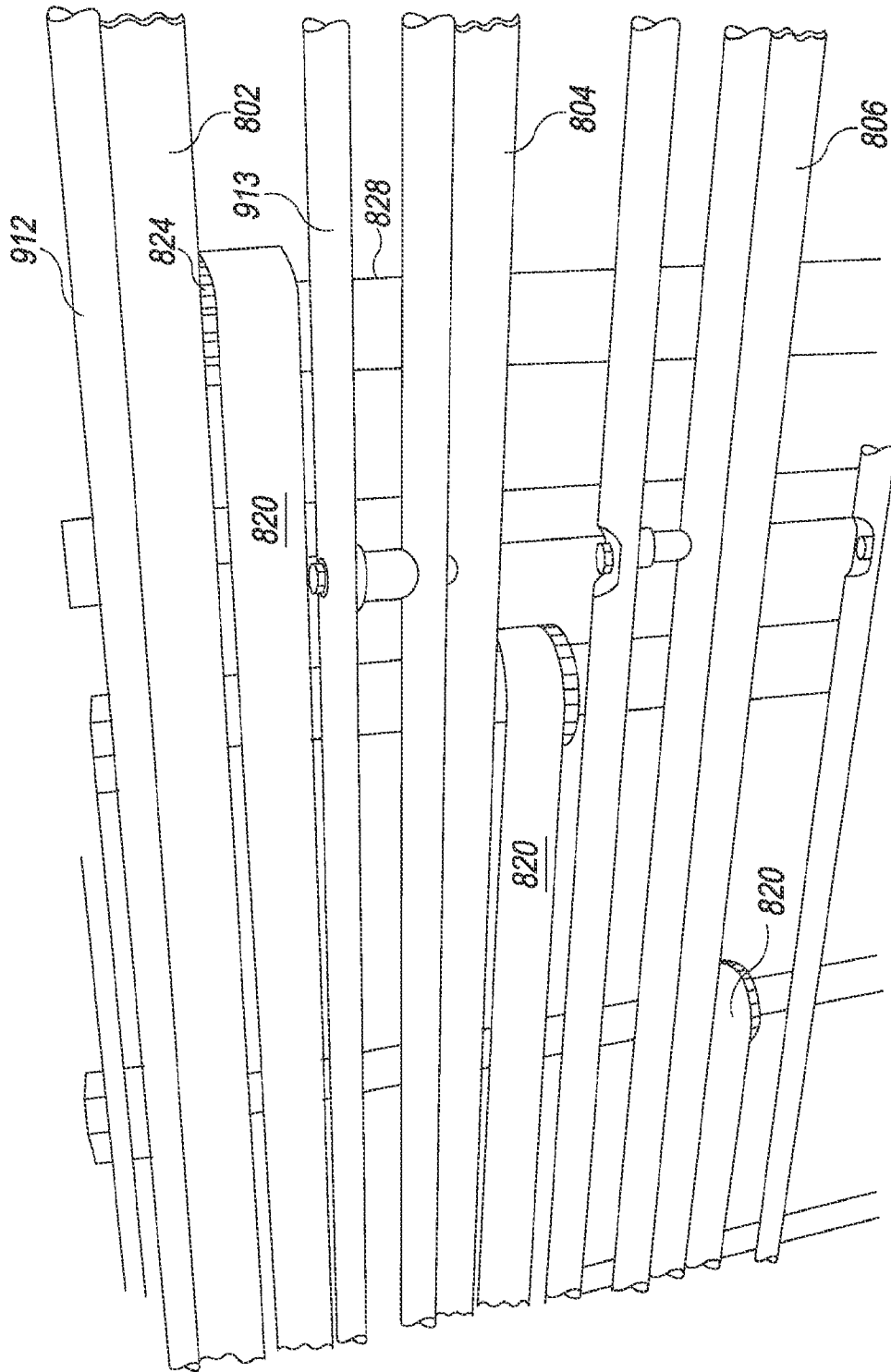


Fig. 2A

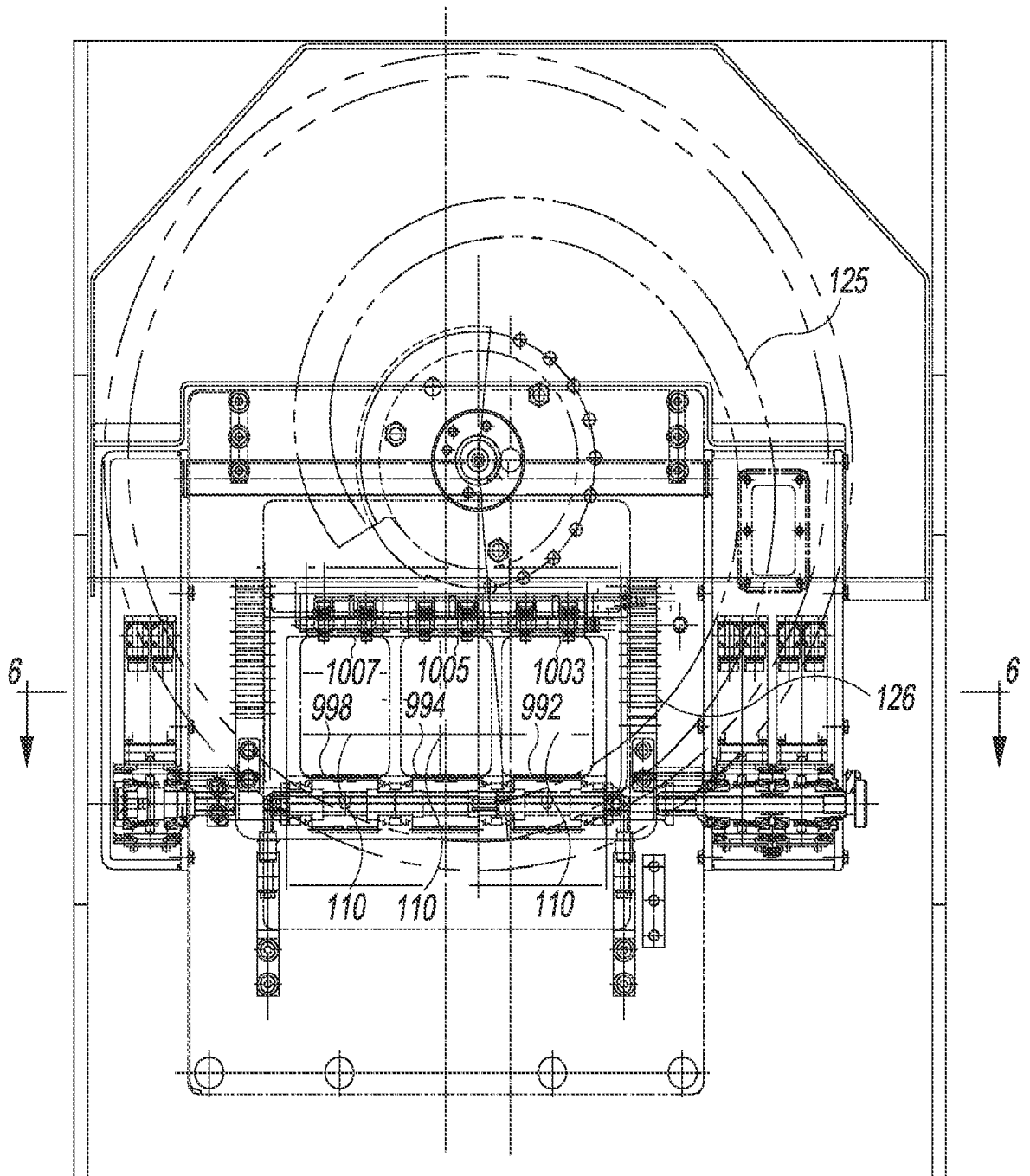


Fig. 3

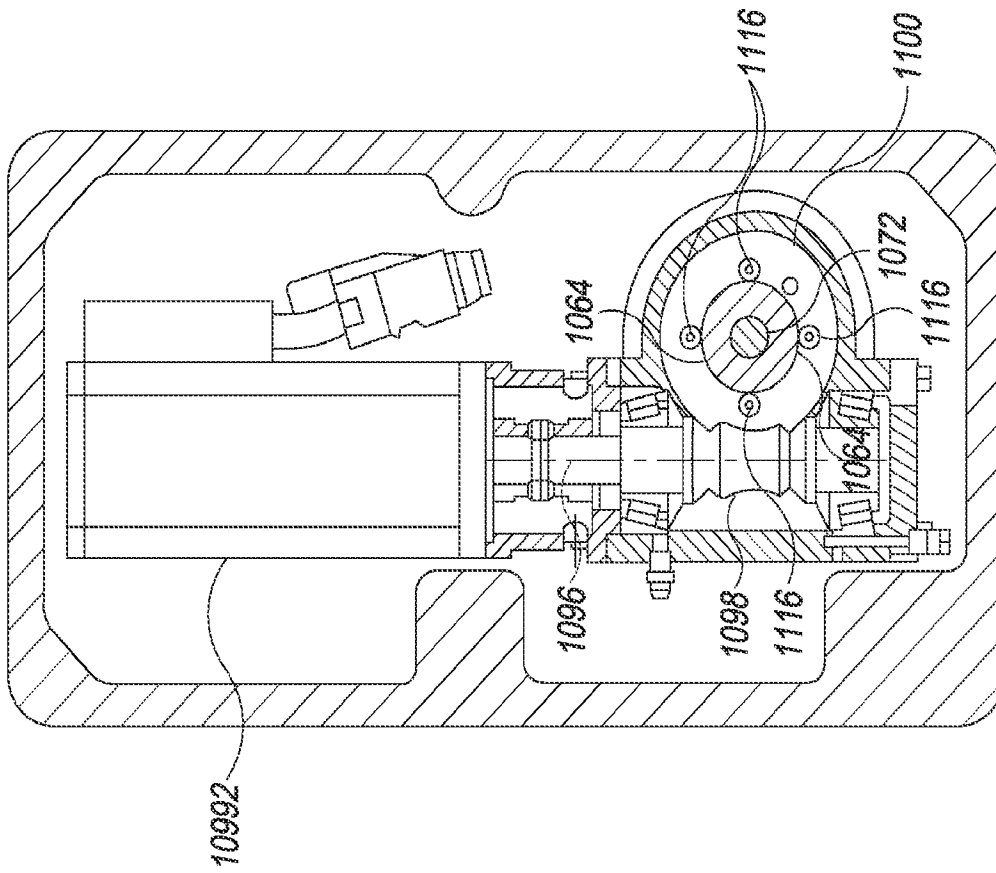


Fig. 5

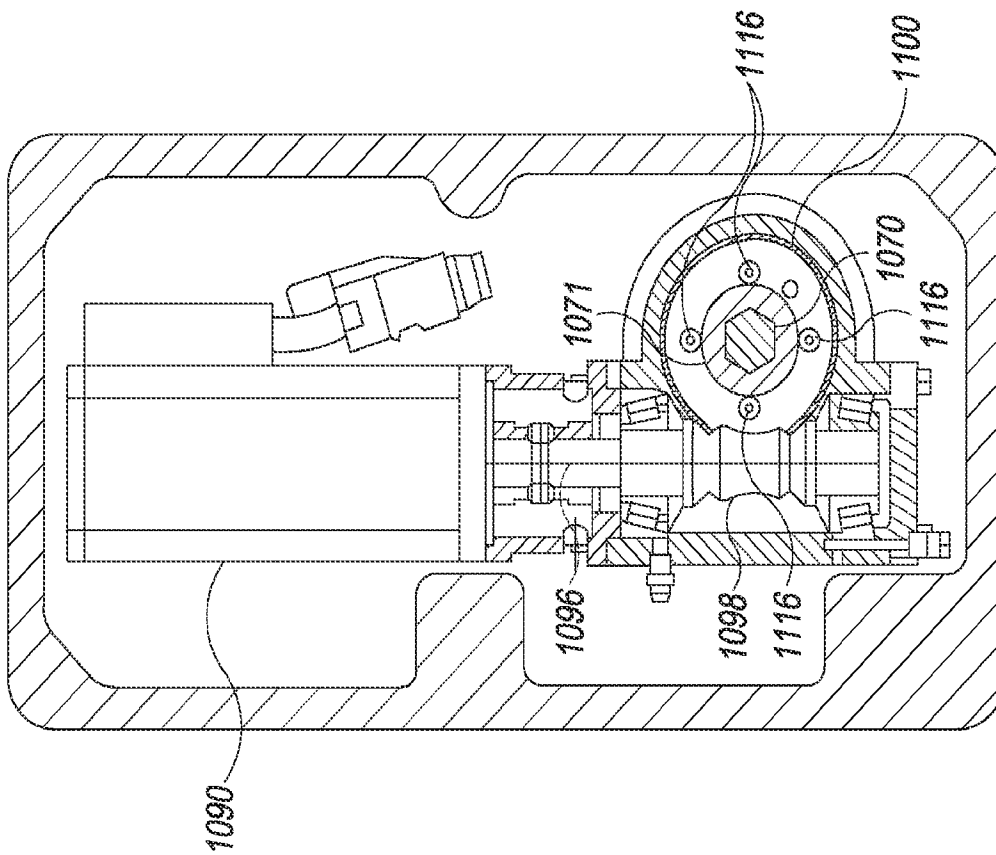


Fig. 4

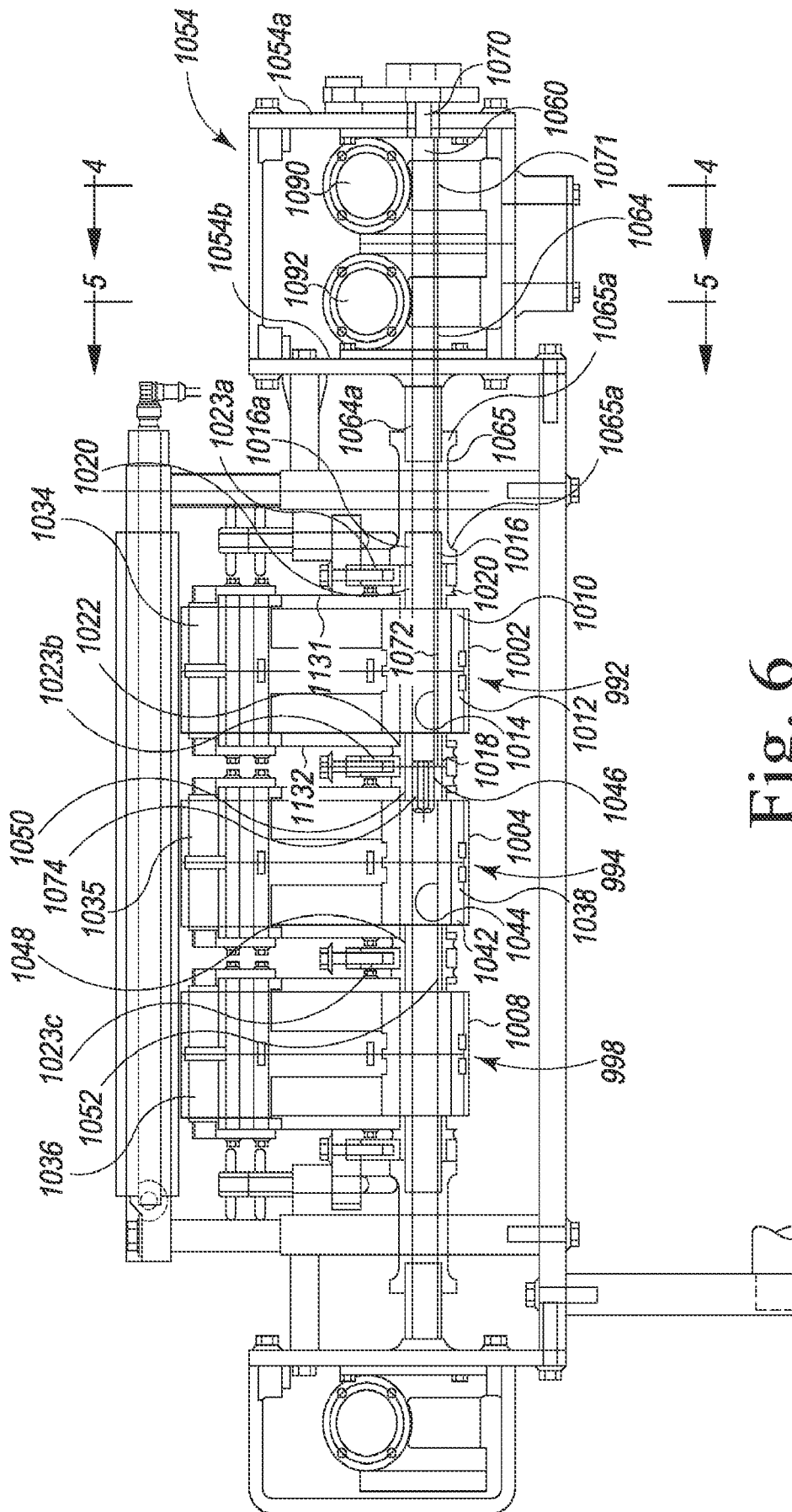


Fig. 6

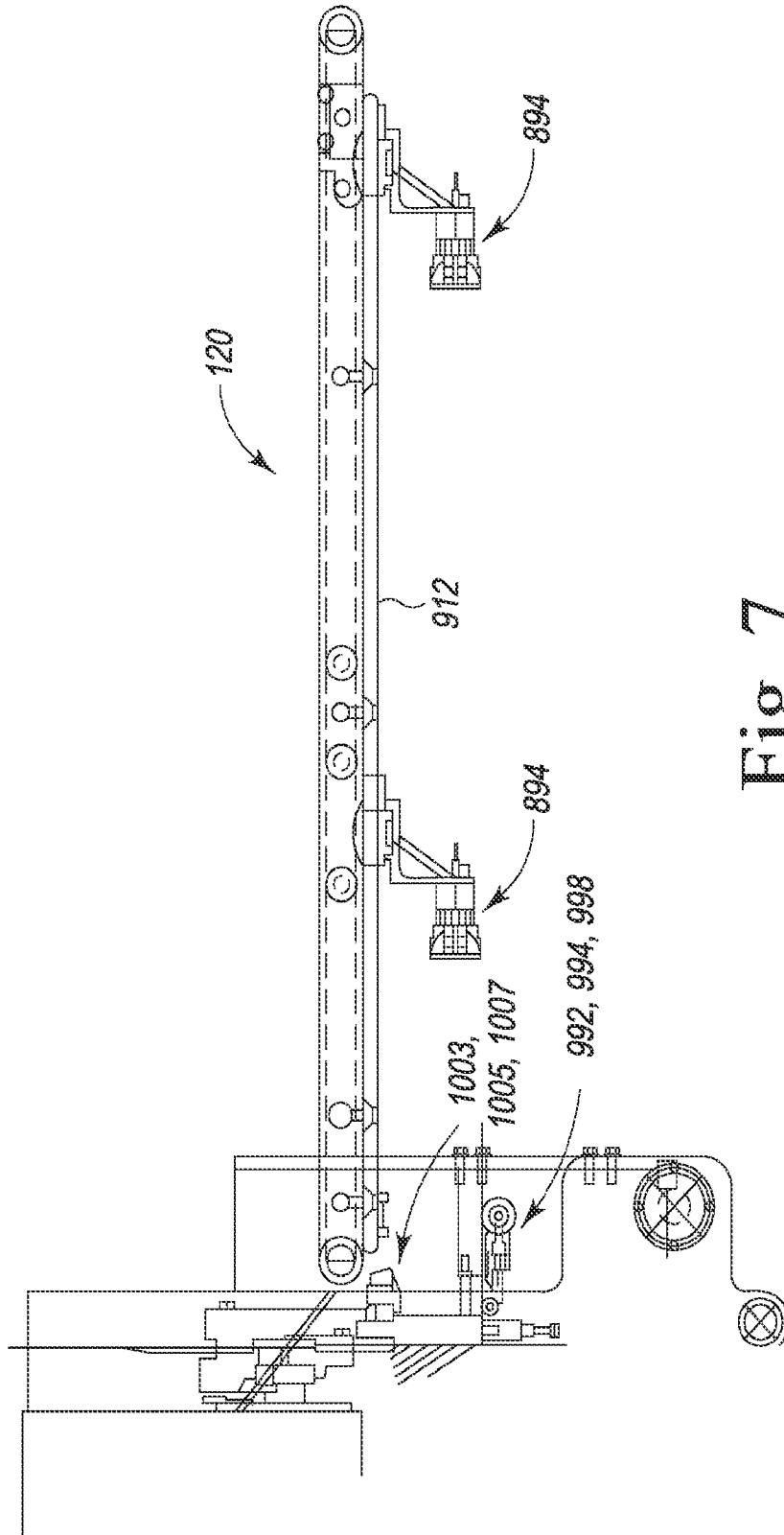


Fig. 7

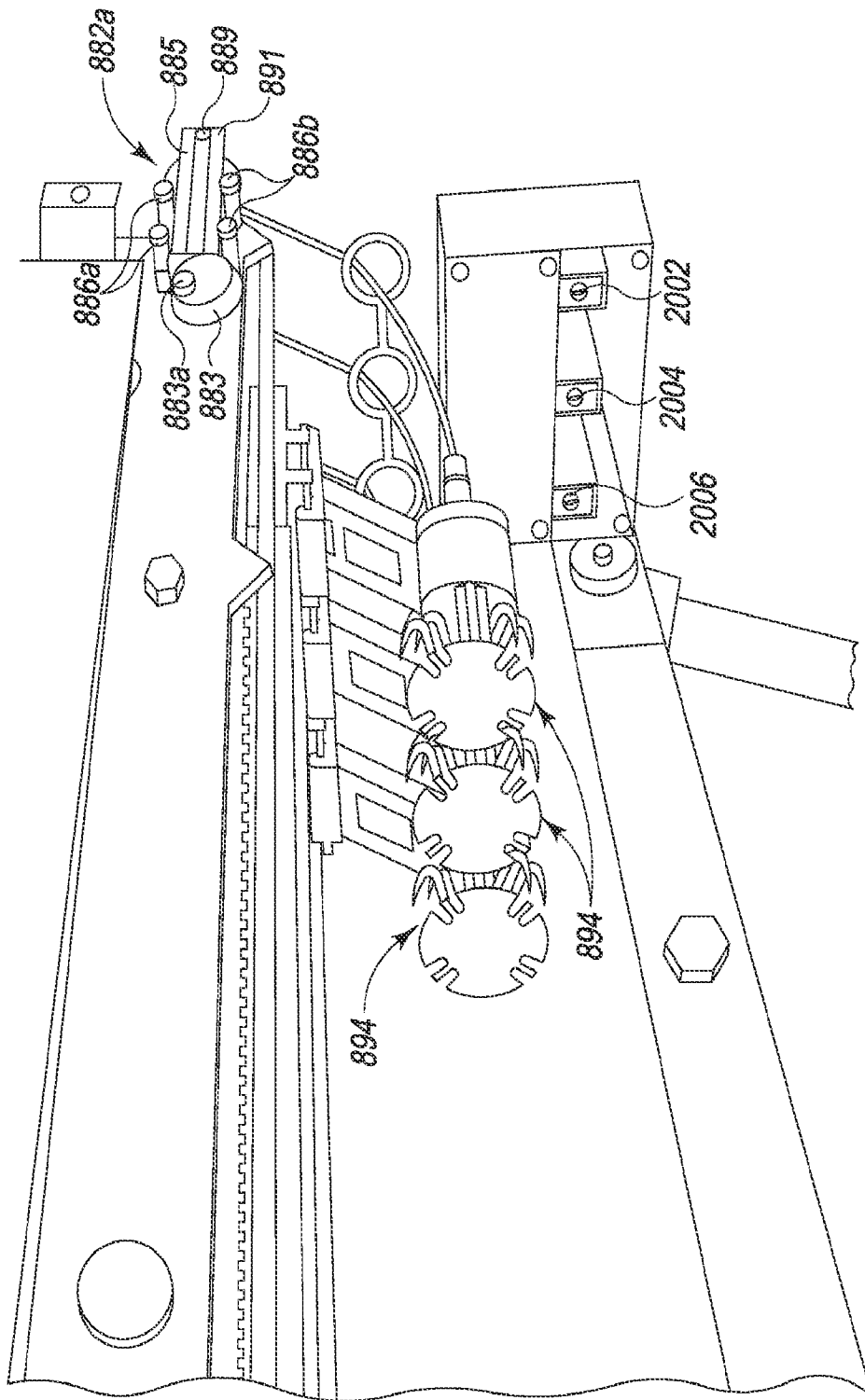


Fig. 7A

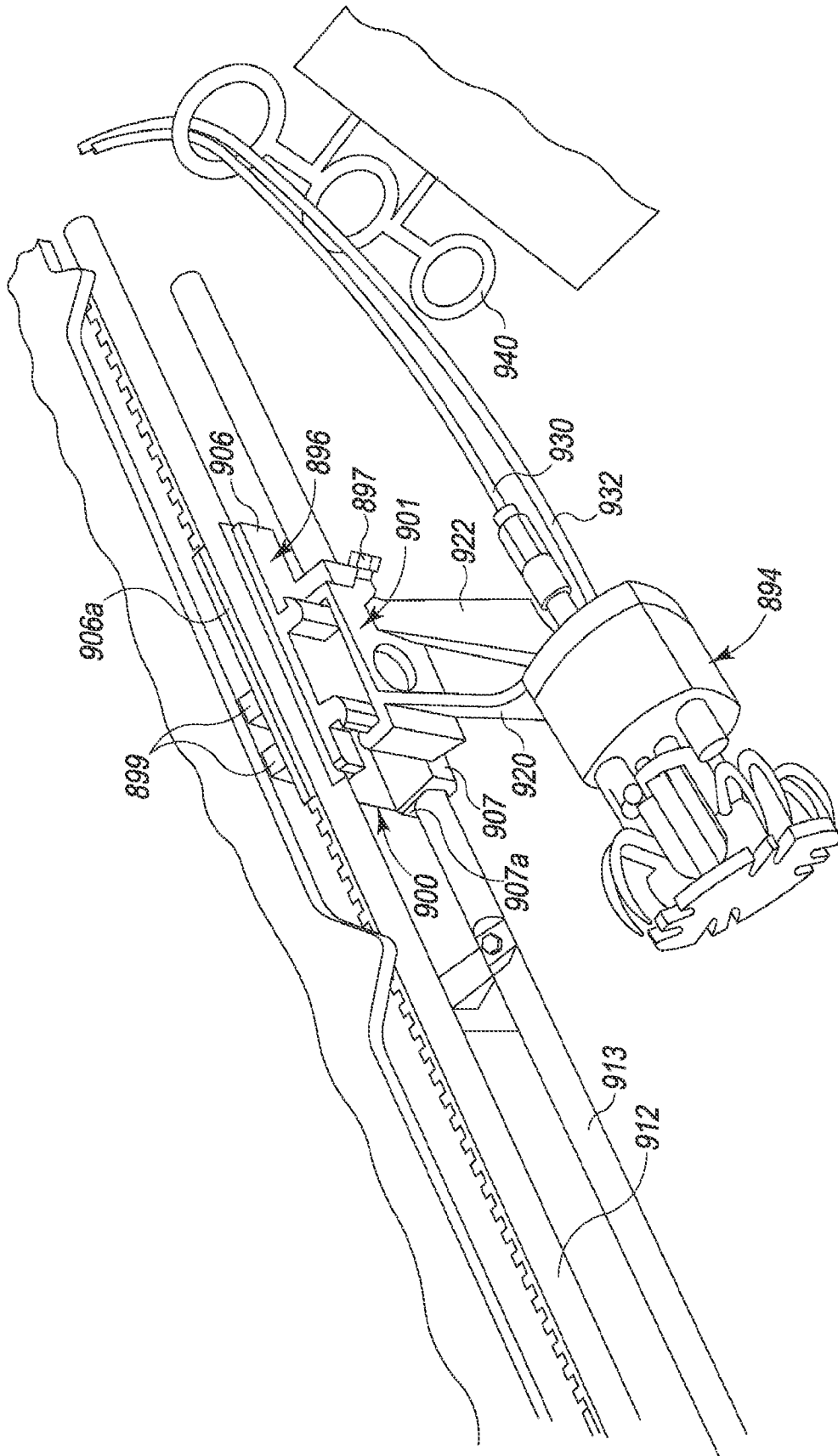


Fig. 7B

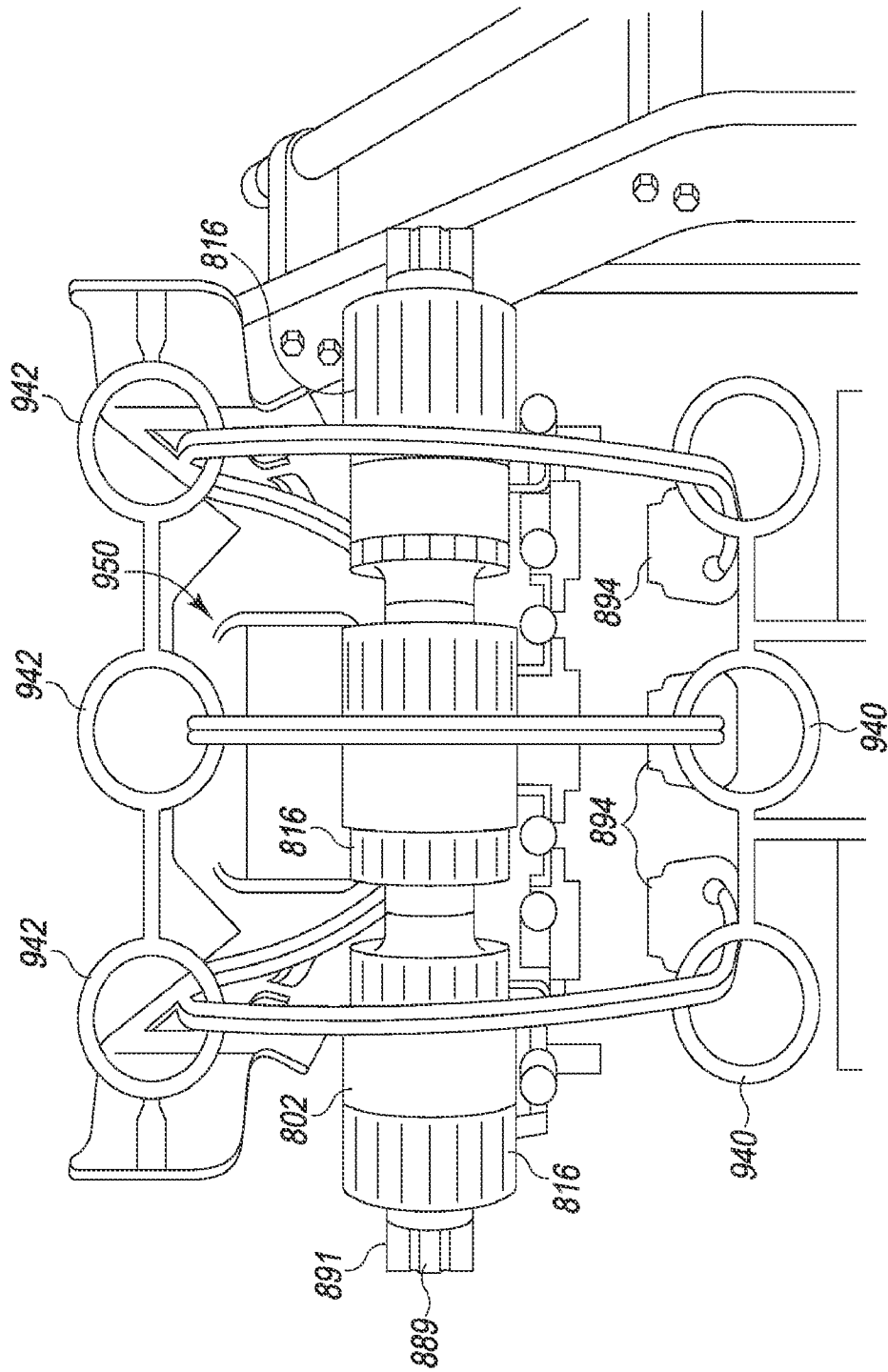


Fig. 7C

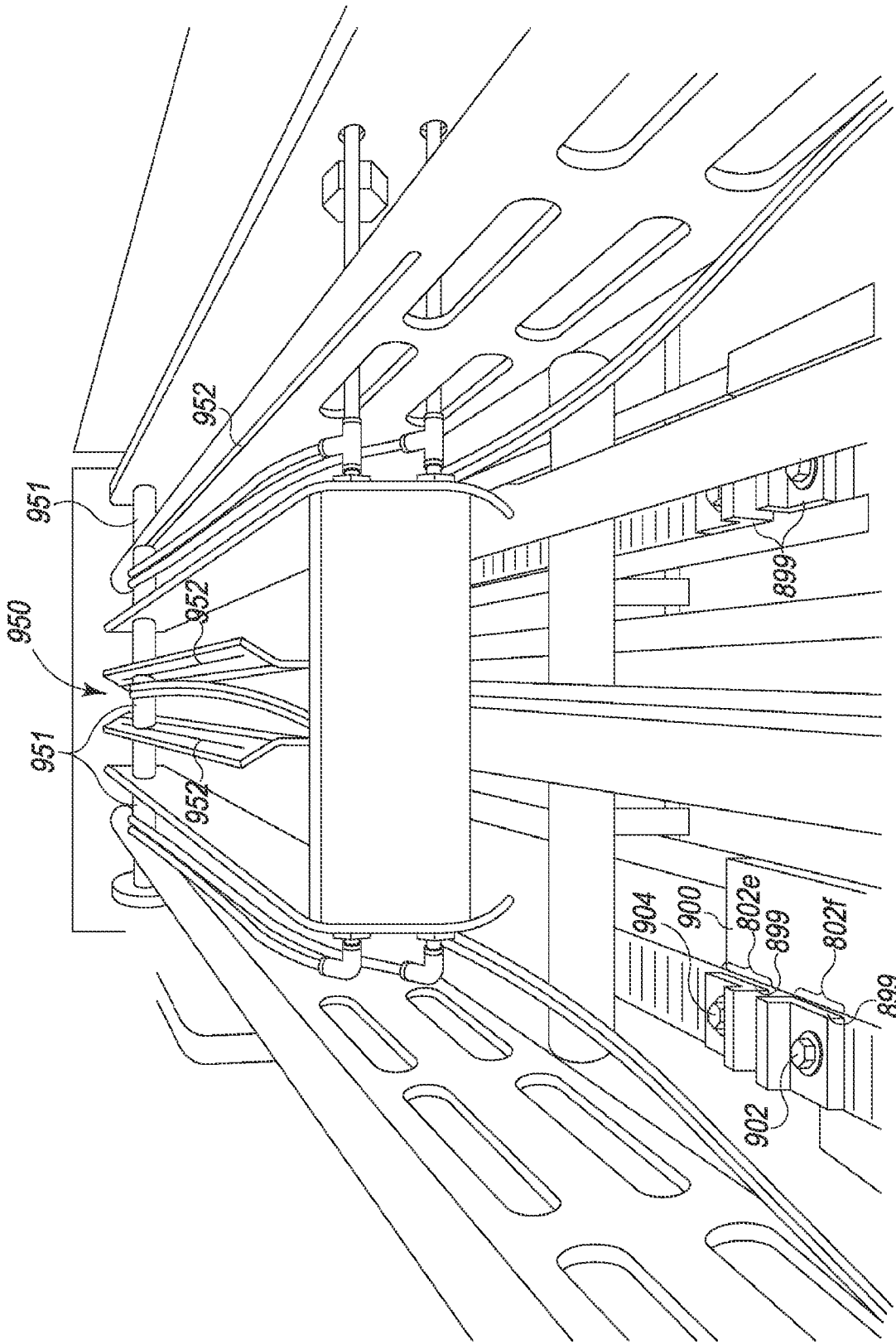


Fig. 7D

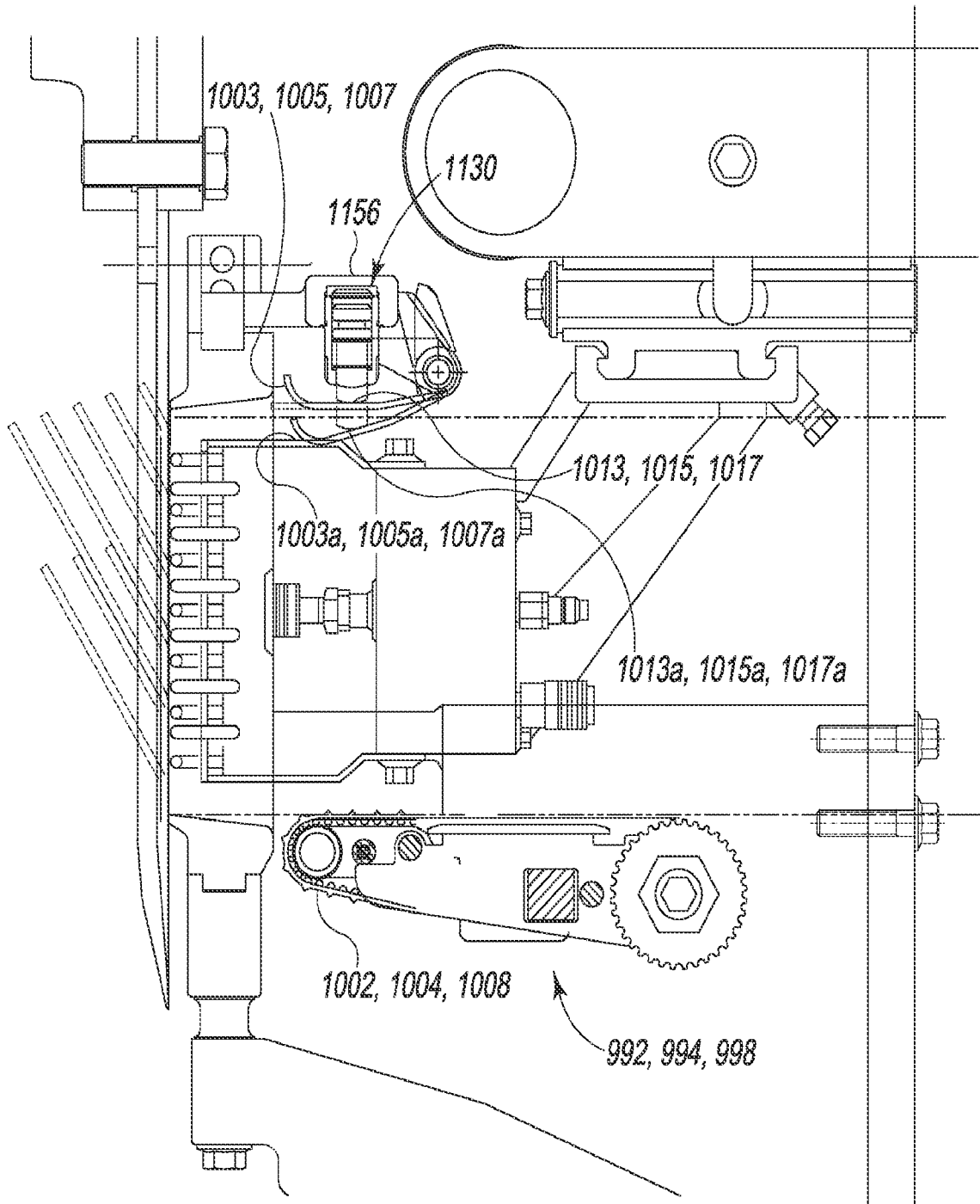


Fig. 7E

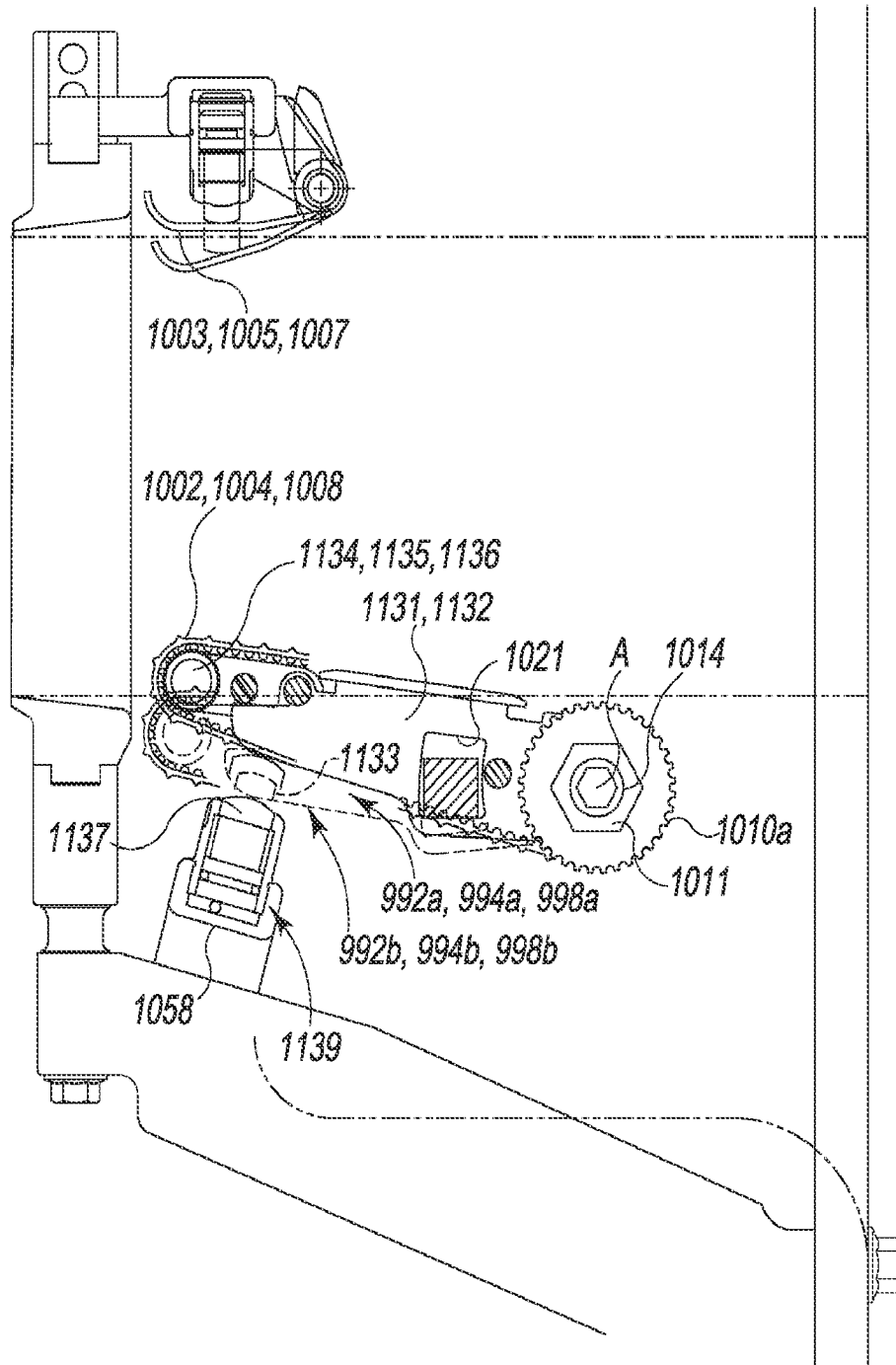


Fig. 7F

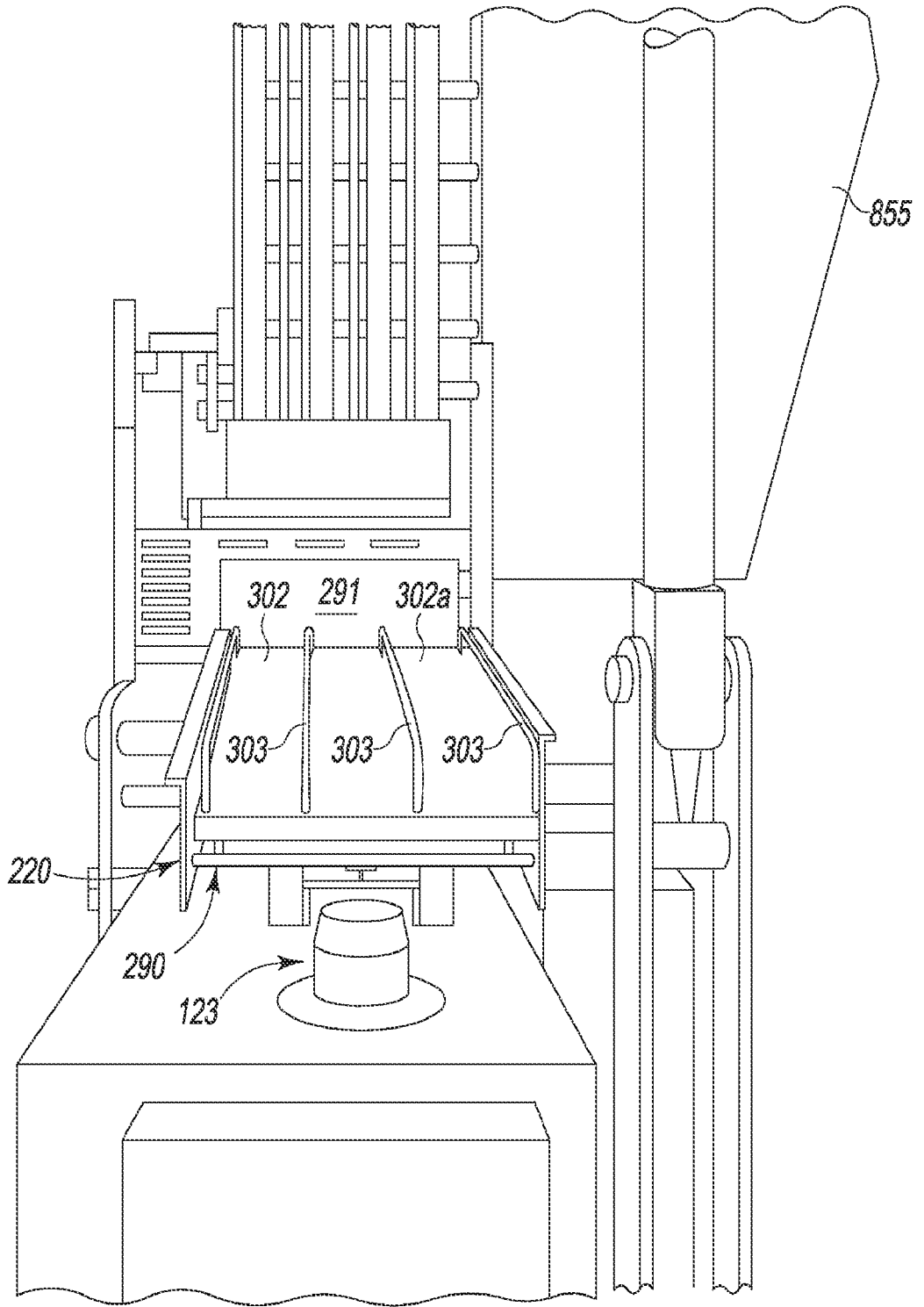


Fig. 8

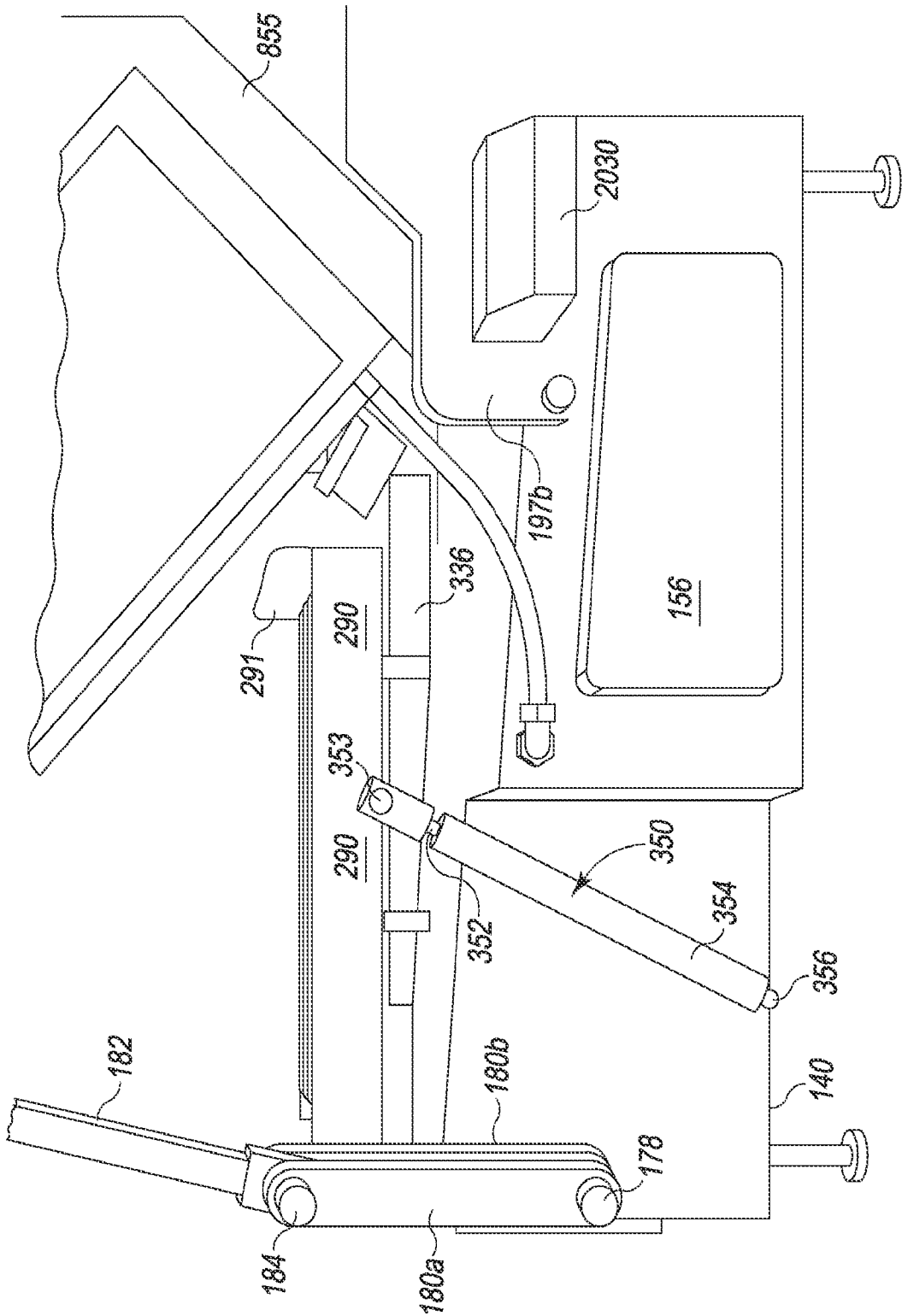


Fig. 9

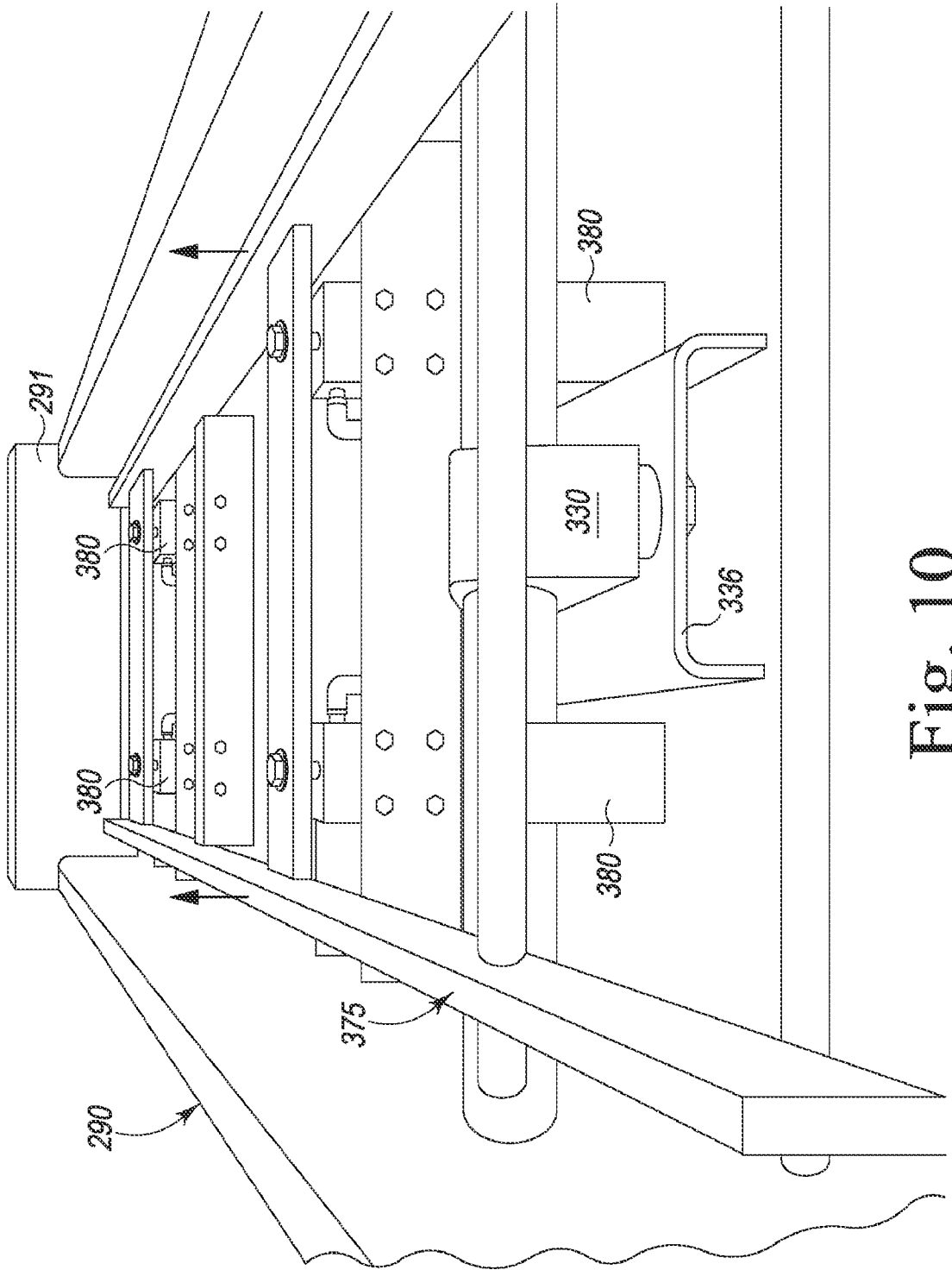


Fig. 10

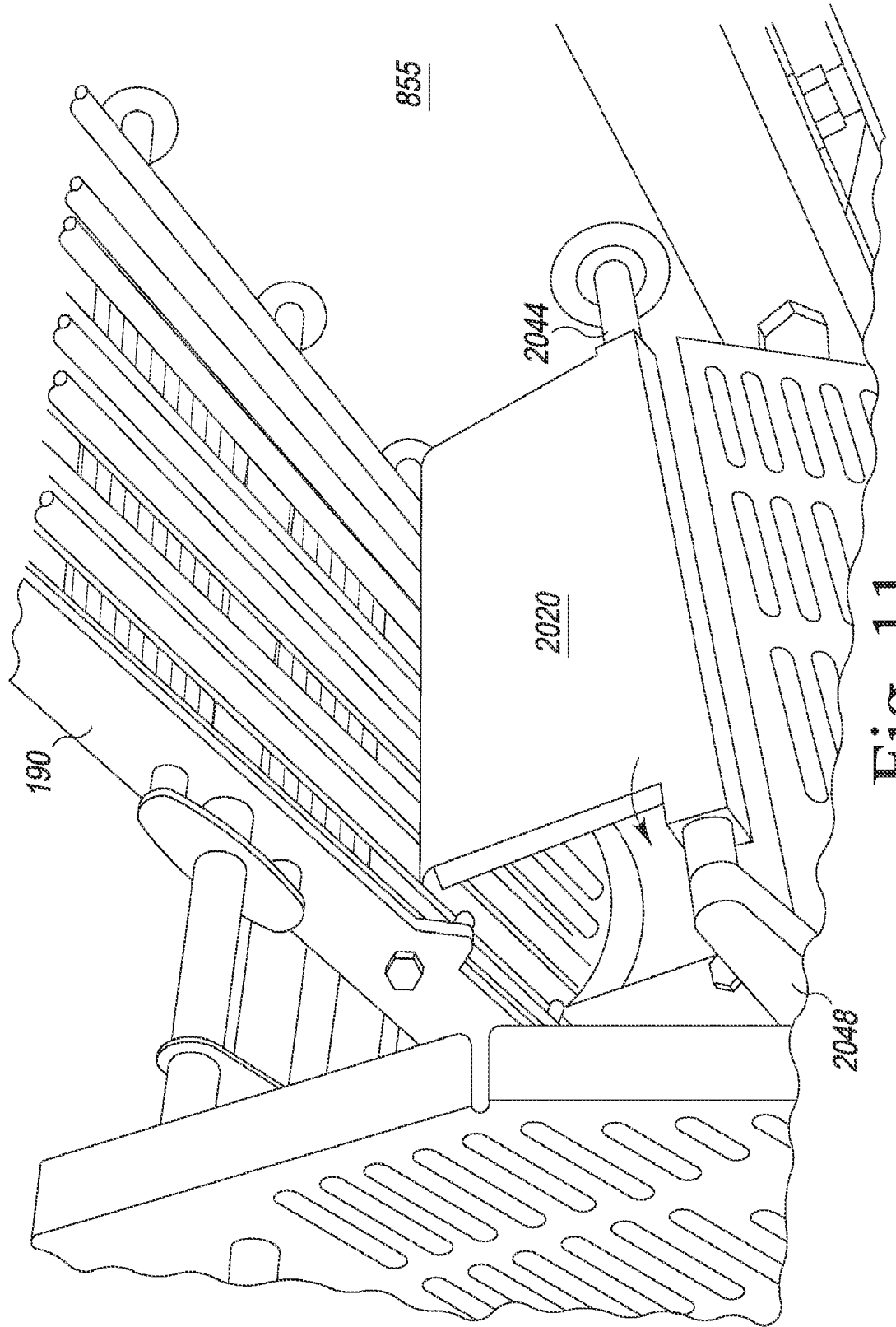


Fig. 11

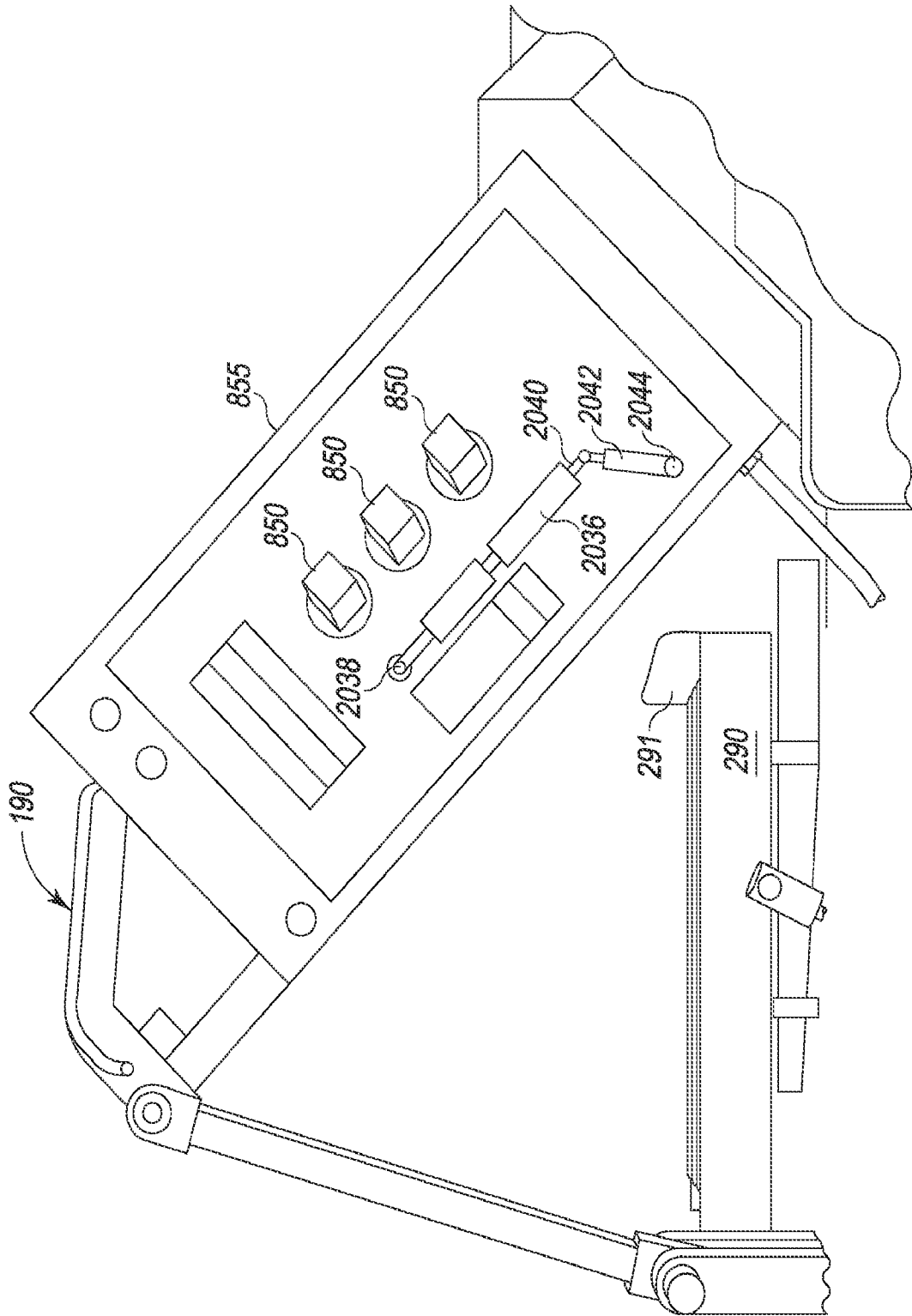


Fig. 12

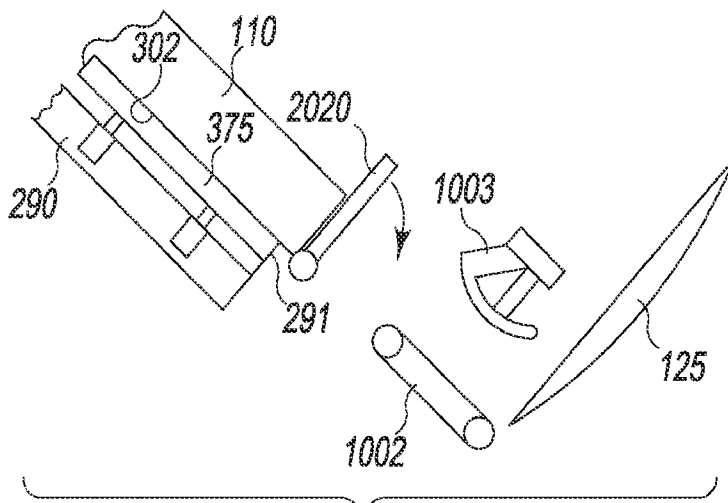


Fig. 13A

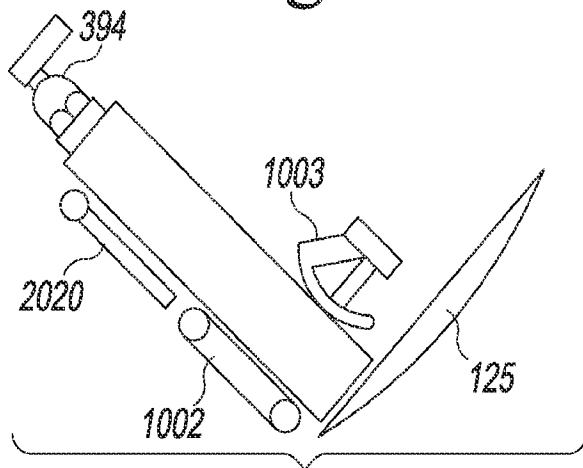


Fig. 13B

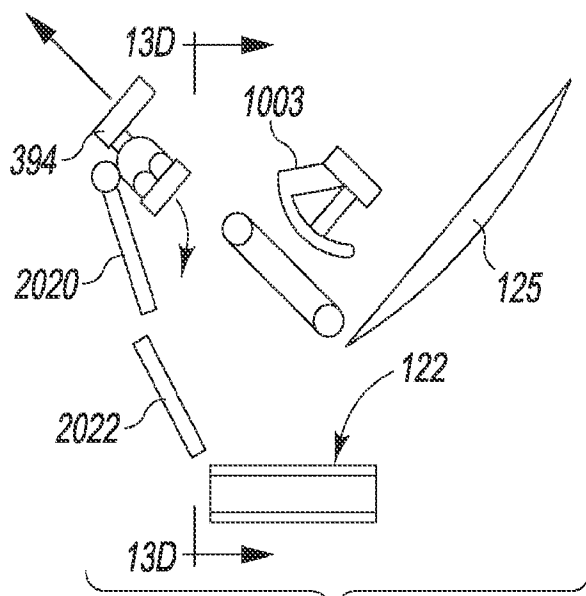


Fig. 13C

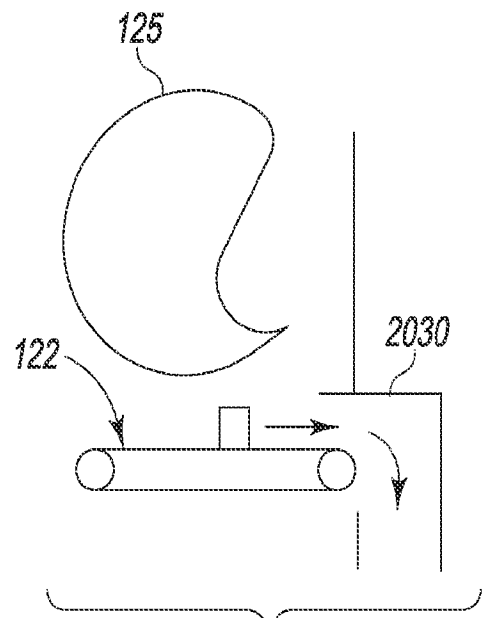


Fig. 13D