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AUTOMATED TRAILER LOADING SYSTEMS AND RELATED METHODS**CROSS-REFERENCE TO RELATED APPLICATION**

[0001] This patent claims the benefit of U.S. Provisional Patent Application No. 63/518,849, filed August 10, 2023, US. Provisional Patent Application No. 63/658,783, filed on June 11, 2024, U.S. Provisional Patent Application No. 63/658,779, filed on June 11, 2024, and U.S. Provisional Patent Application No. 63/658,777, filed on June 11, 2024. U.S. Provisional Patent Application No. 63/518,849, US. Provisional Patent Application No. 63/658,783, U.S. Provisional Patent Application No. 63/658,779, and U.S. Provisional Patent Application No. 63/658,777 are incorporated by reference herein in their entireties. Priority to U.S. Provisional Patent Application No. 63/518,849, US. Provisional Patent Application No. 63/658,783, U.S. Provisional Patent Application No. 63/658,779, and U.S. Provisional Patent Application No. 63/658,777 is hereby claimed.

FIELD OF THE DISCLOSURE

[0002] This disclosure relates generally to dock levelers and, more particularly, to automated trailer loading systems and related methods.

BACKGROUND

[0003] Loading docks provide an area for vehicles (e.g., trucks, trailers, etc.) to move next to an elevated platform of a building (e.g., a material handling facility) so that cargo can be readily transferred between the vehicle and the building. Automation in the loading of trailers has seen significant advancements in recent years. Traditional manual/fork truck pallet loading processes have been replaced and/or augmented by various automated systems, aiming to

improve productivity and efficiency, reduce labor costs, and enhance safety.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 is a perspective view of an example loading bay of an example loading dock implemented with an example automated trailer loading system (ATLS) in accordance with teachings disclosed herein.

[0005] FIG. 2 is a perspective, partial cutaway view of the example loading bay of FIG. 1.

[0006] FIG. 3A is a perspective front view of the example ATLS of FIGS. 1 and 2.

[0007] FIG. 3B is a perspective rear view of the example ATLS of FIG. 3A.

[0008] FIG. 3C is a side view of the example ATLS of FIGS. 3A and 3B.

[0009] FIG. 3D is a perspective view of an example housing of the example ATLS of FIGS. 3A-3C.

[0010] FIG. 4A is a perspective front view of the example ATLS of FIGS. 1-3C.

[0011] FIG. 4B is a perspective review view of the example ATLS of FIG. 4A.

[0012] FIG. 4C is a side view of the example ATLS of FIGS. 4A and 4B.

[0013] FIG. 5 is a partial perspective view of an example lip of the example ATLS of FIGS. 1-4C shown in an example stored position.

[0014] FIGS. 6A and 6B are partial, perspective views of the example lip of the example ATLS of FIG. 5 shown in an example extended position.

[0015] FIGS. 7A-7C are partial, top views of the example ATLS at different example lateral positions.

[0016] FIGS. 8 is a partial, perspective view of the example conveyor of the example ATLS of FIGS. 1-7C.

[0017] FIG. 9A is an exploded view of an example slat of the example conveyor of FIGS. 8.

[0018] FIG. 9B is an assembled view of the example slat of FIG. 9A.

[0019] FIGS. 10A is a partial, perspective view of the example conveyor of FIG. 8 shown in a straight or flat condition.

[0020] FIG. 10B is a partial, perspective view of the conveyor of FIG. 8 shown in an example bent, deflected, or curved condition.

[0021] FIG. 10C is a partial, bottom view of the example conveyor of FIGS. 10A and 10B.

[0022] FIG. 10D is a side view of FIG. 10A.

[0023] FIG. 10E is a side view of a portion of the example conveyor of FIGS. 10A-10C flexed in an example first direction.

[0024] FIG. 10F is a side view of a portion of the example conveyor of FIGS. 10A-10C flexed in an example second direction.

[0025] FIG. 11 is a partial perspective view of the example ATLS of FIGS. 1-10C with a portion of an example drive system.

[0026] FIGS. 12-16 illustrate the example ATLS of FIGS. 1-11 at different operational positions or conditions.

[0027] FIG. 17A is a partial, perspective view of an example unload bar of the example ATLS of FIGS. 12-16.

[0028] FIG. 17B is a partial perspective view of the example unload bar of the ATLS of FIG. 17A shown in an extended or use position.

[0029] FIG. 18 is a perspective view of an example block plate of the example unload bar of FIG. 17B shown in an example expanded position.

[0030] FIG. 19A is a perspective view of another example loading dock having another example ATLS disclosed herein.

[0031] FIG. 19B is an enlarged portion of the example ATLS of FIG. 19A showing a floor in transparent to illustrate the ATLS.

[0032] FIG. 19C is a side view of the example ATLS of FIGS. 19A and 19B.

[0033] FIG. 20A is a partial, perspective view of the example conveyor of the ATLS of FIG. 19A.

[0034] FIG. 20B is a side view of FIG. 20A.

[0035] FIG. 20C is a bottom view of FIG. 2A.

[0036] FIG. 20D is a perspective view of an example slat of the example conveyor of FIG. 20A.

[0037] FIG. 21 is a partial perspective view of another example conveyor of another example ATLS disclosed herein.

[0038] FIG. 22A is a partial perspective view of another example conveyor of another example ATLS disclosed herein.

[0039] FIG. 22B is a side view of FIG. 22A.

[0040] FIG. 23 is a top view of another example slat of another example conveyor of another example ATLS disclosed herein.

[0041] FIG. 24 is a perspective view of another example slat disclosed herein.

[0042] FIG. 25 is a partial, perspective view of a conveyor of another example ATLS disclosed herein.

[0043] FIGS. 26A and 26B are perspective views of another example ATLS disclosed herein.

[0044] FIG. 27A is a top view of another example frame that can implement an example ATLS disclosed herein. The example frame of FIG. 27A is shown in an example first or initial position.

[0045] FIG. 27B is a top view of the example frame of FIG. 27A shown in an example skewed position.

[0046] FIG. 27C is a partial, perspective, top view of the example frame of FIG. 27A showing an example skewing system disclosed herein.

[0047] FIG. 27D is a partial, perspective, bottom view of the example frame of FIG. 27D.

[0048] FIG. 28A is a perspective view of an example actuator disclosed herein.

[0049] FIG. 28B is a perspective, cutaway view of the example actuator of FIG. 28A.

[0050] FIG. 29A is a side view of the example lip of the example ATLS of FIGS. 1A and 1B in an example scanning position.

[0051] FIG. 29B is a side view of the example lip of FIG. 29A shown in an example loading/unloading or extended position.

[0052] FIG. 29C is a side view of the example lip of FIG. 29A shown in an example stored position.

[0053] FIG. 29D is a perspective view of the example loading dock and the example cargo area of the vehicle of FIGS. 1A and 1B with the example scanning system performing an example scanning operation.

[0054] FIGS. 30A-30C are different views of another example conveyor that can be used to implement an example conveyor or ATLS disclosed herein.

[0055] FIG. 31A is a perspective view of an example slat of FIGS. 30A-30C.

[0056] FIG. 31B is a bottom view of the example slat of FIG. 31A.

[0057] FIGS. 32A-32B illustrate another example slat that can be implemented with example conveyors or ATLS disclosed herein.

[0058] In general, the same reference numbers will be used throughout the drawing(s) and accompanying written description to refer to the same or like parts. The figures are not to scale. As used in this patent, stating that any part (e.g., a layer, film, area, region, or plate) is in any way on (e.g., positioned on, located on, disposed on, or formed on, etc.) another part, indicates that the referenced part is either in contact with the other part, or that the referenced part is above the other part with one or more intermediate part(s) located therebetween.

DETAILED DESCRIPTION

[0059] Warehouses employ loading docks for loading and/or unloading goods between the loading docks and vehicles. Automatic Trailer Loading Systems (ATLS), also known as slug loaders, are advanced technologies designed to automate loading trailers or containers with goods or cargo. These systems are commonly used in logistics and transportation industries to improve productivity, efficiency, reduce manual labor and improve safety. Slug loading systems typically include various components, including conveyors, sensors, and/or control systems. The process begins with the goods or cargo placed on a conveyor of an ATLS in the order that will best use the trailer's interior space (e.g., cube). Automatic trailer loading systems advantageously optimize space utilization. By precisely arranging the goods or cargo within the trailer, these systems can increase (e.g., maximize) a load capacity and/or reduce (e.g., minimize) wasted space. This can lead to significant cost savings and increased productivity. Additionally, slug loading systems offer improved safety and reduced risk of damage to the goods or cargo. One or more sensors and/or control systems can be employed to improve (e.g., ensure precise) handling and/or placement of the cargo in the vehicle.

[0060] Example methods, apparatus, and articles of manufacture disclosed herein provide automated trailer loading systems for positioning cargo or goods within a trailer or container. Specifically, example automated trailer loading systems disclosed herein employ a conveyor for supporting and/or moving goods within the trailer or container. In contrast to some automated trailer loading systems, automated trailer loading systems disclosed herein employ a roller type conveyor system that can roll up to a stored position. Example automated trailer loading systems disclosed herein significantly reduce a footprint/space required inside a loading dock compared to traditional automated trailer loading systems that take up as much as sixty feet in length (e.g., per dock door or loading bay of a loading dock) inside the loading dock or warehouse due to the fact that those other systems stage/load entire trailers at once as opposed to incrementally loading a trailer as the systems disclosed herein. Thus, example automated trailer loading systems disclosed herein do not require stage loading an entire load of a trailer and/or do not require moving an entire load into a trailer at once or simultaneously. In some examples, at least a portion of a conveyor of example automated trailer loading systems disclosed herein roll up or store underneath a floor of the loading dock and/or warehouse. For example, at least a portion of a conveyor of an example automated trailer loading system disclosed herein can store, flex or bend within a track (e.g., a spiral box or loop box) in a pit area of a loading dock and/or underneath a floor of a loading dock or warehouse. In some examples, example automated trailer loading systems disclosed herein employ a roll-up or foldable conveyor system embedded into a floor behind a dock leveler. Material handling equipment (e.g., a forklift) loads a conveyor from one end and the conveyor moves into a loading area of a trailer or container (e.g., at 4-5 feet intervals). After the conveyor is fully loaded and extended into the vehicle (e.g., a total extension of approximately between 53 feet and 70 feet), an example conveyor of example automated trailer loading system disclosed herein is fully retracted. Example conveyors

disclosed herein can be driven via one or more motors and/or transmission systems. For example, some example conveyors disclosed herein employ one or more push/pull chain and sprocket systems. For example, to retract the conveyor, the conveyor rolls into a large coil in a track or spiral box located in the building floor via a motor and transmission system. In some examples, a conveyor of an example automated trailer loading system can be approximately between 50 feet and 80 feet in length when fully extended (e.g., fully flat or completely unrolled). In some examples, a conveyor of an example automated trailer loading system can be coiled or retracted within a housing having a length of between approximately 9 feet and 13 feet (e.g., 12 feet) and a width of between approximately 6 feet and 10 feet (e.g., 8 feet).

[0061] FIG. 1 is a perspective view of an example loading bay 101 of an example loading dock 100 implemented with an example automated trailer loading system (ATLS) 102 in accordance with teachings disclosed herein. The loading bay 101 of the illustrated example can be a warehouse, cargo transport unit, and/or loading structure. The loading bay 101 of the illustrated example includes a dock wall 104 defining a doorway 106 leading to a platform 108 (e.g., the doorway 106 allows access between an interior of the loading bay 101 and an exterior of the loading bay 101). The example ATLS 102 of the of the illustrated example is positioned in the loading dock 100 underneath a floor 110 of the loading dock 100 adjacent the platform 108. The ATLS 102 is used to load cargo inside a cargo area 112 (e.g., a cargo bed, a trailer bed, etc.) of a trailer or vehicle 114. The loading dock 100 of the illustrated example includes rails 116 flanking the ATLS 102. While only one loading bay 101 is illustrated in FIG. 1, in some examples, the loading dock 100 of the illustrated example has a plurality of loading bays positioned in juxtaposition or adjacent relative to one another. In some such examples, each loading bay 101 of an example loading dock can include a dedicated ATLS 102 disclosed herein.

[0062] FIG. 2 is a perspective, partial cutaway view of the example loading bay 101 of FIG. 1. The ATLS 102 of the illustrated example is positioned within a pit area 204 of the loading dock 100 adjacent the floor 110 of the loading dock 100. The ATLS 102 of the illustrated example is coupled to a platform face or pit rear wall 202 (e.g., a dock face, a front face, a vertical wall, a platform face, etc.) of a pit area 204 of the loading dock 100. For example, the ATLS 102 is positioned in the pit area 204 and is offset relative to an exterior or dock face 205 of the dock wall 104. In some examples, the pit area 204 can have a depth of 12 feet. The ATLS 102 of the illustrated example includes a plurality of feet 206. In some examples, the feet 206 are adjustable to adjust a vertical height of the ATLS 102 relative to an uppermost surface 208 of the floor 110. In some examples, the feet 206 can be adjustable via a motorized system (e.g., a motorized ball screw adjustment mechanism or assembly, a motorized lead screw adjustment mechanism or assembly, etc.). In some examples, the feet 206 can be actuators that extend vertically to move or adjust a vertical height of the ATLS 102.

[0063] FIG. 3A is a perspective front view of the example ATLS 102 of FIGS. 1 and 2. FIG. 3B is a perspective rear view of the example ATLS 102 of FIG. 3A. FIG. 3C is a side view of the example ATLS 102 of FIGS. 3A and 3B. FIG. 3D is a perspective view of the housing 302 of the example ATLS 102 of FIGS. 3A-3D.

[0064] Referring to FIGS. 3A-3D, the example ATLS 102 includes a housing 302, a platform 304, a lip 306, and a conveyor system 310. The lip 306 is pivotally coupled to the housing 302 via a hinge 312. To prevent damage to the ATLS 102, the housing 302 of the illustrated example includes a first bumper 314a adjacent a first side 316a (e.g., a right side) of the housing 302 and a second bumper 314b adjacent a second side 316b (e.g., a left side) of the housing 302 opposite the first side 316a.

[0065] The housing 302 of the illustrated example includes a spiral box 318 (e.g., a frame, a movable frame) (FIG. 3D) and a frame 320 (e.g., a fixed frame). As described in greater detail below, the spiral box 318 can move relative to the frame 320. In other words, the frame 320 is fixed relative to the loading dock 100 and the spiral box 318 can move relative to the loading dock 100. The spiral box 318 includes side walls 322 (e.g., plates) (shown as transparent in FIGS. 3A and 3B) and the platform 304. The side walls 322 of the illustrated example include a first side wall 322a adjacent the first side 316a of the ATLS 102 and a second side wall 322b (e.g., spaced from the first side wall 322a and) adjacent the second side 316b of the ATLS 102. The side walls 322 of the illustrated example support or define (e.g., a first portion of) a track 324. The first side wall 322a has a first track portion 324a and the second side wall 322b has a second track portion 324b. The track 324 of the illustrated example has a spiral shape or pathway. For example, the track 324 includes a plurality of channels having an oblong shape.

[0066] The platform 304 is positioned (e.g., above and) between the side walls 322. The platform 304 of the illustrated example includes a first side guide rail 304a and a second side guide rail 304b opposite the first side guide rail 304a. The first and second side guide rails 304a, 304b guide the conveyor system 310 across the platform 304 between a rear edge 304c (e.g., a rear end) of the platform 304 and a front edge 304d (e.g., a front end) of the platform 304.

[0067] The frame 320 of the illustrated example includes a front wall or front plate 325 and a plurality of support beams 326. The support beams 326 include lower lateral support beams 326a, 326b (e.g., first and second side beams), upper lateral support beams 326c, 326d (e.g., first and second side beams), a lower rear beam 326e, and an upper rear beam 326f. The lower lateral support beams 326a, 326b extend between the front plate 325 and the rear beam 326e. The upper lateral support beams 326c, 326d extend between the front plate 325 and the

upper rear beam 326f. The vertical side plates 328 couple the upper lateral support beams 326c, 326d and the lower lateral support beams 326a, 326b.

[0068] The conveyor system 310 of the illustrated example includes a conveyor 330 and a conveyor drive system 342. The conveyor 330 of the illustrated example includes a plurality of slats 334 and a guide ramp 336 (e.g., a lead ramp or wedge). The conveyor 330 of the illustrated example is foldable, deflectable, or bendable. In this manner, the conveyor 330 of the illustrated example can roll up, wind, coil or otherwise fold to a stored position 338. For instance, the slats 334 enable the conveyor 330 to roll or bend about the track 324 when the conveyor 330 is in the stored position 338. When moving to the stored position 338, a trailing edge or end 330a of the conveyor 330 snakes around the channels of the track 324 in a spiral pattern. The track 324 and/or the platform 304 includes an opening adjacent the rear edge 304c of the platform 304 and/or frame 220 to allow the conveyor 330 to enter and/or exit the track 324 and/or the cavity 340. The channels of the track 324 are vertically spaced from each other. The conveyor 330 of the illustrated example can have a total extended length of approximately between 65 feet and 75 feet (e.g., 70 feet). The platform 304 and/or the ATLS 102 can have a length of approximately between 10 feet and 14 feet (e.g., 12 feet). Thus, the conveyor 330 can be configured to accommodate a cargo bed having a length of approximately 53 feet.

[0069] The housing 302 and/or the spiral box 318 of the illustrated example defines a cavity 340. For example, the cavity 340 is defined between the first side wall 322a and the second side wall 322b, between the platform 304 and the lower lateral support beams 326a, 326b, and between the front plate 325 and the upper and lower rear beams 326e, 326f. The cavity 340 of the housing 302 receives the conveyor 330. For instance, in the stored position 338, the conveyor 330 is positioned within the cavity 340 of the ATLS 102 (e.g., defined by the housing assembly). For example, the conveyor 330 of the illustrated example is snaked or

wounded within the cavity 340 (e.g., via the track 324). The track 324 (e.g., the vertically separated channels) keeps the conveyor 330 from intertangling or interwinding. During a loading operation, the conveyor 330 is extended (e.g., unfolded or unrolled) from the cavity 340 via the track 324 and moved into the cargo area 112 of the vehicle 114. The track 324 maintains an orientation of the conveyor 330 when extended and ensures that the conveyor 330 does not become entangled during deployment.

[0070] To move the conveyor 330 between the stored position 338 and an extended or operational position, the ATLS 102 of the illustrated example includes a conveyor drive system 342. The conveyor drive system 342 of the illustrated example includes a first motor 344a and a second motor 344b. The first motor 344a is mounted or coupled adjacent to the first side wall 322a via a first side mounting beam 346a and the second motor 344b is mounted or coupled adjacent to the second side wall 322b via a second side mounting beam 346b. As described in greater detail below, the first motor 344a and the second motor 344b drive a transmission (e.g., having a plurality of gears, sprockets, etc.) via an output shaft 346. Rotation of the output shaft 346 in a first rotational direction about an axis of rotation via the first and second motors 344a, 344b causes the conveyor to retract to the stored position 338 and rotation of the output shaft 346 in a second rotational direction opposite the first direction about the axis of rotation via the first and second motors 344a, 344b causes the conveyor 330 to extend to an extended or operational position.

[0071] FIG. 4A is a perspective front view of the example ATLS 102. The ATLS 102 of the illustrated example is shown without the conveyor 330 and the front plate 325. FIG. 4B is a perspective review view of the example ATLS 102 of FIG. 4A. FIG. 4C is a side view of the example ATLS 102 of FIGS. 4A and 4B. To transition between the platform 304 and the cargo area 112, the ATLS 102 employs the lip 306. Referring to FIGS. 4A and 4C, the ATLS 102 of

the illustrated example includes a first cylinder or lip actuator 402 (e.g., a linear actuator) to move the lip 306 between a raised position and a lowered position about an axis of rotation or lip pivot axis 404 defined by the hinge 312.

[0072] To span a gap (e.g., a vertical gap) and/or compensate for height difference between the platform 304 of the ATLS 102 and the cargo area 112 of the vehicle 114, the platform 304 of the ATLS 102 of the illustrated example can be adjusted or leveled. For example, the ATLS 102 of the illustrated example includes platform leveling cylinders or actuators 406 to adjust an angle of the platform 304 relative to horizontal or the floor 110. For example, the conveyor 330 moves across or travels on top of the platform 304. As the angle of the platform changes (e.g., vertically), so does the projected angle of the conveyor 330.

[0073] To span a gap (e.g., a horizontal or lateral gap) between the ATLS 102 and the cargo area 112 of the vehicle 114 when the vehicle 114 is not in alignment (e.g., perfect lateral alignment) with the doorway 106 and/or the ATLS 102, the ATLS 102 of the illustrated example enables alignment of the ATLS 102, the platform 304 and/or the conveyor 330 relative to the vehicle 114. Thus, in addition to compensating for a height difference between the platform 304 and the cargo area 112, the ATLS 102 moves (e.g., slides) in lateral or horizontal directions relative to the cargo area 112 and/or the floor 110 of the loading dock 100 to enable lateral adjustment and/or alignment of the ATLS 102 relative to the cargo area 112 when the trailer is not perfectly aligned (e.g., perfectly perpendicular) relative to the doorway 106. To laterally align the cargo area 112 and the ATLS 102, the ATLS 102 is movable in the lateral directions (e.g., horizontal directions) about a pivot point 405 or pivot axis 408.

[0074] To enable lateral movement of the spiral box 318 about the pivot axis 408, the ATLS 102 of the illustrated example includes a pivot cylinder or pivot actuator 410. For example, the pivot actuator 410 causes the spiral box 318 and/or the side walls 322 to pivot

about the pivot axis 408. Thus, the frame 320 is fixed (e.g., to the building) while the spiral box 318 (e.g., a moveable frame) pivots about the pivot axis 408. The platform 304 and the conveyor 330 also pivot with the spiral box 318 about the pivot axis 408. Thus, the entire spiral box 318 including the conveyor 330 (e.g., a slat belt) pivots about the pivot point 405 to adjust a lateral angle relative to a trailer angle. The frame 320 (e.g., the support beams 326) surrounding the spiral box 318 does not rotate or pivot about the pivot axis 408 (e.g., the frame 320 is permanently mounted to the building or loading dock 100 and/or is otherwise fixed so that it does not rotate about the pivot point 405). The pivot actuator 410 includes a transmission (e.g., a plate) operatively coupled to the spiral box 318 (e.g., a rear plate not shown) that causes the spiral box 318 to shift laterally via the pivot point 405 when actuated between a first position and a second position. The actuators 402, 406 and/or 410 can be hydraulic actuators, electric actuators, linear actuators and/or any other actuator(s). In some examples, the spiral box 318 can be configured to move vertically and/or can shift laterally or sideways (e.g., see FIG. 27). In some examples, the pivot point 405 can move telescopically and/or vertically when moving the spiral box 318 vertically.

[0075] FIG. 5 is a perspective, partial view of the lip 306 of the example ATLS 102 shown in an example stored position 502 (e.g., a vertical position). To move the lip 306 to the stored position 502, the lip actuator 402 is operated (e.g., extended, or actuated), thereby causing the lip 306 to rotate (e.g., upward) about the lip pivot axis 404 to the stored position 502.

[0076] FIGS. 6A and 6B are partial, perspective views of the lip 306 of the example ATLS 102 shown in an example extended position 602 (e.g., a horizontal position). To move the lip 306 to the extended position 602, the lip actuator 402 is operated (e.g., retracted), thereby causing the lip 306 to rotate (e.g., downward) about the lip pivot axis 404 to the extended position 602. Additionally, FIG. 6A shows the platform 304 in an example first position 604 at

which the platform 304 is raised relative to the frame 320 or the first side wall 322a by a height H. FIG. 6B shows the platform 304 in an example second position 606 at which the platform 304 is lowered relative to the frame 320 or the side wall 322 (e.g., to reduce or eliminate the height H) to adjust an elevation of an upper surface of the platform 304 relative to the cargo area 112. Such vertical adjustment of the platform 304 facilitates transition of the platform 304 for cargo beds having different heights. For example, the platform actuators 406 can be operated to adjust a height (e.g., a vertical height H) of the platform 304 relative to the frame 320 and/or the side walls 322.

[0077] FIGS. 7A-7C are partial, top views of the example ATLS 102 showing the ATLS at different lateral (e.g., horizontal) positions. FIG. 7A illustrates the platform 304, the spiral box 318 and/or the conveyor 330 at a first lateral position 702 relative to the frame and/or the dock wall 104. FIG. 7B illustrates the platform 304, the spiral box 318 and/or the conveyor 330 at a straight or non-lateral offset position 704 relative to the frame 320 and/or the dock wall 104. FIG. 7C illustrates the platform 304, the spiral box 318 and/or the conveyor 330 at a second lateral position 706 relative to the frame 320 and/or the dock wall 104.

[0078] When in the first lateral position 702, a side surface 708 of the platform 304 is angled or skewed toward the first side 316a (e.g., a right side of the frame 320 in the orientation of FIG. 7A). For example, a front or leading edge 710 of the platform 304 adjacent the front plate 325 of the frame 320 is shifted toward the first side 316a (e.g., a right side of the frame in the orientation of FIG. 7A) and is closer to the first side 316a compared to a rear end or trailing edge 712 of the platform 304. In other words, the leading edge 710 is closer to the first side 316a (e.g., the right side) of the ATLS 102 than the trailing edge 712 of the platform 304.

[0079] In the straight position 704 shown in FIG. 7B, the leading edge 710 of the platform 304 is substantially aligned with the trailing edge 712. In other words, a side surface

708 (e.g., or side edge) of the platform 304 is substantially parallel (e.g., perfectly parallel or within 5 degrees of perfectly parallel) relative to the first side 316a of the ATLS 102.

[0080] When in the second lateral position 706, the side surface 708 of the platform 304 is angled toward the second side 316b (e.g., a left side of the frame 320 in the orientation of FIG. 7C). For example, the trailing edge 714 of the platform 304 is shifted toward the first side 316a (e.g., the right side) of the frame in the orientation of FIG. 7C and the leading edge 710 of the platform is positioned farther away from the first side 316a (e.g., the right side) and toward the second side 316b (e.g., the left side of the frame 320) compared to the trailing edge 714 of the platform 304. In other words, the leading edge 710 is closer to the second side 316b of the ATLS 102 than the trailing edge 714.

[0081] FIGS. 8 is a partial, perspective view of the example conveyor 330 of FIGS. 1-7C. The conveyor 330 of the illustrated example includes the slats 334 and the guide ramp 336 coupled to a leading edge 802 (or end) of the conveyor 330. The slats 334 are pivotally coupled together to define a conveyor belt 804. The conveyor belt 804 supports a load for moving the load into the cargo area 112. To guide the conveyor 330 within the channels formed by the track 324, the conveyor 330 of the illustrated example includes a plurality of track rollers 806. The track rollers 806 are supported or coupled to lateral edges of the slats 334. In addition, to enable or facilitate movement of the conveyor 330 about the track 324, the conveyor 330 of the illustrated example includes a guide roller 808. The guide roller 808 is coupled to the guide ramp 336 and a slat 334 defining the leading edge 802. In the illustrated example, the track rollers 806 rotate about an axis of the rotation 810 that is parallel relative to a longitudinal axis 812 of the slats 334. The guide roller 808 rotates about an axis of rotation 814 that is perpendicular relative to the longitudinal axis 812 of the slats 334. In other words, the guide roller 808 rotates about the axis of rotation 814 that is non-parallel (e.g., perpendicular) relative

to the axis of rotation 810 of the track rollers 806. In some examples, the guide roller 808 is mounted at an angle such that the axis of the rotation 814 of the guide roller 808 is angled (e.g., non-perpendicular) relative to the longitudinal axis 812 of the slats 334. In some examples, a plurality of guide rollers 808 is positioned intermittently between two or more sets of the track rollers 806 (e.g., five track rollers). In some examples, only one guide roller 808 is used. In some examples, one guide roller is positioned between every 3 track rollers, 4 track rollers, 5 track rollers, etc. In some examples, the track rollers 806 can be replaced with guide rollers 808. In some examples, the guide roller 808 and/or the track rollers 806 are pivotally coupled to the slats 334 to enable rotation of the guide roller 808 and/or the track rollers 806 relative to the lateral edges of the slats 334 (e.g., during operation of the conveyor 330).

[0082] FIG. 9A is an exploded view of an example slat 334 of FIGS. 8. FIG. 9B is an assembled view of the slat 334 of FIG. 9A. The slat 334 of the illustrated example includes a plank 902 (e.g., a support beam or channel), a plurality of chain links 904, inner rollers 906, and the track rollers 806. The plank 902 of the illustrated example can be made of aluminum, steel and/or any other material(s). The plank 902 of the illustrated example includes a plurality of cutouts 908 to receive respective ones of the chain links 904. In the illustrated example, the plank 902 includes four cutouts 908 to receive four chain links 904. In other examples, the plank 902 can include one cutout and one respective chain links, two cutouts and two chain links, three cutouts and three chain links, and/or any number of cutouts and chain links 904. The plank 902 of the illustrated example defines a channel 910 (e.g., a c-channel) to receive the chain links 904 and the inner rollers 906. The chain links 904 include flanges 904a to attach to the plank 902 via fasteners (e.g., bolts, screws, etc.). The track rollers 806 attach to lateral edges of the plank 902 via a mounting bracket and rotate via a bearing or bushing. In some examples, the conveyor 330 can have a width of approximately between 94 inches and 104 inches (e.g., 96

inches). In some examples, the planks 902 can have a longitudinal length of approximately 96 inches. The planks 902 can be aluminum and can be formed via extrusion, machining, etc.

[0083] To reduce friction between a load and an upper surface 914 of the plank 902, the slat 334 of the illustrated example includes a cover 916. The cover 916 of the illustrated example attaches or couples to the plank 902 via fasteners (e.g., screws, bolts, etc.). The cover 916 of the illustrated example is composed of a low-friction material such as, for example, an ultra-high molecular weight (UHMW) material or polyethylene (UHMWPE) and/or any other material having low-friction characteristics (e.g., thermoplastic polyethylene, plastic material, etc.). The cover 916 covers the chain links 904 to prevent or restrict formation of a debris trap.

Additionally, to improve or facilitate movement of the conveyor 330 relative to the platform 304 and/or the cargo area 112 of the vehicle 114, the slat 334 includes the inner rollers 906. The inner rollers 906 are coupled to the plank 902 via brackets and rotate relative to the plank 902 via bearings and/or bushings. The slat 334 of the illustrated example includes four inner rollers 906. The track rollers 806 and/or the inner rollers 906 can be composed of UHWM, steel, or other plastic material(s). Thus, the conveyor 330 includes end or track rollers 806 for the spiral box 318 and inner rollers 906 on an underside of the conveyor 330. In some examples, the slat 334 can include one inner roller, two inner rollers, three inner rollers, five inner rollers, and/or any number of inner rollers. Additionally, the slat 334 of the illustrated example includes four chain links 904 spaced across a longitudinal length of the slat 334. However, in some examples, the slat 334 can include one chain link, two chain links, three chain links, five chain links, and/or any number of chain links.

[0084] FIGS. 10A is a partial, perspective view of the example conveyor 330 of FIGS. 8 shown in an example straight or flat condition 1002. FIG. 10B is a partial perspective view of the example conveyor 330 of FIG. 8 shown in an example bent, deflected, or curved condition

1004. FIG. 10C is a partial, bottom view of the example conveyor 330 of FIGS. 10A and 10B. FIG. 10D is a side view of FIG. 10A.

[0085] To enable the conveyor 330 to operatively couple to the conveyor drive system 342, the conveyor 330 of the illustrated example includes a transmission assembly 1006. The transmission assembly 1006 of the illustrated example includes a chain 1008 that is formed by pivotally coupling adjacent ones of the chain links 904 of the slats 334. Each of the slats 334 includes a portion of the chain 1008 such that the slats 334, when coupled together, form the chain 1008 to engage a sprocket or drive gear of the conveyor drive system 342. Additionally, the chain 1008 pivotally couples the slats 334 to enable the conveyor 330 to move or bend (e.g., the curved condition 1004) during rolling and unrolling of the conveyor 330 from the spiral box 318. For example, a first chain link of a first slat is coupled to a second chain link of a second slat via a pin to enable the first and second chain links to pivot relative to each other when coupled as the chain 1008. Thus, the conveyor 330 of the illustrated example includes the plurality of slats 334 pivotally coupled via the chain 1008. The conveyor 330 of the illustrated example includes four chains 1008. Each of the chains 1008 can be spaced apart by approximately 3 feet and 5 feet. However, in some examples, the conveyor 330 can include one chain, two chains, three chains, five chains, and/or any number of chains.

[0086] Referring to FIG. 10D, the chain 1008 has a chain pitch 1020. The chain pitch 1020 of the illustrated example can be between approximately 4 inches and 10 inches. The conveyor 330 of the illustrated example includes a height H between an upper surface 1021 of the slats 334 and a lower most surface 1023 of the inner rollers 906. The height H of the illustrated example can be approximately between 2 inches and 8 inches. The chain 1008 and the low profile of the conveyor 330 in the H direction enables the conveyor 330 to bend or flex during rolling or unrolling events.

[0087] FIGS. 10E shows the conveyor 330 flexing or deflected in a first or downward direction 1022. For example, FIG. 10E is a side view of a portion 1025 of the conveyor 330 positioned within the track 324 of the spiral box 318. For example, such downward deflection facilitates winding of the conveyor 330 within the track 324 of the spiral box 318. The portion 1025 of the conveyor 330 has a radius of curvature R when inside the spiral box 318. For example, the radius of curvature R can be approximately between 6 inches and 8 inches. The ends 1027 of the slats 334 have a clearance C (e.g., 0.05 to 0.07 inches) when the portion 1025 of the conveyor is in the position of FIG. 10E. (e.g., a rolled up position). In general, the conveyor 330 can flex within the spiral box 318 via the track 324 when the conveyor 330 is in a stored configuration (e.g., a first operating position 1202 of FIG. 12).

[0088] FIG. 10F is a side view of a portion 1030 of the example conveyor 330 flexing or deflected in a second or upward direction 1032. For example, the conveyor 330 of the illustrated example can flex by an angle 1034 in the upward direction 1032. The upward flex can be limited by corners 1036 of adjacent ones of the slats 334 touching or engaging. In the illustrated example, the angle 1034 can be approximately between 6 degrees and 9 degrees (e.g., 8 degrees). The upward flex (e.g., 8 degrees) is advantageous to navigate over any lip/bridge going into the cargo area 112 and/or to accommodate height differences between dock height or floor and cargo bed height. Thus, the conveyor 330 of the illustrated example, via the chain 1008, can move between a first flexed condition in the downward direction 1022, a flat condition, and a second flexed condition in the upward direction 1032.

[0089] FIG. 11 is a partial perspective view of the example ATLS 102 showing a portion of the example conveyor drive system 342 and/or the transmission assembly 1006. The conveyor drive system 342 includes the first and second motors 344a, 344b, the output shaft 346 and a sprocket 1102 coupled to the output shaft 346 that is driven by the motors 334a, 334b.

Although only one sprocket 1102 is shown in FIG. 11, the conveyor drive system 342 and/or the transmission assembly 1006 includes a sprocket for each chain 1008 of the conveyor 330. For example, in this example, the conveyor drive system 342 and/or the transmission assembly 1006 includes a four sprockets. Thus respective ones of the sprockets 1102 engage or drive respective ones of the chains 1008. The first and second motors 344a, 344b rotate the output shaft 346 to turn sprockets 1102 about a rotational axis of the output shaft 346 to drive the chains 1008 of the conveyor 330 to move (e.g. push/pull) the conveyor 330 between the stored position 338 and one or more extended positions.

[0090] FIG. 12 is a perspective view of the example loading dock 100 of FIG. 1 showing the example ATLS 102 in a first operative position 1202 and the vehicle 114 parked at the loading dock 100 and positioned for a loading operation. Prior to movement of the ATLS 102 from the stored position 338 to the first operative position 1202, the ATLS 102 can be adjusted relative to the cargo area 112 of the vehicle 114. For example, to adjust for a vertical height of the cargo bed and/or to provide a transition between the platform 304 and the cargo area 112, the lip 306 is moved to the extended position 602 via the lip actuator 402. Additionally, to adjust for a vertical height between the cargo area 112 and the floor 110, the platform 304 can be adjusted (e.g., vertically) via the platform actuators 406 (e.g., and/or vertical actuators 2800 of FIG. 28A and 28B). For example, the belt bottom height can be approximately 52 inches and the dock height can be approximately 48 inches. Thus, the platform 304 and/or the lip 306 can transition to the cargo area 112.

[0091] Additionally, to adjust for a lateral or horizontal skew of the cargo area 112 relative to the doorway 106, the pivot actuator 410 can be actuated to adjust the lateral position of the conveyor 330 relative to the cargo area 112 (see FIGS. 7A-7C, FIGS. 27A-27B). The up/down and left/right adjustability of the conveyor 330 (via the platform 304 and/or the spiral

box 318) helps to center and/or square the conveyor 330 relative to the cargo area 112 for improved loading operation. Additionally, such adjustments enable the ATLS 102 to adjust for different vehicles having cargo bed height variations and/or loading docks having dock height variations. Additionally, although not shown, some example loading docks employ a vehicle restraint (e.g., a hook that engages an ICC bar) that can restrain the vehicle 114 at the loading dock 100 prior to adjusting the ATLS 102 relative to the cargo area 112.

[0092] In the first operative position 1202, the conveyor 330 advances a first distance 1204 from a rear edge 1206 of the frame 320 and/or a rear edge 304c of the platform 304 that is greater than a distance from the rear edge 1206 when the conveyor 330 is in the stored position 338. In other words, in the first operative position 1202, the guide ramp 332 advances toward the cargo area 112. The first distance 1204 causes the conveyor 330 to partially unfold or extend from the spiral box 318. For example, at the first operative position 1202, the conveyor 330 extends from the rear edge 1206 of the ATLS 102 a distance of approximately 4 feet to enable placement of pallets or cargo on the extended portion 1208 of the conveyor 330. In general, the conveyor 330 can flex within the spiral box 318 via the track 324 when the conveyor 330 is in a stored configuration and the conveyor 330 can be rigid when the conveyor is in an extended configuration (e.g., when the conveyor 330 is outside of the cavity 340 of the spiral box 318).

[0093] FIG. 13 is a perspective view of the ATLS 102 at the first operative position 1202. In the illustrated example, a loading vehicle 1302 (e.g., a forklift) positioned a first pallet 1304 and a second pallet 1306 (e.g., a first set of pallets 1308) on the extended portion 1208 of the conveyor 330. Specifically, the first pallet 1304 and the second pallet 1306 are positioned in a side-by-side relationship or orientation.

[0094] FIG. 14 is a perspective view of the ATLS 102 at a second operative position 1402. At the second operative position 1402, the conveyor 330 indexes a second distance 1406

greater than the first distance 1204 to further extend and/or expose from the spiral box 318. For example, at the second operative position 1402, the conveyor 330 indexes forward approximately forty inches and the next set of pallets 1404 (e.g., cargo) is positioned on the further exposed portion of the conveyor 330. This process is repeated until the cargo is positioned in the cargo area 112.

[0095] FIG. 15 is a perspective view of the ATLS 102 at a third operative position 1502. At the third operative position 1502, the conveyor 330 indexes to a third distance 1504 to further extend and/or expose from the spiral box 318. Additionally, the guide ramp 332 and/or portions of the conveyor 330 are positioned within the cargo area 112. In other words, the first set of pallets 1308 are positioned in the cargo area 112. The conveyor 330 continues to index forward to expose additional portions of the conveyor 330 from the spiral box 318 adjacent the rear edge 1206 sufficient to receive another set of pallets 1404.

[0096] FIG. 16 is a perspective view of the ATLS 102 in a fourth operative position 1602. In the fourth operative position 1602, the conveyor is extended (e.g., fully extended) a distance 1603 such that the first set of pallets 1308 is positioned adjacent a front end or nose 1604 of the cargo area 112 and a last set of pallets 1606 is positioned adjacent a rear end 1608 of the vehicle 114 adjacent the doorway 106. In some examples, the distance 1603 can be approximately between 52 feet and 75 feet. In the fourth operative position 1602, the cargo area 112 is loaded with the pallets. The cargo area 112 was loaded via the ATLS 102 without requiring the loading vehicle 1302 to move within the cargo area 112 of the vehicle 114. In some examples, an automated cargo vehicle can be used instead of the forklift to position the pallets on the conveyor 330. In some examples, a control system (e.g., a controller and/or sensors) can be used to automatically advance the conveyor 330 (e.g., to index the conveyor 330 incrementally) after placement of the pallets on the conveyor 330.

[0097] During operation of the conveyor 330 from the stored position 338 to the fourth operative position 1602 shown in FIG. 16, the track rollers 806 engage the track 324 to facilitate extraction or extension of the conveyor 330 from the spiral box 318. Additionally, the inner rollers 906 facilitate or reduce friction between the conveyor 330 and the platform 304 and/or the cargo area 112 as the conveyor 330 advances into the cargo area 112. In some instances, the track rollers 806 engagement with the first and/or second side guide rails 304a, 304b of the platform 304 help maintain the conveyor 330 square and/or centered relative to the cargo area 112 during extension and/or retraction of the conveyor 330 between the extended position and the stored position 338.

[0098] FIG. 17A is a partial, perspective view of the loading dock 100 and the ATLS 102 showing an example unload bar 1700 of the ATLS 102. The unload bar 1700 is mounted to the dock wall 104 (e.g., to an interior side 1702 of the dock wall 104) adjacent or around the doorway 106. The unload bar 1700 shown in FIG. 17A is in a non-use or stored position 1704.

[0099] FIG. 17B is a partial, perspective view of the loading dock 100 and the unload bar 1700 of the ATLS 102 shown in a use or extended position 1706. To retract the conveyor 330 when the conveyor 330 is positioned in the cargo area 112 and the pallets and/or cargo are positioned on the conveyor 330 as shown in FIG. 16, the ATLS 102 of the illustrated example employs the unload bar 1700. In the extended position 1706, the unload bar 1700 of the illustrated example blocks or inhibits movement of the cargo and/or the pallets in the cargo area 112 when retracting the conveyor 330 from the cargo area 112.

[00100] The unload bar 1700 of the illustrated example includes vertical side frames 1708 (e.g., beams) adjacent lateral edges of the doorway 106 and a retractable brace or extension arm 1710 that spans across the doorway 106 between the vertical side frames 1708. Additionally, the unload bar 1700 includes a plurality of block plates 1712 coupled to or

supported by the extension arm 1710. The block plates 1712 of the illustrated example expand into the cargo area 112 to engage the last set of pallets 1606 (e.g., the pallets or cargo closest to the doorway 106) to inhibit or block movement of the pallets or cargo toward the doorway 106 when the conveyor 330 is retracted toward the stored position 338. For example, although the pallets or cargo are positioned on the conveyor 330 when the conveyor 330 is extended (e.g., fully extended) into the cargo area 112, the conveyor 330 slides from underneath the pallets or cargo when moved toward the retracted or stored position 338. As a result, the cargo or pallets remain in the cargo area 112 while the conveyor 330 is retracted toward the stored position 338. This is facilitated by the block plates 1712 and/or the unload bar 1700 by exerting a force in a direction toward the nose 1604 of the cargo area 112 and preventing sliding movement of the pallets or cargo toward the doorway 106 when the conveyor 330 is retracted in a direction toward the doorway 106.

[00101] FIG. 18 is a perspective view of the example block plate 1712 of FIG. 17 shown in an extended position 1800. The block plate 1712 includes a first frame 1802 and a second frame 1804 moveably coupled via scissor frame connection 1806. In the extended position 1800, the first frame 1802 extends away from the second frame 1804. In the extended position 1800, the first frame 1802 extends into the cargo area 112 of the vehicle 114 (e.g., by a distance of approximately between 6 inches and 36 inches). The block plate 1712 includes an actuator 1808 to extend and retract the frames 1802, 1804 between a collapsed position (e.g., at which the frames 1802, 1804 engage) and the extended position 1800 (e.g., at which the frames 1802, 1804 are spaced apart and do not engage). The actuator 1808 (e.g., a linear actuator, a hydraulic actuator, etc.) provides a retaining force against the cargo in a direction toward a front end (e.g., the nose 1604) of the cargo area 112 when the conveyor 330 is retracted from the cargo area 112 in a direction toward the rear end 1608 of the cargo area 112.

[00102] FIG. 19A is a perspective view of another example loading dock 1900 having another example ATLS 1902 disclosed herein. FIG. 19B is an enlarged portion of the ATLS 1902 of FIG. 19A showing a floor 110 in transparent to illustrate the ATLS 1902. FIG. 19C is a side view of the example ATLS 1902 of FIGS. 19A and 19B. Many of the components of the example loading dock 1900 and/or the ATLS 1902 (and FIGS. 20A-26B) are substantially similar or identical to the components described above in connection with FIGS. 1-18. As such, those components will not be described in detail again below. Instead, the interested reader is referred to the above corresponding descriptions for a complete written description of the structure and operation of such components. To facilitate this process, similar or identical reference numbers will be used for like structures.

[00103] Referring to FIGS. 19A-19C, the ATLS 1902 of the illustrated example is positioned behind a dock leveler 1904. The dock leveler 1904 of the illustrated example is positioned between the ATLS 1902 and a doorway 106 of a loading bay 1901 of the loading dock 1900. Thus, in the illustrated example, the dock leveler 1904 is separate from the ATLS 1902. Thus, the dock leveler 1904 and the ATLS 1902 are positioned in a pit area 204 of the loading dock 1900. A conveyor 1906 of the ATLS 1902 moves along an upper surface of a deck 1908 of the dock leveler 1904 and into the cargo area 112 of the vehicle 114. The conveyor 1906 of the ATLS 1902 stores within a spiral box 1910. The spiral box 1910 includes a track 1912 to enable the conveyor 1906 to roll up within the spiral box 1910. The ATLS 1902 of the illustrated example may not adjust relative to the loading dock 1900 and may not include the lip 306 (e.g., the ATLS 1902 may not include the actuators 402, 406, 410).

[00104] FIG. 20A is a partial, perspective view of the example conveyor 1906 of the ATLS 1902. FIG. 20B is a side view of FIG. 20A. FIG. 20C is a bottom view of FIG. 20A. FIG. 20D is a perspective view of a slat 2002 of the conveyor 1906 of FIG. 20A. Referring to FIGS.

20A-2D, the conveyor 1906 includes a plurality of slats 2002 pivotally coupled together via a chain 2004. The chain 2004 is formed via a plurality of chain links 2008. In this example, each slat 2002 carries a chain link 2008 on respective ones of the lateral edges 2006. The slats 2002 are coupled together via the chain links 2008 to define the chain 2004. The conveyor 1906 includes a first chain on a first lateral edge 2006a and a second chain of a second lateral edge 2006b. Additionally, rollers 2010 are positioned underneath the slats 2002 to facilitate or reduce friction during extension and retraction of the conveyor 1906 within the cargo area 112 of the vehicle 114. Each of the chain links 2008 includes an opening 2014 to receive a track roller.

[00105] FIG. 21 is a partial, perspective view of another example conveyor 2100 of an example ATLS 2102 disclosed herein. In the illustrated example, the conveyor 2100 includes a plurality of surface rollers 2104 (anti-friction rollers) formed on or protruding from an upper surface 2106 of the conveyor 2100. For example, the conveyor 2100 of the illustrated example includes a plurality of slats 2108 and a guide ramp 2110. The surface rollers 2104 spaced (e.g., equally) between lateral edges 2112 of the slats 2108. In the illustrated example, each slat 2108 includes a row of the surface rollers 2104. The guide ramp 2110 also includes a row of the surface rollers 2104. The surface rollers 2104 of the illustrated example rotate about an axis that is substantially parallel (e.g., perfectly parallel or within 5 degrees of perfectly parallel) relative to rotational axes 2114 of track rollers 2116 supported by the slats 2108. The surface rollers 2104 of the illustrated example have a cylindrical or oblong shape.

[00106] FIG. 22A is a partial perspective view of another example conveyor 2200 of another example ATLS 2202 disclose herein. FIG. 22B is a side view of FIG. 22A. The conveyor 2200 of the illustrated example includes surface rollers 2204 that have a spherical shape.

[00107] FIG. 23 is a top view of another example slat 2300 of another example conveyor 2301 of another example ATLS 2302 disclosed herein. The slat 2300 of the illustrated example includes a plurality of surface rollers 2304 extending from an upper surface 2306. The surface rollers 2304 are elongated rollers and have rotational axes that are parallel relative to a longitudinal axis 2308 of the slat 2300. In this example, the slat 2300 includes six rollers spaced apart across a length of the slat 2300 between lateral edges 2300a, 2300b of the slat 2300. The surface rollers 2104 of FIG. 21, the surface rollers 2204 of FIG. 22A and 22B, and the surface rollers 2304 of FIG. 23 help reduce friction and/or facilitate removal of a conveyor from the cargo area 112 when cargo is positioned on the conveyor (see FIG. 17B).

[00108] FIG. 24 is a perspective view of another example slat 2400 disclosed herein. The slat 2400 includes a plank 2402, a cover 2404, inner rollers 2406, track rollers 2408 and lateral chain links 2410. The inner rollers 2406 are positioned in a channel 2412 formed on a lower surface 2414 of the plank 2402. There are four inner rollers in this example. A first chain link 2410a is attached to a first lateral edge 2402a of the plank 2402 and a second chain link 2410b is attached to a second lateral edge 2402b of the plank 2402. The track rollers 2408 are coupled to the lateral edges 2402a, 2402b of the plank 2402.

[00109] FIG. 25 is a partial, perspective view of a conveyor 2500 of another example ATLS 2502 disclosed herein. The conveyor 2500 of the illustrated example includes a plurality of slats 2400 of FIG. 24. The cover 2404 of the illustrated example is positioned within a channel or slot 2504 formed on an upper surface 2506 of the plank 2402 (e.g., the slot 2504 extends along a longitudinal length of the plank 2402). Thus, the cover 2404 of the illustrated example includes a groove 2508 on a side wall of the cover 2404 that engages a wing 2504a (e.g., a flange or bent portion) of the plank 2402 defined by the slot 2504. The cover 2404 is inserted in the slot 2504 from a lateral end of the plank 2402 and pushed toward the other lateral

edge until lateral edges of the cover 2404 align with respective lateral edges of the plank 2402. The cover 2404 is retained by the plank 2402 without use of screws, bolts, or other fasteners, thereby facilitating manufacturing. A drive gear 2510 (e.g., a gear) rotates via a conveyor drive system 342 that causes teeth 2512 of the drive gear 2510 to engage and drive the chain 2516 provided by the chain links 2410 to drive the conveyor 2500 between stored and extended positions.

[00110] FIGS. 26A and 26B are perspective views of another example ATLS 2602 disclosed herein. The ATLS 2602 includes a conveyor 2604 having a plurality of slats 2606 and a guide ramp 2608. Each of the slats 2606 includes a chain link 2610. The chain links 2610 pivotally couple to form a chain 2612 that is driven by a sprocket 2614 coupled to an output shaft 346. The chain links 2610 each includes an opening to mount or receive a track roller 2616 for engaging a spiral track 2618 of a spiral box 2620.

[00111] FIG. 27A is a top view of an example frame assembly 2702 (e.g., a housing) and skewing system 2704 that can implement an example ATLS disclosed herein (e.g., the example ATLS 102 of FIGS. 1A and 1B, the ATLS 2502 of FIG. 25, the ATLS 2602 of FIGS. 26A and 26B, etc.). The example frame assembly 2702 is shown in an example first or initial position 2700. FIG. 27B is a top view of FIG. 27A with the frame assembly 2702 in an example skewed position 2701. FIG. 27C is a partial, perspective view of an example skewing system 2704 of FIGS. 27A and 27B. FIG. 27D is another partial, perspective view of the example skewing system 2704 of FIGS. 27A-27C.

[00112] The frame assembly 2702 includes a support structure 2706 (e.g., a fixed frame or fixed beams) and a moveable frame 2705 (e.g., to support the conveyor 330). The skewing system 2704 of the example frame assembly 2702 includes a first actuator 2708 (e.g., a front end drive), and a second actuator 2710 (e.g., a rear end drive). The first actuator 2708 extends from a

first side 2712 of the support structure 2706 to a first or front end 2714 of the moveable frame 2705. Further, the first actuator 2708 is fixed or mounted to the support structure 2706 and coupled or mounted to the front end 2714 of the moveable frame 2705. Similarly, the second actuator 2710 extends from a second side 2716 of the support structure 2706 to a second or rear end 2718 of the moveable frame 2705 opposing the first side 2712. Further, the second actuator 2710 is fixed or mounted to the support structure 2706 and coupled or mounted to the rear end 2718 of the moveable frame 2705. As shown in the example of FIGS. 27A and 27B, the first and second actuators 2708, 2710 can move or actuate to modify a positioning of the moveable frame 2705 and/or the platform 304 relative to a centerline 2720 (e.g., and/or a centerline of the vehicle 114 or the doorway 106). The skewing system 2704 of FIGS. 27A and 27B can be employed to move the front end 2714 and/or the rear end 2718 in a first lateral direction 2722 and/or a second lateral direction 2724 to angle the moveable frame 2705 (e.g., to the different skewed positions) and, thus, position the ATLS 102 (e.g., the conveyor 330), in alignment with respect to a vehicle or trailer (e.g., the vehicle 114). Additionally, the skewing system 2704 of FIGS. 27A and 27B can be employed to move the front end 2714 and the rear end 2718 (e.g., simultaneously or a same distance) in the first lateral direction 2722 and/or the second lateral direction 2724 to offset a lateral position of the moveable frame 2705 relative to horizontal or a centerline of the doorway 106 and, thus, position the ATLS 102 (e.g., the conveyor 330), in alignment with respect to a vehicle or trailer (e.g., the vehicle 114). In other words, the longitudinal axis or centerline 2720 of the moveable frame 2705 (e.g., of the ATLS 102) can be positioned in an offset position laterally in the first lateral direction 2722 and/or the second lateral direction 2724 relative to a centerline of the doorway 106. In other words, although the longitudinal axis or centerline of the ATLS 102 and/or platform 304 is offset laterally relative to the centerline of the doorway 106, the centerline of the ATLS 102 maintains a substantially parallel (e.g., parallel

within 5 degrees of perfectly parallel) or parallel (e.g., perfectly parallel) relationship with the longitudinal axis of the doorway 106.

[00113] FIG. 27C is a detailed view of the skewing system 2704 showing the first actuator 2708 extending between the first side 2712 of the support structure 2706 and the front end 2714 of the moveable frame 2705. Additionally, the moveable frame 2705 includes a track 2730 (e.g., the track 324) extending from the front end 2714 towards the rear end 2718 (FIGS. 27A-27B). The track 324 can receive the conveyor 330 and/or any other conveyor disclosed herein.

[00114] FIG. 27D is another detailed view of the skewing system 2704 illustrating how the moveable frame 2705 is coupled to the support structure 2706. To reduce friction and/or facilitate movement of the front end 912 of the moveable frame 2705 and/or the rear end 2718 of the moveable frame 2705 in the first lateral direction 2722 and/or the second lateral direction 2724, the skewing system 2704 of the illustrated example includes glide pads 2726. The glide pads 2726 are coupled to the moveable frame 2705. Specifically, the glide pads 2726 of the illustrated example are coupled or positioned at each corner of the moveable frame 2705. In the illustrated example, the glide pads 2726 include a plurality of rollers 2728 that engage a floor (e.g., the floor 110 of the pit area 204) to facilitate movement of the moveable frame 2705 in the lateral directions 2722, 2724.

[00115] FIG. 28A is a perspective view of an example vertical actuator 2800 disclosed herein that can adjust (e.g., vertically adjust) a position of the moveable frame 2705 of FIGS. 27A-27D). FIG. 28B is a perspective, cutaway view of the example vertical actuator 2800 of FIG. 28A. To move an ATLS (e.g., the ATLS 102, the spiral box 318) and/or the moveable frame 2705 disclosed herein in a vertical direction, the frame assembly 2702 of the illustrated example includes a plurality of vertical actuators 2800 (e.g., linear actuators). Specifically, the

vertical actuators 2800 are coupled to the moveable frame 2705 of FIGS. 27A-27D. For example, the vertical actuators 2800 of the illustrated example are positioned in respective corners (e.g., four corners) of the frame assembly 2702 and/or the moveable frame 2705.

[00116] The vertical actuator 2800 of the illustrated example includes an actuator end 2802a (e.g., a piston) and a cylinder 2802b (e.g., a base). The cylinder 2802b of the vertical actuator 2800 is coupled to a housing 2804 (e.g., a mounting bracket). In the illustrated example, the housing 2804 encloses or encompasses the cylinder 2802b of the vertical actuator 2802. The actuator end 2802a (e.g., a piston) of the vertical actuators 2800 is coupled (e.g., fixed) to (e.g., a bracket of) the moveable frame 2705 and the cylinder 2802b of the vertical actuators 2800 is coupled or mounted (e.g., fixed to) to a base 2806 of the housing 2804. The housing 2804 slidably couples within pockets formed in respective corners of the moveable frame 2705. In some examples, the housing 2804 is mounted or coupled (e.g., welded) to the moveable frame 2705. Thus, the vertical actuators 2800 can move with the moveable frame 2705 laterally or sideways and can cause the moveable frame 2705 to move vertically. When moving sideways or laterally, the housing 2804 of the illustrated example can move relative to the support structure 2706. Specifically, the housing 2804 has a bottom surface 2808 that engages a pit floor of the pit area 204. To facilitate movement of the vertical actuator 2800 (e.g., reduce friction) laterally or sideways, the housing 2804 of the illustrated example includes the glide pad 2726 on the bottom surface 2808 of the housing 2804.

[00117] In operation, the alignment system including the vertical actuators 2800 can move the moveable frame 2705 in a first vertical direction (e.g., an upward direction) and a second vertical direction (e.g., a downward direction), and/or can tilt the front end 2714 of the moveable frame 2705 relative to the rear end 2718 in the longitudinal and/or horizontal directions. For example, extension of the vertical actuators 2800 causes the moveable frame

2705 to move (e.g., lift) away from the support structure 2706 and retraction of the vertical actuators 2800 causes the moveable frame 2705 to move toward the support structure 2706. Thus, the actuator end 2802a can move the moveable frame 2705 relative to the support structure 2706 and/or the housing 2804 in the vertical directions. For example, FIG. 28B shows the actuator end 2802a at different stroke positions 2810, 2812, and 2814. Each of the vertical actuators 2800 can be operated independently and can cause a respective one of the corners of the moveable frame 2705 to move relative to another respective one of the corners of the moveable frame 2705. Thus, respective ones of the corners of the moveable frame 2705 can be positioned at different heights (e.g., vertical heights or stroke positions). The alignment system including the vertical actuators 2800 can be employed to adjust a height (e.g., a vertical height) and/or a slope (e.g., a tilt or vertical angle) of the ATLS 102 (or other example ATLS disclosed herein), the conveyor 330 and/or the moveable frame 2705 between the front end 2714 and the rear end 2718 of the moveable frame 2705. For example, the vertical actuators 2800 adjacent the front end 2714 can be actuated or extended to a length greater than a length or extension of the vertical actuators 2800 adjacent the rear end 2718 to tilt or slope the conveyor 330 and/or the moveable frame 2705 downwardly in a direction between the front end 2714 and the rear end 2718. Likewise, the vertical actuators 2800 adjacent the front end 2714 can be actuated or retracted to a length that is less than a length or extension of the vertical actuators 2800 adjacent the rear end 2718 to tilt or slope the conveyor 330 and/or the moveable frame 2705 upwardly in a direction between the front end 2714 and the rear end 2718. The frame assembly 2702 of the illustrated example includes four vertical actuators. However, in some examples, the frame assembly 2702 can include one actuator, two actuators, six actuators and/or any number of actuators.

[00118] FIG. 29A is a side view of an example sensor system 2900 disclosed herein. The example sensor system 2900 can be implemented with the example ATLS disclosed herein. For example, the sensor system 2900 of FIG. 29A is shown with the example ATLS 102. In FIG. 29A, the lip 306 of the example ATLS 102 of FIGS. 1A and 1B is in the example scanning position 2902 to enable the example sensor system 2900 to perform a scanning operation. FIG. 29B is a side view of the lip 306 of FIG. 29A shown in an example loading/unloading or extended position 2906. FIG. 29C is a side view of the lip 306 of FIG. 29A shown in an example stored position 2908.

[00119] Referring to FIG. 29A, the sensor system 2900 is positioned (e.g., mounted) underneath the lip 306 of the ATLS 102. The sensor system 2900 can be built or integrated with the platform 304 of the ATLS 102 and/or can otherwise be positioned underneath or below a conveyor (e.g., the conveyor 330) or travel path of a conveyor (e.g., the conveyor 330) of the ATLS 102 after the scanning operation so that the sensor system 2900 does not interfere with a loading/unloading operation. For example, the sensor system 2900 is mounted to the housing 302 (e.g., the front plate 325 of FIG. 3) of the ATLS 102.

[00120] In operation, the lip 306 rotates about the hinge 312 (e.g., pivot joint) to move the lip 306 between the scanning position 2902 of FIG. 29A, the extended position 2906 of FIG. 29B, and the stored position 2908 of FIG. 29C. In FIG. 29A, the lip 306 moves to a raised or upright position to expose the sensor system 2900 and enable the sensor system 2900 to perform a scanning operation (e.g., scan the cargo area 112 of the vehicle 114 (see FIG. 29D)). Thus, the lip 306 moves to a position above the sensor system 2900 so that the lip 306 does not obstruct a sensing path 2910 of the sensor system 2900. After the sensor system 2900 completes the scanning operation (e.g., to determine the position of the vehicle 114, a length of the cargo area 120, etc.), the lip 306 moves to an operating position or extended position 2906. In the extended

position 2906, the lip 306 covers and/or is otherwise positioned above the bottom portion of the doorway 106 and spans a gap between the cargo area 112 of the vehicle 114 and the floor 110 of the loading dock 100 (FIG. 1A). In FIG. 29C, after a loading/unloading event, the lip 306 moves to a non-use position or stored position 2908. In the stored position 2908, the lip 306 covers the sensor system 2900.

[00121] FIG. 29D is a perspective view of the example loading dock 100 and the example cargo area 112 of the vehicle 114 with the example sensor system 2900 performing an example scanning operation 2912. In the illustrated example, the sensor system 2900 includes a first sensor 2914 and a second sensor 2916 that perform a scan (e.g., a two-dimensional scan) in a first direction 2918 (e.g., a horizontal direction or between the inner side walls of the trailer) and a second direction 2920 (e.g., a vertical direction or between an upper roof surface and a floor surface) different than the first direction (e.g., perpendicular relative to the first direction) to determine information regarding the cargo area 112 including, but not limited to, a central reference of the vehicle 114, a width of an opening of the vehicle 114, a height of the opening of the vehicle 114, a depth or length of the cargo area 112, obstructions within the cargo area 112, an orientation of the vehicle 114 relative to a reference of the ATLS 102 and/or the doorway 106, a vertical position of the ATLS 102 relative to the vehicle 114 (e.g., a floor 2922 of the cargo area 112), and/or other information regarding a position of the vehicle 114 relative to the loading dock 100 and/or information regarding the cargo area 112. Based on this information, the ATLS 102 commands or causes actuation of the actuators (e.g., the actuators 402, 406, 410, 2800, etc.) to align the conveyor 330 and/or the ATLS 102 relative to the cargo area 112.

[00122] FIGS. 30A-30C are different views of another example conveyor 3000 that can be used to implement example ATLS described herein (e.g., the ATLS 102, the ATLS 2502, the ATLS 2600, etc.). For example, the conveyor 3000 can be used in place of the example

conveyor 330. FIG. 30A is a partial, perspective view of the conveyor 3000 shown in a straight or flat condition (e.g., a non-curved condition). FIG. 30B is a partial, bottom view of the example conveyor 3000 of FIG. 30A. FIG. 30C illustrates a portion of the conveyor 3000 in an example bent or curved condition.

[00123] To enable the conveyor 3000 to wind (e.g., roll or bend) about the track 324 (FIGS. 3A-3D) when the conveyor 3000 moves between a retracted position (e.g., the first operative position 1202 of FIG. 12) and an extended position (e.g., the fourth operative position 1602 of FIG. 16), the conveyor 3000 of the illustrated example includes a plurality of slats 3002. The slats 3002 of the illustrated example are pivotally coupled together to define the conveyor 3000. The slats 3002 include a plurality of planks that are pivotally coupled and can deflect, curve or bend relative to each other to enable the conveyor 3000 to roll or move within the track 324. The slats 3002 are described in detail in FIGS. 31A and 31B.

[00124] To reduce friction between a load and an upper surface 3003 of the conveyor 3000 (e.g., the slats 3002) and improve or facilitate removal of a load position on the conveyor 3000 when the conveyor 3000 moves from the extended position to a retracted position, the slats 3002 of the illustrated example include upper or outer rollers 3004. Additionally, to improve or facilitate movement of the conveyor 3000 relative to the platform 304 and/or a cargo area 112 of the vehicle 114, the slats 3002 of the illustrated example include lower or inner rollers 3006 (FIG. 30B). The inner rollers 3006 are coupled to the slats 3002 via brackets and rotate relative to the slats 3002 via bearings and/or bushings. As shown in FIGS. 30A and 30B, the outer rollers 3004 are positioned on a first side 3008 of the slats 3002 and the inner rollers 3006 are positioned on a second side 3010 of the slats 3002 opposite the first side 3008. The outer rollers 3004 protrude from the upper surface 3003 (e.g., a cargo supporting surface) of the conveyor 3000 and/or the slats 3002.

[00125] The example slats 3002 of the illustrated example include a drive interface 3012 to operatively couple to the conveyor drive system 342 and/or the transmission assembly 1006. Additionally or alternatively, the drive interface 3012 enables the slats 3002 to couple to each other. For example, the drive interface 3012 of the illustrated example includes chain links 3014. Thus, the slats 3002 of the illustrated example are coupled (e.g., linked, connected, etc.) via example chain links 3014 to provide/define the conveyor 3000 (e.g., a conveyor belt). The chain links 3014 maintain connection between the slats 3002 as the conveyor 3000 moves between the extended position and the retracted position (e.g., from a straight condition (FIGS. 30A and 30B) to a curved condition (FIG. 4C)). In some examples, the drive interface 3012 can be any other structure including a gear shaped structure. As shown in FIG. 4C, the conveyor 3000 can roll or bend in the stored position 338 (FIG. 3C). For example, in FIG. 4C, the slats 3002 are angled with respect to one another in a bent or curved condition. Thus, the conveyor 3000 is foldable, deflectable, or bendable. When the conveyor 3000 is moved to the extended position, the conveyor 3000 curves/traverses/moves along the track 324 (e.g., as shown in FIG. 30C). In particular, end rollers 3016 (e.g., track rollers) positioned at opposing ends of the slats 3002 engage with and/or roll along the track 324 as the conveyor 3000 moves between the stored configuration and the extended configuration. As such, the end rollers 3016 guide the conveyor 3000 within the channels formed by the track 324 (FIGS. 3A-3D). The end rollers 3016 are supported or coupled to opposing ends of the slats 3002. Neither the inner rollers 3006 nor the outer rollers 3004 engage the track 324 during operation of the ATLS 102.

[00126] FIG. 31A is a perspective view of the example slat 3002a of FIGS. 30A-30C. FIG. 31B is a bottom view of the slat 3002a of FIG. 31A. The slat 3002a of the illustrated example is a plank 3100 (e.g., a C-shaped plank or beam) having front and rear walls 3100a, 3100b joined by an upper wall or surface 3100c and a cavity or channel 3100d defined between

the front and rear walls 3100a, 3100b. The plank 3100 can be made of metal, plastic, aluminum, an alloy and/or any other material(s). The outer rollers 3004 of the slat 3002a of the illustrated example extend through the opposing first side 3008 and the second side 3010 (e.g., upper and lower sides, through the slat 3002a, etc.) of the slat 3002a. The inner rollers 3006 of the illustrated example are positioned on the second side 3010 (e.g., a lower side) of the slat 3002a and do not extend to an upper surface and/or the first side 3008 (e.g., an upper side) of the slat 3002a. Thus, at least portions of the outer rollers 3004 extend above the first side 3008 (e.g., an upper surface) of the slat 3002a and the inner rollers 3006 are positioned underneath the slat 3002a on the second side 3010 (e.g., the lower side) of the slat 3002a. In this example, the slat 3002a includes a plurality of pairs (e.g., four pairs) of the outer rollers 3004 and the inner rollers 3006 that extend along a longitudinal axis 3102 of the slat 3002a between a first longitudinal end 3104 of the slat 3002a and a second longitudinal end 3106 of the slat 3002a opposite the first longitudinal end 3104. A first pair 3108 of the outer and inner rollers 3004, 3006 is positioned adjacent the first longitudinal end 3104 of the slat 3002a and a second pair 3110 of the outer and inner rollers 3004, 3006 is positioned adjacent the second longitudinal end 3106 of the slat 3002a. A third pair 3112 of the outer and inner rollers 3004, 3006 is adjacent a fourth pair 3114 of the outer and inner rollers 3004, 3006. Further, the third and fourth pairs 3112, 3114 are positioned between the first and second pairs 3108, 3110 along the longitudinal axis 3102. The third pair 3112 and the fourth pair 3114 of outer and inner rollers 3004, 3006 are positioned adjacent to a midpoint (e.g., a half-length, half of a longitudinal length, etc.) of the slat 3002a. The third pair 3112 is positioned on a first side of the midpoint and the fourth pair 3114 is positioned on a second side of the midpoint opposite the first side of the midpoint.

[00127] As shown in the example of FIGS. 31A and 31B, the slat 3002a includes a first chain link 3014a positioned on the first side 3008 of the slat 3002a and a second chain link

3014b positioned on the second side 3010 of the slat 3002a spaced from the first chain link 3014a. The first chain link 3014a is positioned on the slat 3002a between the first pair 3108 and the third pair 3112 of outer and inner rollers 3004, 3006. Similarly, the second chain link 3014b is positioned on the slat 3002a between the fourth pair 3114 and the second pair 3110 of outer and inner rollers 3004, 3006. Further, the slat 3002a includes the end rollers 3016 positioned at or extending from the longitudinal ends 3104, 3106 that interface with (e.g., engage with and/or roll along) the track 324 as the conveyor 330 moves between the first operating position 1202 (e.g., a stored configuration) and the fourth operating position 1602 (e.g., the extended configuration). The chain links 3014a and 3014b interface with the conveyor drive system 342 to move the conveyor 330. In some examples, the drive interface 3012 and/or the chain link 3014 can be positioned at a midpoint or center of the slat 3002a in addition to or instead of the chain links 3014a and 3014b. The end rollers 3016, the outer rollers 3004, and the inner rollers 3006 each have rotational axes that are parallel relative to the longitudinal axis 3102 of the slat 3002a. In some examples, the end rollers 3016 are pivotally coupled to the slats 3002 to enable rotation of the end rollers 3016 relative to the lateral edges of the slats 3002 (e.g., during operation of the conveyor 330). In other words, the end rollers 3016 can deflect, bend or pivot relative to the respective longitudinal ends 3104, 3106 of the slat 3002a during operation or movement of the conveyor 330. The end rollers 3016, the outer rollers 3004 and/or the inner rollers 3006 can be composed of an Ultra High Molecular Weight Polyethylene (UHMW) material, steel, or other plastic material(s). In some examples, the end rollers 3016, the outer rollers 3004 and/or the inner rollers 3006 can include bearings (e.g., needle bearings, ball bearings, etc.) to facilitate rotation about an axis (e.g., rotational axes parallel relative to the longitudinal axis 3102).

[00128] FIGS. 32A and 32B illustrate another example slat 3200 (e.g., a plank) disclosed herein that can be implemented in the example conveyor 330. FIG. 32A is a side view of the slat 3200. FIG. 32B is a perspective view of the slat 3200 coupled to another one of the slat 3200. The example slat 3200 includes a roller 3202 and chain links 3204, 3206. The chain links 3204, 3206 link the two the slats 3200.

[00129] To reduce friction between a load and an upper surface 3208 of a conveyor or slats 3200, the slat 3200 of the illustrated example includes a cover 3210. The cover 3210 of the illustrated example attaches or couples to a plank 3212 of the slat 3200 via fasteners (e.g., screws, bolts, etc.). The plank 3212 is a beam (e.g., a C-channel beam) composed of metal, plastic and/or any other material(s). The cover 3210 of the illustrated example is composed of a low-friction material such as, for example, a UHMW material or polyethylene (UHMWPE) and/or any other material having low-friction characteristics (e.g., thermoplastic polyethylene, plastic material, etc.). The cover 3210 covers the chain links 3204, 3206 to prevent or restrict formation of a debris trap. Further, the slat 3200 and/or the cover 3210 of the illustrated example has a dome shaped top portion 3214. In the example of FIGS. 2A and 32B, the dome shaped top portion 3214 of the slat 3200 mitigates catch/pinch points between the slat 3200 and a load carried by the conveyor 330 and/or the slats 3200. In contrast to the slat 3002a of FIGS. 31A and 31B, the slat 3200 of the illustrated example does not include the outer rollers 3004 or any other rollers extending from an upper surface of the slat 3200.

[00130] Although each example of the ATLS, conveyors, slats, and/or loading docks disclosed above have certain features and/or components, it should be understood that it is not necessary for a particular feature of one example to be used exclusively with that example. Instead, any of the features described above and/or depicted in the drawings can be combined with any of the examples, in addition to or in substitution for any of the other features of those

examples. One example's features are not mutually exclusive to another example's features. Instead, the scope of this disclosure encompasses any combination of any of the features. In some examples, an ATLS, conveyors, slats, rollers, track rollers, guide rollers, anti-friction rollers, or other components, etc., in accordance with the teachings of this disclosure may have a combination of the features of the example disclosed herein.

[00131] "Including" and "comprising" (and all forms and tenses thereof) are used herein to be open ended terms. Thus, whenever a claim employs any form of "include" or "comprise" (e.g., comprises, includes, comprising, including, having, etc.) as a preamble or within a claim recitation of any kind, it is to be understood that additional elements, terms, etc., may be present without falling outside the scope of the corresponding claim or recitation. As used herein, when the phrase "at least" is used as the transition term in, for example, a preamble of a claim, it is open-ended in the same manner as the term "comprising" and "including" are open ended. The term "and/or" when used, for example, in a form such as A, B, and/or C refers to any combination or subset of A, B, C such as (1) A alone, (2) B alone, (3) C alone, (4) A with B, (5) A with C, (6) B with C, or (7) A with B and with C. As used herein in the context of describing structures, components, items, objects and/or things, the phrase "at least one of A and B" is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B. Similarly, as used herein in the context of describing structures, components, items, objects and/or things, the phrase "at least one of A or B" is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B. As used herein in the context of describing the performance or execution of processes, instructions, actions, activities, etc., the phrase "at least one of A and B" is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B. Similarly, as used herein in the context of describing the

performance or execution of processes, instructions, actions, activities, etc., the phrase “at least one of A or B” is intended to refer to implementations including any of (1) at least one A, (2) at least one B, or (3) at least one A and at least one B.

[00132] As used herein, singular references (e.g., “a”, “an”, “first”, “second”, etc.) do not exclude a plurality. The term “a” or “an” object, as used herein, refers to one or more of that object. The terms “a” (or “an”), “one or more”, and “at least one” are used interchangeably herein. Furthermore, although individually listed, a plurality of means, elements, or actions may be implemented by, e.g., the same entity or object. Additionally, although individual features may be included in different examples or claims, these may possibly be combined, and the inclusion in different examples or claims does not imply that a combination of features is not feasible and/or advantageous.

[00133] As used herein, unless otherwise stated, the term “above” describes the relationship of two parts relative to Earth. A first part is above a second part, if the second part has at least one part between Earth and the first part. Likewise, as used herein, a first part is “below” a second part when the first part is closer to the Earth than the second part. As noted above, a first part can be above or below a second part with one or more of: other parts therebetween, without other parts therebetween, with the first and second parts touching, or without the first and second parts being in direct contact with one another.

[00134] As used in this patent, stating that any part is in any way on (e.g., positioned on, located on, disposed on, or formed on, etc.) another part, indicates that the referenced part is either in contact with the other part, or that the referenced part is above the other part with one or more intermediate part(s) located therebetween.

[00135] As used herein, connection references (e.g., attached, coupled, connected, and joined) may include intermediate members between the elements referenced by the connection

reference and/or relative movement between those elements unless otherwise indicated. As such, connection references do not necessarily infer that two elements are directly connected and/or in fixed relation to each other. As used herein, stating that any part is in “contact” with another part is defined to mean that there is no intermediate part between the two parts.

[00136] Unless specifically stated otherwise, descriptors such as “first,” “second,” “third,” etc., are used herein without imputing or otherwise indicating any meaning of priority, physical order, arrangement in a list, and/or ordering in any way, but are merely used as labels and/or arbitrary names to distinguish elements for ease of understanding the disclosed examples. In some examples, the descriptor “first” may be used to refer to an element in the detailed description, while the same element may be referred to in a claim with a different descriptor such as “second” or “third.” In such instances, it should be understood that such descriptors are used merely for identifying those elements distinctly within the context of the discussion (e.g., within a claim) in which the elements might, for example, otherwise share a same name.

[00137] As used herein, “approximately” and “about” modify their subjects/values to recognize the potential presence of variations that occur in real world applications. For example, “approximately” and “about” may modify dimensions that may not be exact due to manufacturing tolerances and/or other real world imperfections as will be understood by persons of ordinary skill in the art. For example, “approximately” and “about” may indicate such dimensions may be within a tolerance range of +/- 10% unless otherwise specified herein.

[00138] Example methods, apparatus, systems, and articles of manufacture to improve performance, manufacturing, and/or assembly of automated trailer loading systems are disclosed herein. Further examples and combinations thereof include the following:

[00139] Example 1 includes an automated trailer loading system (ATLS) including a frame, a track carried by the frame, a conveyor moveably coupled to the frame, the conveyor to flex

within the frame via the track when the conveyor is in a stored configuration, the conveyor being rigid when the conveyor is in an extended configuration, and a drive system to engage the conveyor to move the conveyor relative to the frame between the stored configuration and the extended configuration.

[00140] Example 2 includes the ATLS of example 1, wherein the conveyor includes a plurality of slats, the slats configured to bend relative to each other when the conveyor is in the stored position.

[00141] Example 3 includes the ATLS of example 1 or example 2, wherein the slats include a plurality of chain links positioned a lower surface of the slats, the drive system including at least one of a gear or sprocket to engage the chain links to move the conveyor between the extended position and the stored position.

[00142] Example 4 includes the ATLS of any one of examples 1-3, wherein the conveyor bends within the frame via the track when the conveyor is in the stored position.

[00143] Example 5 includes the ATLS of any one of examples 1-4, further including a sensor system coupled to the frame, the sensor system to scan a cargo area of a vehicle parked adjacent the ATLS.

[00144] Example 6 includes the ATLS of any one of examples 1-5, wherein the track has a spiral pattern.

[00145] Example 7 includes an automated trailer loading system (ATLS) including a frame, a track carried by the frame, and a conveyor moveably coupled to the frame, the conveyor rollable between an extended configuration and a stored configuration, the conveyor to roll within the frame in at least one loop via the track when the conveyor is in the stored configuration.

[00146] Example 8 includes the ATLS of example 7, wherein a first portion of the conveyor is stored underneath a second portion of the conveyor in the stored configuration.

[00147] Example 9 includes the ATLS of example 7 or example 8, wherein the frame includes a first side wall and a second side wall.

[00148] Example 10 includes the ATLS of any one of examples 7-9, wherein the first side wall and the second side wall include a plurality of first channels to define the track.

[00149] Example 11 includes the ATLS of any one of examples 7-10, wherein the track includes an opening adjacent a rear edge of the frame to allow the conveyor to enter or exit the frame.

[00150] Example 12 includes the ATLS of any one of examples 7-11, wherein the conveyor extends away from the frame into a vehicle in the extended configuration.

[00151] Example 13 includes the ATLS of any one of examples 7-12, wherein the conveyor includes track rollers, the track rollers to engage the track when the conveyor moves between the extended position and the stored position.

[00152] Example 14 includes an automated trailer loading system (ATLS) including a housing, a track positioned or carried by the housing, and a conveyor moveably coupled to the housing, the conveyor rollable within a cavity of the housing via the track when the conveyor is in a stored position.

[00153] Example 15 includes the ATLS of any one of examples 7-14, wherein the conveyor includes a plurality of slats defining a conveyor belt.

[00154] Example 16 includes the ATLS of any one of examples 7-15, wherein the slats each include a plank having a first side defining an upper surface and a second side opposite the first side defining a channel.

[00155] Example 17 includes the ATLS of any one of examples 7-16, wherein the plank includes a cover coupled to the upper surface of the plank.

[00156] Example 18 includes the ATLS of any one of examples 7-17, wherein the plank includes a first roller extending from the upper surface of the plank.

[00157] Example 19 includes the ATLS of any one of examples 7-18, wherein the plank includes a second roller extending from the lower surface of the plank.

[00158] Example 20 includes the ATLS of any one of examples 7-19, further including track rollers coupled to lateral edges of the plank, the track rollers to engage the track to guide the conveyor when the conveyor moves between the stored position and an extended position.

[00159] The following claims are hereby incorporated into this Detailed Description by this reference. Although certain examples, methods, apparatus, and articles of manufacture have been disclosed herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent covers all systems, methods, apparatus, and articles of manufacture fairly falling within the scope of the claims of this patent.

What Is Claimed Is:

1. An automated trailer loading system (ATLS) comprising:
 - a frame;
 - a track carried by the frame;
 - a conveyor moveably coupled to the frame, the conveyor to flex within the frame via the track when the conveyor is in a stored configuration, the conveyor being rigid when the conveyor is in an extended configuration; and
 - a drive system to engage the conveyor to move the conveyor relative to the frame between the stored configuration and the extended configuration.
2. The ATLS of claim 1, wherein the conveyor includes a plurality of slats, the slats configured to bend relative to each other when the conveyor is in the stored position.
3. The ATLS of claim 2, wherein the slats include a plurality of chain links positioned a lower surface of the slats, the drive system including at least one of a gear or sprocket to engage the chain links to move the conveyor between the extended position and the stored position.
4. The ATLS of claim 1, wherein the conveyor bends within the frame via the track when the conveyor is in the stored position.
5. The ATLS of claim 1, further including a sensor system coupled to the frame, the sensor system to scan a cargo area of a vehicle parked adjacent the ATLS.
6. The ATLS of claim 1, wherein the track has a spiral pattern.
7. An automated trailer loading system (ATLS) comprising:
 - a frame;
 - a track carried by the frame; and

a conveyor moveably coupled to the frame, the conveyor rollable between an extended configuration and a stored configuration, the conveyor to roll within the frame in at least one loop via the track when the conveyor is in the stored configuration.

8. The ATLS of claim 7, wherein a first portion of the conveyor is stored underneath a second portion of the conveyor in the stored configuration.

9. The ATLS of claim 7, wherein the frame includes a first side wall and a second side wall.

10. The ATLS of claim 9, wherein the first side wall and the second side wall include a plurality of first channels to define the track.

11. The ATLS of claim 7, wherein the track includes an opening adjacent a rear edge of the frame to allow the conveyor to enter or exit the frame.

12. The ATLS of claim 7, wherein the conveyor extends away from the frame into a vehicle in the extended configuration.

13. The ATLS of claim 7, wherein the conveyor includes track rollers, the track rollers to engage the track when the conveyor moves between the extended position and the stored position.

14. An automated trailer loading system (ATLS) comprising:

a housing;

a track positioned or carried by the housing; and

a conveyor moveably coupled to the housing, the conveyor rollable within a cavity of the housing via the track when the conveyor is in a stored position.

15. The ATLS of claim 14, wherein the conveyor includes a plurality of slats defining a conveyor belt.

16. The ATLS of claim 15, wherein the slats each include a plank having a first side defining an upper surface and a second side opposite the first side defining a channel.

17. The ATLS of claim 16, wherein the plank includes a cover coupled to the upper surface of the plank.

18. The ATLS of claim 16, wherein the plank includes a first roller extending from the upper surface of the plank.

19. The ATLS of claim 18, wherein the plank includes a second roller extending from the lower surface of the plank.

20. The ATLS of claim 16, further including track rollers coupled to lateral edges of the plank, the track rollers to engage the track to guide the conveyor when the conveyor moves between the stored position and an extended position.

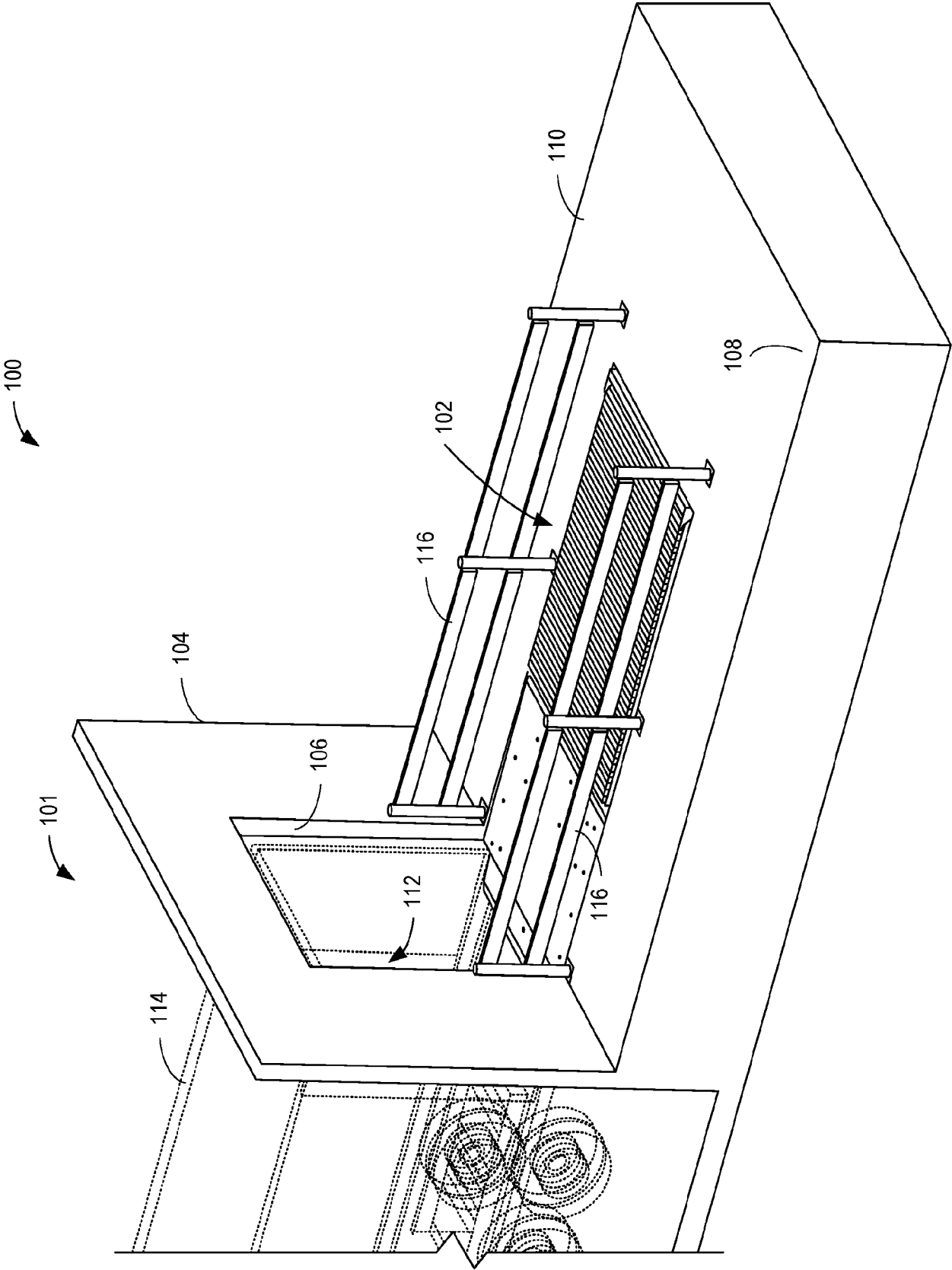


FIG. 1

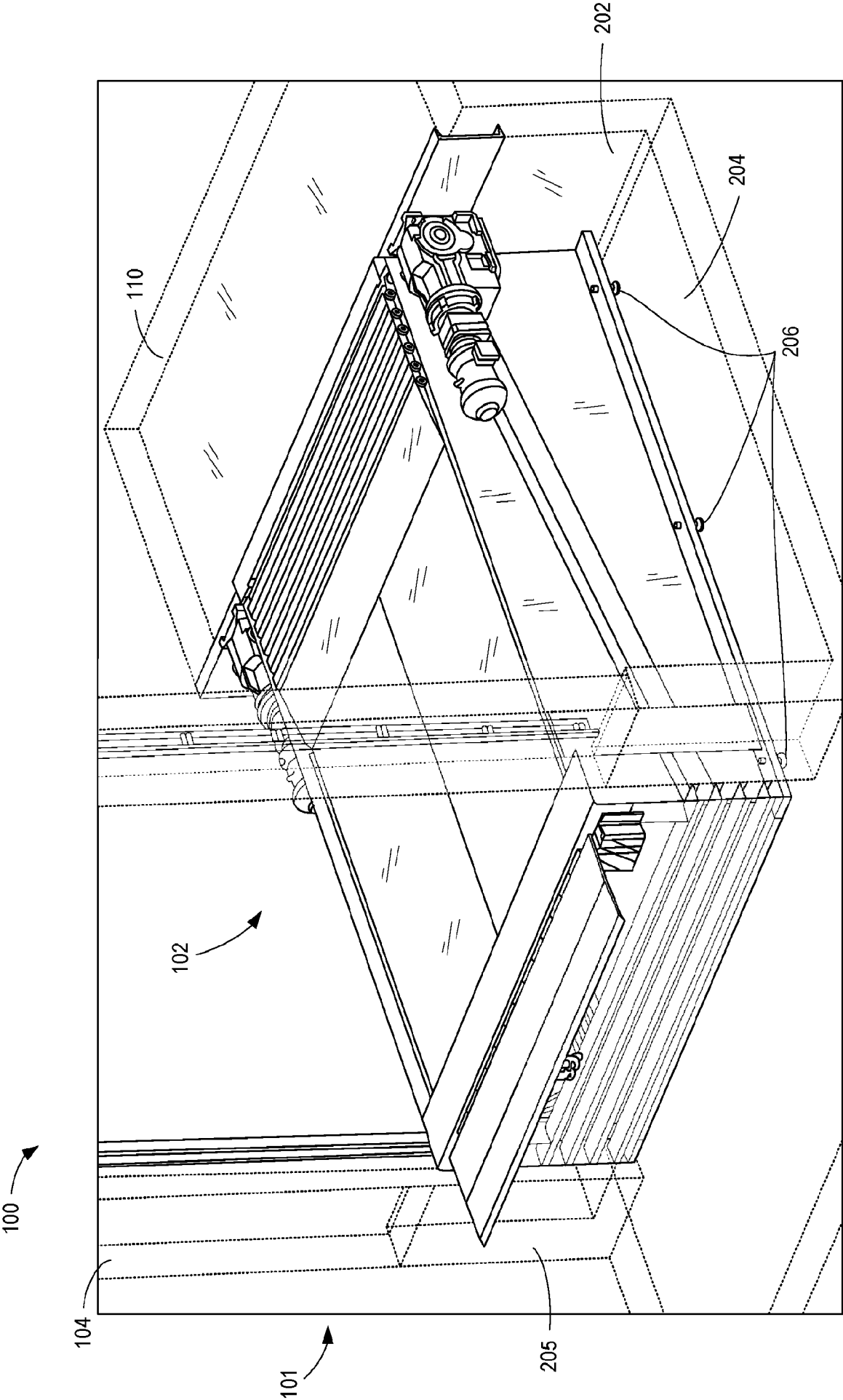


FIG. 2

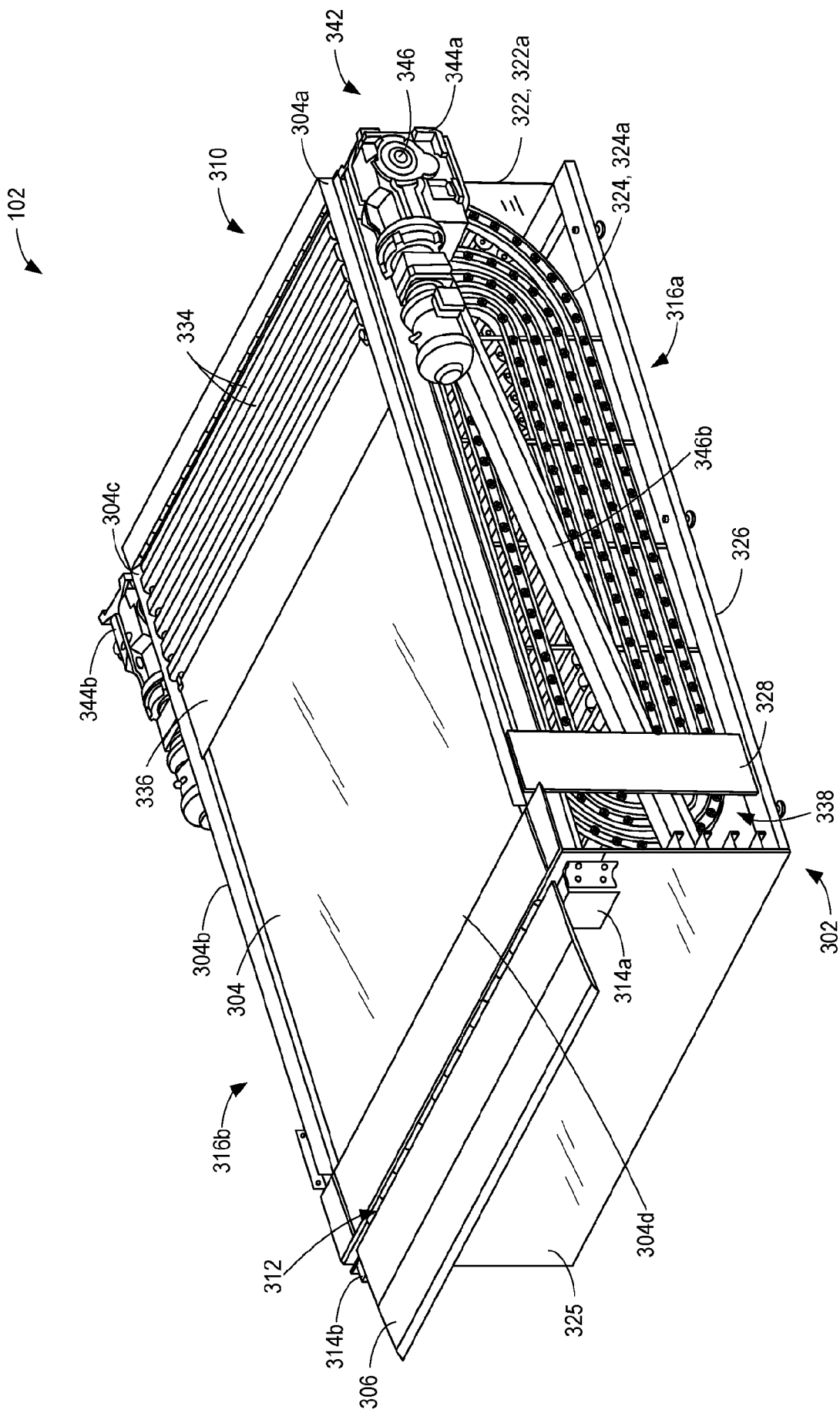


FIG. 3A

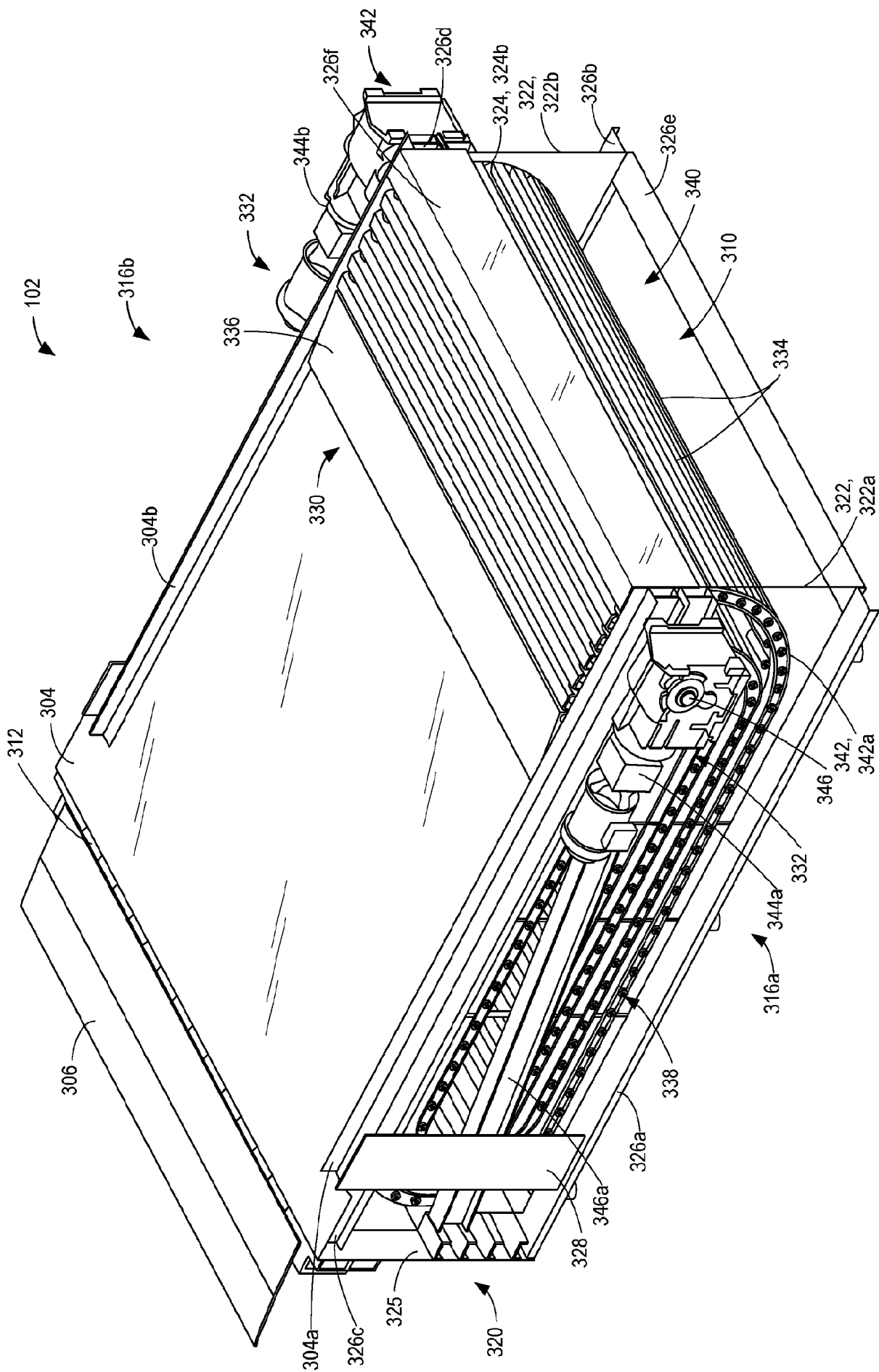


FIG. 3B

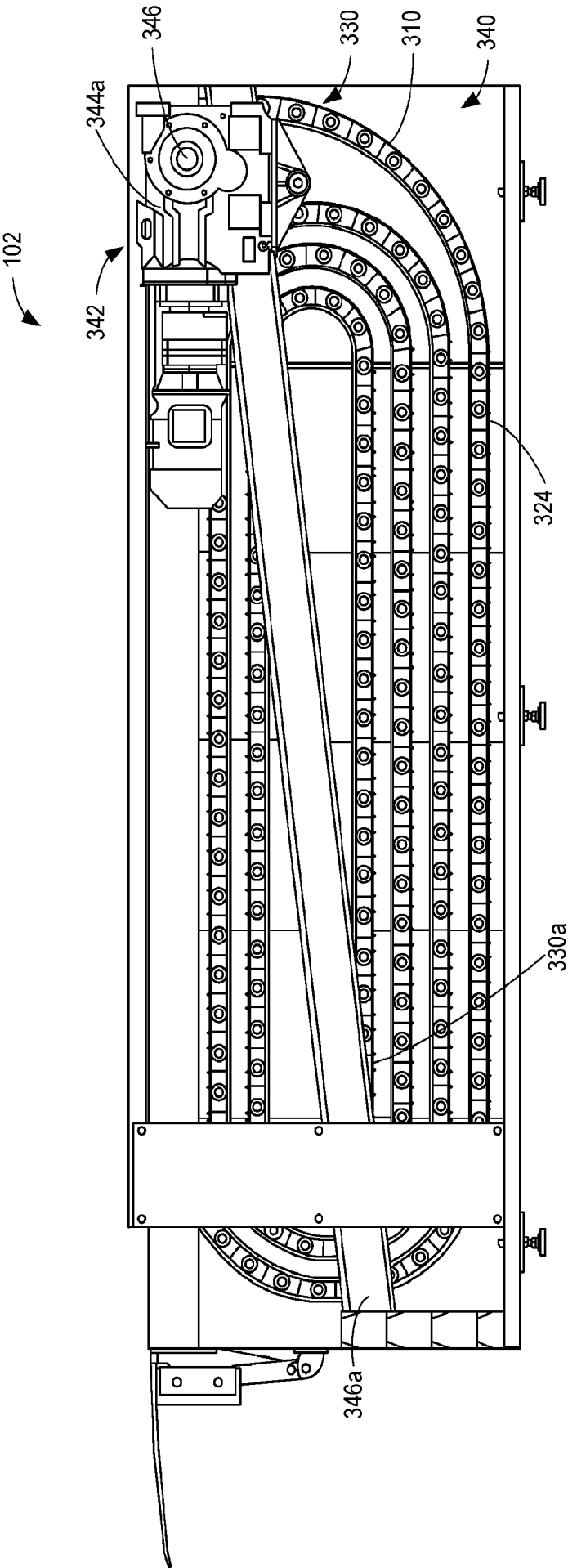


FIG. 3C

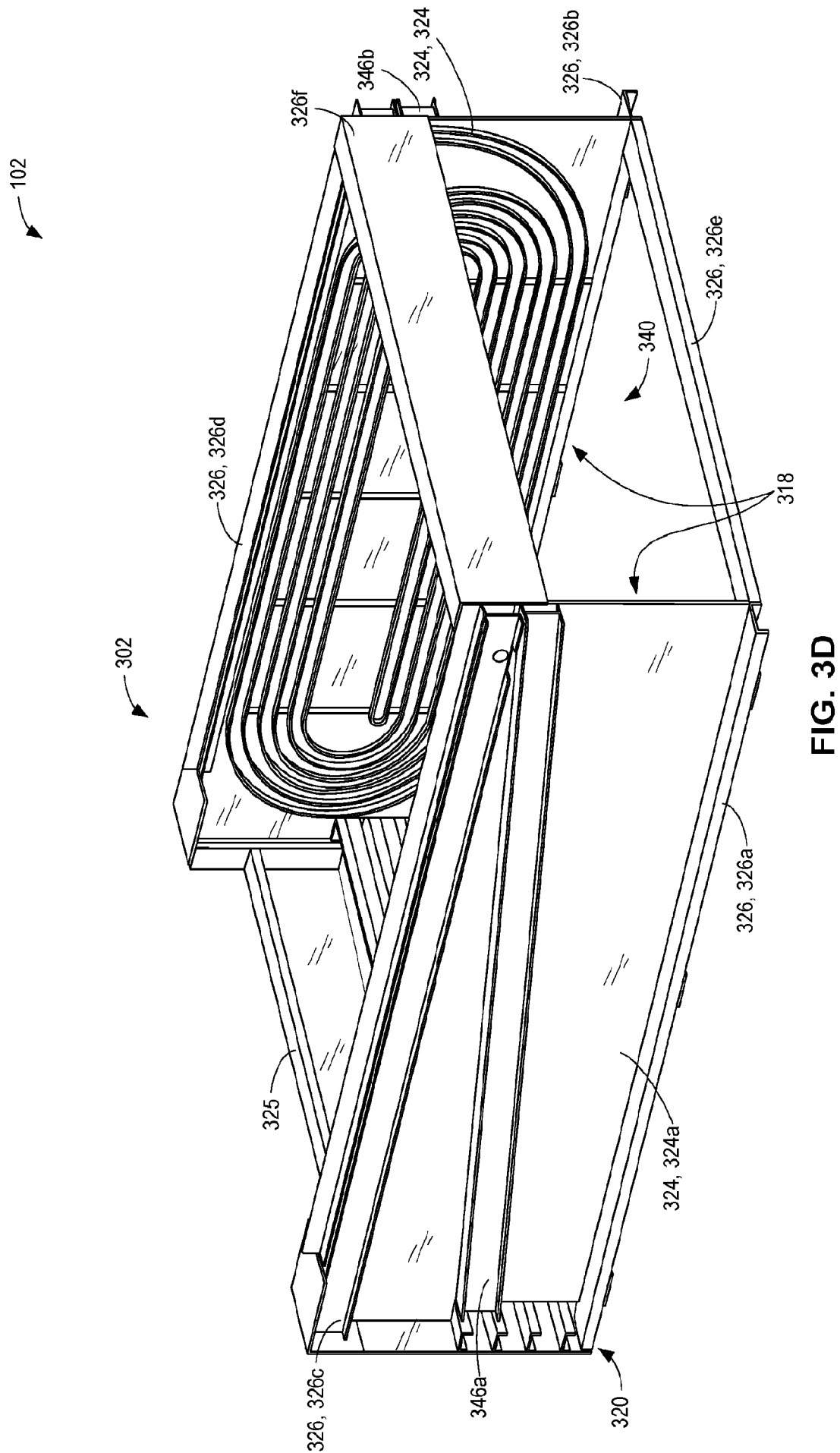


FIG. 3D

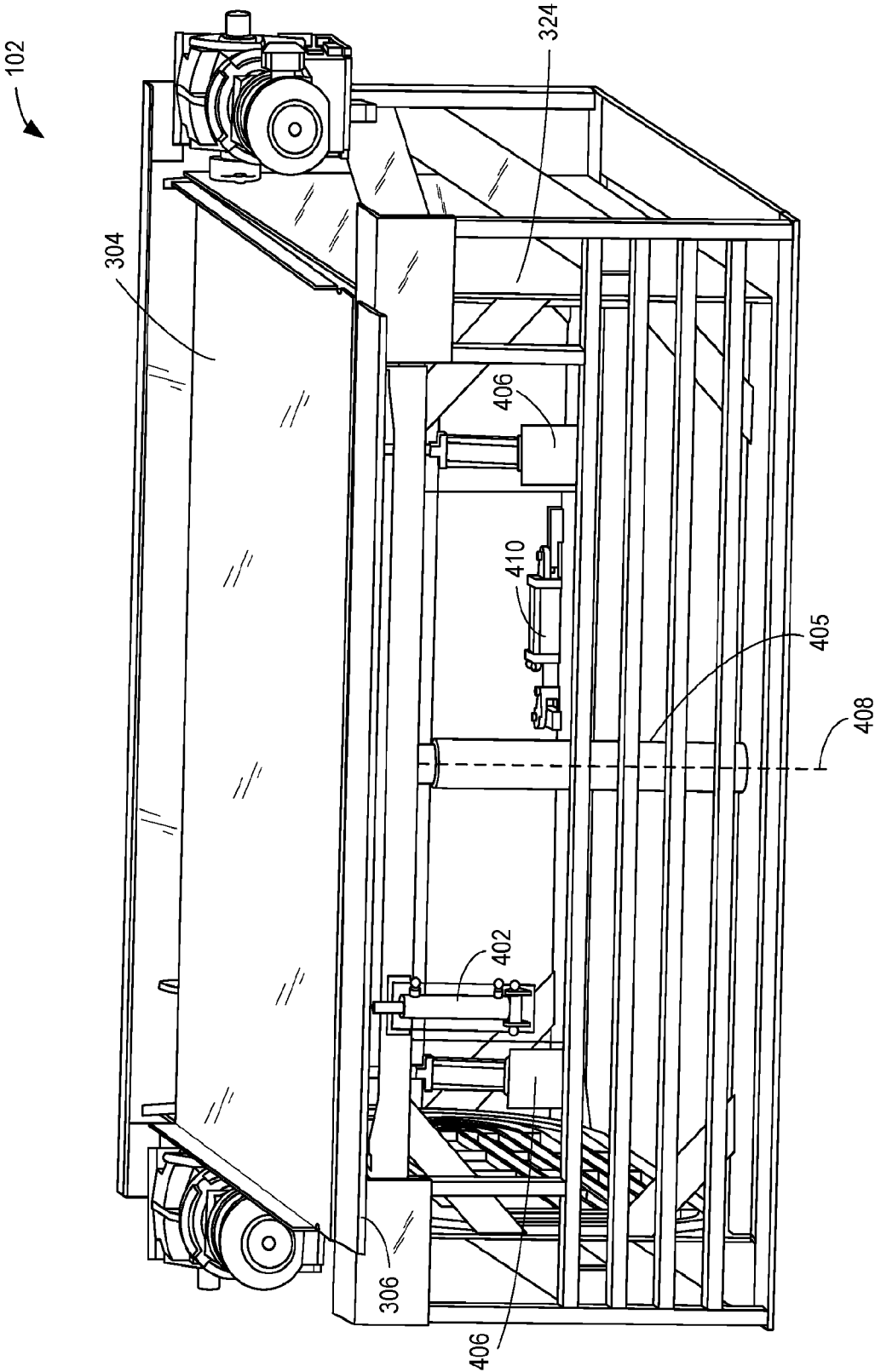


FIG. 4A

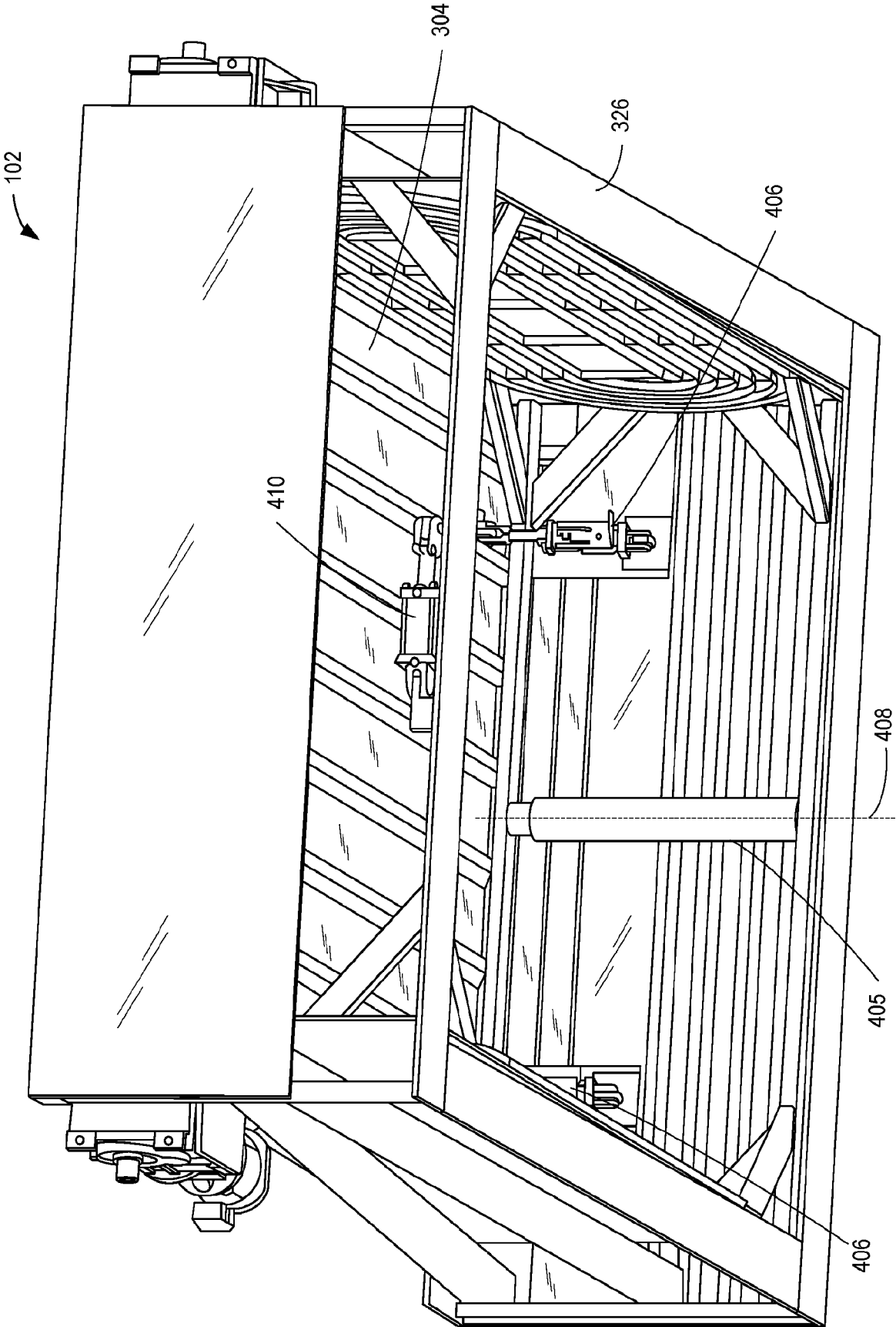


FIG. 4B

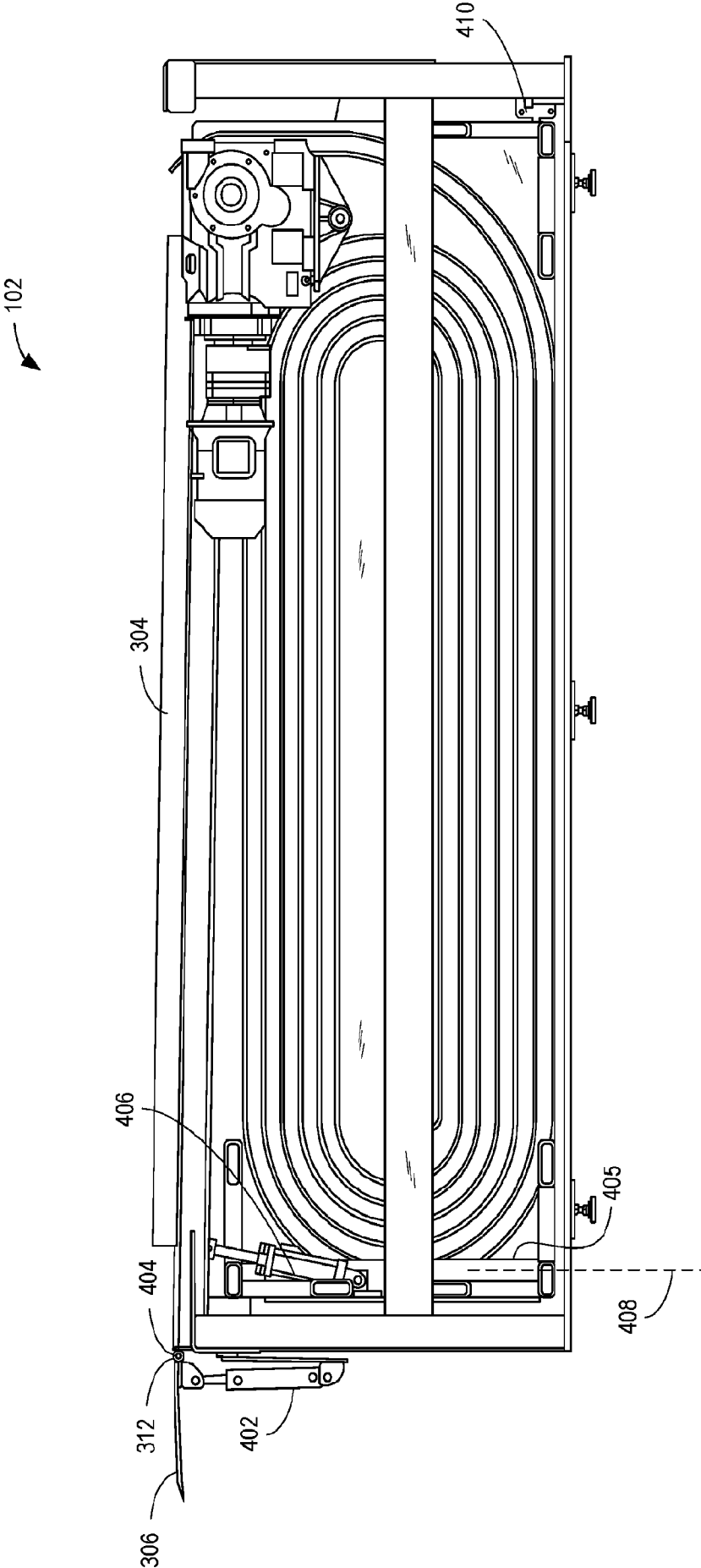


FIG. 4C

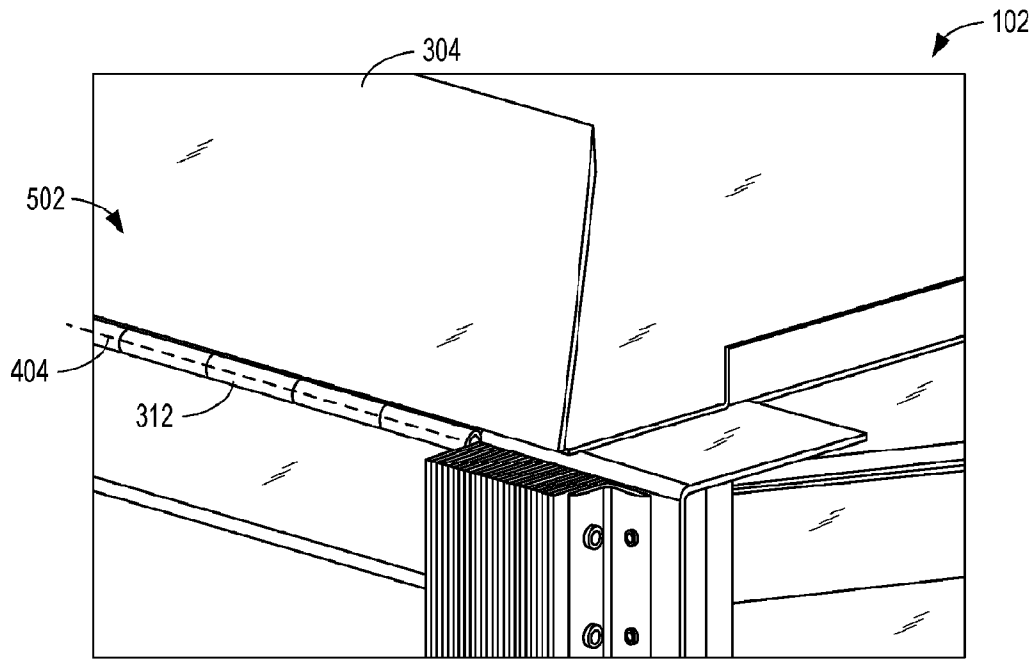


FIG. 5

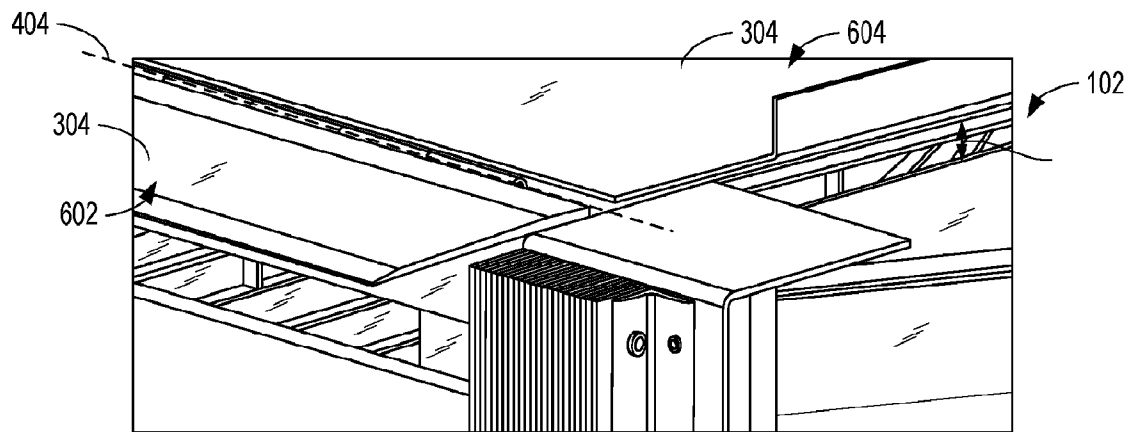


FIG. 6A

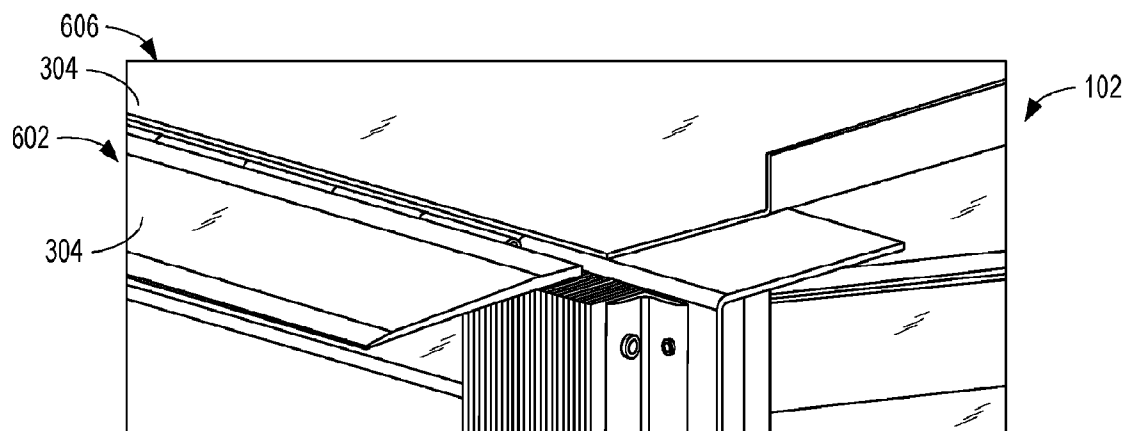


FIG. 6B

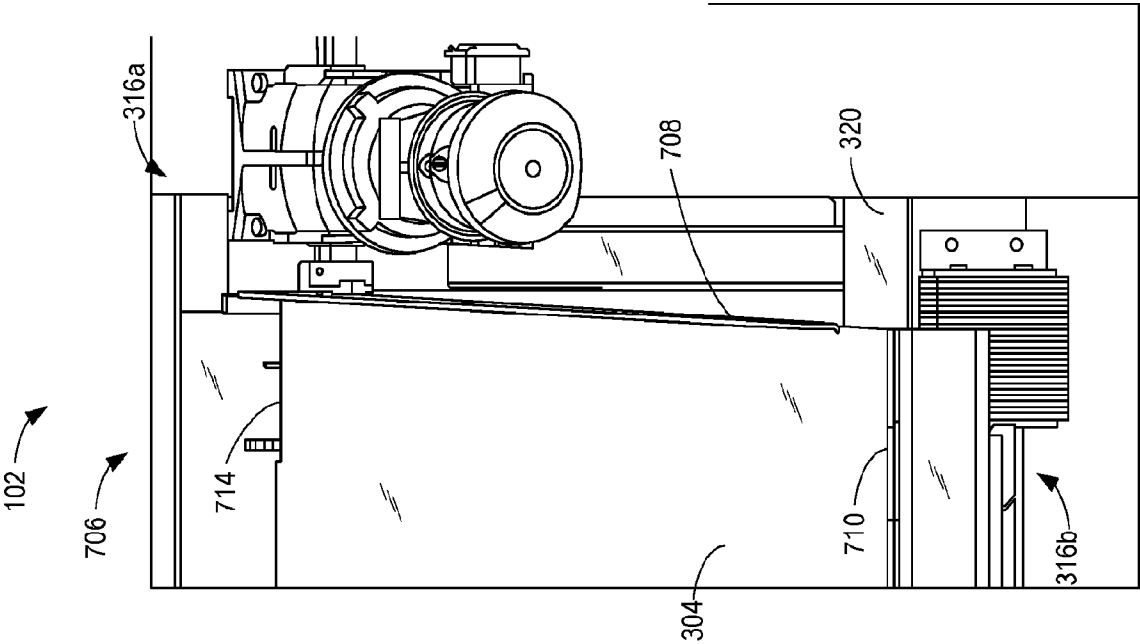


FIG. 7C

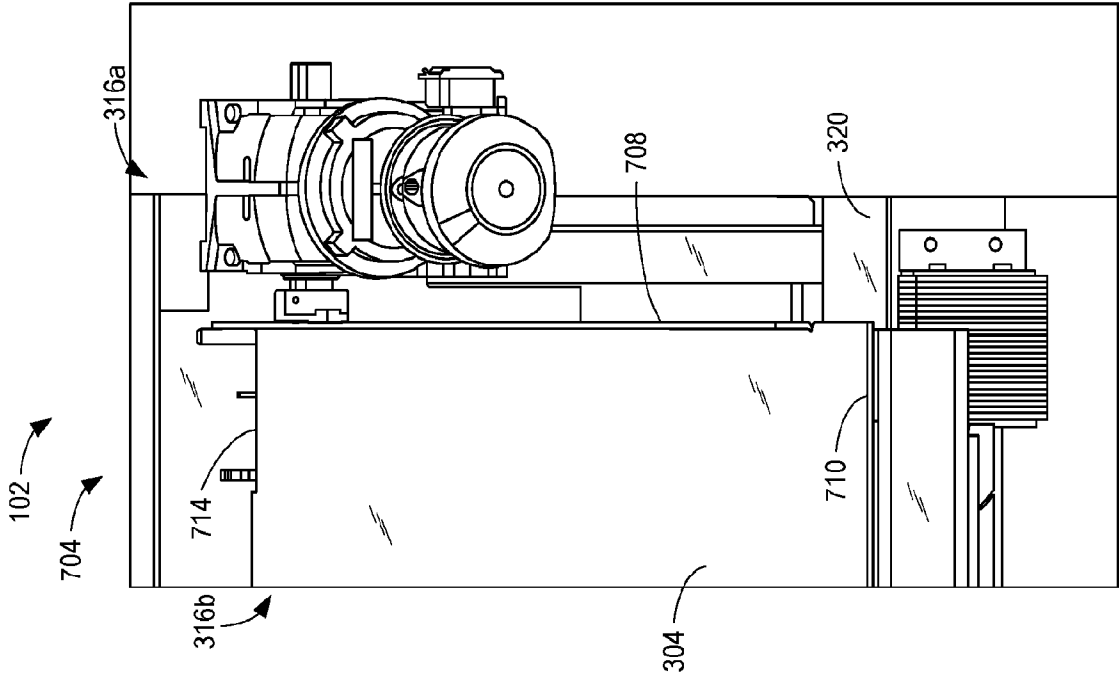


FIG. 7B

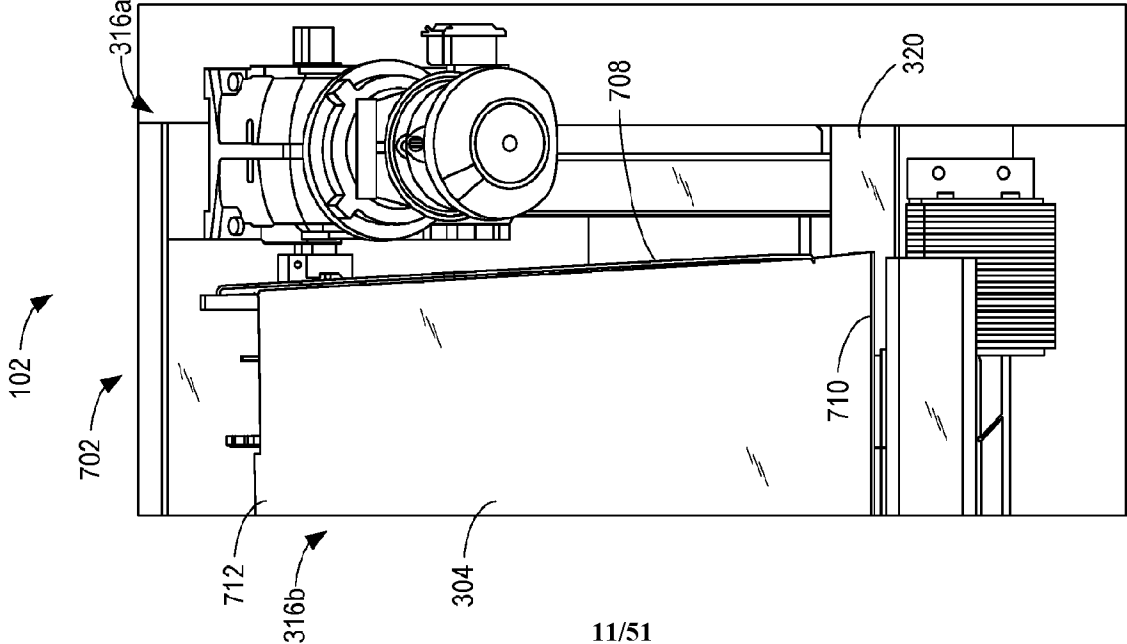


FIG. 7A

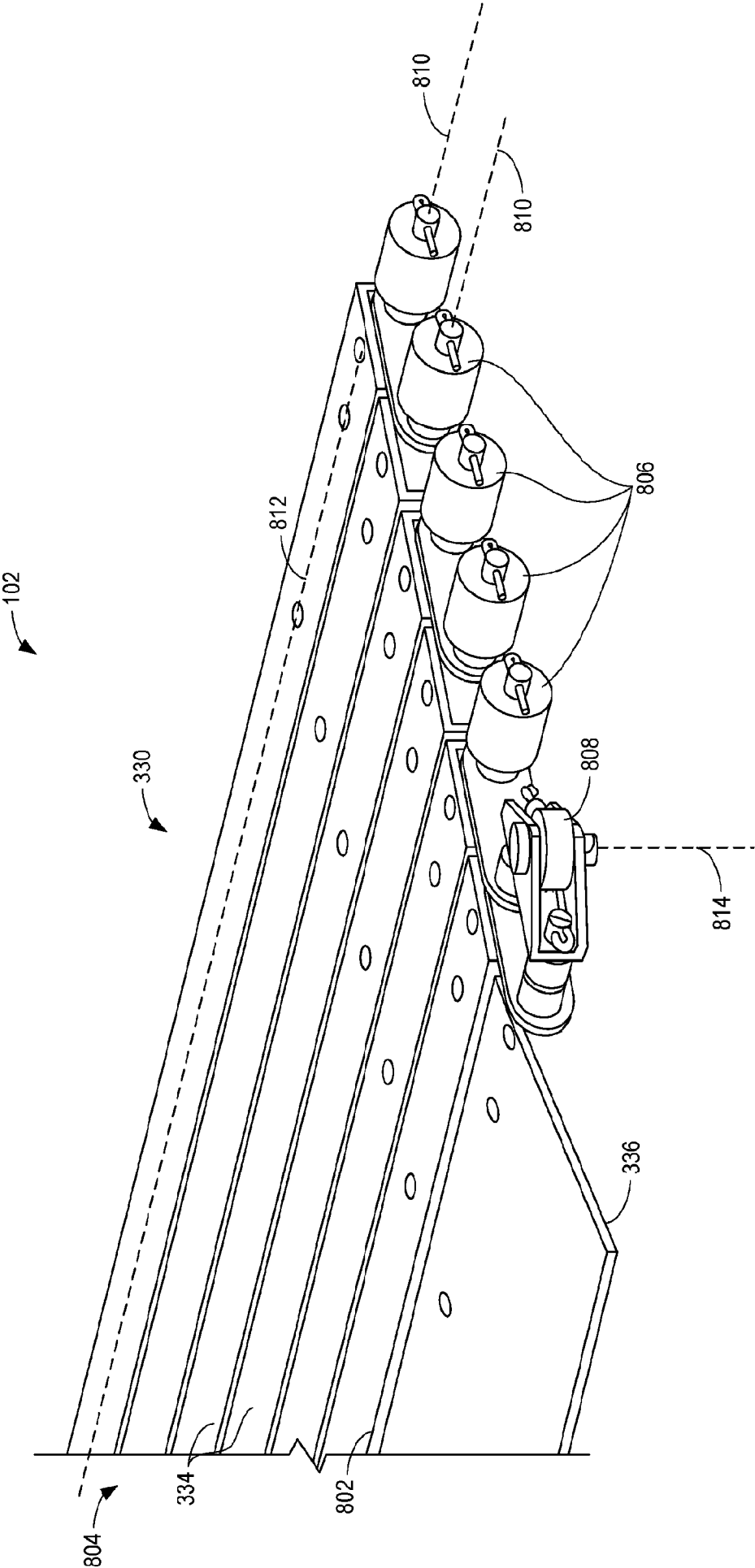


FIG. 8

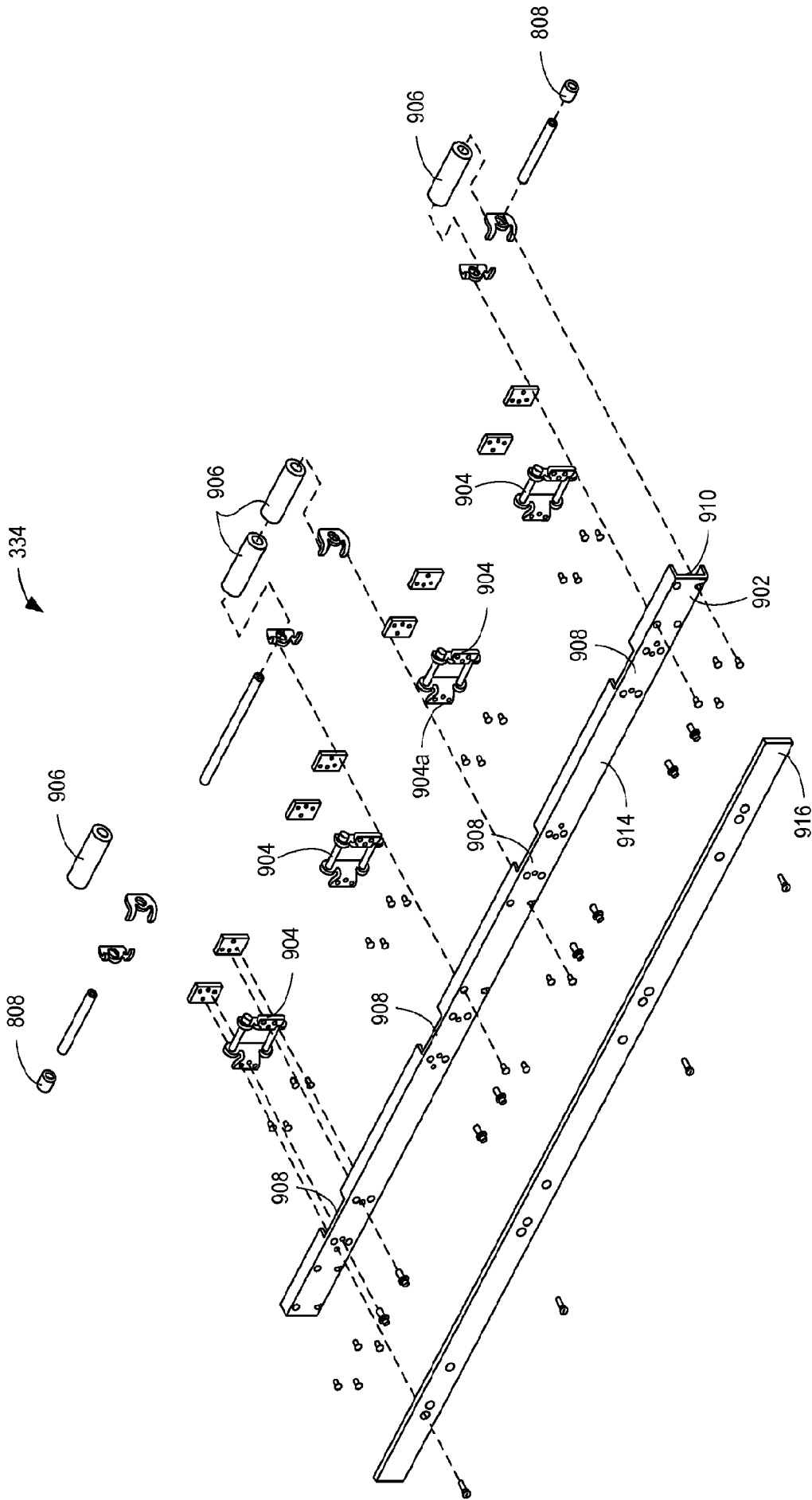


FIG. 9A

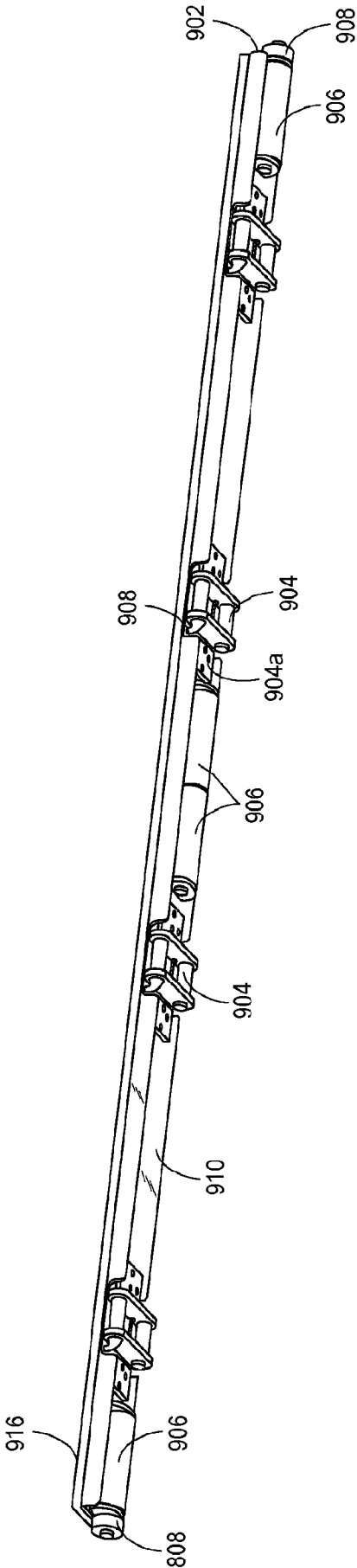
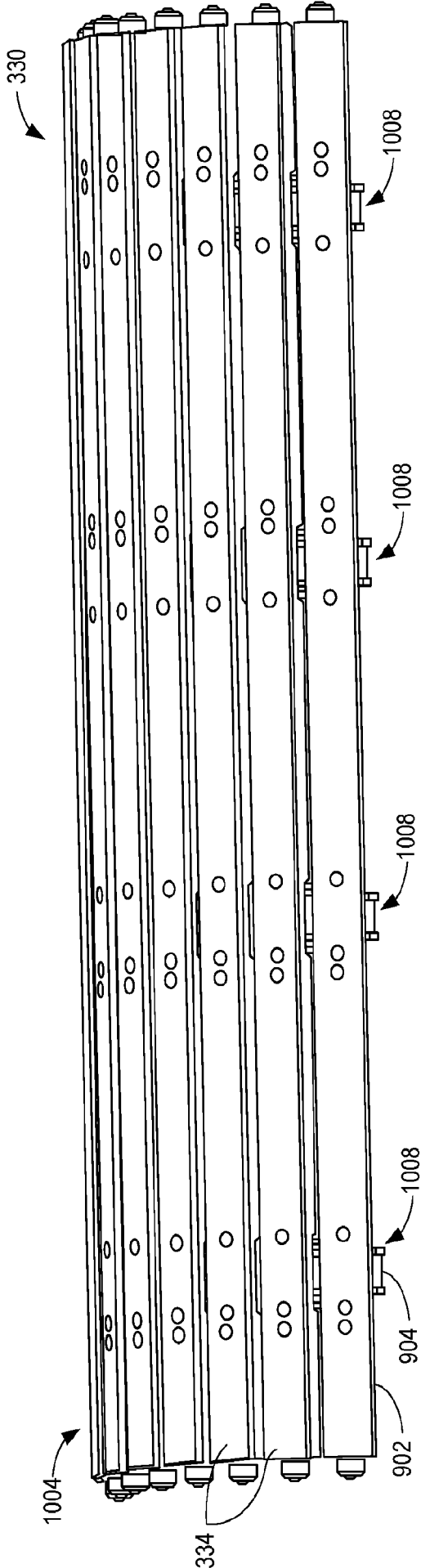
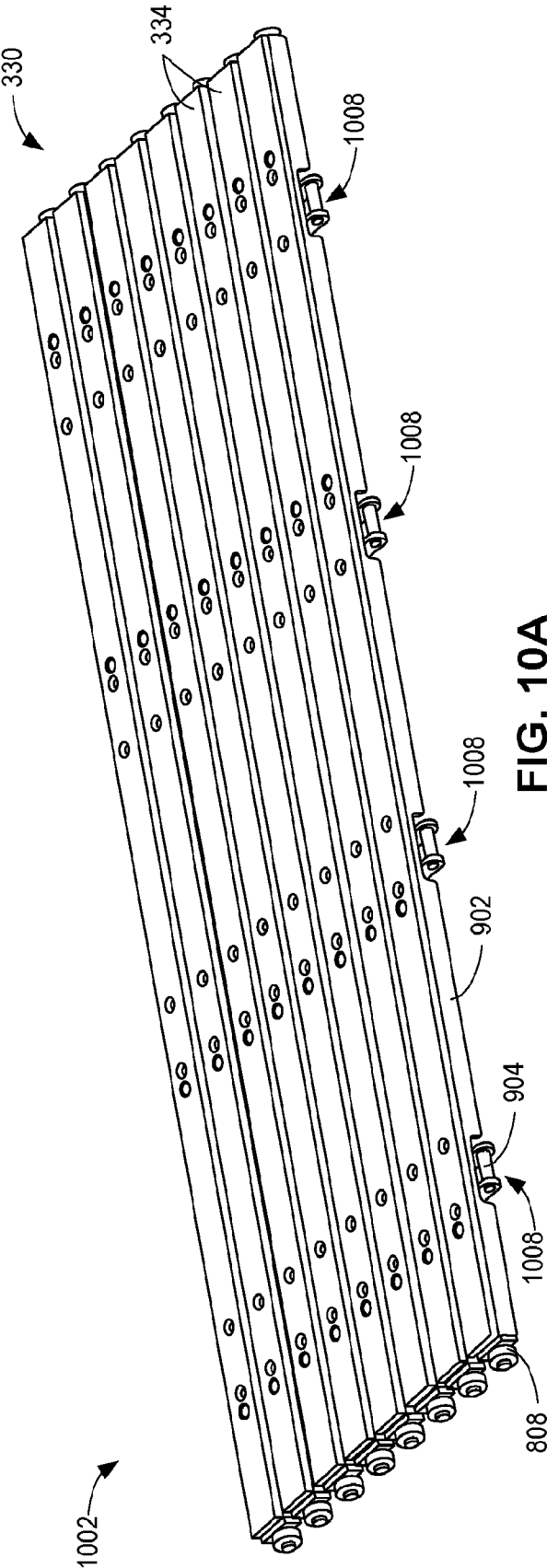


FIG. 9B



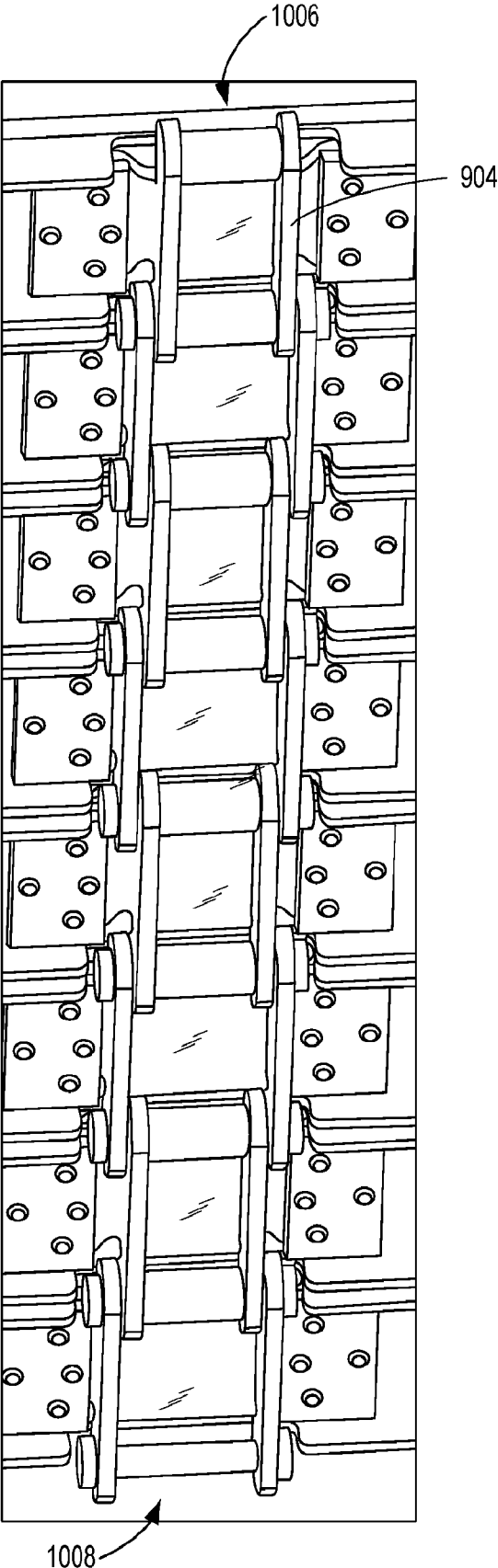


FIG. 10C

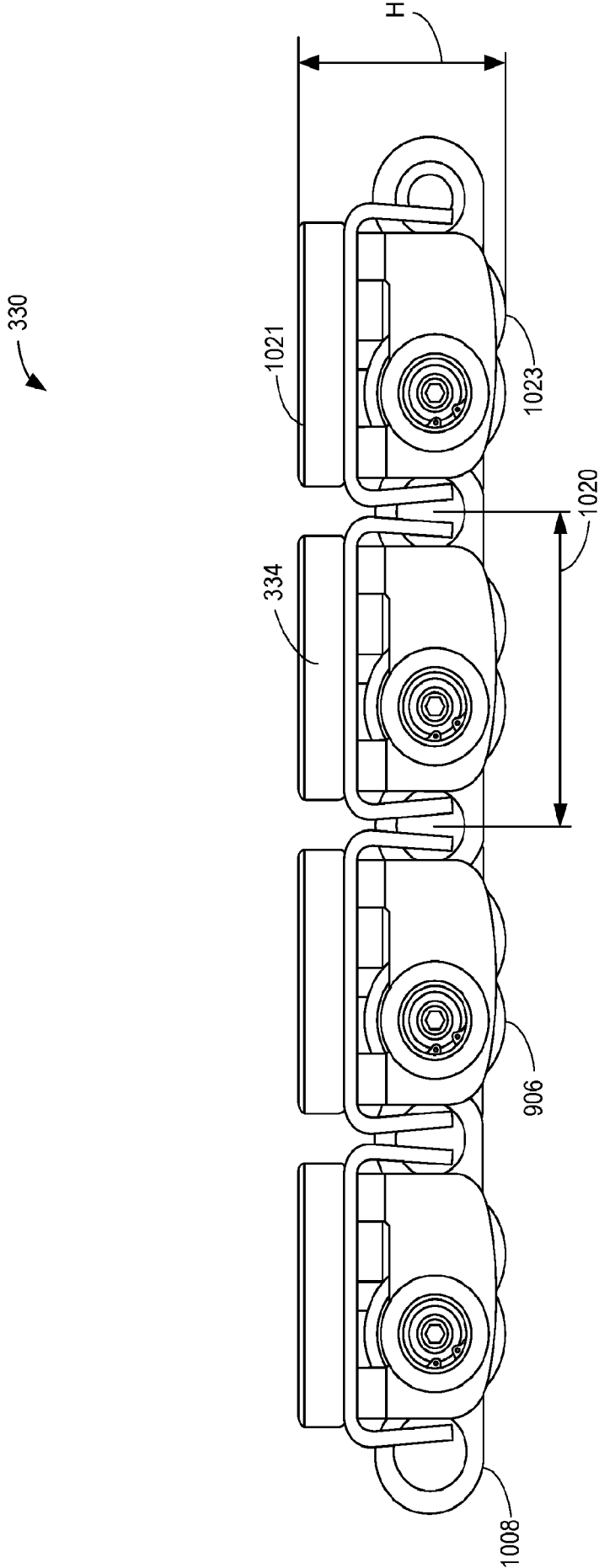


FIG. 10D

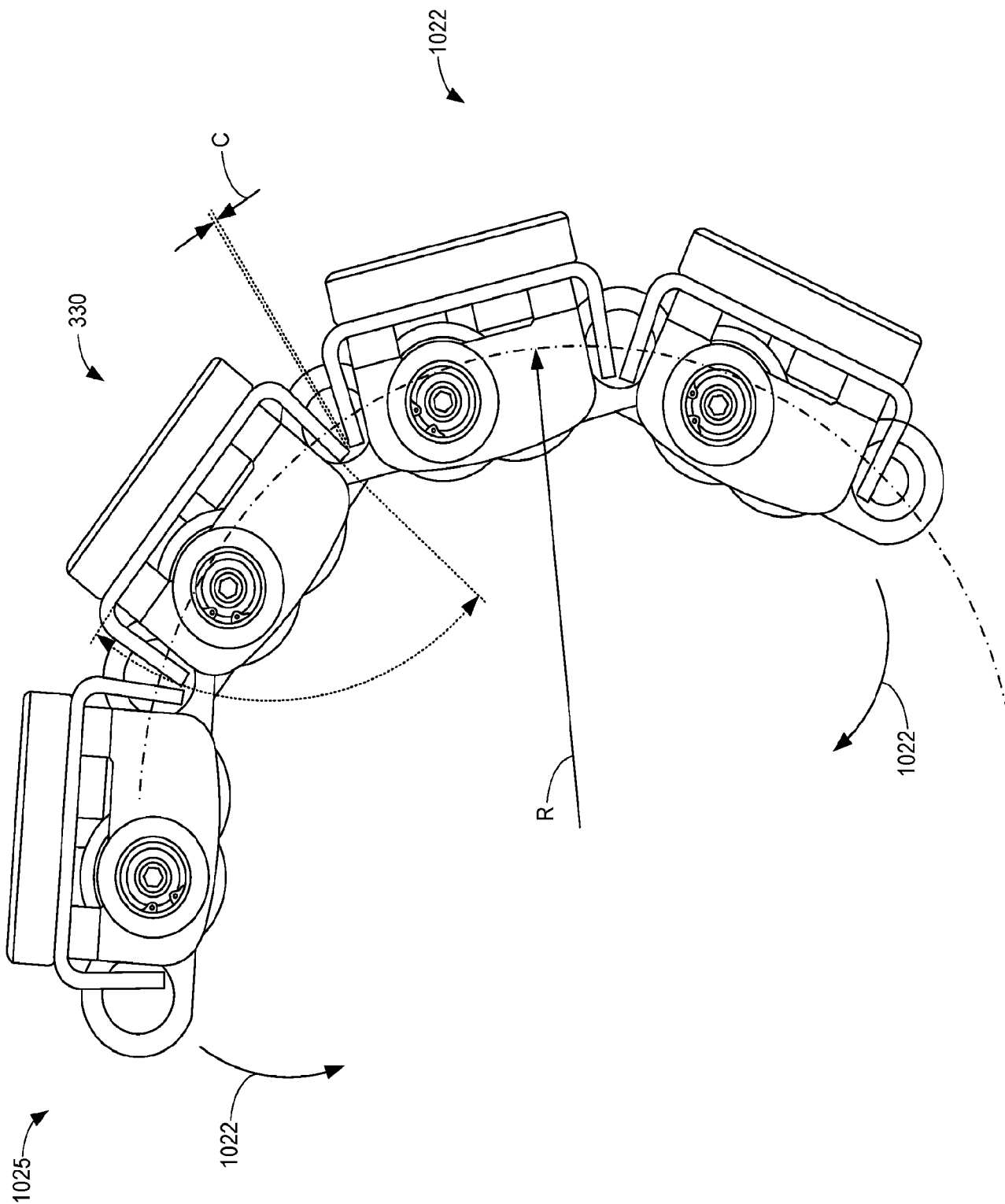


FIG. 10E

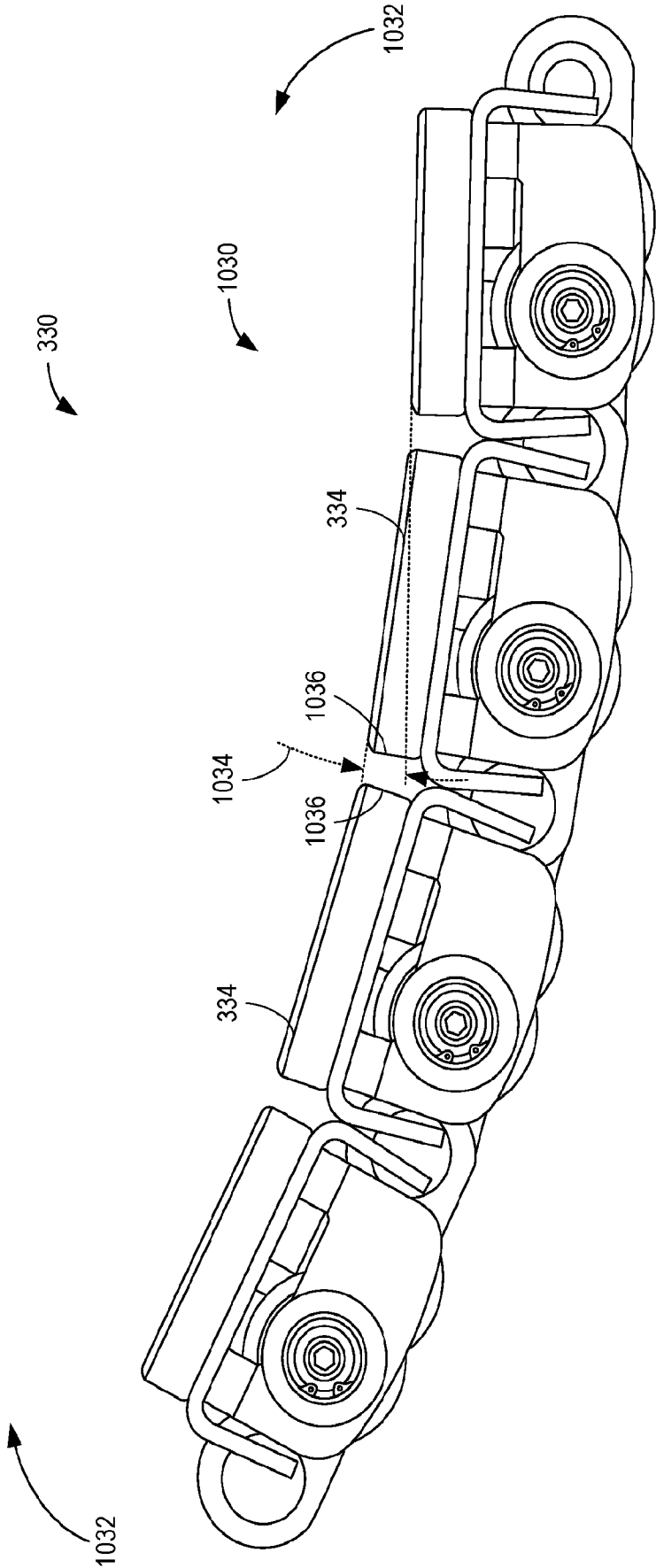


FIG. 10F

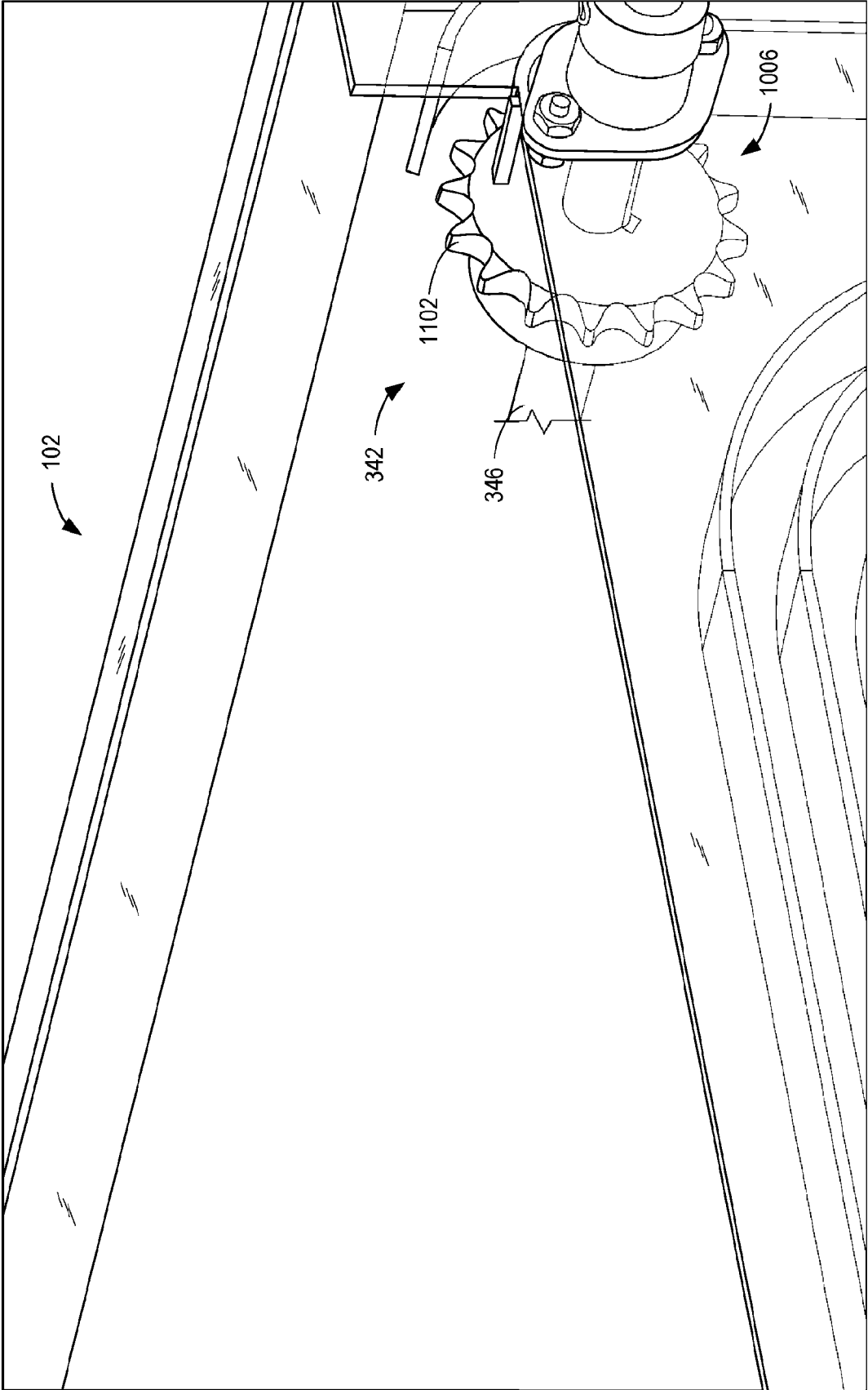
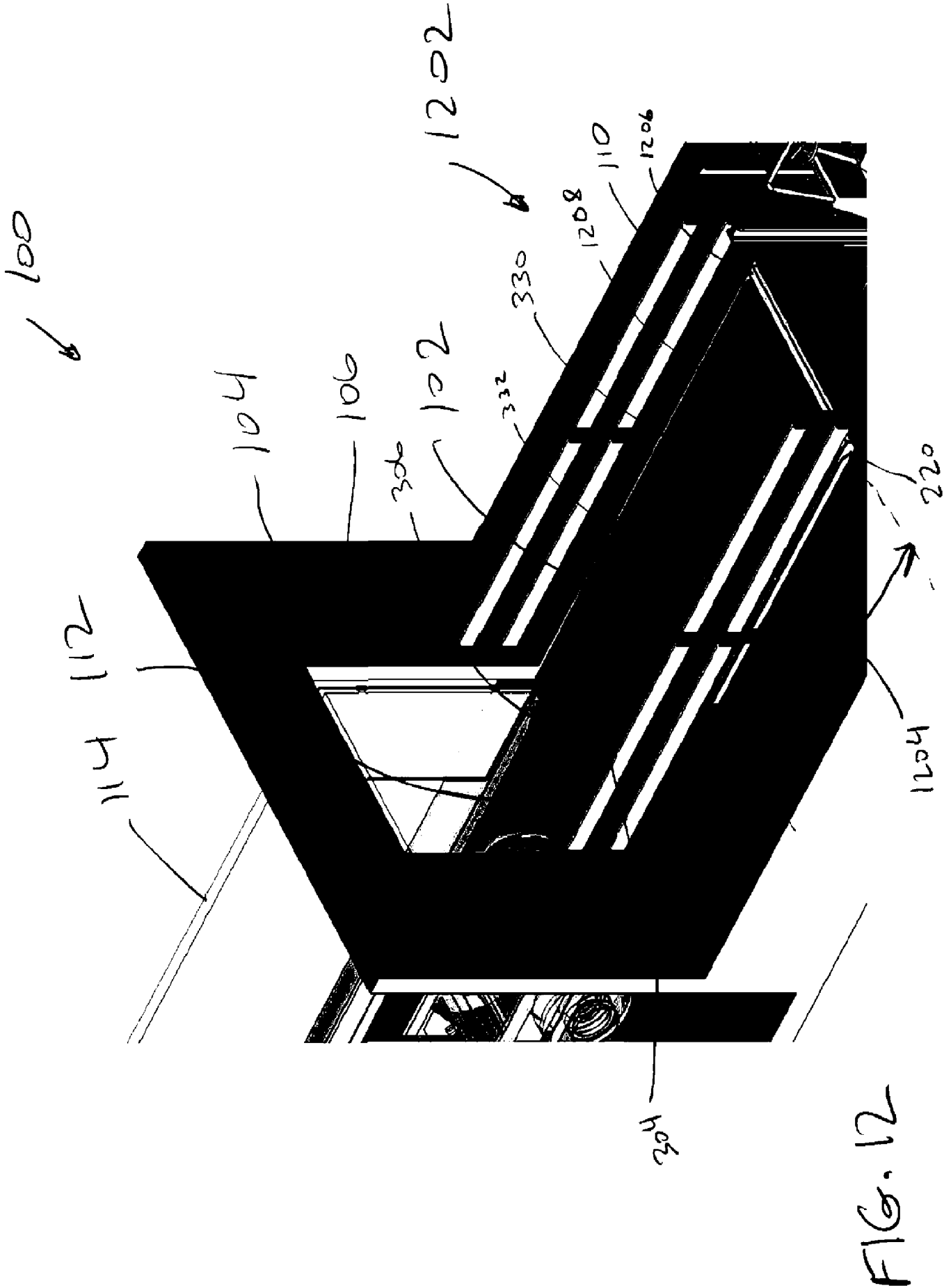


FIG. 11



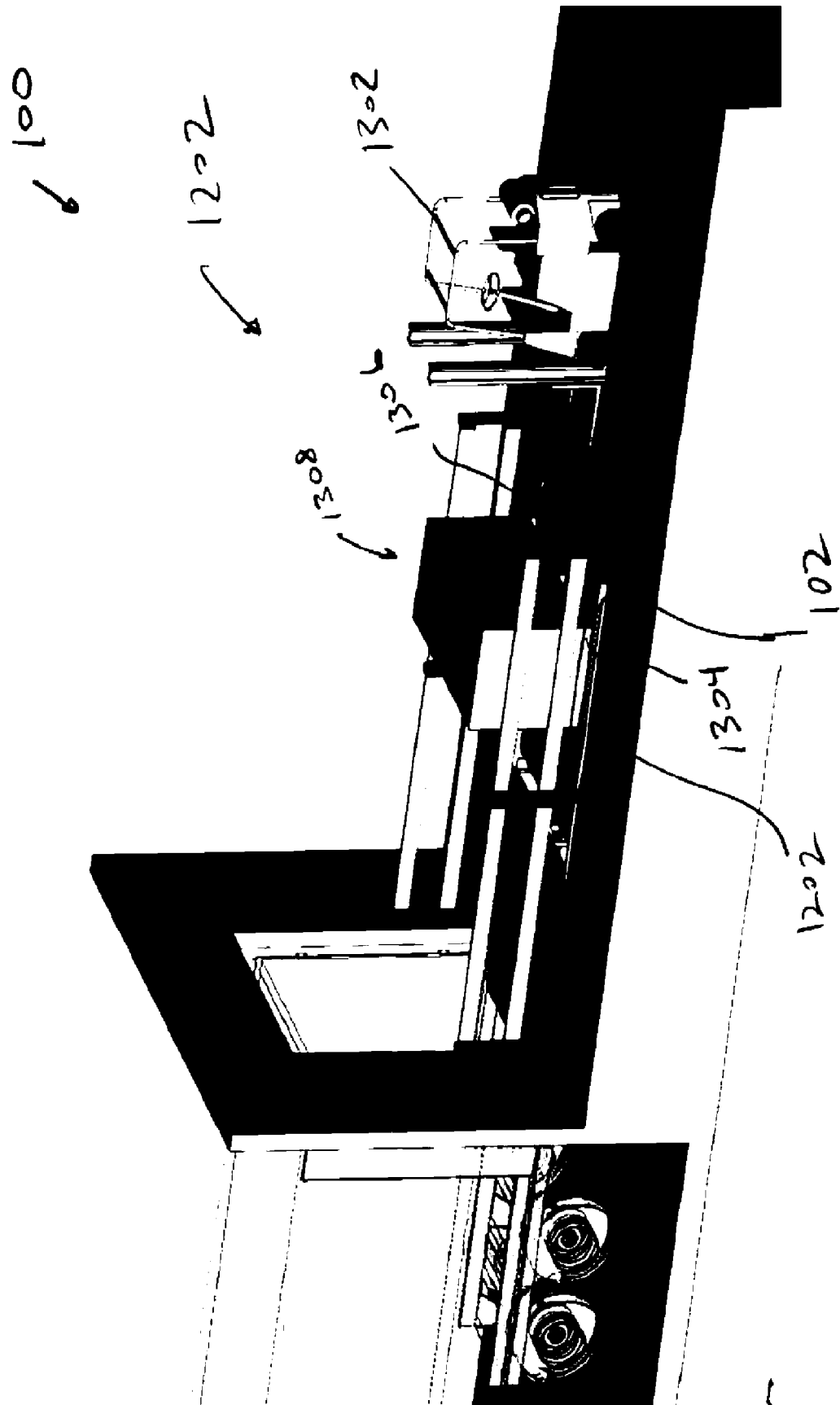


FIG. 13

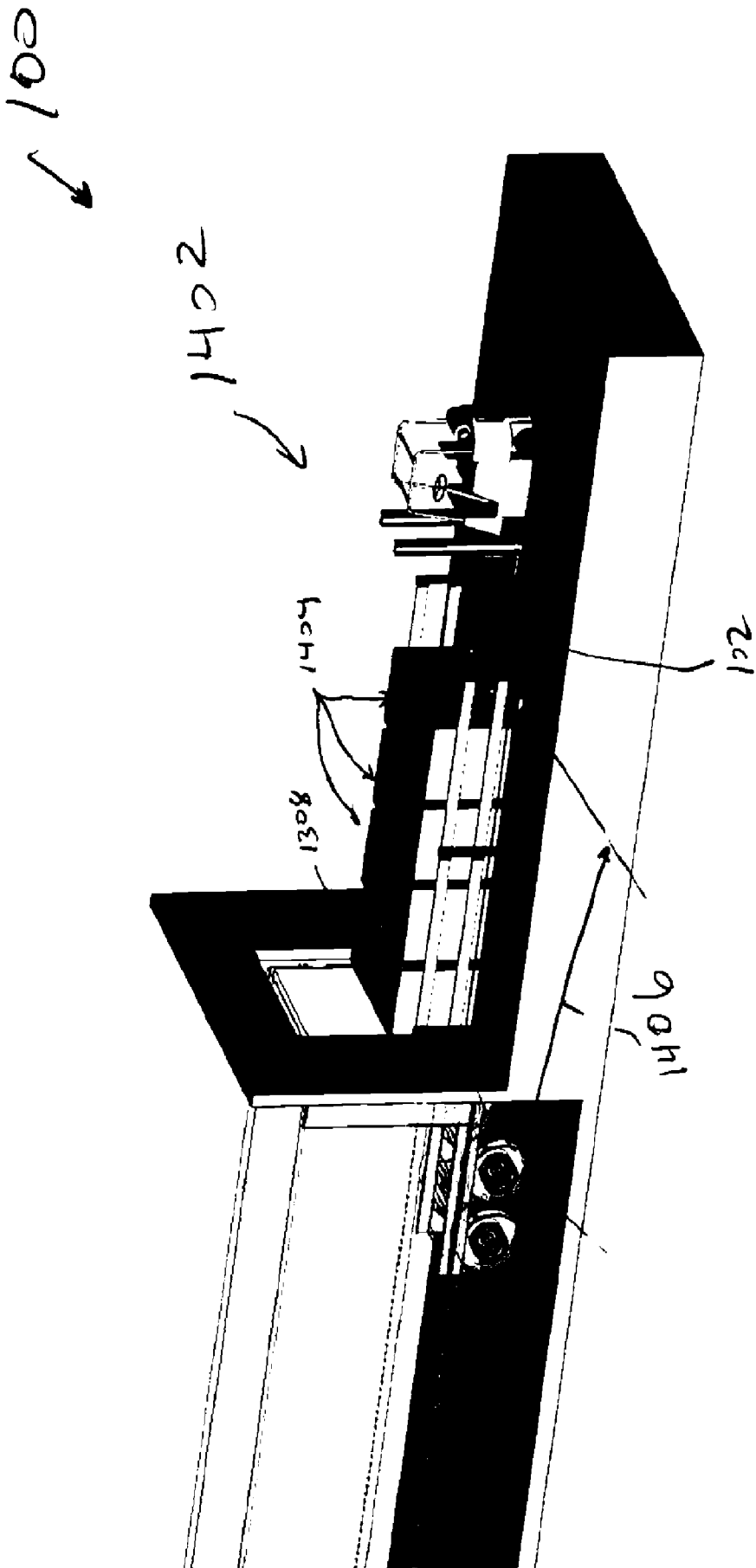


FIG. 14

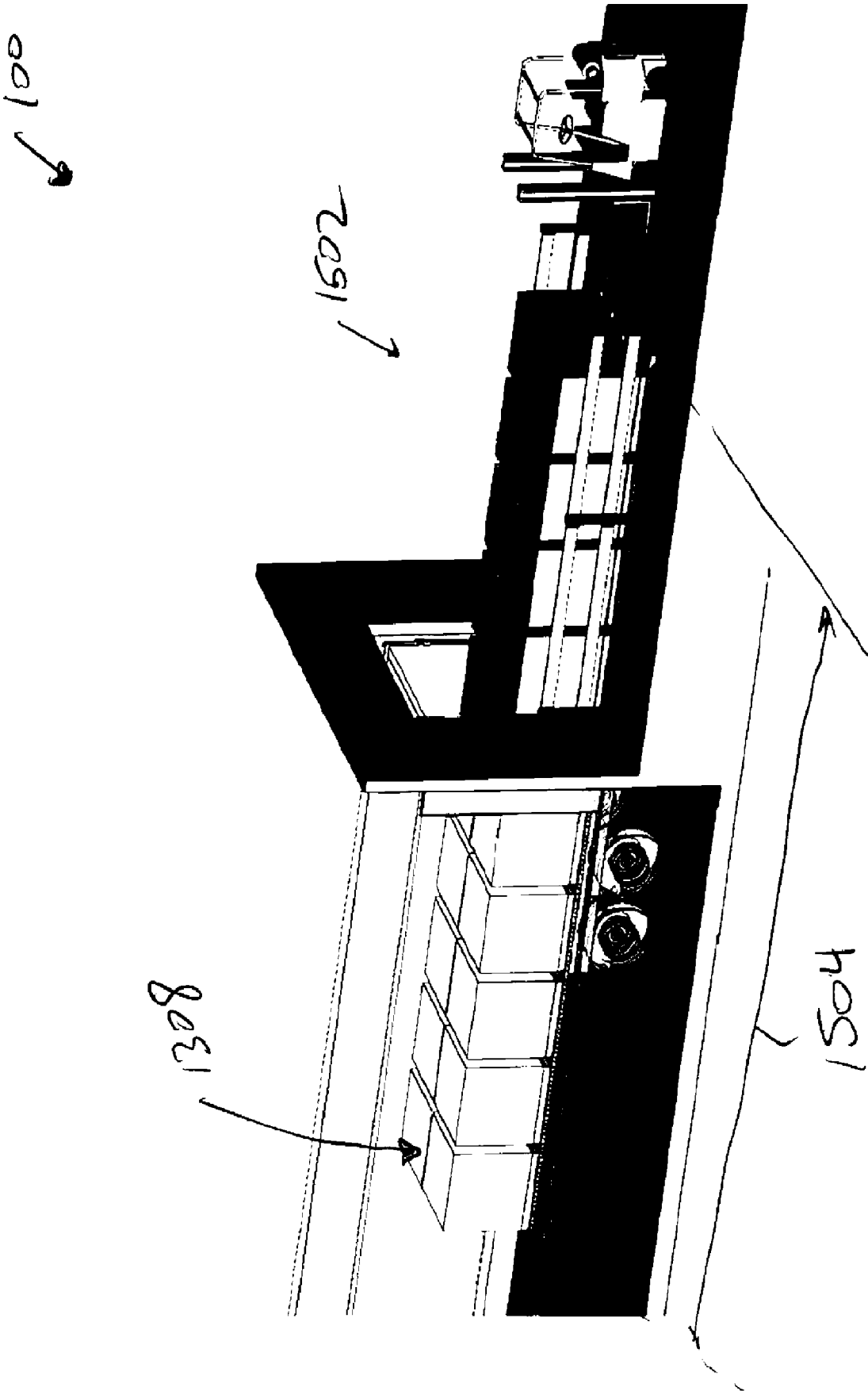


FIG. 15

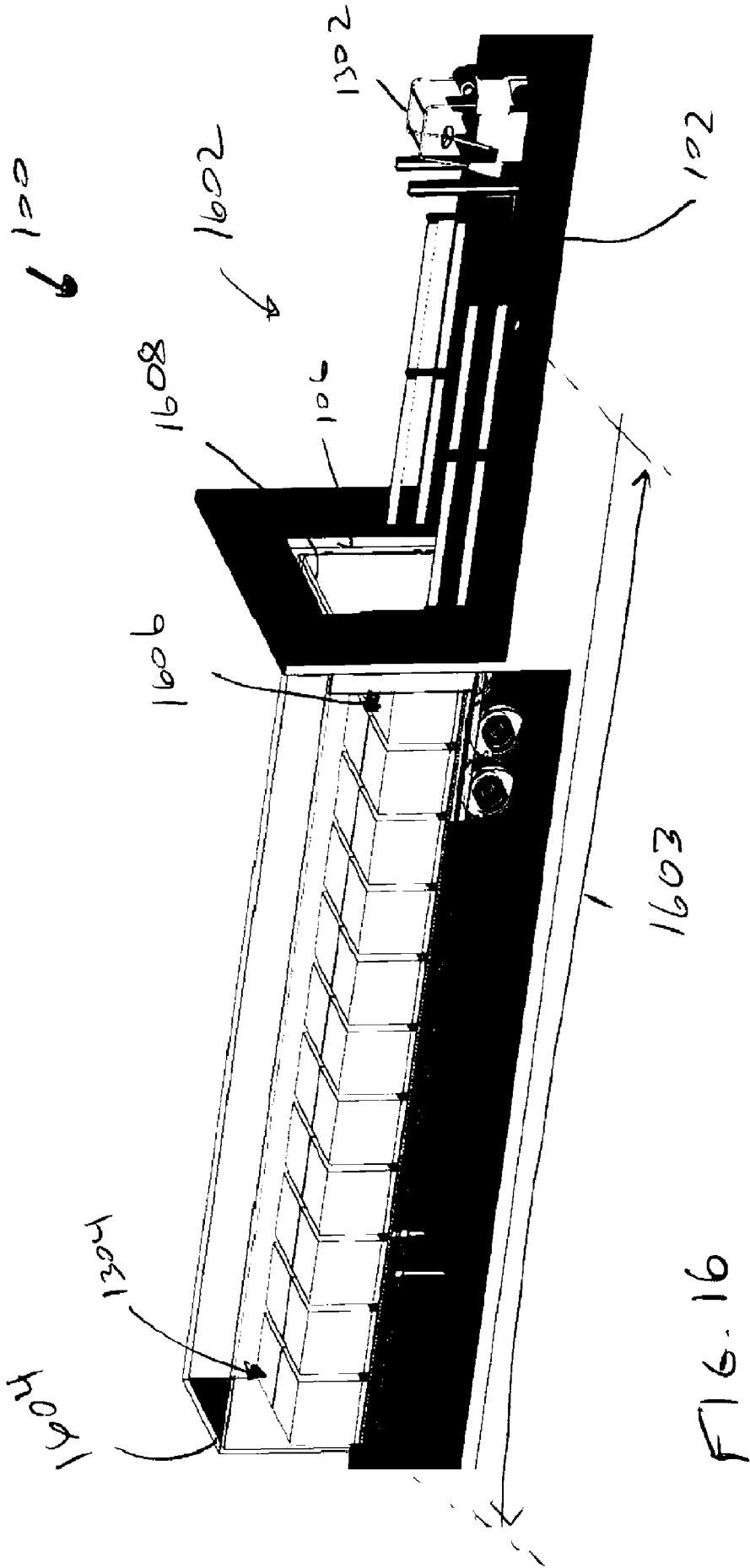
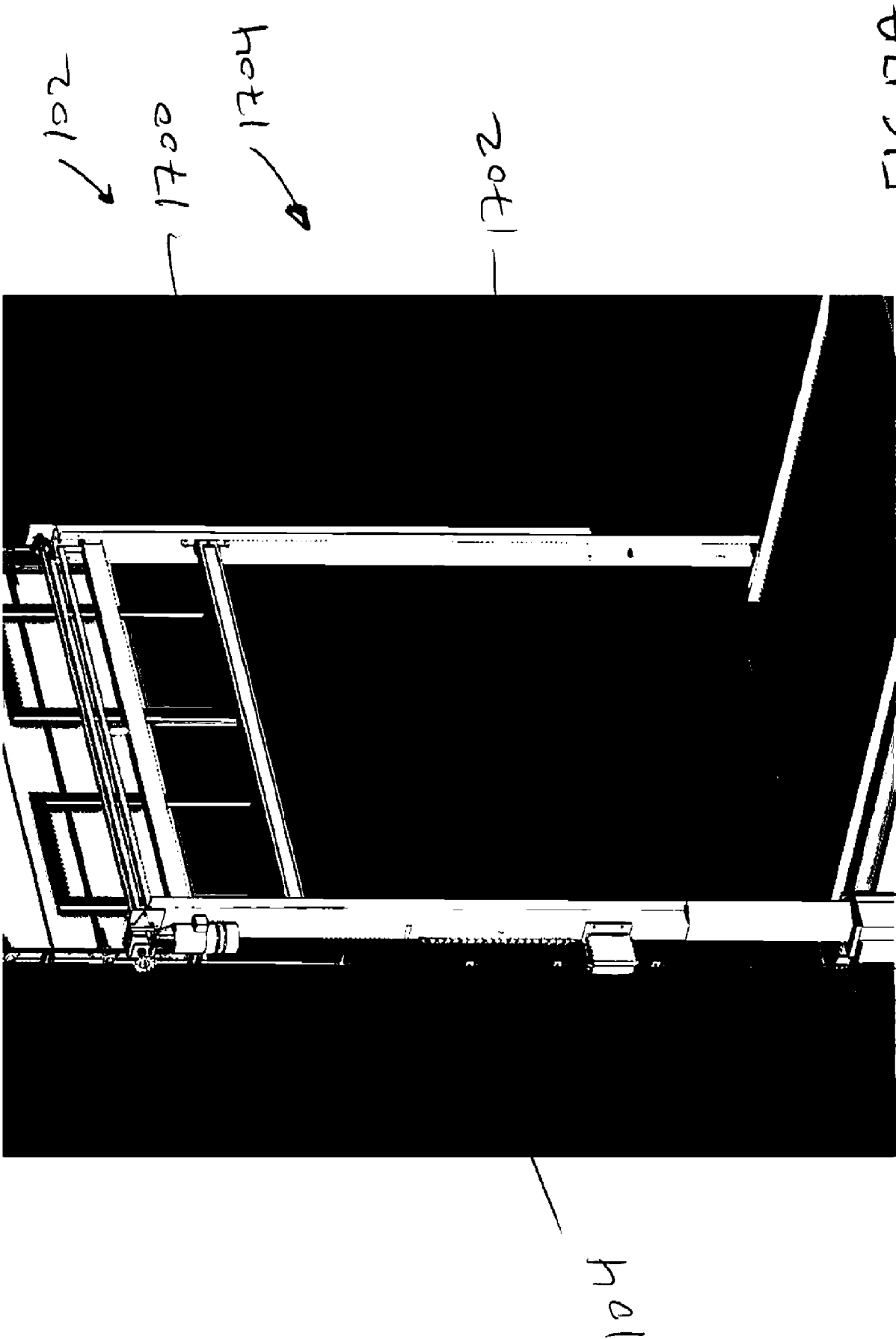
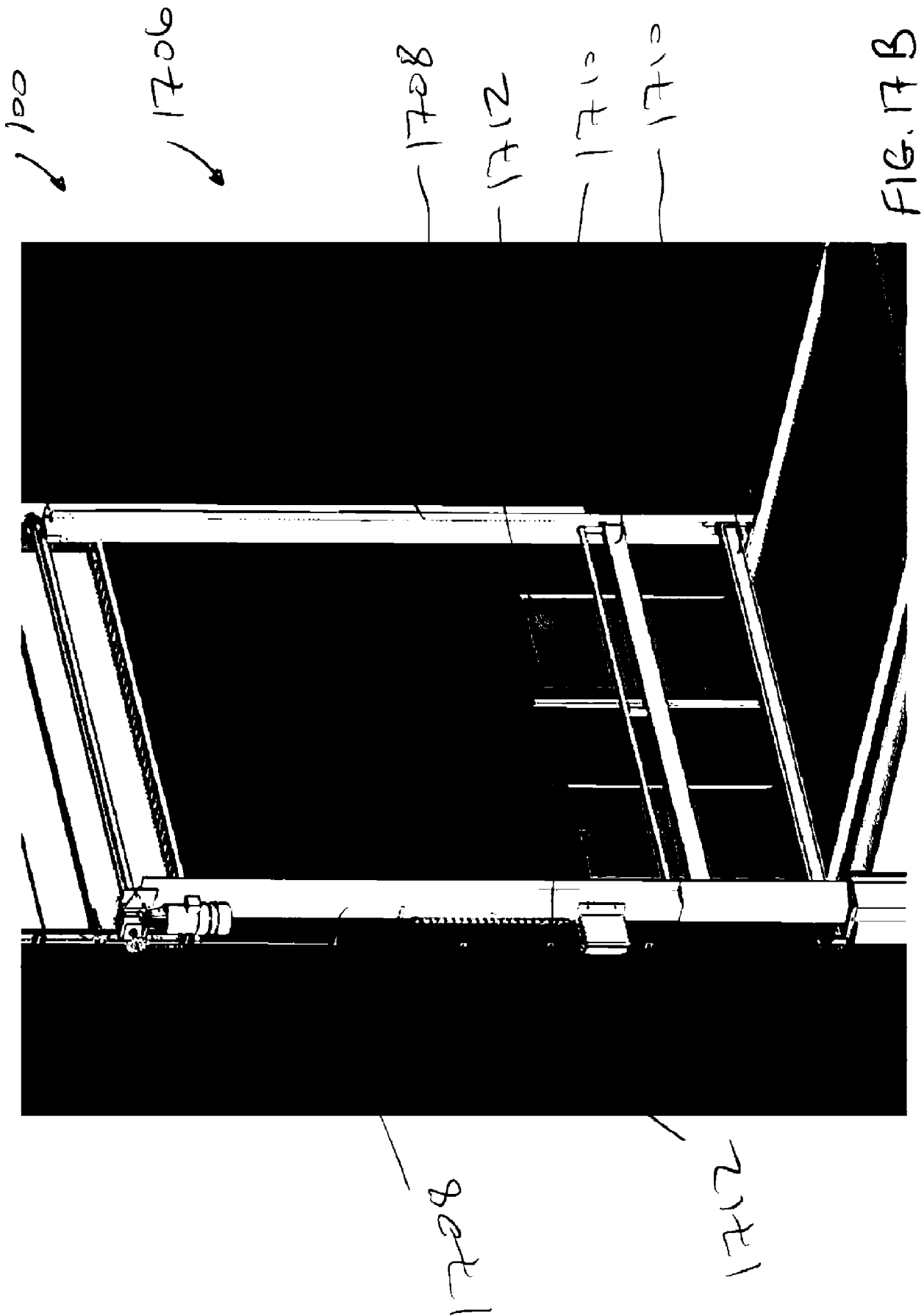


FIG. 16





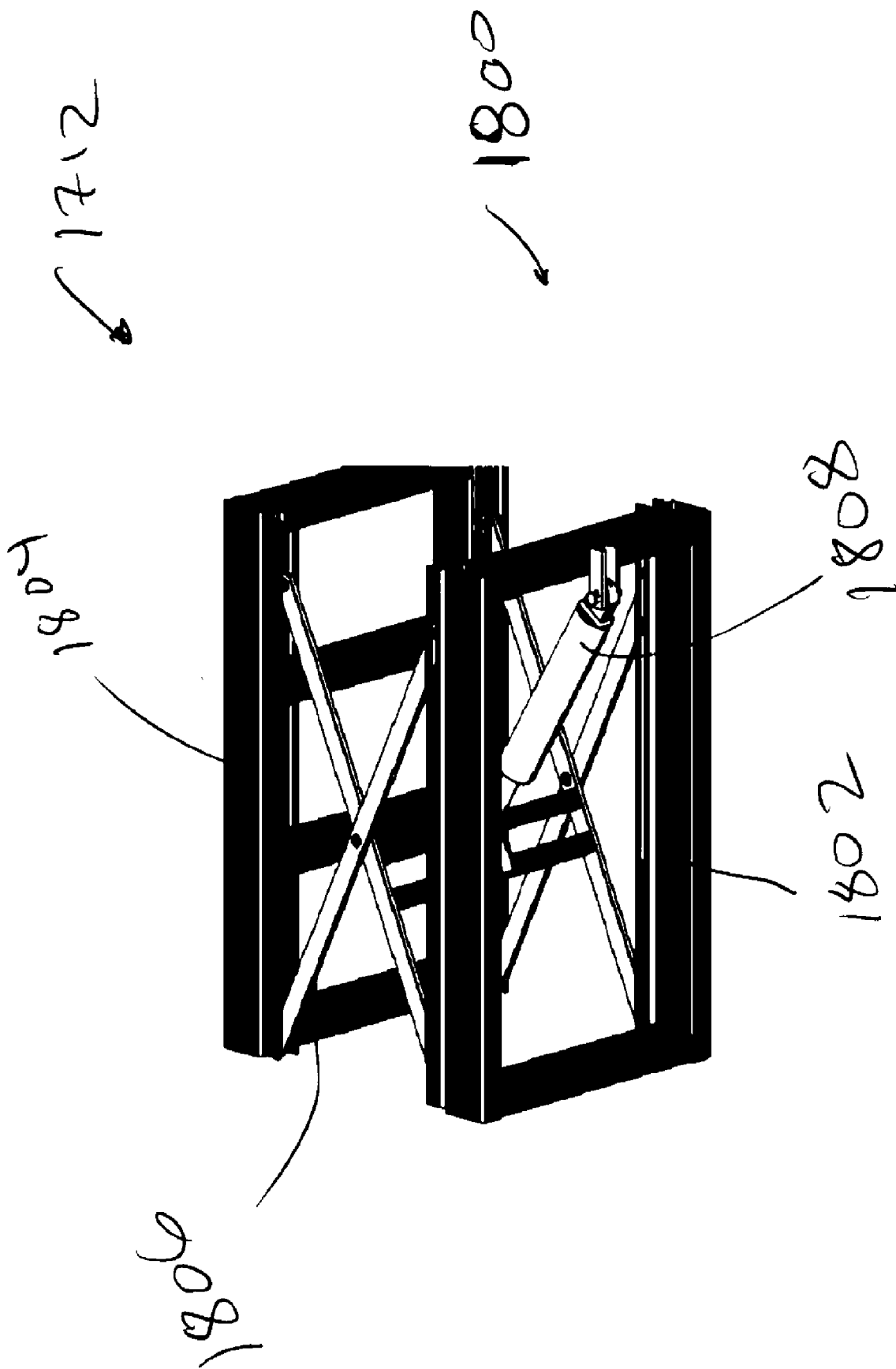
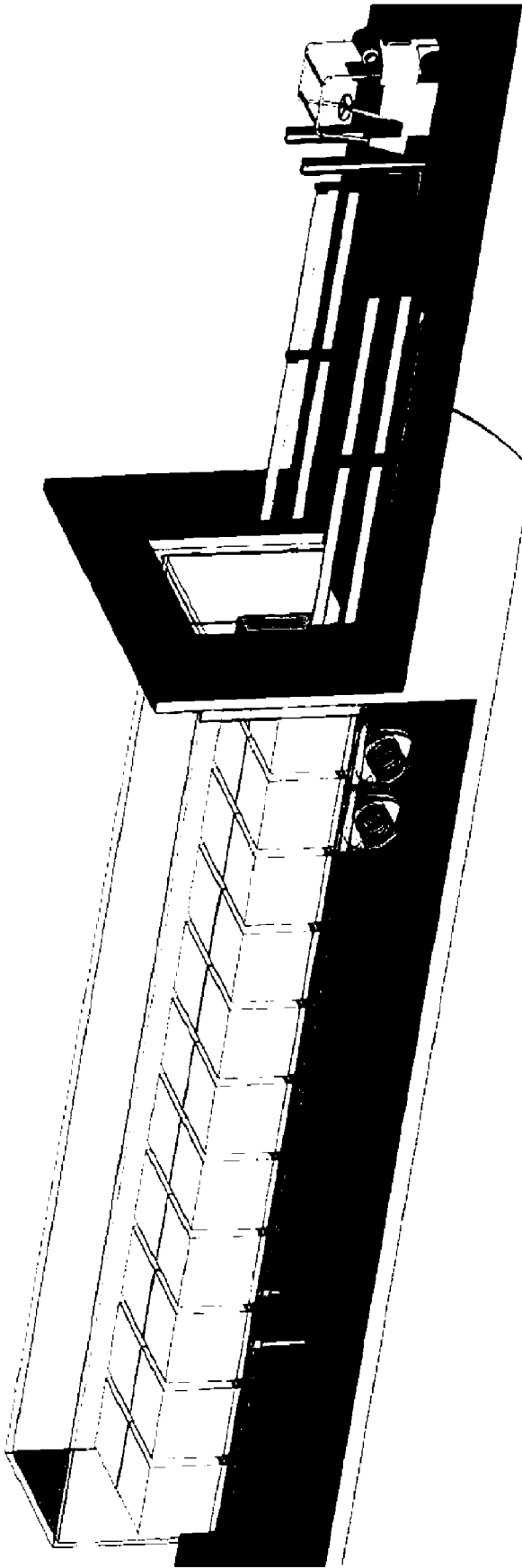


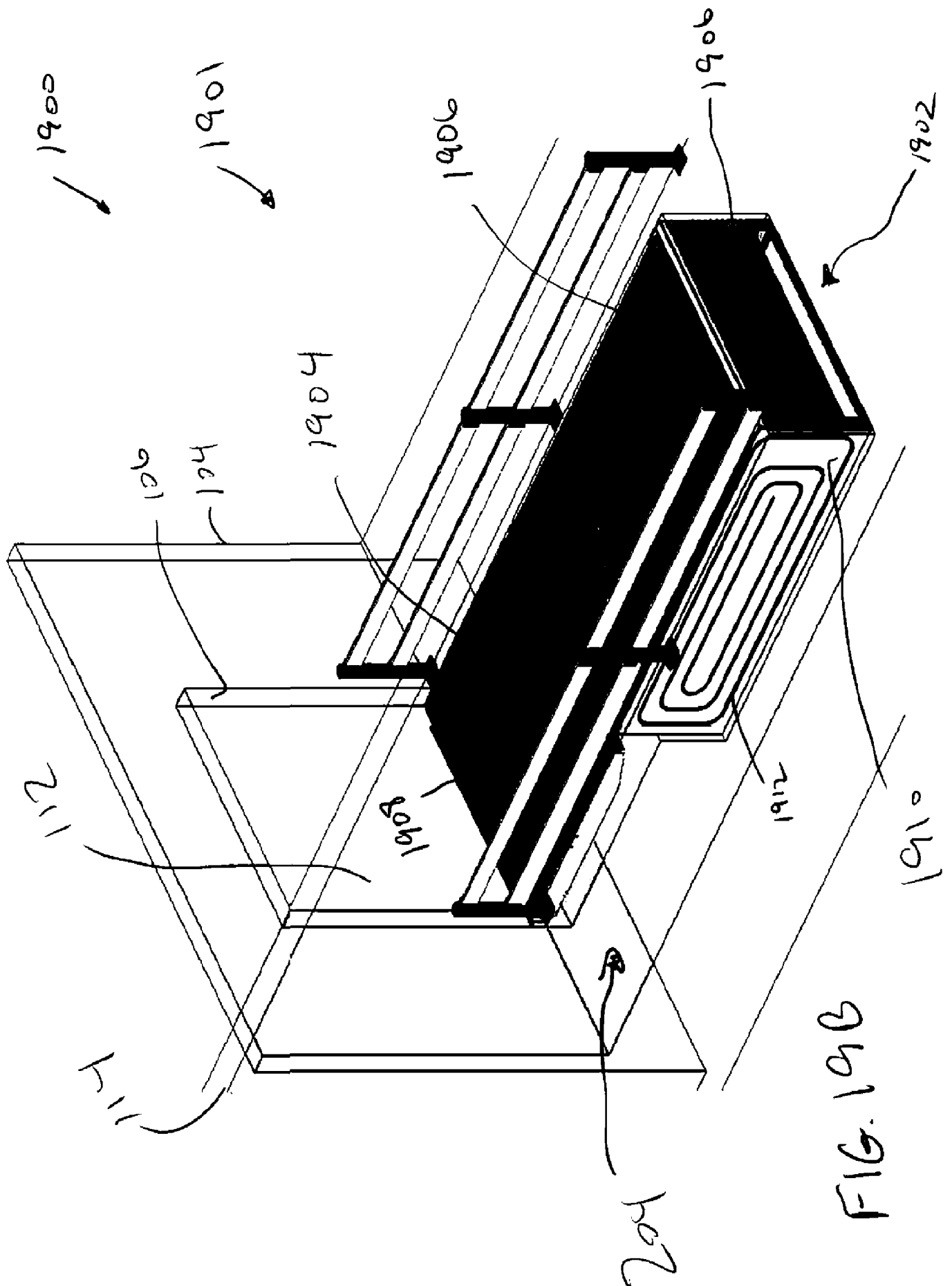
FIG. 18

1900



1902

FIG. 19A



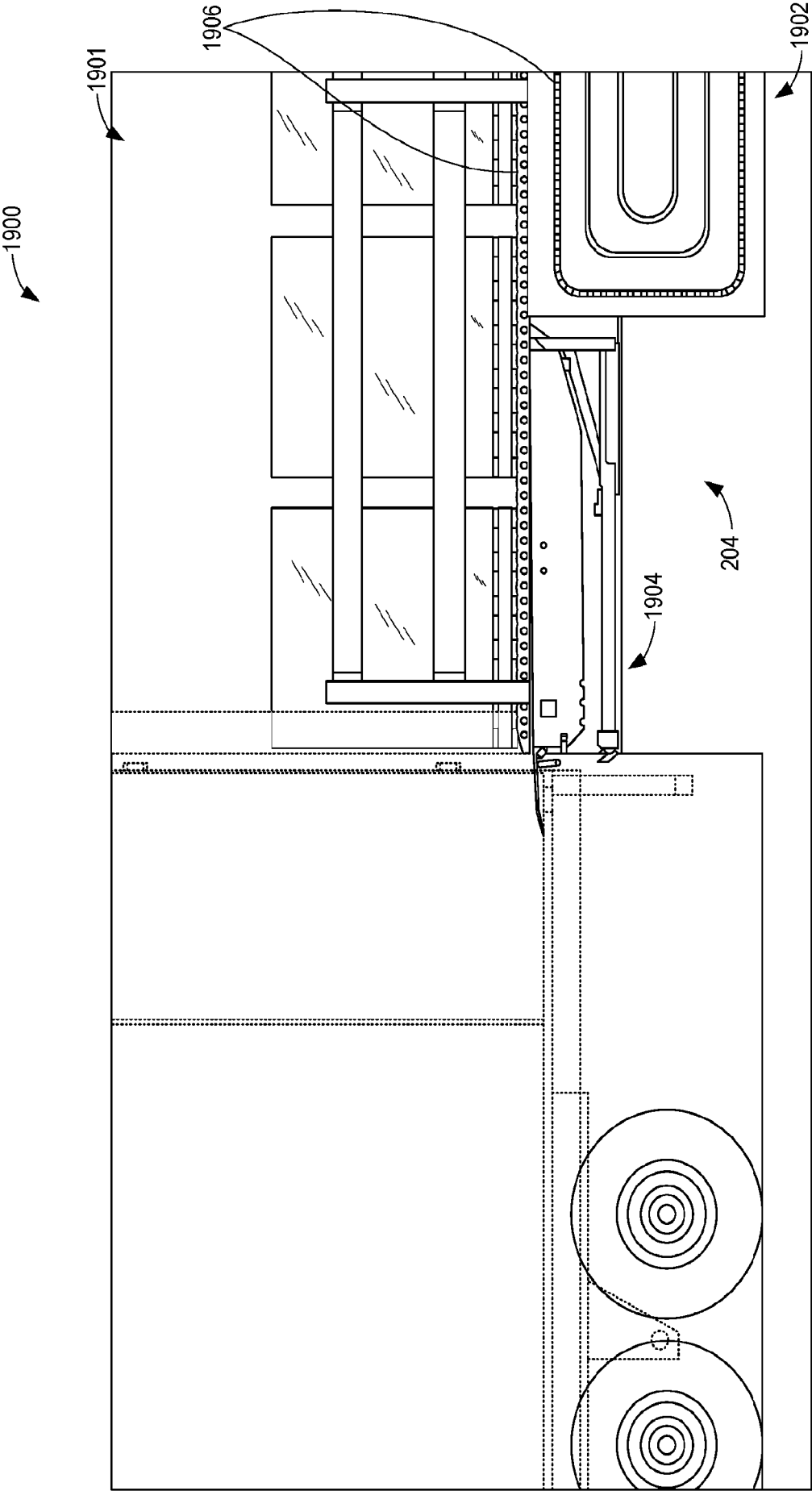


FIG. 19C

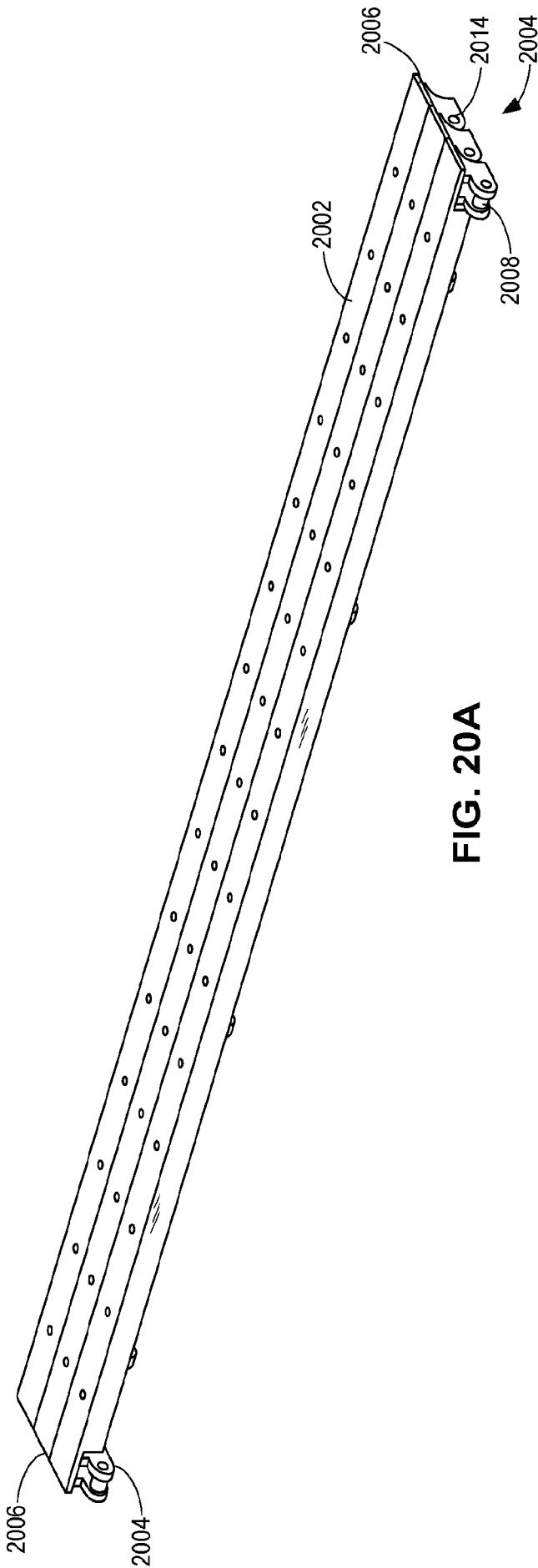


FIG. 20A

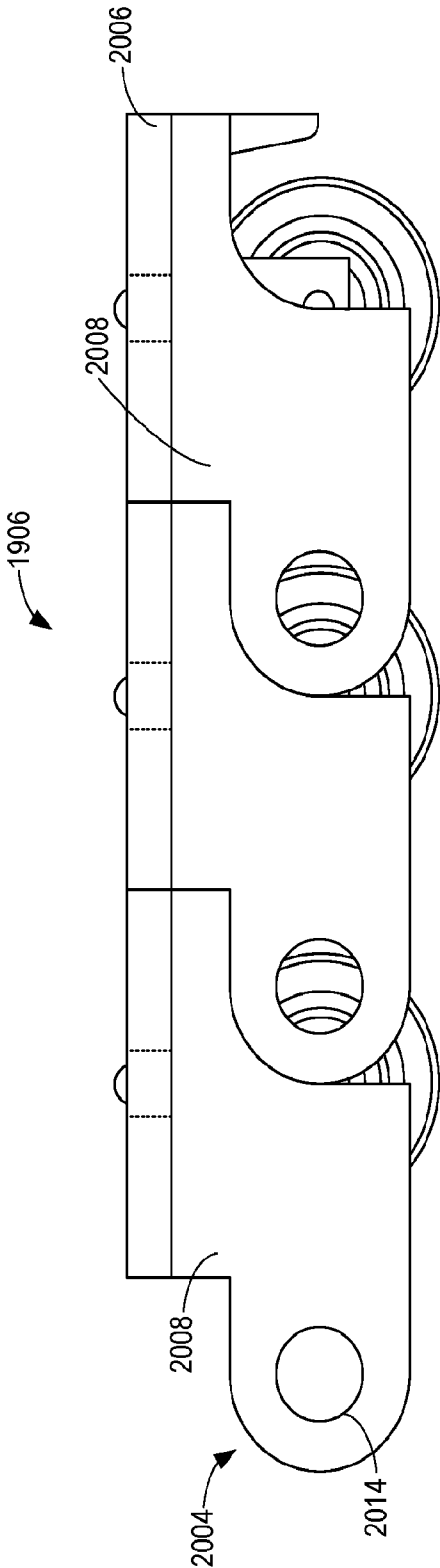


FIG. 20B

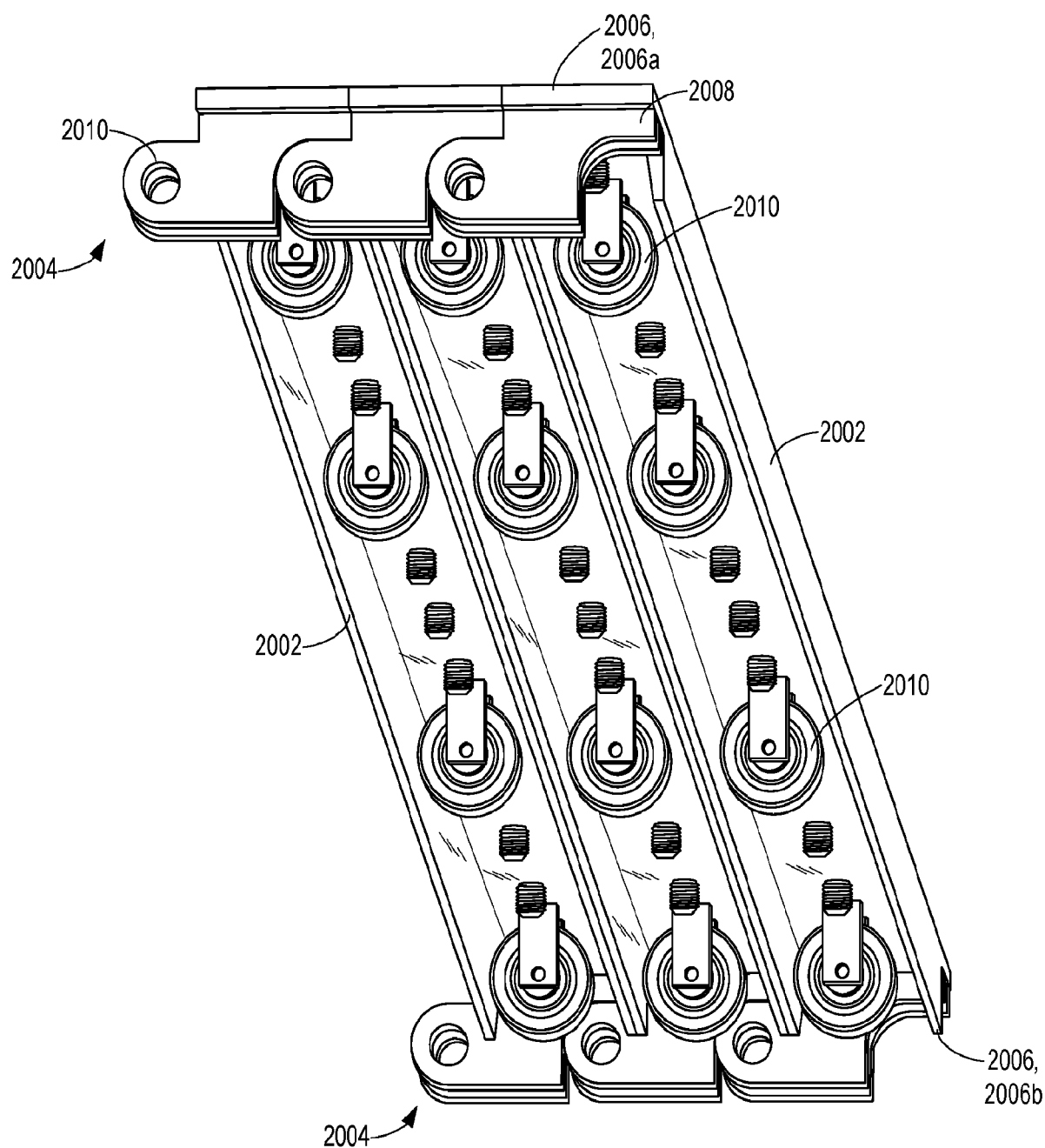


FIG. 20C

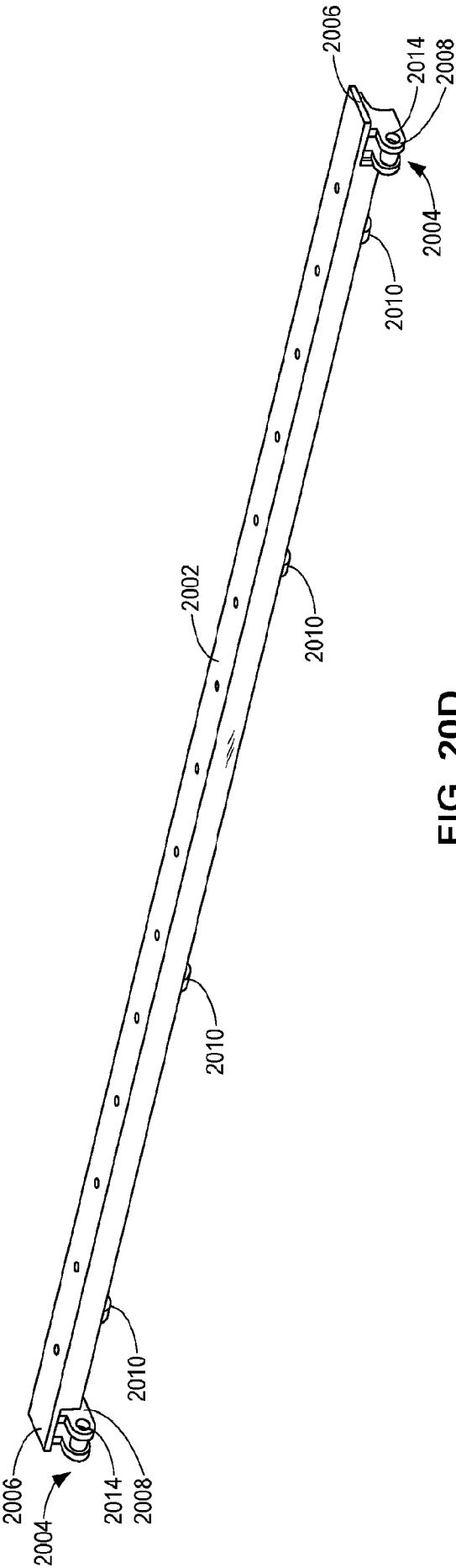


FIG. 20D

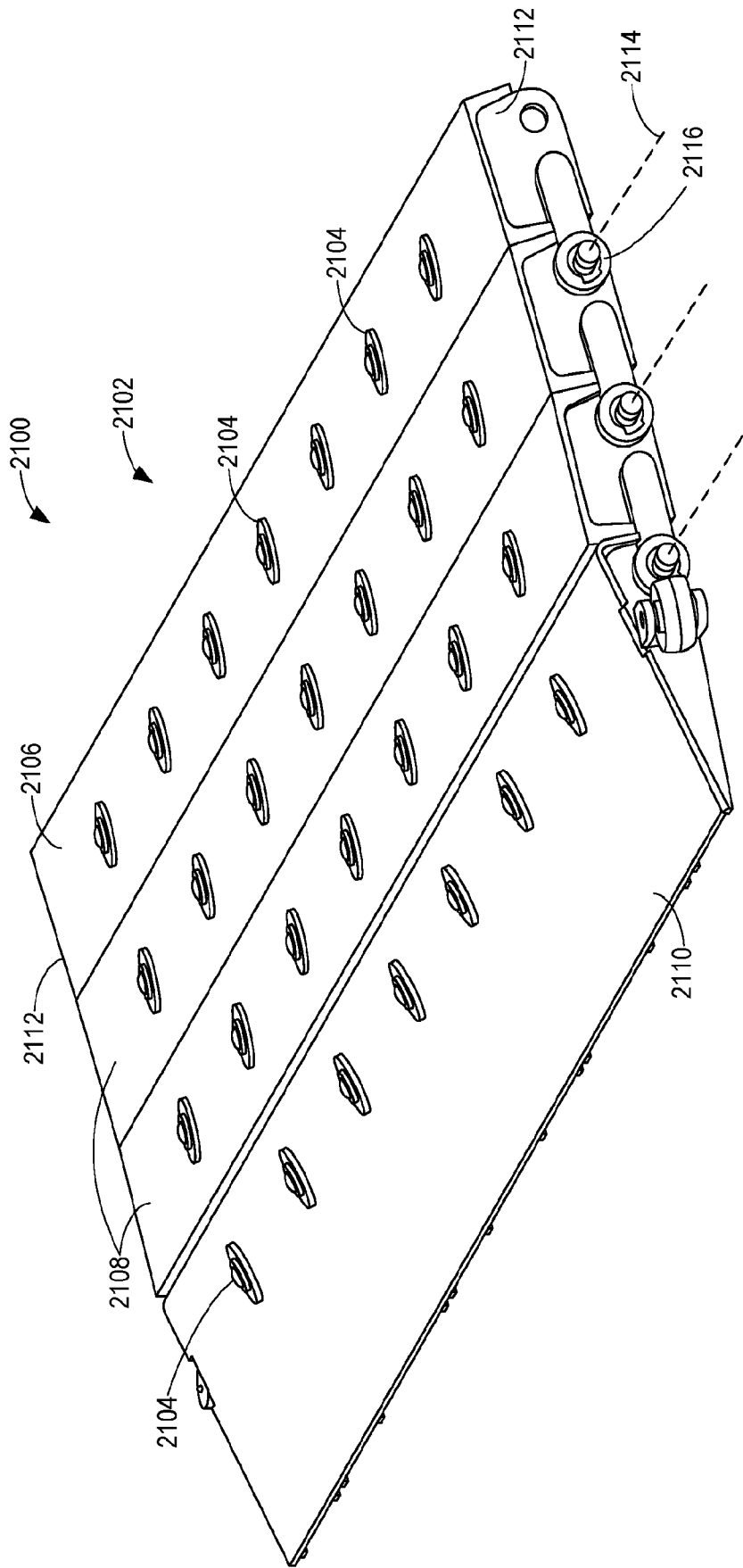


FIG. 21

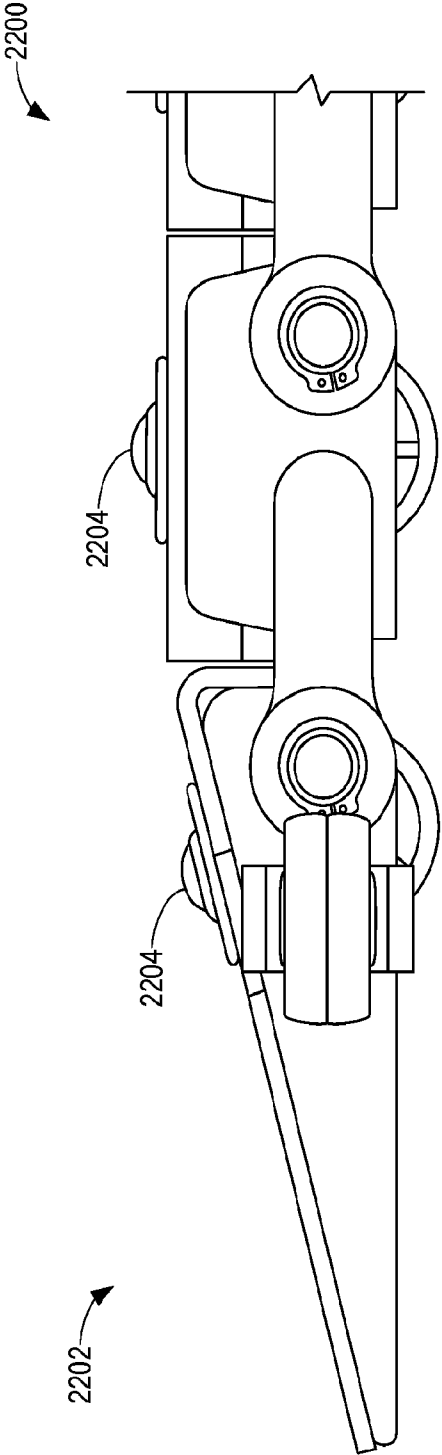


FIG. 22A

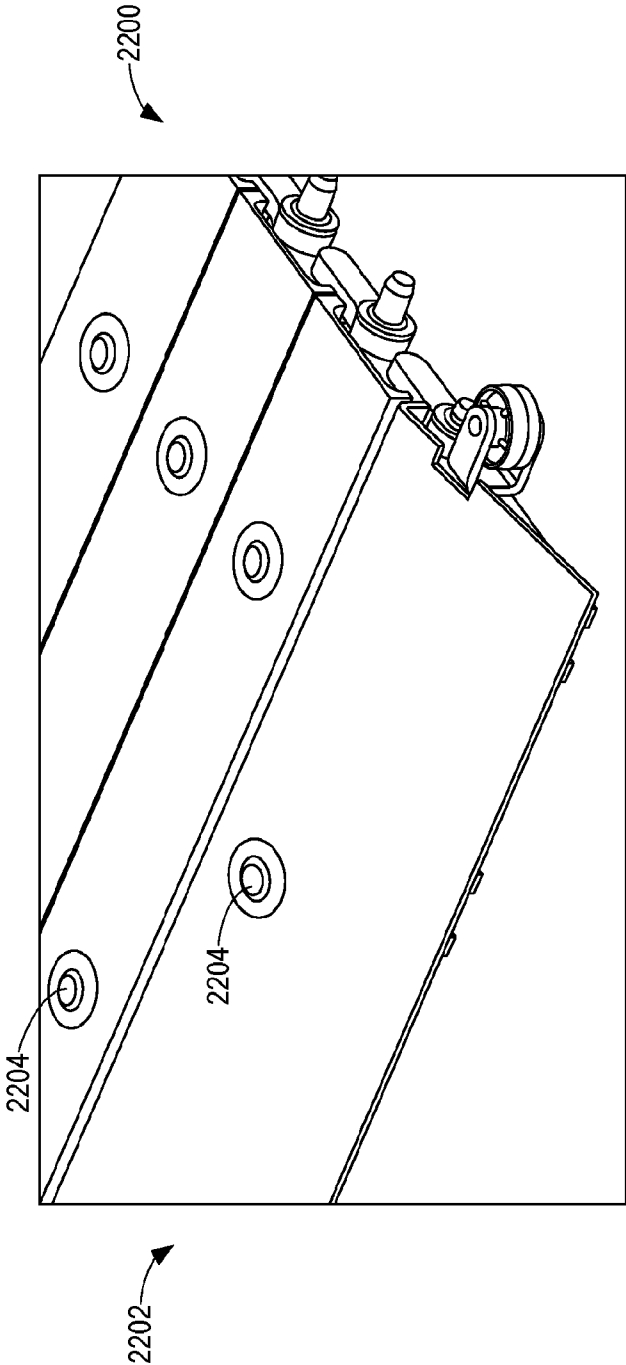


FIG. 22B

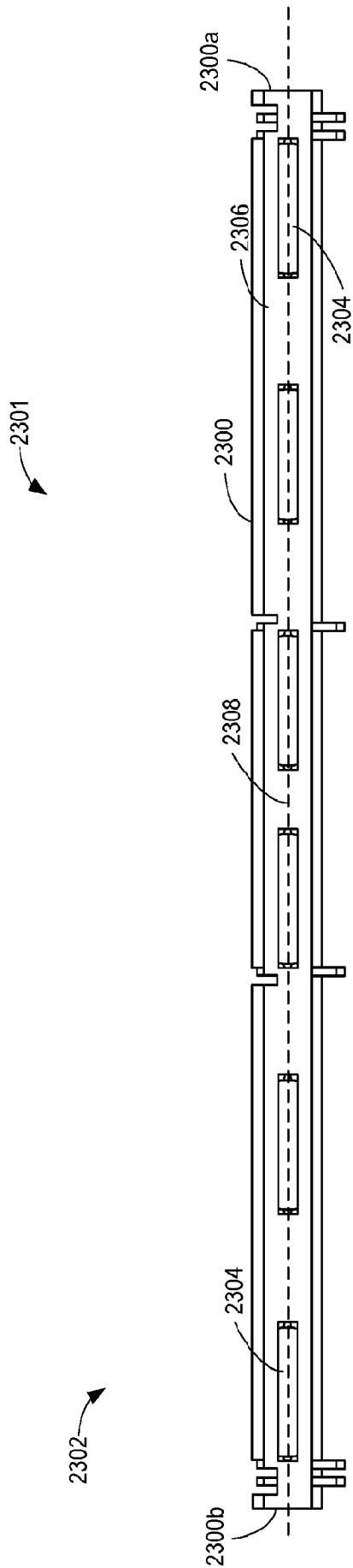


FIG. 23

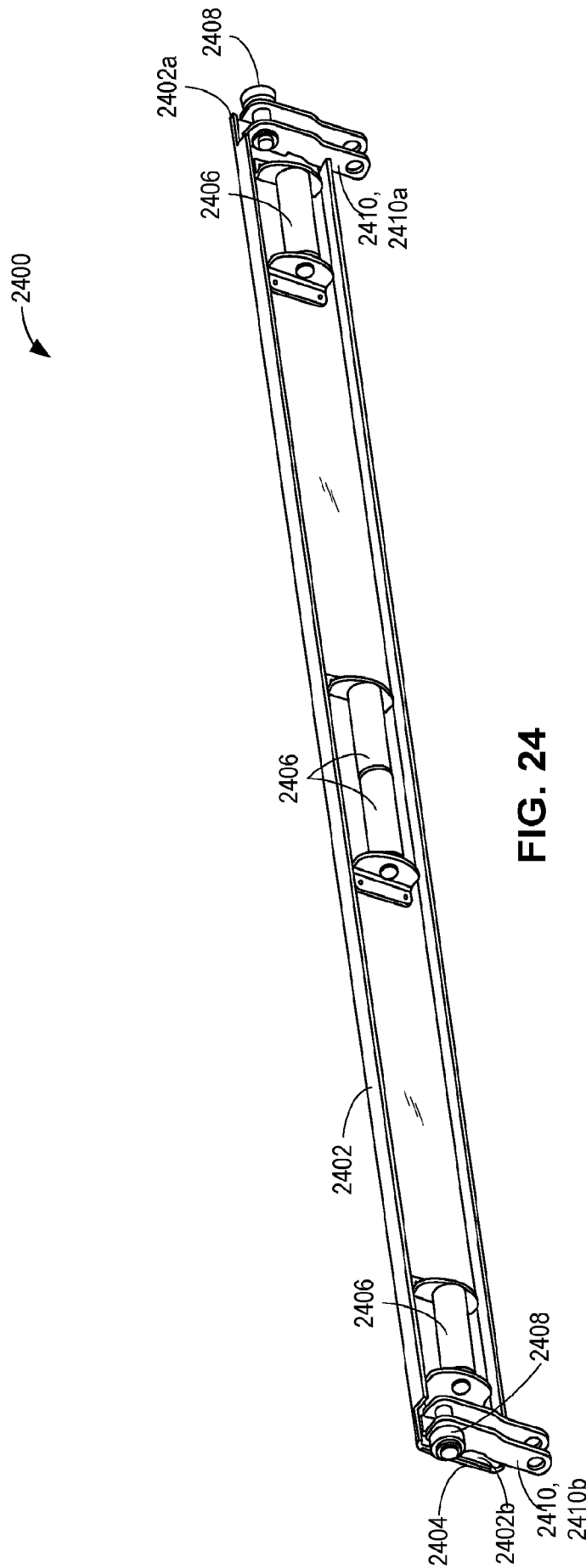


FIG. 24

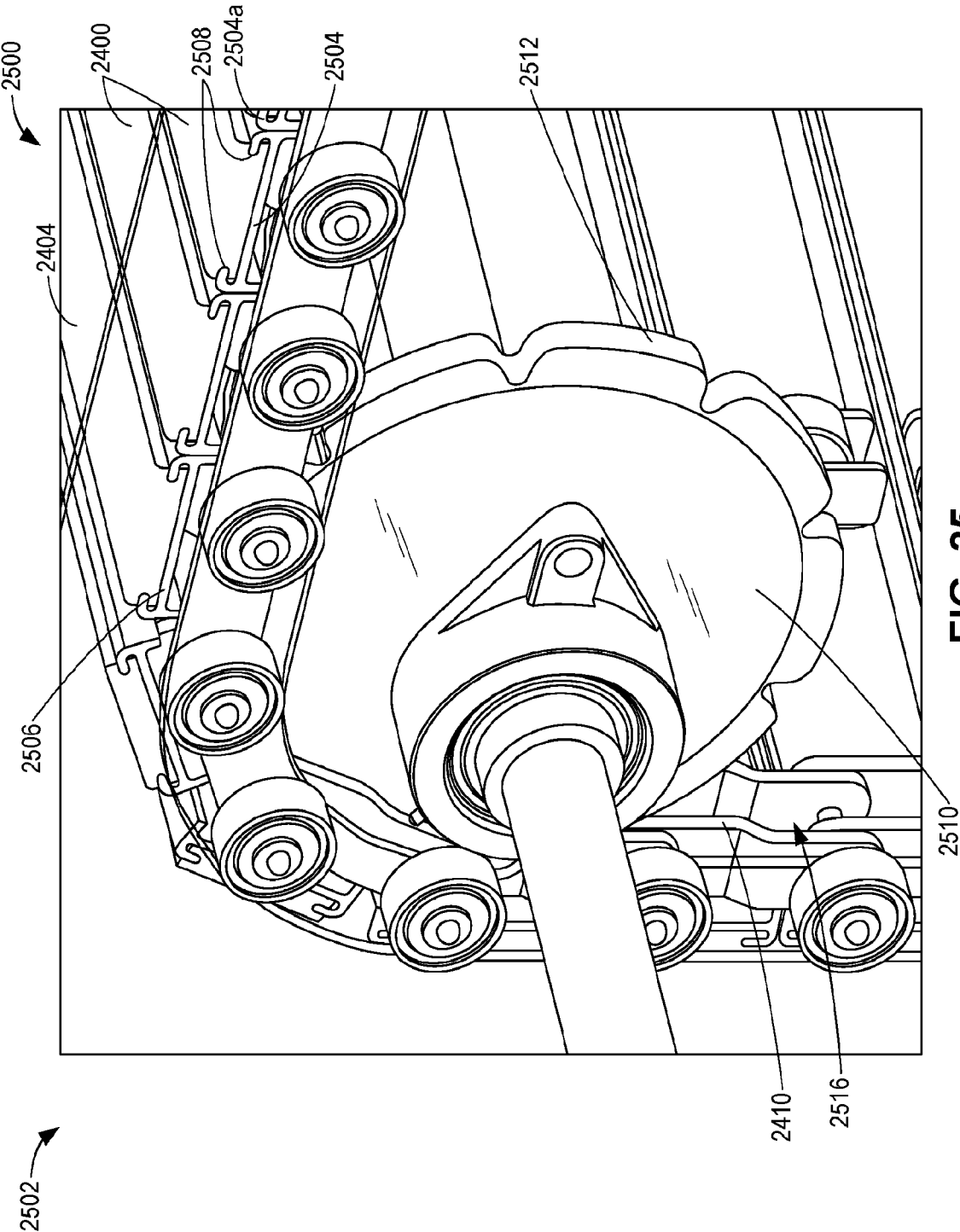


FIG. 25

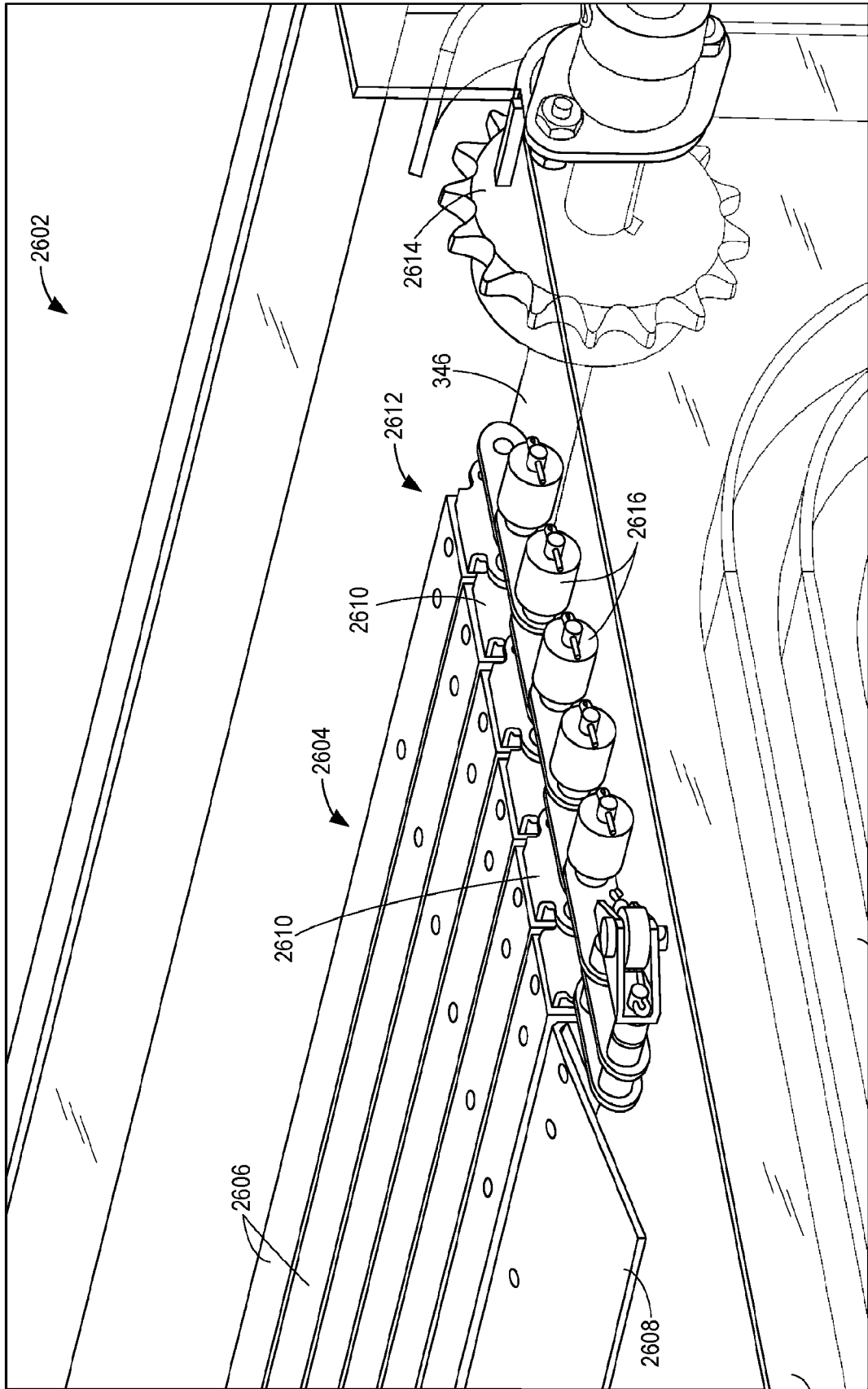


FIG. 26A

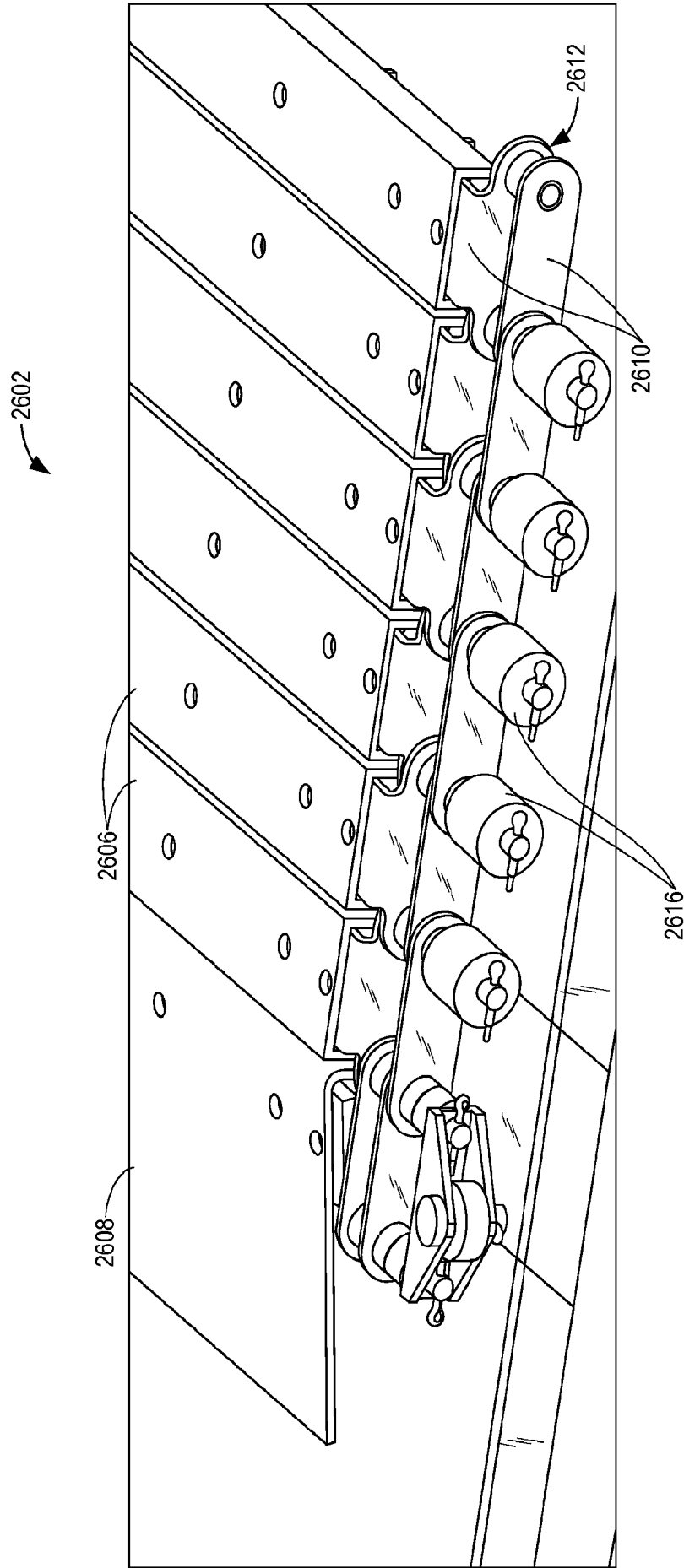


FIG. 26B

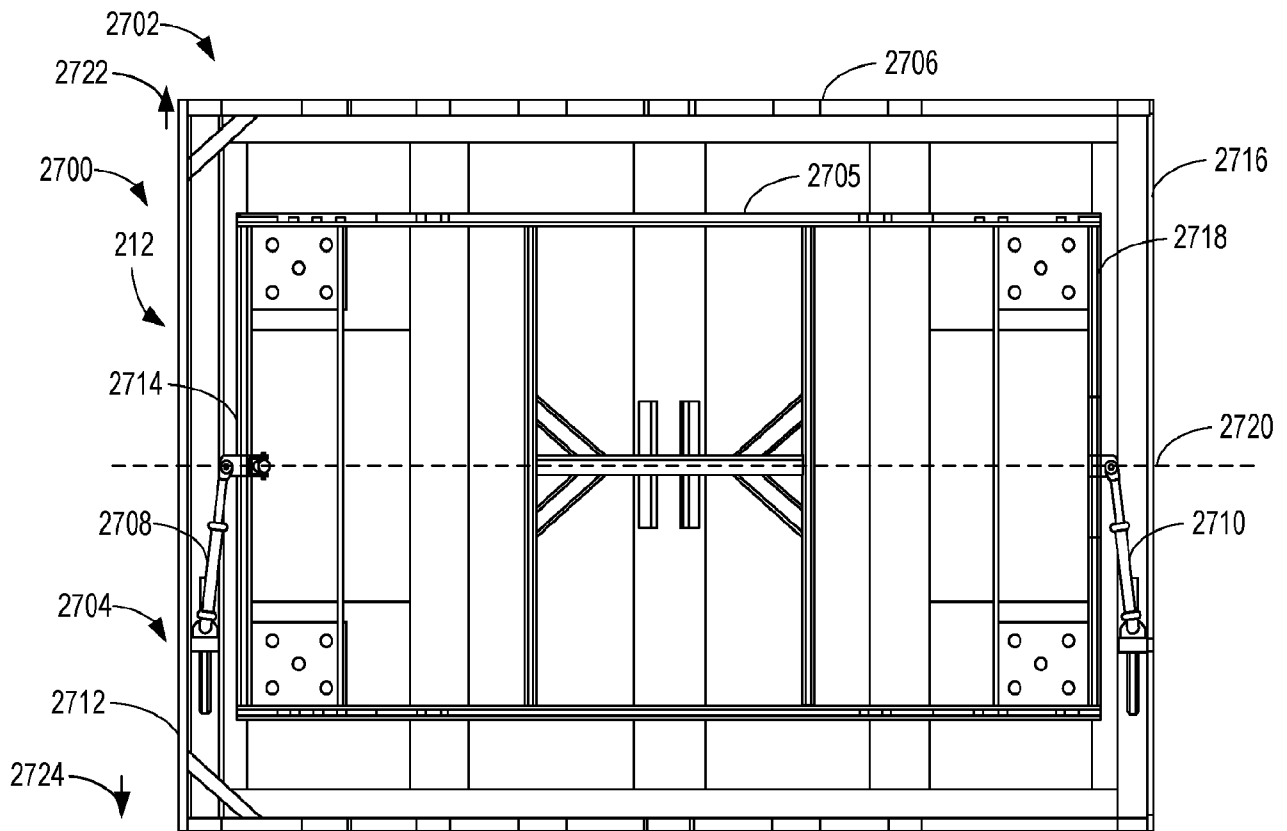


FIG. 27A

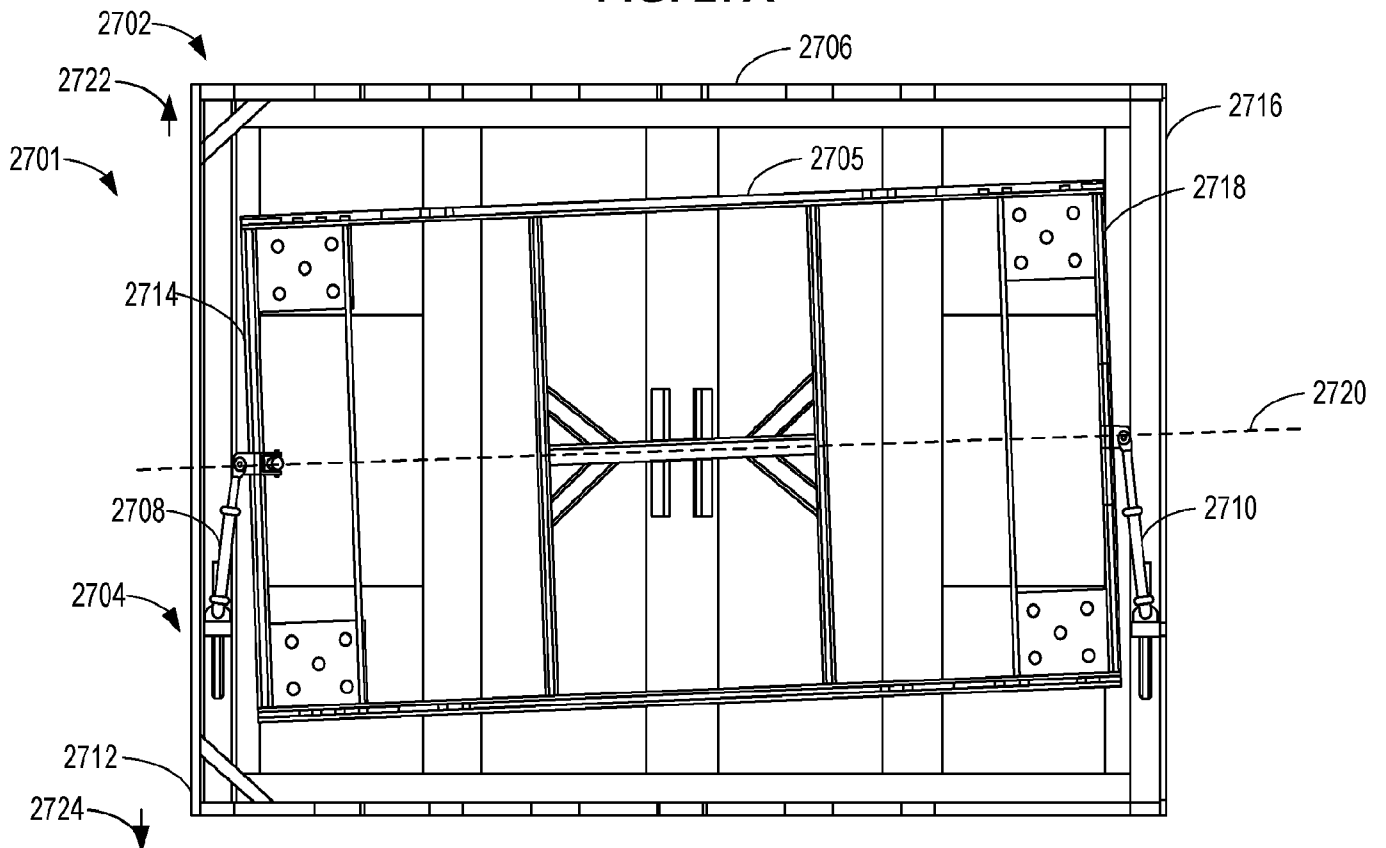


FIG. 27B

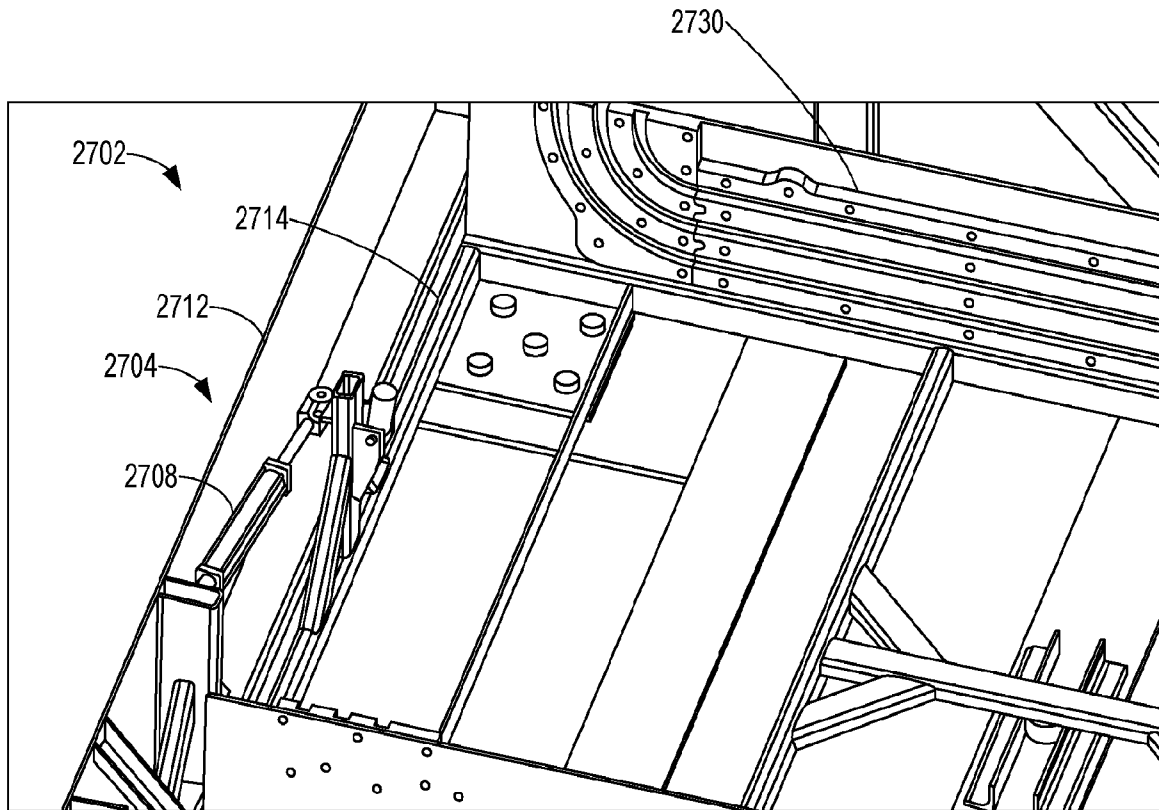


FIG. 27C

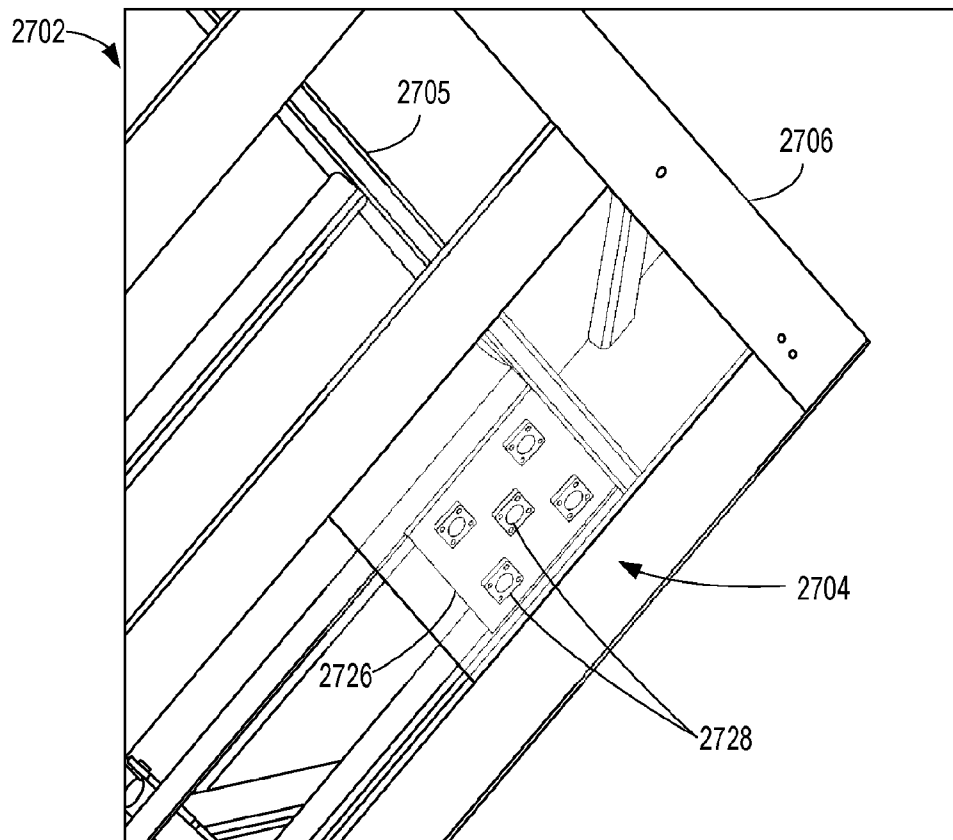


FIG. 27D

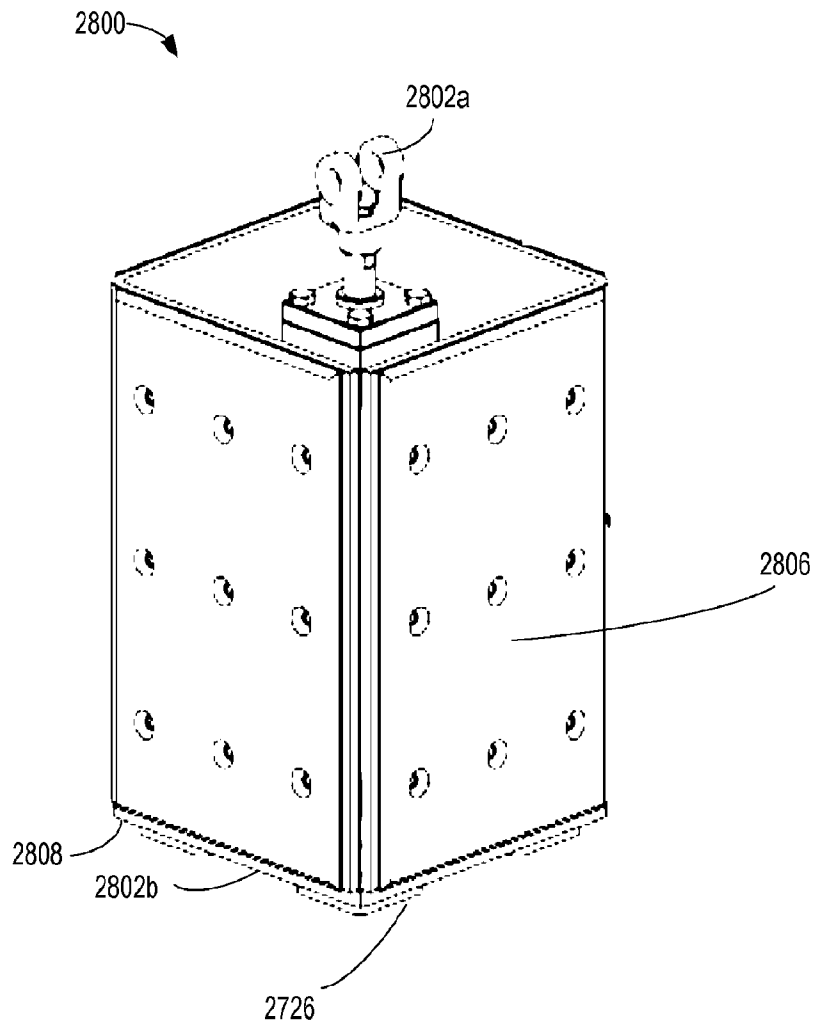


FIG. 28A

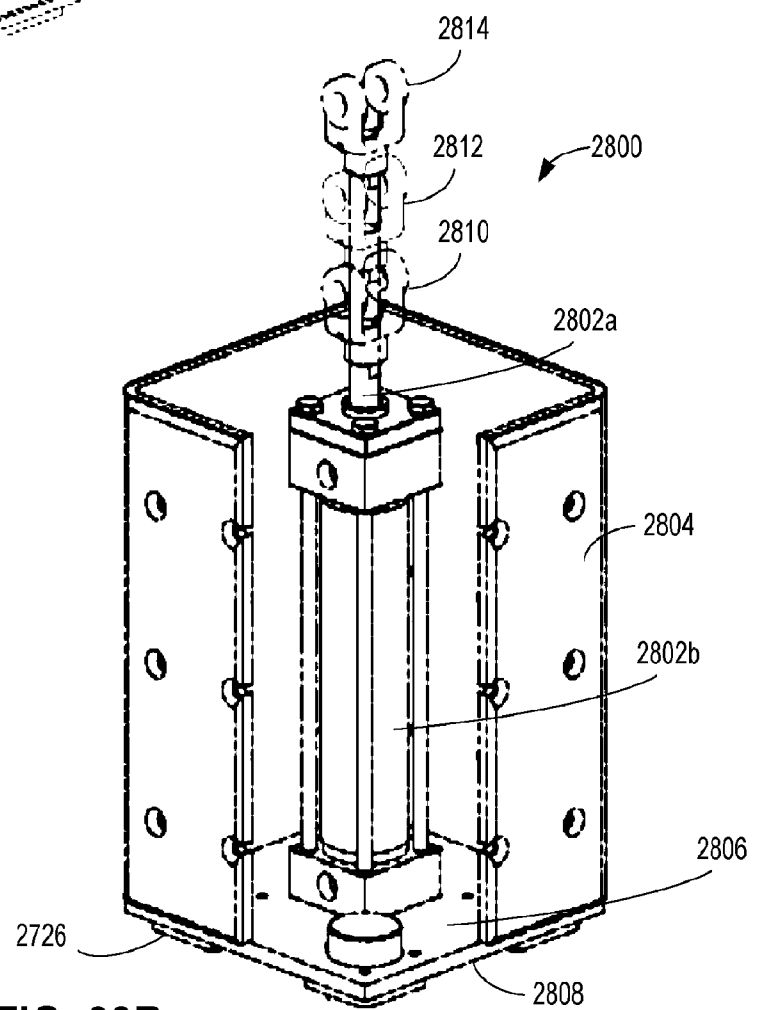


FIG. 28B

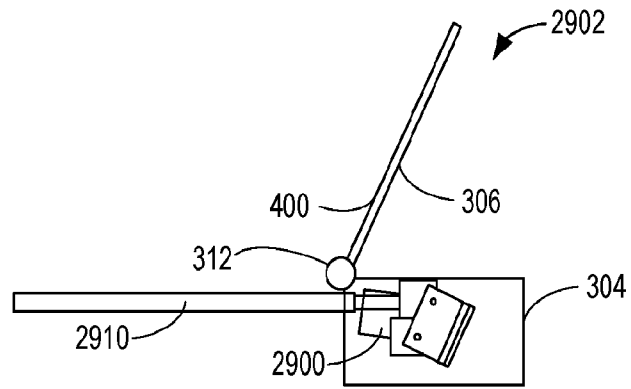


FIG. 29A

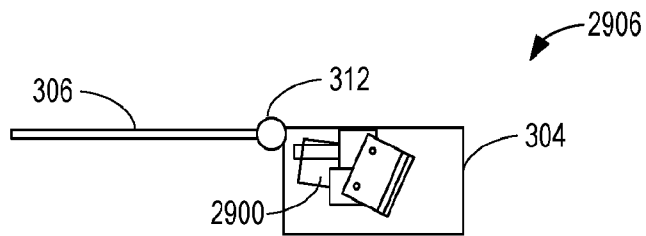


FIG. 29B

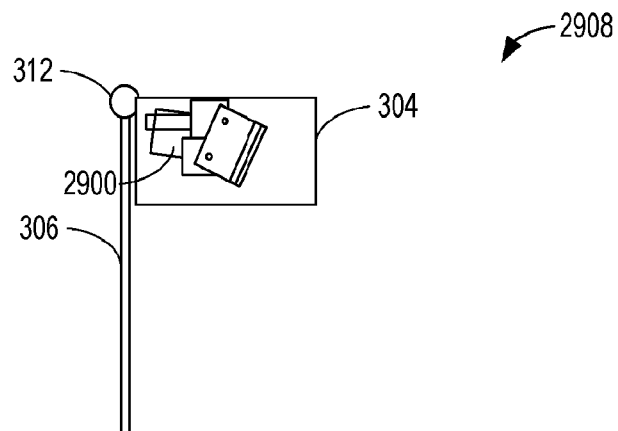


FIG. 29C

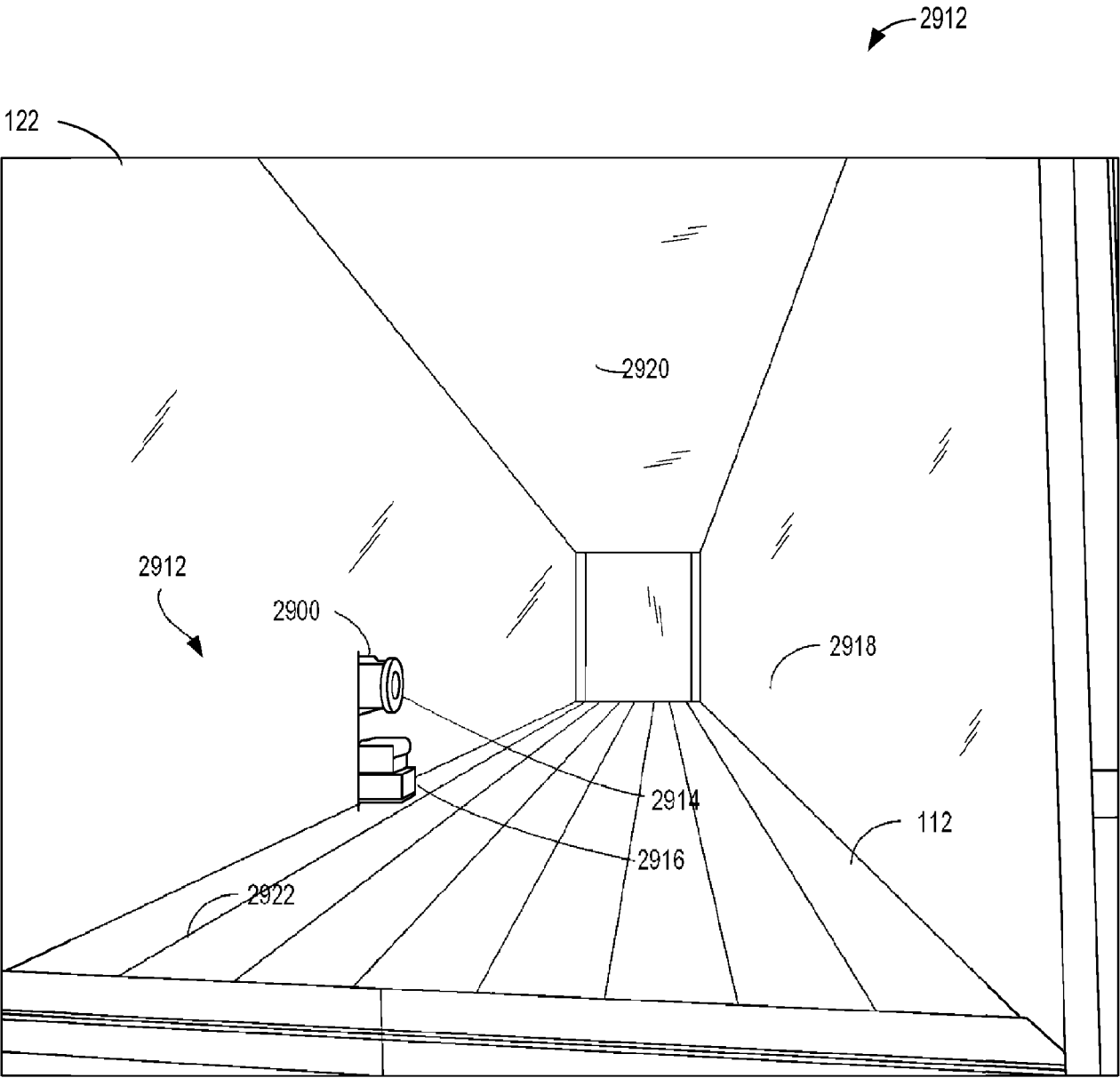


FIG. 29D

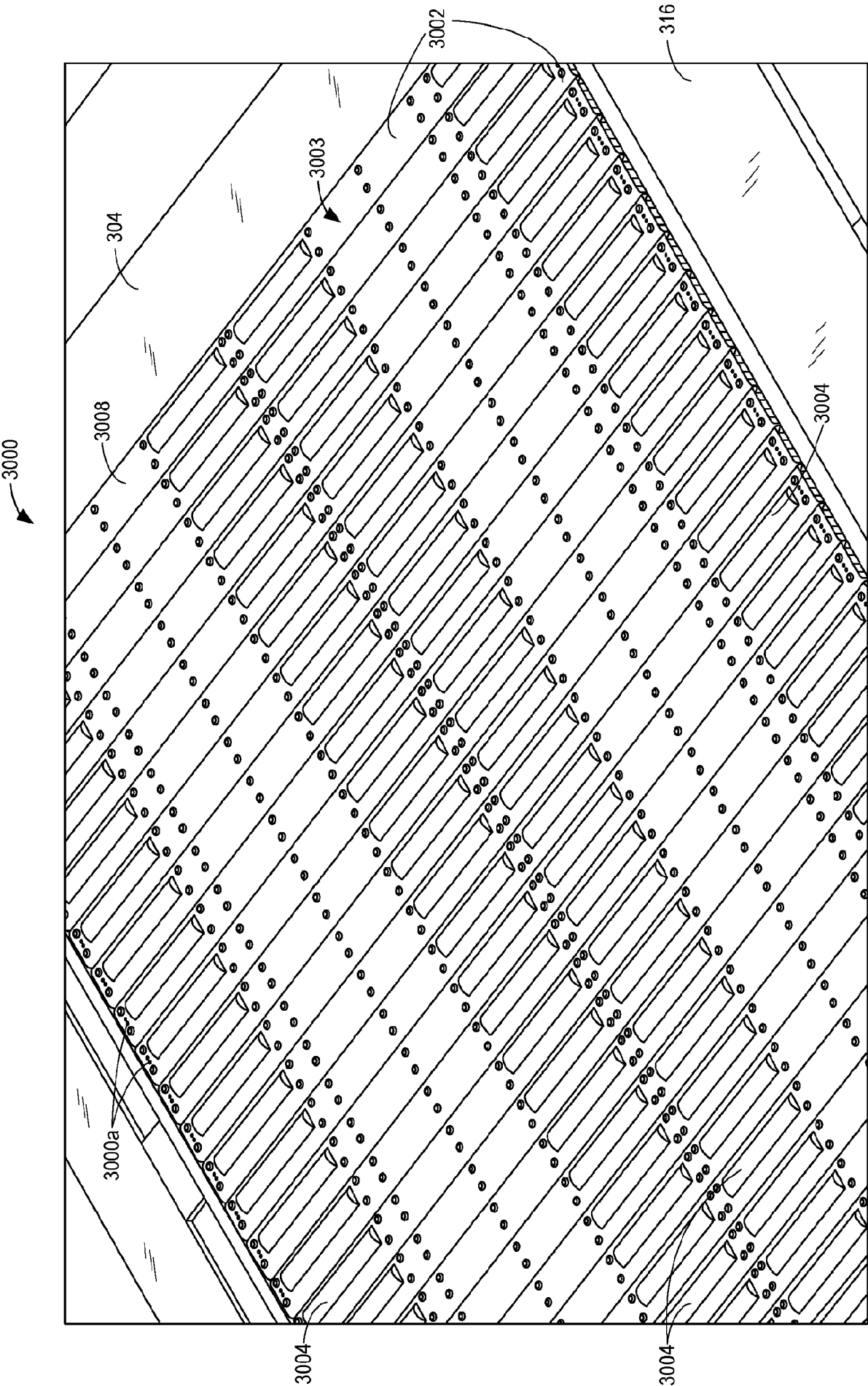


FIG. 30A

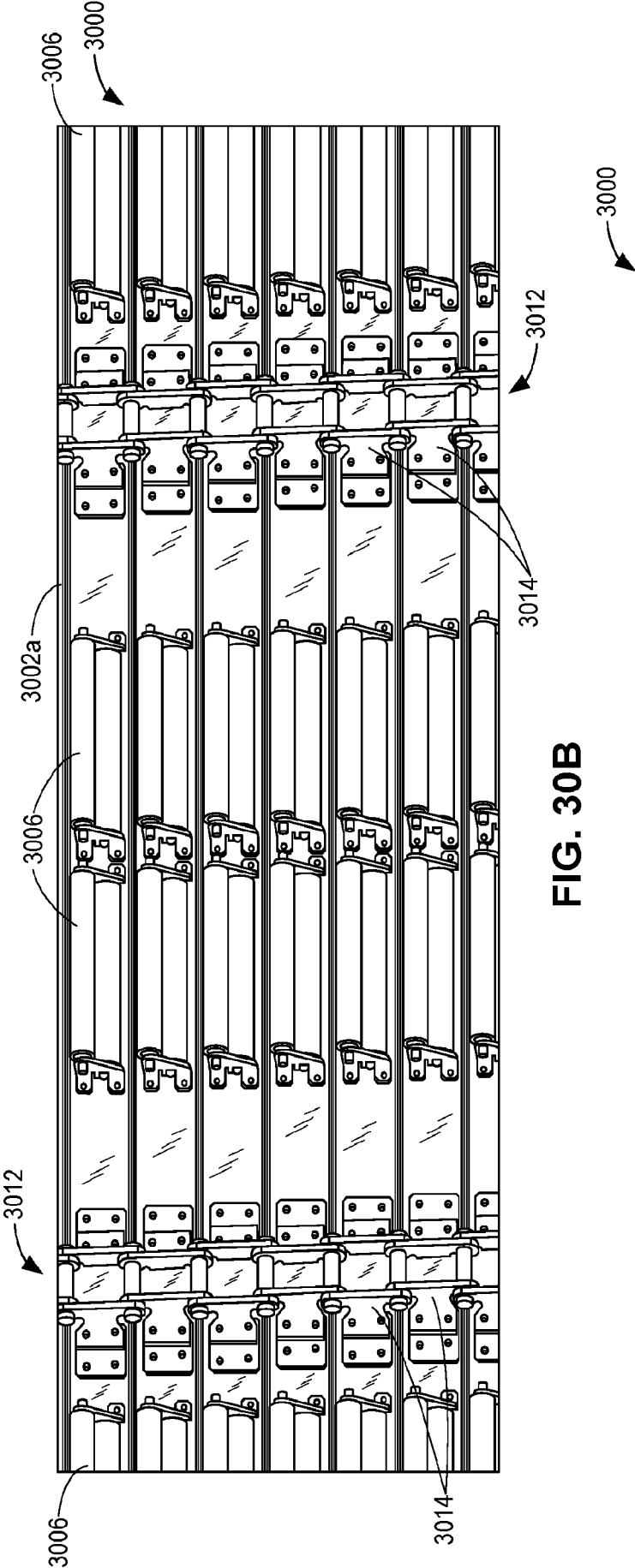


FIG. 30B

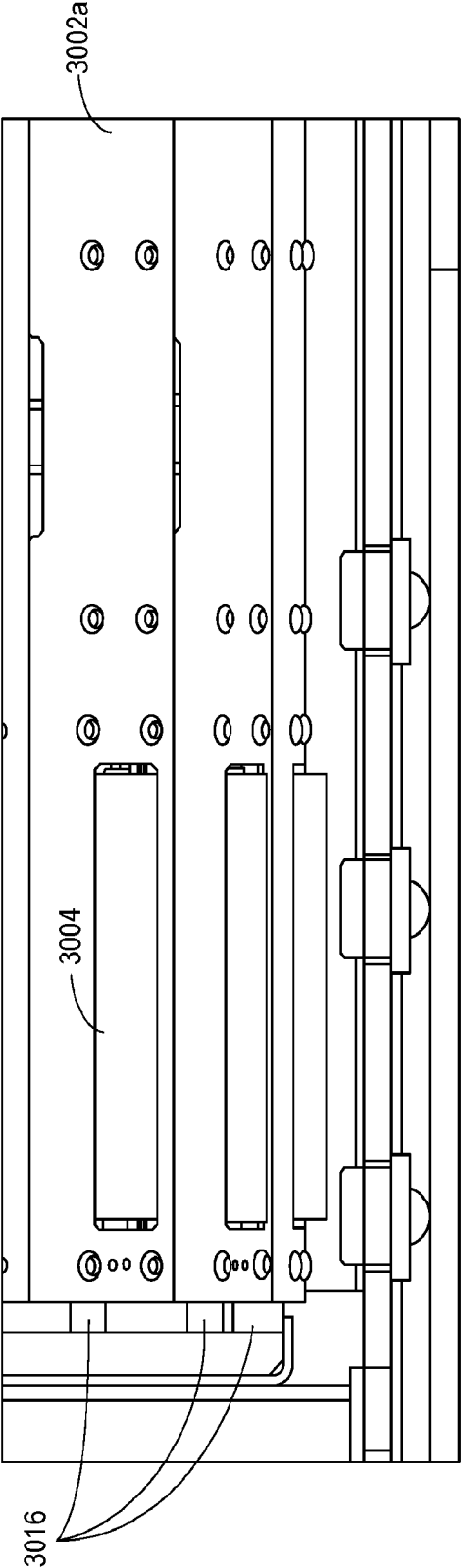


FIG. 30C

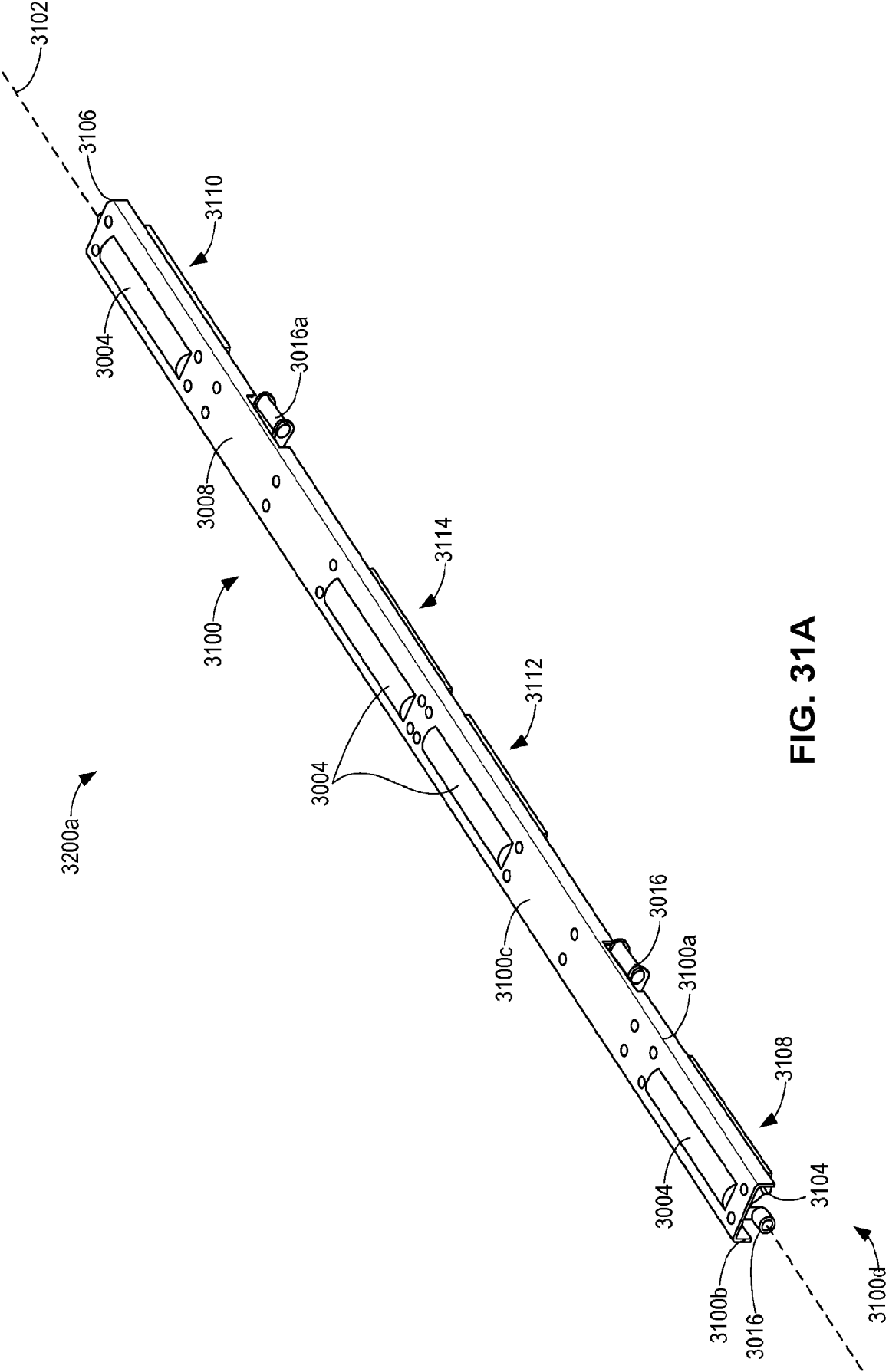


FIG. 31A

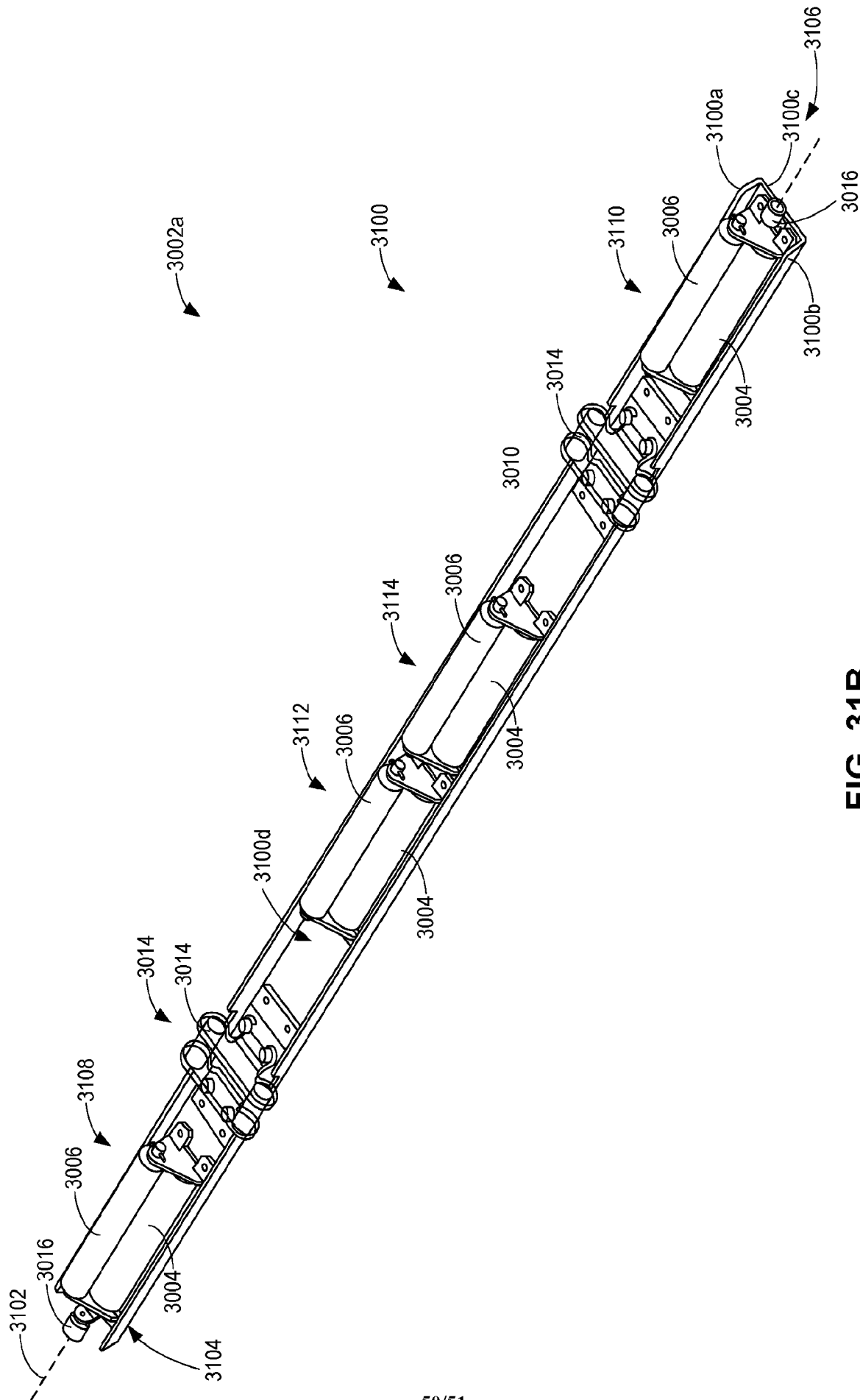
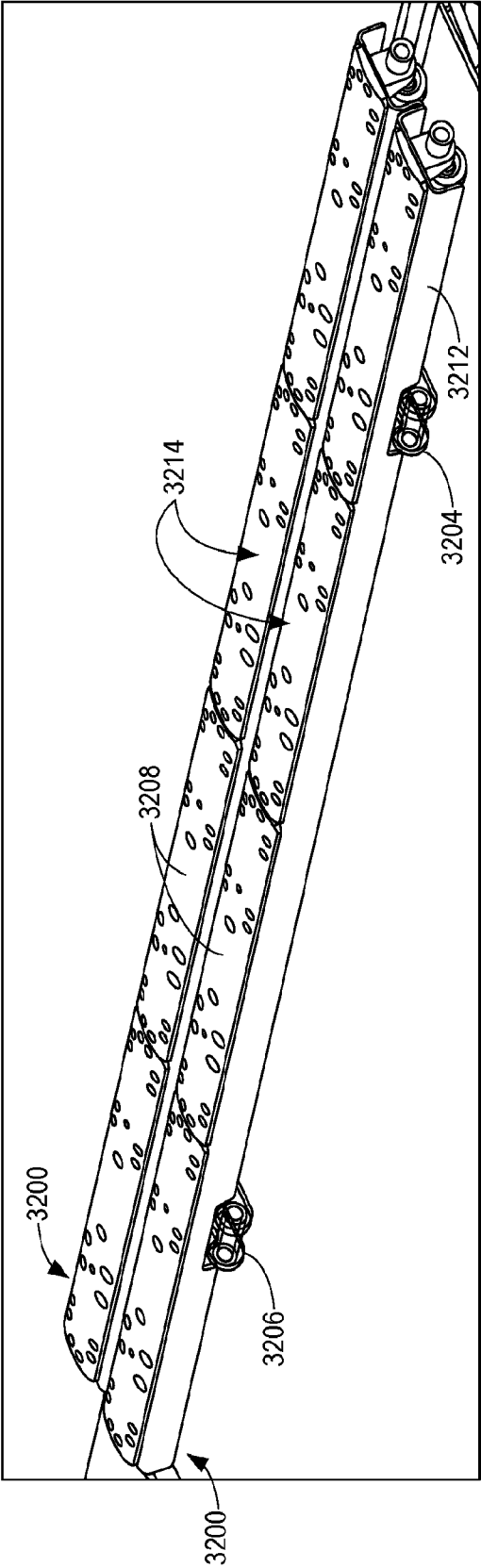
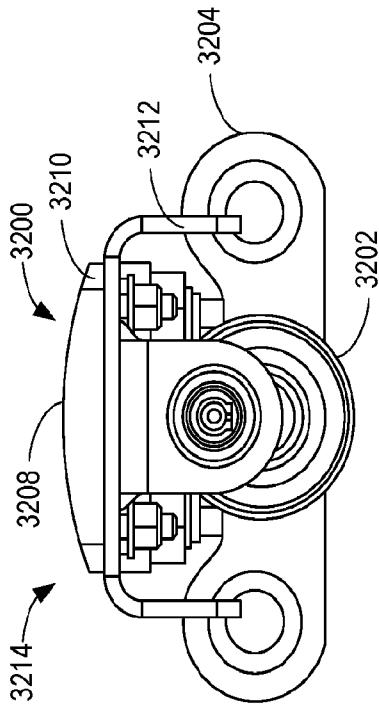


FIG. 31B



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2024/041758

A. CLASSIFICATION OF SUBJECT MATTER					
INV.	B65G21/14	B65G17/06	B65G17/08	B65G17/24	B65G17/32
	B65G17/40	B65G67/08	B65G67/20	B65G69/28	
ADD.					
According to International Patent Classification (IPC) or to both national classification and IPC					
B. FIELDS SEARCHED					
Minimum documentation searched (classification system followed by classification symbols) B65G B64F					
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched					
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data					
C. DOCUMENTS CONSIDERED TO BE RELEVANT					
Category*	Citation of document, with indication, where appropriate, of the relevant passages				Relevant to claim No.
X	DE 295 17 974 U1 (FAHRION OTMAR [DE]) 13 March 1997 (1997-03-13) page 12, line 25 - page 13, line 10; figures 1-13 -----				1-18,20
X	US 2005/265817 A1 (BLANC PHILIPPE [FR]) 1 December 2005 (2005-12-01)				1-4,7-16
Y	paragraph [0074]; figures 1-7 -----				19
X	EP 3 261 964 B1 (STERTIL BV [NL]) 3 July 2019 (2019-07-03) paragraphs [0013] - [0015]; figures 1-4 -----				1,2,4,5, 7-12, 14-17
X	CN 114 435 991 B (QINGDAO KEJIE ROBOT LTD COMPANY) 4 October 2022 (2022-10-04) figures 1-7 ----- -/-				1,4-14
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.					
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family					
Date of the actual completion of the international search 23 October 2024			Date of mailing of the international search report 07/11/2024		
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016			Authorized officer Thenert, Alexander		

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2024/041758

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 762 429 B1 (KRONES AG [DE]) 21 June 2017 (2017-06-21)	1-4, 7-12, 14-16,18
Y	paragraph [0033]; figures 1-7 -----	19
A	DE 20 2017 103380 U1 (HOERMANN KG ANTRIEBSTECHNIK [DE]) 24 July 2018 (2018-07-24) paragraphs [0003], [0042]; figures 1-5 -----	5

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2024/041758

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			EP 2762429 A1 06-08-2014
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