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(71) Demandeur/Applicant:
PRIMAPAK, LLC, US

(72) Inventeurs/Inventors:
SANFILIPPO, JOHN E., US;
SANFILIPPO, JAMES J., US;
SORIA, FRANCISCO JAVIER, US

(74) Agent: SMART & BIGGAR

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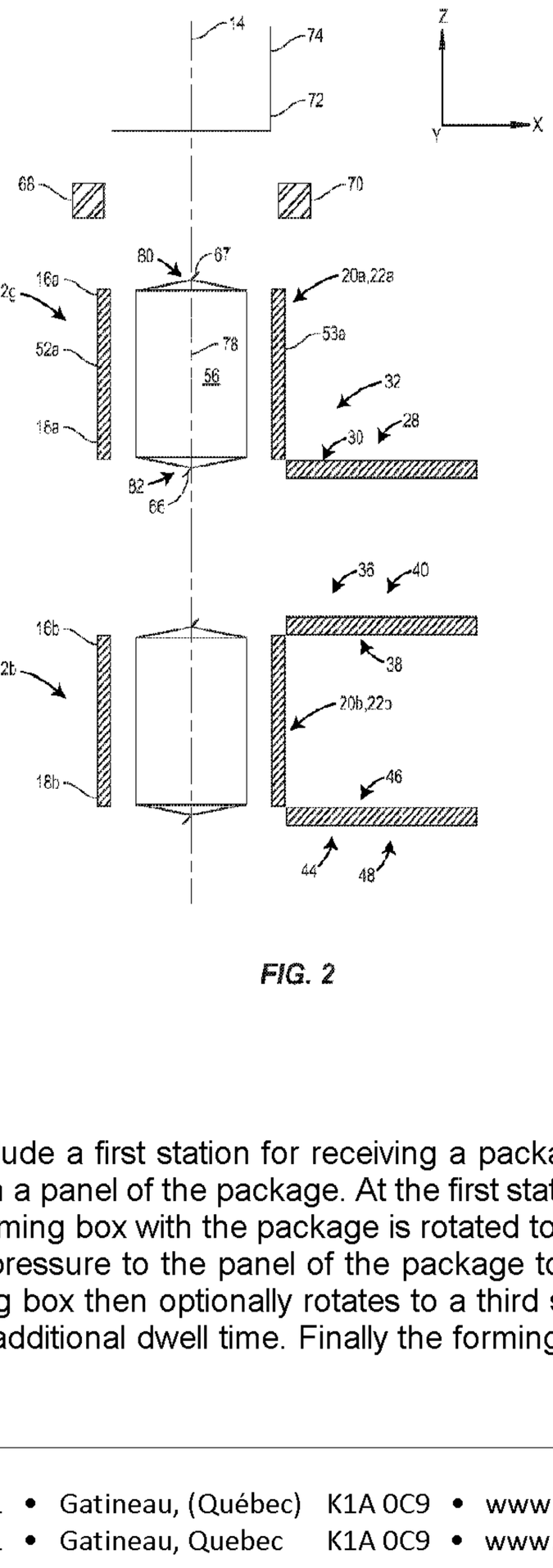


FIG. 2

(57) Abrégé/Abstract:
An apparatus for forming a package can include a first station for receiving a package from a packaging machine, the package having a trailing seal extending outwardly from a panel of the package. At the first station, the package is received in a forming box, which is rotated about the apparatus. The forming box with the package is rotated to a second station in which a flap folding plate extends to fold the trailing seal and apply a pressure to the panel of the package to flatten the panel of the package against an internal pressure of the package. The forming box then optionally rotates to a third station in which a holding plate maintains the pressure to the panel of the package for an additional dwell time. Finally the forming box rotates to a fourth position in which the package is released from the forming box.

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(71) Applicant: **CLEAR LAM PACKAGING, INC.** [US/US]; 1950 Pratt Boulevard, Elk Grove Village, IL 60007 (US).

(72) Inventors: **SANFILIPPO, John, E.**; 1950 Pratt Boulevard, Elk Grove Village, IL 60007 (US). **SANFILIPPO, James, J.**; 799 Plum Tree Road, Barrington Hills, IL 60010 (US). **SORIA, Francisco, Javier**; 230 Church Street, West Chicago, IL 60185 (US).

(74) Agent: **BURNETTE, Jennifer**; Marshall, Gerstein & Borun LLP, 233 S. Wacker Drive, 6300 Willis Tower, Chicago, IL 60606-6357 (US).

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(54) Title: APPARATUS AND METHOD FOR MAKING A FLEXIBLE PACKAGE

(57) Abstract: An apparatus for forming a package can include a first station for receiving a package from a packaging machine, the package having a trailing seal extending outwardly from a panel of the package. At the first station, the package is received in a forming box, which is rotated about the apparatus. The forming box with the package is rotated to a second station in which a flap folding plate extends to fold the trailing seal and apply a pressure to the panel of the package to flatten the panel of the package against an internal pressure of the package. The forming box then optionally rotates to a third station in which a holding plate maintains the pressure to the panel of the package for an additional dwell time. Finally the forming box rotates to a fourth position in which the package is released from the forming box.

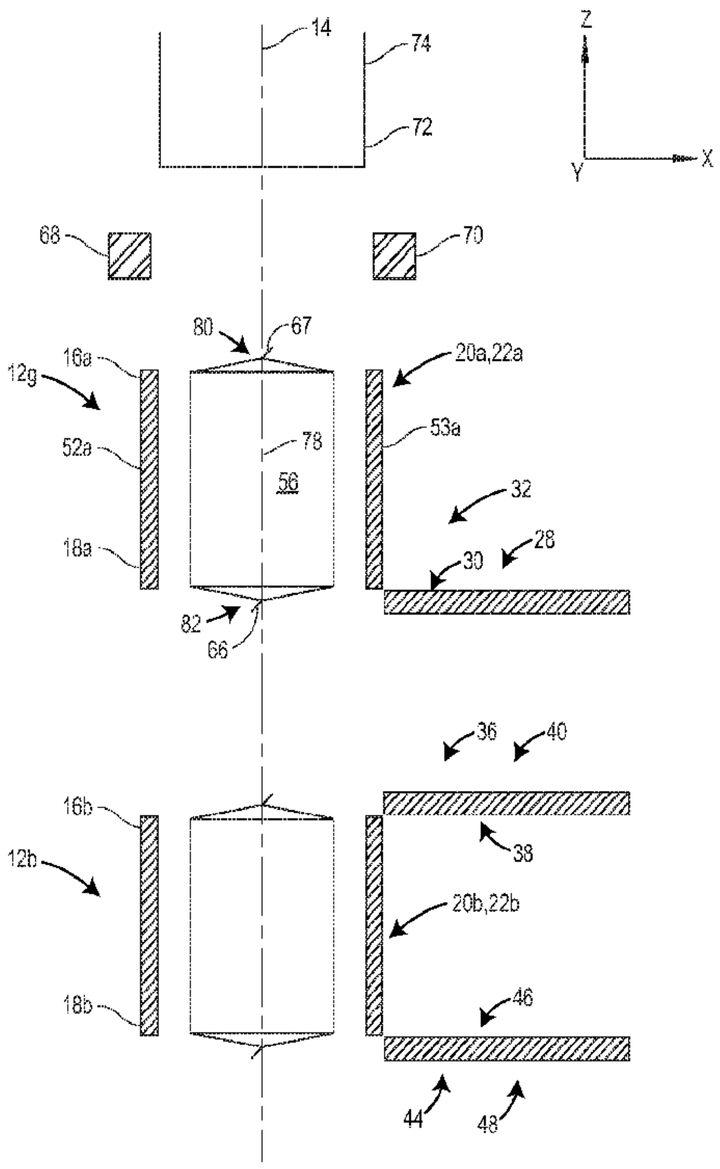


FIG. 2

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APPARATUS AND METHOD FOR MAKING A FLEXIBLE PACKAGE

BACKGROUND

FIELD OF THE DISCLOSURE

[0001] The disclosure relates to apparatus, systems, and methods for making a flexible package.

BRIEF DESCRIPTION OF RELATED TECHNOLOGY

[0002] Vertical form, fill, and seal (VFFS) packaging machines are commonly used in the snack food industry for forming, filling, and sealing bags of products (*e.g.*, nuts, chips, crackers, etc.). Such packaging machines take a packaging film or flexible material from a roll and form the flexible material into a vertical tube around a product delivery cylinder. The packaging film is typically longitudinally sealed and a transverse bottom seal is formed. The package is next filled with the desired product, and a transverse bottom seal is formed. The top and bottom transverse seals each typically extend perpendicularly or obliquely from a top portion and bottom portion of the package. So disposed, the top and bottom transverse seals are subject to damage when being boxed for shipment, and may lead to irregular spacing within the package, thereby reducing packaging efficiency and increasing shipping costs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Figure 1 is a schematic front view of an embodiment of an apparatus for forming a flexible package;

[0004] Figure 2 is a further schematic front view of the embodiment of Figure 1;

[0005] Figure 3A is a plan view of an embodiment of a first forming box of an embodiment of the apparatus of Figure 1;

[0006] Figure 3B is a perspective view of the embodiment of the first forming box of Figure 3A;

[0007] Figure 4A is a front view of an embodiment of a first forming box in a first position;

[0008] Figure 4B is a front view of the embodiment of the first forming box of Figure 4A in a second position;

[0009] Figures 5A to 5M are various views of an apparatus for forming a flexible package;

[0010] Figure 6 is a schematic front view of an embodiment of a system including an embodiment of an apparatus for forming a flexible package;

[0011] Figure 7A is a front view of an embodiment of a first forming box in a first position;

[0012] Figure 7B is a front view of the embodiment of the first forming box of Figure 7A in a second position;

[0013] Figure 8A is a plan view of an embodiment of a second forming box of an embodiment of the apparatus of Figure 1;

[0014] Figure 8B is a perspective view of the embodiment of the second forming box of Figure 3A;

[0015] Figure 9A is a front view of an embodiment of a second forming box in a first position;

[0016] Figure 9B is a front view of the embodiment of the second forming box of Figure 9A in a second position;

[0017] Figure 10A is a front view of an embodiment of a first upstream folding bar in a first position;

[0018] Figure 10B is a front view of the embodiment of the first upstream folding bar of Figure 10A in a second position;

[0019] Figures 11A to 11R are various views of embodiments of portions of an apparatus for forming a flexible package;

[0020] Figure 12 is a perspective view of an apparatus in accordance with an embodiment of the disclosure including a packaging machine and an interface for further processing of the package into a cubed or cuboid shape;

[0021] Figure 13 is a perspective view of an apparatus in accordance with an embodiment of the disclosure including a packaging machine and an interface for further processing of the package into a cubed or cuboid shape;

[0022] Figure 14 is a perspective view of a portion of the interface of Figure 12, showing a rotary unit of an interface in accordance with an embodiment of the disclosure;

[0023] Figure 15 is a top cut-away view of the rotary unit of the interface of Figure 14, showing the forming boxes and internal rotation apparatuses for rotating the rotary plate and the forming boxes;

[0024] Figure 16 is a top view of a dead plate of an interface in accordance with an embodiment of the disclosure;

[0025] Figure 17 is a schematic illustration of a package residing in the forming box at the first station of an interface in accordance with an embodiment of the disclosure;

[0026] Figure 18A is a close-up view of the flap folding plate at the second station of an interface in accordance with an embodiment of the disclosure, showing the flap folding plate in the first (up) position;

[0027] Figure 18B is a close-up view of the flap folding plate of Figure 18A, showing the flap folding plate in the second (down) position;

[0028] Figure 19A is an isolated view of the flap folding plate in the first (up) position;

[0029] Figure 19B is an isolated view of the flap folding plate in an intermediate position;

[0030] Figure 19C is an isolated view of the flap folding plate in the second (down) position;

[0031] Figure 20 is a bottom perspective view of an interface in accordance with an embodiment of the disclosure;

[0032] Figure 21 is a bottom perspective view of a bracket of the interface in accordance with an embodiment of the disclosure;

[0033] Figure 22 is a bottom perspective view of the rotary plate, dead plate, and forming boxes of an interface in accordance with an embodiment of the disclosure;

[0034] Figure 23A is a chart outlining timing for a method of forming a package using an interface in accordance with an embodiment of the disclosure;

[0035] Figure 23B is a graphical representation of the chart of Figure 23A;

[0036] Figure 24A is a graphical flow chart of a method of forming a package in accordance with an embodiment of the disclosure;

[0037] Figure 24B is a chart of the timing of step illustrated in Figure 24A;

[0038] Figure 24C is a graphical representation of the chart of Figure 24B;

[0039] Figure 25A is a graphical flow chart of a method of forming a package in accordance with another embodiment of the disclosure;

[0040] Figure 25B is a chart of the timing of step illustrated in Figure 25A;

[0041] Figure 25C is a graphical representation of the chart of Figure 25B;

[0042] Figure 26A is a graphical flow chart of a method of forming a package in accordance with yet another embodiment of the disclosure;

[0043] Figure 26B is a chart of the timing of step illustrated in Figure 26A; and

[0044] Figure 26C is a graphical representation of the chart of Figure 26B.

DETAILED DESCRIPTION

[0045] Flexible stackable packages and equipment for making such packages having a generally cubed shape have been disclosed in, for example, U.S. Patent No. 8,602,244, the disclosure of which is incorporated herein by reference. The apparatus, systems, and methods of various embodiments of the disclosure can advantageously allow for formation of such flexible stackable packages with improved rigidity and/or improved shape, for example, a cubed shaped.

[0046] As described in detail below, the apparatus, systems, and methods of the disclosure can produce a flexible package in which first and second seals (also referred to as leading and trailing seals) are folded over and disposed generally in the same plane of the panel of the package from which they extend. The disclosed apparatuses can also advantageously allow for significantly increased processing speeds in forming such products, as well as the ability to convert conventional packaging machines into machines capable of forming such flexible packages.

[0047] The film is processed on the machine with a layout configured to provide a package having a cuboid shape and a predetermined internal package volume. The predetermined internal package volume is a theoretical internal volume of the package if formed without deformation and ideal filling. Processing variations on the machine can result in the actual package being formed to have a different internal package volume within a tolerance range. For example, an acceptable package can be formed if the actual package is about 85% to about 150% of the predetermined internal package volume. Other suitable tolerances include about 120% to

about 130%, about 100% to about 120%, about 85% to about 130%, and other such suitable ranges. A number of factors can be used to determine an acceptable package, including for example, customer perception, shipping factors, and stability of the package including how well the package resists deformation during shipping and use. As described in detail below, the forming boxes used in any of the described embodiments can have an internal volume selected based on the predetermined internal package volume. For example, the forming box can have an internal volume that is about 70% to about 120% of the predetermined internal package volume. Other suitable ranges include about 80% to about 90%, about 80% to about 95%, about 80% to about 100%, about 90% to about 110%, and other such suitable ranges. As described in detail below, proper sizing of the forming box as well as filling of the package to be within the tolerance range of the predetermined package volume can aid in obtaining a cuboid shape to the package by providing a sufficient internal pressure generated when the package is compressed by a forming bar or plate to act against the force of the forming bar or plate to flatten the panel of the package.

[0048] The apparatus 10 in accordance with an embodiment of the disclosure can be adapted to function with known packaging machines, including, but not limited to vertical form fill seal (VFFS) packaging machines, horizontal form, fill and seal (HFFS) machines, sequential assembly machines and the like. As used herein, a "transport path" refers to the path of the flexible material as it is transported through the conventional packaging machine during operation for making a flexible package. Also as used herein, a "transport axis" refers to the axis that extends along the transport path of the flexible material as it is transported through the conventional packaging machine during operation for making a flexible package. Figures 24-26 illustrate graphical flow charts of various methods of forming a package using embodiments of the apparatus 10 disclosed herein.

[0049] In various embodiments, the apparatus 10 can be provided on a frame assembly that is portable, allowing the apparatus 10 to be moved into and out of configuration with the conventional packaging machine, which may include a forming tube or a portion of a forming tube. The frame assembly and/or components of the apparatus 10 can be adjustable to accommodate different packaging machine configurations and heights. In other embodiments, the apparatus 10 may be a permanent and non-adjustable component of the packaging machine.

[0050] As will be described in more detail, the apparatus 10 will use at least one folding bar (*e.g.*, a first downstream folding bar 28, a first upstream folding bar 36, and/or a second downstream folding bar 44 illustrated in Figure 1) to apply pressure to a package (*e.g.*, the package 56a of Figure 4A) on or adjacent to one or more transverse seals (*e.g.*, a first transverse seal 66 and/or a second transverse seal 67 as illustrated in Figure 4A). The first transverse seal 66 is also referred to herein as the leading seal and the second transverse seal 67 is also referred to herein as the trailing seal. This pressure folds the first transverse seal 66a and/or the second transverse seal 67a towards the respective panel from which it extends and can attached the seal 66a, 67a to the material of the corresponding panel of the first package 56a. Additionally, residual heat can remain in the material of the first transverse seal 66a and/or the second transverse seal 67a resulting from the heat imparted to the material by first and second seal bars 68, 70 during the sealing of the first and/or second transverse seal 66, 67. This residual heat can aid in heat sealing the material of the seals 66, 67 to the material of the corresponding panel from which it extends during operation of the folding bars. In various embodiments, the apparatus can utilize multiple folding bars. By simultaneously using multiple folding bars (*e.g.*, the first downstream folding bar 28, the first upstream folding bar 36, and optionally the second downstream folding bar 44 illustrated in Figure 1) and multiple package retaining structure (*e.g.*, retaining structure 12a and the second forming box 12b of Figure 1), the apparatus 10 can provide an efficient way to quickly transversely seal a plurality of packages while folding over and optionally sealing the transverse seals 66a, 67a to the body of the package 56a. Because the transverse seals 66a, 67a are folded over and, in some embodiments, secured to the body of the package 56a, the transverse seals 66a, 67a lie substantially flat or flat on—and not perpendicular or oblique to—the body of the package 56a. Consequently, the top and bottom transverse seals 66a, 67a are not damaged or deformed when being boxed for shipment and do not cause spacing issues while being boxed.

[0051] Turning to the apparatus 10 in more detail, and with reference to Figure 1, an embodiment of the apparatus 10 for making a flexible package may include a retaining structure 12a that extends along the transport axis 14 from a first end 16a to a second end 18a opposite the first end 16a. The retaining structure 12a comprises two or more walls 20a that cooperate to form a lateral enclosure 22a, and each of the two or more walls 20a extend from the first end 16a to the second end 18a of the retaining structure 12a. At least a first one 24a of the two or more

walls 20a displaces relative to a second one 26a of the two or more walls 20a. In an embodiment, the retaining structure 12a can be provided as a first forming box having opposed opened ends that allow the film to be received into the structure from one end and the folding bar 22 to interact with the transverse seal at the opposed end. In some embodiments, the retaining structure 12a, can include a volume adjusting plate that actuates from one of the walls of the retaining structure in a direction perpendicular to the transport direct to define a pre-set internal volume of the package during gas filling and/or sealing of the second transverse seal.

[0052] The apparatus 10 includes a first downstream folding bar 28 disposed downstream (*i.e.*, in a direction along the transport path of the flexible material) of the retaining structure. Embodiments in which the interface is disposed beneath the packaging machine advantageously allow for the package to be dropped seamlessly from the last stage of the packaging machine into the interface without the need for additional transporting or conveying devices. The first downstream folding bar 28 has a contact portion 30, and the first downstream folding bar 28 is displaceable between a first position 32 in which the contact portion 30 is disposed remote from the second end 18a of the retaining structure 12a and a second position 34 in which the contact portion 30 is disposed at or adjacent to the second end 18a of the retaining structure 12a.

[0053] The apparatus 10 also includes a second forming box 12b longitudinally-offset (i.e., offset along the longitudinal transport axis 14) from the retaining structure 12a and downstream of both the retaining structure 12a and the first downstream folding bar 28. The second forming box 12b extends along the transport axis 14 from a first end 16b to a second end 18b opposite the first end 16b. The second forming box 12b includes two or more walls 20b that cooperate to form a lateral enclosure 22b. In various embodiments, the second forming box 12b can restrain the package about the entire circumference of the package. The second forming box 12b can be sized to be about 70% to about 120%, about 80% to about 90%, about 80% to about 95%, about 70% to about 110%, about 80% to about 100%, and other suitable ranges therein, of the pre-determined internal volume of the package. As described in detail below, sizing of the second forming box 12b (and other forming box structures of various other embodiments) to tightly restrain the package to allow for only expansion of the film to the pre-determined internal volume can allow the internal pressure within the package to act against the force of the first upstream folding bar 36 when it actuates to fold the second transverse seal 67 over toward the respective panel of the package.

[0054] The apparatus 10 further includes a first upstream folding bar 36 disposed upstream (*i.e.*, in a direction opposite to the direction of the transport path of the flexible material) of the second forming box 12b and adjacent the first end 16b of the second forming box 12b. The first upstream folding bar 36 may have a contact portion 38 and may be displaceable between a first position 40 in which the contact portion 38 is disposed remote from the second forming box 12b and a second position 42 in which the contact portion 38 is disposed at or adjacent to the first end 16b of the second forming box 12b.

[0055] The apparatus 10 additionally includes a second downstream folding bar 44 disposed downstream of the second forming box 12b and adjacent the second end 18b of the second forming box 12b. The second downstream folding bar 44 includes a contact portion 46 and is displaceable between a first position 48 in which the contact portion 46 is disposed remote from the second forming box 12b and a second position 50 in which the contact portion 46 is disposed at or adjacent to the second end 18b of the second forming box 12b.

[0056] Turning to the apparatus 10 for making a flexible package in more detail, the retaining structure 12a, which is illustrated in Figure 3B, extends along the transport axis 14 from the first end 16a to the second end 18a opposite the first end 16a. The retaining structure 12a may have any suitable shape or combination of shapes. For example, the retaining structure 12a may include two or more walls 20a that cooperate to form the lateral enclosure 22a, and the lateral enclosure 22a may be adapted to at least partially enclose a package 56, as illustrated in Figure 4A. In another embodiment, for example, and as illustrated in Figures 3A and 3B, the retaining structure 12a may include four walls—*i.e.*, a first wall 52a, a second wall 53a, a third wall 54a, and a fourth wall 55a—that cooperate to form the lateral enclosure 22a, and the first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a may cooperate to completely surround a lateral or circumferential portion of the package 56. The first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a may all be planar or substantially planar and may be aligned with the transport axis 14. In addition, the first wall 52a may be parallel to the second wall 53a and offset from the second wall 53a in a direction normal to the transport axis 14 and along the X-axis of the Reference Coordinate System of Figure 3B. The third wall 54a may extend from a first end portion of the first wall 52a and a first end portion of the second wall 53a and the fourth wall 55a may extend from a second end portion of the first wall 52a and a second end portion of the second wall 53a. So configured, the third wall 54a may be parallel to

the fourth wall 55a and offset from the fourth wall 55a in a direction normal to the transport axis 14 and along the Y-axis of the Reference Coordinate System of Figure 3B.

[0057] As illustrated in Figure 3B, each of the first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a may form a top perimeter edge 58a at the first end 16a of the retaining structure 12a. The top perimeter edge 58a may be disposed in a plane normal to the transport axis 14 (*i.e.*, a plane parallel to the X-Y plane of the Reference Coordinate System of Figure 3B). In addition, each of the first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a may form a bottom perimeter edge 58 at the second end 18a of the retaining structure 12a. The bottom perimeter edge 60a may be disposed in a plane normal to the transport axis 14 (*i.e.*, a plane parallel to the X-Y plane of the Reference Coordinate System of Figure 3B) and may be longitudinally offset (*i.e.*, offset in a direction along the transport axis 14) from the plane of the top perimeter edge 58a.

[0058] As illustrated in Figures 4A and 4B, at least a first one 24a of the two or more walls 20a may displace relative to a second one 26a of the two or more walls. For example, the first wall 52a may displace relative to the second wall 53a (or to the transport axis 14), the second wall 53a may displace relative to the first wall 53a (or to the transport axis 14), or both the first wall 52a and the second wall 53a may displace relative to each other (or to the transport axis 14). More specifically, the first wall 52a and/or the second wall 53a may displace from a first position 62a (an example of which illustrated in Figure 4A) to a second position 64a (an example of which is illustrated in Figure 4B). In the first position 62a, the first wall 52a and the second wall 53a may each be a first transverse distance D1 (*i.e.*, a distance normal to the transport axis 14) from the transport axis 14. In the first position 62a, the first wall 52a and the second wall 53a may be parallel or may be disposed at an angle (*e.g.*, an oblique angle) to each other. In the second position 64a, the first wall 52a and the second wall 53a may each be a second transverse distance D2 from the transport axis 14, and the second transverse D2 distance may be greater than the first transverse distance D1. In addition, the first wall 52a and the second wall 53a may be parallel or may be disposed at an angle (*e.g.*, an oblique angle) to each other.

[0059] In the first position 62a, as illustrated in Figure 4A, at least one of the two or more walls 20a (*e.g.*, at least one of the first wall 52a and the second wall 53a) contacts a portion of the package 56, such as a circumferential and/or lateral portion of the package 56. In some

embodiments, at least two of the two or more walls 20a (*e.g.*, each of the first wall 52a and the second wall 53a) contact corresponding portions of the package 56, such as a first circumferential and/or lateral portion of the package 56 and a second circumferential and/or lateral portion of the package 56. In some embodiments, each of the first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a contacts corresponding portions of the package 56, such as a first circumferential and/or lateral portion of the package 56, a second circumferential and/or lateral portion of the package 56, a third circumferential and/or lateral portion of the package 56, and a fourth circumferential and/or lateral portion of the package 56, respectively.

[0060] In the second position 64a, at least one of the two or more walls 20a (*e.g.*, at least one of the first wall 52a and the second wall 53a) transversely displaces away from the transport axis 14 (*e.g.*, in a direction parallel to the X-axis or Y-axis of the Reference Coordinate System of Figure 3B), and in the second position 64a, the at least one of the two or more walls 20a may displace out of contact with (*i.e.*, disengages) the portion of the package 56, such as the circumferential and/or lateral portion of the package 56. In some embodiments in the second portion 64a, at least two of the two or more walls 20a (*e.g.*, each of the first wall 52a and the second wall 53a) transversely displaces away from the transport axis 14, and in the second position 64a, the at least two of the two or more walls 20a may displaces out of contact with (*i.e.*, disengages) the corresponding portions of the package 56, such as the first circumferential and/or lateral portion of the package 56 and the second circumferential and/or lateral portion of the package 56. In other embodiments in the second position 64a, each of the first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a transversely displaces away from the transport axis 14, and each of the first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a may displace out of contact with (*i.e.*, disengage) the corresponding portions of the package 56, such as a first circumferential and/or lateral portion of the package 56, a second circumferential and/or lateral portion of the package 56, a third circumferential and/or lateral portion of the package 56, and a fourth circumferential and/or lateral portion of the package 56, respectively.

[0061] As illustrated in Figures 7A and 7B, the retaining structure 12a may also translate longitudinally (*i.e.*, along the transport axis 14) relative to a second end 72 of a forming tube 74 and/or to the second forming box 12b. For example, the retaining structure 12a may

longitudinally translate towards or away from the second end 72 of the forming tube 74 and/or towards or away from (*e.g.*, upstream or downstream of) the second forming box 12b. In some embodiments, the first end 16a of the retaining structure 12a may be a first longitudinal distance D3 from the second end 72 of the forming tube 74 (or a transverse fixed reference axis upstream of the retaining structure 12a) in a first position 94a, as illustrated in Figure 7A. In a second position 96a illustrated in Figure 7B, the first end 16a of the retaining structure 12a may be a second longitudinal distance D4 from the second end 72 of the forming tube 74 (or the transverse fixed reference axis upstream of the retaining structure 12a), and the second longitudinal distance D4 may be greater than the first longitudinal distance D3.

[0062] Referring to Figures 3A and 3B, the at least one of the two or more walls 20a may be a single, unitary part or may be a segmented wall comprising two or more component parts. More specifically, all of the first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a may be a single unitary part, or at least one of the first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a may be a segmented wall comprising two or more component parts. For example, in the second position 64a (illustrated in Figure 4B) of an embodiment of the retaining structure 12a of Figure 3B, a first portion of the third wall 54a was coupled to the first wall 52a and a second portion of the third wall 54a was coupled to the second wall 53a. So configured, the first portion of the third wall 54a and the first wall 52a rotationally displaces from the first position 62a to and from the second position 64a and the second portion of the third wall 54a and the second wall 53a rotationally displaces from the first position 62a to and from the second position 64a.

[0063] Referring to Figures 1 and 2, the apparatus 10 further includes the first downstream folding bar 28 disposed downstream of the retaining structure 12a, and the first downstream folding bar 28 may be elongated in a transverse direction. The first downstream folding bar 28 may have the contact portion 30 that is adapted to contact an upper or lower (relative to the circumferential and/or lateral) portion of the package 56. For example, the contact portion 30 may be adapted to contact at least a portion of a transverse seal (or flap) formed on an upper or lower portion of the package 56.

[0064] The first downstream folding bar 28 may be transversely displaceable between a first position 32 (illustrated in solid lines in Figures 1) and a second position 34 (illustrated in dashed

lines in Figure 1). In the first position 32, the contact portion 30 is disposed remote from the second end 18a of the retaining structure 12a. More specifically, in the first position 32, a reference point 83 of the contact portion 30 may not intersect the transport axis 14 or may be a first transverse distance 84 from the transport axis 14. In the second position 34, the contact portion 30 is disposed at or adjacent to the second end 18a of the retaining structure 12a such that the contact portion 30 (or the reference point 83 of the contact portion 30) contacts or engages the portion of the transverse seal (or flap) formed on an upper or lower portion of the package 56. For example, in the second position 34, the contact portion 30 (or the reference point 83 of the contact portion 30) contacts or engages a portion of a first transverse seal 66 (or flap) formed on a lower portion of the package 56. In some embodiments, in the second position 34, the reference point 83 of the contact portion 30 may be a second transverse distance 85 from the transport axis 14 that is less than the first transverse distance 84. If the reference point 83 of the contact portion 30 intersects or is aligned with the transport axis 14 in the second position 34, the second transverse distance 85 from the transport axis 14 may be zero.

[0065] The first downstream folding bar 28 may extend transversely across the entire second end 18a of the retaining structure 12a when in the second position 34. In other embodiments, the first downstream folding bar 28 may extend transversely across a portion of the second end 18a of the retaining structure 12a. The first downstream folding bar 28 may extend from the first position 32 to the second position 34 (and vice versa) in any manner known in the art. For example, the first downstream folding bar 28 may be planar or substantially planar and may linearly translate from the first position 32 to the second position 34 (and vice versa) within a plane normal to the transport axis 14. In other embodiments, the first downstream folding bar 28 may rotate from the first position 32 to the second position 34 (and vice versa) within a plane normal to the transport axis 14. In still other embodiments, the first downstream folding bar 28 may include two or more plates (not shown) having transverse edges that are hinged such that in the second position 34, the two or more plates cooperate to form a planar shape and in the first position 32, adjacent plates of the two or more plates rotate about the hinged transverse edges to form an angle of less than 180 degrees (e.g., 45 degrees).

[0066] As illustrated in Figures 7A and 7B, the first downstream folding bar 28 may also longitudinally translate relative to the second end 72 of a forming tube 74 and/or to the second forming box 12b. For example, the first downstream folding bar 28 may longitudinally translate

longitudinally towards or away from the second end 72 of the forming tube 74 and/or towards or way from the second forming box 12b. In some embodiments, the first downstream folding bar 28 may be longitudinally fixed relative to the retaining structure 12a such that the first downstream folding bar 28 longitudinally translates from a first position 98 (when, e.g., the retaining structure 12a is in the first position 94a) illustrated in Figure 7A and a second position 99 (when, e.g., the retaining structure 12a is in the second position 96a) illustrated in Figure 7B. However, the first downstream folding bar 28 may longitudinally translate towards or away from the retaining structure 12a.

[0067] Referring again to Figure 1, the apparatus 10 may include first and second seal bars 68, 70, and the first and second seal bars 68, 70 are disposed upstream of the first end 16a of the retaining structure 12a. The first and second seal bars 68, 70 may also be disposed downstream of the second end 72 of the forming tube 74 such that the first and second seal bars 68, 70 are disposed between the second end 72 of the forming tube 74 and the first end 16a of the retaining structure 12a. As known in the art, and as illustrated in Figure 6, the forming tube 74 may extend along the transport axis 14, and film used to form one of a plurality of packages (e.g., the package 56) may be shaped around the forming tube 74 in known manner. In addition, as is known in the art, product that is to be enclosed in the package 56 may be transported from a hopper (not shown) through an interior passageway through the forming tube 74 and out of the second end in a known manner.

[0068] The first and second seal bars 68, 70 may each be elongated and extend along a linear axis that may extend in a transverse direction (*e.g.*, along the Y-axis of the Reference Coordinate System provided in Figure 1) and each of the first and second seal bars 68, 70 may be parallel. Each of the first and second seal bars 68, 70 may be disposed on opposing sides of the transport axis 14 and each of the first and second seal bars 68, 70 may translate in a transverse direction (*e.g.*, in a direction parallel to the X-axis of the Reference Coordinate System provided in Figure 1) towards the transport axis 14.

[0069] The first and second seal bars 68, 70 may cooperate to form the transverse seal (or flap) formed on an upper or lower portion of the package 56. For example, the first and second seal bars 68, 70 may cooperate to form the first transverse seal 66 (or flap) formed on a lower portion of the package 56. The first and second seal bars 68, 70 may also cooperate to form a

second transverse seal 67 (or flap) formed on an upper portion of the package 56. The first and second seal bars 68, 70 may form the transverse seal (*e.g.*, the first and/or second transverse seal 66, 67) in any known manner, such as by heat sealing. The first and second seal bars 68, 70 may also longitudinally translate with a package 56 (as illustrated in Figures 5B to 5E, for example) while forming the first and/or second transverse seal 66, 67. For example, the first and second seal bars 68, 70 may translate longitudinally upwards or downwards relative to the second end 72 of the forming tube 74 and/or to the first end 16a of the retaining structure 12a.

[0070] Referring again to Figures 1, 8A, and 8B the apparatus 10 may also include the second forming box 12b that extends along the transport axis 14 from the first end 16b to the second end 18b opposite the first end 16b. The second forming box 12b may have any suitable shape or combination of shapes, and the second forming box 12b may be identical physically and functionally to the retaining structure 12a. For example, the second forming box 12b may include two or more walls 20b that cooperate to form the lateral enclosure 22b, and the lateral enclosure 22b may be adapted to at least partially enclose the package 56. As illustrated in Figure 8B, the second forming box 12b may include four walls—*i.e.*, a first wall 52b, a second wall 53b, a third wall 54b, and a fourth wall 55b—that cooperate to form the lateral enclosure 22b, and the first wall 52b, the second wall 53b, the third wall 54b, and the fourth wall 55b may cooperate to completely surround a lateral or circumferential portion of the package 56. The first wall 52b, the second wall 53b, the third wall 54a, and the fourth wall 55b may all be planar or substantially planar and may be aligned with the transport axis 14. In addition, the first wall 52b may be parallel to the second wall 53b and offset from the second wall 53b in a direction normal to the transport axis 14 and along the X-axis of the Reference Coordinate System of Figure 8B. The third wall 54b may extend from a first end portion of the first wall 52b and a first end portion of the second wall 53b and the fourth wall 55b may extend from a second end portion of the first wall 52b and a second end portion of the second wall 53b. So configured, the third wall 54b may be parallel to the fourth wall 55b and offset from the fourth wall 55b in a direction normal to the transport axis 14 and along the Y-axis of the Reference Coordinate System of Figure 8B.

[0071] Still referring to Figure 8B, each of the first wall 52b, the second wall 53b, the third wall 54b, and the fourth wall 55b may form a top perimeter edge 58b at the first end 16b of the second forming box 12b. The top perimeter edge 58b may be disposed in a plane normal to the

transport axis 14 (*i.e.*, a plane parallel to the X-Y plane of the Reference Coordinate System of Figure 8B). In addition, each of the first wall 52b, the second wall 53b, the third wall 54b, and the fourth wall 55ab may form a bottom perimeter edge 58b at the second end 18b of the second forming box 12b. The bottom perimeter edge 60b may be disposed in a plane normal to the transport axis 14 (*i.e.*, a plane parallel to the X-Y plane of the Reference Coordinate System of Figure 8B) and may be longitudinally offset (*i.e.*, offset in a direction along the transport axis 14) from the plane of the top perimeter edge 58b.

[0072] As illustrated in Figures 4A and 4B, at least a first one of the two or more walls 20b displaces relative to a second one of the two or more walls. That is, the first wall 52ba may displace relative to the second wall 53b, the second wall 53b may displace relative to the first wall 53b, or both the first wall 52b and the second wall 53b may displace relative to each other (or to the transport axis 14). More specifically, the first wall 52b and/or the second wall 53b may displace from a first position 62b (an example of which illustrated in Figure 4A) to a second position 64b (an example of which is illustrated in Figure 4B). In the first position 62b, the first wall 52b and the second wall 53b may each be a first transverse distance D1 (*i.e.*, a distance normal to the transport axis 14) from the transport axis 14. In the first position 62b, the first wall 52b and the second wall 53b may be parallel or may be disposed at an angle (*e.g.*, an oblique angle) to each other. In the second position 64b, the first wall 52b and the second wall 53b may each be a second transverse D2 distance from the transport axis 14, and the second transverse distance D2 may be greater than the first transverse distance D1. The first wall 52b and the second wall 53b can move symmetrically such that the first and second transverse distances D1, D2 are symmetrical about the transport axis 14. Alternatively, the first wall 52b and the second wall 53b can move different distances such that the first and second transverse distances D1 and D2 are asymmetrical about the transport axis 14. In still further embodiments, only one of the walls can move while the other is stationary. In addition, the first wall 52b and the second wall 53b may be parallel or may be disposed at an angle (*e.g.*, an oblique angle) to each other.

[0073] In the first position 62b illustrated in Figure 4A, at least one of the two or more walls 20b (*e.g.*, at least one of the first wall 52b and the second wall 53b) contacts a portion of the package 56, such as a circumferential and/or lateral portion of the package 56. In some embodiments, at least two of the two or more walls 20b (*e.g.*, each of the first wall 52b and the second wall 53b) contact corresponding portions of the package 56, such as a first

circumferential and/or lateral portion of the package 56 and a second circumferential and/or lateral portion of the package 56. In some embodiments, each of the first wall 52b, the second wall 53b, the third wall 54b, and the fourth wall 55b contacts corresponding portions of the package 56, such as a first circumferential and/or lateral portion of the package 56, a second circumferential and/or lateral portion of the package 56, a third circumferential and/or lateral portion of the package 56, and a fourth circumferential and/or lateral portion of the package 56, respectively.

[0074] In the second position 64b illustrated in Figure 4B, at least one of the two or more walls 20b (*e.g.*, at least one of the first wall 52b and the second wall 53b) transversely displaces away from the transport axis 14 (*e.g.*, in a direction parallel to the X-axis or Y-axis of the Reference Coordinate System of Figure 2A), and in the second position 64b, the at least one of the two or more walls 20b may displace out of contact with (*i.e.*, disengages) the portion of the package 56, such as the circumferential and/or lateral portion of the package 56. In some embodiments in the second portion 64b, at least two of the two or more walls 20b (*e.g.*, each of the first wall 52b and the second wall 53b) transversely displaces away from the transport axis 14, and in the second position 64b, the at least two of the two or more walls 20b may displace out of contact with (*i.e.*, disengages) the corresponding portions of the package 56, such as the first circumferential and/or lateral portion of the package 56 and the second circumferential and/or lateral portion of the package 56. In other embodiments in the second position 64b, each of the first wall 52b, the second wall 53b, the third wall 54b, and the fourth wall 55b transversely displaces away from the transport axis 14, and each of the first wall 52b, the second wall 53b, the third wall 54b, and the fourth wall 55b may displace out of contact with (*i.e.*, disengage) the corresponding portions of the package 56, such as a first circumferential and/or lateral portion of the package 56, a second circumferential and/or lateral portion of the package 56, a third circumferential and/or lateral portion of the package 56, and a fourth circumferential and/or lateral portion of the package 56, respectively.

[0075] The second forming box 12b may be longitudinally fixed relative to the second end 72 of a forming tube 74 and/or to the retaining structure 12a. However, as illustrated in Figures 9A and 9B, the second forming box 12b may translate longitudinally relative to the second end 72 of a forming tube 74 and/or to the retaining structure 12a. For example, the second forming box 12b may longitudinally translate towards or away from the second end 72 of the forming tube 74

and/or towards or away from the retaining structure 12a. In some embodiments, the first end 16b of the second forming box 12b may be a first longitudinal distance D5 from the second end 72 of the forming tube 74 (or a transverse fixed reference axis upstream of the retaining structure 12a) in a first position 94b, as illustrated in Figure 9A. In a second position 96b illustrated in Figure 9B, the first end 16a of the second forming box 12b may be a second longitudinal distance D6 from the second end 72 of the forming tube 74 (or the transverse fixed reference axis upstream of the retaining structure 12a), and the second longitudinal distance D6 may be greater than the first longitudinal distance D4.

[0076] Referring to Figures 8A and 8B, the at least one of the two or more walls 20b may be a single, unitary part or may be a segmented wall comprising two or more component parts. More specifically, all of the first wall 52b, the second wall 53b, the third wall 54b, and the fourth wall 55b may be a single unitary part, or at least one of the first wall 52b, the second wall 53b, the third wall 54b, and the fourth wall 55b may be a segmented wall comprising two or more component parts. For example, in the second position 64b of an embodiment of the second forming box 12b of Figure 4B, a first portion of the third wall 54b was coupled to the first wall 52b and a second portion of the third wall 54b was coupled to the second wall 53b. So configured, the first portion of the third wall 54b and the first wall 52b rotationally or laterally displaces from the first position 62b to and from the second position 64b and the second portion of the third wall 54b and the second wall 53b rotationally or laterally displaces from the first position 62b to and from the second position 64b.

[0077] Referring to Figure 1, the apparatus 10 further includes the first upstream folding bar 36 that may be identical in structure and function to the first downstream folding bar 28. The first upstream folding bar 36 may be disposed downstream of the first downstream folding bar 28 and may be upstream of the first end 16b of the second forming body 12b. The first upstream folding bar 36 may be elongated in a transverse direction. The first upstream folding bar 36 may have the contact portion 38 that is adapted to contact an upper or lower (relative to the circumferential and/or lateral) portion of the package 56. For example, the contact portion 38 may be adapted to contact at least a portion of a transverse seal (or flap) formed on an upper or lower portion of the package 56.

[0078] The first upstream folding bar 36 may be transversely displaceable between a first position 40 and a second position 42, as illustrated in Figures 1. In the first position 40, the contact portion 38 is disposed remote from the first end 16b of the second forming box 12b. More specifically, in the first position 40, a reference point 86 of the contact portion 38 may not intersect the transport axis 14 or may be a first transverse distance 87 from the transport axis 14. In the second position 42, the contact portion 38 is disposed at or adjacent to the first end 16b of the second forming box 12b such that the contact portion 38 (or the reference point 86 of the contact portion 38) contacts or engages the portion of the transverse seal (or flap) formed on an upper or lower portion of the package 56. For example, in the second position 42, the contact portion 38 (or the reference point 83 of the contact portion 38) contacts or engages a portion of the second transverse seal 67 (or flap) formed on an upper portion of the package 56. In some embodiments, in the second position 42, the reference point 86 of the contact portion 38 may be a second transverse distance 88 from the transport axis 14 that is less than the first transverse distance 87. If the reference point 86 of the contact portion 38 intersects or is aligned with the transport axis 14 in the second position 42, the second transverse distance 87 from the transport axis 14 may be zero.

[0079] The first upstream folding bar 36 may extend transversely across the entire first end 16b of the second forming box 12b when in the second position 42. In other embodiments, the first upstream folding bar 36 may extend transversely across a portion of the first end 16b of the second forming box 12b. The first upstream folding bar 36 may extend from the first position 40 to the second position 42 (and vice versa) in any manner known in the art. For example, the first upstream folding bar 36 may be planar or substantially planar and may linearly translate from the first position 40 to the second position 42 (and vice versa) within a plane normal to the transport axis 14. In other embodiments, the first upstream folding bar 36 may rotate from the first position 40 to the second position 42 (and vice versa) within a plane normal to the transport axis 14. In other embodiments, the first upstream folding bar 36 may include two or more plates having transverse edges that are hinged such that in the second position 42, the two or more plates cooperate to form a planar shape and in the first position 40, adjacent plates of the two or more plates rotate about the hinged transverse edges to form an angle of less than 180 degrees (*e.g.*, 45 degrees).

[0080] As illustrated in Figures 10A and 10B, the first downstream folding bar 36 may also longitudinally translate relative to the second end 72 of a forming tube 74 and/or to the retaining structure 12a and/or the second forming box 12b. For example, the first downstream folding bar 36 may longitudinally translate longitudinally towards or away from the second end 72 of the forming tube 74 and/or towards or away from the retaining structure 12a and/or the second forming box 12b. In some embodiments, a portion of the first downstream folding bar 36 may be a first longitudinal distance D7 from the second end 72 of the forming tube 74 (or a transverse fixed reference axis upstream of the retaining structure 12a) in a first position 100, as illustrated in Figure 10A. In a second position 101 illustrated in Figure 10B, a portion of the first downstream folding bar 36 may be a second longitudinal distance D8 from the second end 72 of the forming tube 74 (or the transverse fixed reference axis upstream of the retaining structure 12a), and the second distance D8 may be less than the first distance D7.

[0081] Referring once more to Figure 1, the apparatus 10 further includes the second downstream folding bar 44 that may be identical in structure and function to the first downstream folding bar 28 and/or the first upstream folding bar 36. The second downstream folding bar 44 may be disposed downstream of the second end 18b of the second forming body 12b. The second downstream folding bar 44 may be elongated in a transverse direction. The second downstream folding bar 44 may have the contact portion 46 that is adapted to contact an upper or lower (relative to the circumferential and/or lateral) portion of the package 56. For example, the contact portion 46 may be adapted to contact at least a portion of a transverse seal (or flap) formed on an upper or lower portion of the package 56.

[0082] The second downstream folding bar 44 may be transversely displaceable between a first position 48 and a second position 50, illustrated in Figure 1. In the first position 48, the contact portion 46 is disposed remote from the second end 18b of the second forming box 12b. More specifically, in the first position 48, a reference point 89 of the contact portion 46 may not intersect the transport axis 14 or may be a first transverse distance 90 from the transport axis 14. In the second position 50, the contact portion 46 is disposed at or adjacent to the second end 18b of the second forming box 12b such that the contact portion 46 (or the reference point 89 of the contact portion 46) contacts or engages the portion of the transverse seal (or flap) formed on an upper or lower portion of the package 56. For example, in the second position 50, the contact portion 46 (or the reference point of the contact portion 46) contacts or engages a portion of the

first transverse seal 66 (or flap) formed on a lower portion of the package 56. In some embodiments, in the second position 50, the reference point 89 of the contact portion 46 may be a second transverse distance 91 from the transport axis 14 that is less than the first transverse distance 90. If the reference point 89 of the contact portion 46 intersects or is aligned with the transport axis 14 in the second position 50, the second transverse distance 91 from the transport axis 14 may be zero.

[0083] The second downstream folding bar 44 may extend transversely across the entire second end 18b of the second forming box 12b when in the second position 50. In other embodiments, the second downstream folding bar 44 may extend transversely across a portion of the second end 18b of the second forming box 12b. The second downstream folding bar 44 may extend from the first position 48 to the second position 50 (and vice versa) in any manner known in the art. For example, the second downstream folding bar 44 may be planar or substantially planar and may linearly translate from the first position 48 to the second position 50 (and vice versa) within a plane normal to the transport axis 14. In other embodiments, the second downstream folding bar 44 rotate from the first position 48 to the second position 50 (and vice versa) within a plane normal to the transport axis 14. In other embodiments, the second downstream folding bar 44 may include two or more plates having transverse edges that are hinged such that in the second position 50, the two or more plates cooperate to form a planar shape and in the first position 48, adjacent plates of the two or more plates rotate about the hinged transverse edges to form an angle of less than 180 degrees (*e.g.*, 45 degrees).

[0084] As illustrated in Figures 9A and 9B, the second downstream folding bar 44 may also longitudinally translate relative to the second end 72 of a forming tube 74 and/or to the retaining structure 12a and/or to the second forming box 12b. For example, the second downstream folding bar 44 may longitudinally translate longitudinally towards or away from the second end 72 of the forming tube 74 and/or towards or away from the retaining structure 12a. In some embodiments, the second downstream folding bar 44 may be longitudinally fixed relative to the second forming box 12b such that the second downstream folding bar 44 longitudinally translates from a first position 102 (when, e.g., the second forming box 12b is in the first position 94b) illustrated in Figure 9A and a second position 103 (when, e.g., the second forming box 12b is in the second position 96b) illustrated in Figure 9B. However, the first downstream folding bar 28 may longitudinally translate towards or away from the second forming box 12b.

[0085] As previously discussed, the apparatus 10 can be provided on a frame assembly 76 illustrated in Figure 11A that is portable, allowing the apparatus 10 to be moved into and out of configuration with the conventional packaging machine104 illustrated in Figure 6, which may include the forming tube 74 and other known forming features that cooperate to at least partially form the package 56 from a roll of film. The frame assembly 76 may include two or more rollers or casters 106 to facilitate mobility. Various views of various embodiments are illustrated in Figures 11A to 11R. Figures 11A to 11R illustrate the frame assembly and portions of the apparatus in absence of conventional packaging machine 104 elements such as the forming tube to illustrate the apparatus and portability thereof.

[0086] In use, the apparatus 10 may be used to form a plurality of packages 56, such as a first package 56a and a subsequently-formed second package 56b, which can be identical and are illustrated in Figures 4A and 4B. Specifically, the first package 56a, which may be formed in a known manner, may be at least partially disposed within the lateral enclosure 22a of the retaining structure 12a, as illustrated in Figures 2, 4A, and 4B. However, the first package 56a may be at least partially formed and may be at least partially disposed within the lateral enclosure 22a of the retaining structure 12a. The partially-formed first package 56a may include the formed lateral or circumferential portion of the first package 56a (which may be formed and longitudinally-sealed sealed along the forming tube 74 in a known manner) as well as the first transverse seal 66a (or flap) formed on the lower portion of the package 56a, as illustrated in Figure 4A. The first transverse seal 66a (or flap) of the first package 56a may be formed by the first and second seal bars 68, 70. The first package 56a may extend along a first package axis 78a from a first end 80a to a second end 82a opposite to the first end 80a, and the first transverse seal 66a (or flap) may be disposed at or adjacent to the second end 82a. When the first package 56a is at least partially disposed within the lateral enclosure 22a, the second end 82a of the first package 56a may be adjacent to the second end 18a of the retaining structure 12a. In some embodiments, the first package axis 78a may be parallel to or aligned with the transport axis 14.

[0087] Prior to or as the first package 56a is at least partially disposed within the lateral enclosure 22a, the first downstream folding bar 28 may be displaced in a transverse direction (*i.e.*, normal to the transport axis 14) from the first position 32 in which the contact portion 30 of the first downstream folding bar 28 (or in which the reference point 83 of the contact portion 30 of the first downstream folding bar 28) is the first transverse distance 84 from the transport axis

14 to the second position 34 in which the contact surface 30 of the first downstream folding bar 28 (or in which the reference point 83 of contact portion 30 of the first downstream folding bar 28) is the second transverse distance 85 from the transport axis 14 and may be adjacent to the second end 18a of the retaining structure 12a, as illustrated in Figures 5A and 5B. In the second position 34, the contact portion 30 (at or adjacent to the reference point 83) applies pressure to the bottom flap 66a disposed at the second end of the first package. This pressure, in conjunction with residual heat in the material of the first transverse seal 66 transferred by the first and second seal bars 68, 70, folds the seal over and seals the first transverse seal 66 to the material of the lower portion of the first package 56a.

[0088] After (or as) the first downstream folding bar 28 translates from the first position 32 to the second position 34, at least one of the two or more walls 20a that cooperate to form the lateral enclosure 22a of the retaining structure 12a displaces towards the transport axis 14 such that the at least one of the two or more walls 20 contacts a lateral portion of the first package 56a, as illustrated in Figures 5A and 5B. In some embodiments, at least two of the two or more walls 20a (*e.g.*, each of the first wall 52a and the second wall 53a) contact corresponding portions of the package 56a, such as a first circumferential and/or lateral portion of the package 56 and a second circumferential and/or lateral portion of the package 56. In some embodiments, each of the first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a contacts corresponding portions of the package 56, such as a first circumferential and/or lateral portion of the package 56, a second circumferential and/or lateral portion of the package 56, a third circumferential and/or lateral portion of the package 56, and a fourth circumferential and/or lateral portion of the package 56, respectively.

[0089] After (or as) the at least one of the two or more walls 20a displaces towards the transport axis 14, each of the first seal bar 68 and the second seal bar 70 displaces towards the transport axis 14 to seal a portion of the first end 80 of the first package 56a to form the second transverse seal 67 (*i.e.*, the top flap) formed on the upper portion of the first package 56a, as illustrated in Figures 5A and 5B. The first seal bar 68 and the second seal bar 70 may then longitudinally displace downstream while sealing the portion of the first end 80 of the first package 56a, as illustrated in Figures 5B to 5E. The first seal bar 68 and the second seal bar 70 may then displace away from the transport axis 14, as illustrated in Figures 5E and 5F. As illustrated in Figures 5E and 5F, a cutting operation may transversely cut a transverse portion of

the second transverse seal 67a to form a separate and fully-formed first package 56a. The cutting operation may occur as, after, or before the first seal bar 68 and the second seal bar 70 displace towards the transport axis 14 (or as, after, or before the first seal bar 68 and the second seal bar 70 form the second transverse seal 67a.

[0090] Prior to or as the first seal bar 68 and the second seal bar 70 translate towards the transport axis 14 to form the second transverse seal 67a, the first folding box 12a and the first downstream folding bar 28 may longitudinally displace upstream to properly align the first package 56a, as illustrated in Figures 5A and 5B. While the first seal bar 68 and the second seal bar 70 form the second transverse seal 67 and longitudinally translate downstream, the first folding box 12a and the first downstream folding bar 28 may longitudinally displace downstream at the same rate of speed as the first seal bar 68 and the second seal bar 70, as illustrated in Figures 5B to 5E.

[0091] During (or after) any or both of the cutting operation or the first seal bar 68 and the second seal bar 70 form the second transverse seal 67, the first downstream folding bar 28 may transversely displace (or may begin to displace) from the second position 34 to the first position 32. When the first downstream folding bar 28 reaches the first position 32, the first package 56a may displace or begin to displace (under the influence of gravity, and optionally through one or more guides, which are not shown) towards the second folding box 12b.

[0092] As or before the first package 56a displaces or begins to displace out of the first folding box 12a and towards the second folding box 12b, the first upstream folding bar 36 may be in the second position 42 (or may displace from the first position 40 to the second position 42), as illustrated in Figures 5A to 5C and 5J to 5L. In addition, as or before the first package 56a displaces or begins to displace towards the second folding box 12b, the second downstream folding bar 44 may be in the second position 50 (or may displace from the first position 48 to the second position 50), as illustrated in Figures 5B to 5C and 5G to 5M.

[0093] After (or as) the second downstream folding bar 44 translates from the first position 48 to the second position 50, and after or as the first upstream folding bar 36 is in the first position 40, at least one of the two or more walls 20b that cooperate to form the lateral enclosure 22b of the second forming box 12b may displace away from the transport axis 14 such that the at least one of the two or more walls 20b are adapted to receive the first package 56a, as Illustrated in

Figure 5H. In some embodiments, at least two of the two or more walls 20a displace away from the transport axis 14. In some embodiments, each of the first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a displaces away from the transport axis 14.

[0094] After (or as) the first downstream folding bar 28 translates from the second position 34 to the first position 32, the first package 54 may then longitudinally translate downstream such that the first package 56a is at least partially disposed within the lateral enclosure 22b of the second forming box 12b, as illustrated in Figures 5G to 5J. After or as the second end 82 of the first package 56a engages the contact portion 46 of the second downstream folding bar 44 (which is in the second position 50), at least one of the two or more walls 20b that cooperate to form the lateral enclosure 22b of the second forming box 12b may displace towards the transport axis 14 such that the at least one of the two or more walls 20b contacts a lateral portion of the first package 56a, as illustrated in Figure 5J and 5K. In some embodiments, at least two of the two or more walls 20b (*e.g.*, each of the first wall 52b and the second wall 53b) contact corresponding portions of the first package 56a, such as a first circumferential and/or lateral portion of the first package 56a and a second circumferential and/or lateral portion of the first package 56a. In some embodiments, each of the first wall 52b, the second wall 53b, the third wall 54b, and the fourth wall 55b contacts corresponding portions of the first package 56a, such as a first circumferential and/or lateral portion of the first package 56a, a second circumferential and/or lateral portion of the first package 56a, a third circumferential and/or lateral portion of the first package 56a, and a fourth circumferential and/or lateral portion of the first package 56a, respectively.

[0095] After or as the first package 56a is at least partially disposed within the lateral enclosure 22b, the first upstream folding bar 36 may be displaced from the first position 40 to the second position 42 in which the contact surface 38 of the first upstream folding bar 36 (or in which the reference point 86 of the contact portion 38 of the first upstream folding bar 36) may be adjacent to the first end 16b of the second forming box 12b. The first upstream folding bar 36 may also longitudinally translate downstream (from the second position 101 to the first position 100 of Figure 10A and 10B) after or as the first upstream folding bar 36 is displaced from the first position 40 to the second position 42, as illustrated in Figures 5K and 5L. As such, the contact surface 38 of the first upstream folding bar 36 longitudinally travels to come into contact with the top flap 67a disposed at the first end 80a of the first package 56a. In the second position

42, the contact portion 38 (at or adjacent to the reference point 86) applies pressure to the top flap 67a disposed at the first end 80a of the first package 56a. This pressure, in conjunction with residual heat in the material of the second transverse seal 67 transferred by the first and second seal bars 68, 70, folds the seal over and attaches the second transverse seal 67 to the material of the upper portion of the first package 56a.

[0096] As illustrated in Figure 5L, and as the first package 56a is at least partially disposed within the lateral enclosure 22b of the second forming box 12b, and as the first upstream folding bar 36 is in the second position 42, the second downstream folding bar 44 may be in the second position 50, in which the contact portion 46 of the second downstream folding bar 44 (or in which the reference point 89 of contact portion 46) is the second transverse distance 90 from the transport axis 14 and may be adjacent to the second end 18b of the second forming box 12b. In the second position 50, the contact portion 46 (at or adjacent to the reference point 89) applies pressure to the bottom flap 66a disposed at the second end 82 of the first package 56a, which can aid in further setting a crease in the folded second transverse seal and in various embodiment setting a heat seal between the flexible material of the corresponding panel and the second transverse seal imparted when the first downstream folding bar 28 folds the second transverse seal over. The second downstream folding bar 44 also supports the weight of the package during actuation of the first upstream folding bar 36. The first upstream folding bar 36 actuates to a second position to engage the first transverse seal and apply a pressure to the package. This pressure, in conjunction with residual heat in the material of the first transverse seal 66 transferred by the first and second seal bars 68, 70, folds the seal 66 over toward the panel from which it extends and, in some embodiments, attaches the first transverse seal 66 to the material of the lower portion of the first package 56a.

[0097] After the second downstream folding bar 44 is in the second position 50 and applies pressure to the bottom flap 66 disposed at the second end 82 of the first package 56a, the second downstream folding bar 44 then translates to the first position 48, as illustrated in 5B to 5D. When the second downstream folding bar 44 reaches the first position 48, the first package 56a may displace or begin to displace (under the influence of gravity, and optionally through one or more guides, which are not shown) towards a conveyor 108 (illustrated in Figure 6) or other take-away device for further processing or packaging.

[0098] As the cutting operation or the first seal bar 68 and the second seal bar 70 form the second transverse seal 67a of the first package 56a, the first seal bar 68 and the second seal bar 70 may form the first transverse seal 66b of the second package 56b, as illustrated in Figures 5E and 5F. After or as the first package 56a translates from the retaining structure 12a towards the second forming box 12b (*e.g.*, as the first end 80 of the first package 56a is downstream of the second end 18a of the retaining structure 12a) as previously described and as illustrated in Figure 5G, the first downstream folding bar 28 may translate (or may begin to translate) from the first position 32 to the second position 34, as illustrated in Figures 5A and 5B.

[0099] While the first downstream folding bar 28 is in the first position 32, the fully-formed (or at least partially-formed) second package 56b may be at least partially disposed within the lateral enclosure 22a of the retaining structure 12a, as illustrated in Figure 5J to 5M. With reference to Figures 4A and 4B, the partially-formed second package 56b may include the formed lateral or circumferential portion of the second package 56b (which may be formed and longitudinally sealed along the forming tube 74 in a known manner) as well as the first transverse seal 66b (or flap) formed on the lower portion of the second package 56b. The first transverse seal 66b (or flap) of the second package 56b may be formed by the first and second seal bars 68, 70. The second package 56b may extend along a first package axis 78 from a first end 80 to a second end 82 opposite to the first end 80, and the first transverse seal 66 (or flap) may be disposed at or adjacent to the second end 82. When the second package 56b is at least partially disposed within the lateral enclosure 22a, the second end 82 of the second package 56b may be adjacent to the second end 18a of the retaining structure 12a. In some embodiments, the package axis 78 of the second package 56b may be parallel to or aligned with the transport axis 14.

[00100] Prior to or as the second package 56b may be at least partially disposed within the lateral enclosure 22a of the retaining structure 12a, at least one of the two or more walls 20a that cooperate to form the lateral enclosure 22a of the retaining structure 12a displaces away from the transport axis 14 as previously described and as illustrated with reference to the first package 56a in Figures 5F and 5G. The first downstream folding bar 28 may subsequently transversely displace from the first position 32 to the second position 34 (as previously described and as illustrated with reference to the first package 56a Figures 5A and 5B).

[00101] As or after the first downstream folding bar 28 transversely displaces from the first position 32 to the second position 34 and/or as or after the second end 82 of the second package 56b contacts the contact portion 30 of the first downstream folding bar 28, at least one of the two or more walls 20a that cooperate to form the lateral enclosure 22a of the retaining structure 12a displaces towards the transport axis 14 such that the at least one of the two or more walls 20 contacts a lateral portion of the second package 56b (in a manner substantially identical to the first package 56a illustrated in Figures 5A and 5B). In some embodiments, at least two of the two or more walls 20a (*e.g.*, each of the first wall 52a and the second wall 53a) contact corresponding portions of the second package 56b, such as a first circumferential and/or lateral portion of the second package 56b and a second circumferential and/or lateral portion of the second package 56b. In some embodiments, each of the first wall 52a, the second wall 53a, the third wall 54a, and the fourth wall 55a contacts corresponding portions of the second package 56b, such as a first circumferential and/or lateral portion of the second package 56b, a second circumferential and/or lateral portion of the second package 56b, a third circumferential and/or lateral portion of the package 56, and a fourth circumferential and/or lateral portion of the package 56, respectively.

[00102] After (or as) the at least one of the two or more walls 20a displaces towards the transport axis 14, each of the first seal bar 68 and the second seal bar 70 displaces towards the transport axis 14 to seal a portion of the first end 80 of the second package 56b to form the second transverse seal 67b (*i.e.*, the top flap) formed on the upper portion of the second package 56b (in a manner identical to the first package 56a illustrated in Figures 5A and 5B). The first seal bar 68 and the second seal bar 70 may then displace transversely away from the transport axis 14. Prior to or as the first seal bar 68 and the second seal bar 70 translate towards the transport axis 14 to form the second transverse seal 67b, the first folding box 12a and the first downstream folding bar 28 may longitudinally displace upstream to properly align the second package 56b (in a manner substantially identical to the first package 56a illustrated in Figures 5A and 5B). While the first seal bar 68 and the second seal bar 70 form the second transverse seal 67b and longitudinally translate downstream, the first folding box 12a and the first downstream folding bar 28 may longitudinally displace downstream at the same rate of speed as the first seal bar 68 and the second seal bar 70, as illustrated in Figures 5B to 5E (in a manner identical to Figures 5B to 5E). A cutting operation may transversely cut a transverse portion of the second

transverse seal 67 to form a separate and fully-formed second package 56b, (in a manner identical to the first package 56a illustrated in Figure 5F). The cutting operation may occur as, after, or before the first seal bar 68 and the second seal bar 70 displace towards the transport axis 14 (or as, after, or before the first seal bar 68 and the second seal bar 70 form the second transverse seal 67.

[00103] During (or after) any or both of the cutting operation or the first seal bar 68 and the second seal bar 70 form the second transverse seal 67b, the first upstream folding bar 36 may also longitudinally translate upstream (from the first position 100 to the second position 101 of Figure 10A and 10B) after or as the first upstream folding bar 36 is displaced from the second position 42 to the first position 40, as illustrated in Figures 5E and 5F. Also, during (or after) any or both of the cutting operation or the first seal bar 68 and the second seal bar 70 form the second transverse seal 67b, the first downstream folding bar 28 may transversely displace (or may begin to displace) from the second position 34 to the first position 32, as illustrated in Figures 5E to 5G. When the first downstream folding bar 28 reaches the first position 32, the second package 56b may displace or begin to displace (under the influence of gravity, and optionally through one or more guides, which are not shown) towards the second folding box 12b (in a manner identical to the first package 56a illustrated in Figure 5G). Once the second package 56b is at least partially disposed within the lateral enclosure 22b of the second folding box 12b, the process is substantially identical to that when the first package 56a was at least partially disposed within the lateral enclosure 22b of the second folding box 12b.

[00104] The skilled person would recognize that as the cutting operation or the first seal bar 68 and the second seal bar 70 form the second transverse seal 67 of the second package 56b, the first seal bar 68 and the second seal bar 70 may form the first transverse seal 66 of a third package 56c. As the second package 56b translates from the first folding box 12a towards the second forming box 12b (*e.g.*, as the first end 80 of the second package 56b is downstream of the second end 18a of the retaining structure 12a) as previously described, the first downstream folding bar 28 may translate (or may begin to translate from the first position 32 to the second position 34. As or after the first downstream folding bar 28 is in the second position 34, the third package 56c may be at least partially disposed within the lateral enclosure 22a of the retaining structure 12a, and the process is that same for that of the second package 56b previously described.

[00105] The skilled person would recognize that the apparatus 10 provides a high-velocity, mobile sealing machine that, as previously described, uses internal package pressure generated when the package is compressed by the folding bar, in conjunction with residual heat in the material of the first transverse seal 66a and/or the second transverse seal 67a transferred by, for example, the first and second seal bars 68, 70, to fold the seal over and optionally attach the first and second transverse seal 66a, 67a to the material of the lower and/or upper portions of the first package 56a. Because the transverse seals 66a, 67a are secured to the body of the package 56a, the transverse seals 66a, 67a lie substantially flat on—and not perpendicular or oblique to—the body of the package 56a, the top and bottom transverse seals 66a, 67a are not damaged or deformed when being boxed for shipment and do not cause spacing issues while being boxed.

Apparatus with Interface

[00106] Referring to Figures 12 and 13, in accordance with an embodiment, the apparatus 100 for forming a package can include an interface 102 for generating a package having a cube or cuboid shape. The interface 102 can be configured to be used in connection with known packaging machines 104, including, for example, continuous motion vertical form fill seal packaging machines. One example of a continuous motion vertical form fill seal packaging machine is Triangle Model XYT15 Vertical-Form-Fill Seal Bagging Machine. Such conventional bagging machines can conventionally produce, for example, gable top packages in which the bottom of the package is substantially flat. Such conventional packing machines, however, are incapable of forming a cube or cuboid package. The interface 102 in accordance with embodiments of the description can be adapted to work in connection with such conventional machines to form cuboid packages. The conventional packaging machine can be modified in various embodiments to include a flap folding bar that actuates in two axes as opposed to a single axis as is conventional. In any of the foregoing embodiments, a two axis motion, such as described for the flap folding plate 130 of the interface, can be used for any of the described flap folding mechanisms of the packaging machines of the disclosure. In various embodiments, the two axis motion can be controlled by an actuator that allows for independent control of the axes independently. This can allow for more flexibility when folding, which can improve the forming process and ultimately the package shape/structure.

[00107] In accordance with an embodiment, as illustrated in Figures 12 and 13, the interface 102 can be configured to reside beneath a conventional packaging machine 104, such that the package is seamlessly transferred from the conventional bagging machine to the interface. Embodiments in which the interface 102 is disposed beneath the packaging machine advantageously allow for the package to be dropped from the last stage of the packaging machine 104 into the interface 102 without the need for additional devices or transfer steps. However, other placements of the interface are contemplated herein, including arrangements in which conveyors or other transfer devices are utilized to transfer the package from the packaging machine to the interface. It is also contemplated that the interface can be made integral with the packaging machine to provide a single, non-separable packaging machine unit.

[00108] Referring to Figure 14, in accordance with an embodiment, the interface can include a rotary unit 106 that contains a plurality of forming boxes 112 disposed on a rotating axis to allow for translation in a generally circular motion of the forming boxes 112 through multiple stations of the interface 102. In various embodiments, the forming boxes 112 can be attached to a rotating plate 108 that rotates the forming boxes in a circular motion. Any suitable means for rotating the plate 108 can be used. For example, the rotating plate can be servo driven. In such embodiments, the rotating plate 108 can include or be attached to a drive shaft that is connected to a servo motor gearbox for connection to the servo motor.

[00109] Any of the forming box configurations described above can be used in the interface. Referring to Figure 15, in one embodiment, the forming boxes 112 include first and second separable portions 116, 118. The portions 116, 118 can both be movable or only one of the portions can be moveable. For example, the first portion 116 can be in a fixed position and rotate with the movement of the rotating plate 108, while the second portion is moveable into and out of engagement with the first portion 116 as well as rotating with the motion of the rotating plate 108. Referring to Figure 15, in an embodiment, the second portion 116 of the forming boxes 112 can be connected to a cam assembly 120 that guides the second portion 116 in a secondary motion into and out of engagement with the first portion.

[00110] The cam assembly 120 includes a cam follower that resides in a guide disposed beneath the rotating plate 108. For example, in an embodiment, the rotary unit 106 can include a dead plate 110 that resides beneath at least some of the forming boxes 112 and defines a bottom

wall of the forming boxes 112. Referring to Figure 16, the dead plate 110 can include the guide 114 in which the cam follower resides, thereby defining the secondary motion of the forming boxes 112 around the rotary unit 106. As the forming boxes approach different stations, the position of the second portion 118 is adjusted as the cam follower proceeds along the guide 114. The path of the guide 114 can be used to define the position of the second portion 118 of the forming box at a given station of the rotary unit 106. For example, in the first station 122, the package can be received in the forming box 112 from the packaging machine. The forming box 112 can be in a package receiving or open position in which the first and second portions are separated in order to allow the package to drop within the forming box 112. As the forming box 112 transfers to the second position 124, the second portion 118 can be guided into engagement with the first portion 116 to provide a tight fight around the package during subsequent processing. When the forming box 112 approaches the final station (shown as a fourth station 128 in the figures), the second portion 118 can again be guided away from the first portion 116 to allow the forming box 112 to open and the package to exit the rotary unit 106. Referring to Figure 15, the forming box at the first station 122 is shown in an open position, while the forming box 112 at the second station 124 is shown in a closed position.

[00111] The path of the guide 114 can be any suitable shape depending on the number of stations and the desired position of the forming box 112 at a given station. The forming box 112 portions 116, 118 can be actuated to any suitable number of positions. In one embodiment, the forming box is actuated between an open position and a closed position. In another embodiment, the forming box 112 portions 116, 118 can be actuated between a package receiving position in which the portions are slightly separated, a package retaining position, in which the portions are held together to tightly retain the package, and a package ejection position in which the portions are more widely separated than the packaging receiving position.

[00112] Generally, the forming boxes 112 will have a size and shape corresponding to the package 200 to be formed. In various embodiments, the forming boxes 112 can be readily removed from the rotary unit 106 to allow the forming boxes 112 to be easily changed for forming boxes of another size and/or shape to accommodate formation of a different sized or shaped package.

[00113] In accordance with various embodiments, the forming box will be sized to a have an internal volume that is 70% to 120% of the internal volume of the final cuboid package. Other suitable percentages include about 85% to about 100%, about 80% to about 90%, about 80% to about 95%, about 90% to about 100%, and about 80% to about 110%. By so configuring the internal volume of the forming box, the package once resided in the forming box can be pressurized by the application of the folding plate 130 compressing the package. Because the forming box 112 is sized to tightly retain the package, the forming box 112 reduces or prevents deformation of the flexible film beyond the predetermined internal package volume, thereby allowing the internal pressure within the package to act against the force of the flap folding plate, which can aid in achieving the cuboid shape of the package. As discussed in detail below, the package can be configured to a have predetermined internal package volume during sealing of the package on the packaging machine. The internal package volume can be adjusted by the amount of product and/or the amount of gas allowed in or removed from the package just prior to sealing. The forming box 112 is also sized to account for the presence of quad seals on one or more panels of the package, as the presence of the quad seal can affect the width the forming box needed so not to deform or damage the one or more quad seals. Referring to Figure 17, the forming box 112 is also configured such that at least a portion of the panel of the package 200 having the trailing seal 210 will be disposed above the top edge of the walls of the forming box such that the trailing seal can be engaged by the folding plate or flap. In some embodiments, the forming boxes 112 can include a volume adjuster that allows the internal volume of the box 112 to be adjusted during processing to accommodate packages that may be over or under filled with gas during the package sealing steps performed upstream of the interface 102.

[00114] Alternatively or additionally, the packaging machine 104 can be adapted to include a volume-adjusting box that includes an actuating plate that squeezes the package to adjust the volume to the desired value just prior to sealing the package. The interface can be provided with the volume-adjusting box as a separate unit to be installed on the packaging machine. Providing the package with a sufficient internal volume (resulting from the presence of product and entrapped air or gas) within the package, as well as providing properly sized forming boxes aids in achieving well defined folds and creases in the package during processing on the interface, which in turn can allow for improved cuboid shaping and retention of the cuboid shape. Various conditions can be adjusted to control the internal package volume to achieve a targeted

(predetermined) internal package volume. For example, the volume-adjusting box can be used to remove gas from the package by slightly squeezing the package. This can be done with or without a gas flushing operation that adds gas to the package to further expand the package after filling with product. Gas flushing operations are known in the art and any known rates of fill, times of fill, and types of gasses can be used depending on the product contained therein. The speed of the seal jaws of the packaging machine can also be used to control the internal package volume. Actuation of the seal jaw more quickly can result in more gas being trapped within the package, while actuation of the seal jaw more slowly allows for the package to equilibrate and have less trapped gas.

[00115] The forming box 112 can also include gas channels and/or other heating and cooling elements to facilitate folding and/or shaping of the package while the package resides in the forming box. Heating of portions of the forming box 112 can aid in forming defined edges of the package, while cooling can aid in setting any folds or seals in the package.

[00116] Further discussion of the interface 102 will be made to an apparatus having four forming boxes 112 as illustrated in the figures. However, it is contemplated that additional or fewer forming boxes can be utilized. The number of forming boxes 112 included in the interface 102 can be determined based on a number of factors, including, but not limited to, the type and/or thickness of film used and ease of heat sealing and creasing, the desired speed of packages to be produced in a unit of time, the size of the interface and corresponding size of the packaging machine to which the interface is to be adapted, as well as the size of the forming boxes (which in turn relates to the size of the packages) and the number of secondary operations (such as heat setting edges) that are to be performed. For example, the interface can include 2, 3, 4, 5, 6, 7, 8, 9, or 10 forming boxes.

[00117] For ease of reference, the operation of the interface 106 will be described with reference to the progression of a single forming box. Figures 23A and 23B illustrate a timing chart for forming a package in accordance with an embodiment of the disclosure using the interfaces. As one forming box leaves a station, the next forming box enters that station. For example, as a forming box at the first station 122 leaves the first station, the forming box disposed at the fourth station 128 rotates to enter the first station. In various embodiments, the forming boxes can move continuously through the stations. The forming boxes can be arranged

a fixed distance between each forming box or can be disposed at variable distances. For example, the rotary unit can be provided in a race-track configuration as opposed to the rotating disc as shown in the figures. In such embodiments, motor driven chain drive or other actuating devices can be used to transport the forming boxes between the stations. Linear motor technology can allow for independent control of the distance between forming boxes and the timing of the forming boxes at a given station.

[00118] In the embodiment shown and described in detail below, the interface includes four stations and four forming boxes, with the forming boxes rotating in a clockwise direction. Counter-clockwise rotation is also contemplated herein. Further, as noted above, fewer or more forming boxes are also within the contemplation of the disclosure. Fewer or more stations are also contemplated herein. The rotary motion of the interface and processing of the package in multiple stations using multiple forming boxes allows for the interface to perform the cubing function with sufficient timing to define the edges of the package and, in particular, in part substantially flat panels to the sides of the package having the leading and trailing seals, while keeping up with the rate of the continuous motion packaging machine.

[00119] The interface can be rotated at various speeds and configurations. For example, the interface can run in an intermittent mode where the rotation is stopped for a duration of time before rotating the forming boxes to the next station. Stopping of the rotation can aid in transferring the package from the packaging machine to the forming box at the first station of the interface. This can be particularly useful when the package is transferred to the forming box at the first station by gravity after the seal of the package is cut from the continuous tube of flexible film in the packaging machine. In other embodiments, the rotary unit 106 can be rotated continuously through the stations. The rotary unit 106 can be rotated at a continuous speed or a variable speed. For example, in an embodiment utilizing variable speed, the rotary unit 106 can slow as a forming box is approaching and or at the first station to receive a package and then speed up in the distance between stations. Any suitable rotating speed configuration can be used.

[00120] In operation, a package is transferred from the packaging machine to the interface such that the panel of the package 200 having the trailing seal 210 is disposed near the top of the forming box 112 with the trailing seal 210 extending above the top edge of the forming box 112. On the packaging machine, the package is oriented such that the leading and trailing seals extend

outwardly from a panel of the package in a direction that is parallel to the transport direction of the film. The packaging machine can include a flap folding apparatus for folding a leading seal of the package over such that it is disposed substantially in the plane of the panel of the package and, in some embodiments, attached to the respective panel of the package. The trailing seal 210 of the package 200, however, may remain substantially extended in an upright position after processing in the packaging machine.

[00121] Referring again to Figure 14, the package can then be transferred to the first station 122 of the interface into a forming box 112 disposed in the first station 122. In an embodiment, the packaging machine can form a combination leading and trailing seal in which a trailing seal of first package is formed in combination with the leading seal of the upstream package. At substantially the same time, the leading seal of the first package can be folded over by a flap folding bar that actuates across the package to engage the seal and fold it over to towards the panel of the package from which it extends. The combination leading and trailing seal can then be cut, which results in dropping of the package to the interface. In some embodiments, the packaging machine can be modified to include a flap folding bar that can be raised in a coordinated manner with the operation of the seal jaws.

[00122] Guide boxes or other guiding devices may be included on the interface and/or the packaging machine above the forming box at the first station 122 to facilitate transfer of the package in the proper orientation into the forming box 112. Referring to Figure 17, in the proper orientation, the package will reside with the folded leading seal disposed against a bottom wall of the forming box 112, if present, or on a dead plate and the trailing seal will be disposed in an upright position extending at least slightly above the top edge of the walls of the forming box 112.

[00123] At the first station 122, the forming box 112 can be disposed in the package receiving position to receive the package. As shown in Figure 14, the package receiving position can be a separation of first and second portions 116, 118 of the forming box as described in detail above. Once the package is received, the forming box 112 can be rotated to the second station. As described above, the rotary unit can rotate the forming boxes continuously with continuous or variable speed, or intermittently where the forming boxes stop for a preset delay.

[00124] Referring to Figures 18A and 18B, the forming box is rotated to the second station 124, the package is engaged by a flap folding plate 130. The flap folding plate 130 actuates from a first (up) position (shown in Figure 18A) downward towards and across the package to a second (down) position (shown in Figure 18B) in which it engages and folds the trailing seal 210 over towards the panel of the package from which it extends and applies a force to the panel of the package to flatten the panel of the package. In other embodiments, the flap folding plate 130 can actuate linearly perpendicular to the top of the forming box between the first and second positions. Various types of movement of the flap folding plate 130 can be accomplished in any embodiment of the disclosure. For example, the flap folding plate 130 can be actuated in an angled linear motion as shown in the Figures 18A and 18B. The flap folding plate 130 can be coupled to an actuator or motor that allows for independent control of the flap folding plate 130 position in each of the two axis of movement. Other embodiments, include the flap folding plate 130 may be actuated along two axes by a pre-configured cam path or using a programmable path on independent axes.

[00125] The force applied by the flap folding plate 130 also translates to an applied force against the panel of the package having the leading seal, forcing the panel against the bottom wall of the forming box 112, if present, or dead plate 110, which can aid in further defining a flat, cube-like shape to that panel of the package, as well. Figure 18B illustrates a gap between the top of the folding box 112 and the flap folding plate 130 when the flap folding plate is in the second, downward, position. The size of the gap can be varied depending on the package size and the internal volume of the package that is present to act against the force of the flap folding plate and aid in forming the side into a flat or flatter shape. In some embodiments, the flap folding plate 130 can be disposed just above the top of the forming box 112 when it is in the second, downward, position. The flap folding plate 130 can be configured to begin actuating when the forming box 112 is at a pre-set distance from the first station 124, but prior to the forming box 112 reaching the second station 126. For example, the flap folding plate 130 can begin to actuate when the forming box is 0° to 30° prior to the second station 124. For example, the flap folding plate 130 can actuate when the forming box has positioned the package a sufficient distance towards the second station to allow the flap folding plate 130 to engage substantially all of the trailing seal substantially perpendicularly to the trailing seal.

[00126] In various embodiments, the flap folding plate 130 has actuated to the second (down) position in which it is disposed over the forming box and applies a pressure to the package to hold the trailing seal in the folded over position by the time the forming box reaches the second station. In other embodiments, for example, in an intermittent motion configuration, the flap folding plate 130 can actuate while the forming box 112 is stopped at the second station.

[00127] As noted above, the forming box is sized such that the internal volume with the flap folding bar 130 in the down position allows for the internal package to be slightly pressurized. This internal pressure presses against the film, opposing the force of the flap folding bar 130, which aids in defining the package to have the cuboid shape. Without sufficient internal pressure or a properly sized forming box, packages having less defined and sharp edges may be produced. The size of the forming box 112 can affect how the internal pressure against the force of the flap folding plate 130. For example, if the package has sufficient internal pressure, but is not held tightly in the forming box, the force of the flap folding plate 130 may cause the faces of the package to deform outwardly until they contact the walls of the forming box, thereby compressing the side panels having the leading and trailing seals towards each other rather than flattening against a resistant internal pressure. Similarly, if the forming box is properly size for a given predicted internal final package volume, but the package is under pressurized during sealing, there will be insufficient force to oppose the force of the flap folding plate to maintain and define the package shape. As with an improperly size forming box 112, the under pressurized package may result in deformation of the package within the forming box, leading to a less defined cuboid shape, for example, a trapezoidal shape.

[00128] The flap folding plate 130 can actuate using any known actuator or combinations of actuators. Further, as noted above, while the figures illustrate motion of the flap folding bar 130 in an angled linear motion, non-linear motion in two axes or single axis motion are contemplated herein. Referring to Figures 19A-19C, in one embodiment, the flap folding plate 130 can include a rail 132 disposed on the plate 130 and can be connected to an actuating arm 136, which in turn can be actuated by any suitable means such as motor or servo. A carriage assembly 134 or other rail connecting device can engage the rail 132. Referring again to Figures 18A and 18B, the carriage assembly or rail connecting device can be attached to the interface, for example, at a bracket 138, to retain the flap folding plate 130 in the proper position above the second station 124. Figure 19A shows the flap folding plate 130 in the first position in which it is disposed up

and away from the forming box. Figure 19B shows the flap folding plate 130 in an intermediate position. Figure 19C shows the flap folding plate 130 in the second position in which it is positioned downward towards the forming box and engaging the package. The rail 132 can be angled such that the flap folding bar 130 is actuated both down and across the panel of the package exposed above the forming box 112. For example, the rail can be angled about 15° to about 70°, about 20° to about 30°, about 20° to about 45°, or about 15° to about 30°, and other suitable ranges therein. In other embodiments, the flap folding plate 130 can have a two-axis motion that is not constrained by a rail or guide angle as the embodiment shown in Figure 18A and 18B. Various known two-axis actuators can be used giving free motion in both axes. In various embodiments, two-axis motion can be defined by a cam track that guides a cam follower and along with it the flap folding bar in a desired motion. Other embodiment can include systems for providing a programmable motion profile.

[00129] The flap folding plate 130 can have any size or shape. In various embodiments, the flap folding plate is sized such that when actuated to the second (down) position, the plate covers the entire width of the forming box 112. Where the interface is contemplated for use with different sized forming boxes, the flap folding plate can be sized to have a width that is at least as wide as the widest forming box to be used. The flap folding plate 130 can have a length such that it is capable of engaging all or at least a portion of the package prior to the forming box being positioned in the second station 124. Additionally or alternatively, the flap folding plate 130 can have a length such that it is also capable of remaining in contact with the package when the forming box 112 leaves the second station. As illustrated in Figure 21 and discussed in detail below, the flap folding plate 130 can be sized so that it resides in the path between the second and third stations and is next to and optionally in contact with the holding plate 140 when in the second down position.

[00130] Referring to Figure 20, the forming box can optionally transition to a third station 126 that includes a holding plate 140 for providing additional dwell time to the folded trailing seal. Alternatively, the forming box can be transitioned to a final station (shown in the figures as a fourth station 128) for release of the package to a take-away device. As the forming box transitions from the second station 124 to the third station 126 or final station 128 where no third station 126 is present, the flap folding plate 130 moves back to the first position to reset for receipt of the next forming box into the second station 124. After transition out of the second

station 124, the package at the trailing seal and associated panel engages with a holding plate 140 disposed above the third station. Referring to Figure 20, the holding plate 140 can be configured to extend up to the end of the second station 124, such that there is substantially no gap between the flap folding plate 130 (when in the second position) and the holding plate 140. For example, the holding plate can extend such that at least a portion of the holding plate covers substantially all of the top of the forming box when the forming box is 0° to about 70° after the end of the second station 124 or any point therebetween..

[00131] Figure 21 is an isolated view of the flap folding plate 130 and holding plate 140 in accordance with an embodiment of the disclosure. The flap folding plate 130 and the holding plate 140 can be attached to a bracket 138. The flap folding plate 130 and holding plate 140 can be configured so they are directly adjacent each other and there is substantially no gap between the end of the flap folding plate 130 and the end of the holding plate 140. The transition from the flap folding plate 130 to the holding plate 140 can be disposed at the edge of the forming box located in the second station 124 or at a distance past the second station 124, between the second and third stations, 124, 126. The holding plate 140 can be in a stationary position at a height for engaging the package in the forming box as it rotates from the flap folding plate 130 to the holding plate 140. In other embodiments, the holding plate 140 can actuate in a linear (up and down) position to engage the package as it rotates to a predetermined position. For example, the holding plate 140 can actuate from a first (up) position to a second (down) position when the forming box is 0° to 70° past the end of the second station 124 and then actuate from the second (down) position to the first (up) position when the forming box is 0° to 70° past the end of the third station.

[00132] In various embodiments, the transition between the folding plate 130 and the holding plate 140 occurs at the edge of the forming box at the second station 124 so that the package transfers quickly to the stationary 140 and the flap folding plate 130 can be withdrawn to the first position as the forming box transitions out of the second station to reset for the next forming box. The holding plate 140 can also be disposed such that it is in line with the flap folding bar 130 when it is disposed in the second (downward) position and engaging the package. So configured, once the forming box begins to transition out of the second station, the package immediately or substantially immediately engages the holding plate 140. For example, in one embodiment, the package can be engaged with the flap folding plate 130 and the holding plate

140 at the same time. Thus, pressure is maintained on the trailing seal 210 and associated panel of the package through the entire transition between the second and third stations, despite release of the flap folding plate 130 when the package is disposed out of the second station 124. The holding plate 140 can also extend past the third station 126 through the transition between the third and fourth stations 126, 128 or even above the fourth station as well. In other embodiments, the holding plate 140 terminates at the third station or at a transition point between the third and fourth stations.

[00133] The holding plate 140 applies continued dwell pressure to the panel of the package and the folded trailing seal. This added dwell time can allow for the additional time needed for attaching the trailing seal to the panel of the package or imparting a strong fold in the trailing seal so that it resides in the substantially the same plane as the panel of the package and does not unfold during use. When it is desired to attach the trailing seal to the panel of the package, any number of processes can be used including heat sealing and/or the application of an adhesive. Advantageously, the interface with the added dwell time provided by the holding plate 140 can allow for attachment of the trailing seal using the residual heat remaining in the trailing seal during the seal forming process to heat seal the trailing seal to the film at the panel of the package.

[00134] Referring to Figure 22, the forming box 112 then transitions to the final (fourth) station 128 where the package is released from the forming box 112. While reference is made herein to a fourth station, it should be understood that the number of the stations will change depending on the number of stations included in the interface. At a minimum the interface will include a package receiving station (first station 122 of the Figures), a flap folding station (second station 124 of the figures) and a final package release station (fourth station 126 of the figures). The interface can optionally include a dwell time station where a holding plate 140 applies pressure to the trailing seal after flap folding as added dwell time. Additional stations, such as edge heating stations, can also be included in the interface as desired.

[00135] Referring to Figures 14 and 15, at the fourth station 128, the forming box can open slightly to release the package. Referring again to Figure 22, in various embodiments, the forming box does not include a bottom wall and instead is positioned adjacent to a dead plate 110. The dead plate can be sized and shaped to be disposed in the first, second, and third

stations, but not in the fourth station. Thus, when the forming box with the package reaches the fourth station, the package drops through the opening in the bottom of the forming box onto a take away system, such as a conveyor. Figure 16 illustrates the dead plate 110 in isolation showing an embodiment in which the dead plate is shaped as a truncated disc. The truncation of the disc corresponds to the location of the fourth station 128, which allows the package to fall through the forming box 112 past the dead plate 110 and onto a take away system, such as a conveyor. Other configurations of the dead plate can be used. For example, the dead plate can be a complete disc having an aperture disposed in the location of the fourth station that is sized to allow the package to fall through the aperture to the take away system. Figure 12 illustrates an embodiment in which the package is released from the fourth station 128 onto a conveyor.

[00136] In other embodiments, the forming box can include a bottom wall that actuates out of position to provide an opening in the bottom of the forming box through which the package can drop. In yet further embodiments, the forming box can actuate to an opening position in which the package can be ejected from a side of the forming box as opposed to through the bottom.

[00137] Referring to Figures 16 and 21, the dead plate 110 and/or the holding plate 140 can include one or more groves 142 housing outlets of gas or air passageways to allow for heated and/or cooled air to be directed onto the package. While reference herein is made to air outlets and passages, it should be understood that other gasses can be suitably used and flowed through these structures as an alternative to air. For example, in an embodiment, the dead plate can direct heated air or other gas toward the panel of the package having the leading seal (residing at the bottom of the forming box) to aid in further defining the shape of the package at that end while it is constrained in the forming box. For example, the heated air can be directed to the package for a first portion of the rotary cycle. The first portion can be, for example, through the first and second stations. The dead plate can then be configured to direct cooled air to set the panel of the package at the bottom of the forming box through a second portion of the rotary cycle, for example, through the transition of the forming box from the second to the fourth stations.

[00138] In an embodiment, the holding plate 140 can include grooves 142 and air passages to direct cooled or heated air to the trailing seal panel of the package. For example, in an embodiment, the holding plate 140 can direct heated air to the panel of the package with the

trailing seal when the package initially transitions from the second station to the third station and then direct cooled air to the panel of the package when it is in the third station and through transition to the end of the holding plate 140. Any timing or configuration of cooled or heated air can be used in either the dead plate or the holding plate 140. It is also contemplated herein that no heating or cooling using air directed to the package is used.

[00139] Referring to Figure 21, in an embodiment, the interface can include an upper bracket 138 that may include a transition guide box 144 that guides the package from the packaging machine into the forming box at the first station. As described above, the holding plate 140 and the flap folding plate 130 can be attached to the bracket 138. Referring to Figure 20, the bracket 138 can be attached to a frame 146 of the interface. The frame can house the rotary unit 106 having rotating plate 108, the forming boxes 112, the dead plate 110, and various actuating mechanisms needed for rotation of the forming boxes 112 and/or the rotary plate 108. The bracket 138 can be adjustable on the frame 146 such that the position of the holding plate 140 and the flap folding plate 130 can be adjusted relative to the top of the forming boxes to accommodate changes in package and/or forming box size. The frame 146 can also be adjustable such that the entire height of the interface can be adjusted to accommodate packaging machines having different heights. Adjustment of the frame and/or bracket on the frame can be accomplished manually. Alternatively actuators can be provided to aid in adjustment of either or both of the frame and/or the bracket.

[00140] While various embodiments have been described above, the disclosure is not intended to be limited thereto. Variations can be made to the disclosed embodiments that are still within the scope of the appended aspects.

Aspects of the Disclosure:

Apsect 1. A method of forming a plurality of packages using an apparatus that includes a retaining structure and at least one forming box, each of the retaining structure and at least one forming box each extending along a transport axis from a first end to a second end, and each of the retaining structure and at least one forming box having two or more walls that cooperate to form a lateral enclosure, the method comprising:

(a) positioning a first package of the plurality of packages at least partially within the lateral enclosure of the retaining structure, the first package extending along a first package axis

from a first end and a second end opposite to the first end, and wherein the second end of the first package is adjacent to the second end of the retaining structure, the first package having a bottom flap;

(b) displacing a first downstream folding bar in a direction normal to the transport axis from a first position in which a contact portion of the first downstream folding bar is a first transverse distance from the transport axis to a second position in which the contact surface of the first downstream folding bar is a second transverse distance from the transport axis and adjacent to the second end of the retaining structure, wherein the first transverse distance is greater than the second transverse distance, and wherein in the second position, the contact portion applies pressure to a bottom flap disposed at the second end of the first package;

(c) optionally displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the retaining structure towards the transport axis such that the at least one of the two or more walls contacts a portion of the first package;

(d) displacing each of a first seal bar and a second seal bar towards the transport axis to seal a portion of the first end of the first package to form a top flap of the first package;

(e) displacing the first downstream folding bar in a direction normal to the transport axis from the second position to the first position;

(f) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the retaining structure away from the transport axis such that the at least one of the two or more walls disengages the portion of the first package;

(g) displacing each of the first seal bar and the second seal bar away from the transport axis after sealing the portion of the first end of the first package to form the top flap of the first package;

(h) displacing a second downstream folding bar in a direction normal to the transport axis from a first position in which a contact portion of the second downstream folding bar is a first transverse distance from the transport axis to a second position in which the contact surface of the second downstream folding bar is a second transverse distance from the transport axis and adjacent to the second end of the at least one forming box, wherein the first transverse distance is greater than the second transverse distance;

(i) positioning the first package at least partially within the lateral enclosure of the at least one forming box, wherein the second end of the first package is adjacent to the second end of the at least one forming box and the second end of the first package is in contact with the contact portion of the second downstream folding bar;

(j) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the at least one forming box towards the transport axis such that the at least one of the two or more walls contacts a portion of the first package;

(k) displacing a first upstream folding bar in a direction normal to the transport axis from a first position in which a contact portion of the first upstream folding bar is a first transverse distance from the transport axis to a second position in which the contact surface of the first upstream folding bar is a second transverse distance from the transport axis and adjacent to the first end of the at least one forming box, wherein the first transverse distance is greater than the second transverse distance, and wherein in the second position, the contact portion applies pressure to a top flap disposed at the first end of the first package;

(l) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the at least one forming box away from the transport axis such that the at least one of the two or more walls disengages the portion of the first package;

(m) displacing the second downstream folding bar in a direction normal to the transport axis from the second position to the first position; and

(n) displacing the first upstream folding bar in a direction normal to the transport axis from the second position to the first position.

Apsect 2. The method of aspect 1, wherein (b) displacing the first downstream folding bar from the first position to the second position occurs at the same time as (c) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the retaining structure towards the transport axis.

Apsect 3. The method of aspect 1, wherein (b) displacing the first downstream folding bar from the first position to the second position occurs after (c) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the retaining structure towards the transport axis and/or before (d) displacing each of the first seal bar and the second

seal towards the transport axis to seal a portion of the first end of the first package to form the top flap of the first package.

Apsect 4. The method of aspect 1, wherein (c) displacing the at least one of the two or more walls that cooperate to form the lateral enclosure of the retaining structure towards the transport axis occurs at the same time as (d) displacing each of the first seal bar and the second seal bar towards the transport axis.

Apsect 5. The method of aspect 1, wherein (c) displacing the at least one of the two or more walls that cooperate to form the lateral enclosure of the retaining structure towards the transport axis occurs before (d) displacing each of the first seal bar and the second seal bar towards the transport axis.

Apsect 6. The method of aspect 1, wherein (e) displacing the first downstream folding bar from the second position to the first position occurs after (c) displacing the at least one of the two or more walls that cooperate to form the lateral enclosure of the retaining structure towards the transport axis.

Apsect 7. The method of aspect 1, wherein (e) displacing the first downstream folding bar from the second position to the first position occurs at the same time as (c) displacing the at least one of the two or more walls that cooperate to form the lateral enclosure of the retaining structure towards the transport axis.

Apsect 8. The method of aspect 1, wherein the first package axis is parallel to or aligned with the transport axis.

Apsect 9. The method of aspect 1, wherein (e) displacing the first downstream folding bar from the second position to the first position occurs after (g) displacing each of the first seal bar and the second seal bar away from the transport axis after sealing the portion of the first end of the first package to form the top flap of the first package.

Apsect 10. The method of aspect 1, wherein (e) displacing the first downstream folding bar from the second position to the first position occurs while (g) displacing each of the first seal bar and the second seal bar away from the transport axis after sealing the portion of the first end of the first package to form the top flap of the first package.

Apsect 11. The method of aspect 1, wherein (h) displacing the second downstream folding bar from the first position to the second position occurs before (e) displacing the first downstream folding bar from the second position to the first position.

Apsect 12. The method of aspect 1, wherein (h) displacing the second downstream folding bar from the first position to the second position occurs while (e) displacing the first downstream folding bar from the second position to the first position.

Apsect 13. The method of aspect 1, wherein (h) displacing the second downstream folding bar from the first position to the second position occurs before (i) positioning the first package at least partially within the lateral enclosure of the at least one forming box, wherein the second end of the first package is adjacent to or above the second end of the at least one forming box.

Apsect 14. The method of aspect 1, wherein (h) displacing the second downstream folding bar from the first position to the second position occurs while (i) positioning the first package at least partially within the lateral enclosure of the at least one forming box, wherein the second end of the first package is adjacent to or above the second end of the at least one forming box.

Apsect 15. The method of aspect 1, wherein (j) displacing the first upstream folding bar from the first position to the second position occurs after (i) positioning the first package at least partially within the lateral enclosure of the at least one forming box, wherein the second end of the first package is adjacent to or above the second end of the at least one forming box.

Apsect 16. The method of aspect 1, wherein (a) positioning a first package at least partially within the lateral enclosure of the retaining structure occurs after (b) displacing the first downstream folding bar from the first position to the second position.

Apsect 17. The method of aspect 1, wherein (a) positioning a first package at least partially within the lateral enclosure of the retaining structure occurs while (b) displacing the first downstream folding bar from the first position to the second position.

Apsect 18. The method of aspect 1, wherein (k) displacing the first upstream folding bar from the first position to the second position occurs while (j) displacing at least one of the

two or more walls that cooperate to form the lateral enclosure of the at least one forming box towards the transport axis.

Apsect 19. The method of aspect 1, wherein (k) displacing the first upstream folding bar from the first position to the second position occurs after (j) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the at least one forming box towards the transport axis.

Apsect 20. The method of aspect 1, wherein (l) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the at least one forming box away from the transport axis occurs at the same time as (m) displacing the second downstream folding bar from the second position to the first position.

Apsect 21. The method of aspect 1, wherein (l) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the at least one forming box away from the transport axis occurs after (m) displacing the second downstream folding bar from the second position to the first position.

Apsect 22. The method of aspect 1, wherein (n) displacing the first upstream folding bar in a direction normal to the transport axis from the second position to the first position occurs after (m) displacing the second downstream folding bar from the second position to the first position.

Apsect 23. The method of aspect 1, wherein (n) displacing the first upstream folding bar in a direction normal to the transport axis from the second position to the first position occurs after (l) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the at least one forming box away from the transport axis.

Apsect 24. The method of aspect 1, wherein (n) displacing the first upstream folding bar in a direction normal to the transport axis from the second position to the first position occurs while (l) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the at least one forming box away from the transport axis.

Apsect 25. The method of aspect 1, further comprising:

(o) positioning a second package of the plurality of packages at least partially within the lateral enclosure of the retaining structure, the second package extending along a second package

axis from a first end to a second end opposite to the first end, and wherein the second end of the second package is adjacent to the second end of the retaining structure.

Apsect 26. The method of aspect 25, wherein (o) positioning a second package at least partially within the lateral enclosure of the retaining structure occurs before (m) displacing the second downstream folding bar in a direction normal to the transport axis from the second position to the first position.

Apsect 27. The method of aspect 25, further comprising:

(p) displacing the first downstream folding bar in a direction normal to the transport axis from the first position in which the contact portion of the first downstream folding bar is remote from the second end of the retaining structure to the second position in which the contact surface of the first downstream folding bar is adjacent to the second end of the retaining structure, wherein in the second position, the contact portion applies pressure to a bottom flap disposed at the second end of the second package.

Apsect 28. The method of aspect 25, wherein (p) displacing the first downstream folding bar from the first position to the second position occurs before (m) displacing the second downstream folding bar in a direction normal to the transport axis from the second position to the first position.

Apsect 29. The method of aspect 27, further comprising:

(q) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the retaining structure towards the transport axis such that the at least one of the two or more walls contacts a portion of the second package.

Apsect 30. The method of aspect 25, wherein (q) displacing at least one of the two or more walls that cooperate to form the lateral enclosure of the retaining structure towards the transport axis occurs before (m) displacing the second downstream folding bar in a direction normal to the transport axis from the second position to the first position.

Apsect 31. An apparatus for forming a flexible package, comprising:

a retaining structure that extends along a transport axis from a first end to a second end opposite the first end, wherein the retaining structure comprises two or more walls that cooperate to form a lateral enclosure, wherein each of the two or more walls extend from the first end to the

second end of the retaining structure, wherein at least a first one of the two or more walls displaces relative to a second one of the two or more walls, and wherein the flexible package is adapted to be disposed at least partially within the lateral enclosure;

an elongated first downstream folding bar disposed downstream of the retaining structure, wherein the first downstream folding bar includes a contact portion and is displaceable between a first position in which the contact portion is a first transverse distance from the transport axis to a second position in which the contact surface of the first downstream folding bar is a second transverse distance from the transport axis and adjacent to the second end of the retaining structure, wherein the first transverse distance is greater than the second transverse distance, and wherein in the second position, the contact portion is adapted to apply pressure to a bottom flap disposed at the second end of the flexible package;

a forming box longitudinally-offset from the retaining structure and downstream of both the retaining structure and the first downstream folding bar, the forming box extending along the transport axis from a first end to a second end opposite the first end, wherein the forming box comprises two or more walls that cooperate to form a lateral enclosure, and wherein when the first downstream folding bar is in the first position, the contact portion of the first downstream folding bar is disposed between the second end of the retaining structure and the first end of the folding box, and wherein the flexible package is adapted to be disposed at least partially within the lateral enclosure;

a first upstream folding bar disposed upstream of the forming box and adjacent the first end of the forming box, wherein the first upstream folding bar has a contact portion and is displaceable between a first position in which the contact portion is a first transverse distance from the transport axis to a second position in which the contact surface of the first upstream folding bar is a second transverse distance from the transport axis and adjacent to the first end of the forming box, wherein the first transverse distance is greater than the second transverse distance, and wherein in the second position, the contact portion is adapted to apply pressure to a top flap disposed at the first end of the flexible package; and

a second downstream folding bar disposed downstream of the forming box and adjacent the second end of the forming box, wherein the second downstream folding bar includes a contact portion and is displaceable between a first position in which a contact portion of the

second downstream folding bar is a first transverse distance from the transport axis to a second position in which the contact surface of the second downstream folding bar is a second transverse distance from the transport axis and adjacent to the second end of the second forming box, wherein the first transverse distance is greater than the second transverse distance, and wherein in the second position, the contact portion is adapted to apply pressure to the bottom flap disposed at the first end of the flexible package.

Apsect 32. The apparatus of aspect 31, wherein each of the two or more walls of the retaining structure and the forming box extends from the first end to the second end of the retaining structure and the forming box.

Apsect 33. The apparatus of aspect 31, wherein the two or more walls of one or both of the retaining structure and the forming box includes first, second, third, and fourth walls.

Apsect 34. The apparatus of aspect 31, further comprising one or more retaining structure actuators operatively coupled to the retaining structure to actuate the retaining structure between a first position for receiving a package, a second position for retaining a package, and a third position for releasing the package; and

one or more forming box actuators operatively coupled to the forming box to actuate the forming box between a first position for receiving a package, a second position for retaining a package, and a third position for releasing the package.

Apsect 35. The apparatus of aspect 31, further comprising one or more first downstream folding bar actuators operatively coupled to the first downstream folding bar to actuate the first downstream folding bar in a direction substantially transverse to a transport path of a flexible material between the first position and the second position.

Apsect 36. The apparatus of aspect 31, wherein the two or more walls that cooperate to form the lateral enclosure of each of the retaining structure and the forming box extend along the transport axis.

Apsect 37. A system for making a flexible package, comprising:

a packaging machine comprising a forming tube and at least one seal bar, the seal bar adapted to form at least one of a top flap disposed at a first end of the flexible package or a bottom flap disposed at a second end of the flexible package; and

a modular apparatus for forming a flexible package, the modular apparatus comprising:

a retaining structure disposed downstream of the at least one seal bar, the retaining structure extending along a transport axis from a first end to a second end opposite the first end, wherein the retaining structure comprises two or more walls that cooperate to form a lateral enclosure, wherein each of the two or more walls extend from the first end to the second end of the retaining structure;

an elongated first downstream folding bar disposed downstream of the retaining structure, wherein the first downstream folding bar includes a contact portion and is displaceable between a first position in which the contact portion is a first transverse distance from the transport axis to a second position in which the contact surface of the first downstream folding bar is a second transverse distance from the transport axis and adjacent to the second end of the retaining structure, wherein the first transverse distance is greater than the second transverse distance, and wherein in the second position, the contact portion is adapted to apply pressure to the bottom flap disposed at the second end of the flexible package;

a forming box longitudinally-offset from the retaining structure and downstream of both the retaining structure and the first downstream folding bar, the forming box extending along the transport axis from a first end to a second end opposite the first end, wherein the forming box comprises two or more walls that cooperate to form a lateral enclosure, and wherein when the first downstream folding bar is in the first position, the contact portion of the first downstream folding bar is disposed between the second end of the retaining structure and the first end of the folding box, and wherein the flexible package is adapted to be disposed at least partially within the lateral enclosure;

a first upstream folding bar disposed upstream of the forming box and adjacent the first end of the forming box, wherein the first upstream folding bar has a contact portion and is displaceable between a first position in which the contact portion is a first transverse distance from the transport axis to a second position in which the contact surface of the first upstream folding bar is a second transverse distance from the transport axis and adjacent to the first end of the forming box, wherein the first transverse distance is greater than the second transverse distance, and wherein in the second position, the

contact portion is adapted to apply pressure to the top flap disposed at the first end of the flexible package; and

a second downstream folding bar disposed downstream of the forming box and adjacent the second end of the forming box, wherein the second downstream folding bar includes a contact portion and is displaceable between a first position in which a contact portion of the second downstream folding bar is a first transverse distance from the transport axis to a second position in which the contact surface of the second downstream folding bar is a second transverse distance from the transport axis and adjacent to the second end of the forming box, wherein the first transverse distance is greater than the second transverse distance, and wherein in the second position, the contact portion is adapted to apply pressure to the bottom flap disposed at the first end of the flexible package.

Apsect 38. The system of aspect 37, wherein each of the two or more walls of the retaining structure and/or the forming box extends from the first end to the second end of the retaining structure and the forming box.

Apsect 39. The system of aspect 37, wherein the two or more walls of one or more of the retaining structure and/or the forming box includes first, second, third, and fourth walls.

Apsect 40. The system of aspect 37, wherein any one of the forming bars can actuate in a direction parallel to the transport axis, optionally in coordinated manner with the seal jaws.

Apsect 41. The system of aspect 37, further comprising one or more retaining structure actuators operatively coupled to the retaining structure to actuate the retaining structure between a first position for receiving a package, a second position for retaining a package, and a third position for releasing the package; and/or

one or more forming box actuators operatively coupled to the forming box to actuate the forming box between a first position for receiving a package, a second position for retaining a package, and a third position for releasing the package.

Apsect 42. The system of aspect 37, further comprising one or more retaining structure actuators operatively coupled to the retaining structure to actuate the retaining structure

between a first position for receiving or releasing a package and a second position for retaining a package; and/or

one or more forming box actuators operatively coupled to the forming box to actuate the forming box between a first position for receiving or releasing a package and a second position for retaining a package.

Apsect 43. The system of aspect 37, further comprising one or more first downstream folding bar actuators operatively coupled to the first downstream folding bar to actuate the first downstream folding bar in a direction substantially transverse to a transport path of a flexible material between the first position and the second position.

Apsect 44. The system of aspect 37, wherein the two or more walls that cooperate to form the lateral enclosure of each of the retaining structure and the forming box extend along the transport axis.

Apsect 45. An apparatus for forming a package, comprising:

one or more forming boxes coupled to a rotating plate that rotates the forming boxes through tat least first, second, and third stations of the apparatus, wherein the forming boxes each include a plurality of walls that cooperate to define an internal volume and are each open on opposed first and second ends;

a dead plate disposed beneath the second ends of the forming boxes in at least the first and second stations; and

a flap folding plate disposed above the forming box at the second station and coupled to an actuator that actuates the flap folding plate towards the forming box as the forming box transitions from the first station to the second station or when the forming box is positioned at the second station.

Apsect 46. An apparatus for forming a package, comprising:

one or more forming boxes coupled to a rotating plate that rotates the forming boxes through at least first, second, third, and fourth stations of the apparatus, wherein the forming boxes each include a plurality of walls that cooperate to define an internal volume and are each open on opposed first and second ends;

a dead plate disposed beneath the second ends of the forming boxes disposed at the first, second, and third stations;

a flap folding plate disposed above the forming box at the second station and coupled to an actuator that actuates the flap folding plate towards the forming box as the forming box transitions from the first station to the second station or when the forming box is positioned at the second station; and

a holding plate disposed over the forming box disposed at the third station.

Apsect 47. The apparatus of aspect 45 or 46, further comprising a transition guide box disposed above the forming box at the first station.

Apsect 48. The apparatus of any one of aspects 45 to 47, wherein each forming box includes a first portion and a second portion, the second portion being separable from the first portion.

Apsect 49. The apparatus of aspect 48, wherein the second portion is coupled to a cam assembly comprising a cam follower, the dead plate includes a guide in which the cam follower resides, the guide defining a path for the cam follower that controls the position of the second portion such that the forming box can be actuated between an open to a closed position.

Apsect 50. The apparatus of any one of aspects 45 to 49, wherein the forming boxes have an internal volume as defined by the plurality of walls, the dead plate, and the flap folding plate in the actuated position that is about 70% to about 120% of a predetermined internal package volume.

Apsect 51. The apparatus of aspect 50, wherein the forming boxes have an internal volume of 80% to 90% of the predetermined internal package.

Apsect 52. The apparatus of any one of aspects 46 to 51, wherein the flap folding plate and the holding plate are coupled to a bracket.

Apsect 53. The apparatus of any one of aspects 46 to 51, wherein the flap folding plate is coupled to a bracket.

Apsect 54. The apparatus of any one of aspects 46 to 53, wherein the flap folding plate extends a distance between the first and second stations to at least an end of the second station.

Apsect 55. The apparatus of any one of aspects 46 to 54, wherein the holding plate extends a distance between the second and third stations to a distance past the third station.

Apsect 56. The apparatus of any one of aspects 46 to 55, wherein the holding plate is adjacent to the flap folding plate when the flap folding plate is actuated.

Apsect 57. The apparatus of any one of aspects 46 to 56, wherein the holding plate includes air passageways and outlets to direct heated and/or cooled air onto the package.

Apsect 58. The apparatus of any one of aspects 46 to 57, wherein the holding plate is stationary.

Apsect 59. The apparatus of any one of aspects 46 to 58, wherein the holding plate is coupled to an actuator that linearly actuates the holding plate between first and second positions.

Apsect 60. The apparatus of any one of aspects 45 to 59, wherein the dead plate includes air passageways and outlets to direct heated and/or cooled air onto the package.

Apsect 61. The apparatus of any one of aspects 45 to 60, wherein the flap folding plate comprises a rail defining an angled path along which a carriage assembly travels, and an actuating arm that actuates the flap folding plate from a first position disposed away from the forming box to a second position disposed over the forming box at the second station, the carriage assembly being coupled to a frame of the apparatus to position the flap folding plate at the second station, wherein the carriage assembly travels along the rail when the actuating arm actuates the flap folding plate.

Apsect 62. The apparatus of any one of aspects 45 and 47 to 61, further comprising a conveyor disposed beneath the third station such that the package is released from the forming box at the third station and is transferred to the conveyor.

Apsect 63. The apparatus of any one of aspects 46 to 62, further comprising a conveyor disposed beneath the fourth station such that the package is released from the forming box at the fourth station and is transferred to the conveyor.

Apsect 64. The apparatus of any one of aspects 45 to 63, wherein the apparatus comprises four forming boxes.

Apsect 65. . The apparatus of any one of aspects 45 to 63, wherein the apparatus comprises six forming boxes.

Apsect 66. The apparatus of any one of aspects 45 to 65, wherein the apparatus comprises at least two forming boxes.

Apsect 67. A system for forming a package, comprising:

a continuous motion packaging machine; and

the apparatus of any one of aspects 45 to 66.

Apsect 68. The system of aspect 67, further comprising a volume adjusting box disposed on the continuous motion packaging machine downstream of a seal jaw of the packaging machine for sealing a trailing seal of the package.

Apsect 69. The system of aspect 67 or 68, wherein the continuous motion packaging machine comprises a flap folding bar coupled to an actuator that actuates the flap folding bar in two directions.

Apsect 70. A method for forming a package, comprising:

receiving, in an interface apparatus, a package having a trailing seal extending outwardly from a panel of a package in a forming box positioned at a first station of the interface, wherein the package is received in the forming box with the trailing seal extending outwardly from an open top end of the forming box;

rotating the forming box to a second station of the interface;

actuating a flap folding plate from a first position to a second position in which the flap folding plate extends downwardly and across the package to engage the trailing seal and apply a pressure to the panel of the package from which the trailing seal extends, wherein the flap folding plate is actuated when the forming box is rotated to a pre-determined distance between the first and second stations or at the second station; and

rotating the forming box to a third station of the interface, wherein the forming box does not have a bottom surface at the third station and the package is transferred from the forming box through the open bottom surface to a take away device.

Apsect 71. A method for forming a package, comprising:

receiving, in an interface apparatus, a package having a trailing seal extending outwardly from a panel of a package in a forming box positioned at a first station of the interface, wherein the package is received in the forming box with the trailing seal extending outwardly from an open top end of the forming box;

rotating the forming box to a second station of the interface;

actuating a flap folding plate from a first position to a second position in which the flap folding plate extends downwardly and across the package to engage the trailing seal and apply a pressure to the panel of the package from which the trailing seal extends, wherein the flap folding plate is actuated when the forming box is rotated to a pre-determined distance between the first and second stations;

rotating the forming box to a third station of the interface, wherein the third station comprises a holding plate disposed above the forming box, the holding plate disposed to engage the folded trailing seal and panel of the package; and

rotating the forming box to a fourth station of the interface, wherein the forming box does not have a bottom surface at the fourth station and the package is transferred from the forming box through the open bottom surface to a take away device.

Apsect 72. The method of aspect 70, wherein a bottom surface of the forming box in the first and second third stations is provided by a dead plate, wherein the dead plate is not disposed in the third station such that the bottom surface of the forming box in the third station is open.

Apsect 73. The method of aspect 71, wherein a bottom surface of the forming box in the first, second, and third stations is provided by a dead plate, wherein the dead plate is not disposed in the fourth station such that the bottom surface of the forming box in the fourth station is open.

Apsect 74. The method of any one of aspects 70 to 73, wherein the flap folding plate actuates when the forming box is rotated 0° to 30° prior to the second station.

Apsect 75. The method of any one of aspects 71 to 74, wherein the holding plate extends to an end of the second station and abuts the flap folding plate when the flap folding plate is in the second position, and the flap folding plate is actuated from the second position to the first position once the forming box rotates 0° to 70° away from the second station.

Apsect 76. The method of any one of aspects 71 to 75, wherein the holding plate extends up to the fourth station.

Apsect 77. The method of any one of aspects 71 to 76, wherein the holding plate is stationary.

Apsect 78. The method of any one of aspects 71 to 77, further comprising actuating the holding plate from a first position in which it is disposed away from the forming box at the third station to a second position in which the holding plate is disposed over the forming box at the third station and contacts the package when the forming box is at least partially disposed under the holding plate.

Apsect 79. The method of aspect 78, wherein the holding plate extends to a distance between the second and third stations such that at least a portion of the holding plate substantially completely covers the forming box when the forming box is 0° to 70° past the second station.

Apsect 80. The method of any one of aspects 70 to 79, wherein the forming box is in a first position at the first station with first and second portions of the forming box separated to receive the package.

Apsect 81. The method of aspect 80, wherein the first and second portions of the forming box actuate to a second position in which the first and second portions are closed to retain the package in the forming box once the forming box rotates out of the first station and before the forming box reaches the pre-determined distance between the first and second stations.

Apsect 82. The method of any one of aspects 70 to 81, further comprising adjusting an internal volume of the package to a predetermined internal volume prior to receiving the package in the interface.

Apsect 83. The method of aspect 82, wherein the internal volume of the package is adjusted by filling the package with a gas prior to sealing the package.

Apsect 84. The method of aspect 82, wherein the internal volume of the package is adjusted by receiving the package in a volume adjusting box prior to sealing the package, actuating a volume adjusting plate to contact the package and apply a pressure to the package to adjust the internal volume of the package.

Apsect 85. The method of aspect 84, further comprises filling the package with a gas prior to adjusting the internal volume in the volume adjusting box.

Apsect 86. The method of any one of aspects 70 to 85 wherein the package has a predetermined internal volume, the forming box has an internal volume when the top wall is defined by the flap folding plate actuated in the second position, is about 70% to about 120% of the predetermined internal volume of the package.

Apsect 87. The method of aspect 86, wherein the internal volume of the forming box is about 80% to about 90% of the predetermined internal volume of the package.

Apsect 88. The method of any one of aspects 70 to 87, wherein the forming box rotates between the stations continuously.

Apsect 89. The method of aspect 88, wherein the forming box rotates at a uniform speed.

Apsect 90. The method of aspect 88, wherein the forming box rotates at variable speed.

Apsect 91. The method of any one of aspects 70 to 87, wherein the forming box rotates with intermittent motion stopping for a pre-set delay when a forming box is positioned at a station.

WHAT IS CLAIMED:

1. An apparatus for forming a package, comprising:

one or more forming boxes coupled to a rotating plate that rotates the forming boxes through tat least first, second, and third stations of the apparatus, wherein the forming boxes each include a plurality of walls that cooperate to define an internal volume and are each open on opposed first and second ends;

a dead plate disposed beneath the second ends of the forming boxes in at least the first and second stations; and

a flap folding plate disposed above the forming box at the second station and coupled to an actuator that actuates the flap folding plate towards the forming box as the forming box transitions from the first station to the second station or when the forming box is positioned at the second station.

2. An apparatus for forming a package, comprising:

one or more forming boxes coupled to a rotating plate that rotates the forming boxes through at least first, second, third, and fourth stations of the apparatus, wherein the forming boxes each include a plurality of walls that cooperate to define an internal volume and are each open on opposed first and second ends;

a dead plate disposed beneath the second ends of the forming boxes disposed at the first, second, and third stations;

a flap folding plate disposed above the forming box at the second station and coupled to an actuator that actuates the flap folding plate towards the forming box as the forming box transitions from the first station to the second station or when the forming box is positioned at the second station; and

a holding plate disposed over the forming box disposed at the third station.

3. The apparatus of claim 1 or 2, further comprising a transition guide box disposed above the forming box at the first station.

4. The apparatus of any one of claims 1 to 3, wherein each forming box includes a first portion and a second portion, the second portion being separable from the first portion.

5. The apparatus of claim 4, wherein the second portion is coupled to a cam assembly comprising a cam follower, the dead plate includes a guide in which the cam follower resides, the guide defining a path for the cam follower that controls the position of the second portion such that the forming box can be actuated between an open to a closed position.

6. The apparatus of any one of claims 1 to 5, wherein the forming boxes have an internal volume as defined by the plurality of walls, the dead plate, and the flap folding plate in the actuated position that is about 70% to about 120% of a predetermined internal package volume.

7. The apparatus of claim 6, wherein the forming boxes have an internal volume of 80% to 90% of the predetermined internal package.

8. The apparatus of any one of claims 2 to 7, wherein the flap folding plate and the holding plate are coupled to a bracket.

9. The apparatus of any one of claims 2 to 7, wherein the flap folding plate is coupled to a bracket.

10. The apparatus of any one of claims 2 to 9, wherein the flap folding plate extends a distance between the first and second stations to at least an end of the second station.

11. The apparatus of any one of claims 2 to 20, wherein the holding plate extends a distance between the second and third stations to a distance past the third station.

12. The apparatus of any one of claims 2 to 11, wherein the holding plate is adjacent to the flap folding plate when the flap folding plate is actuated.

13. The apparatus of any one of claims 2 to 12, wherein the holding plate includes air passageways and outlets to direct heated and/or cooled air onto the package.

14. The apparatus of any one of claims 2 to 13, wherein the holding plate is stationary.

15. The apparatus of any one of claims 2 to 14, wherein the holding plate is coupled to an actuator that linearly actuates the holding plate between first and second positions.

16. The apparatus of any one of claims 1 to 15, wherein the dead plate includes air passageways and outlets to direct heated and/or cooled air onto the package.

17. The apparatus of any one of claims 1 to 16, wherein the flap folding plate comprises a rail defining an angled path along which a carriage assembly travels, and an actuating arm that actuates the flap folding plate from a first position disposed away from the forming box to a second position disposed over the forming box at the second station, the carriage assembly being coupled to a frame of the apparatus to position the flap folding plate at the second station, wherein the carriage assembly travels along the rail when the actuating arm actuates the flap folding plate.

18. The apparatus of any one of claims 1 and 3 to 17, further comprising a conveyor disposed beneath the third station such that the package is released from the forming box at the third station and is transferred to the conveyor.

19. The apparatus of any one of claims 2 to 18, further comprising a conveyor disposed beneath the fourth station such that the package is released from the forming box at the fourth station and is transferred to the conveyor.

20. The apparatus of any one of claims 1 to 19, wherein the apparatus comprises four forming boxes.

21. . The apparatus of any one of claims 1 to 19, wherein the apparatus comprises six forming boxes.

22. The apparatus of any one of claims 1 to 21, wherein the apparatus comprises at least two forming boxes.

23. A system for forming a package, comprising:

a continuous motion packaging machine; and

the apparatus of any one of claims 1 to 22.

24. The system of claim 23, further comprising a volume adjusting box disposed on the continuous motion packaging machine downstream of a seal jaw of the packaging machine for sealing a trailing seal of the package.

25. The system of claim 23 or 24, wherein the continuous motion packaging machine comprises a flap folding bar coupled to an actuator that actuates the flap folding bar in two directions.

26. A method for forming a package, comprising:

receiving, in an interface apparatus, a package having a trailing seal extending outwardly from a panel of a package in a forming box positioned at a first station of the interface, wherein the package is received in the forming box with the trailing seal extending outwardly from an open top end of the forming box;

rotating the forming box to a second station of the interface;

actuating a flap folding plate from a first position to a second position in which the flap folding plate extends downwardly and across the package to engage the trailing seal and apply a pressure to the panel of the package from which the trailing seal extends, wherein the flap folding plate is actuated when the forming box is rotated to a pre-determined distance between the first and second stations or at the second station; and

rotating the forming box to a third station of the interface, wherein the forming box does not have a bottom surface at the third station and the package is transferred from the forming box through the open bottom surface to a take away device.

27. A method for forming a package, comprising:

receiving, in an interface apparatus, a package having a trailing seal extending outwardly from a panel of a package in a forming box positioned at a first station of the interface, wherein the package is received in the forming box with the trailing seal extending outwardly from an open top end of the forming box;

rotating the forming box to a second station of the interface;

actuating a flap folding plate from a first position to a second position in which the flap folding plate extends downwardly and across the package to engage the trailing seal and apply a pressure to the panel of the package from which the trailing seal extends, wherein the flap folding plate is actuated when the forming box is rotated to a pre-determined distance between the first and second stations;

rotating the forming box to a third station of the interface, wherein the third station comprises a holding plate disposed above the forming box, the holding plate disposed to engage the folded trailing seal and panel of the package; and

rotating the forming box to a fourth station of the interface, wherein the forming box does not have a bottom surface at the fourth station and the package is transferred from the forming box through the open bottom surface to a take away device.

28. The method of claim 26, wherein a bottom surface of the forming box in the first and second third stations is provided by a dead plate, wherein the dead plate is not disposed in the third station such that the bottom surface of the forming box in the third station is open.

29. The method of claim 27, wherein a bottom surface of the forming box in the first, second, and third stations is provided by a dead plate, wherein the dead plate is not disposed in the fourth station such that the bottom surface of the forming box in the fourth station is open.

30. The method of any one of claims 26 to 29, wherein the flap folding plate actuates when the forming box is rotated 0° to 30° prior to the second station.

31. The method of any one of claims 27 to 30, wherein the holding plate extends to an end of the second station and abuts the flap folding plate when the flap folding plate is in the second position, and the flap folding plate is actuated from the second position to the first position once the forming box rotates 0° to 70° away from the second station.

32. The method of any one of claims 27 to 31, wherein the holding plate extends up to the fourth station.

33. The method of any one of claims 27 to 32, wherein the holding plate is stationary.

34. The method of any one of claims 27 to 33, further comprising actuating the holding plate from a first position in which it is disposed away from the forming box at the third station to a second position in which the holding plate is disposed over the forming box at the third station and contacts the package when the forming box is at least partially disposed under the holding plate.

35. The method of claim 34, wherein the holding plate extends to a distance between the second and third stations such that at least a portion of the holding plate substantially completely covers the forming box when the forming box is 0° to 70° past the second station.

36. The method of any one of claims 26 to 35, wherein the forming box is in a first position at the first station with first and second portions of the forming box separated to receive the package.

37. The method of claim 36, wherein the first and second portions of the forming box actuate to a second position in which the first and second portions are closed to retain the package in the forming box once the forming box rotates out of the first station and before the forming box reaches the pre-determined distance between the first and second stations.

38. The method of any one of claims 26 to 27, further comprising adjusting an internal volume of the package to a predetermined internal volume prior to receiving the package in the interface.

39. The method of claim 38, wherein the internal volume of the package is adjusted by filling the package with a gas prior to sealing the package.

40. The method of claim 38, wherein the internal volume of the package is adjusted by receiving the package in a volume adjusting box prior to sealing the package, actuating a volume adjusting plate to contact the package and apply a pressure to the package to adjust the internal volume of the package.

41. The method of claim 40, further comprises filling the package with a gas prior to adjusting the internal volume in the volume adjusting box.

42. The method of any one of claims 26 to 41 wherein the package has a predetermined internal volume, the forming box has an internal volume when the top wall is defined by the flap folding plate actuated in the second position, is about 70% to about 120% of the predetermined internal volume of the package.

43. The method of claim 42, wherein the internal volume of the forming box is about 80% to about 90% of the predetermined internal volume of the package.

44. The method of any one of claims 26 to 43, wherein the forming box rotates between the stations continuously.

45. The method of claim 44, wherein the forming box rotates at a uniform speed.

46. The method of claim 44, wherein the forming box rotates at variable speed.

47. The method of any one of claims 26 to 43, wherein the forming box rotates with intermittent motion stopping for a pre-set delay when a forming box is positioned at a station.

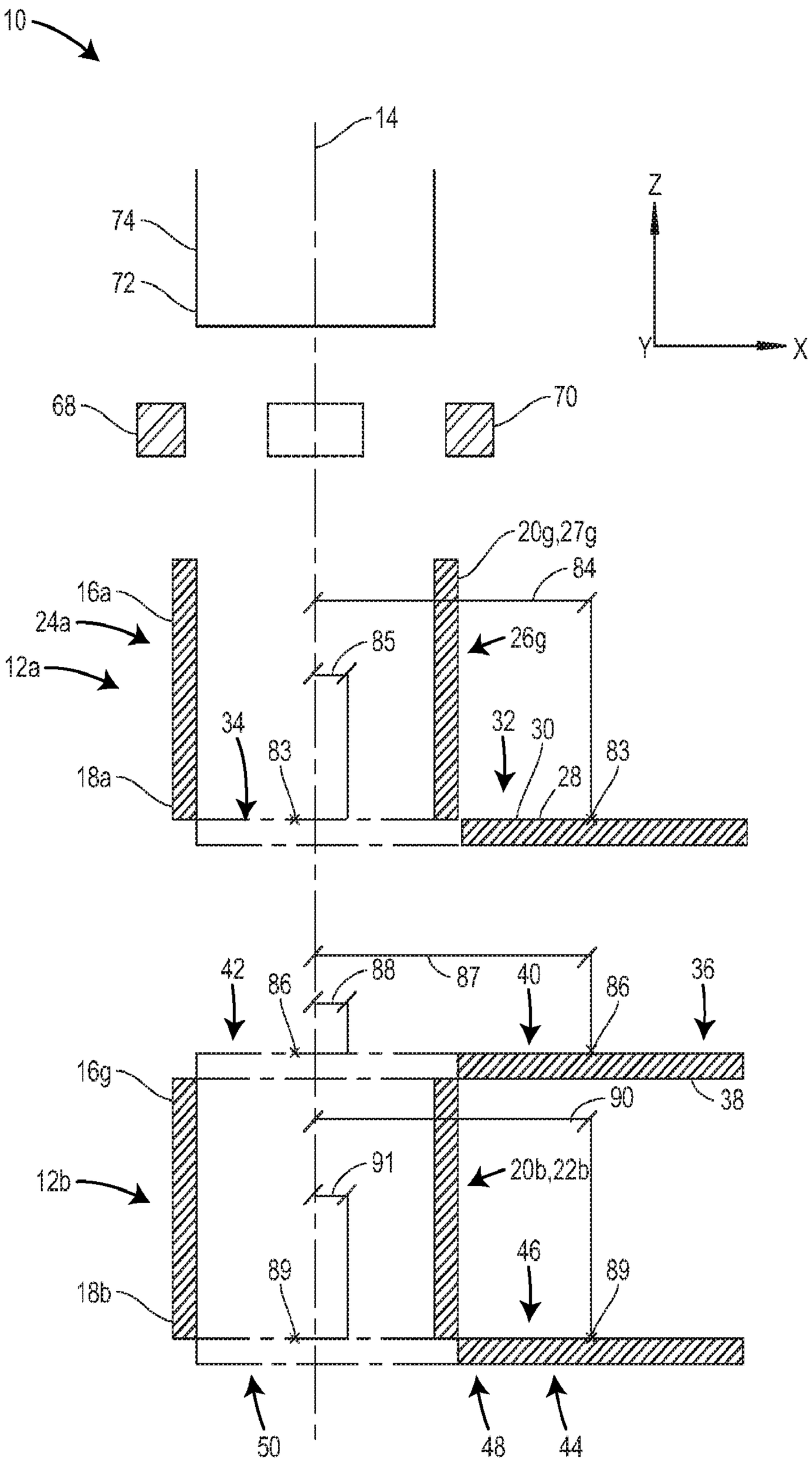

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FIG. 1

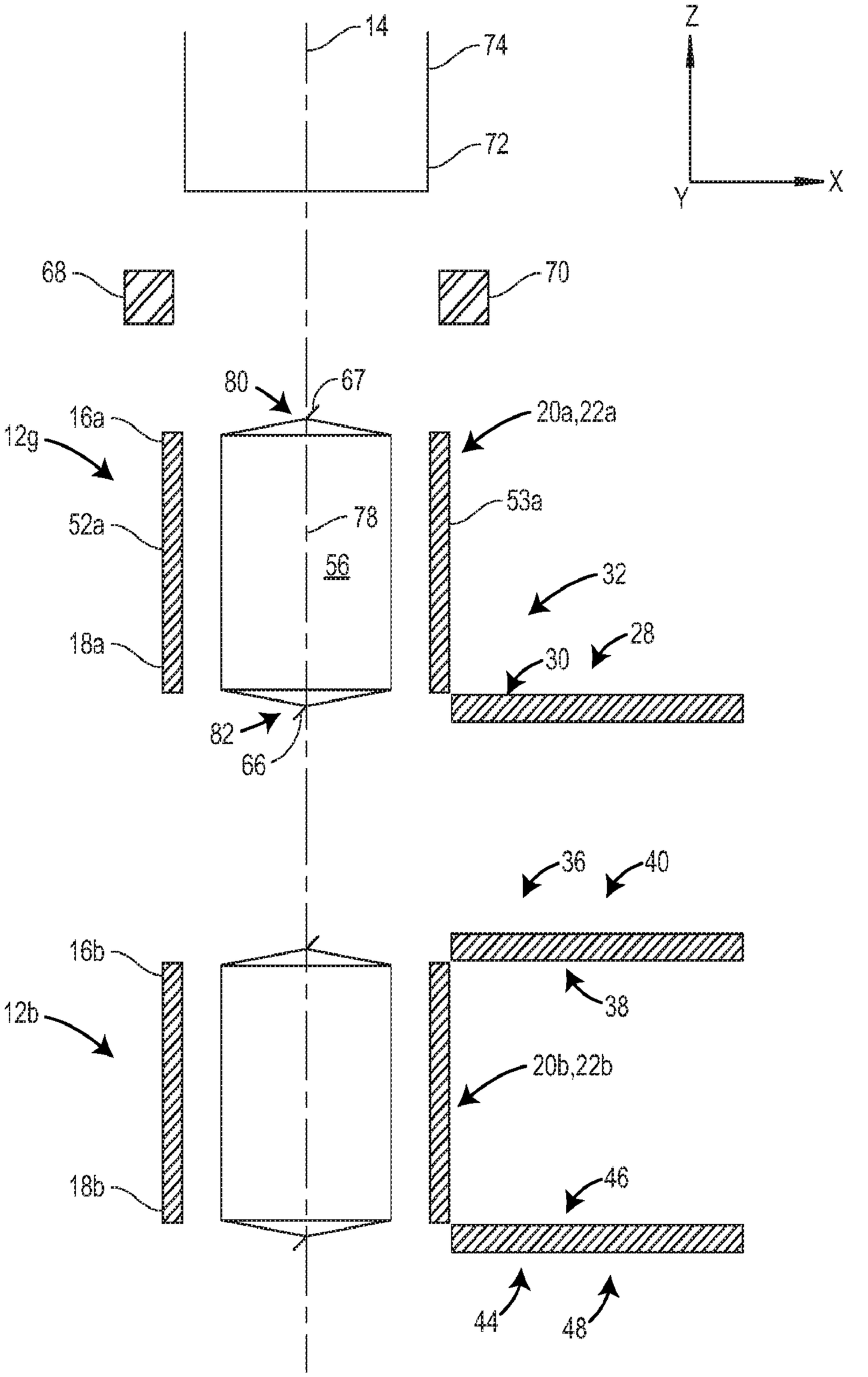

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FIG. 2

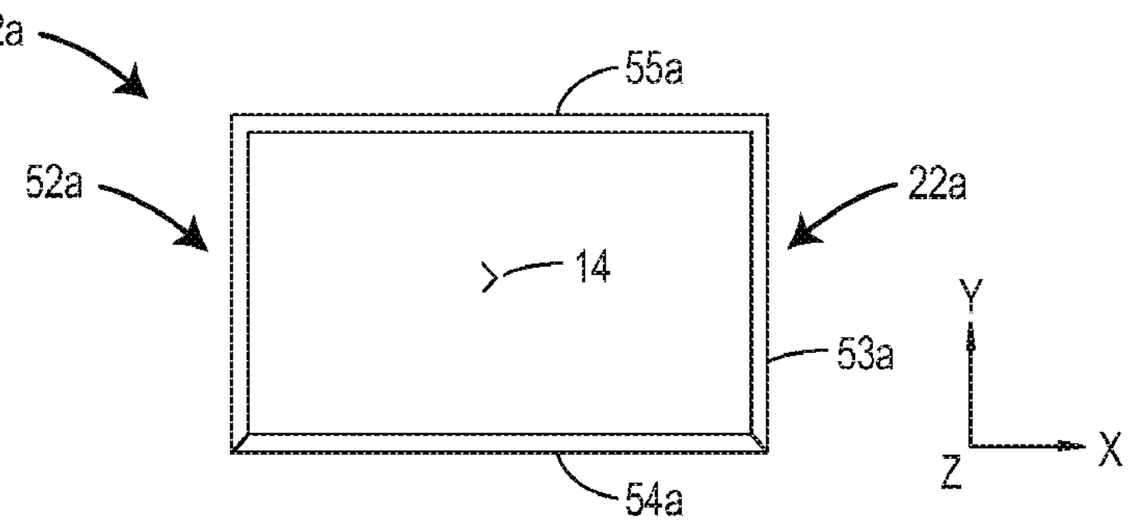


FIG. 3A

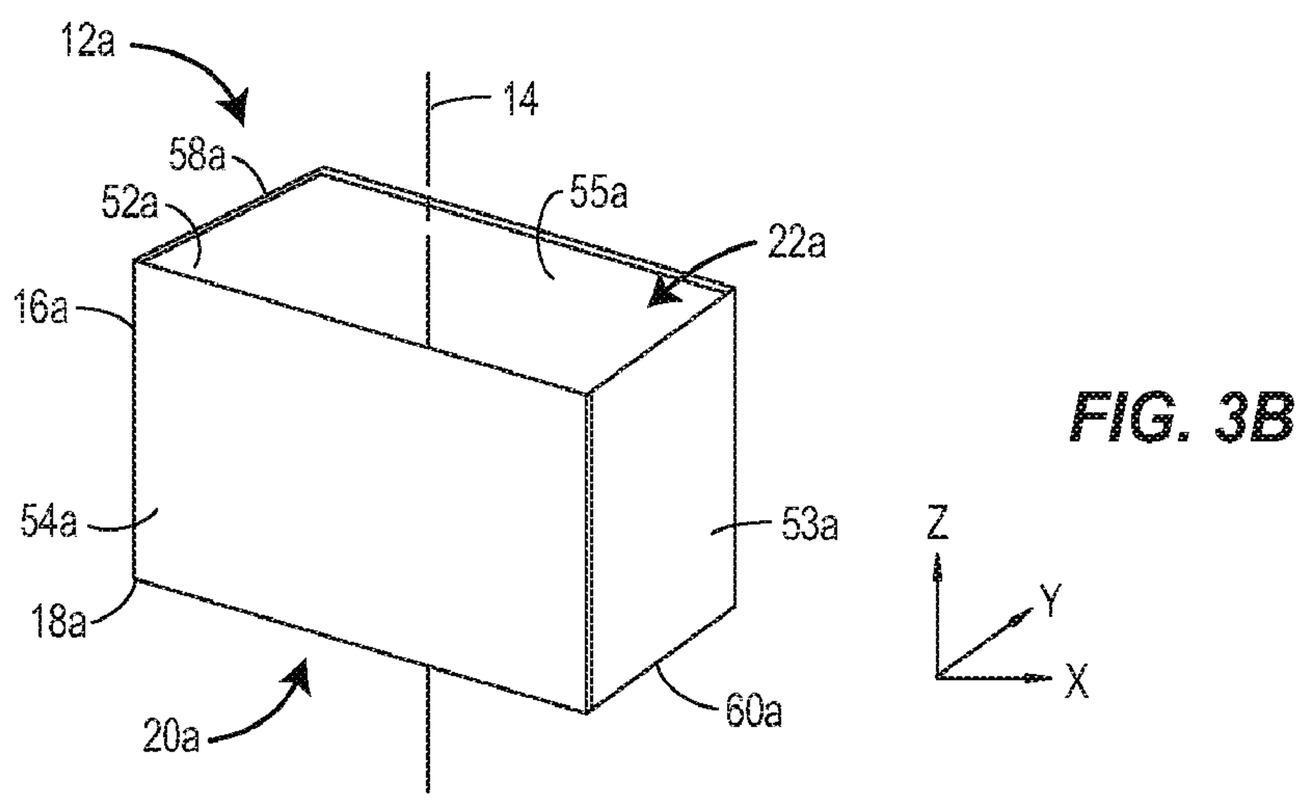


FIG. 3B

FIG. 7A

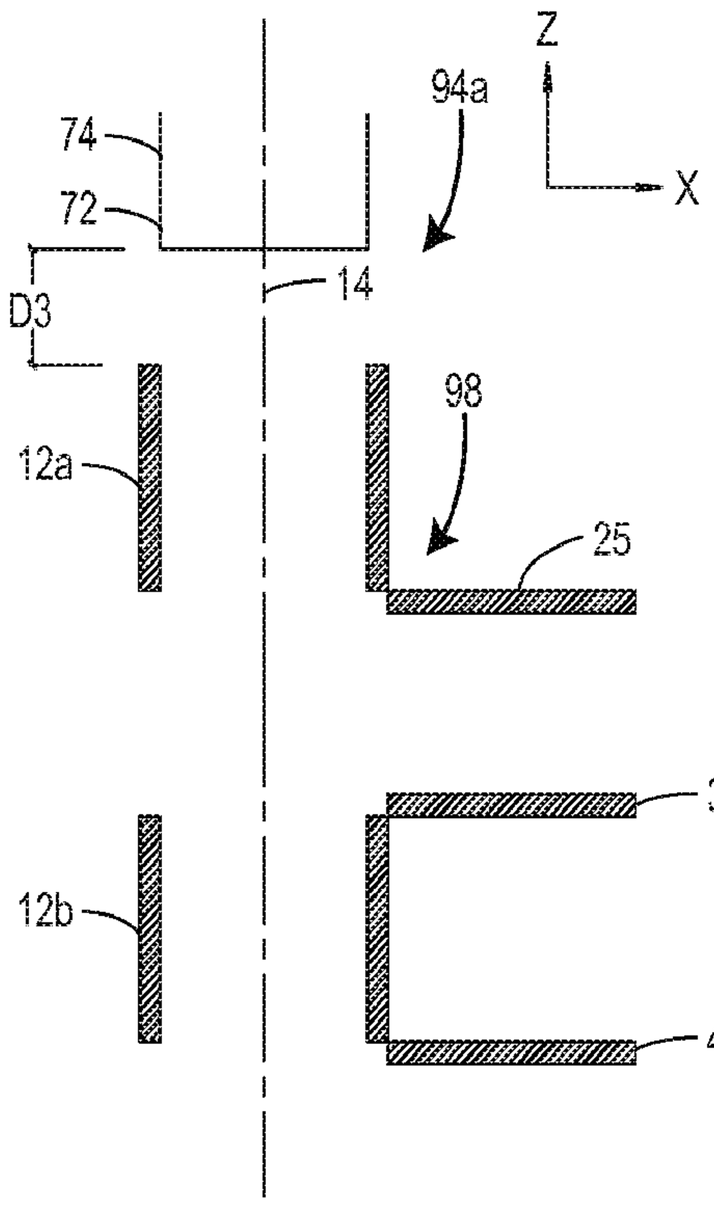


FIG. 7B

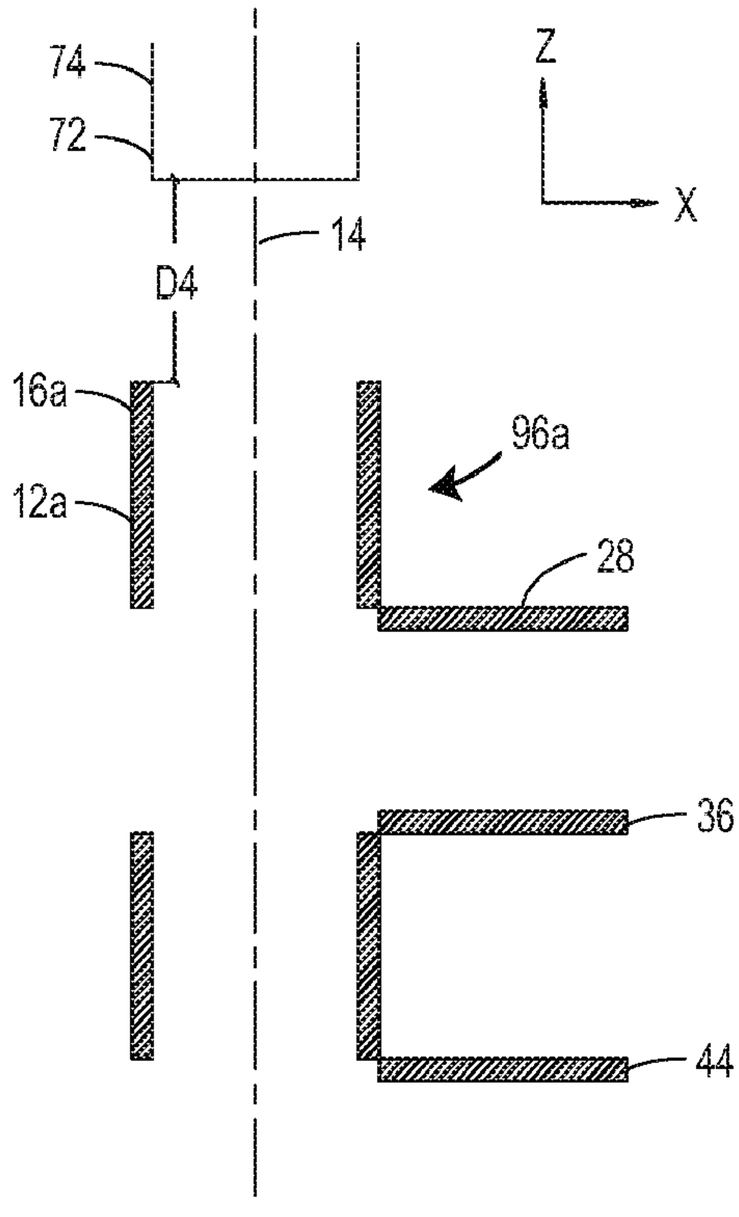


FIG. 4A

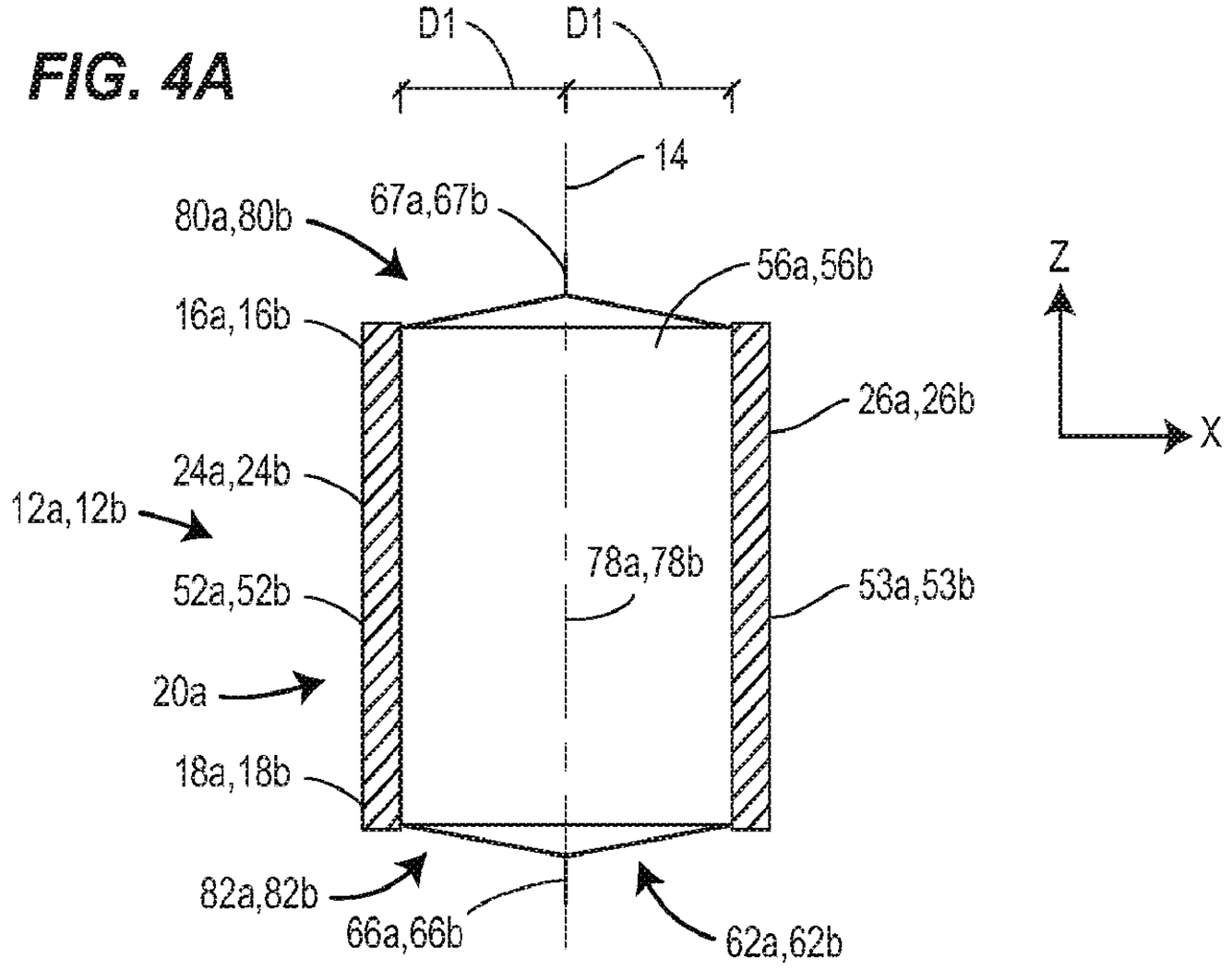

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X

FIG. 4B

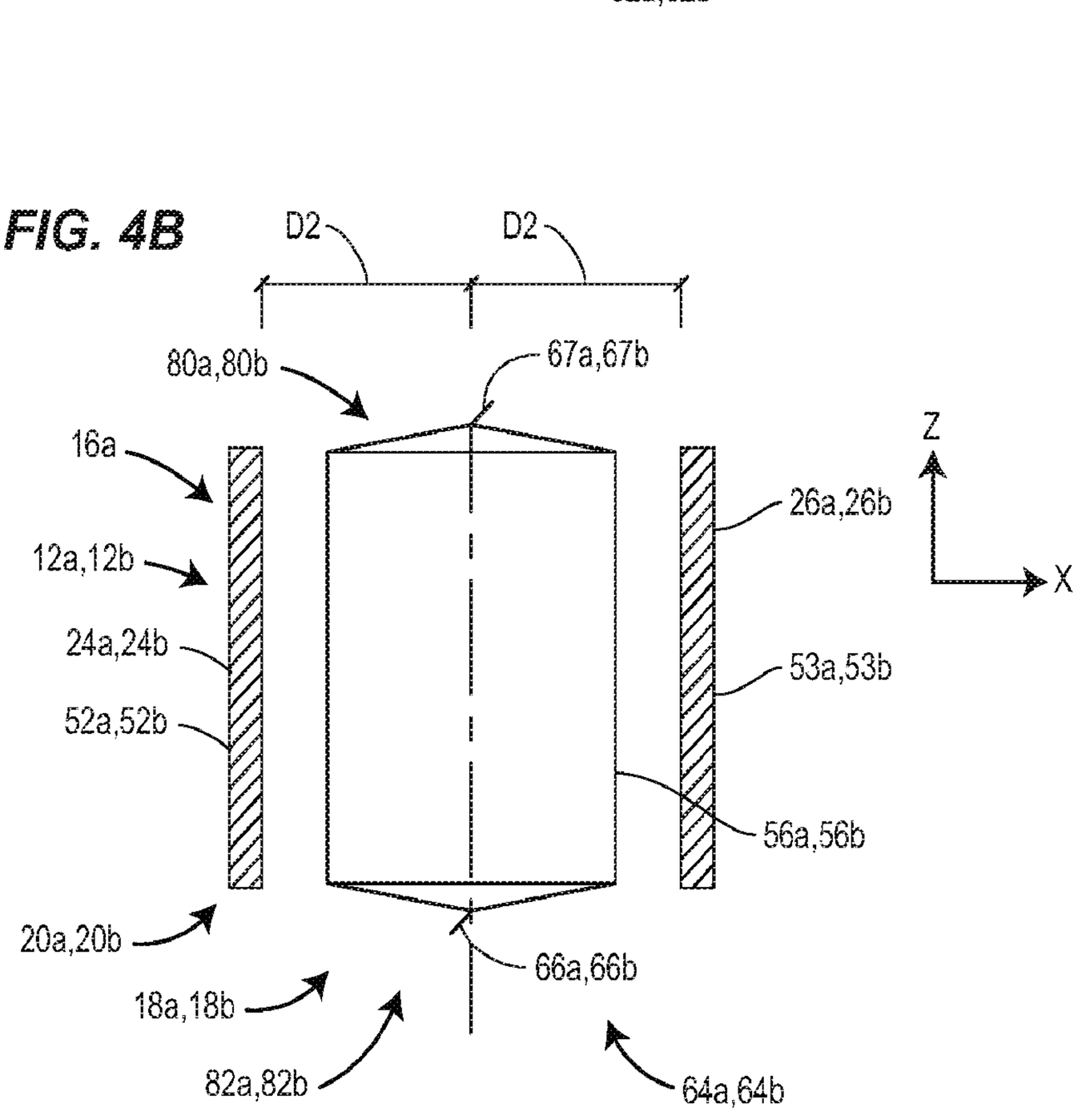

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X

FIG. 5A

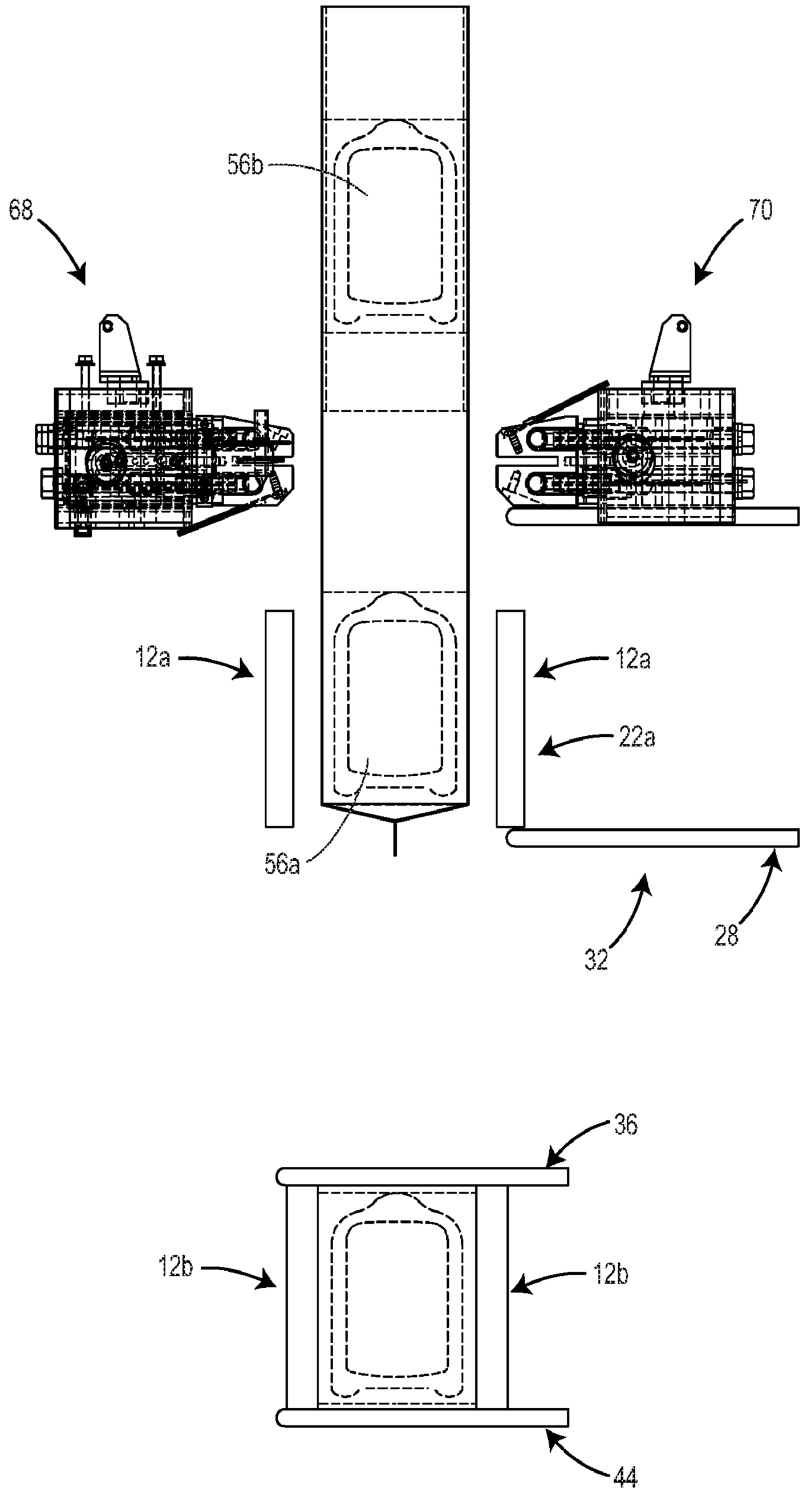


FIG. 5B

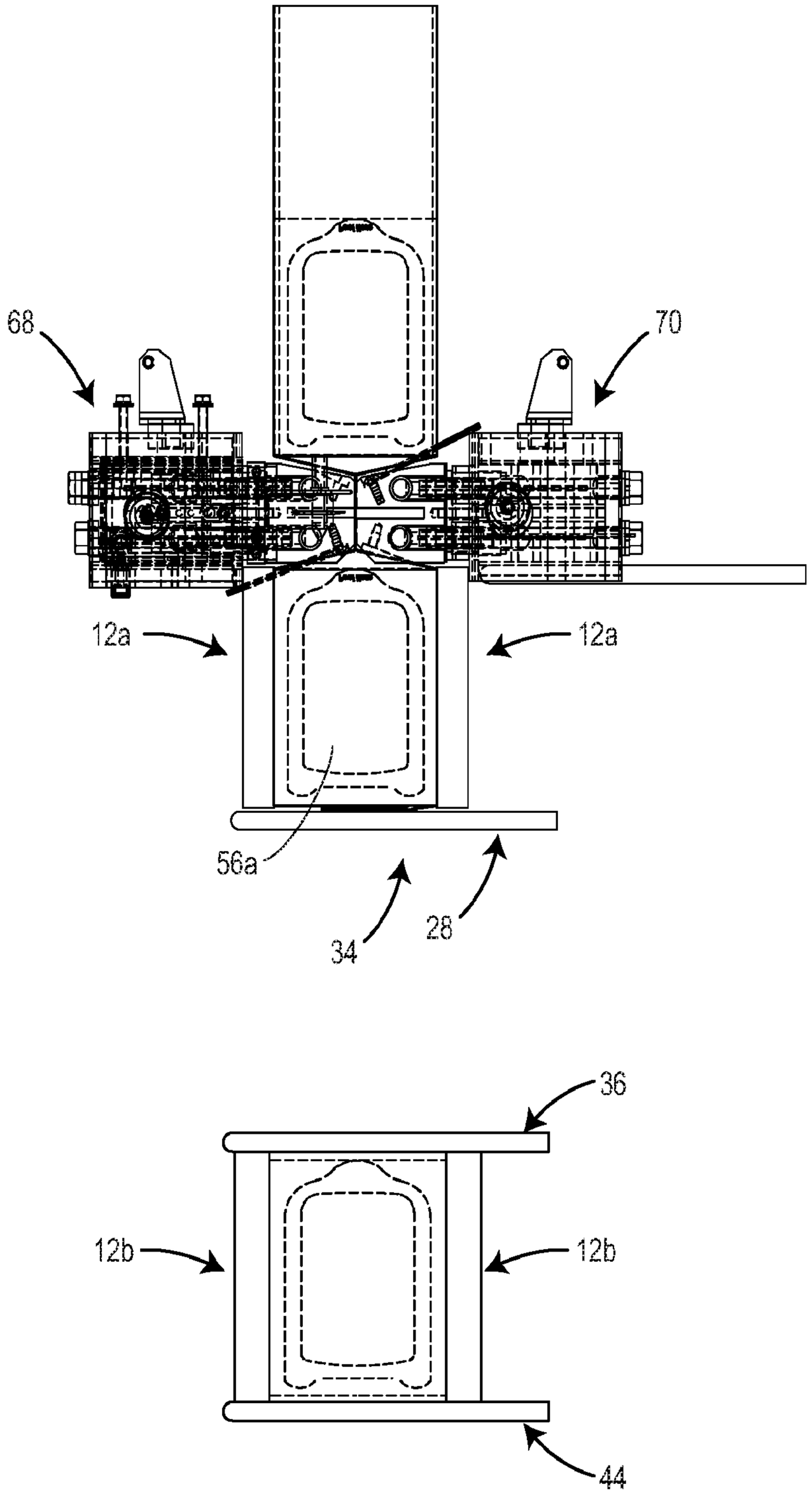


FIG. 5C

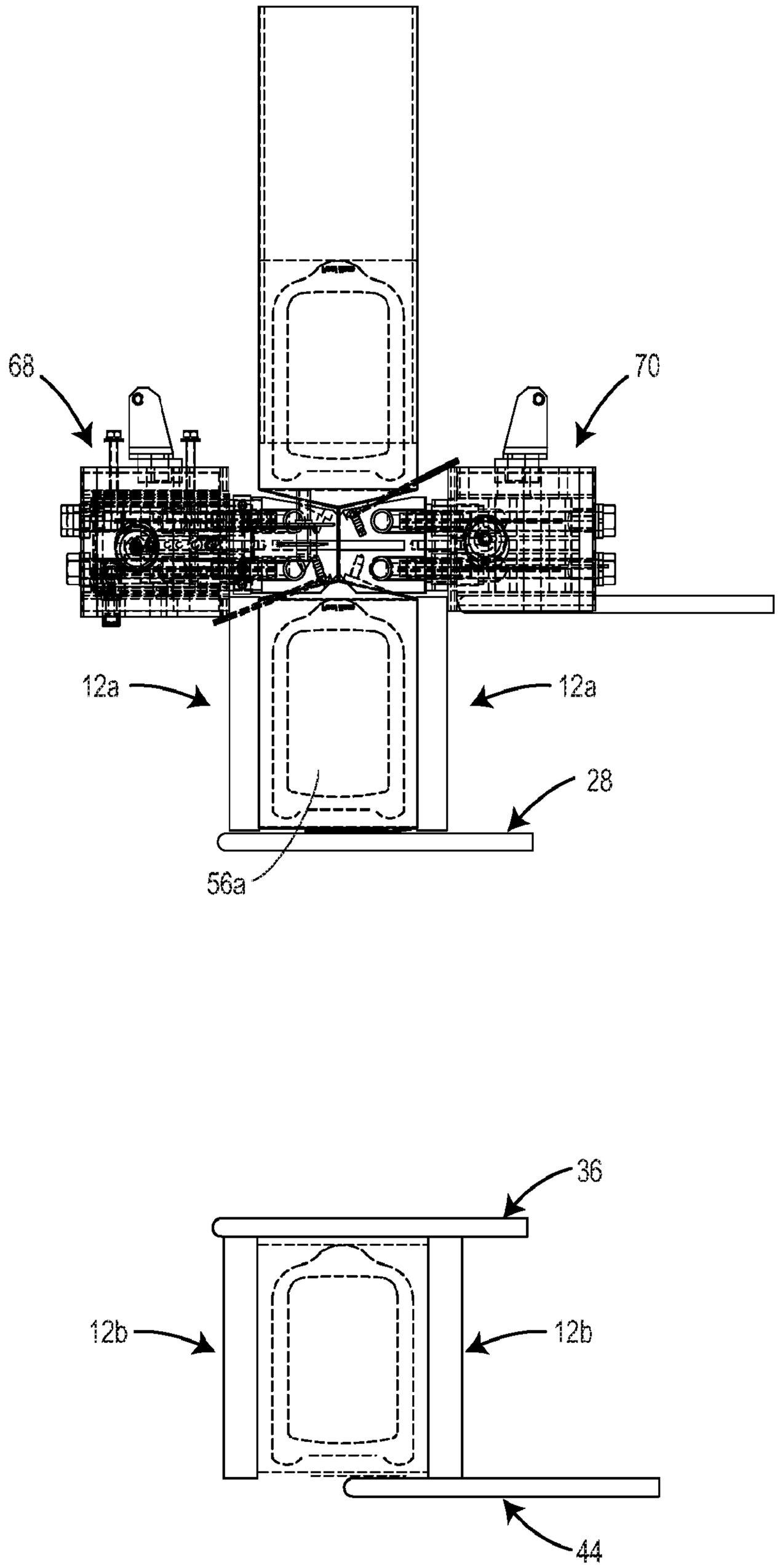
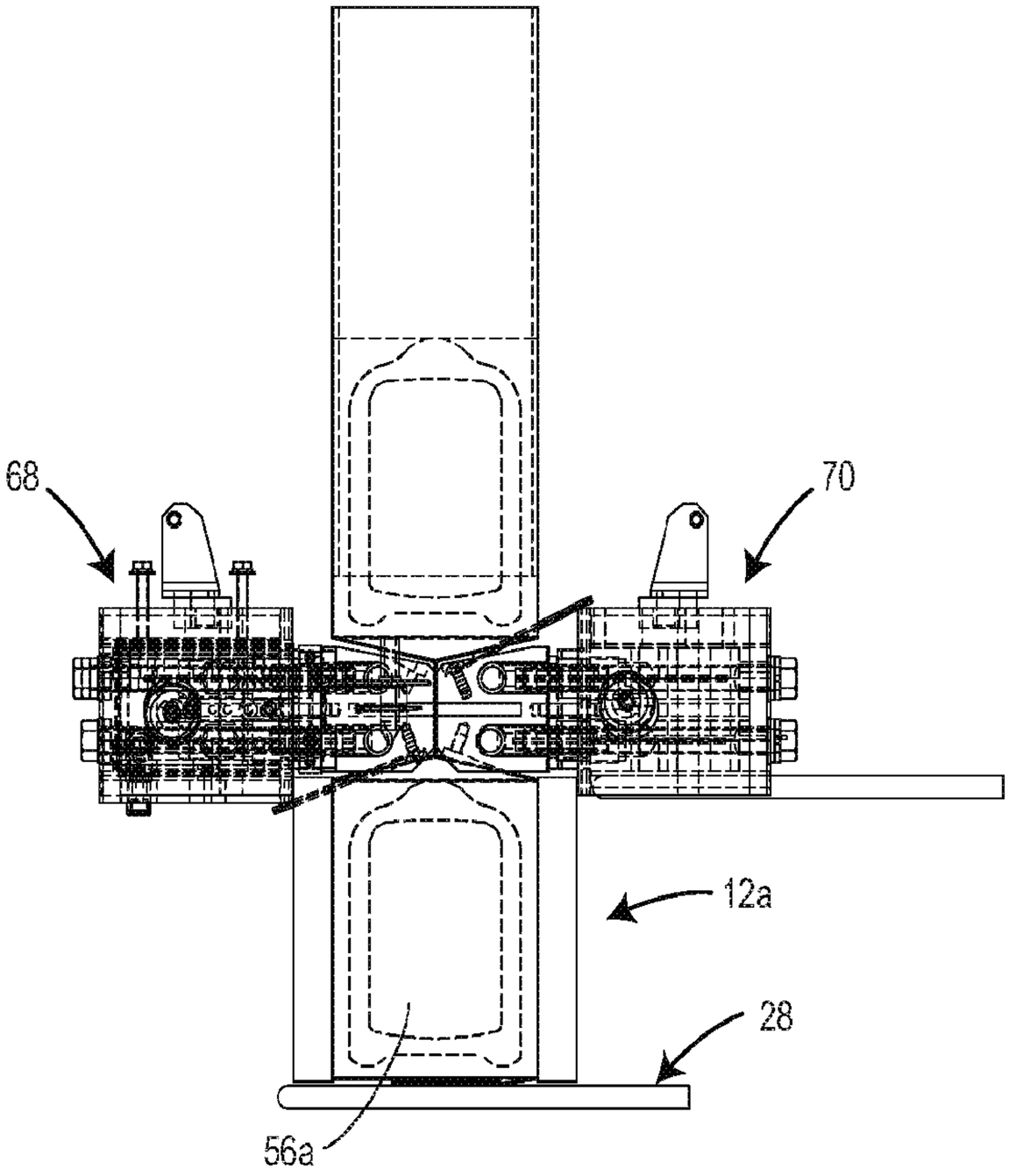


FIG. 5D



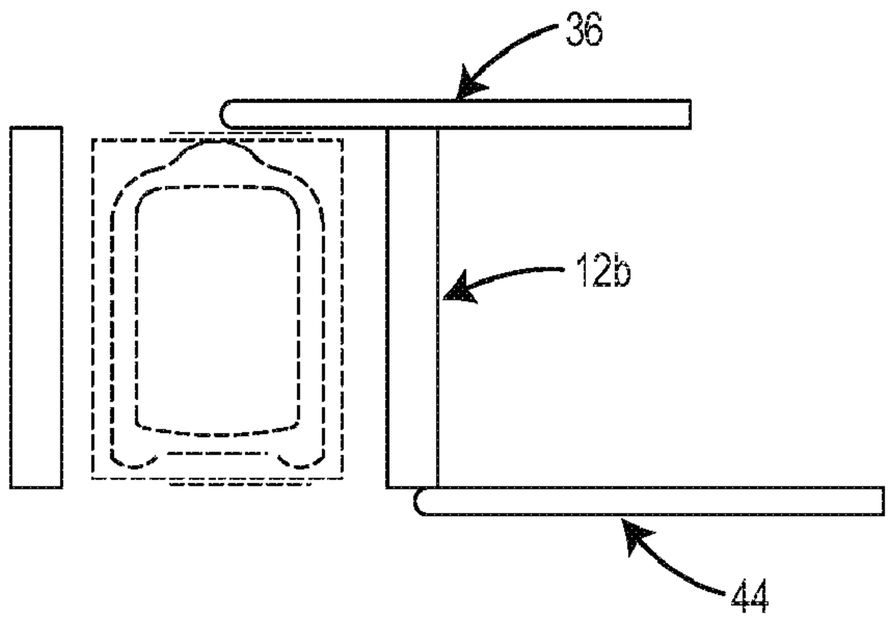
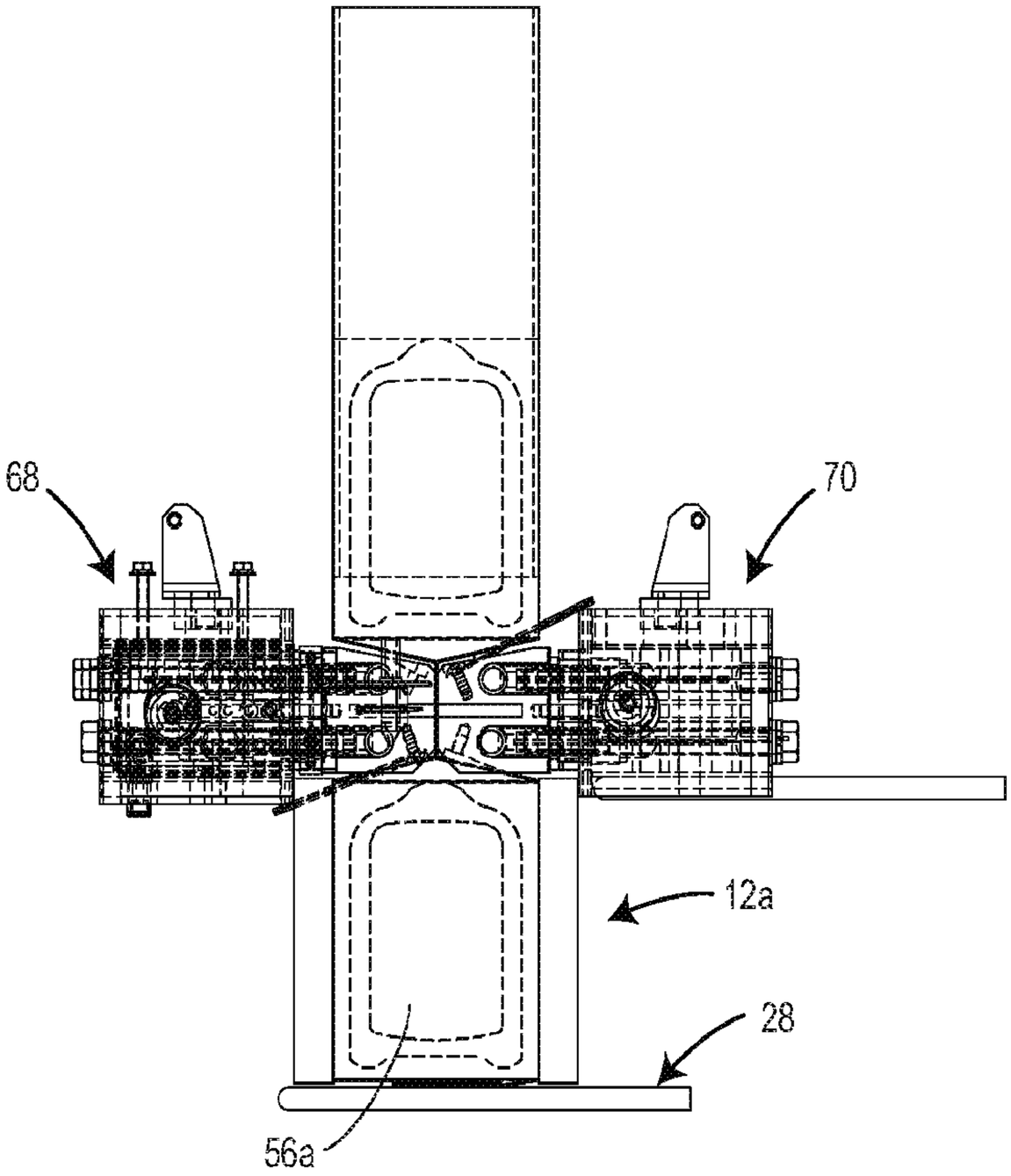


FIG. 5E



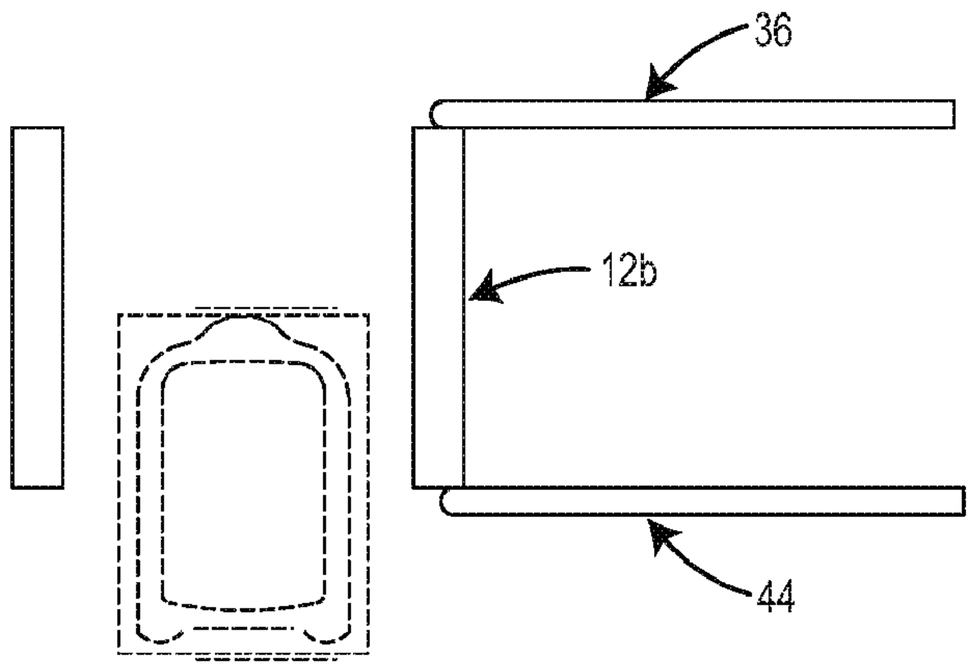


FIG. 5F

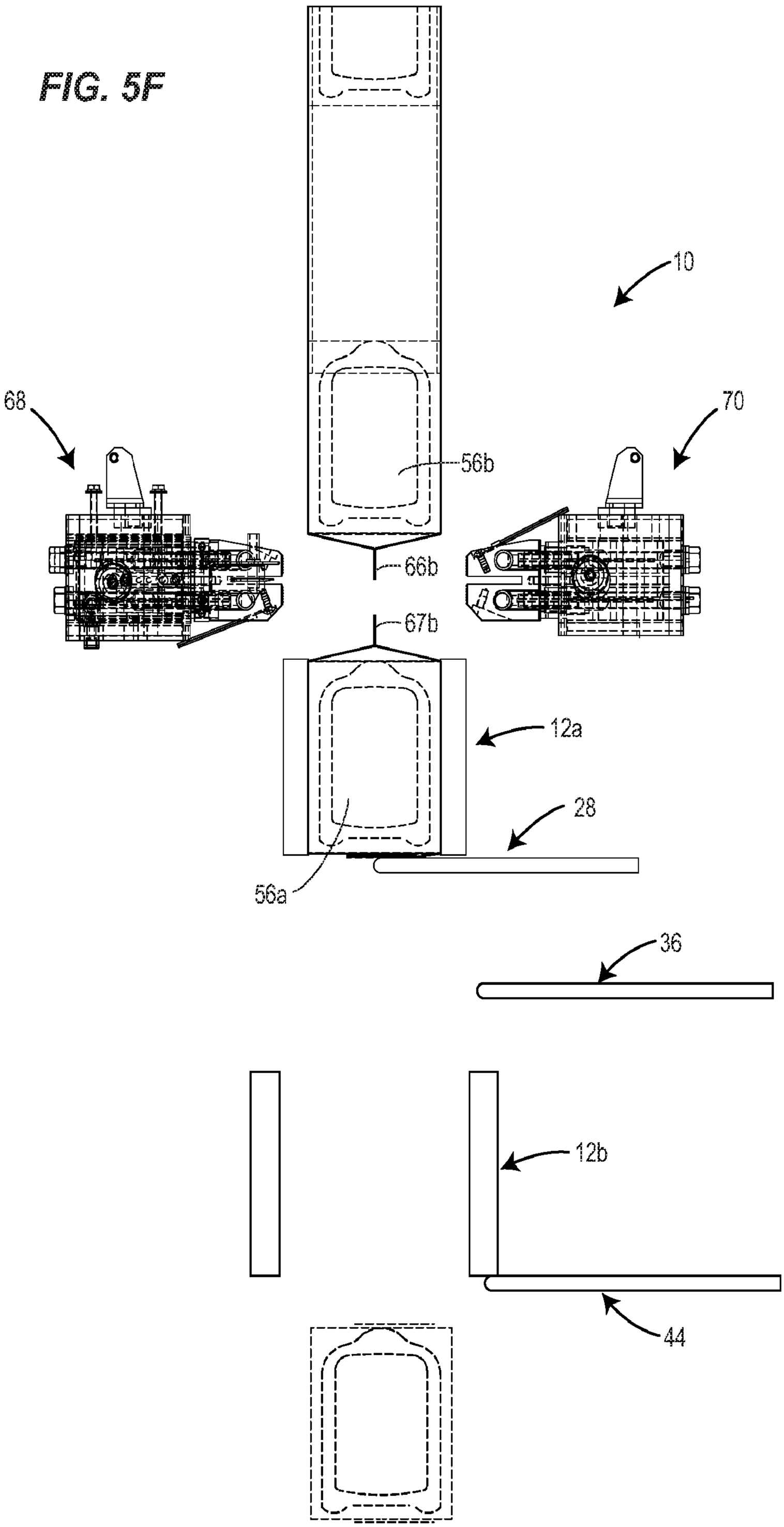


FIG. 5G

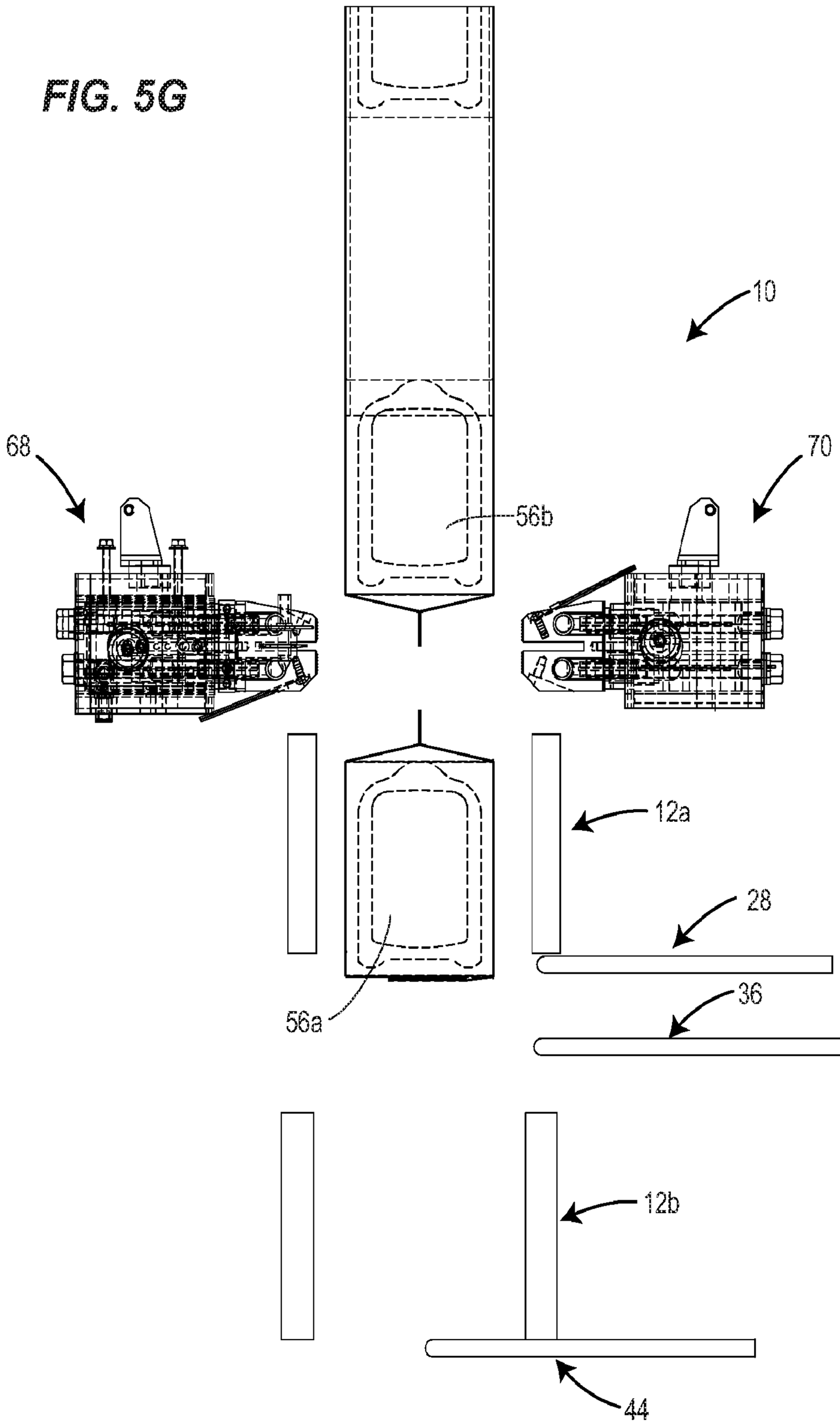


FIG. 5H

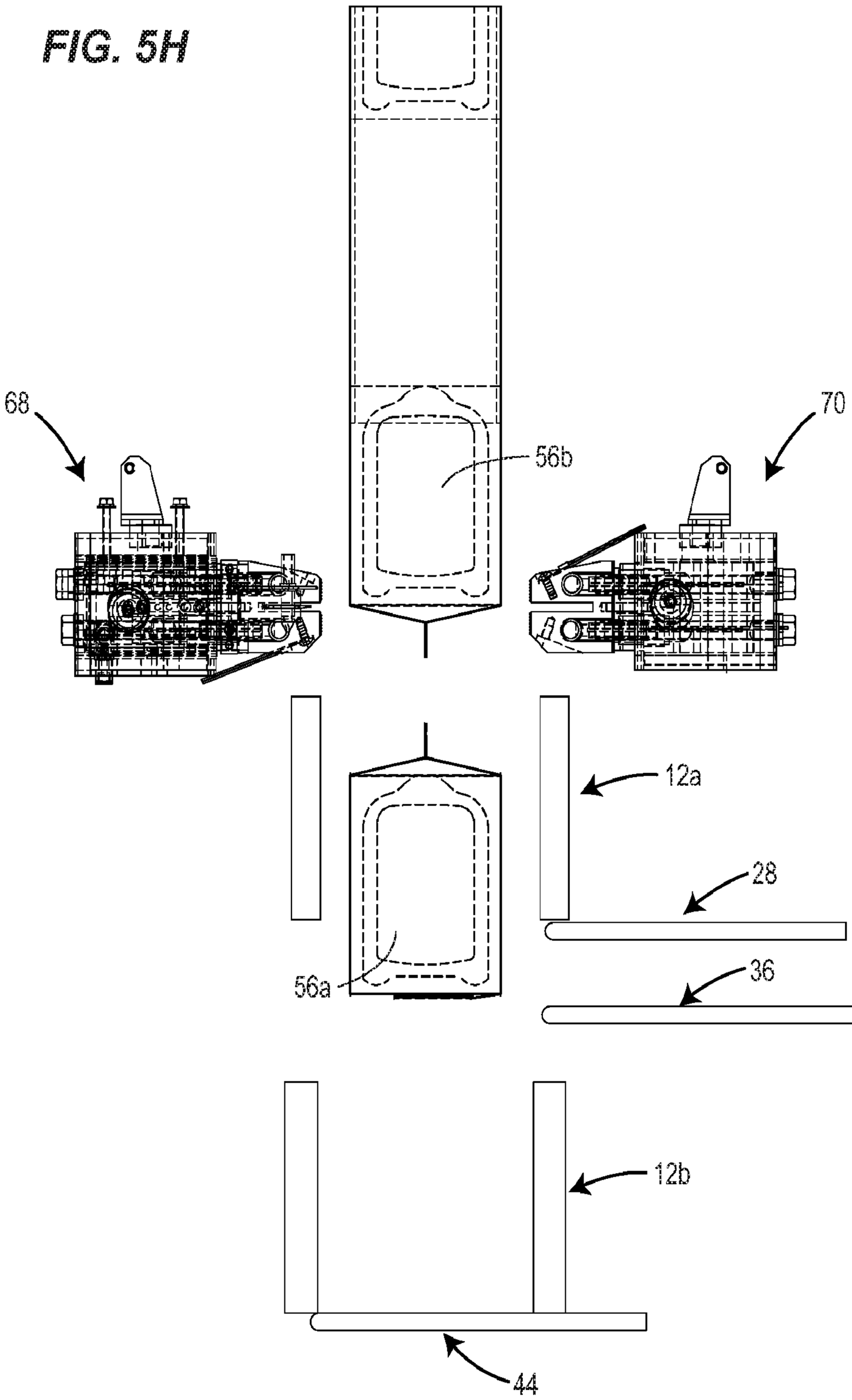


FIG. 5I

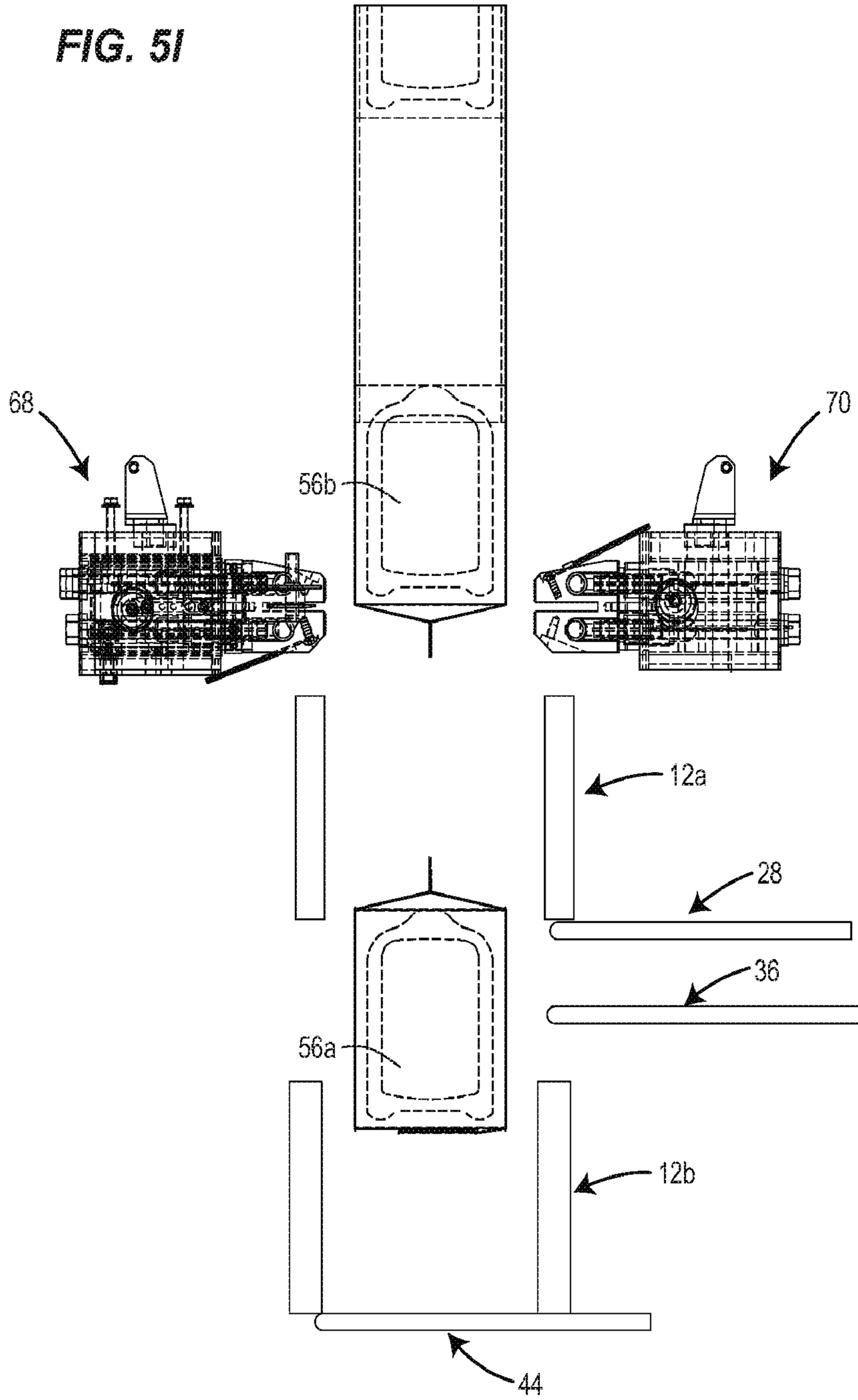


FIG. 5J

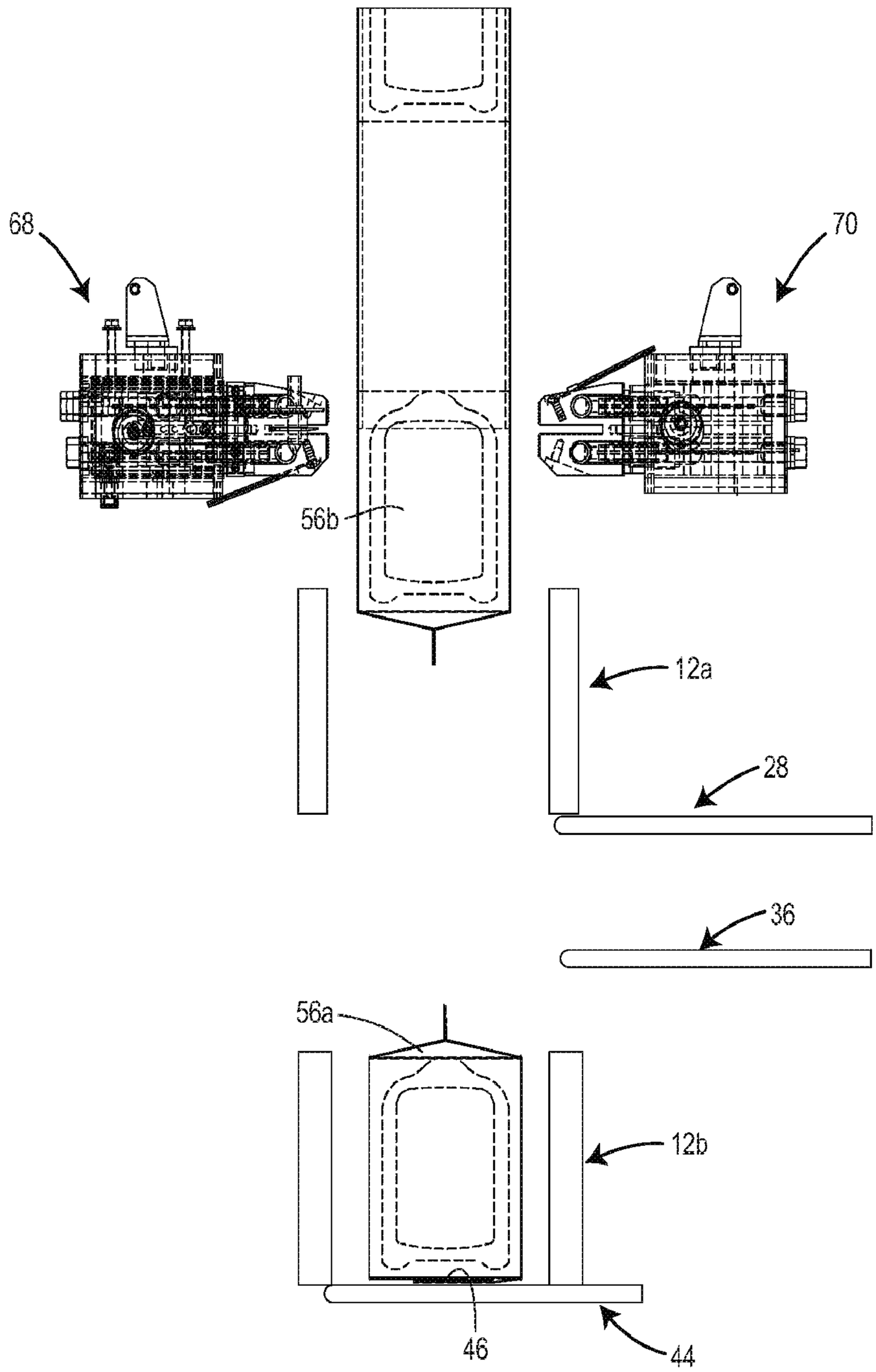


FIG. 5K

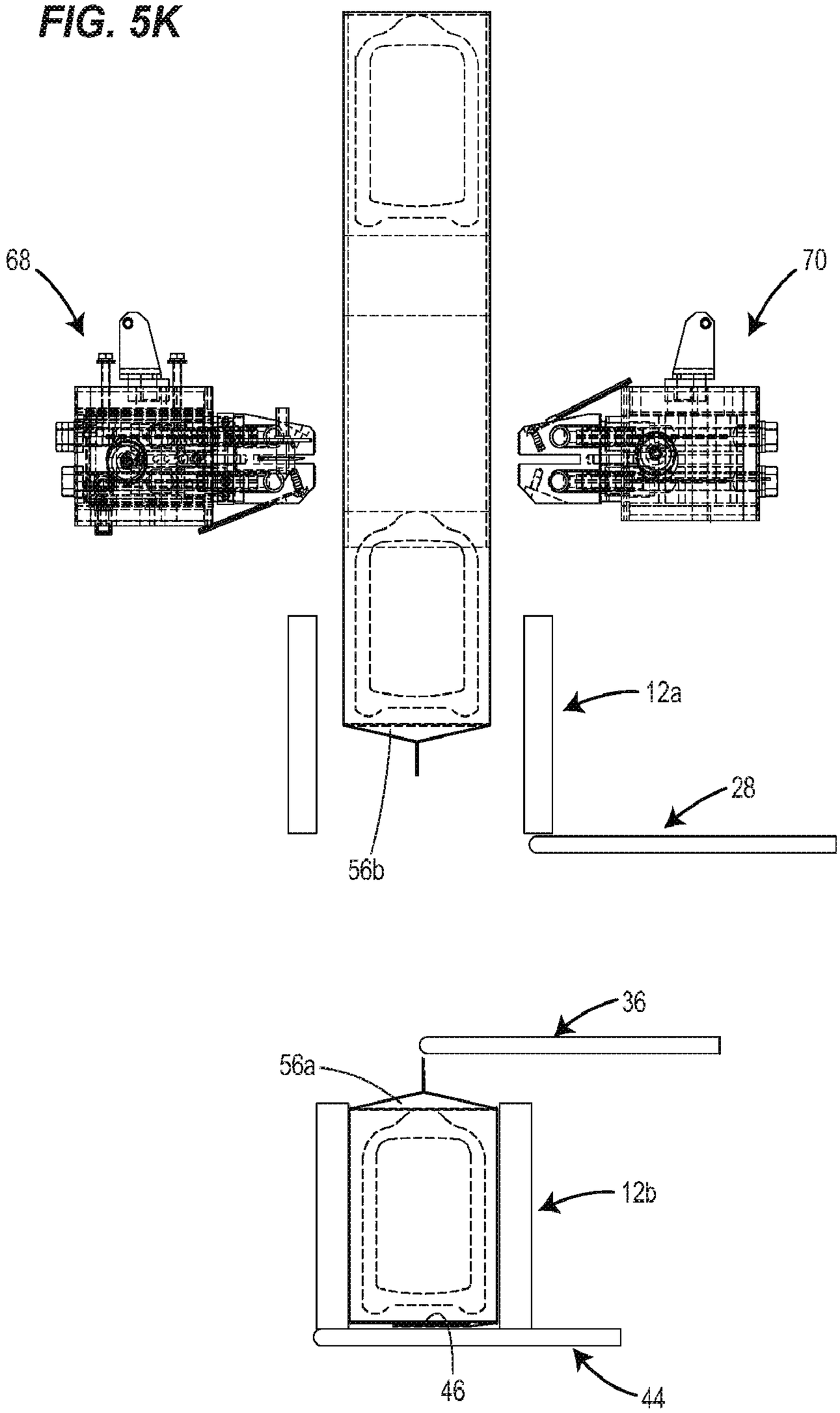


FIG. 5L

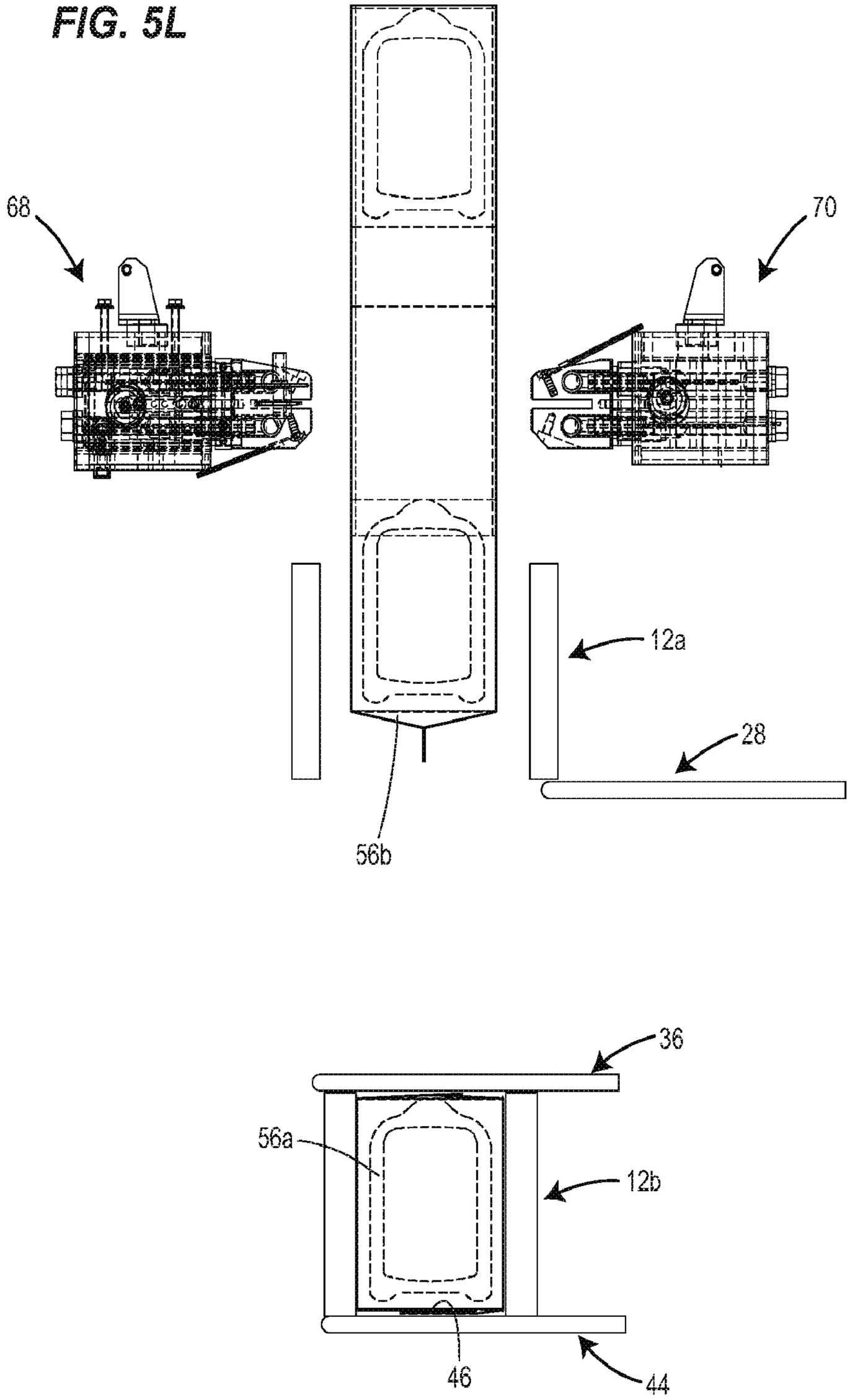
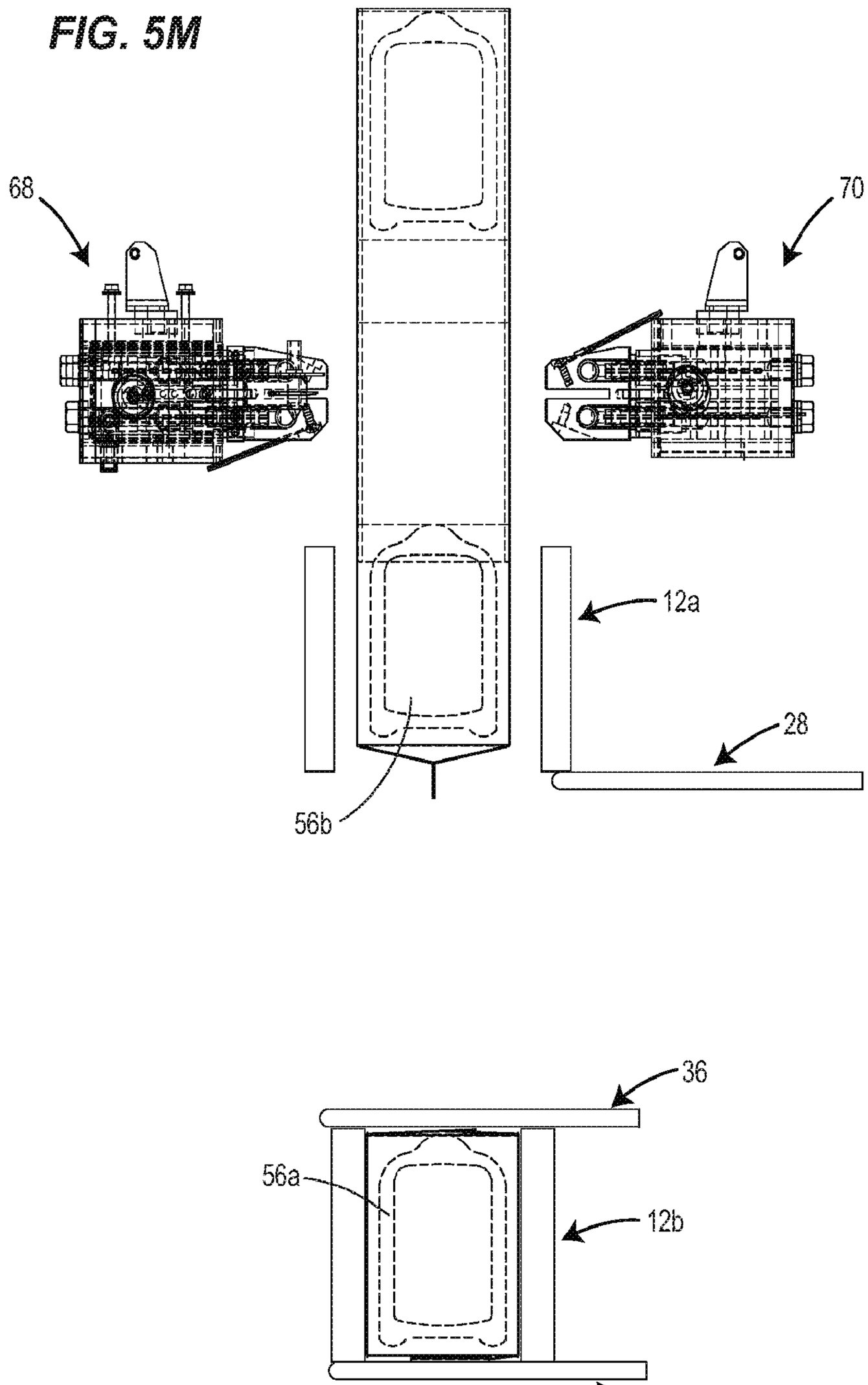


FIG. 5M



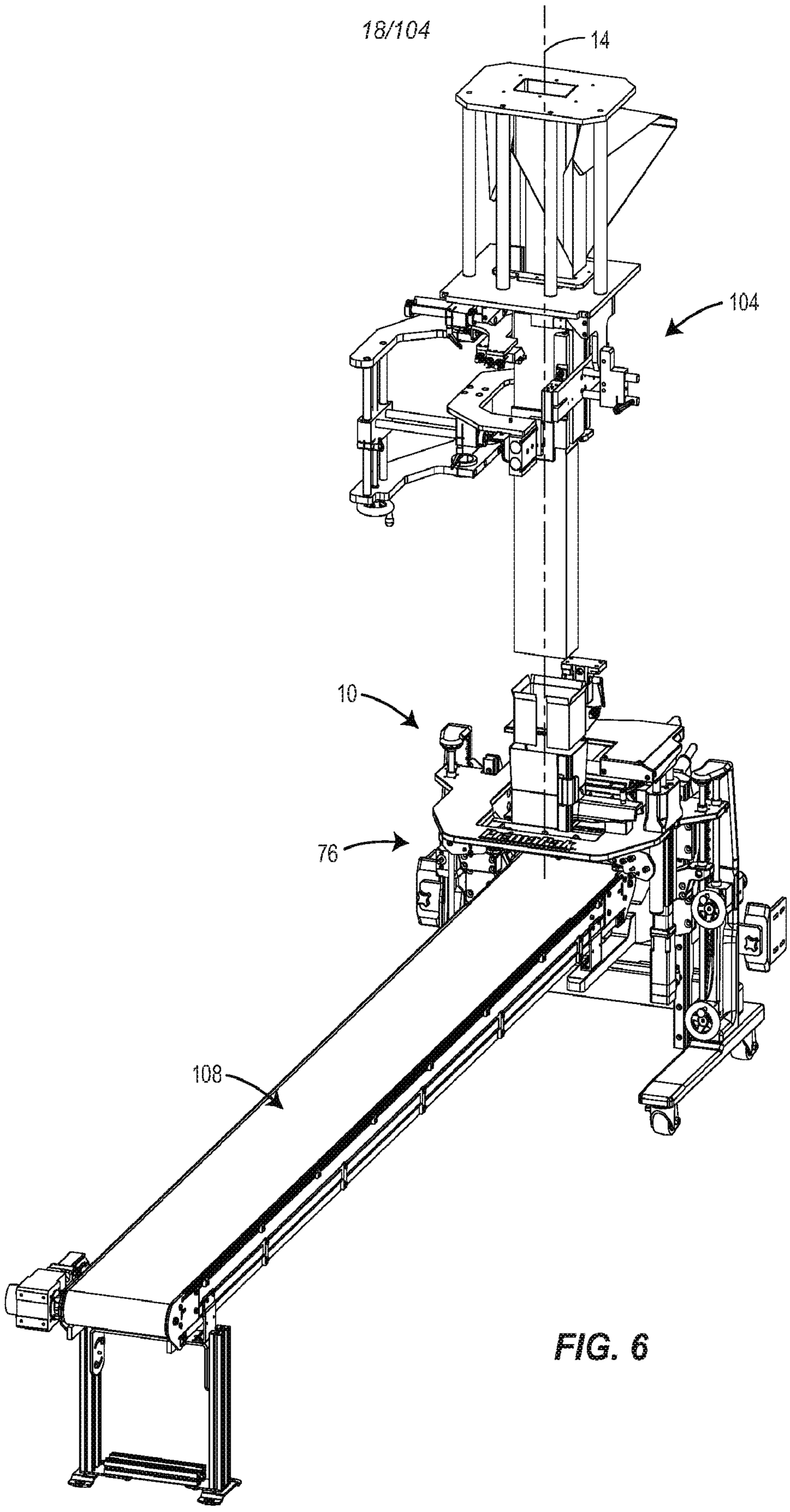


FIG. 6

FIG. 8A

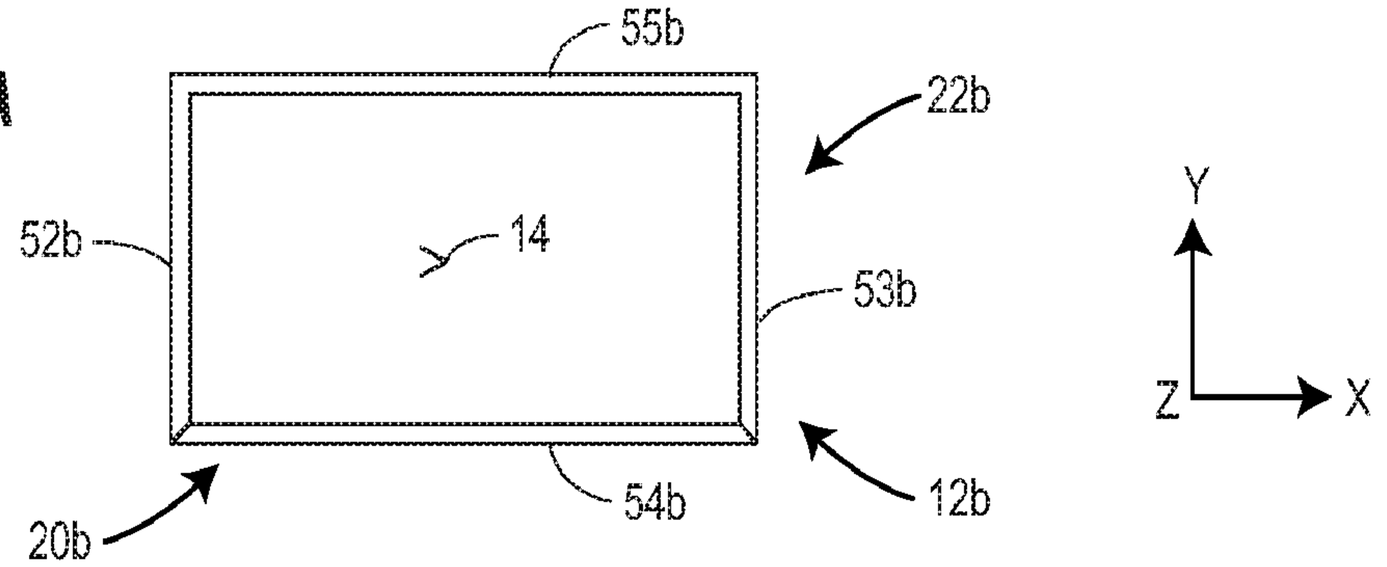
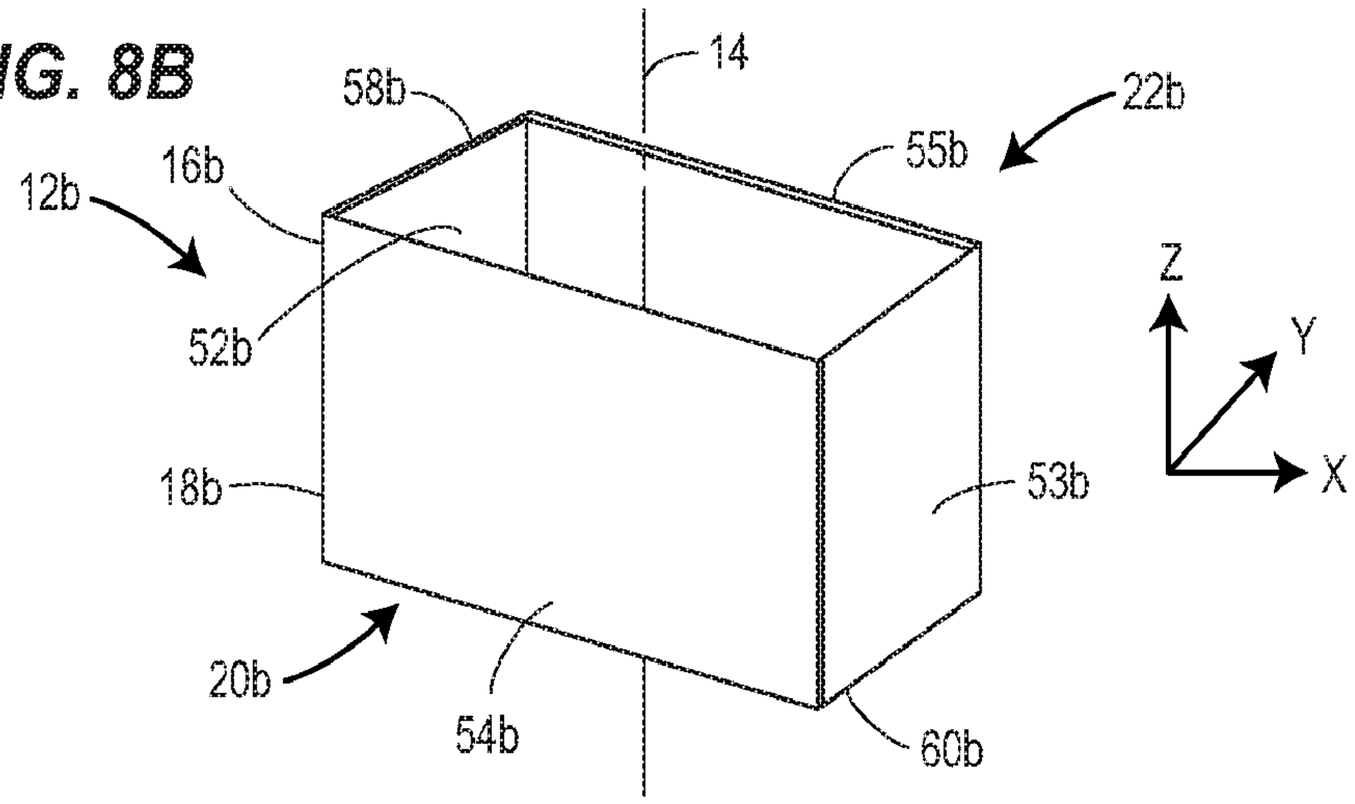


FIG. 8B



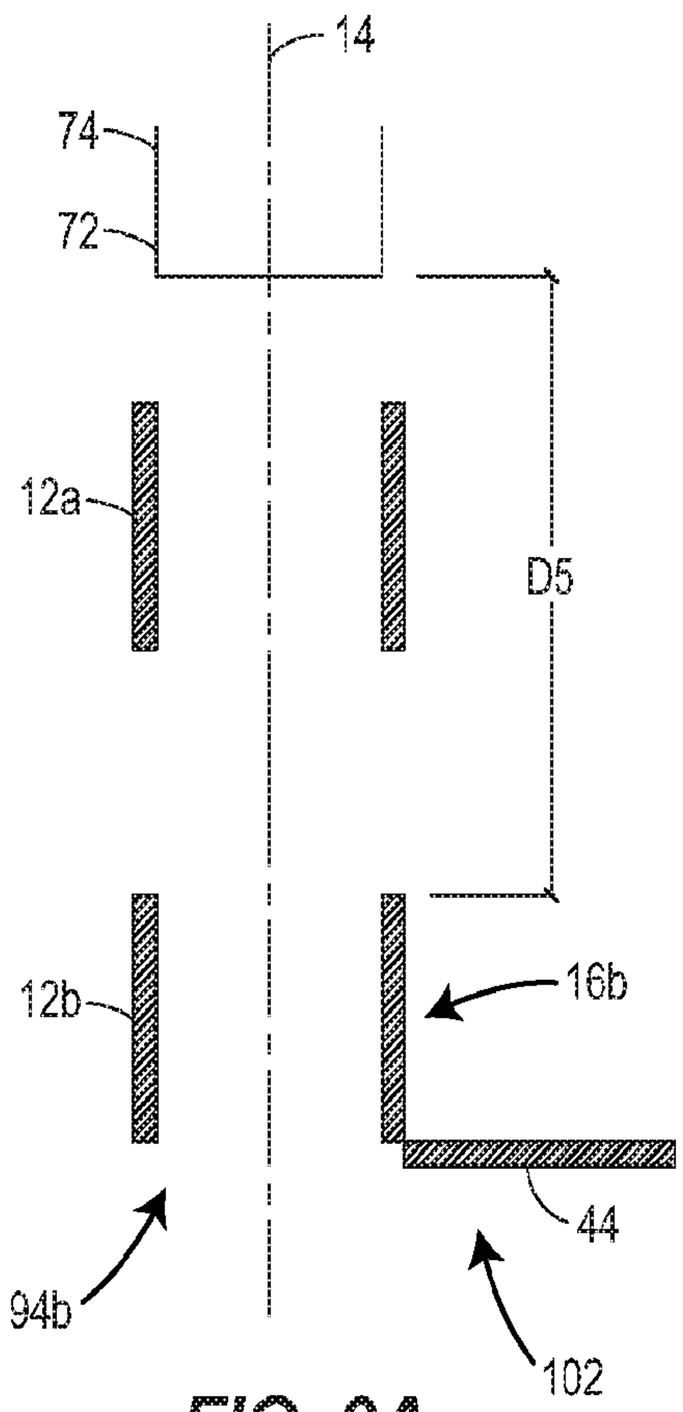


FIG. 9A

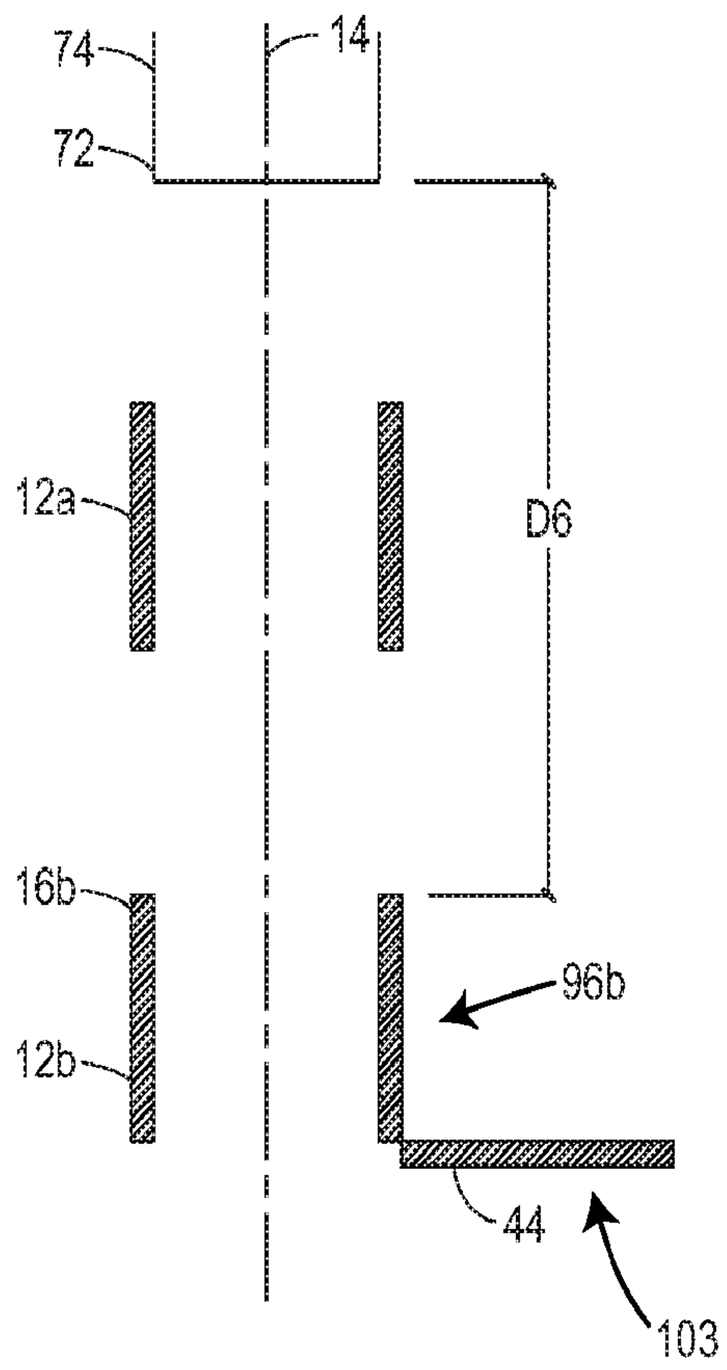


FIG. 9B

FIG. 10A

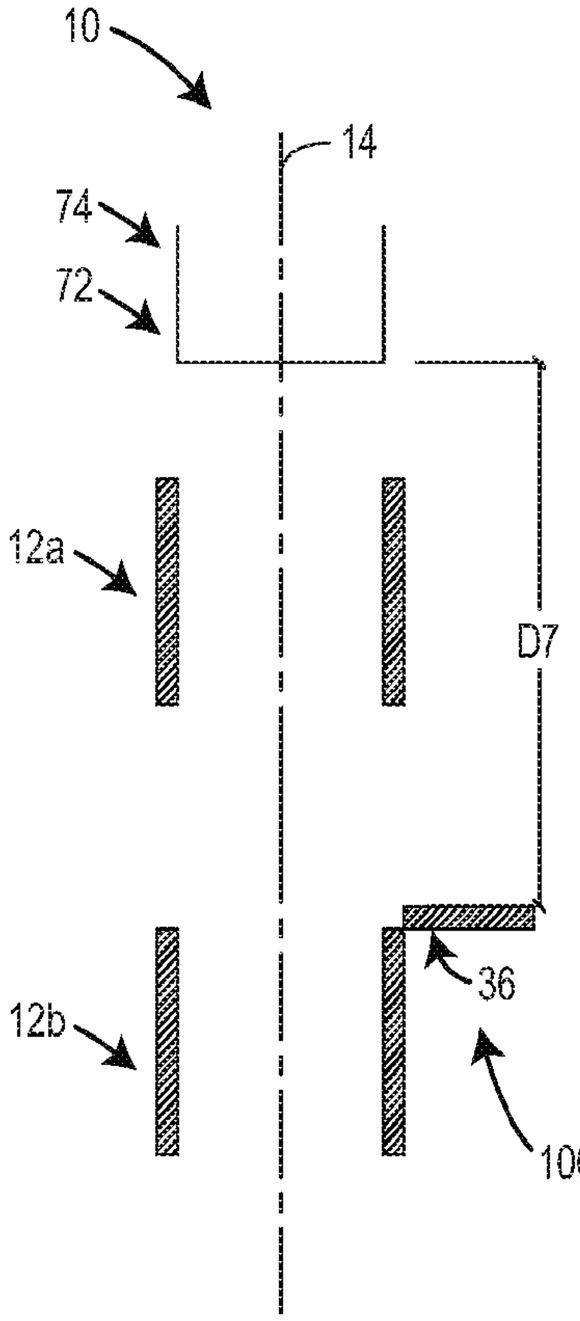
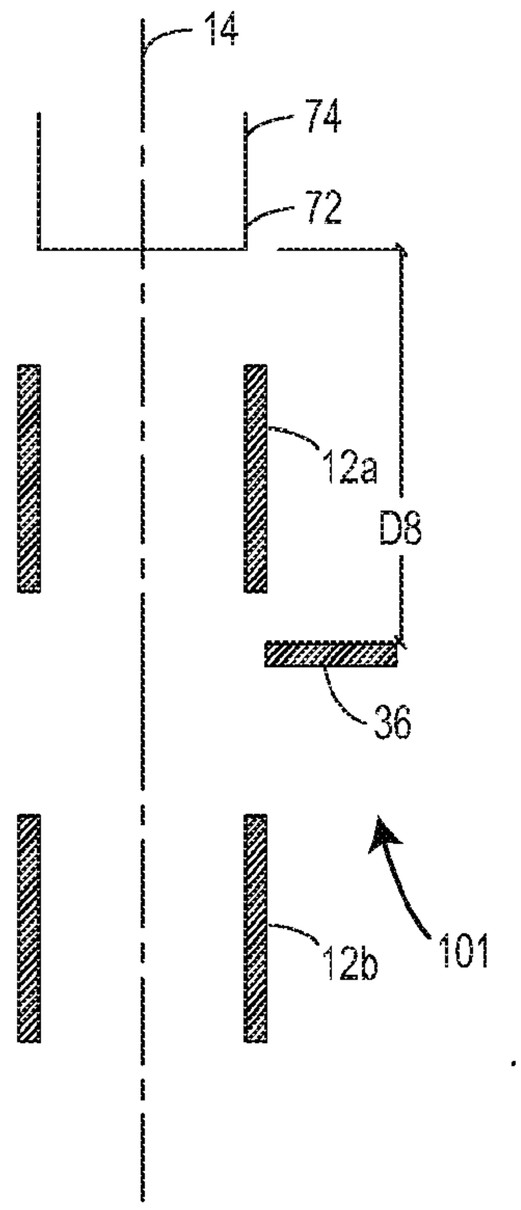


FIG. 10B



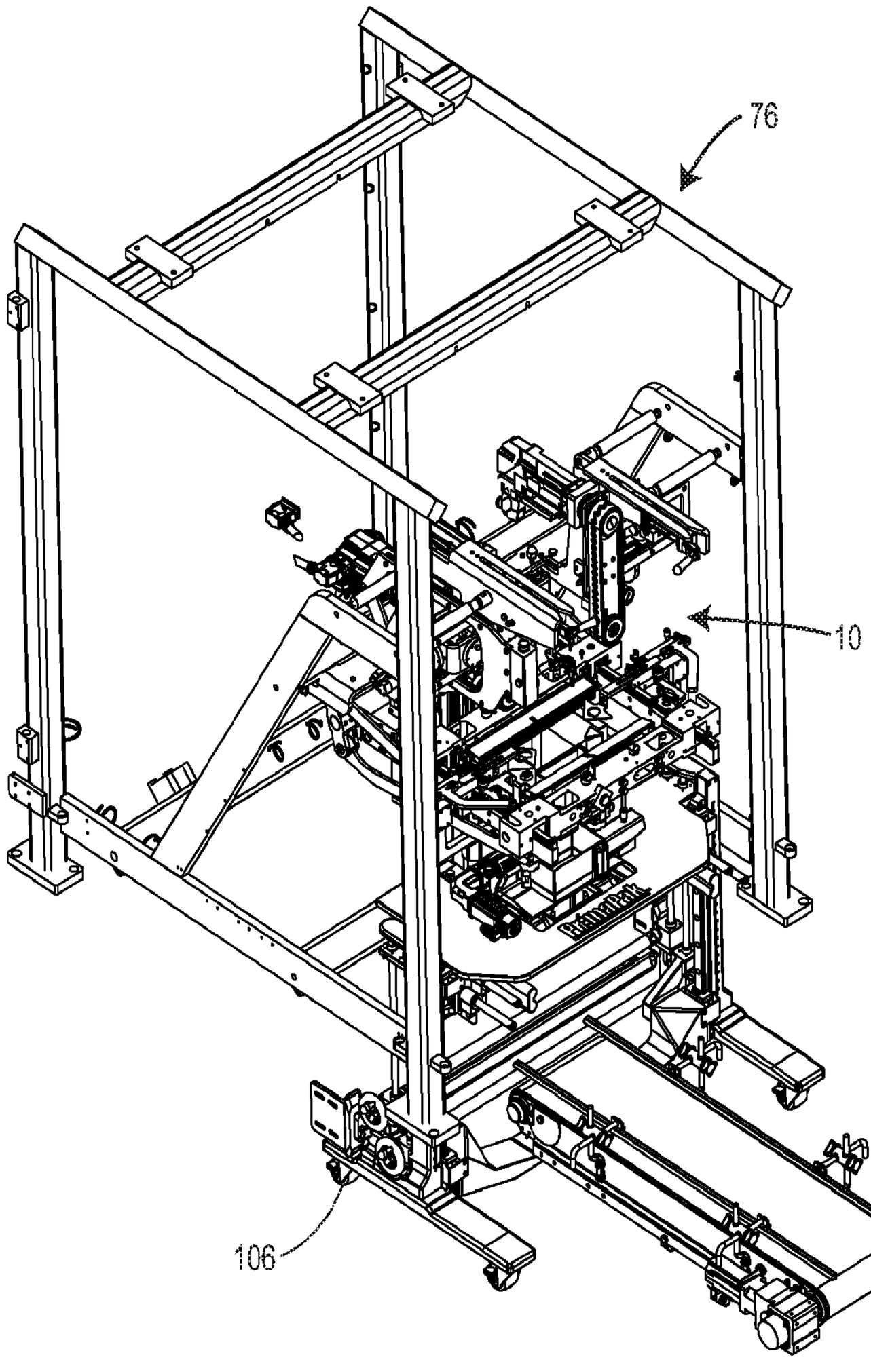


FIG. 11A

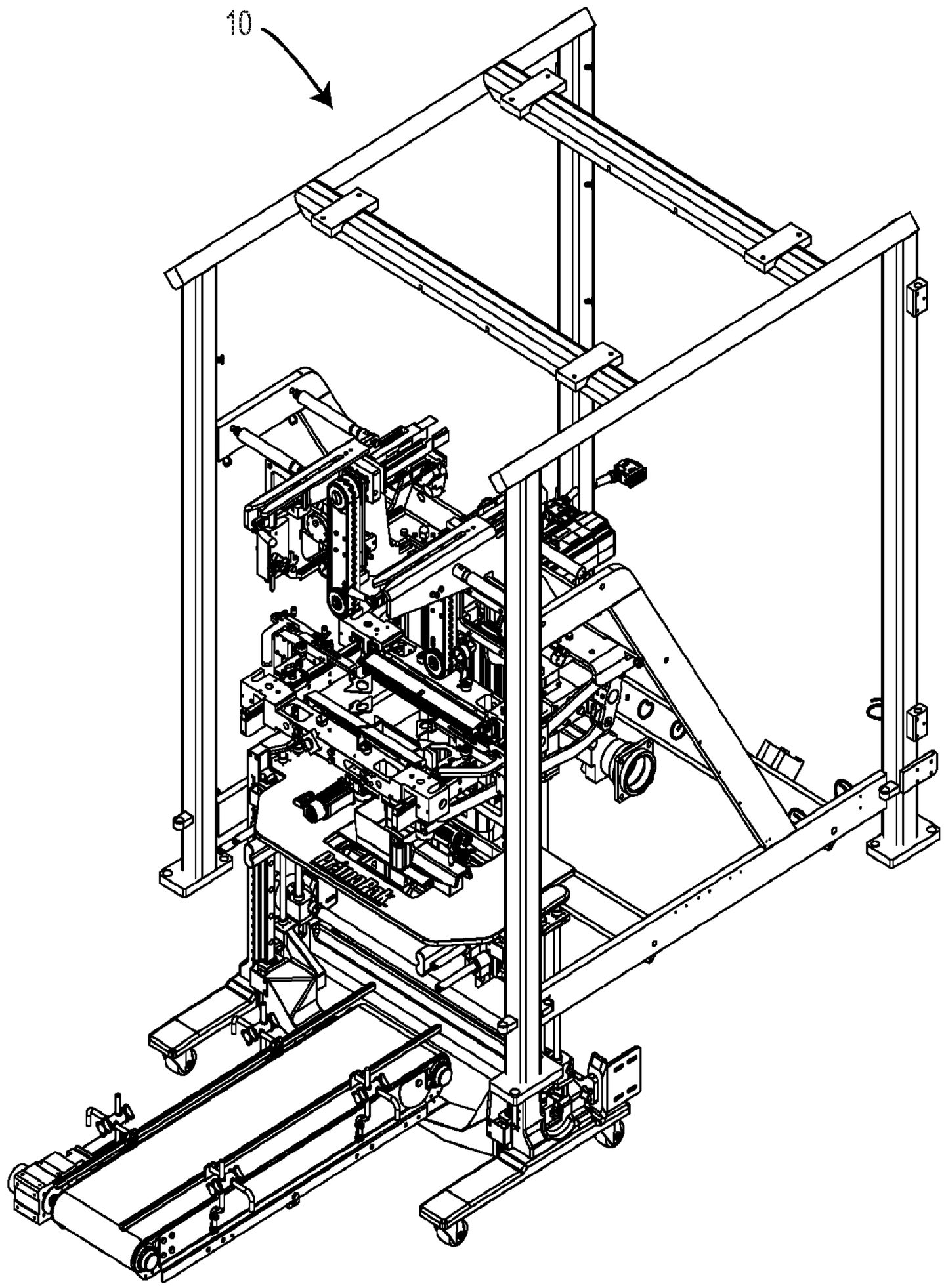


FIG. 11B

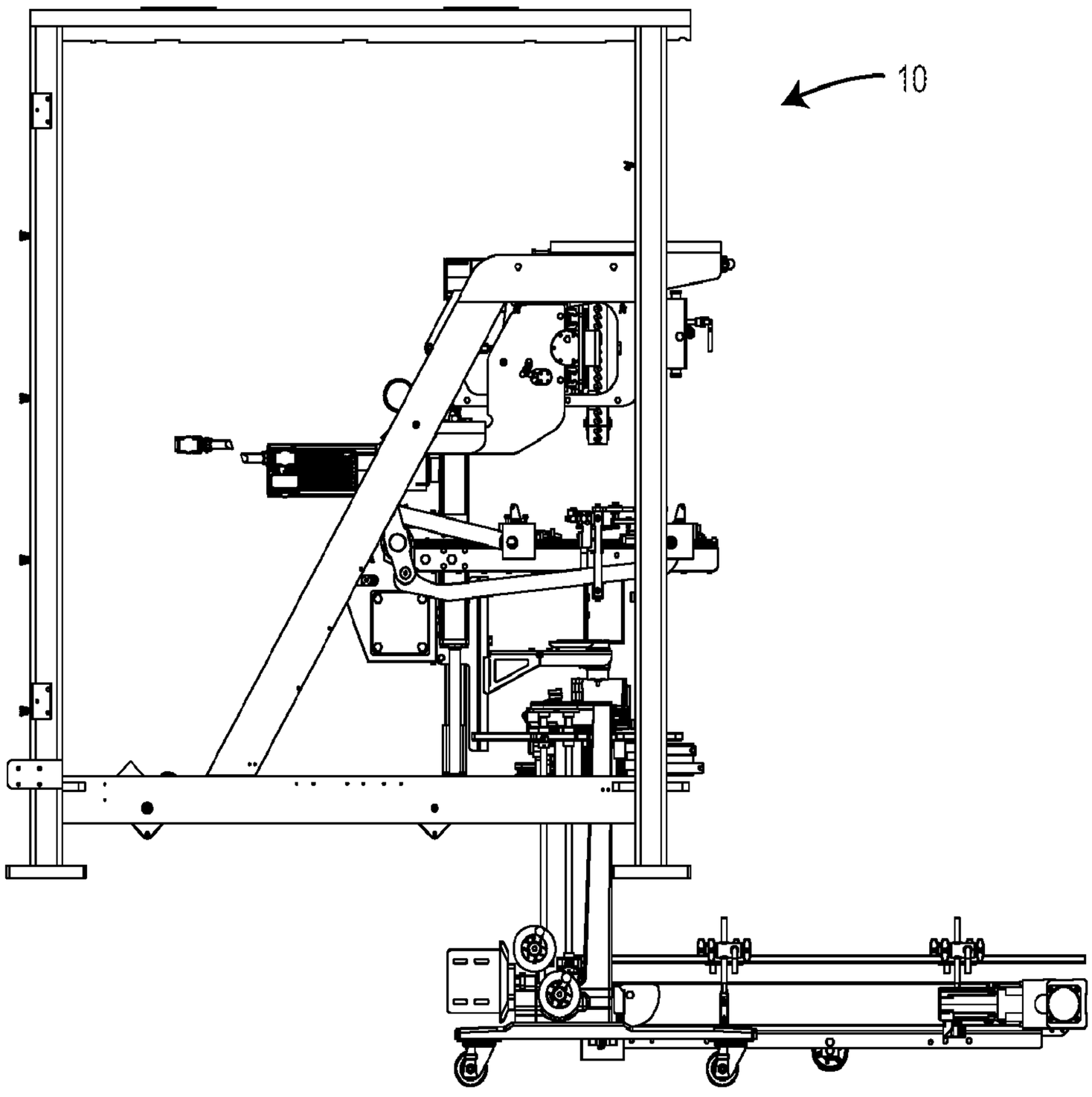


FIG. 11C

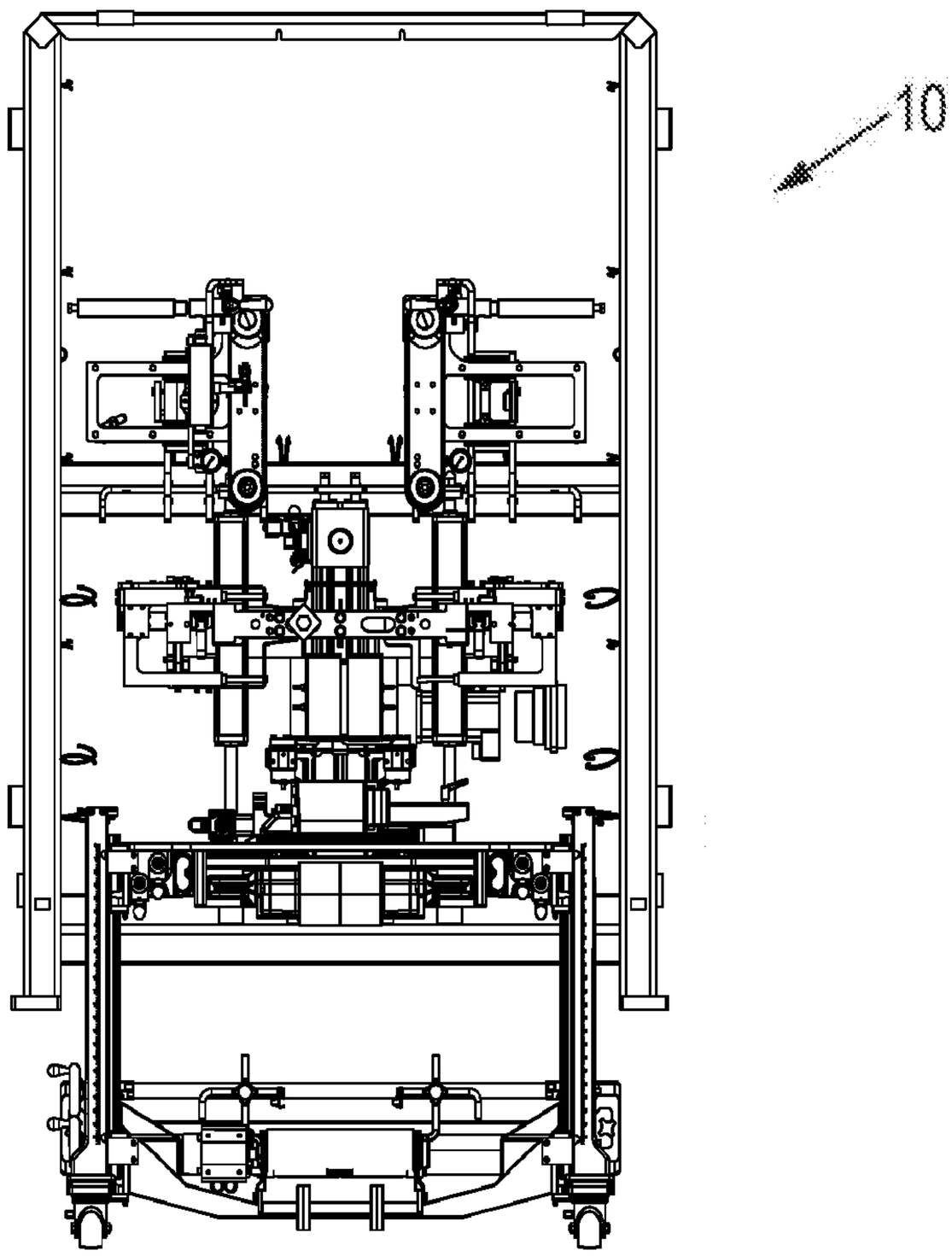


FIG. 11D

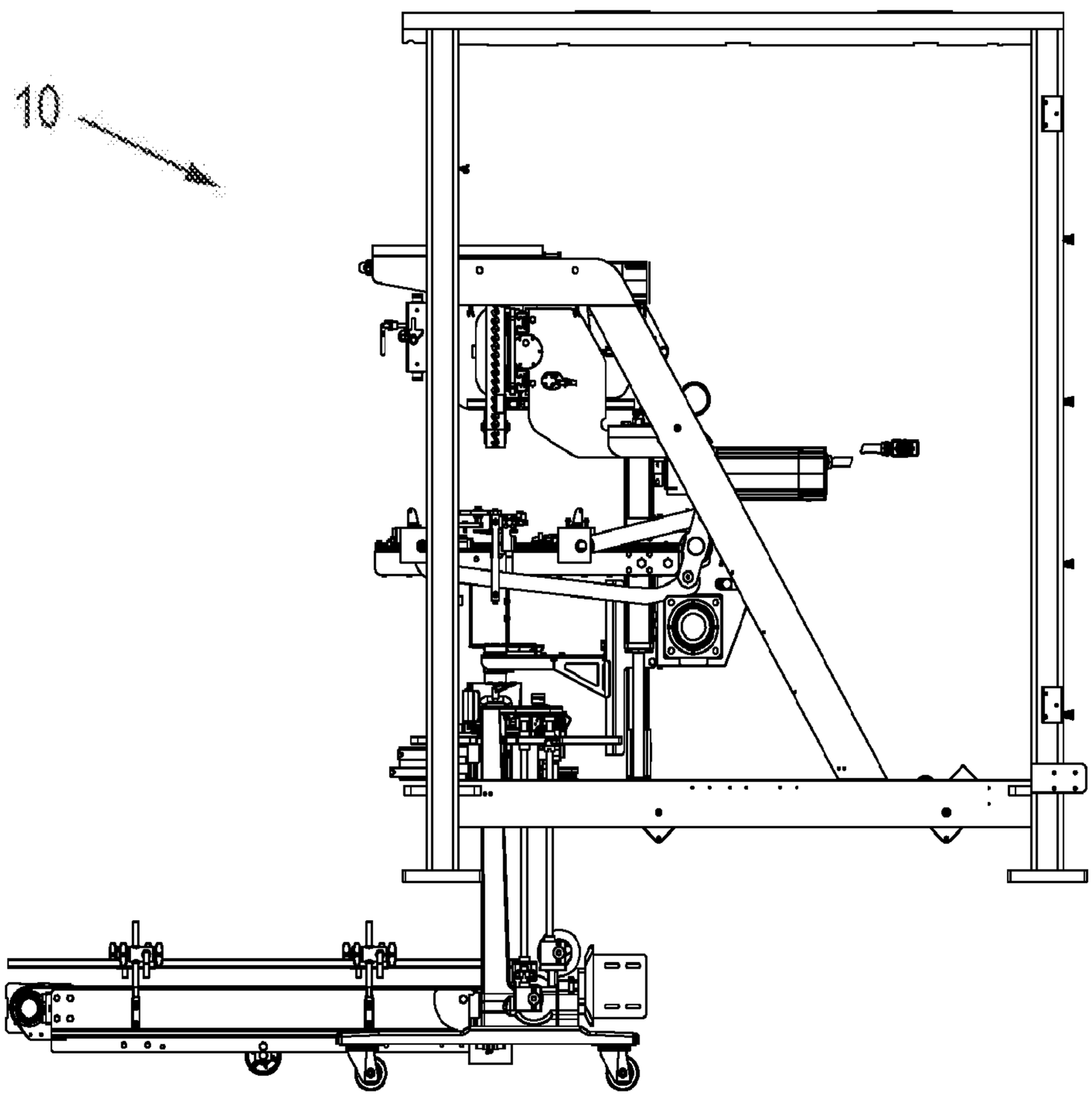


FIG. 11E

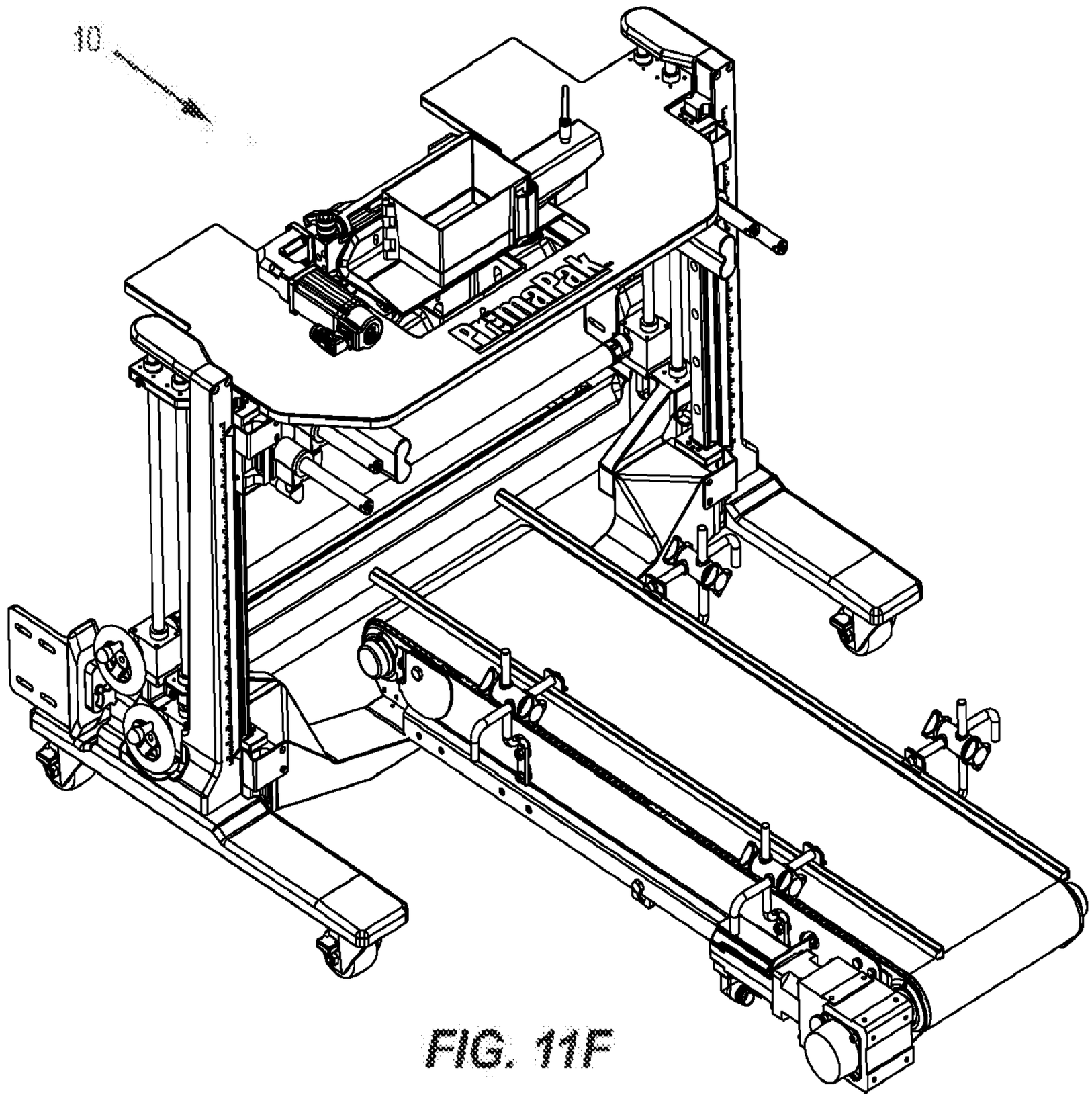


FIG. 11F

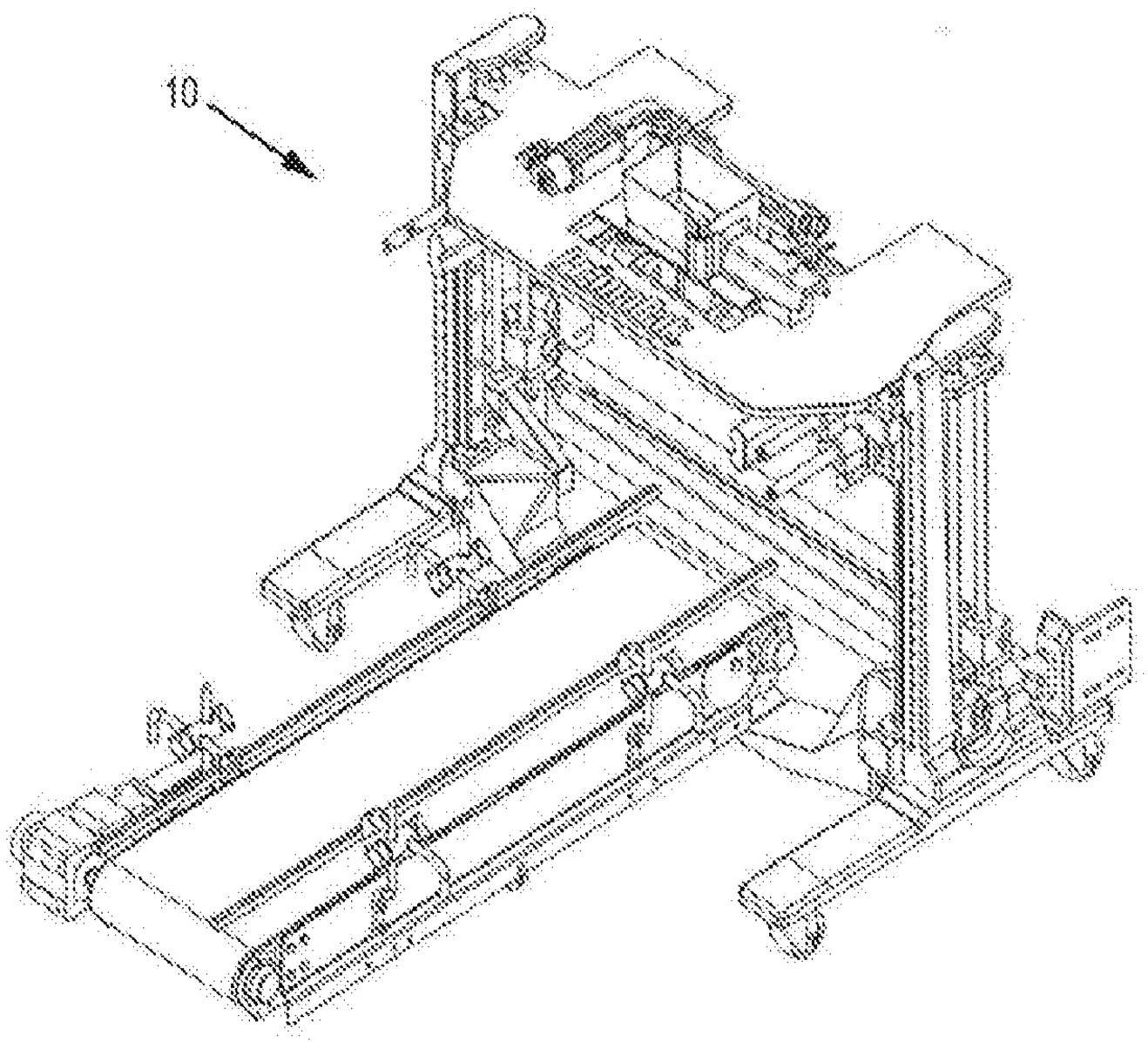


FIG. 11G

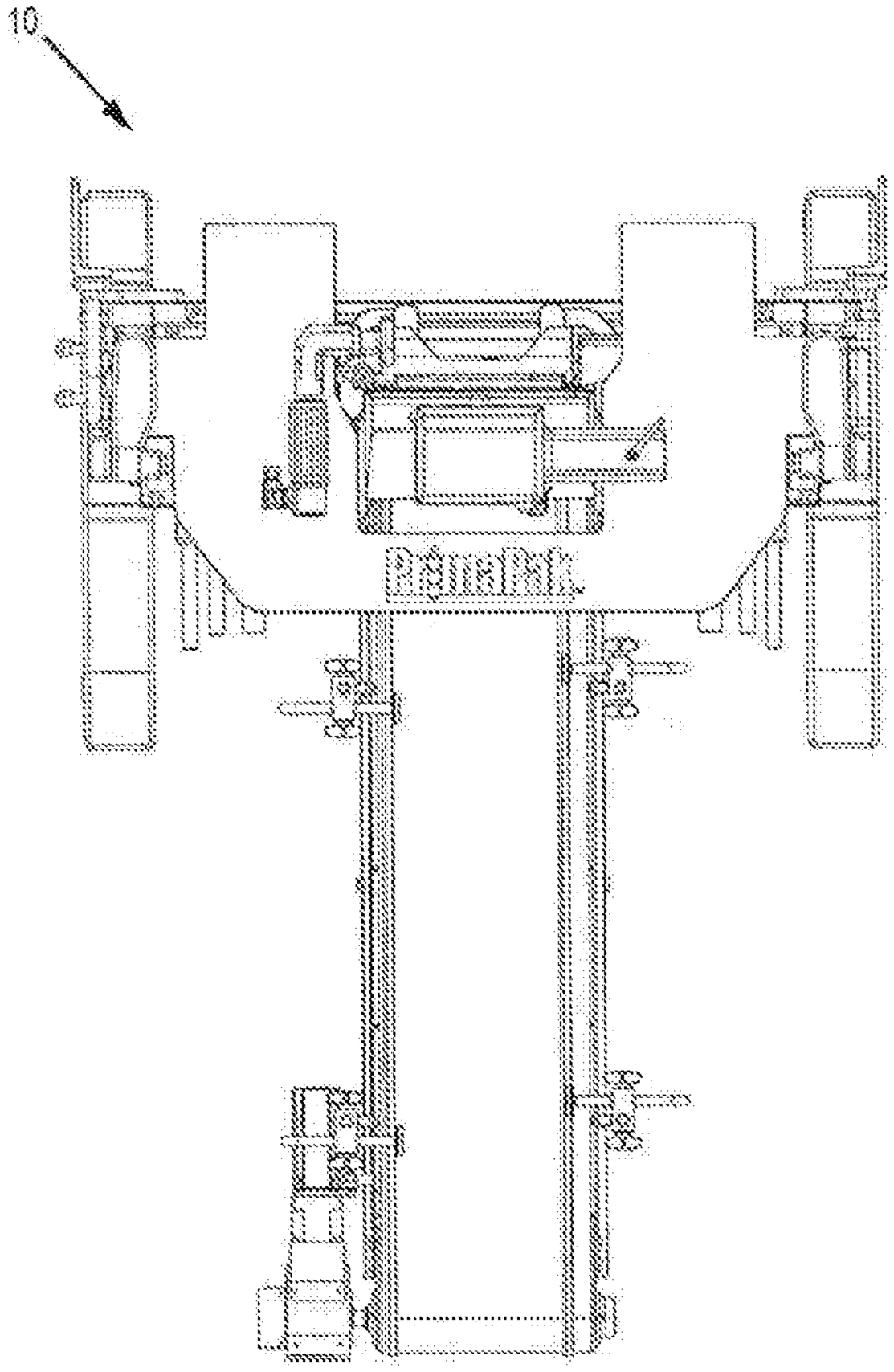


FIG. 11H

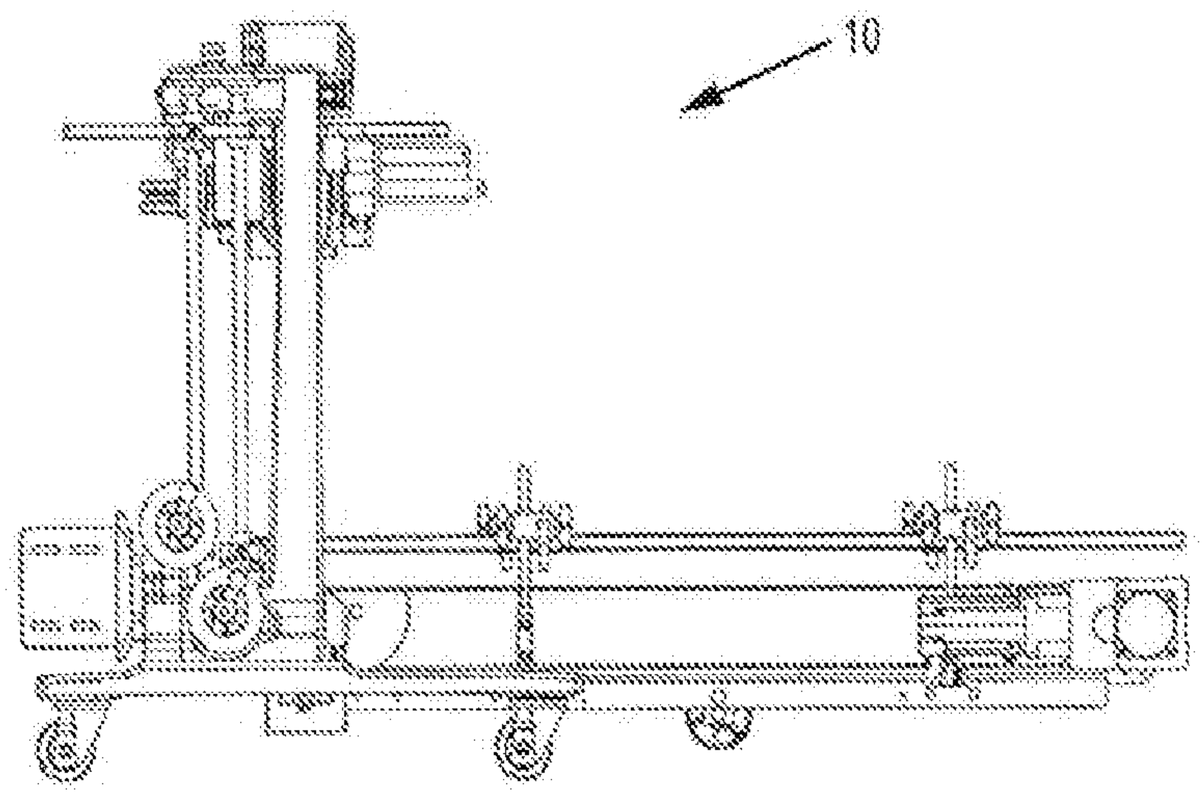


FIG. 111

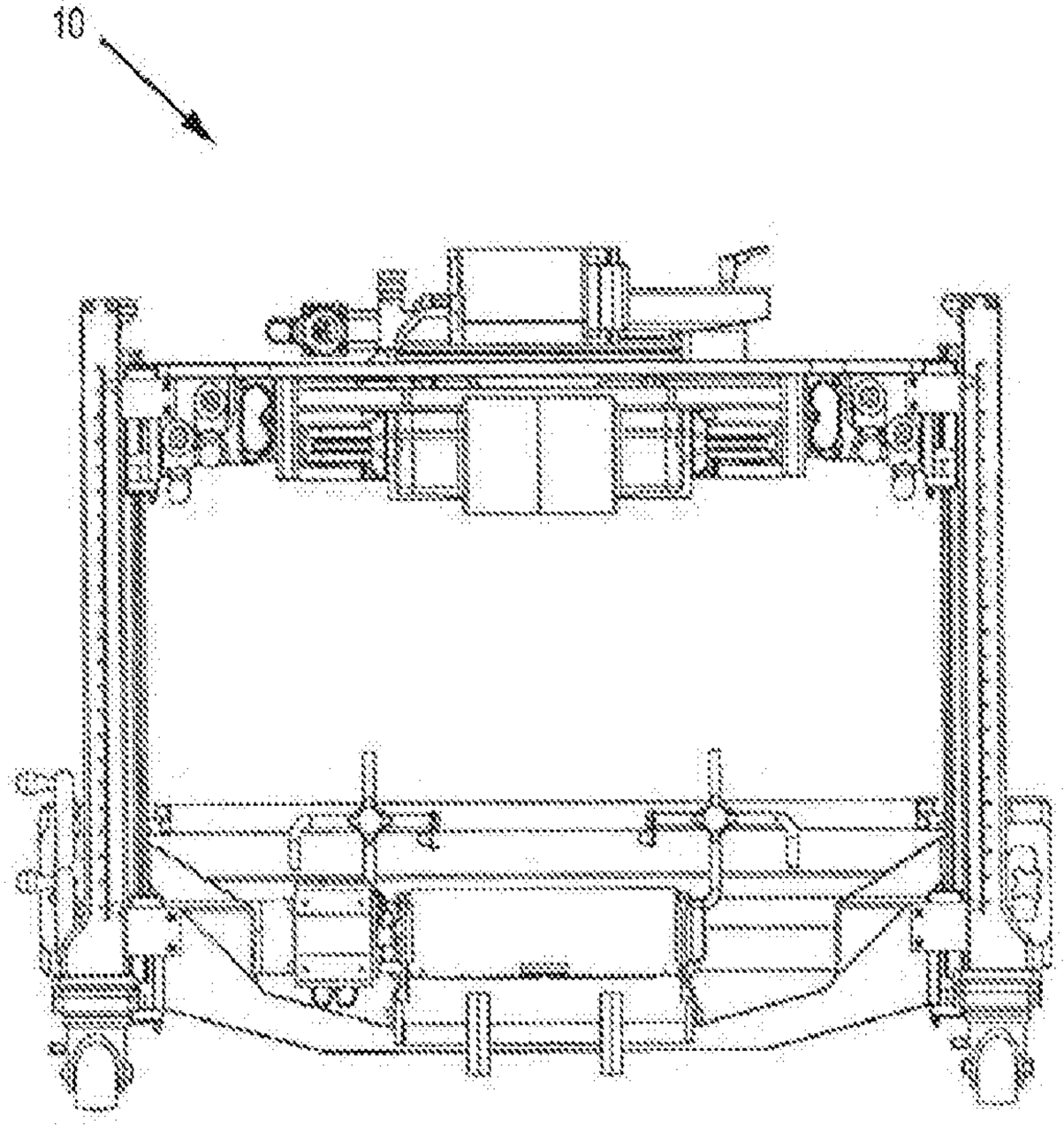


FIG. 11J

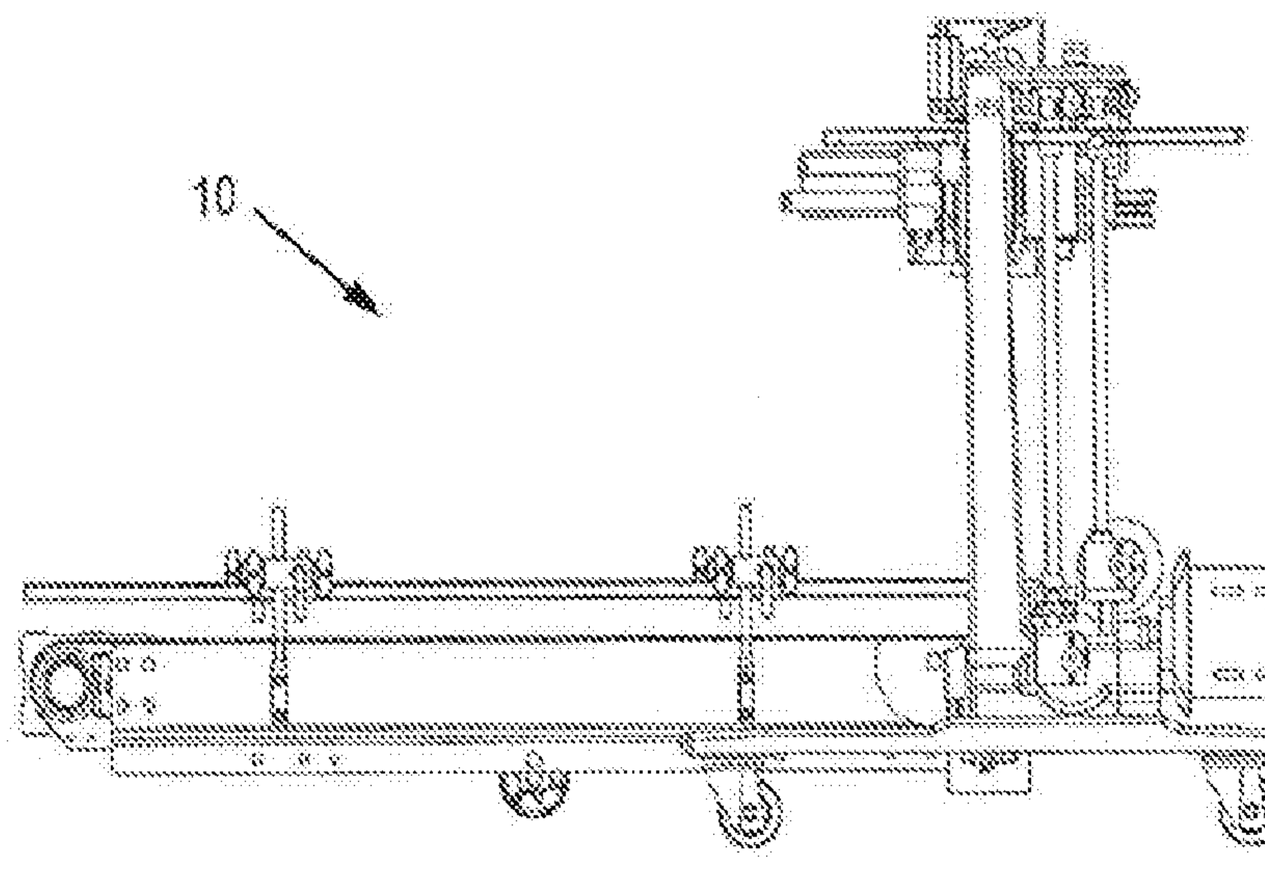


FIG. 11K

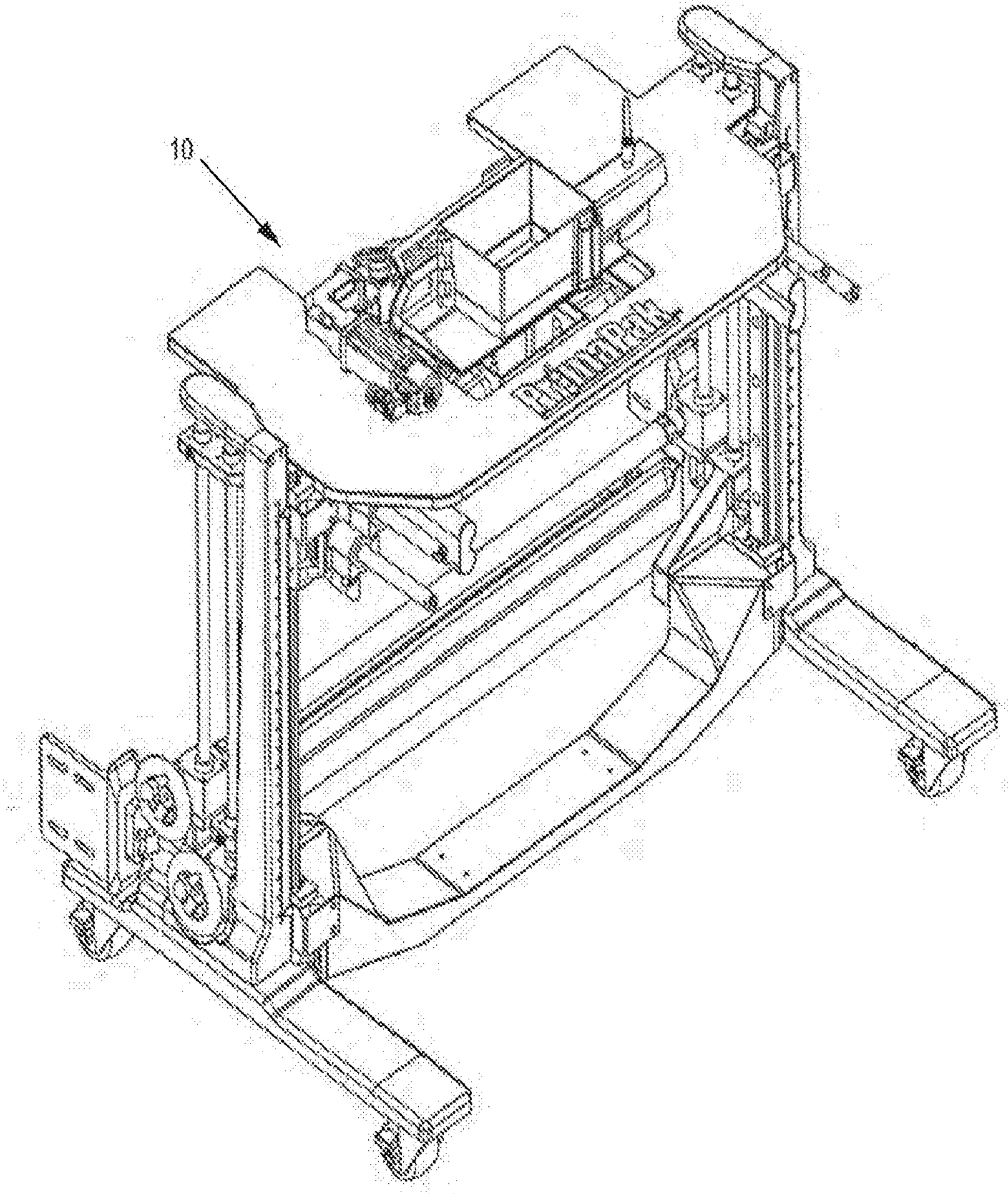


FIG. 11L

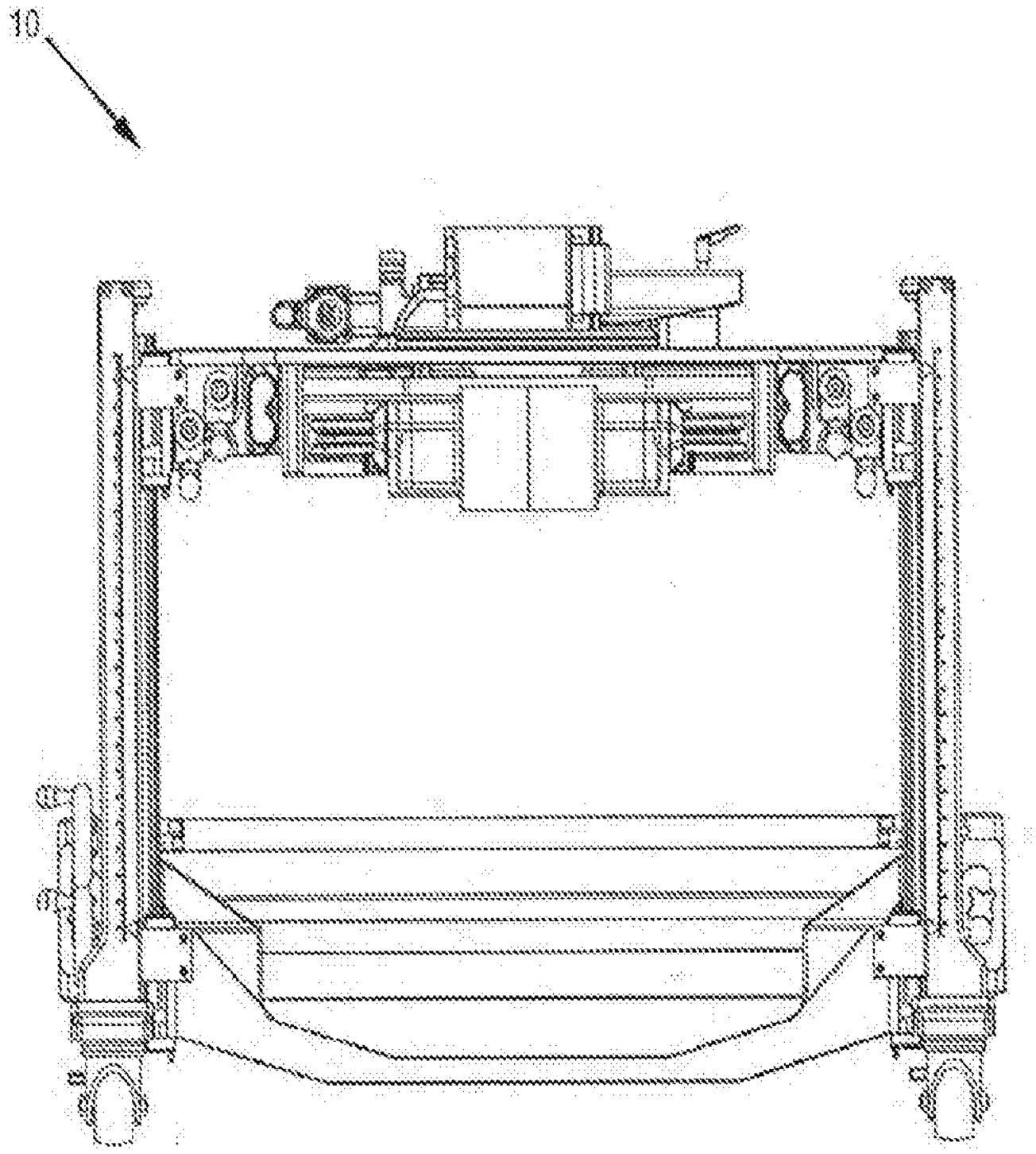


FIG. 11M

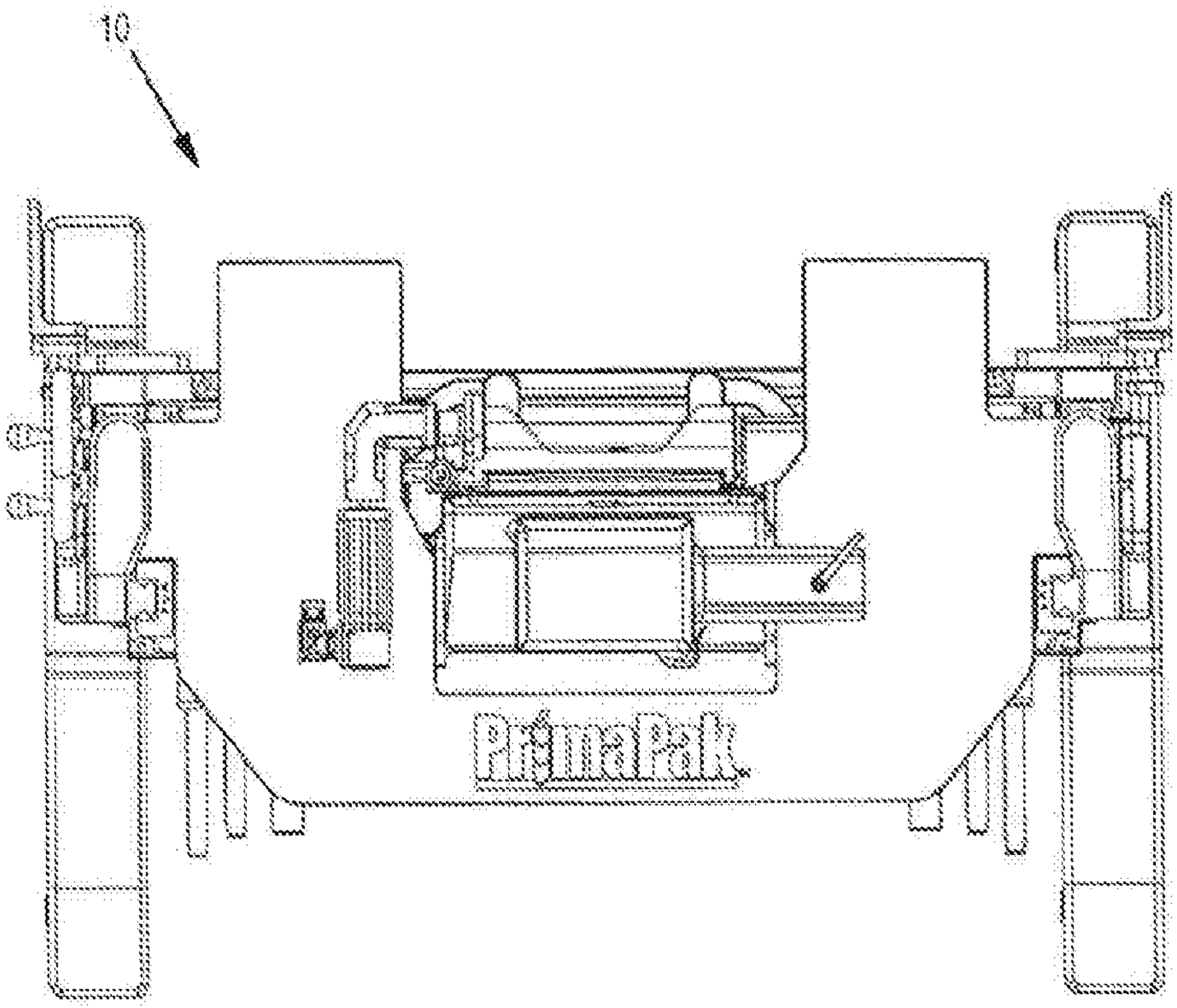


FIG. 11N

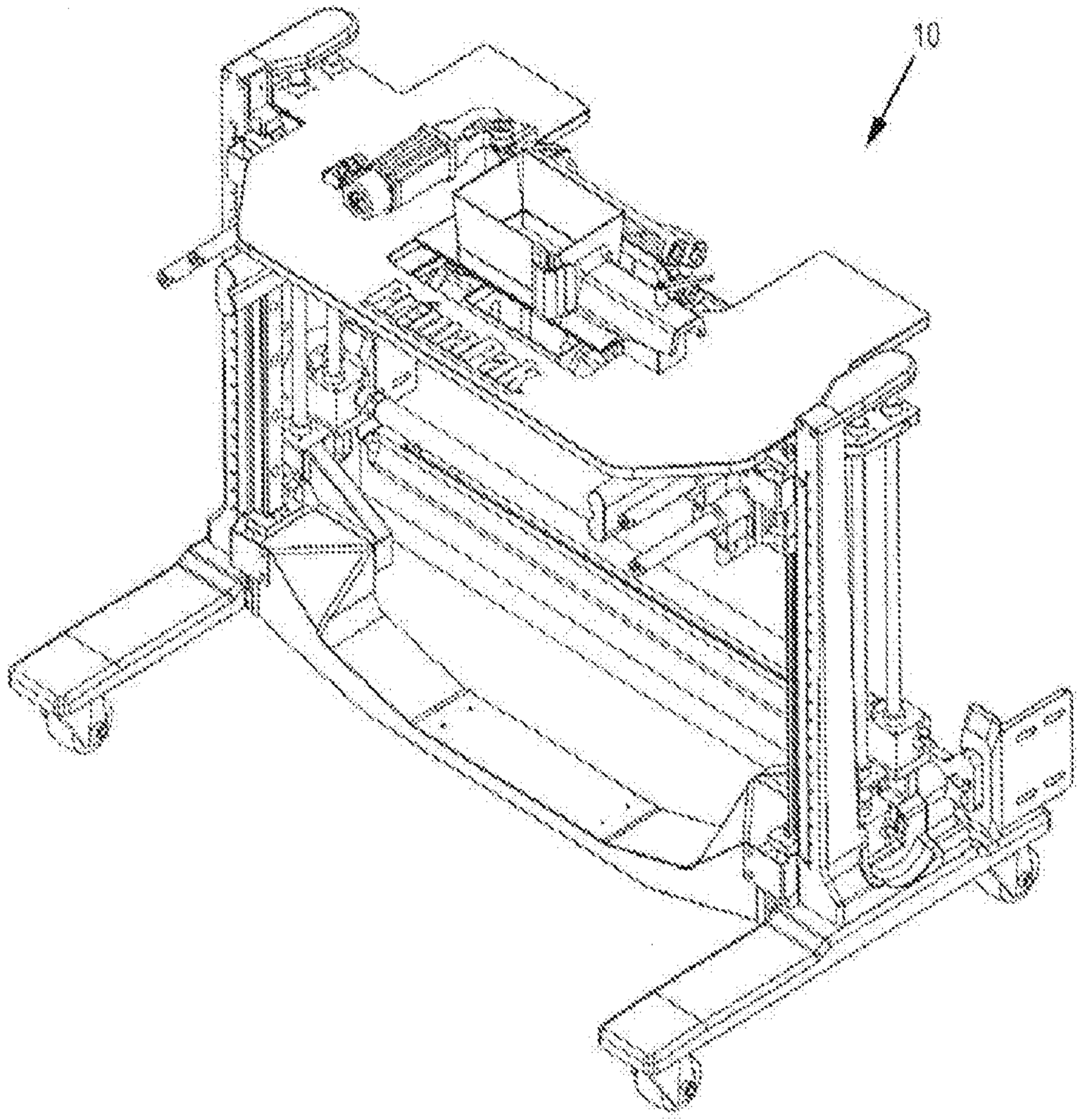


FIG. 110

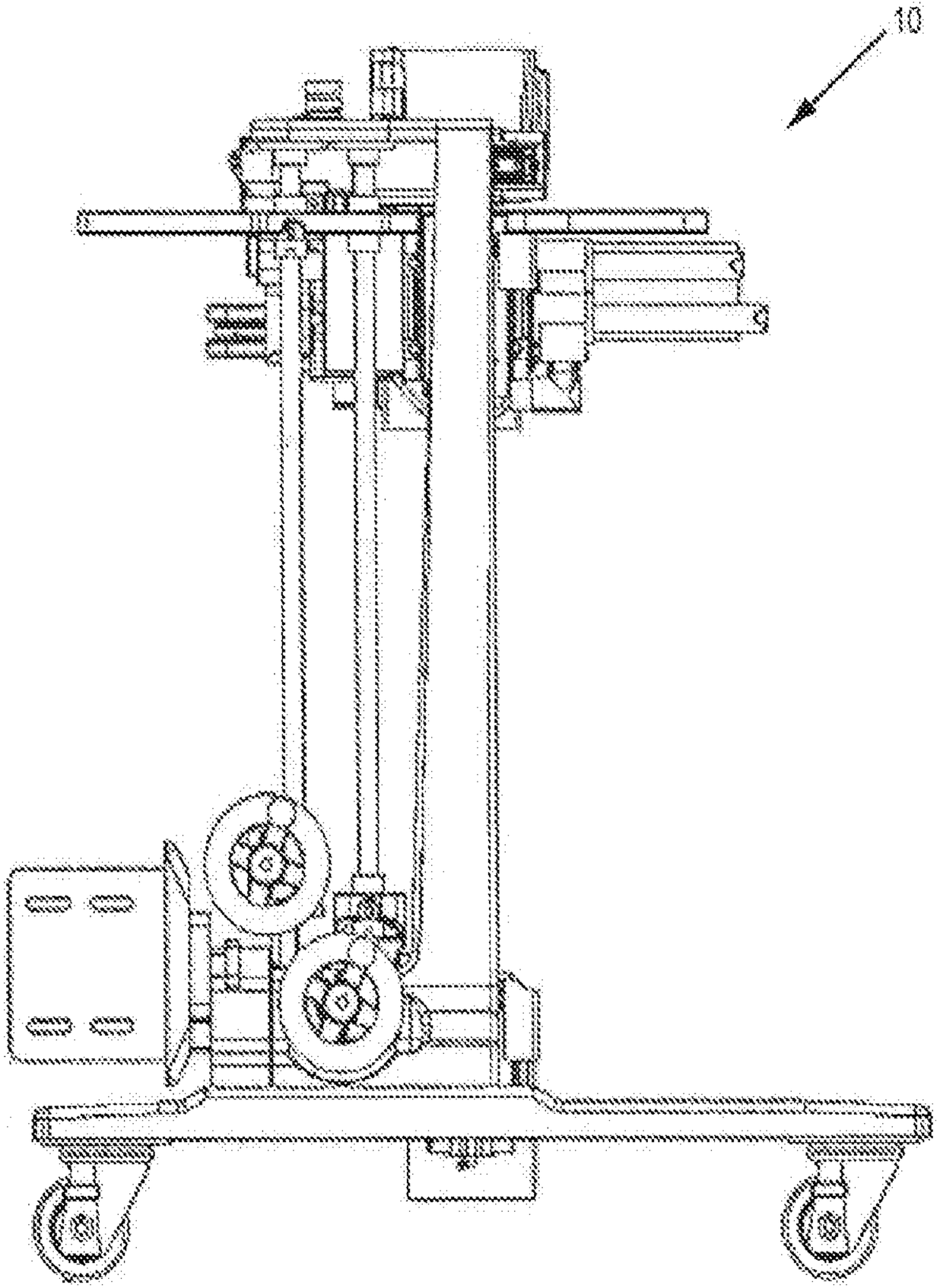


FIG. 11P

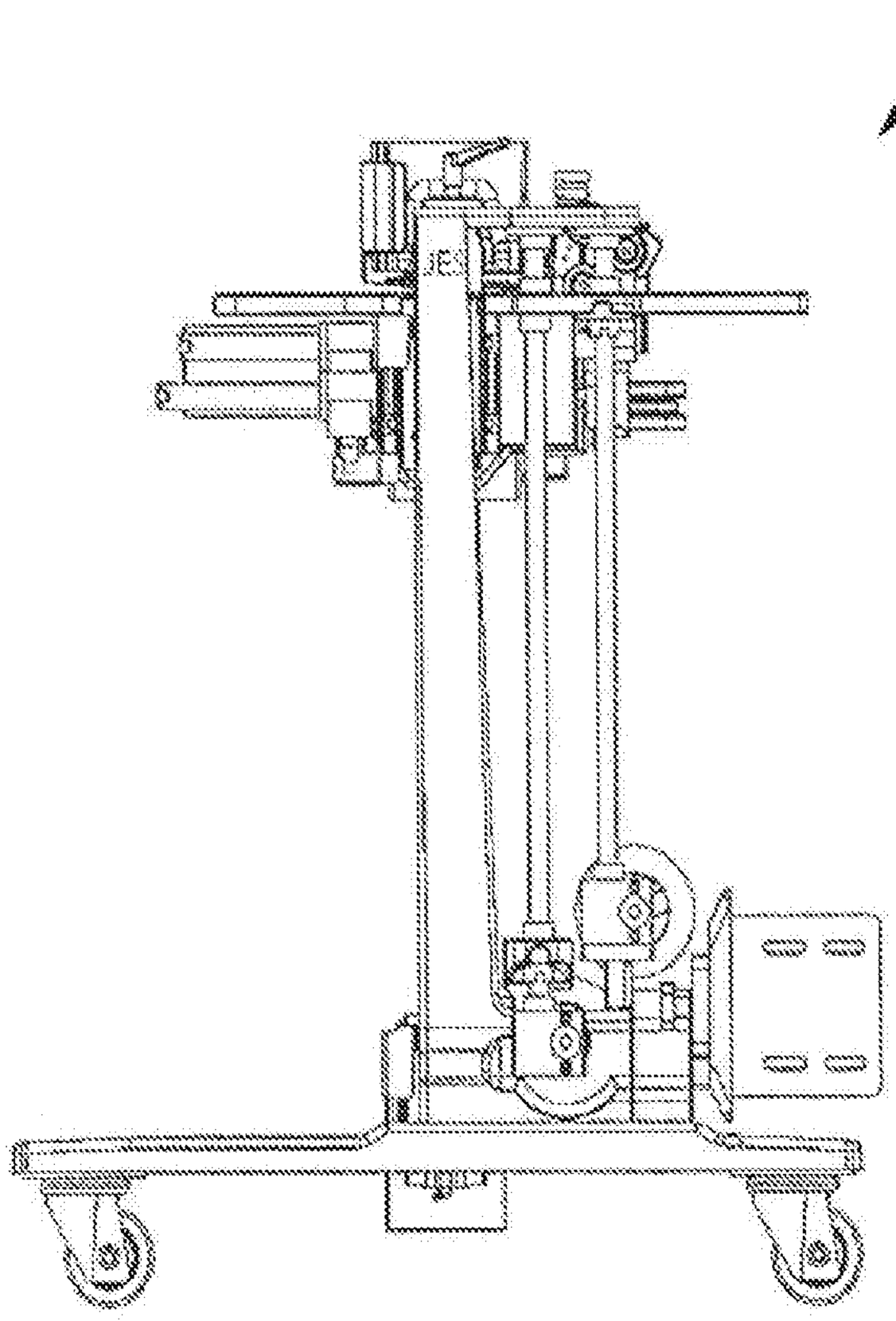


FIG. 11Q

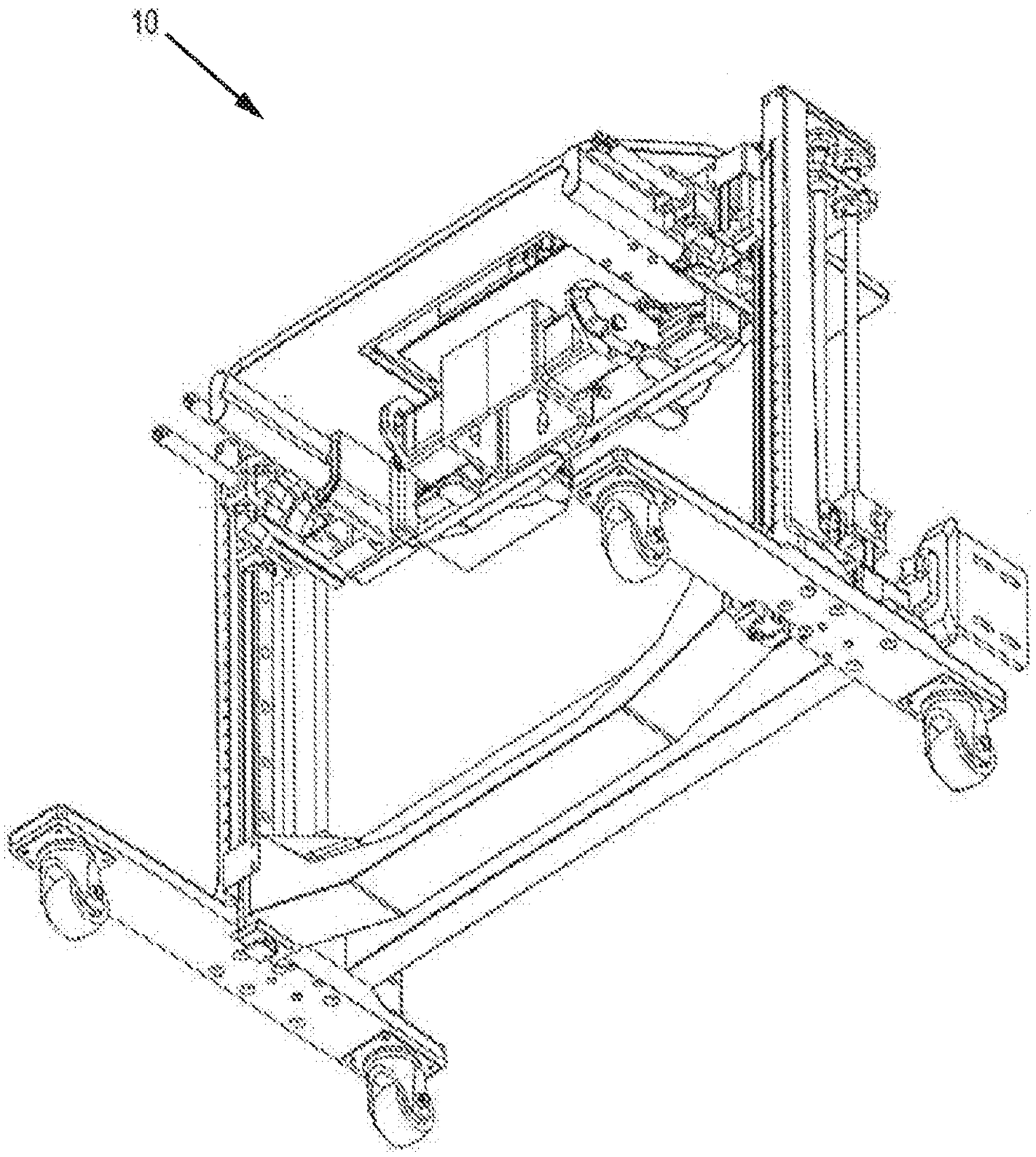


FIG. 11R

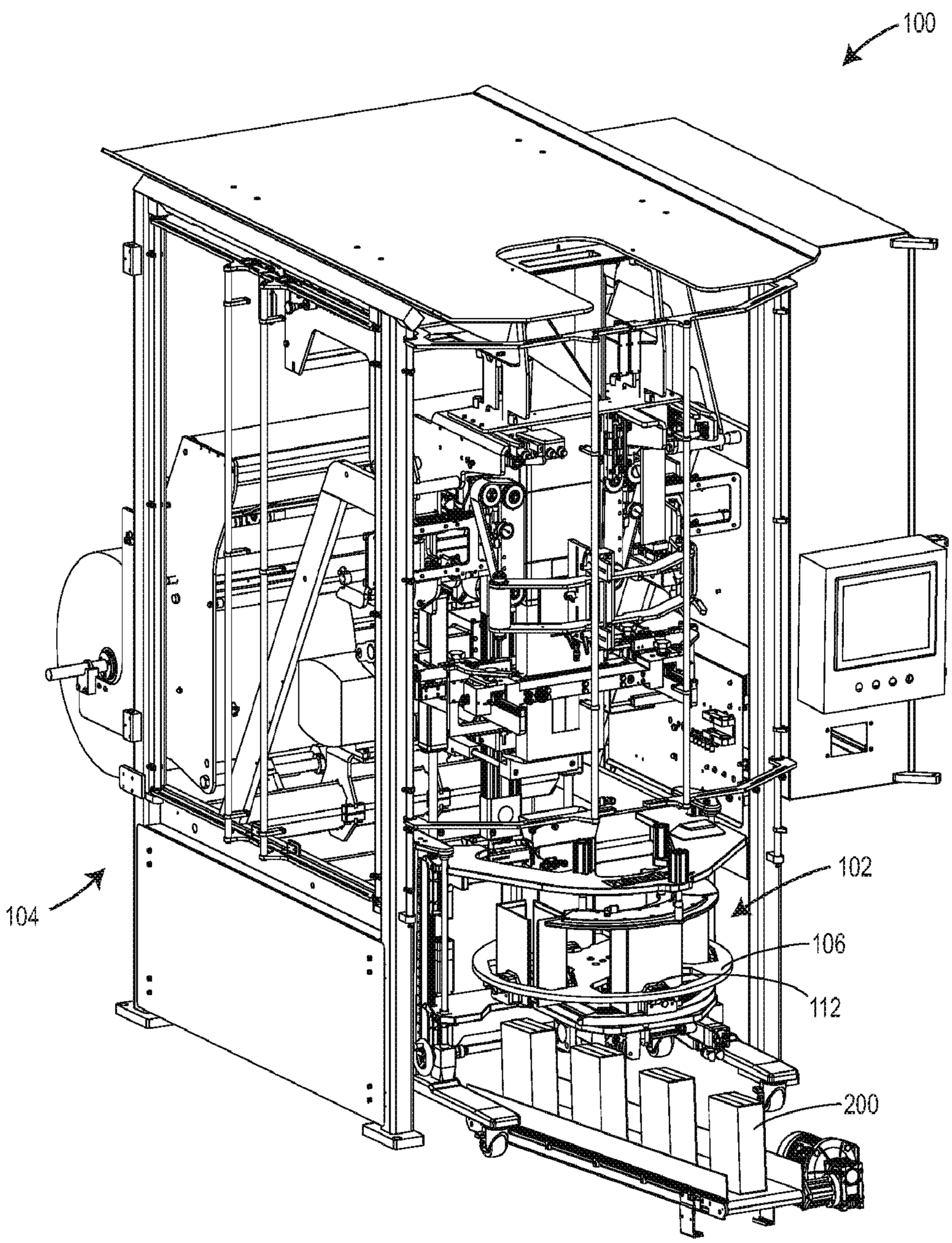


FIG. 12

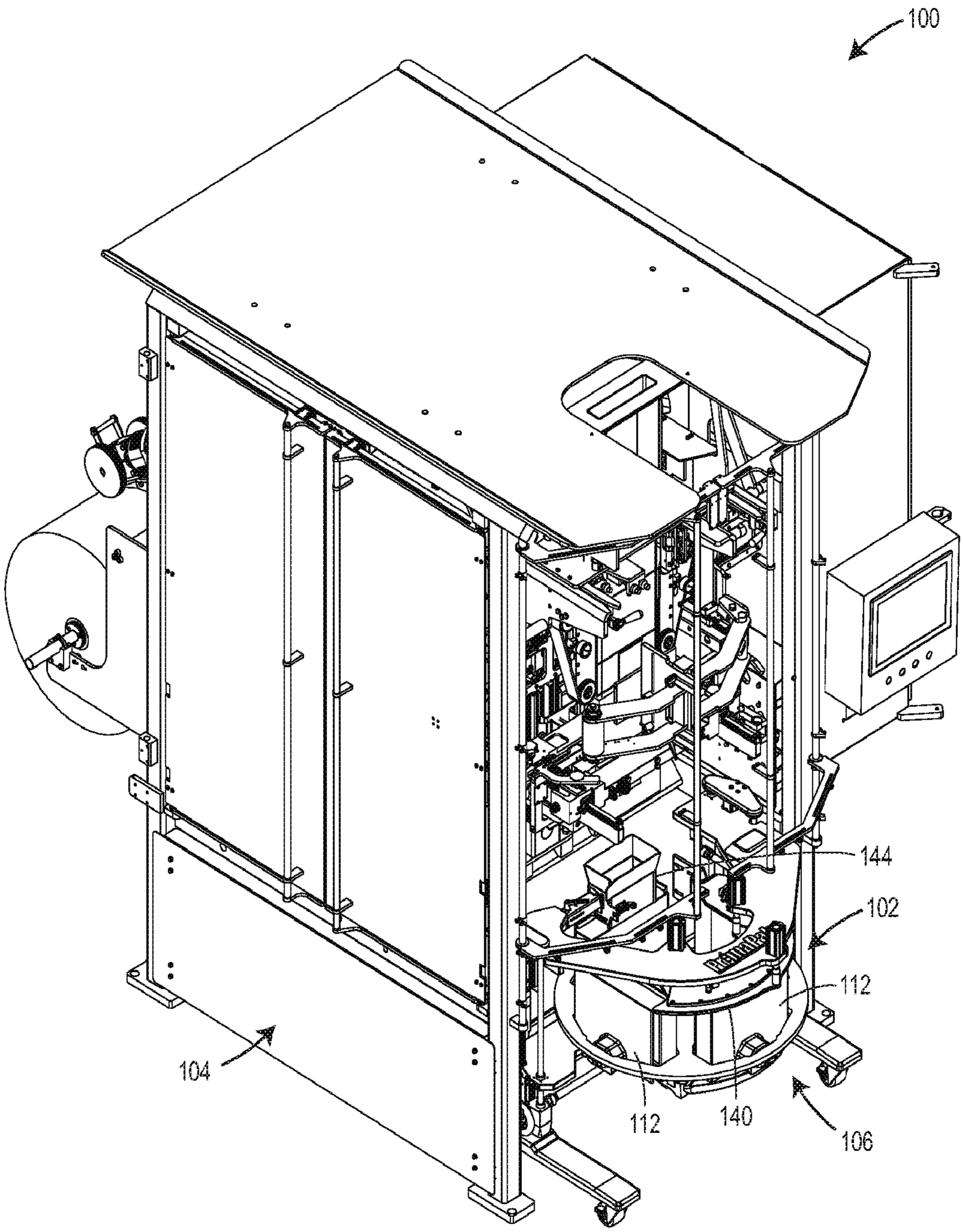
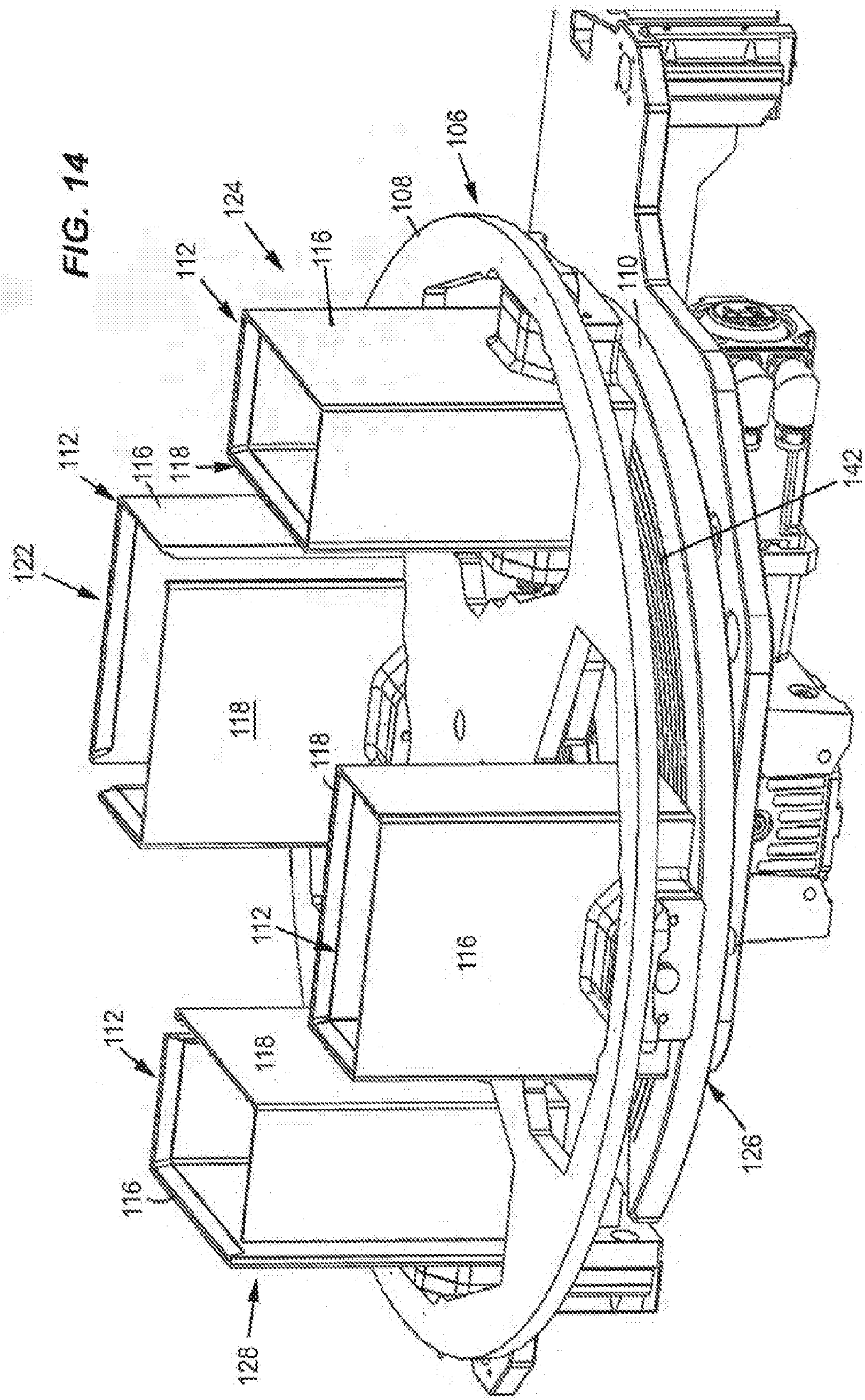


FIG. 13

FIG. 14


100
108
124
112
116
110
112
116
118
142
122
118
118
112
116
112
118
126
116
128

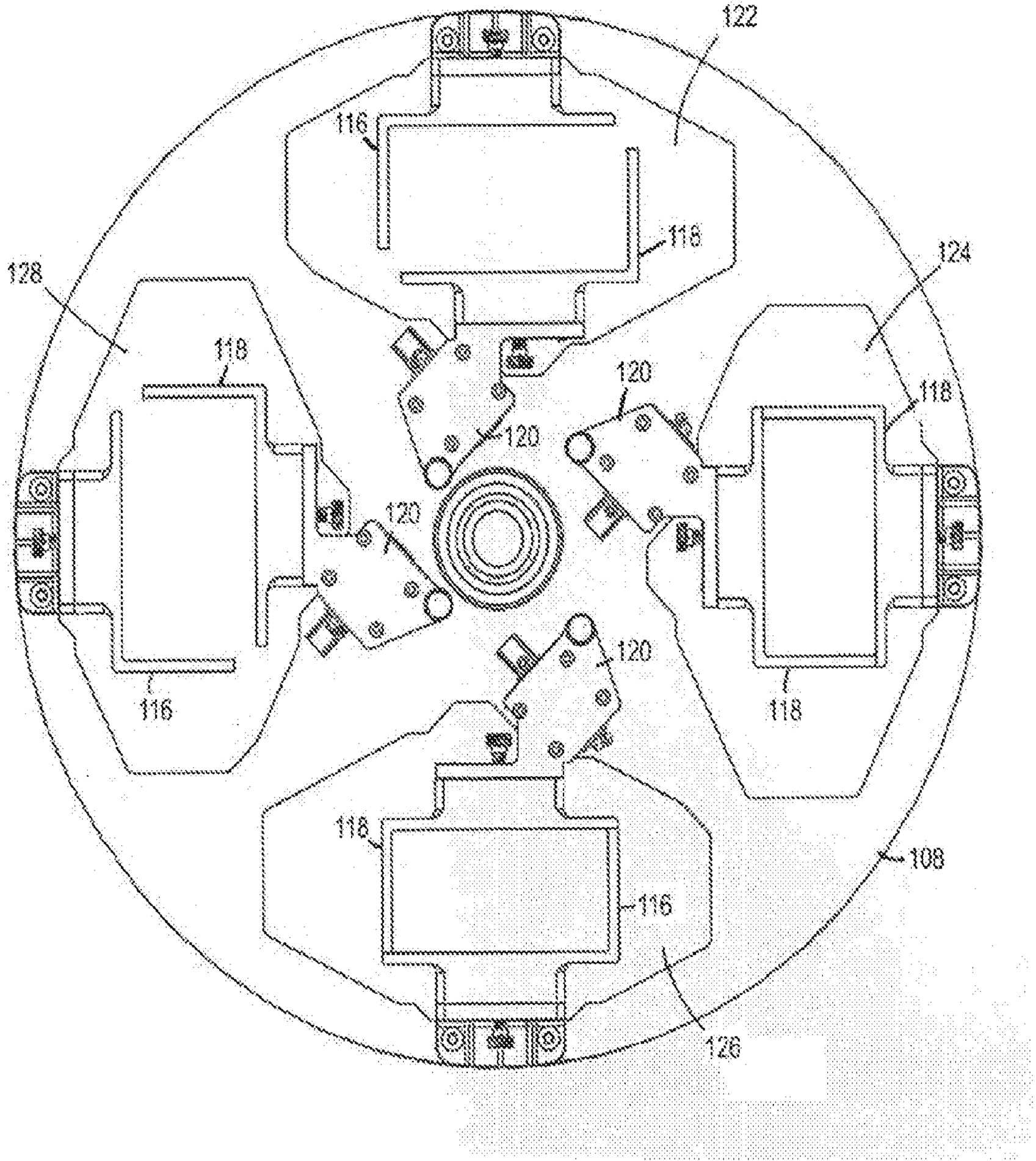

122
116
116
124
128
118
120
118
120
120
116
118
120
118
116
108
116
126

FIG. 15

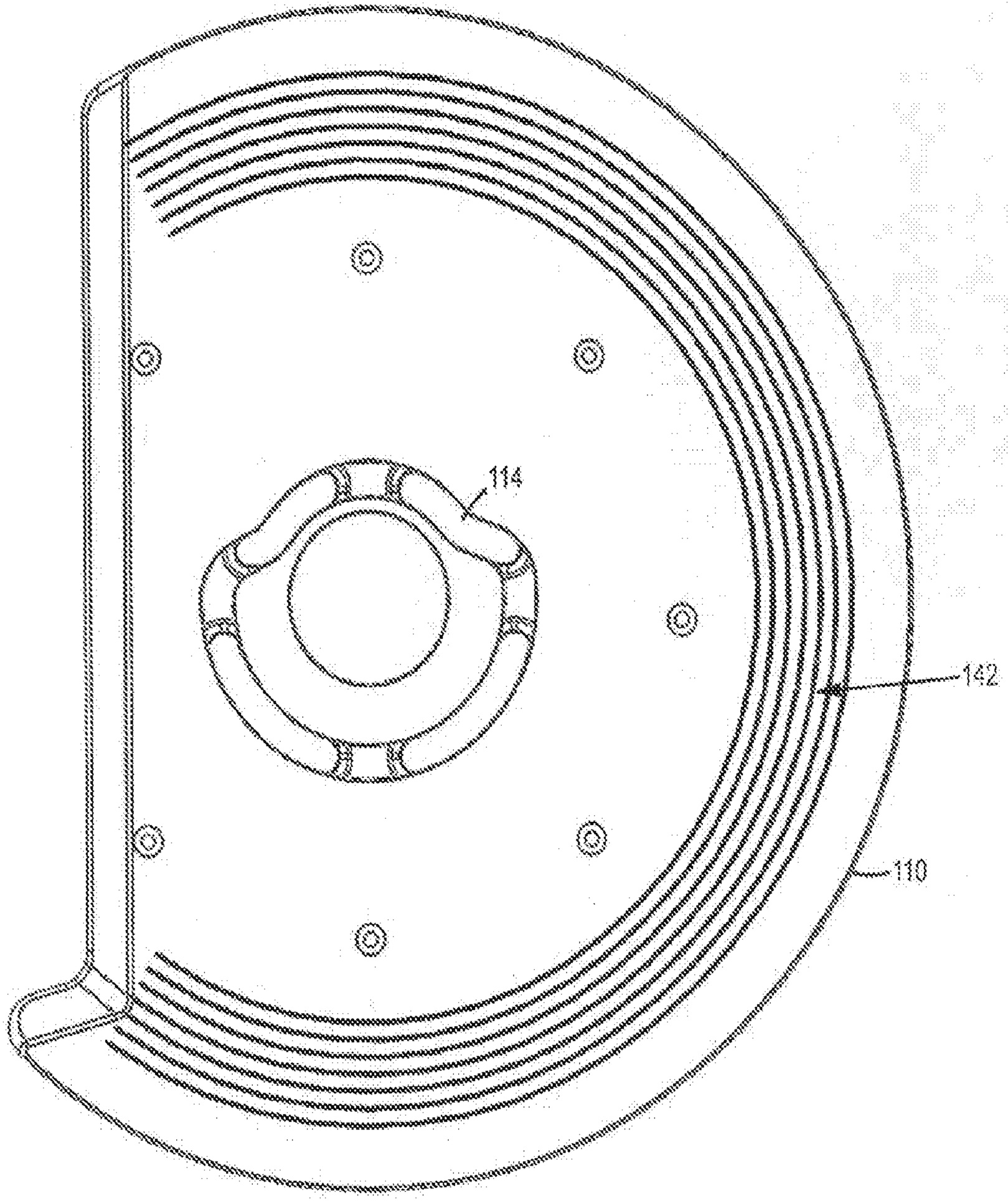


FIG. 16

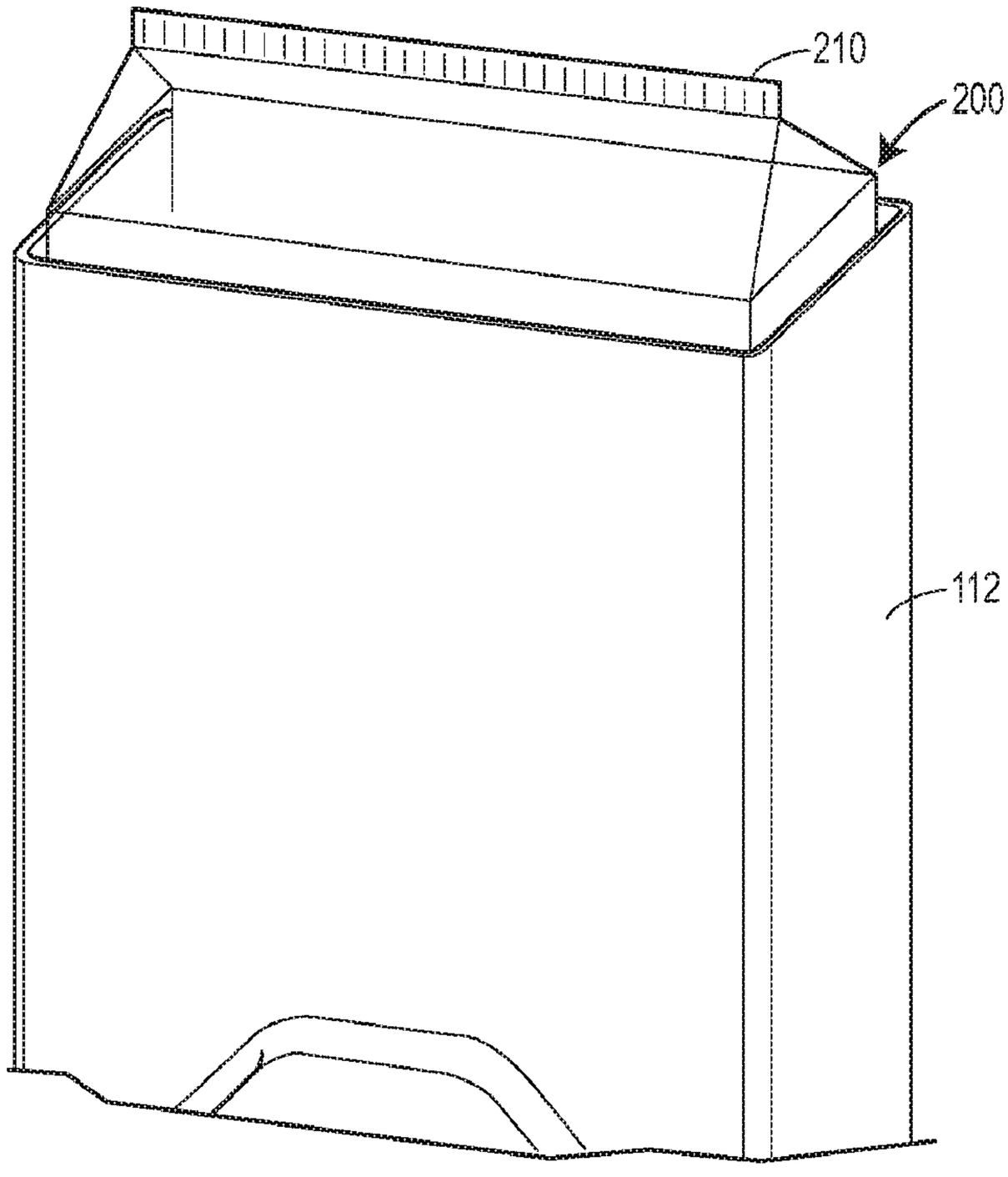


FIG. 17

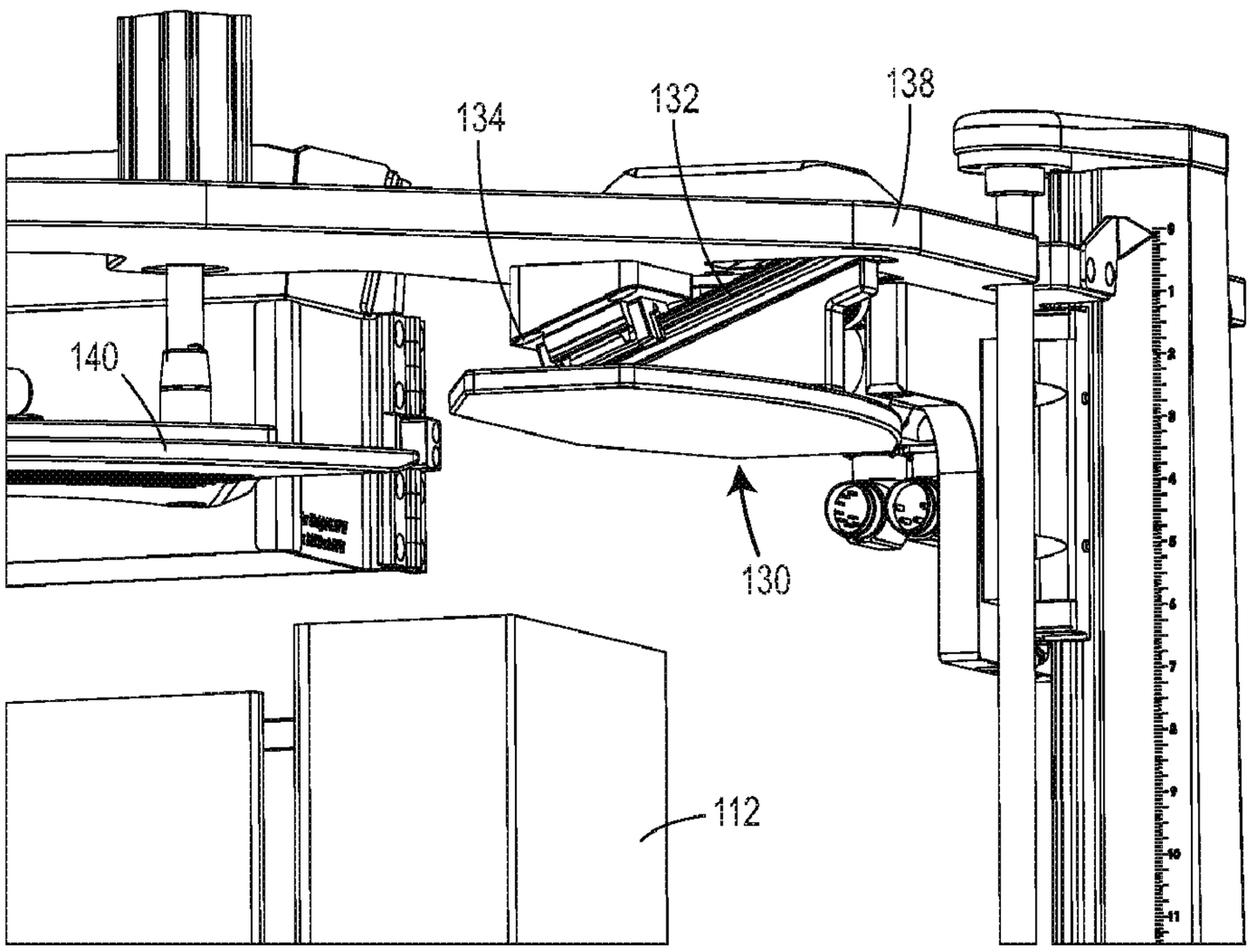


FIG. 18A

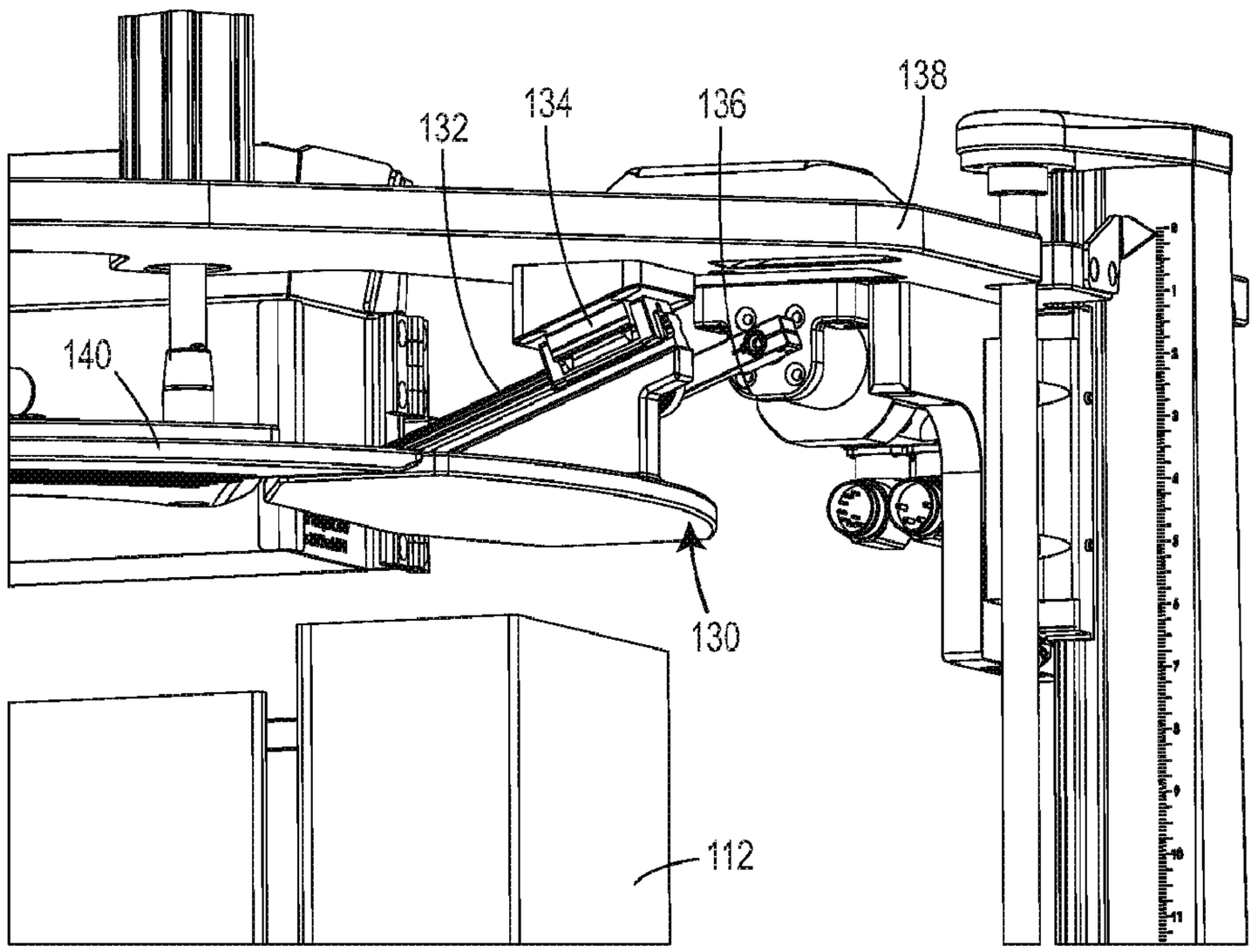


FIG. 18B

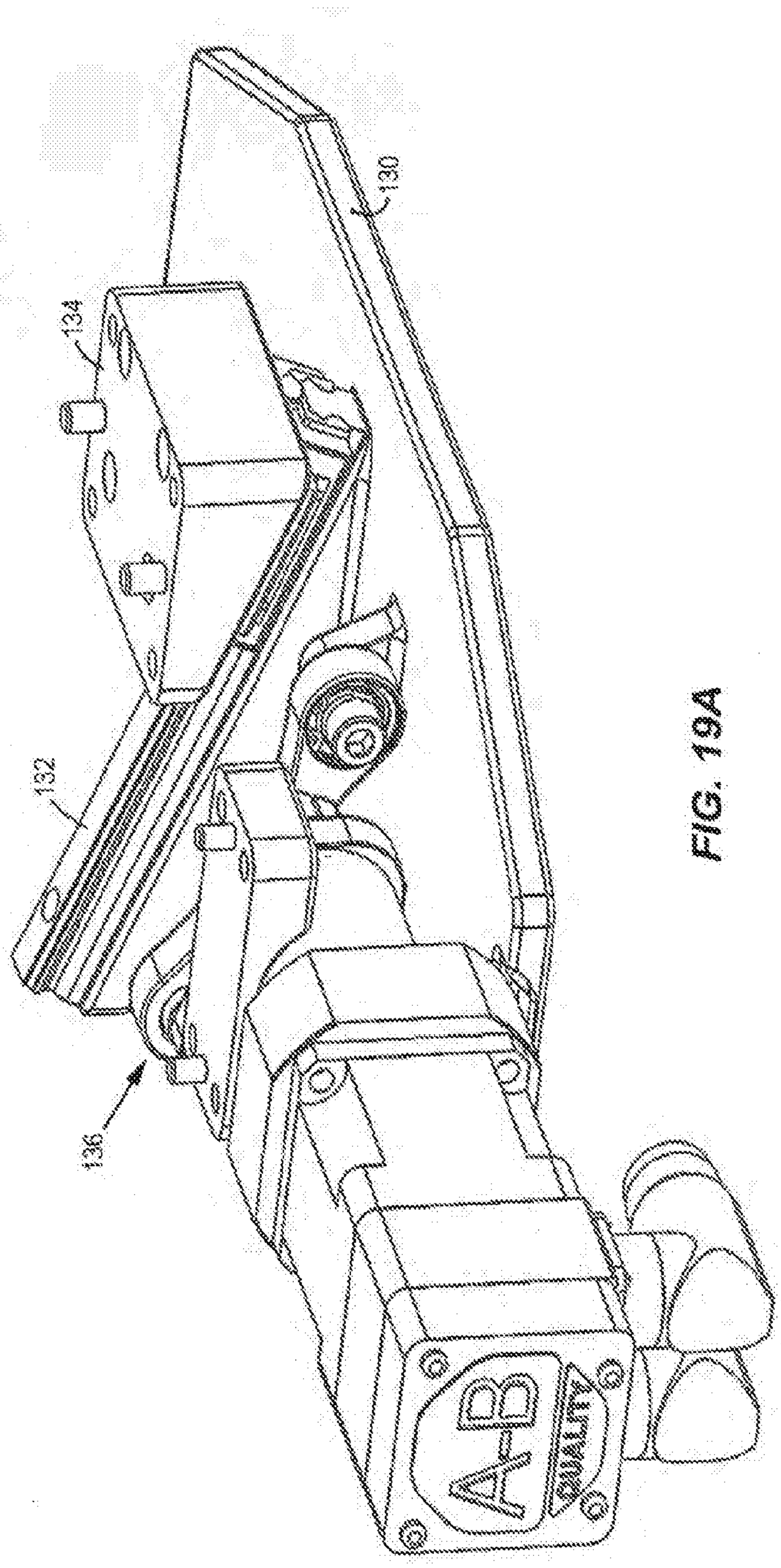


FIG. 19A

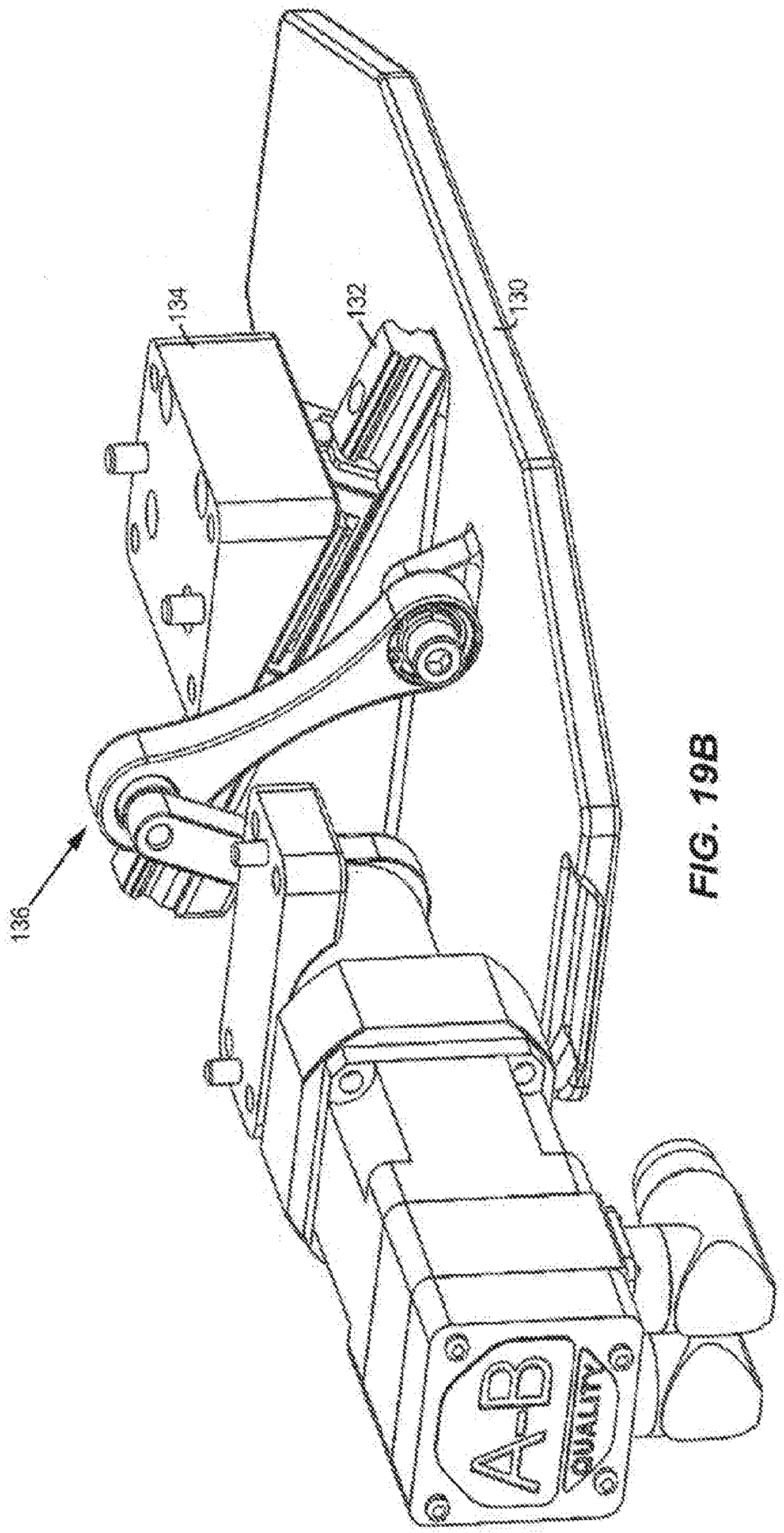


FIG. 19B

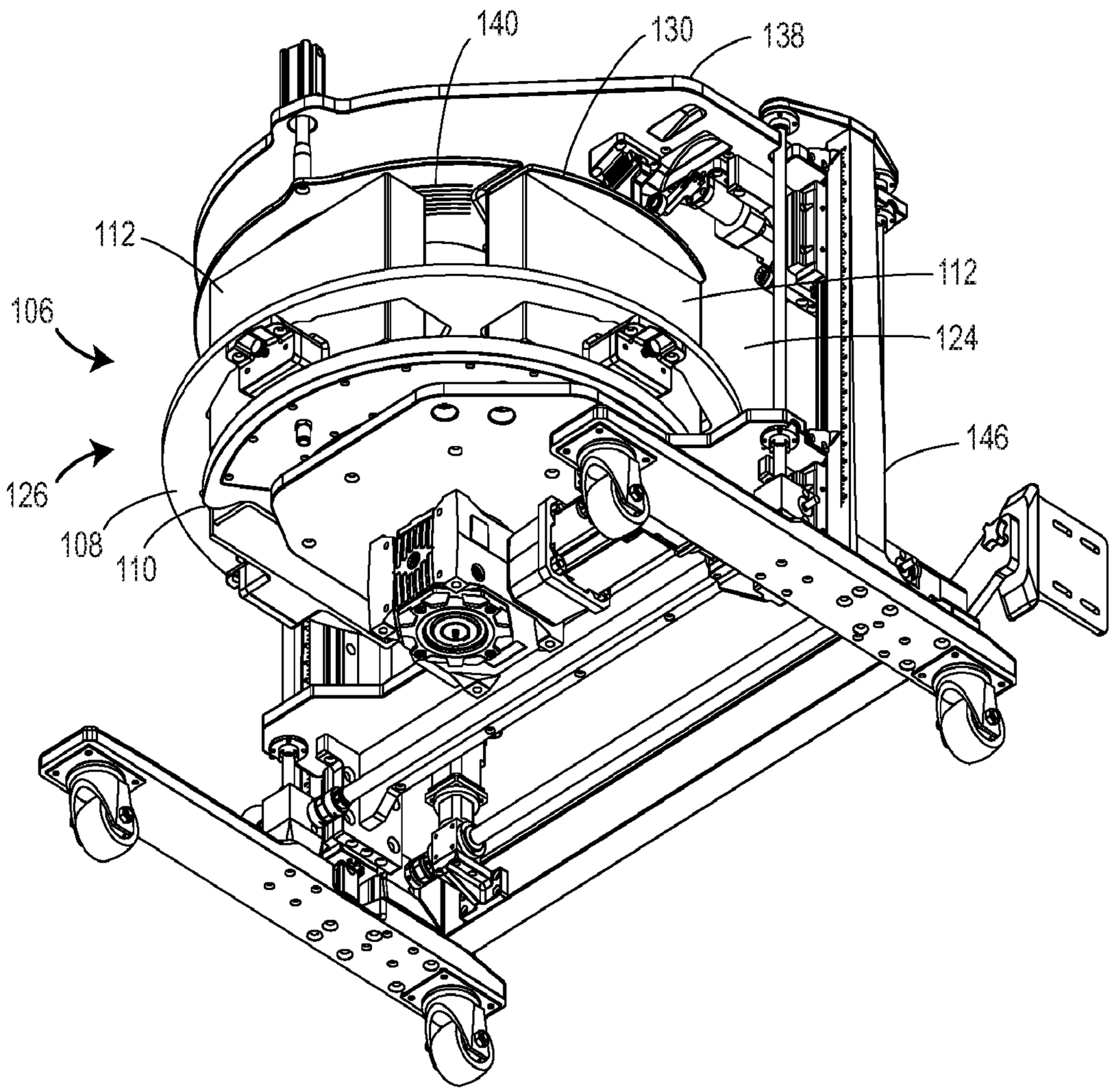


FIG. 20

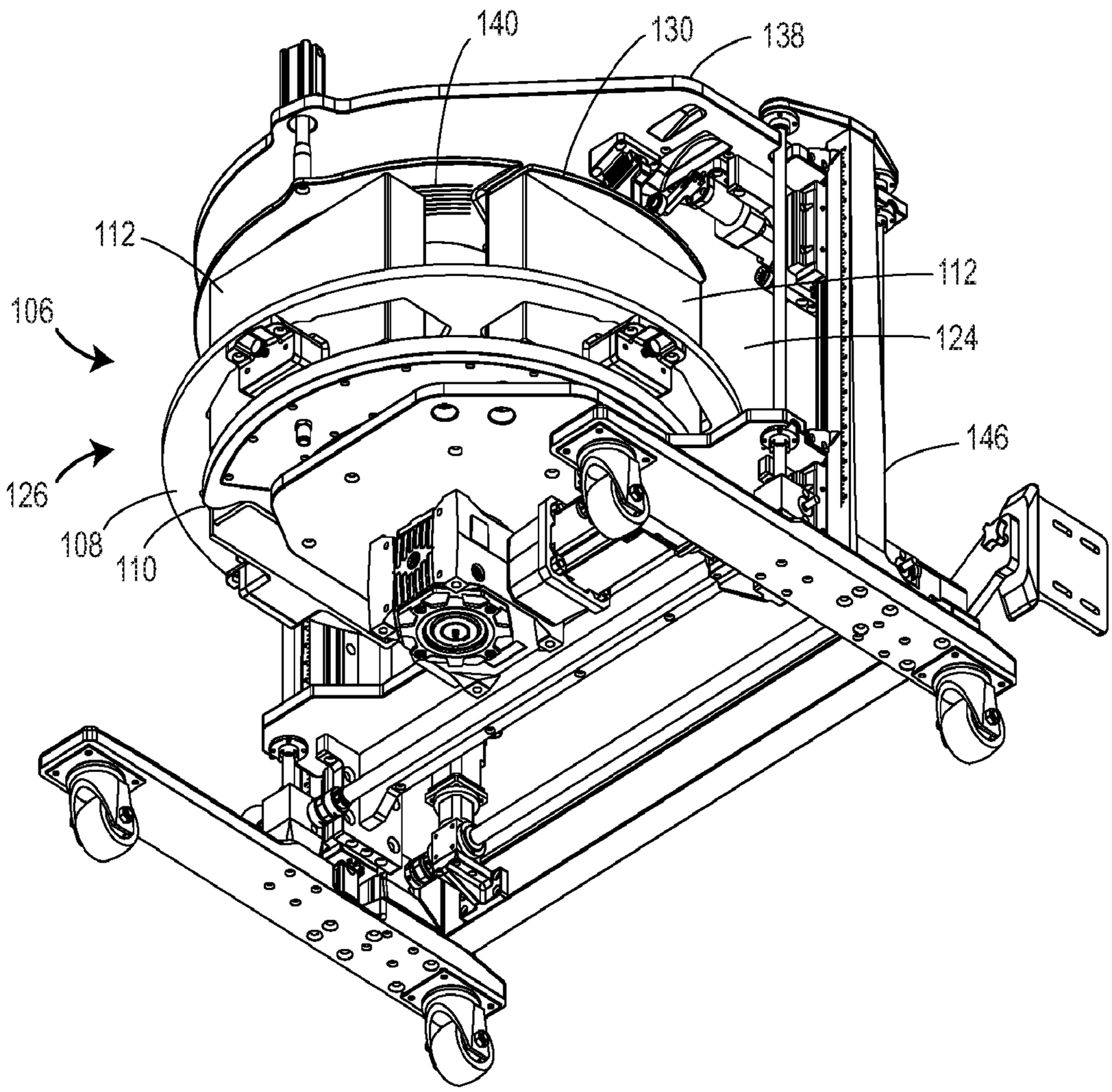


FIG. 20

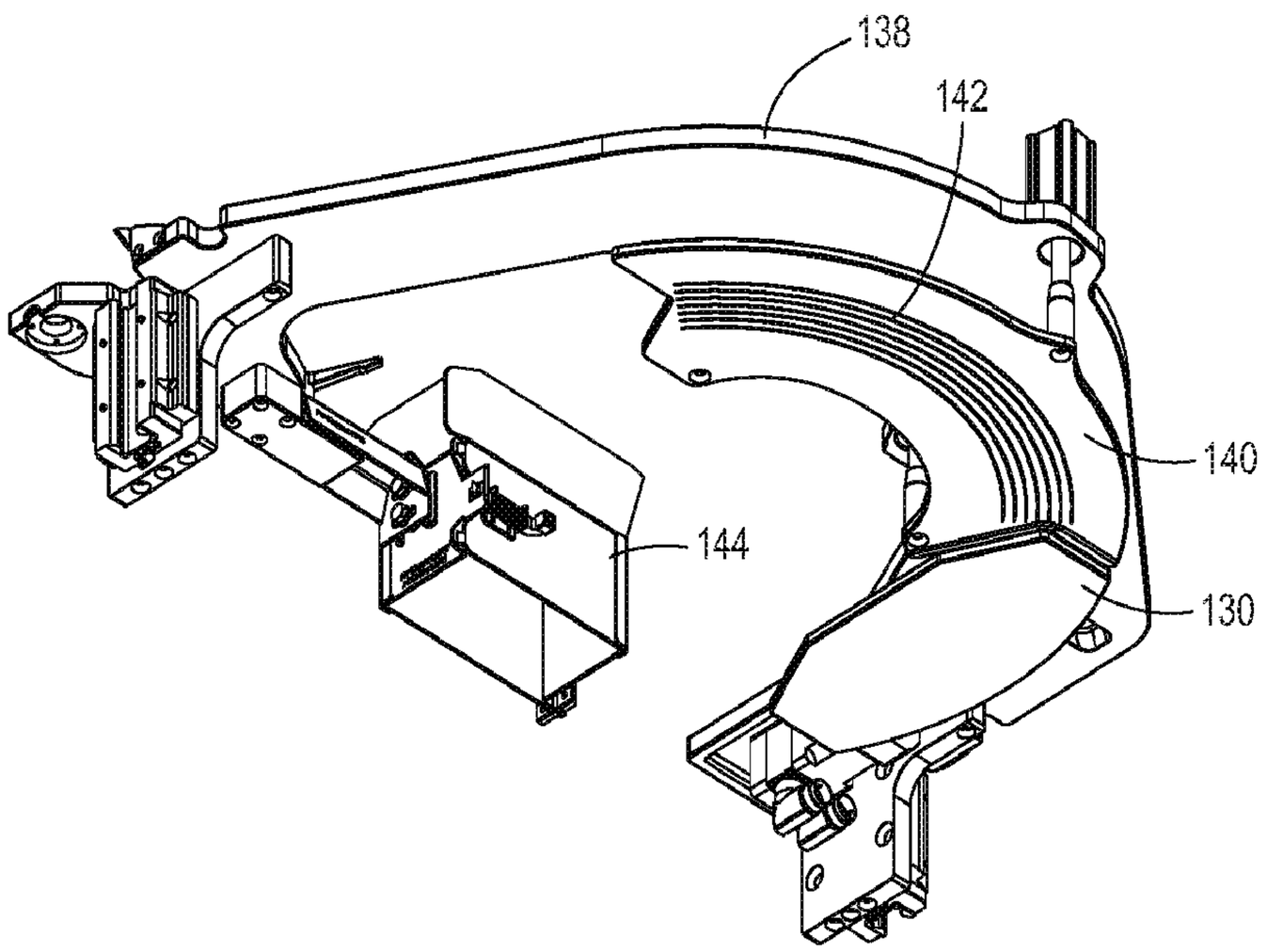


FIG. 21

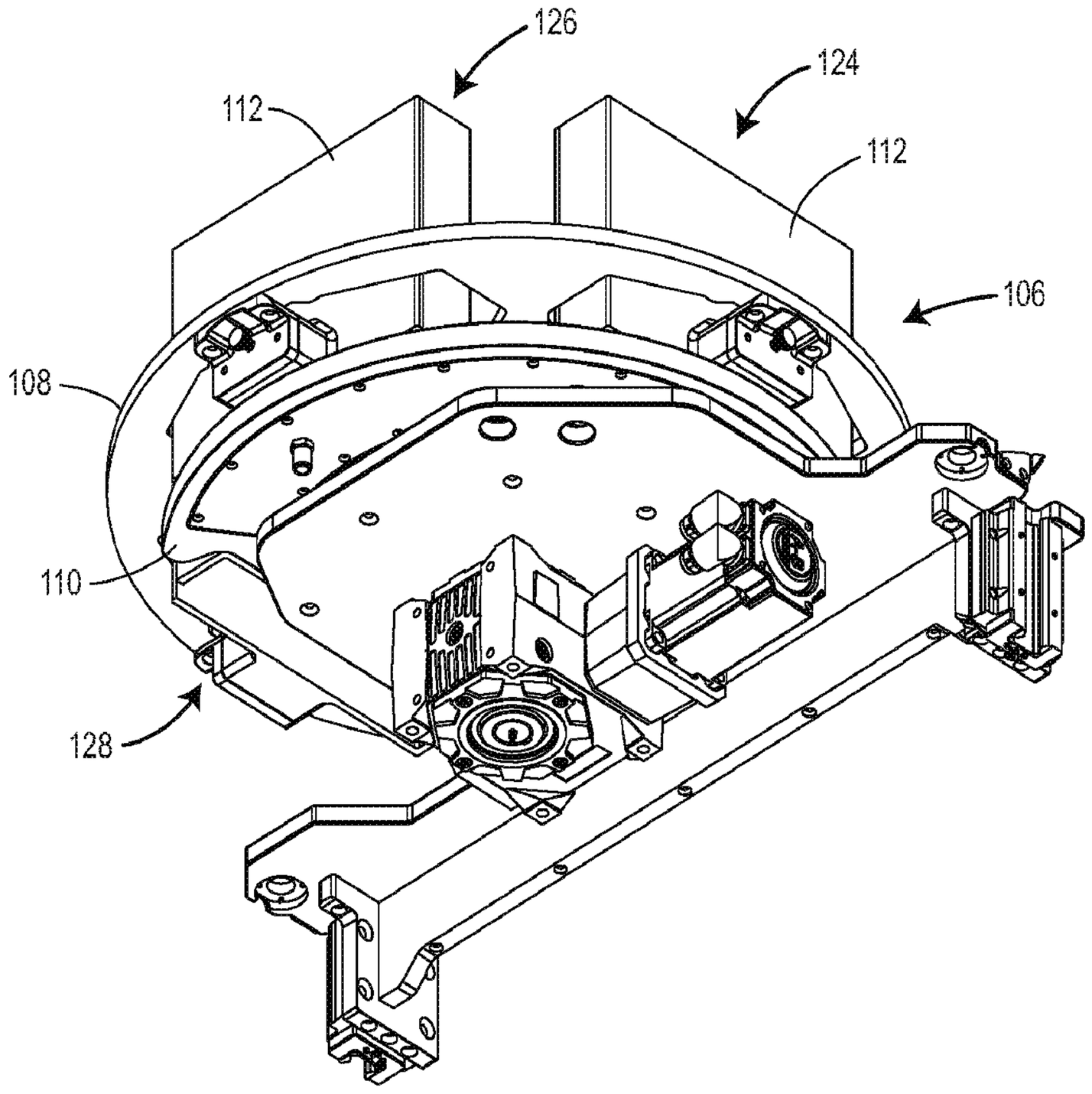


FIG. 22

CA 02998754 2018-03-14

				Estimated Optimum Settings using Servo Motors:				
(Rotary Turret with Bottom Folder on Seal Jaws)								
Continuous Motion Machine Timing - with Bottom Folder on Seal Jaws								Bagger Speed set to ?? PPM
Step #	Machine Operation	Start Time, (mS)	Delay Time, (mS)	Actual Start Time, (mS)	Duration Time, (mS)	Finished Time, (mS)	Starts From	Comments
1	Starting Point, (Seal Jaws at Top, Film Momentarily Stopped)	0	0	0	0	0		
2	Seal Jaws Close	0	0	0	125	125	Beginning	
3	Bottom Flap Folder Actuates In and Up	0	20	20	450	470	At Beginning of Seal Jaws Close	Figures being able to Lift Package and Fold Flap
4	Film and Seal Jaws Start Moving Down at Film Speed	125	0	125	375	500	When Seal Jaws are Closed	Includes Estimated Accel
5	Seal Time	125	0	125	350	475	When Seal Jaws are Closed	
6	Bottom Flap Folder Actuates Down and Out	470	0	470	125	595		Should be Down and Out before Seal Jaws Open
7	Seal Jaws Open	475	0	475	125	600	At End of Seal Time	
8	Seal Jaws Stop Moving Down	600	0	600	75	675	At End of Seal Jaws Open	This is the Estimated Decel
9	Seal Jaws Start Moving Up Fast	675	0	675	275	950		Includes Estimated Accel
10	Seal Jaws Stop Moving Up / Film Pauses	950	0	950	75	1,025		This is the Estimated Decel
11	Ready for Next Cycle	1,025	0	1,025	0	1,025		
				Total Estimated Time, (mS) =		1,025		
				Maximum Speed, (Ppm) =		58.54		

FIG. 23A-1

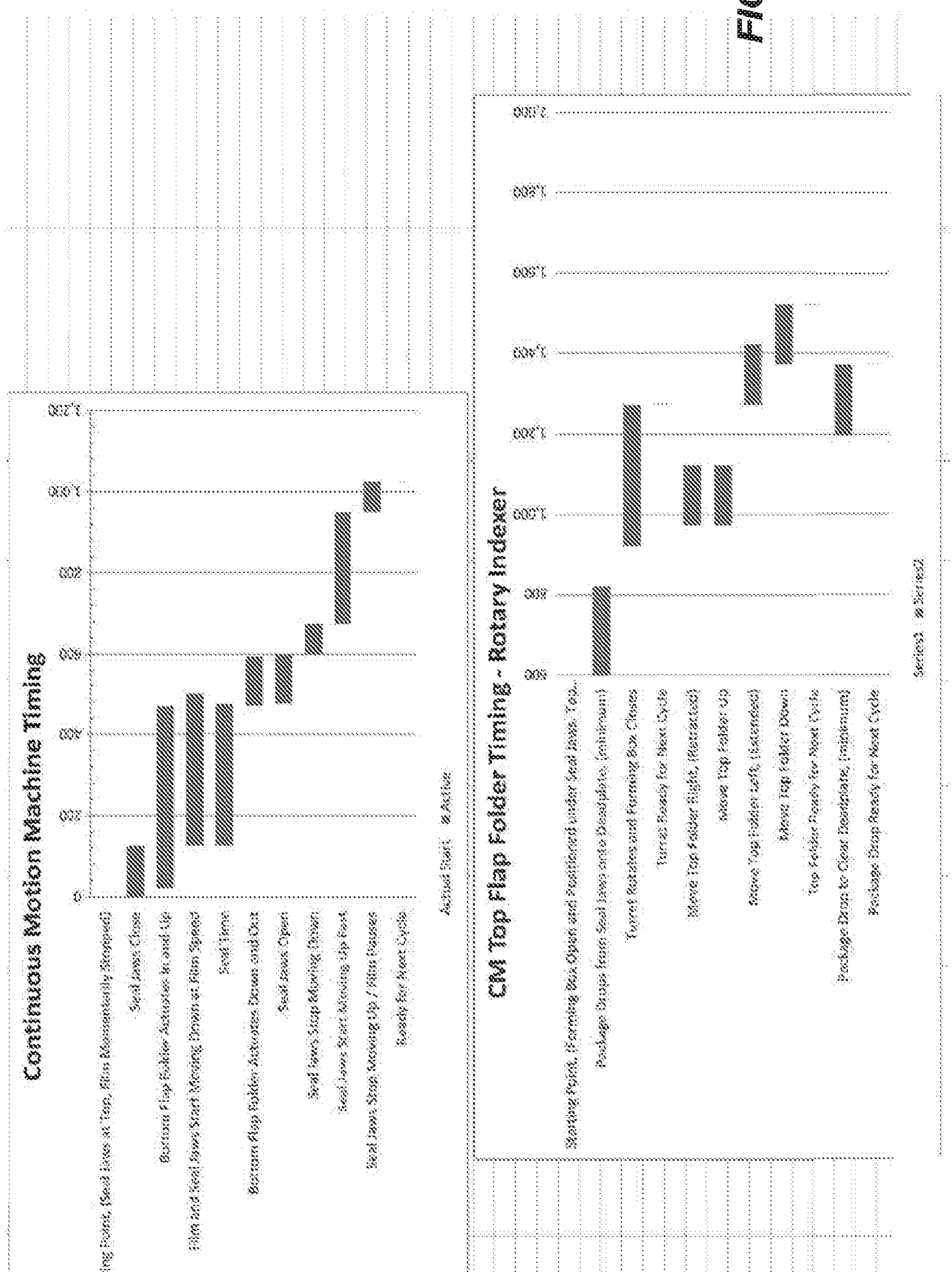
SUBSTITUTE SHEET (RULE 26)

CM Top Flap Folder Timing - Rotary Turret

Step #	Machine Operation	Start Time, (mS)	Delay Time, (mS)	Actual Start Time, (mS)	Duration Time, (mS)	Finished Time, (mS)	Starts From	Comments
20	Starting Point, (Forming Box Open and Positioned under Seal Jaws, Top Folder Extended and Down)	600	0	600	0	600	From Step 6 above	
21	Package Drops from Seal Jaws onto Deadplate, (minimum)	600	0	600	321.14	821		
22	Turret Rotates and Forming Box Closes	821	100	921	350	1,271	After Package Drop	Figured 100 mS Delay to allow for package settling. Ready to receive next package when finished.
23	Turret Ready for Next Cycle	1,271	0	1,271	0	1,271		
24	Move Top Folder Right, (Retracted)	921	50	971	150	1,121	When Turret Starts to Rotate	
25	Move Top Folder Up	921	50	971	150	1,121	When Turret Starts to Rotate	
26	Move Top Folder Left, (Extended)	1,271	0	1,271	150	1,421	After Turret Rotates	
27	Move Top Folder Down	1,423	50	1,573	150	1,523	After Top Folder is Forward	Figure a little lead time, 50 mS
28	Top Folder Ready for Next Cycle	1,523	0	1,523	0	1,523		
29	Package Drop to Clear Deadplate, (minimum)	1,271	75	1,196	176.32	1,372	After Turret Rotates	Figure a little lead time, 75 mS
30	Package Drop Ready for Next Cycle	1,372	0	1,372	0	1,372		
				Estimated Index Time, (mS) =		671		
				Maximum Speed, (Ppm) =		89.40		
				Estimated Folding Time, (mS) =		600		
				Maximum Speed, (Ppm) =		100.00		
				Total Estimated Time, (mS) =		671		
				Maximum Speed, (Ppm) =		89.40		

FIG. 23A-2

FIG. 23B


Continuous Motion Machine Timing
Starting Point, (Seal Jaws at Top, Film Not Moving, Bottom Flap Folder Retracted)
Seal Jaws Close
Bottom Flap Folder Actuates In and Up
Film And Seal Jaws Start Moving Down at Film Speed
Seal Done
Bottom Flap Folder Actuates Down and Out
Seal Jaws Open
Seal Jaws Stop Retracting Down
Seal Jaws Start Retracting Up Fast
Film Stops Moving Up / Film Pauses
Ready For Next Cycle
0
.002
.004
.006
.008
.010
Actual Start
% Active
CM Top Flap Folder Timing - Rotary Indexer
Starting Point, (Forming Box Open and Positioned under Seal Jaws, Top...
Package Drops from Seal Jaws onto Headplate, (Minimum)
Turret Retracts and Forming Box Closes
Turret Ready for Next Cycle
Move Top Folder Left, (Retracted)
Move Top Folder Right, (Retracted)
Move Top Folder Up
Move Top Folder Down
Top Folder Ready for Next Cycle
Package Drop to Clear Headplate, (Minimum)
Package Drop Ready for Next Cycle
.000
.200
.400
.600
.800
1.000
Starting Point,
Actual Start
% Active

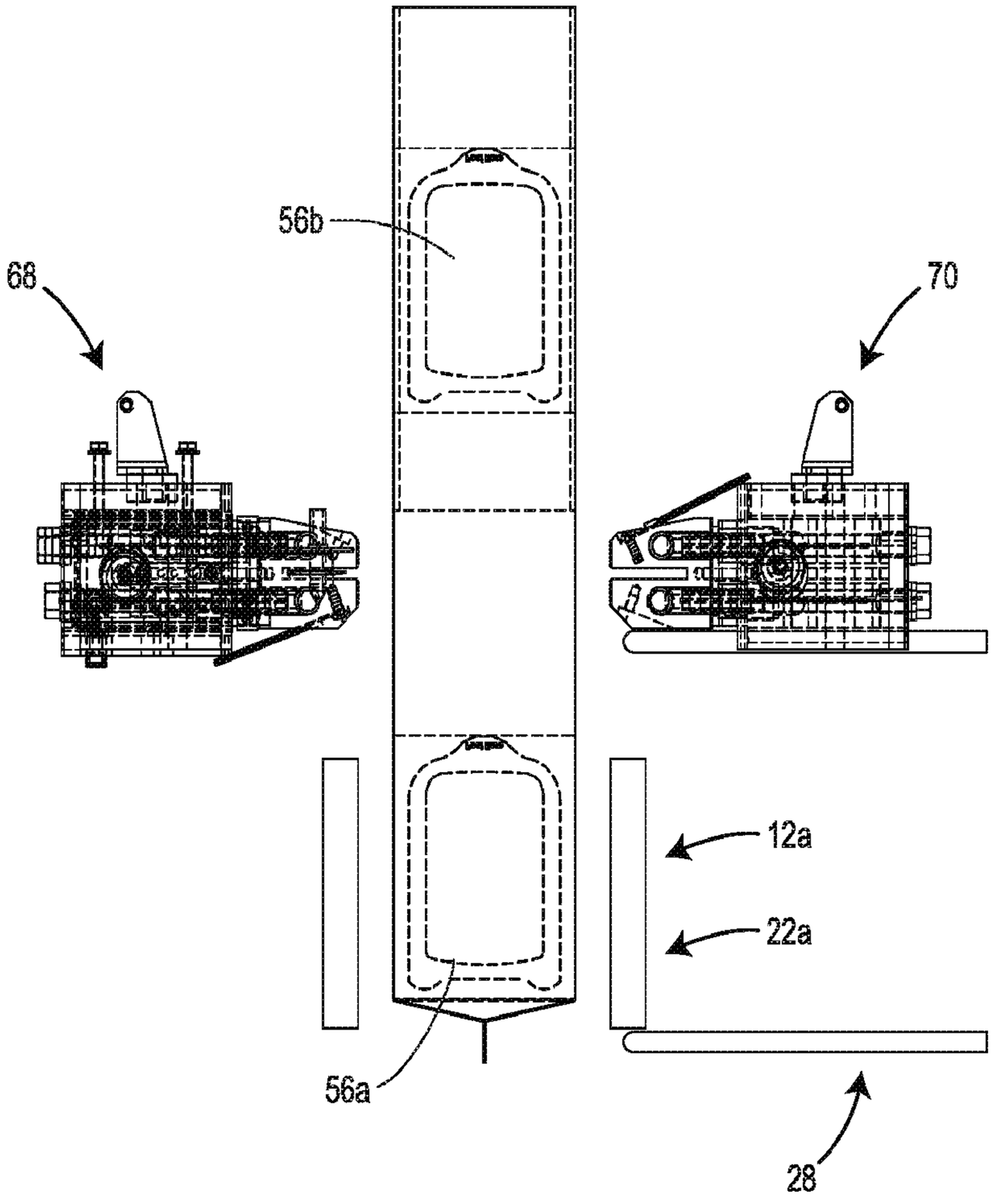


FIG. 24A-1

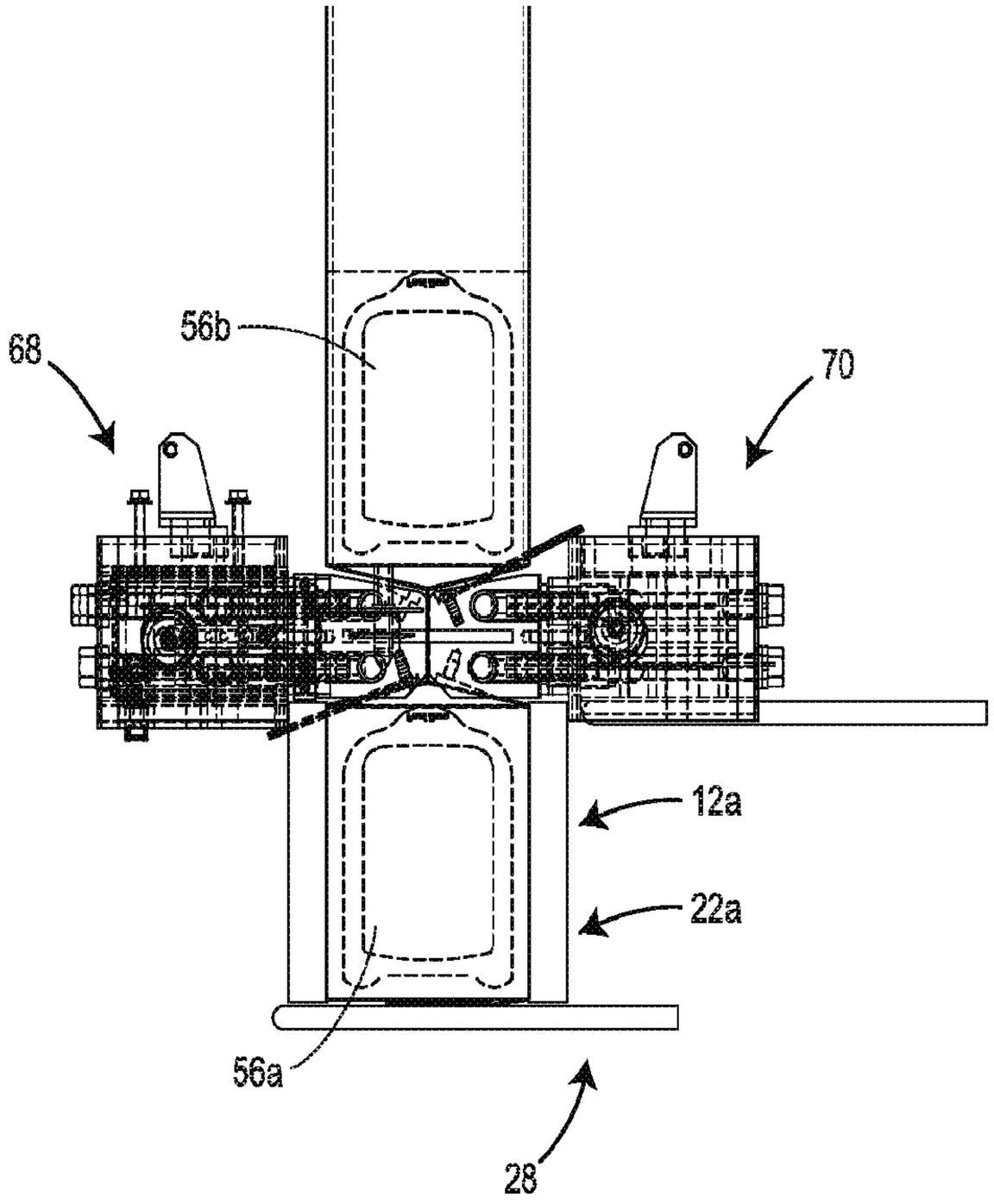


FIG. 24A-2

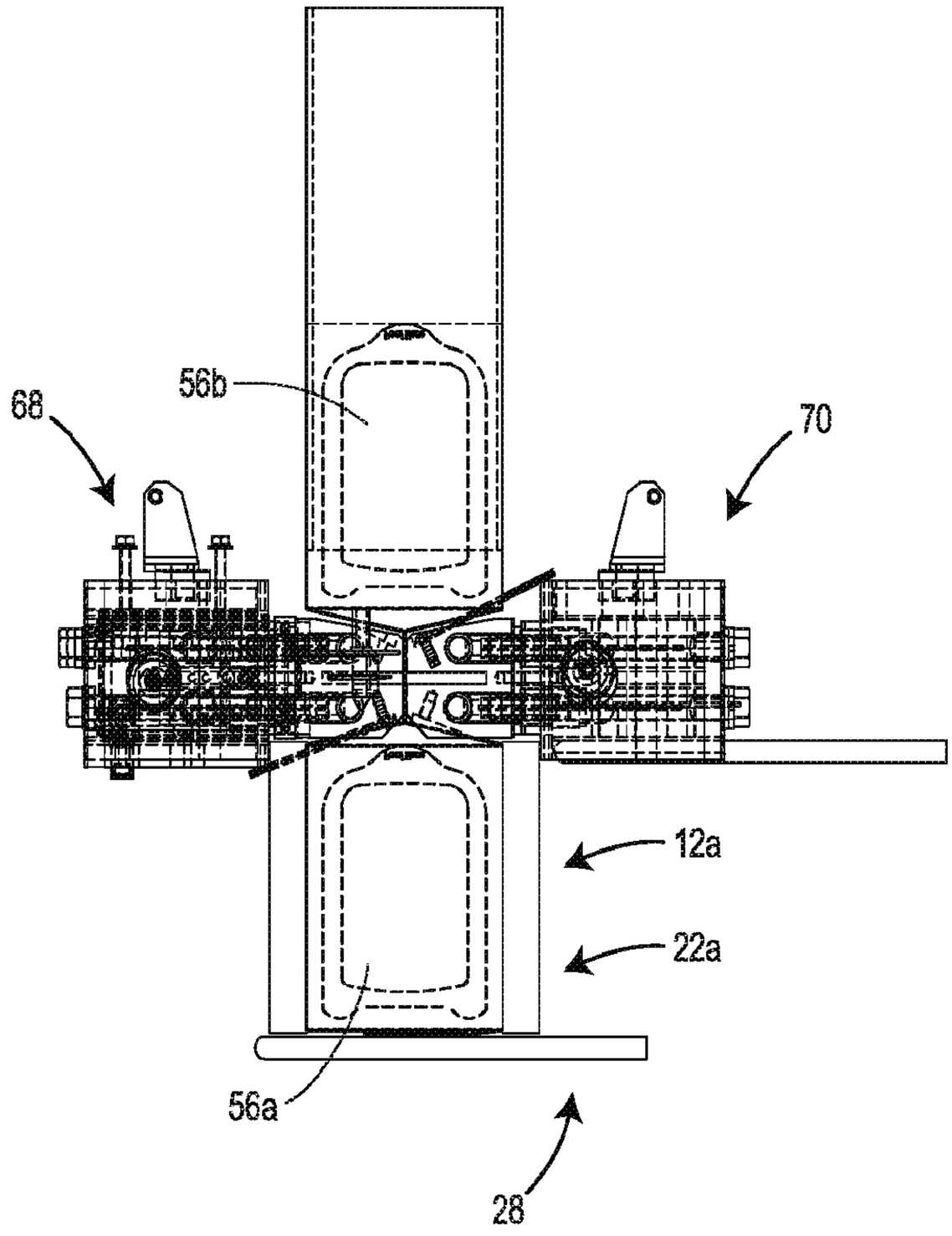


FIG. 24A-3

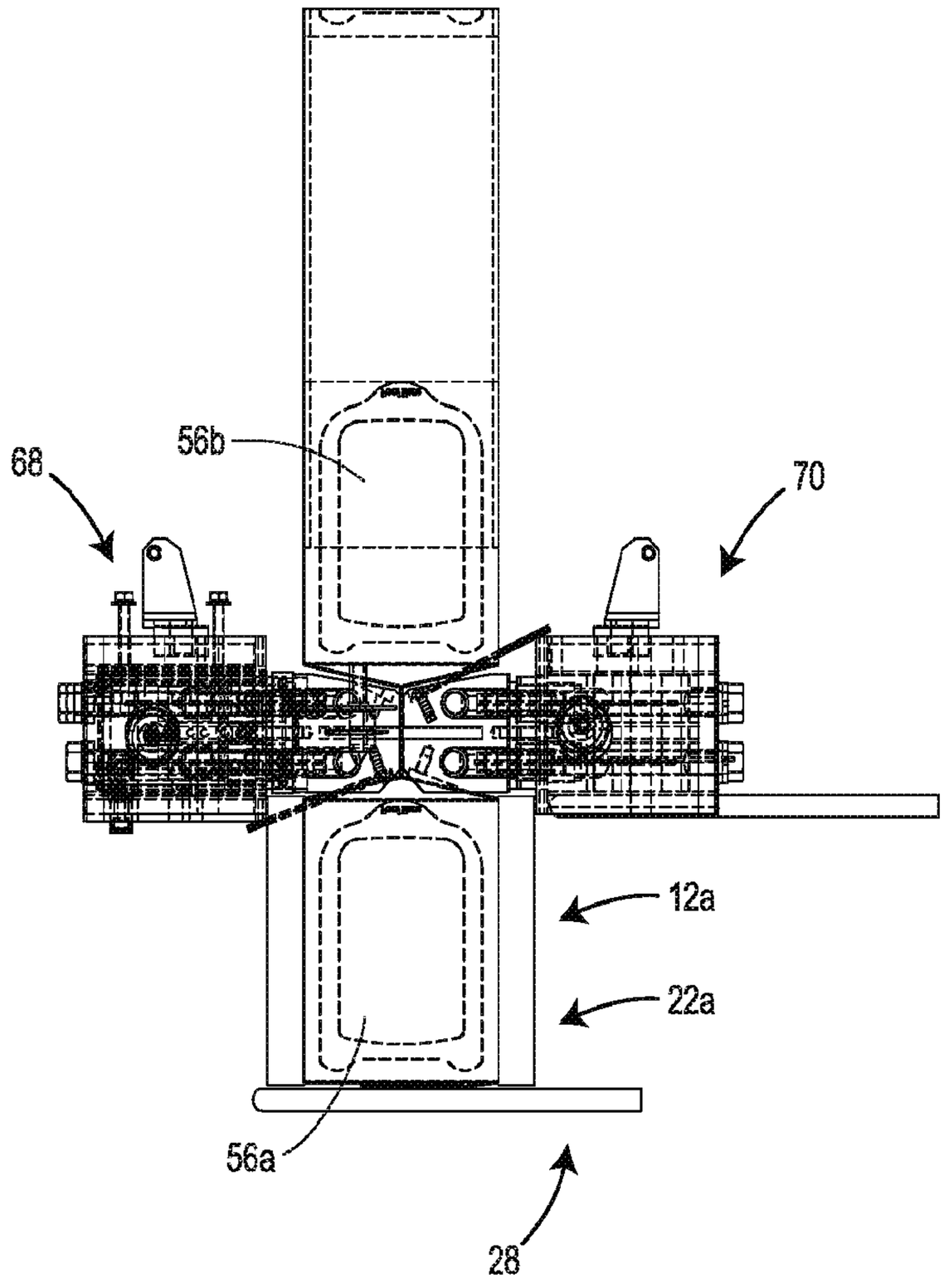


FIG. 24A-4

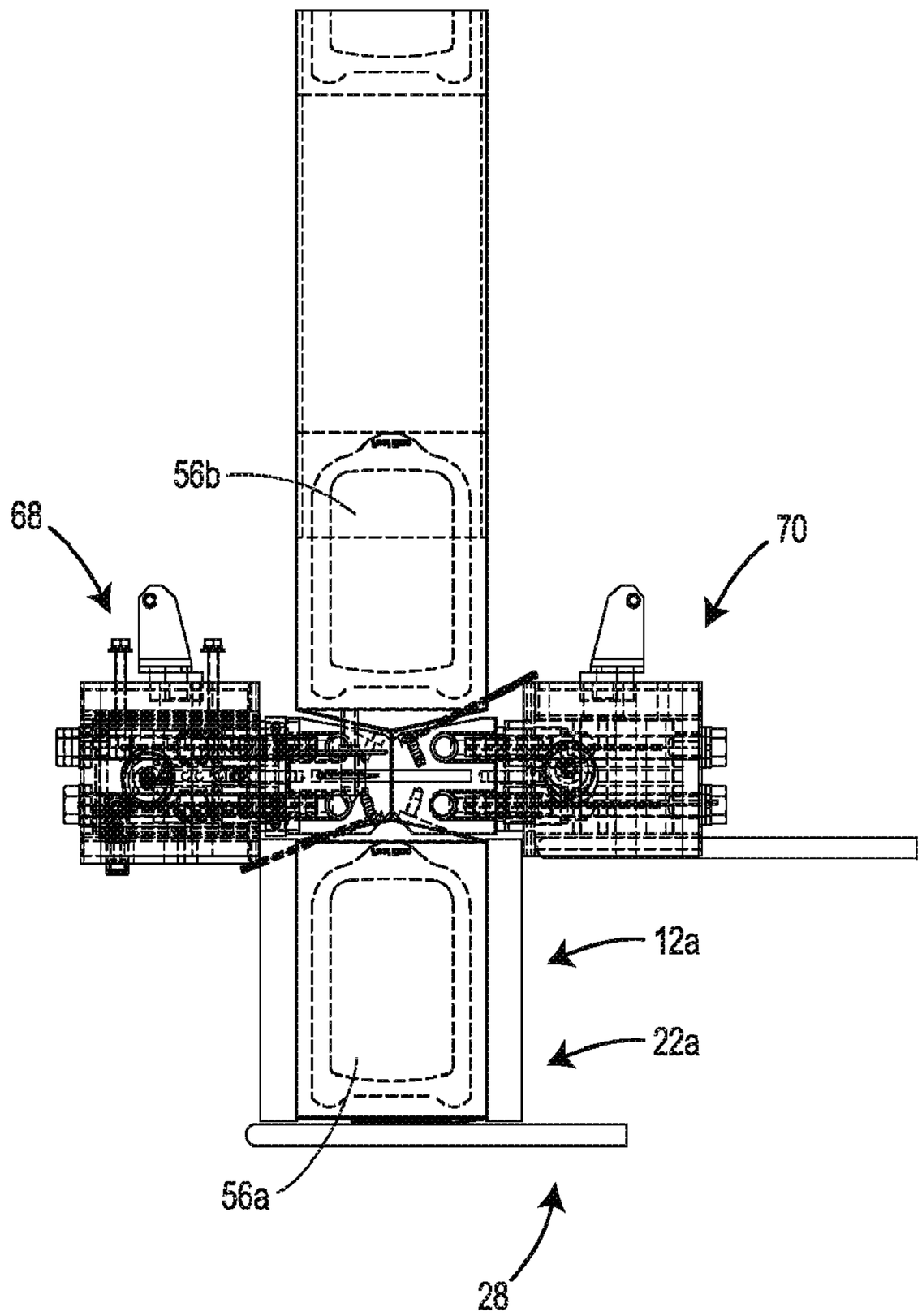


FIG. 24A-5

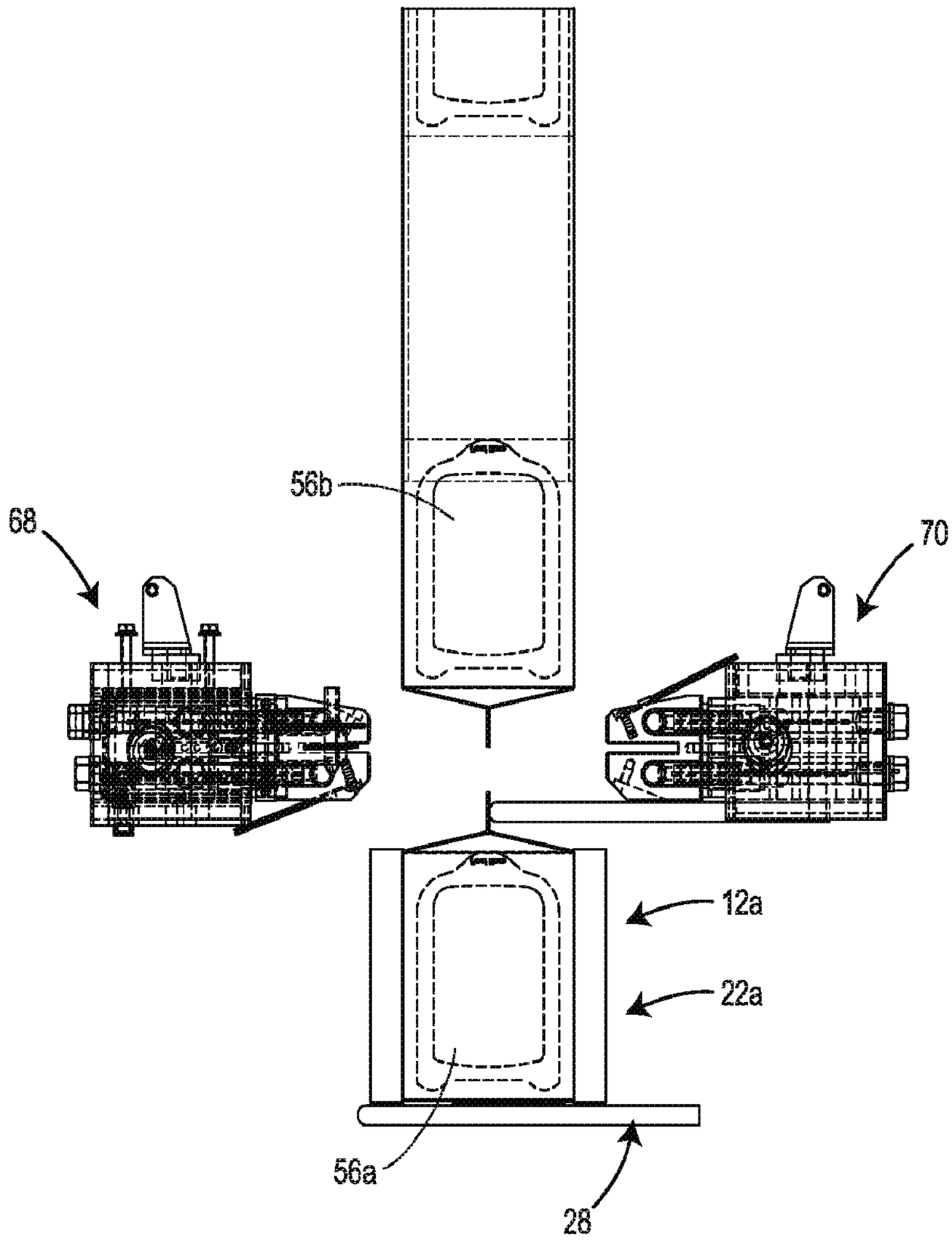


FIG. 24A-6

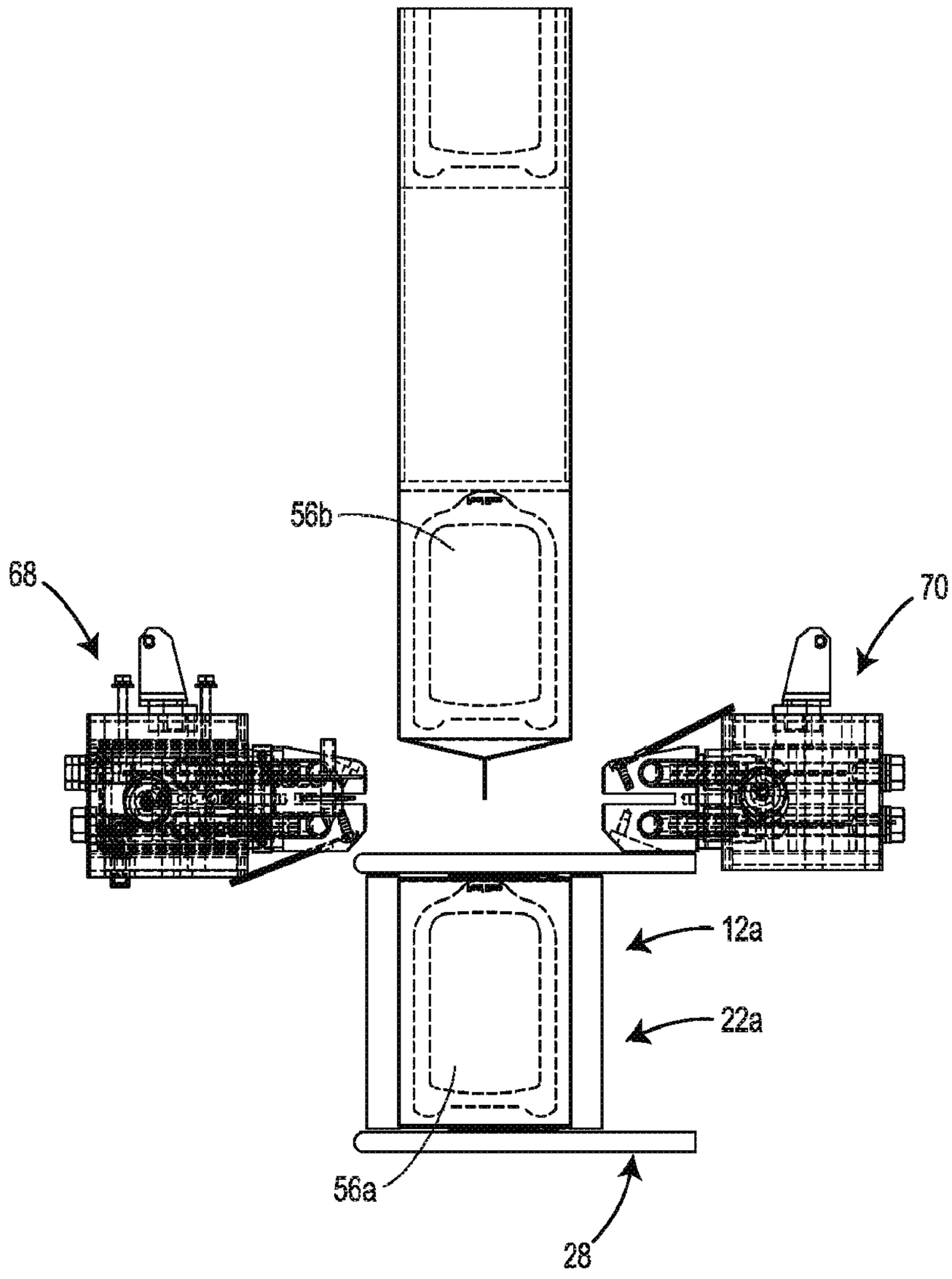


FIG. 24A-7

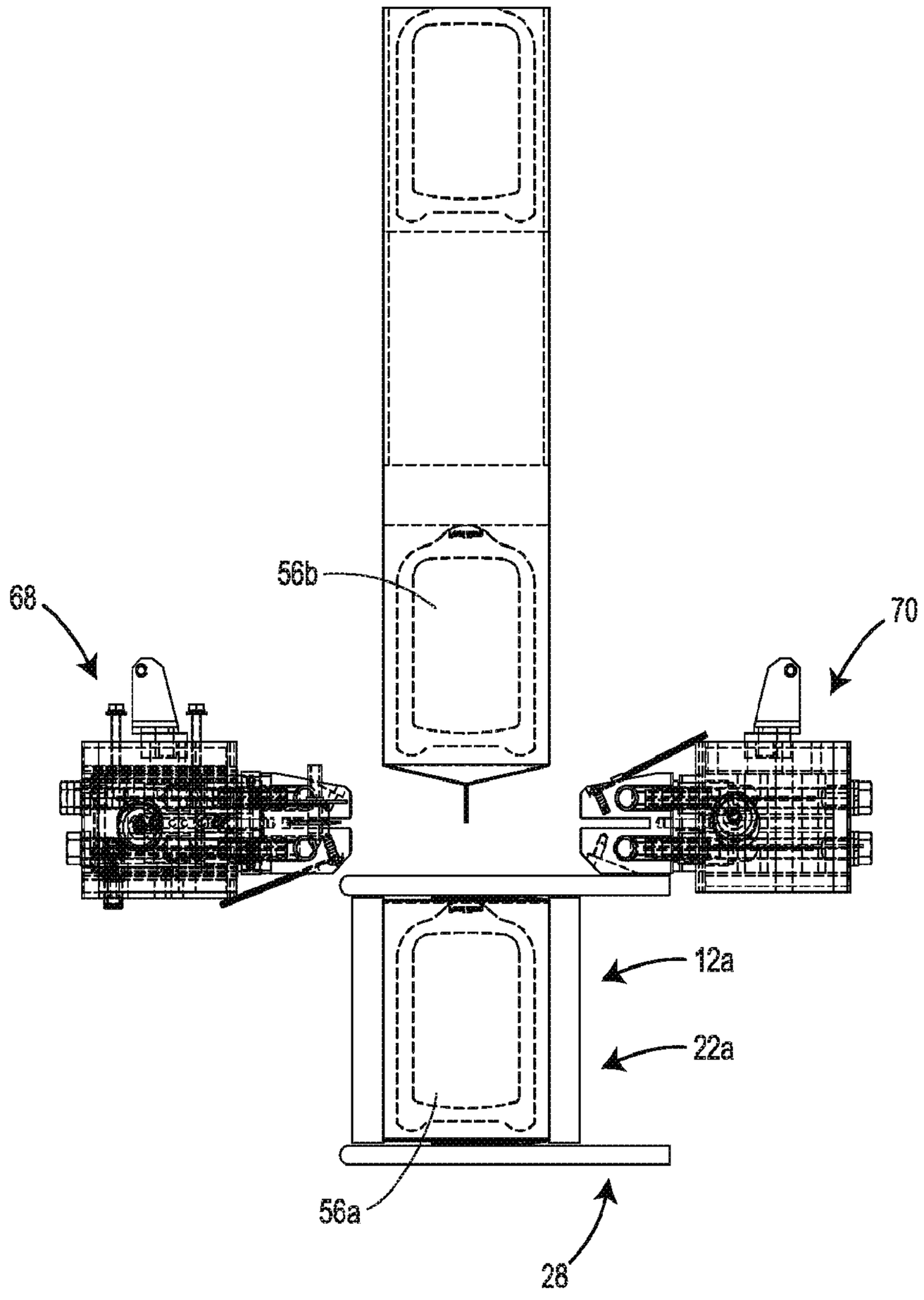


FIG. 24A-8

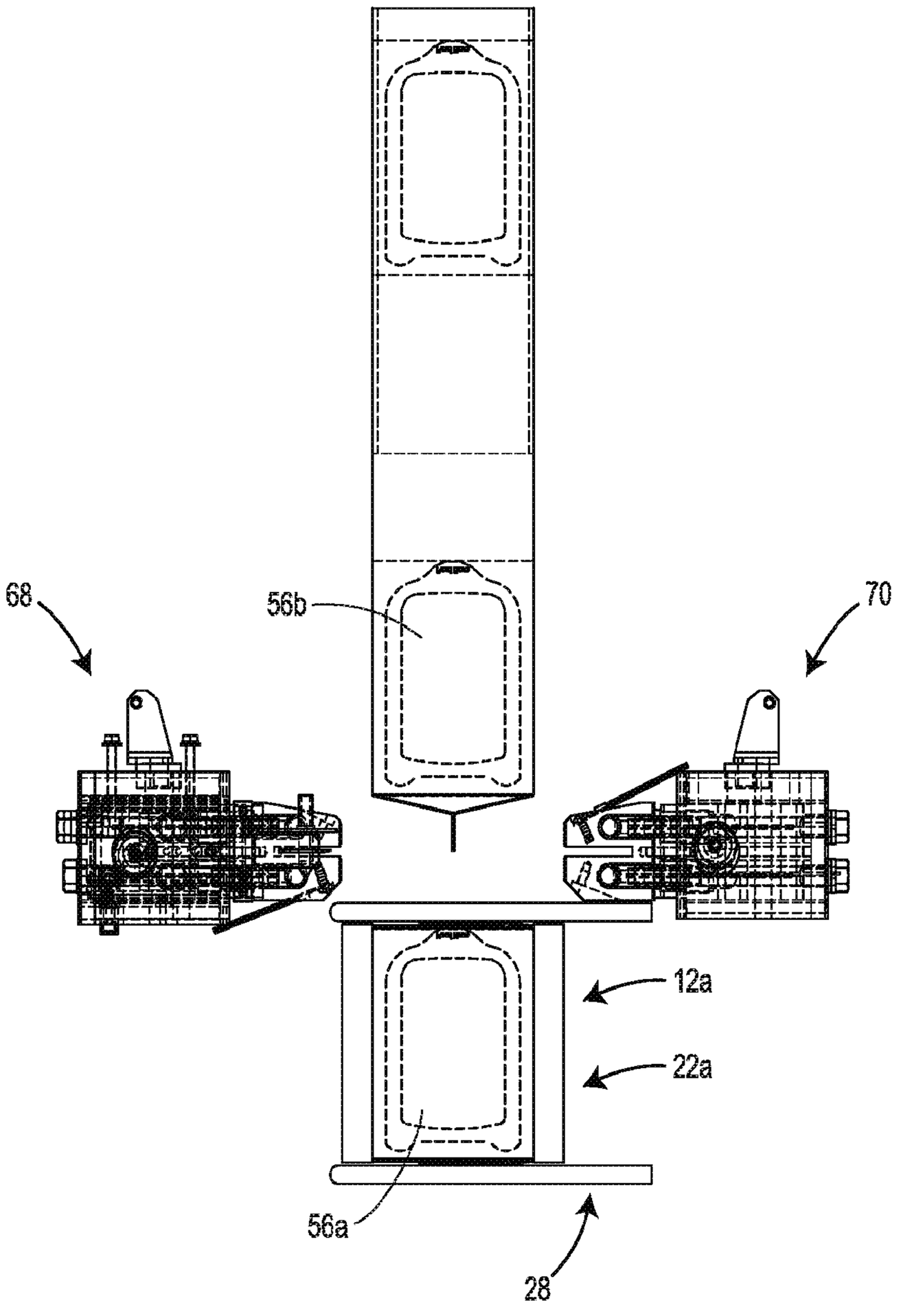


FIG. 24A-9

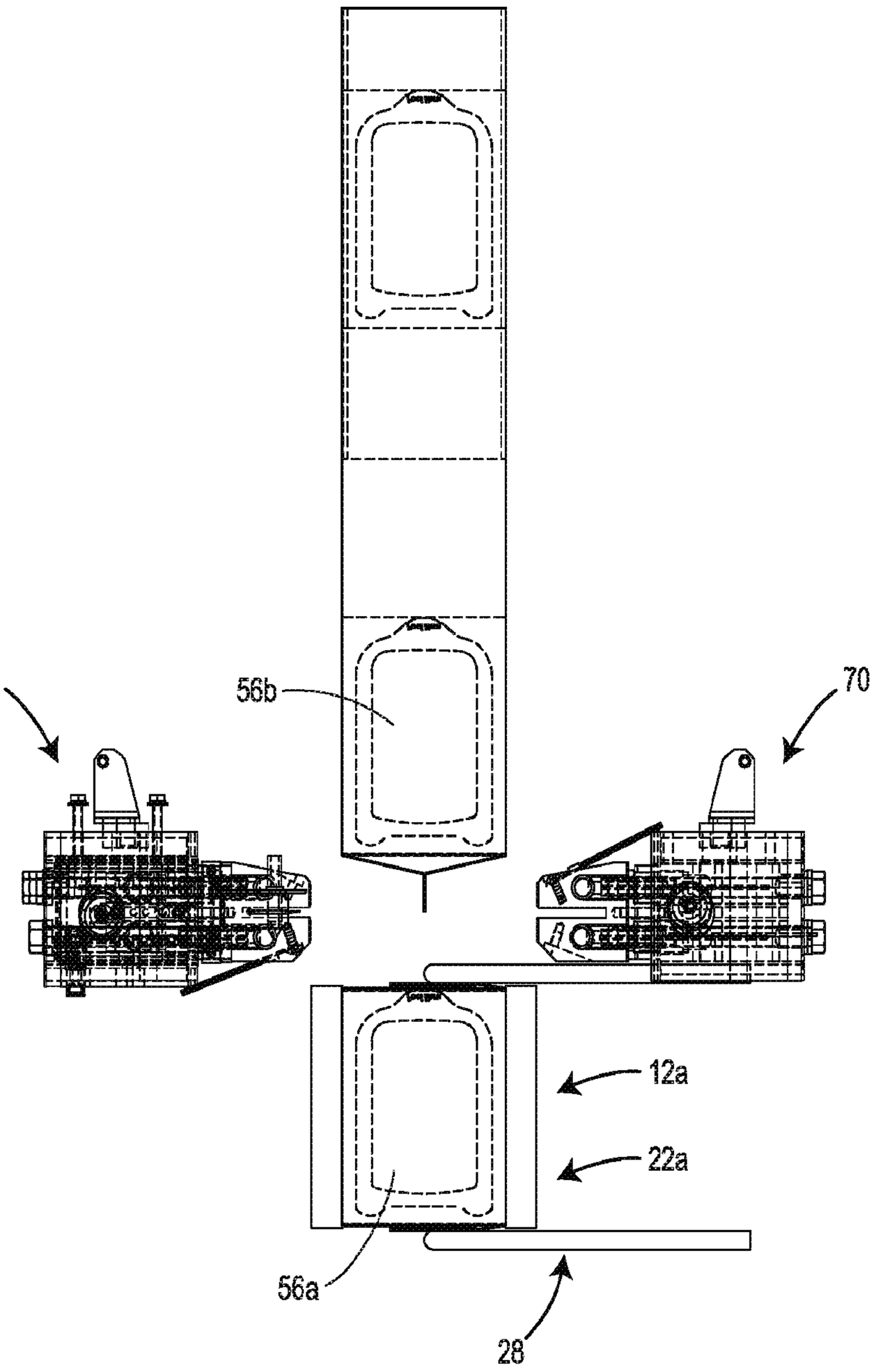


FIG. 24A-10

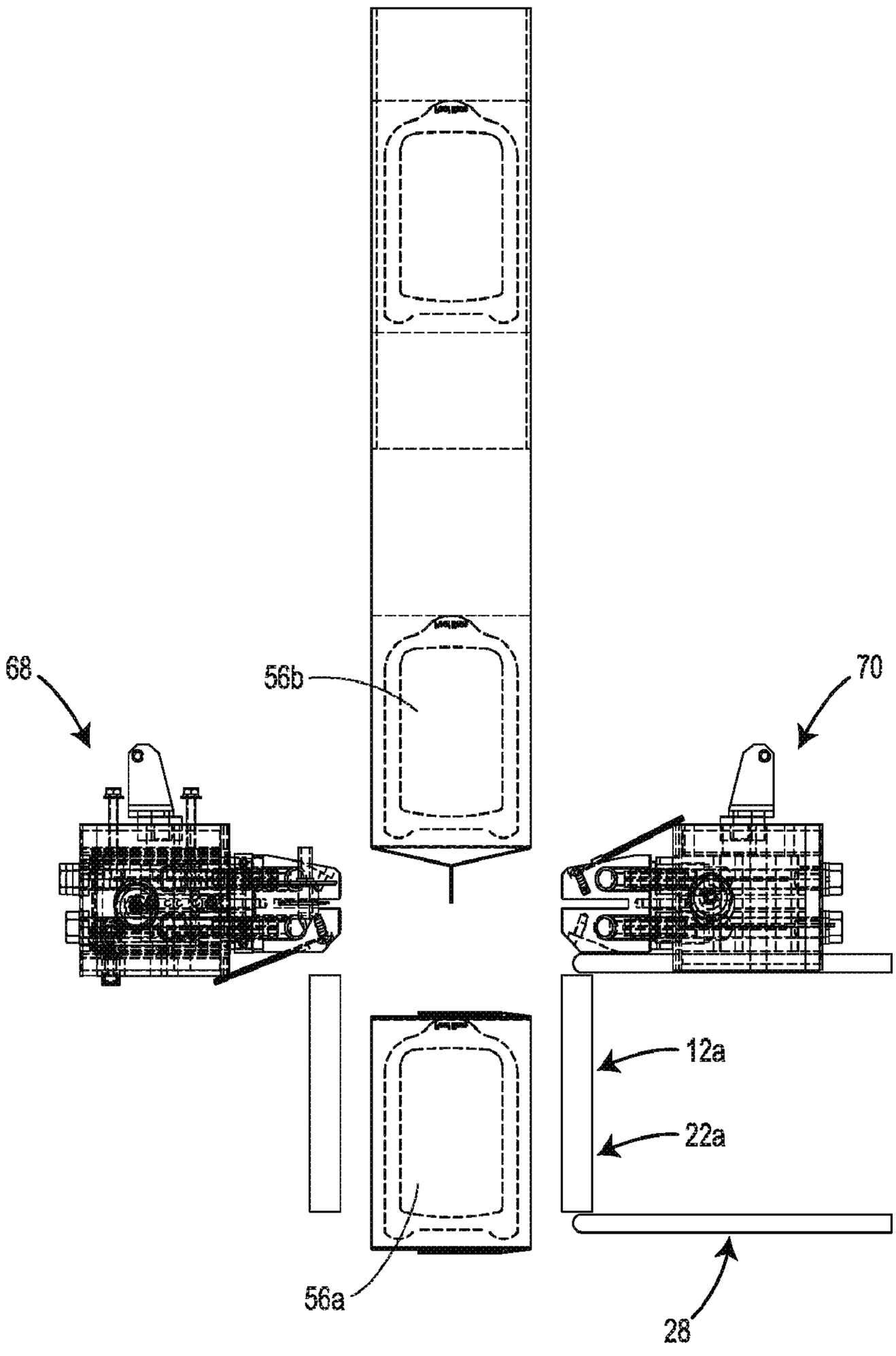


FIG. 24A-11

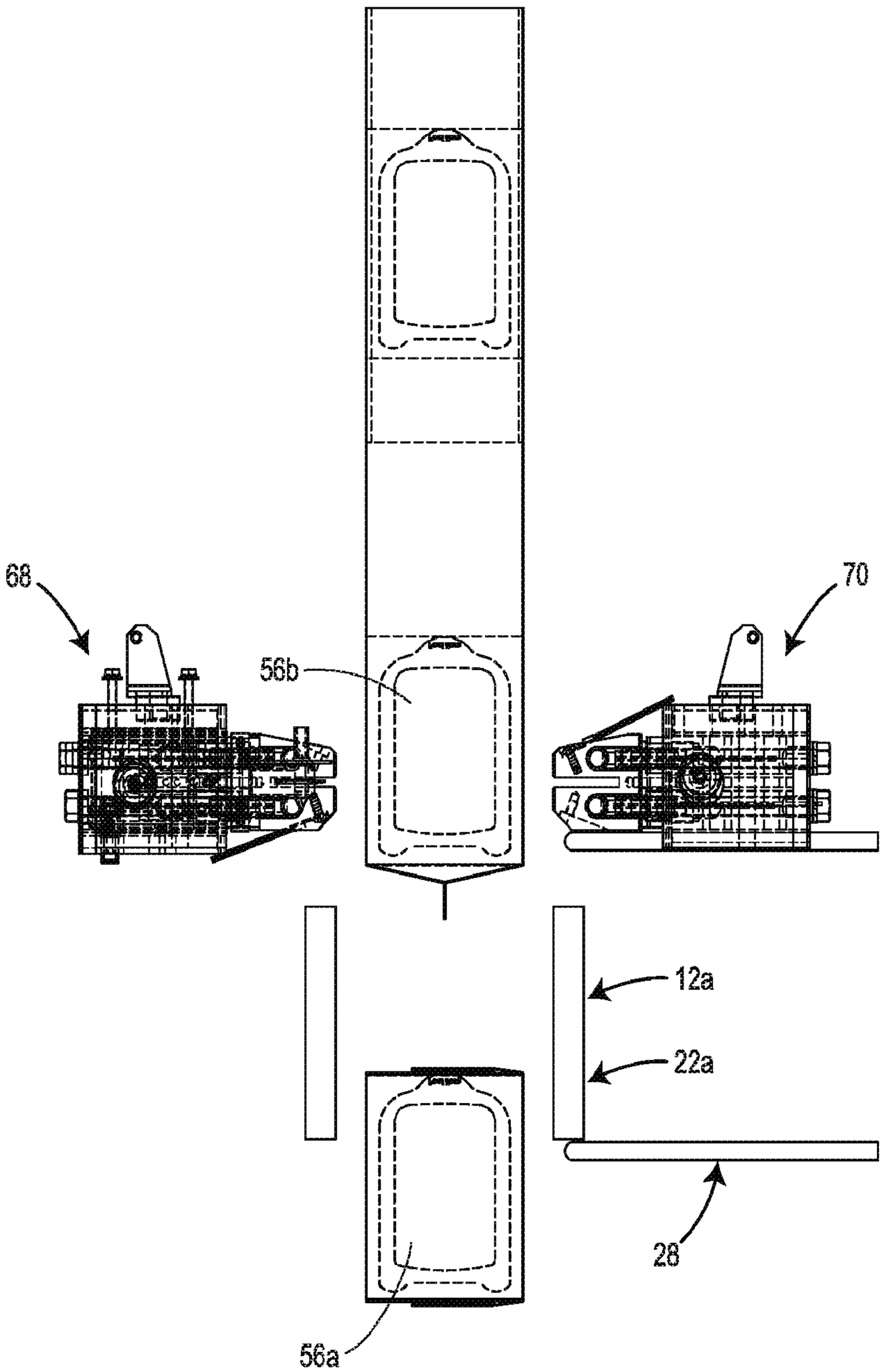


FIG. 24A-12

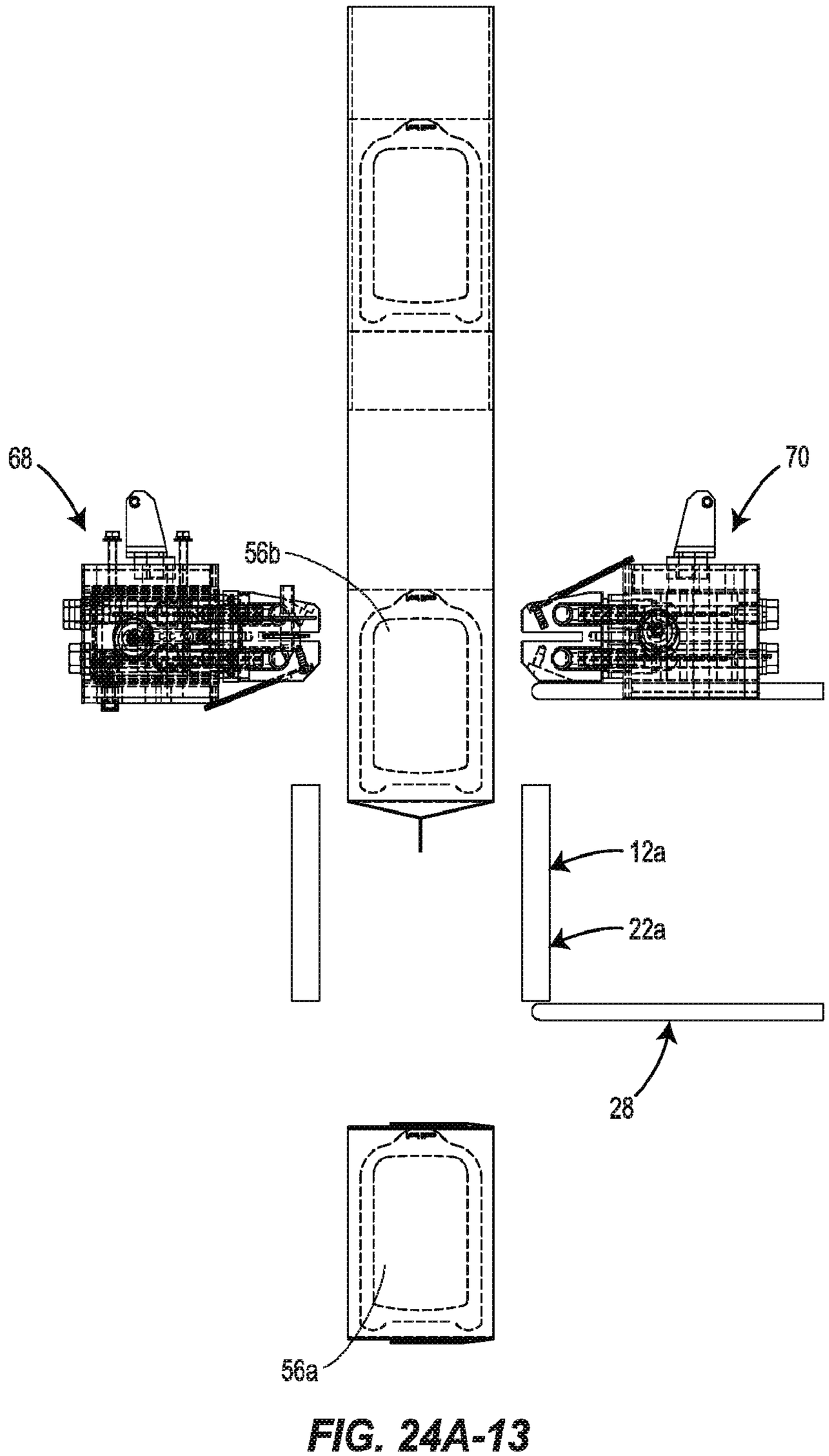


FIG. 24A-13

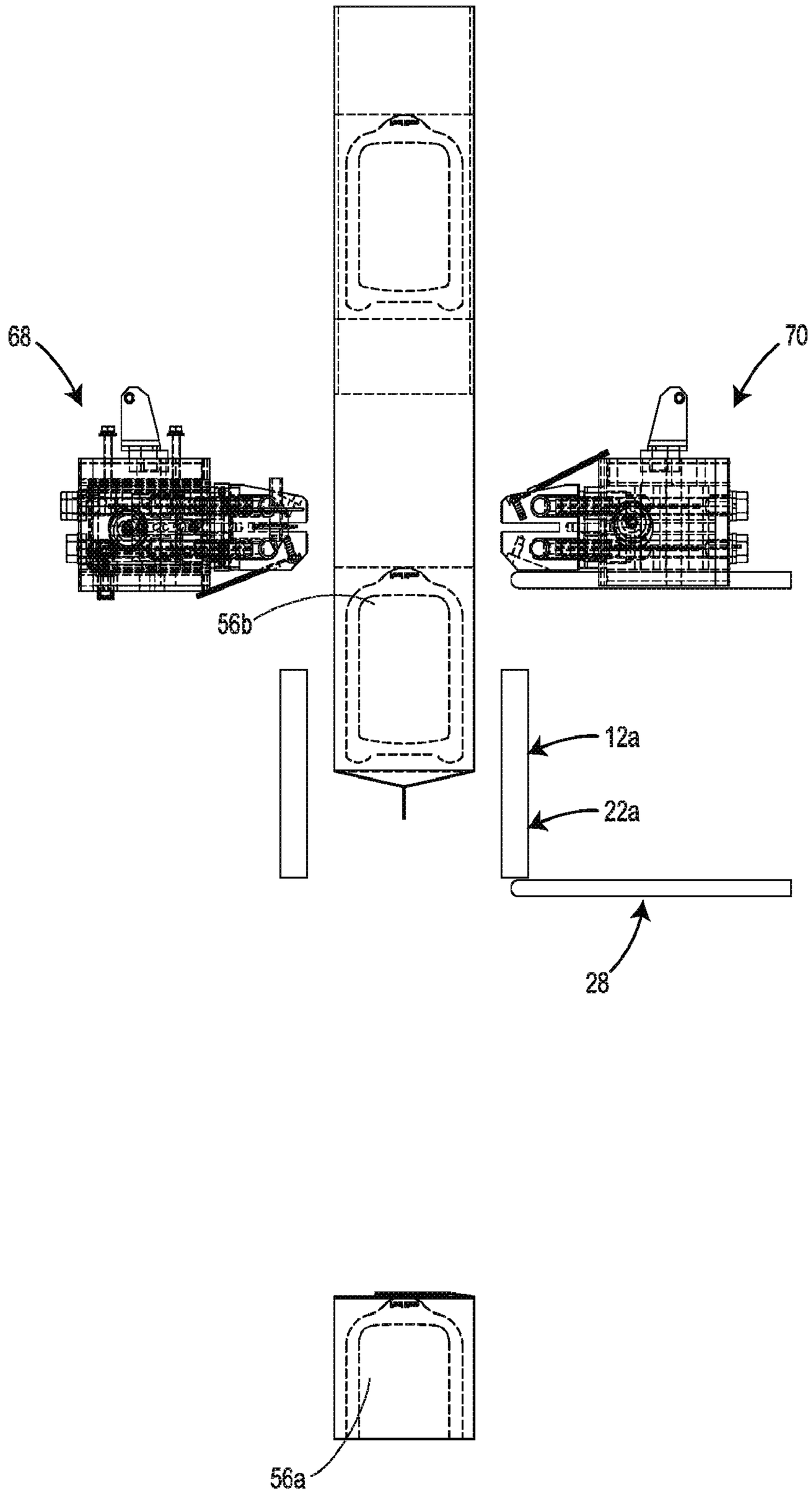


FIG. 24A-14

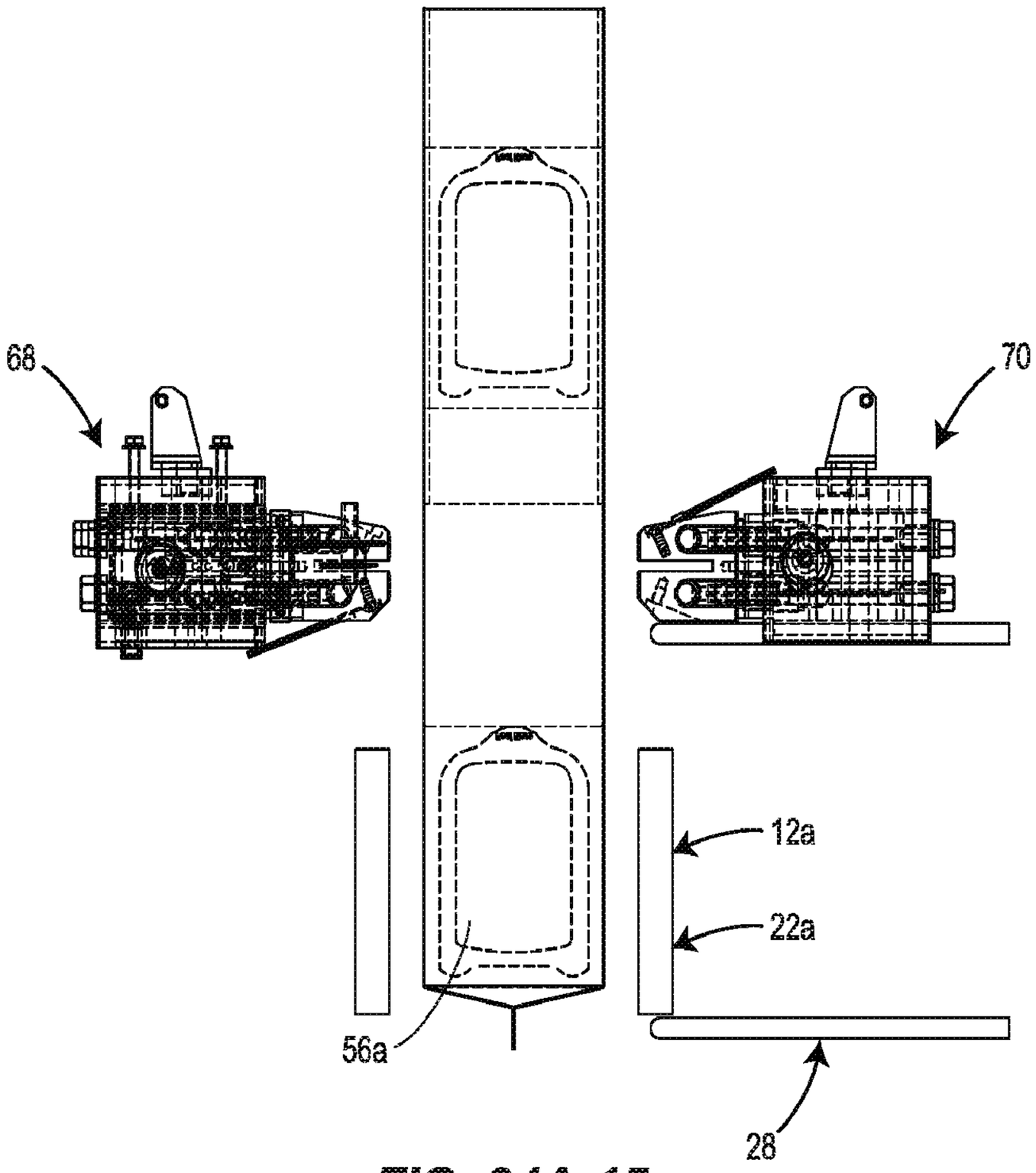


FIG. 24A-15

CA 02998754 2018-03-14

SUBSTITUTE SHEET (RULE 26)

Estimated Continuous Settings Using Linear Motors

(Seal Timing with Top Folder moving with Seal Jaws and Vertical Motion on Forming Box and Bottom Folder)

Continuous Motion Machine Timing using Top Folder moving with Seal Jaws and Vertical Motion on Forming Box and Bottom Folder, (Servo Timing)

Target Speed set to 77 FPM

Step #	Machine Operation	Start Time, (mS)	Delay Time, (mS)	Actual Start Time, (mS)	Duration Time, (mS)	Finished Time, (mS)	Starts From	Comments
0	Starting Point, (Seal Jaws at Top, Film Momentarily Stopped, Top Folder Retracted, Forming Box Open and Down, Bottom Folder Retracted and Down)	0	0	0	0	0		
2A	Seal Jaws Close	0	0	0	125	125	Beginning	
2B	Forming Box Closes as it moves Up	0	30	30	150	180	At Beginning of Seal Jaws Close	
2C	Bottom Folder Extends, (In) as it moves Up	0	70	70	200	270	At Beginning of Seal Jaws Close	Figures being able to Lift Package and Fold Flap
2D	Seal Time Starts	125	0	125	350	475	When Seal Jaws are Closed	
2E - 10C	Film and Seal Jaws Moving Down at Film Speed	125	0	125	980	1,105	When Seal Jaws are Closed	Includes Estimated Accel
6A	Seal Time Finishes	475	0	475	0	475	At End of Seal Time	
6B	Seal Jaws Open	475	0	475	205	680	At End of Seal Time	
6C	Forming Box and Bottom Folder Move Down to position Top Flap	475	13	488	75	563	At End of Seal Time	Slight Delay for jaws to Open Slightly
6D	Top Folder Extends In	475	80	555	150	705	At End of Seal Time	Small Delay for Forming Box and Bottom Folder to Position the Package
7A	Forming Box and Bottom Folder Move Up to Fully Fold Top Flap	555	50	605	75	680	At End of Top Folder Extends In	Slight Lead Time for coordinated motion
7B	Top Folder Time Starts	680	0	680	1,030	1,030		
7C	Film Pauses when in Position	680		680	0	680	Anytime after Seal Jaws Open	
10A	Top Folder Time Finishes	1,030	0	1,030	0	1,030	At End of Top Folder Time	
10B	Top Folder Retracts, (Out)	1,030	0	1,030	150	1,180	At End of Top Folder Time	
10C	Bottom Folder Retracts, (Out)	1,030	0	1,030	150	1,180	At End of Top Folder Time	
33A	Seal Jaws Stop Moving Down	1,030	0	1,030	80	1,110	At End of Top Folder Time	This is the Estimated Decel
11B	Forming Box Opens	1,030	30	1,060	140	1,180	At End of Top Folder Time	
11C	Package Drops	1,180	0	1,180	1,487	1,487	At End of Forming Box Open	Timing shown is for Stationary, will be faster for moving
12 - 15B	Seal Jaws Start Moving Up Fast	1,105	0	1,105	395	1,380	After Seal Jaws are Stopped	Includes Estimated Accel
33	Forming Box and Bottom Folder Move Down to Prepare for Next Cycle	1,180	0	1,180	75	1,255	After Forming Box is Open	
15A	Seal Jaws Stop Moving Up	1,380	0	1,380	76	1,456		This is the Estimated Decel
15B	Ready for Next Cycle	1,455	0	1,455	0	1,455		
				Total Estimated Time, (mS) =		1,455		
				Maximum Speed, (Fpm) =		83.24		

FIG. 24B-1

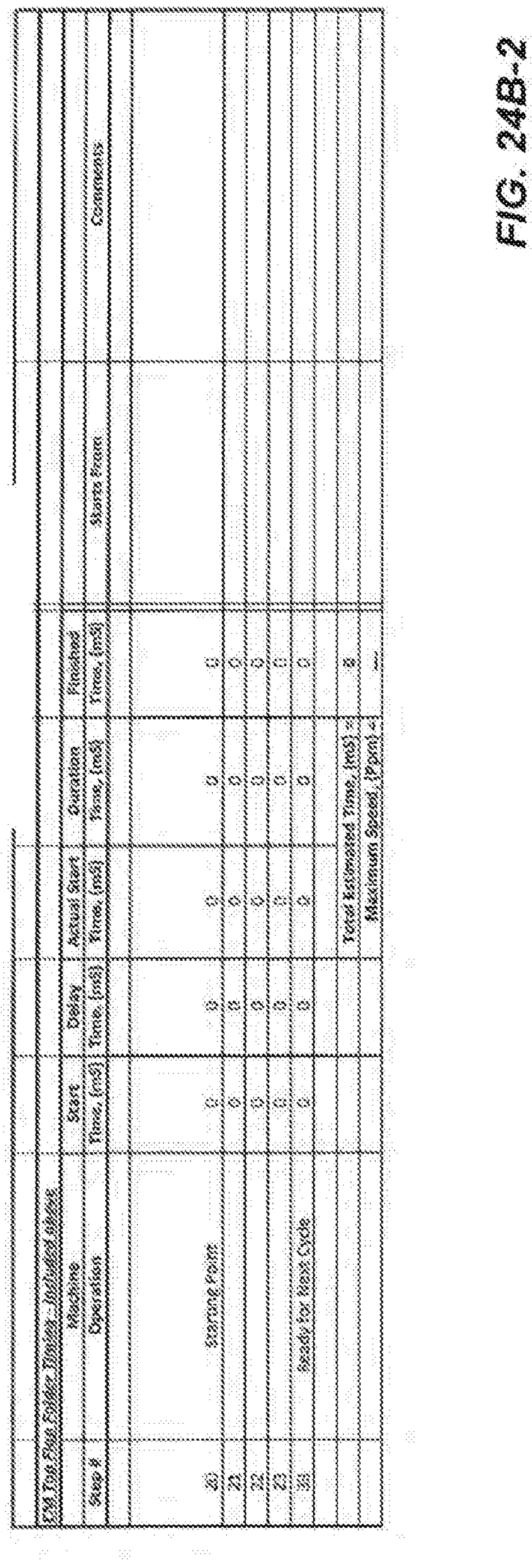
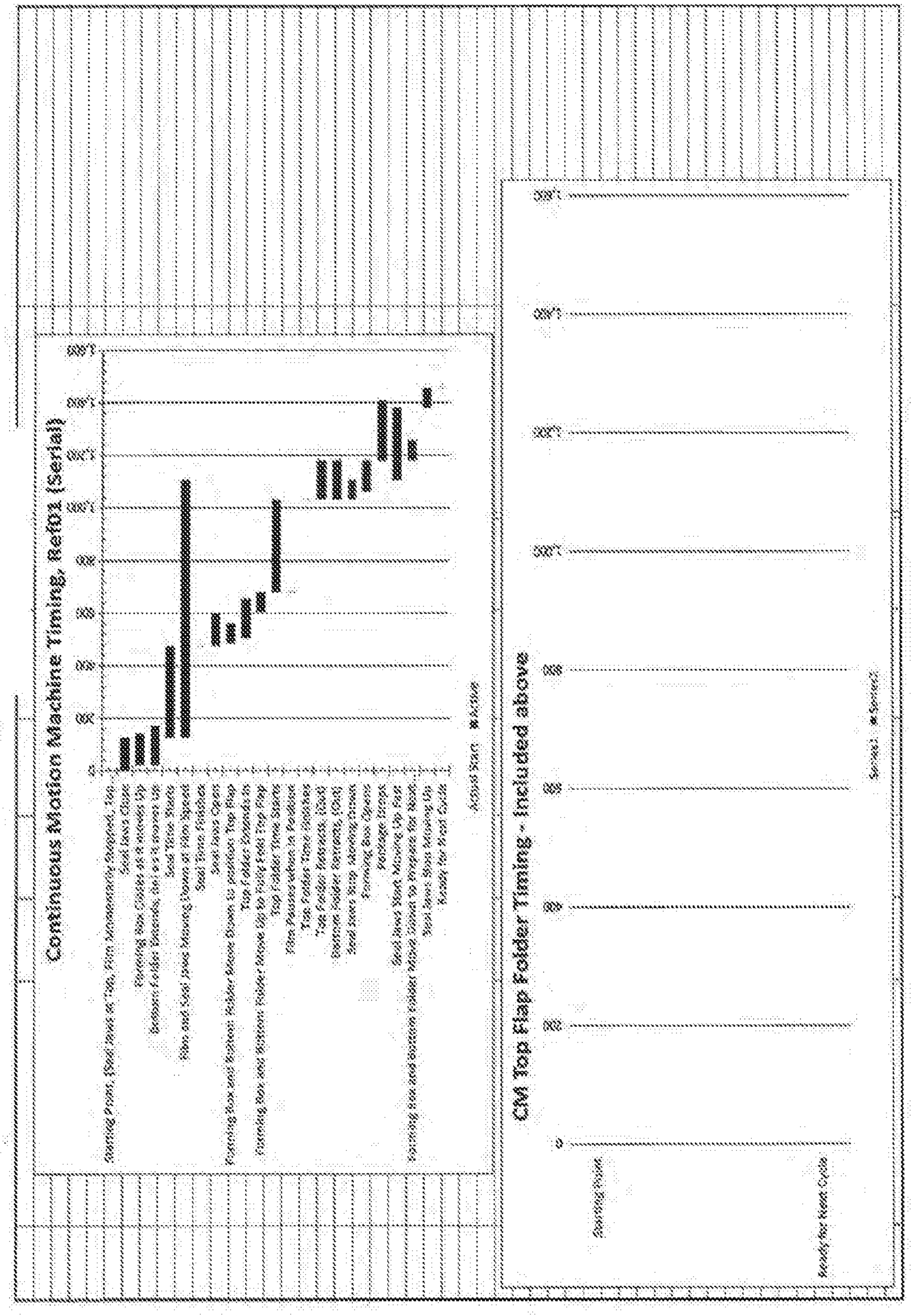

EM Top Pipe Folder Timing – Inclined Mirror
Machine
Operation
Step #
Starting Point
Steady for Next Cycle
Start Time, (ms)
Delay Time, (ms)
Actual Start Time, (ms)
Duration Time, (ms)
Finished Time, (ms)
Comments
Shorts Team
30
22
32
23
33
Total Estimated Time, (ms) =
Maximum Speed, (Ppm) =

FIG. 24B-2

FIG. 24C


Continuous Motion Machine Timing, Before (Serial)
Cut Top Flap Folder Timing - Included above
Cut Top
Serial
Overlap

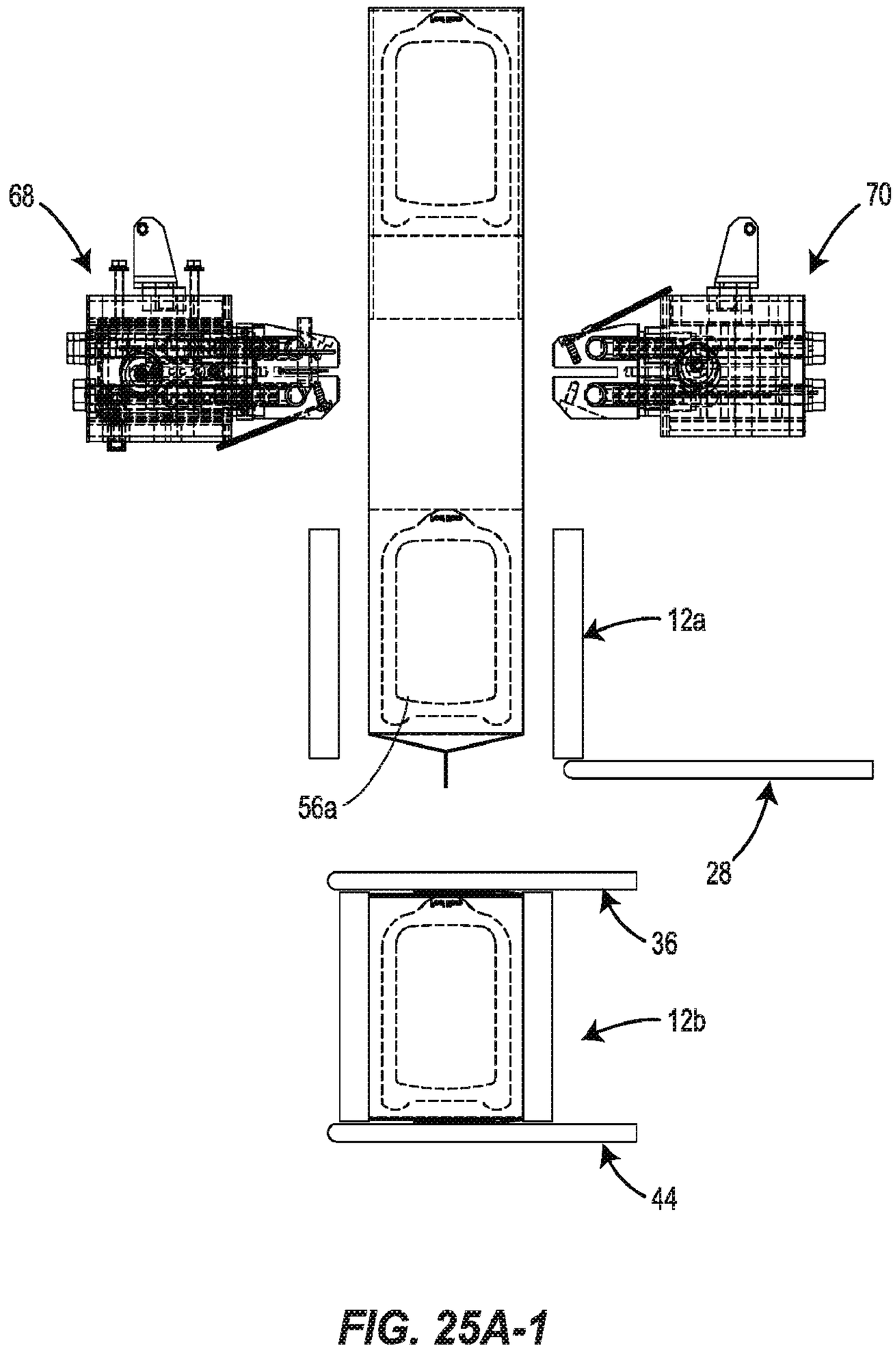


FIG. 25A-1

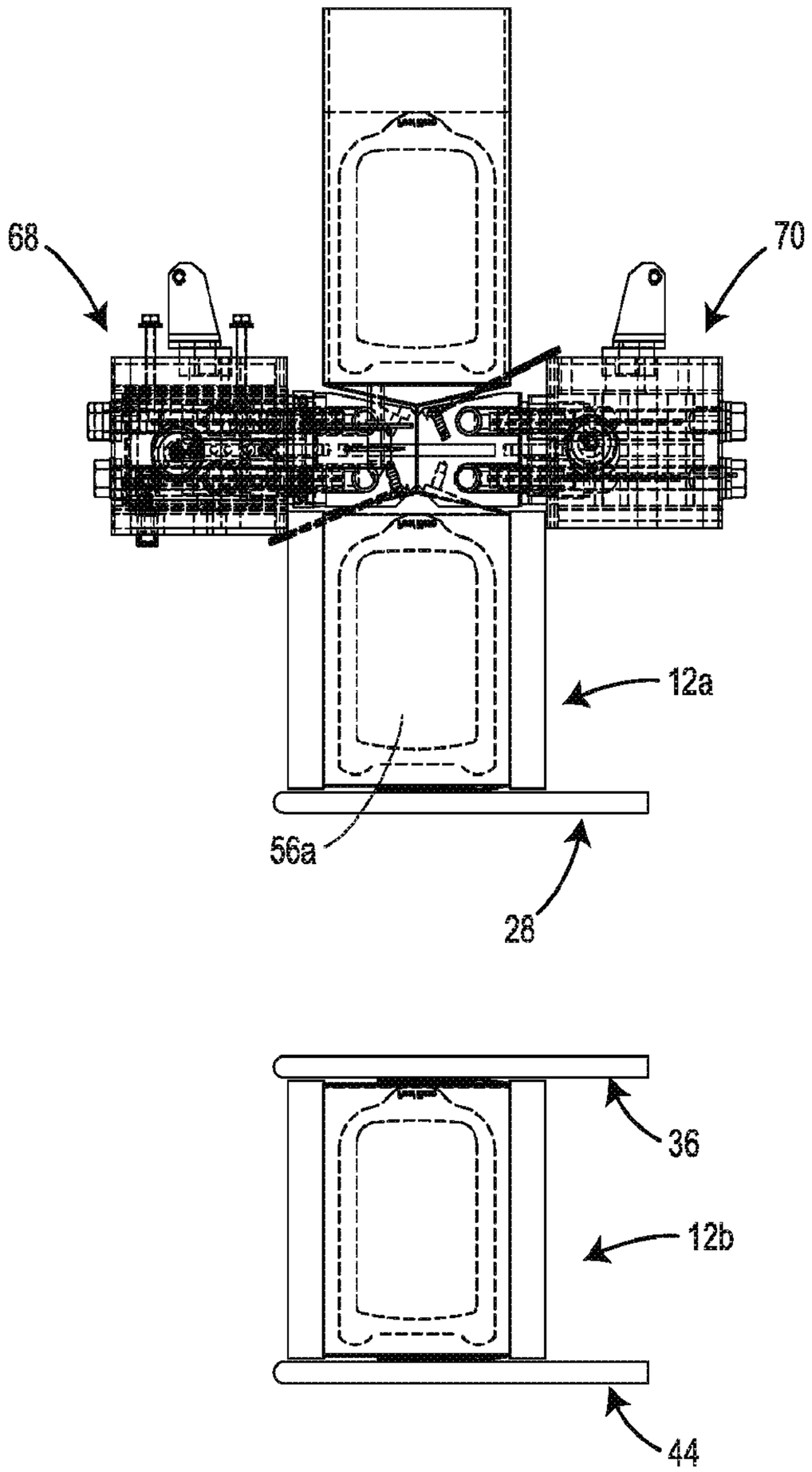


FIG. 25A-2

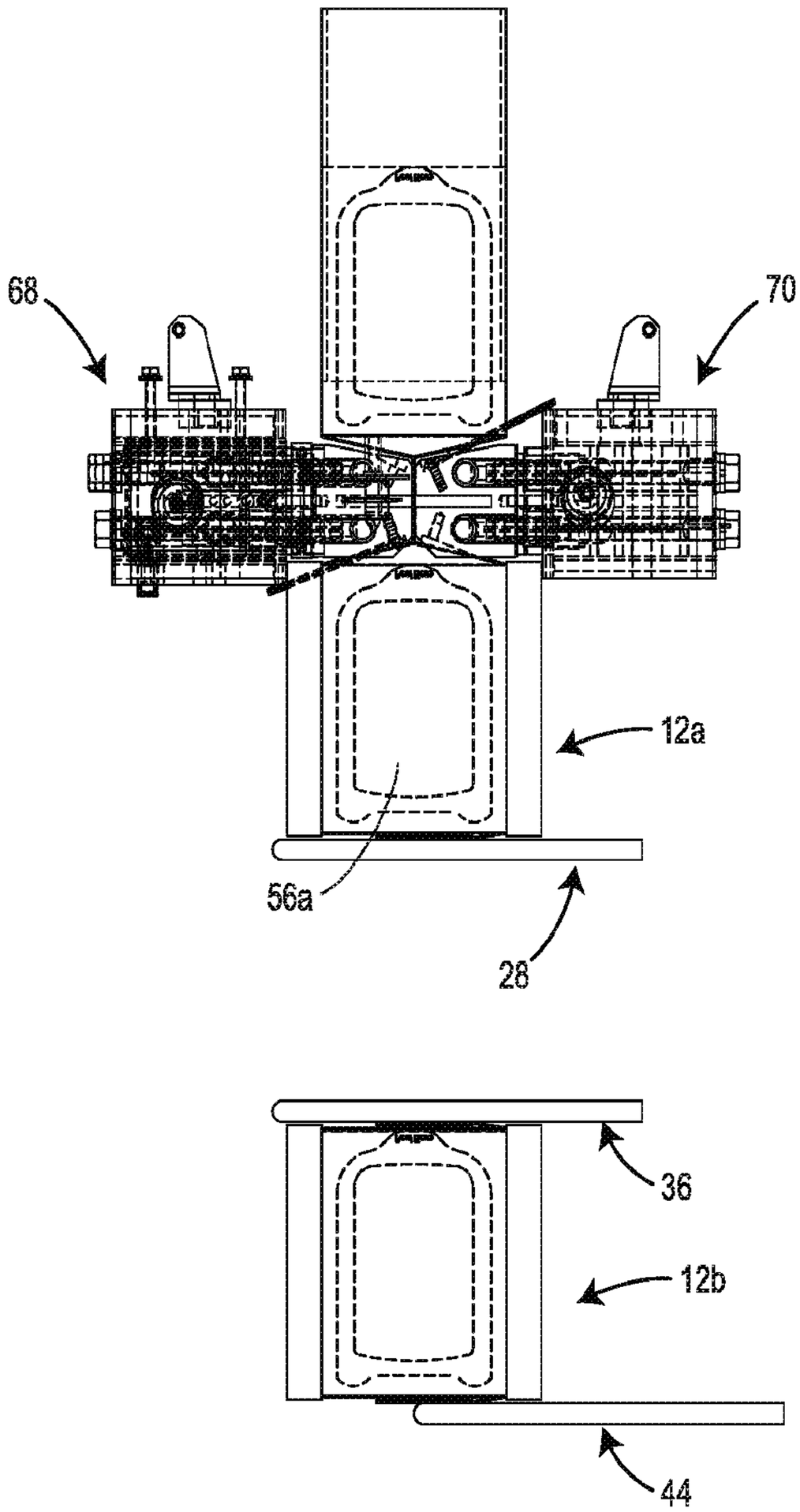


FIG. 25A-3

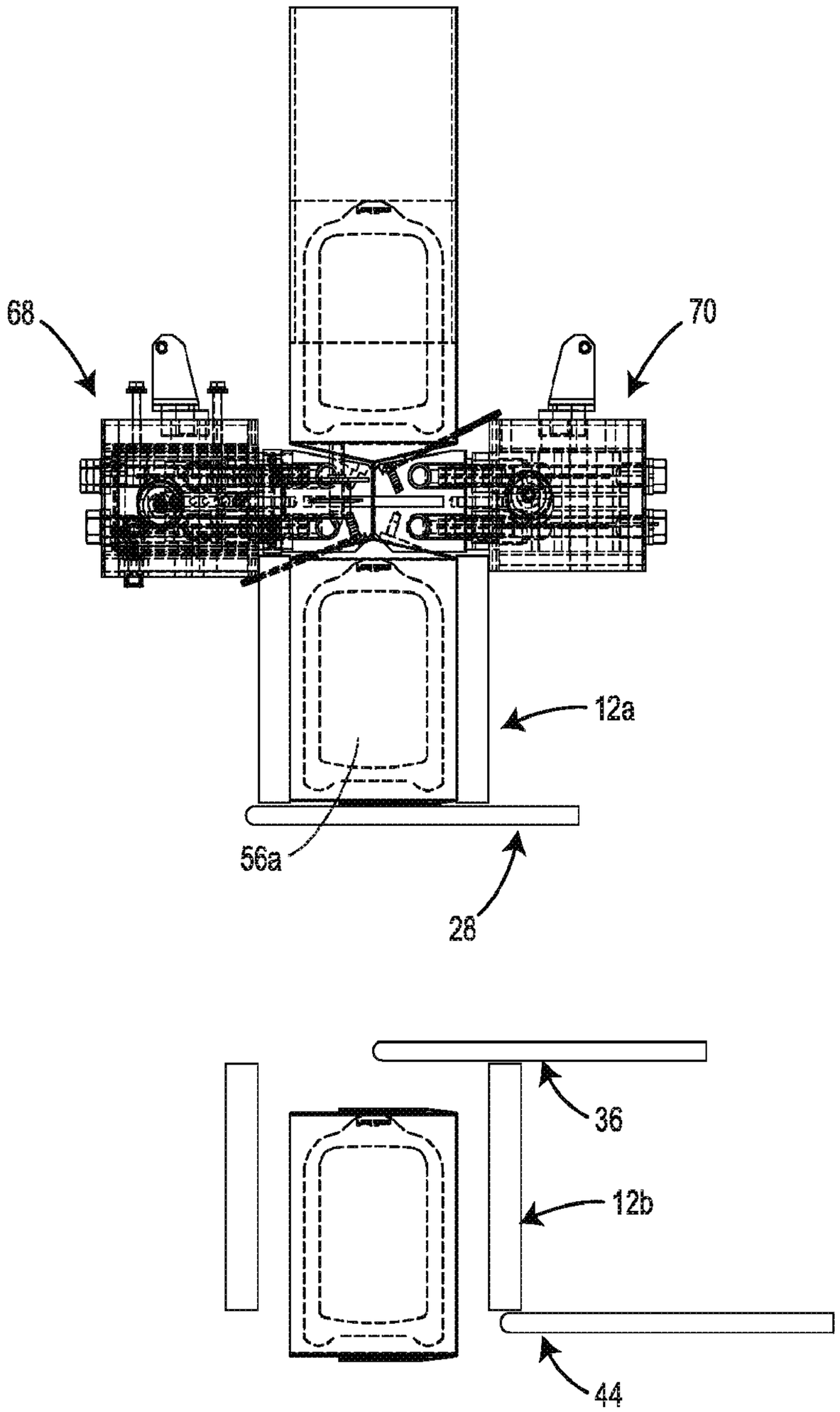


FIG. 25A-4

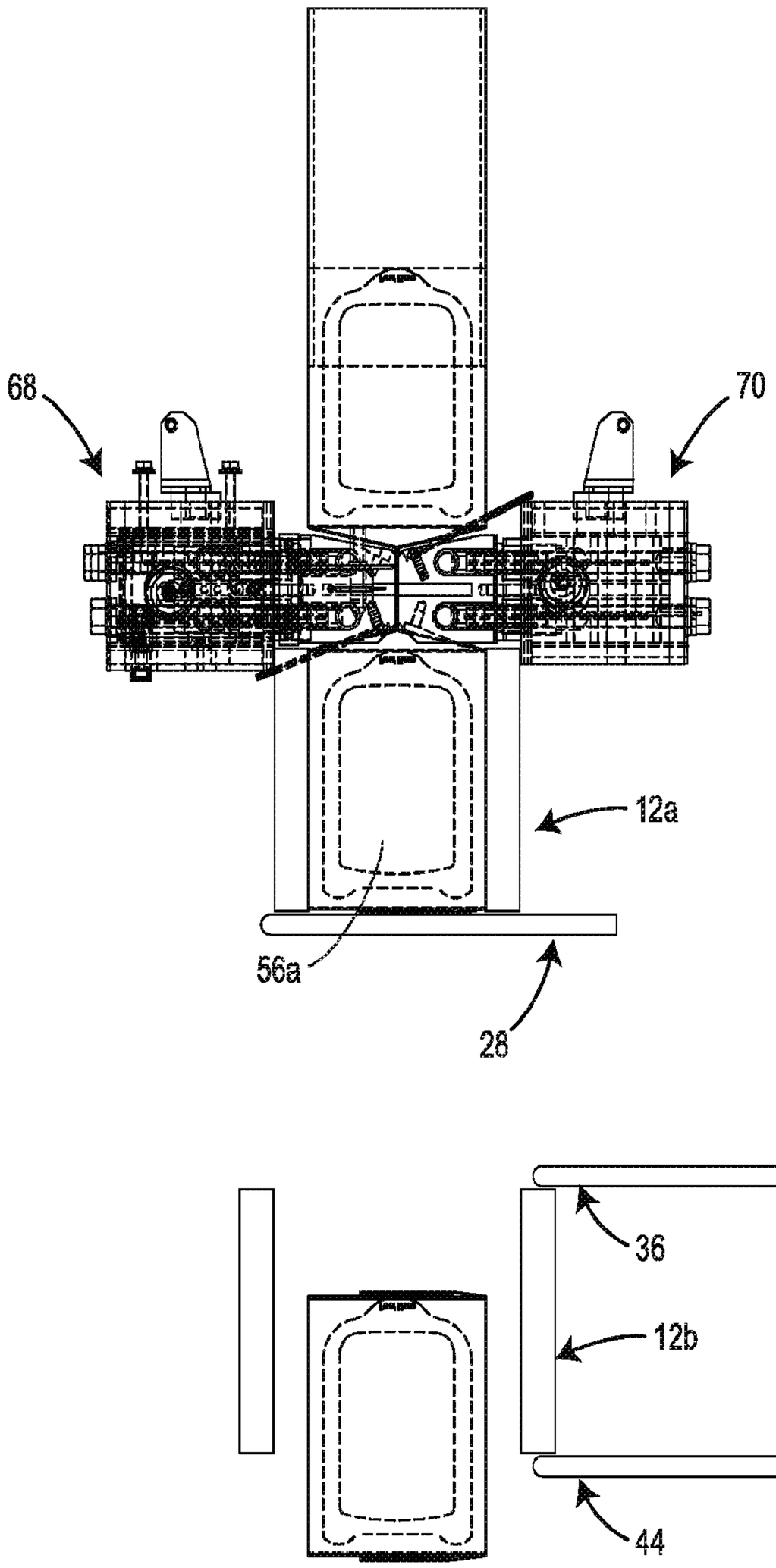


FIG. 25A-5

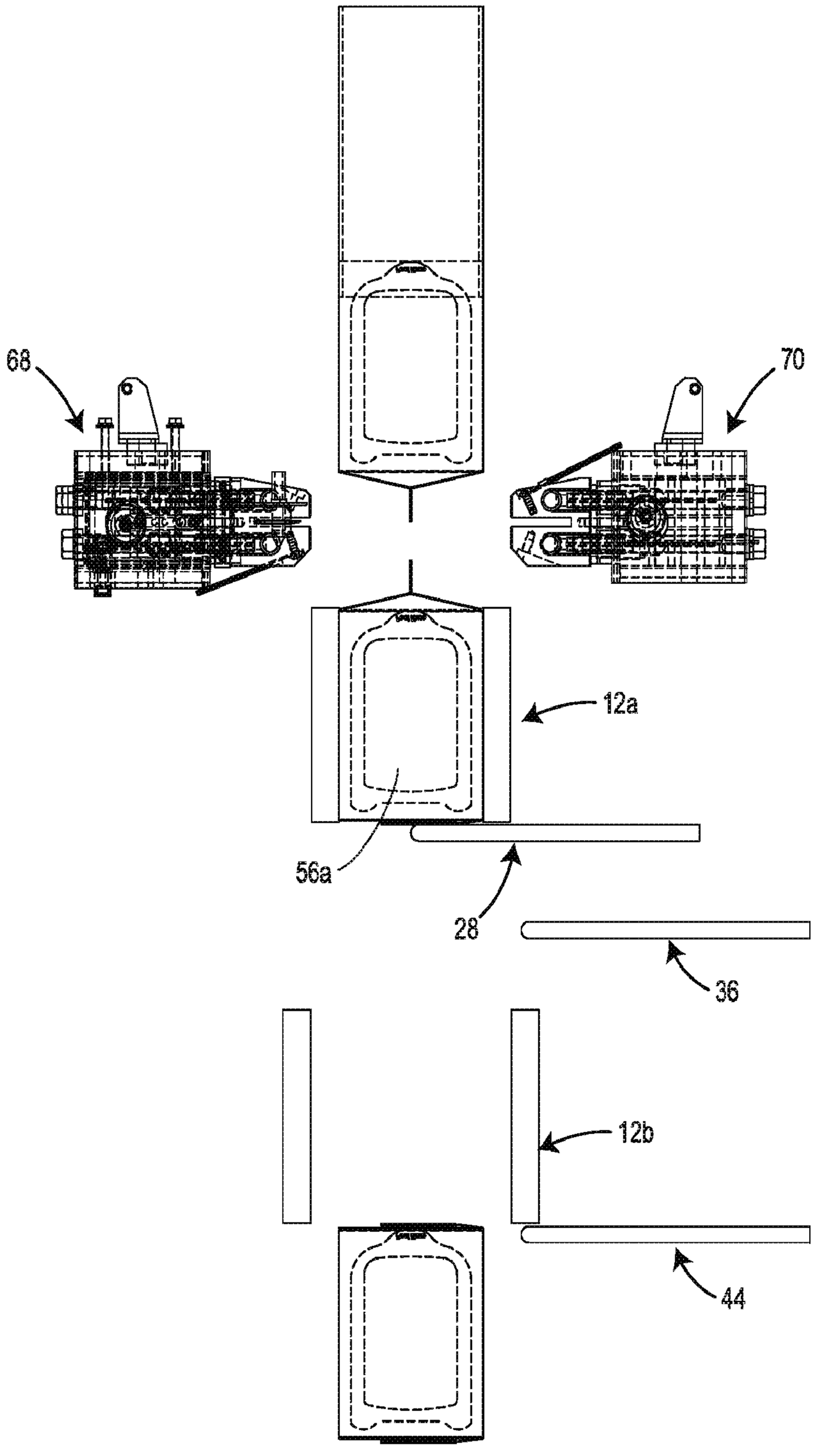


FIG. 25A-6

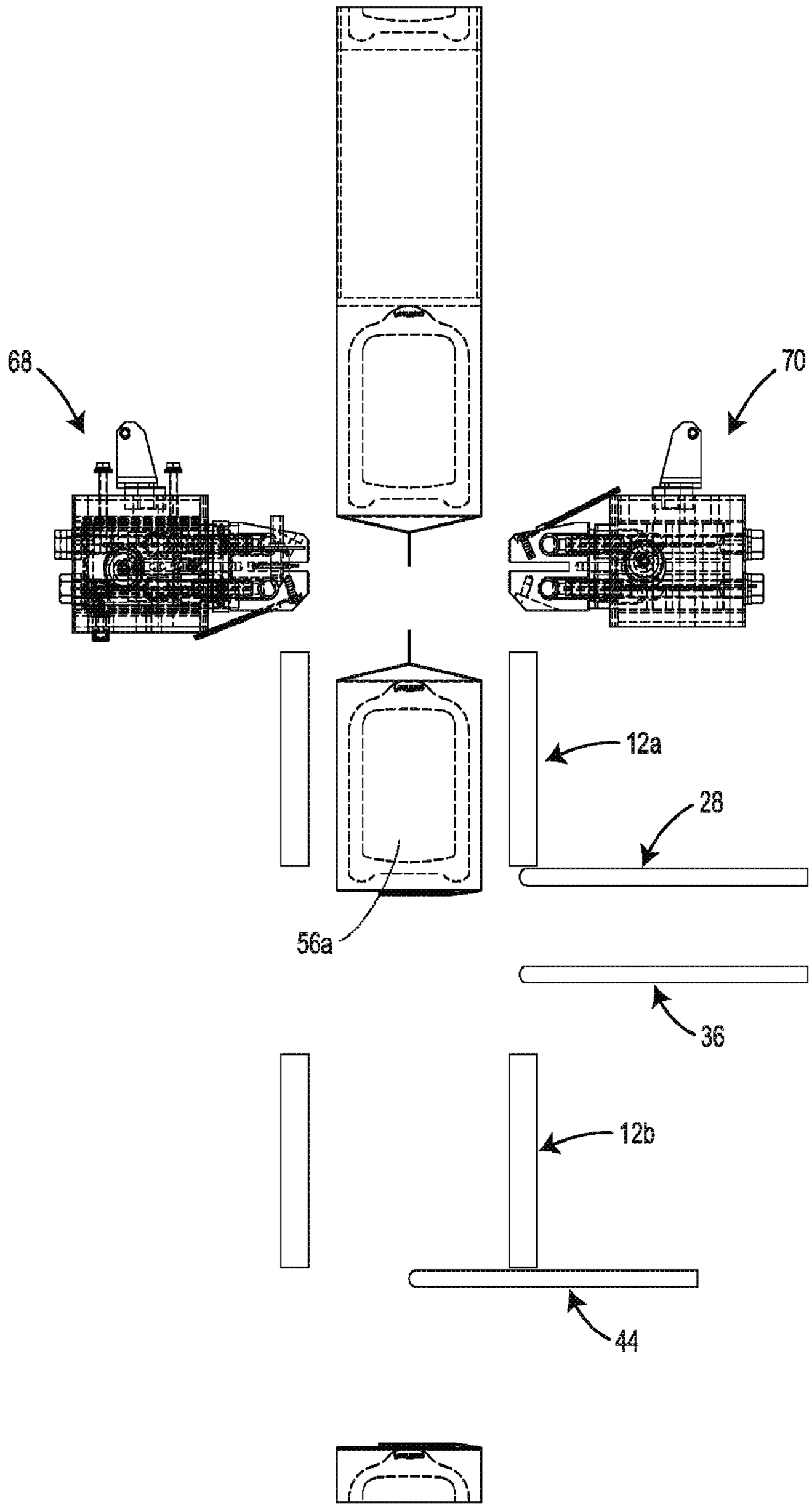


FIG. 25A-7

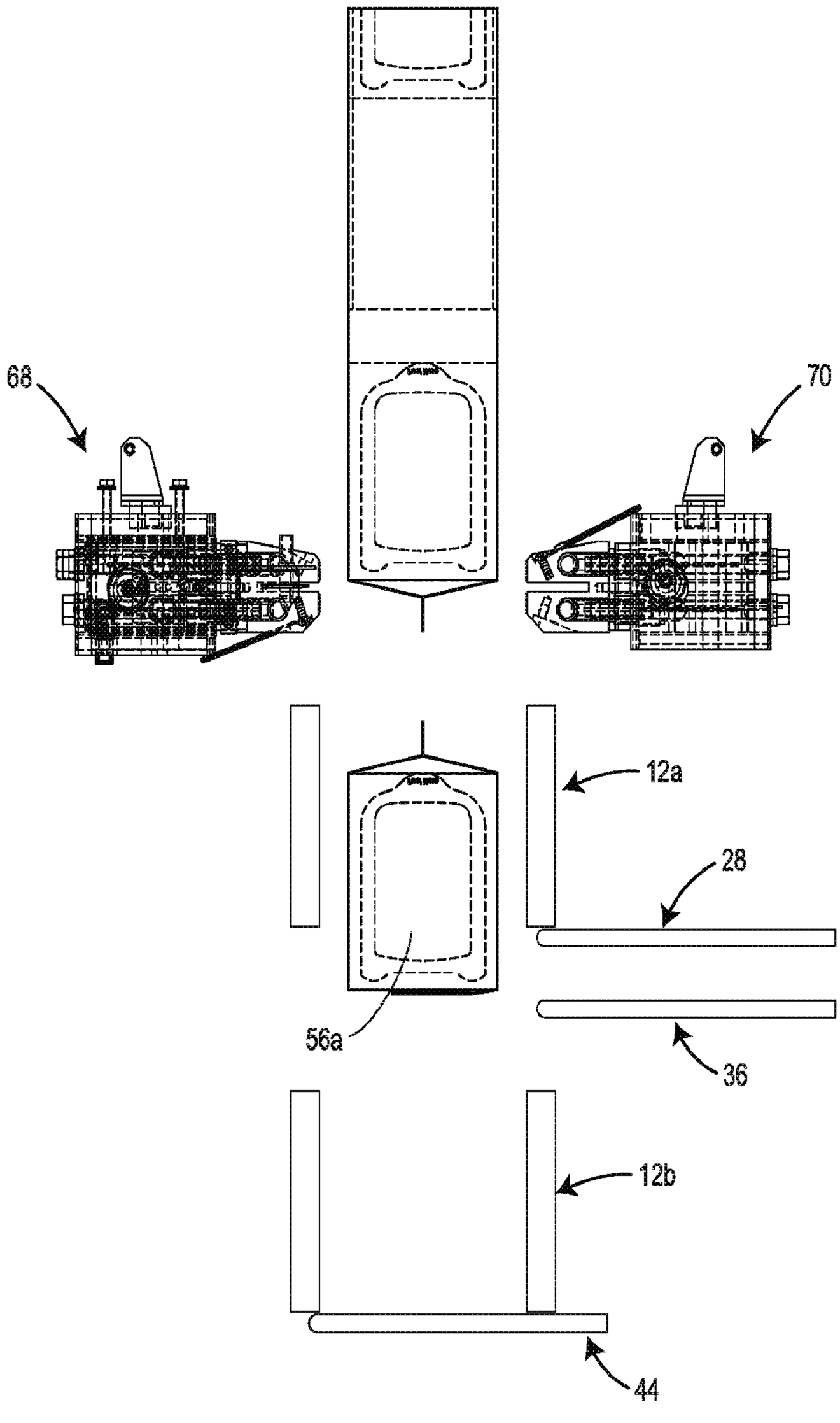


FIG. 25A-8

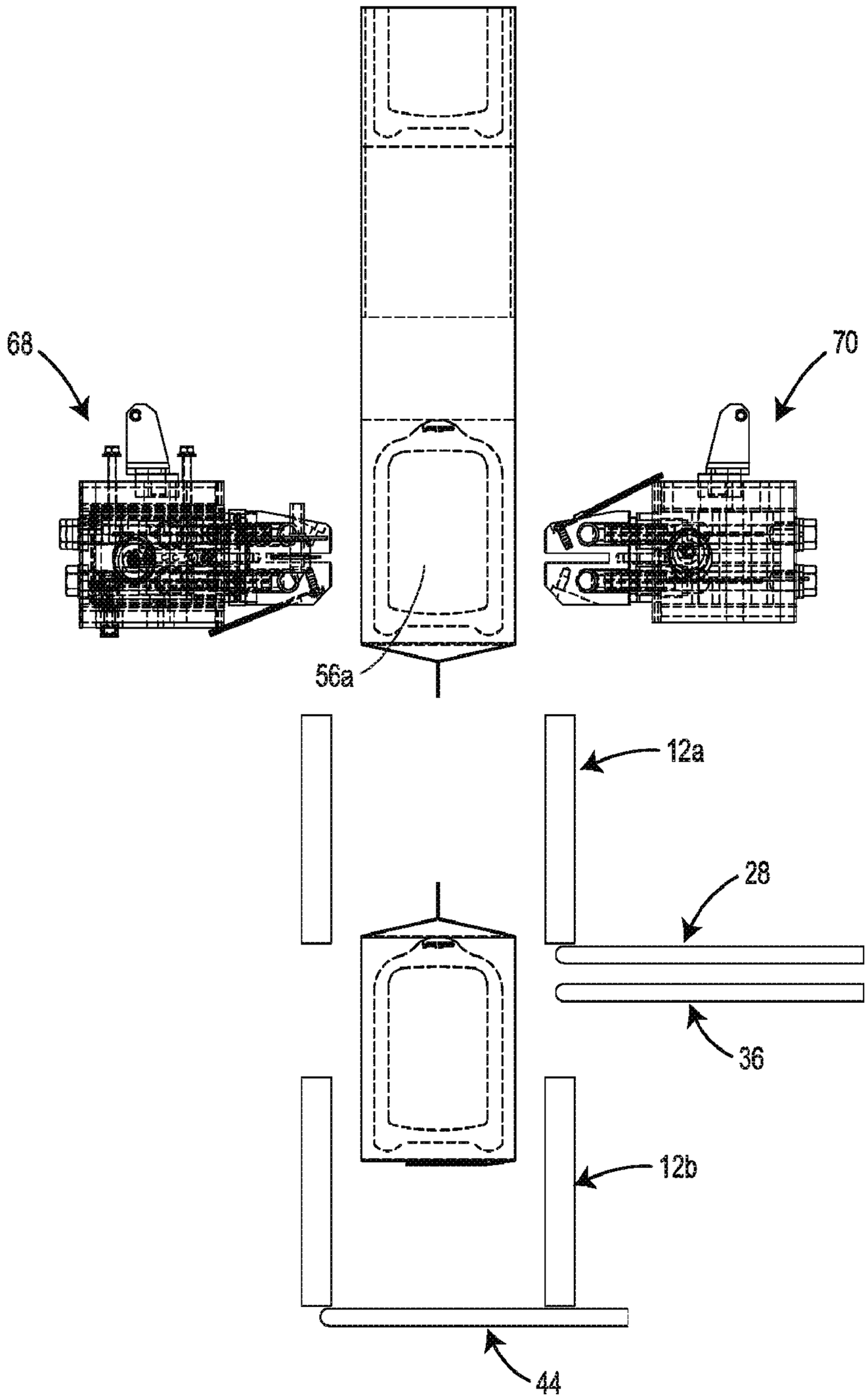


FIG. 25A-9

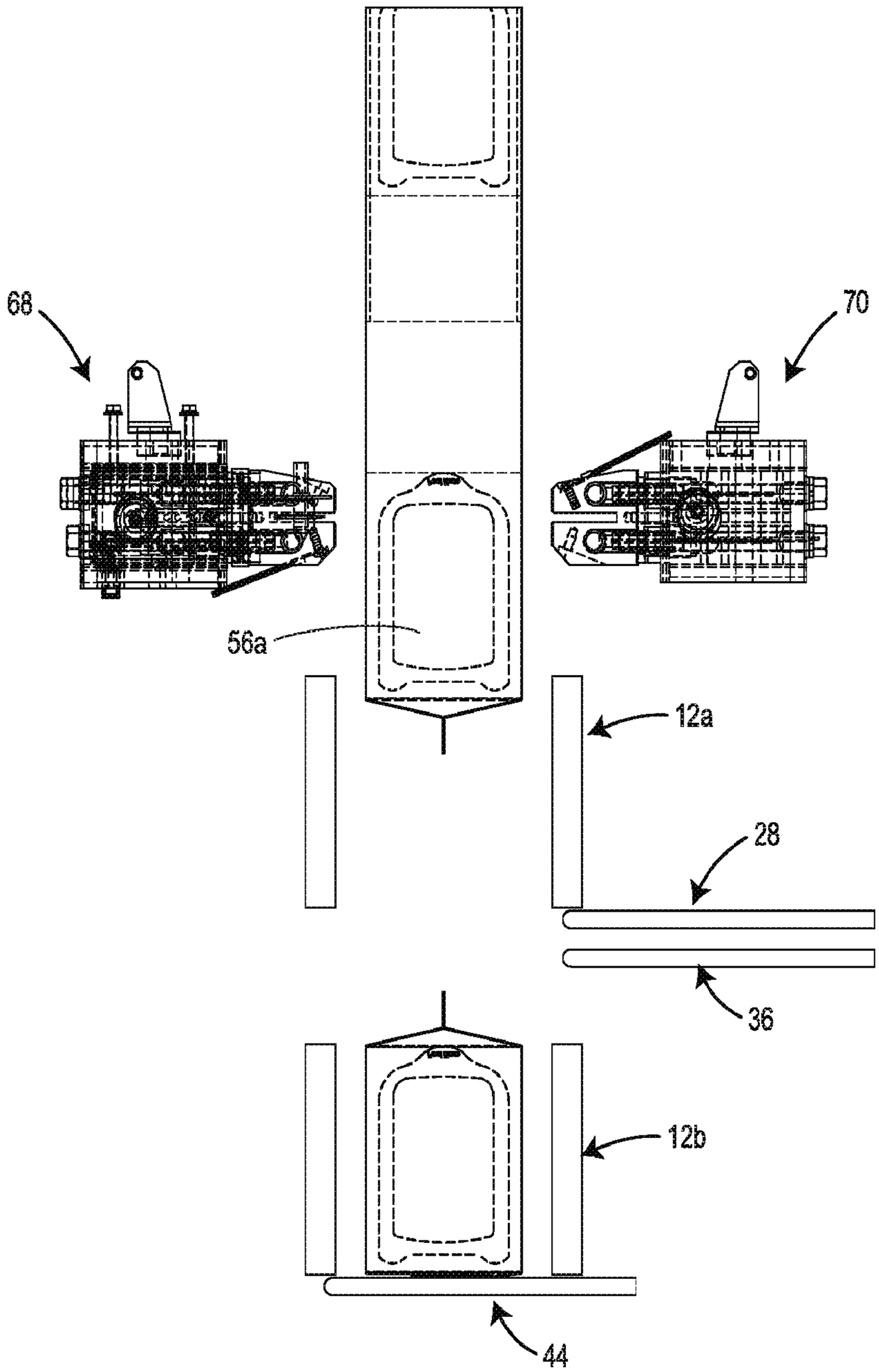


FIG. 25A-10

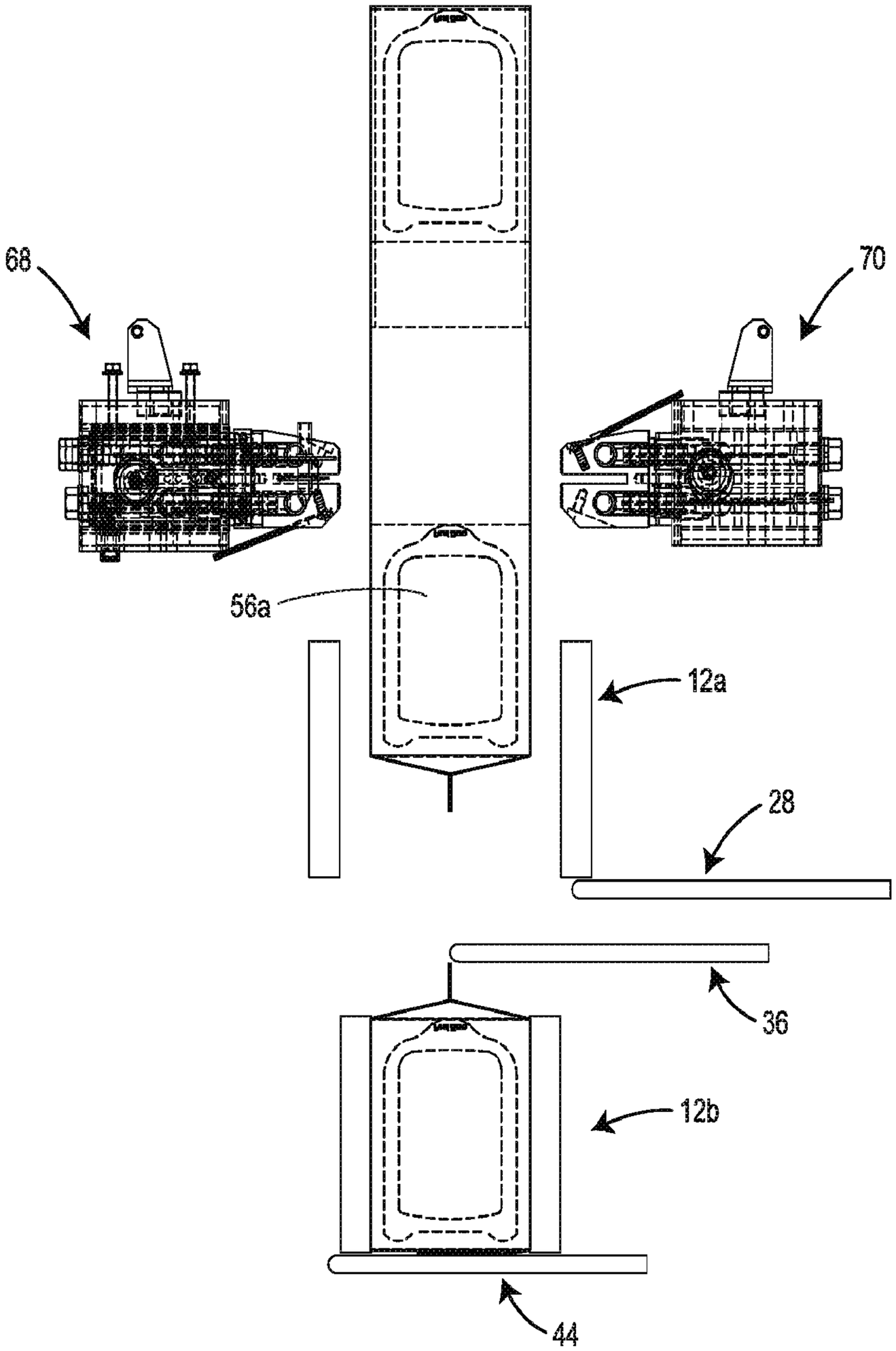


FIG. 25A-11

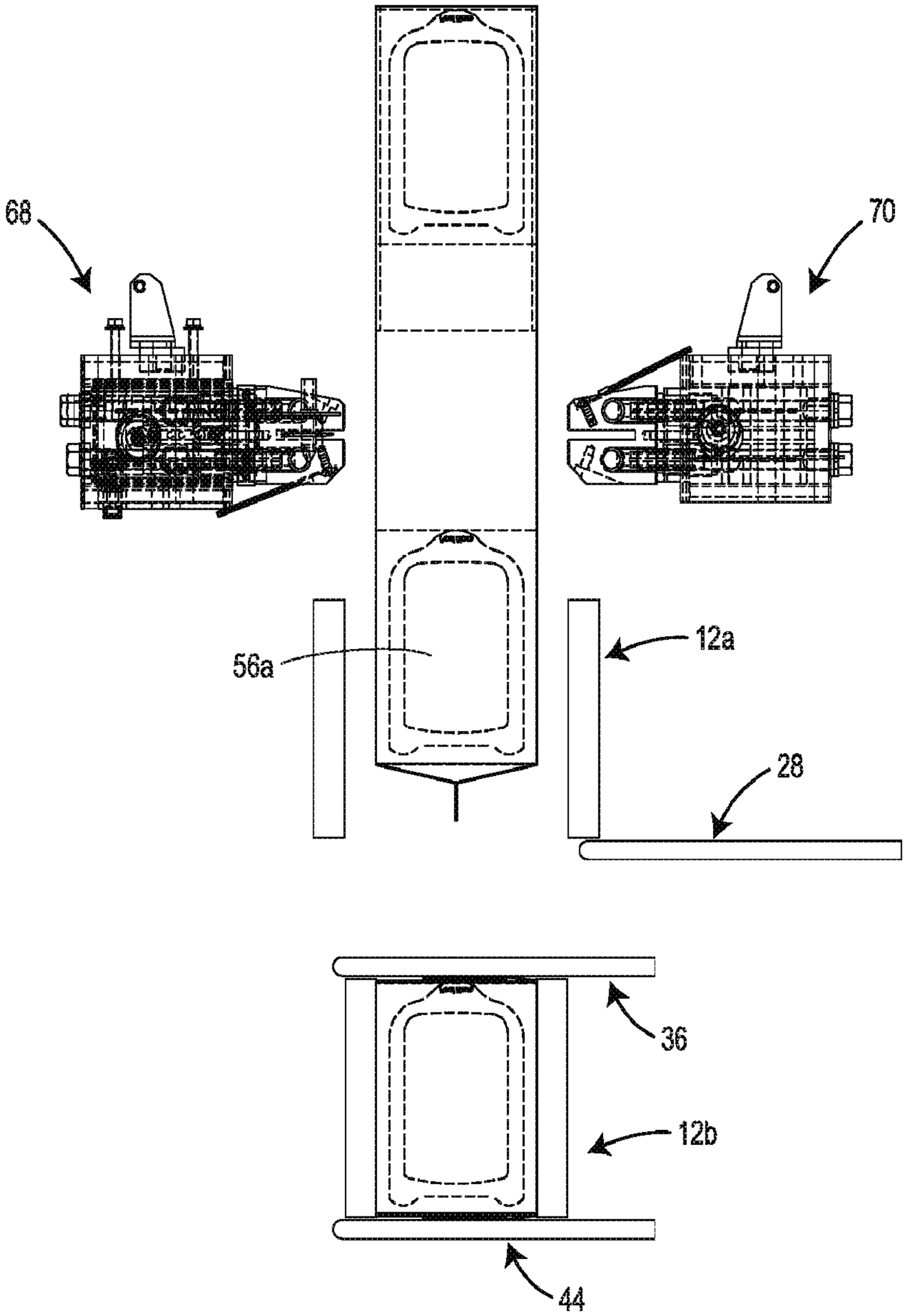


FIG. 25A-12

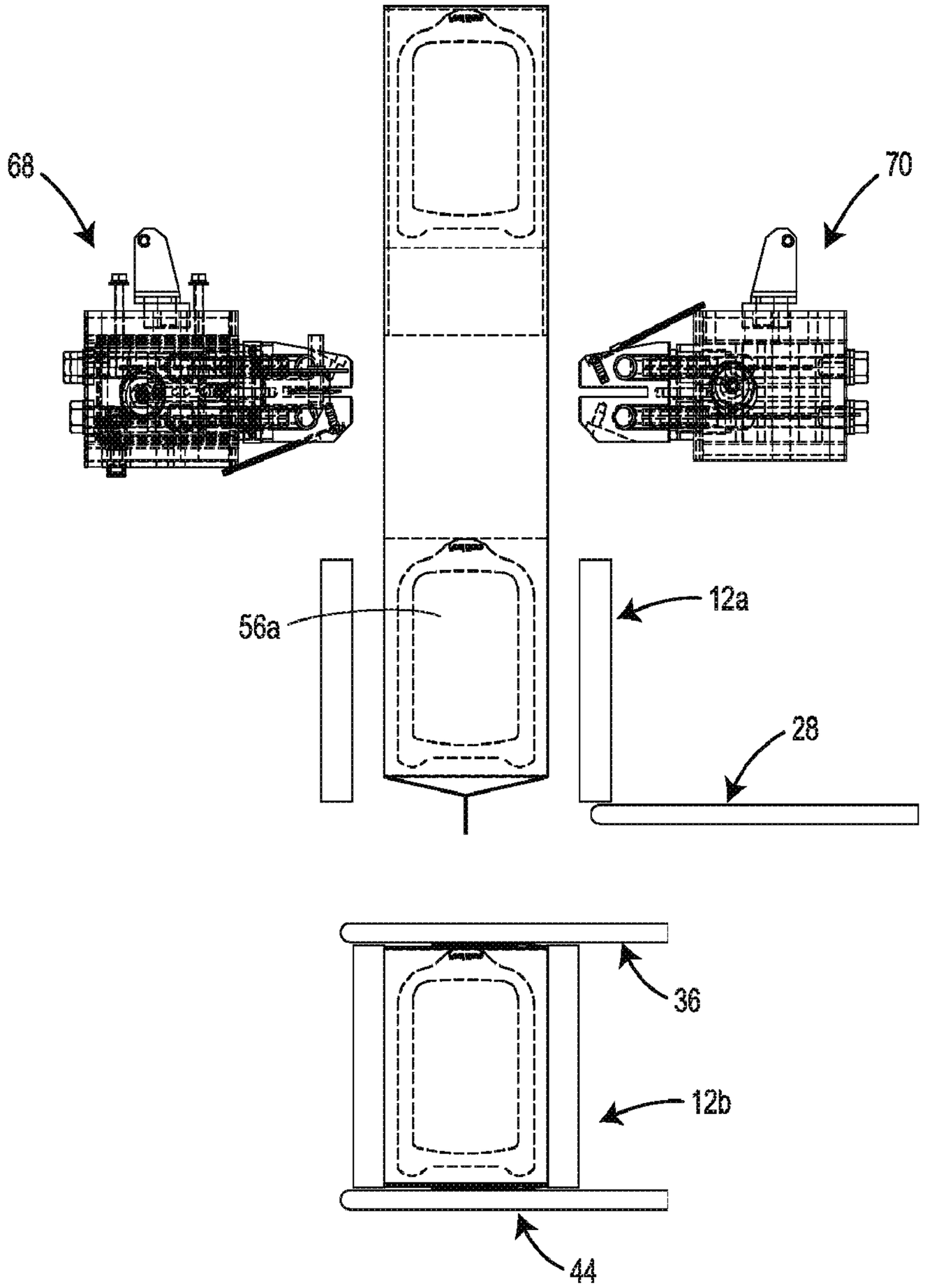


FIG. 25A-13

							being Linear Motors.	
(Parallel Timing with 1st Forming Box + 1st Bottom Folder under Seal Jaws and Independent Top Folder, 2nd Forming Box, and 2nd Bottom Folder)								
Continuous Motion Machine Timing, with 1st Forming Box + 1st Bottom Folder under Seal Jaws, (Parallel Timing)								Bagger Speed set to 77 PPM
Step #	Machine Operation	Start Time, (mS)	Delay Time, (mS)	Actual Start Time, (mS)	Duration Time, (mS)	Finished Time, (mS)	Starts From	Comments
0	Starting Point, (Seal Jaws at Top, Film Momentarily Stopped, 1st Forming Box Open and Down, 1st Bottom Folder Retracted and Down)	0	0	0	0	0		
2A	Seal Jaws Close	0	0	0	125	125	Beginning	
2B	1st Forming Box Closes as it moves Up	0	20	20	125	180	At Beginning of Seal Jaws Close	Figures being able to Lift Package and Fold Flap
2C	1st Bottom Folder Extends, (in) as it moves Up	0	20	20	150	170	At Beginning of Seal Jaws Close	Figures being able to Lift Package and Fold Flap
2D	Seal Time Starts	325	0	325	350	475	When Seal Jaws are Closed	
3E - 6D	Film and Seal Jaws Start Moving Down at Film Speed	325	0	325	950	575	When Seal Jaws are Closed	Includes Estimated Accel
6A	Seal Time Finishes	475	0	475	0	475	At End of Seal Time	
6B	Seal Jaws Open	475	0	475	125	600	At End of Seal Time	
6C	1st Forming Box and 1st Bottom Folder Move Down to create Gap	475	10	485	75	560	At End of Seal Time	
6D	1st Bottom Folder Retracts, (Out)	475	0	475	150	625	At End of Seal Time	Maybe we can Lead???
7A	Seal Jaws Stop Moving Down	600	0	600	75	675	At End of Seal Jaws Open	This is the Estimated Decel
7B	1st Forming Box Opens	600	0	600	120	720	At End of Seal Jaws Open	
7C	Start of Independent Folder Timing	720	0	720	0	720	At End of Forming Box Open	Timing shown is for Stationary, will be faster for moving
7D	Package Drops from 1st to 2nd Bottom Folder	720	0	720	226.53	947	At End of Forming Box Open	
8A - 12	Seal Jaws Start Moving Up Fast	675	0	875	475	950	After Seal Jaws are Stopped	Includes Estimated Accel
8B	1st Forming Box and 1st Bottom Folder Move Down rest of the way to prepare for next cycle	675	0	675	75	750	After Seal Jaws are Stopped	
9 - 13	Film Pauses when in Position	950	0	950	0	950		
13A	Seal Jaws Stop Moving Up	950	0	950	75	1,025		This is the Estimated Decel
13B	Ready for Next Cycle	1,025	0	1,025	0	1,025		
				Total Estimated Time, (mS) =		1,025		
				Maximum Speed, (Ppm) =		58.53		

FIG. 25B-1

CA 02998754 2018-03-14

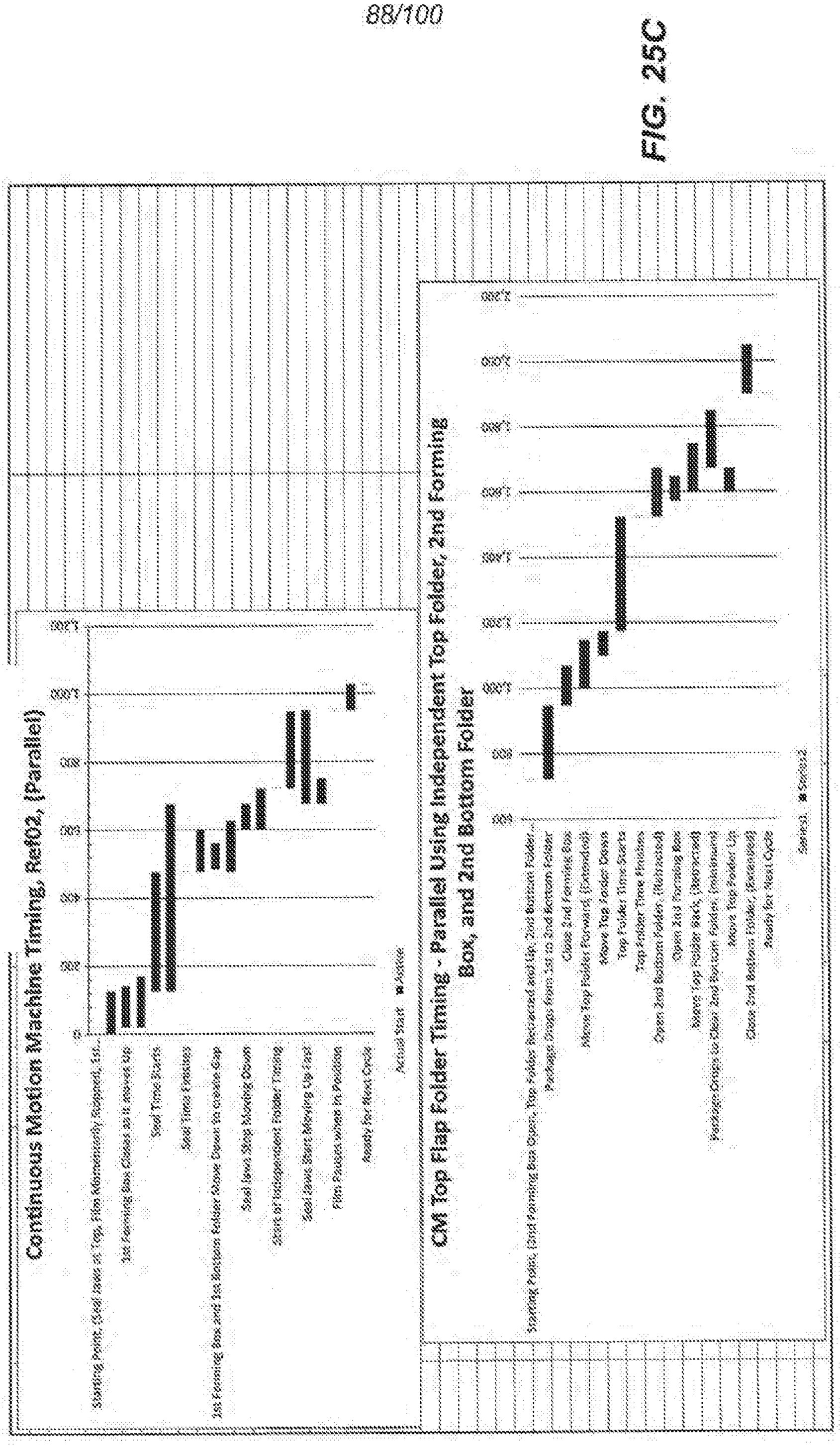
SUBSTITUTE SHEET (RULE 26)

CM Top Flap Folder Timing - Independent Top Folder, 2nd Forming Box, and 2nd Bottom Folder, (Parallel Timing)

Step #	Machine Operation	Start Time, (mS)	Delay Time, (mS)	Actual Start Time, (mS)	Duration Time, (mS)	Finished Time, (mS)	Starts From	Comments
7C	Starting Point, (2nd Forming Box Open, Top Folder Retracted and Up, 2nd Bottom Folder Extended or Extending)	725	0	720	0	720	From Step 7C above	2nd Forming Box and 2nd Bottom Folder Move together with Seal Jaws.
7D - 10	Package Drops from 1st to 2nd Bottom Folder	720	0	720	226.92	947		Timing shown is for Stationary, will take less time for moving.
11A	Close 2nd Forming Box	947	0	947	120	1,067	End of Package Drop	
11B	Move Top Folder Forward, (Extended)	947	50	997	350	1,347	End of Package Drop	Figured 100 mS Delay to allow for package clearance
11C	Move Top Folder Down	1,147	50	1,097	75	1,172	After Top Folder is Forward	Slight Lead Time for coordinated motion.
12	Top Folder Time Starts	1,172	0	1,172	350	1,522	After Top Folder is Down	
3A	Top Folder Time Finishes	1,522	0	1,522	0	1,522	At End of Top Folder Time	
3B	Open 2nd Bottom Folder, (Retracted)	1,522	0	1,522	150	1,672	At End of Top Folder Time	
4B	Open 2nd Forming Box	1,523	50	1,573	75	1,647	At Open 2nd Bottom Folder	
4B	Move Top Folder Back, (Retracted)	1,522	75	1,597	150	1,747	At Open 2nd Bottom Folder	Slight Delay to allow Top Folder to give Package a Downward push.
4C - 6	Package Drops to Clear 2nd Bottom Folder, (minimum)	1,672	0	1,672	176.32	1,848	After 2nd Bottom Folder is Open	Timing shown is for Stationary, will take more time for moving.
5 or 8	Move Top Folder Up	1,597	0	1,597	75	1,672	After Top Folder starts moving Back	Lead Time OK because Package is gone.
7E	Close 2nd Bottom Folder, (Extended)	1,848	50	1,898	150	2,048	End of Package Drop	Delay to allow for package clearance
7F	Ready for Next Cycle	2,048	150	1,898	0	1,898		Lead Time OK because next Package has to make the Drop.
				Total Estimated Time, (mS) =		1,178		
				Maximum Speed, (Ppm) =		50.92		

FIG. 25B-2

FIG. 25C


Continuous Motion Machine Timing, Ref02, (Parallel)
Starting Point, Steel Rule is Top, Film Advancing
1st Forming Box and 1st Bottom Folder Close to Each Other
Seal Time Starts
Seal Time Finishes
Start of Independent Folder Timing
Seal Bars Start Moving Up Fast
Film Positioned where in Position
Ready for Next Cycle
Actual Start
Active
CM Top Flap Folder Timing - Parallel Using Independent Top Box, and 2nd Bottom Folder
Starting Point, Steel Forming Box
Speed
Servo2

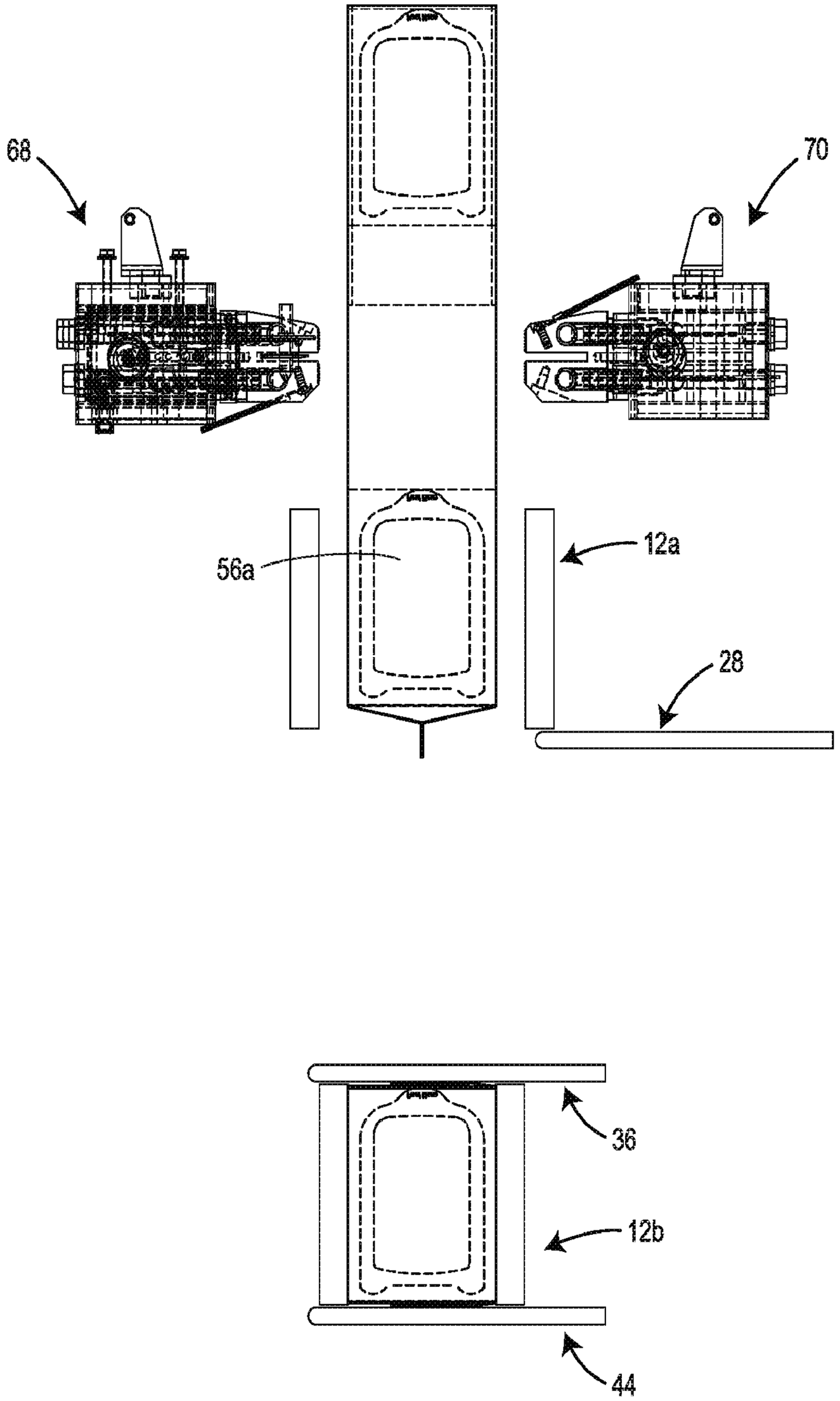


FIG. 26A-1

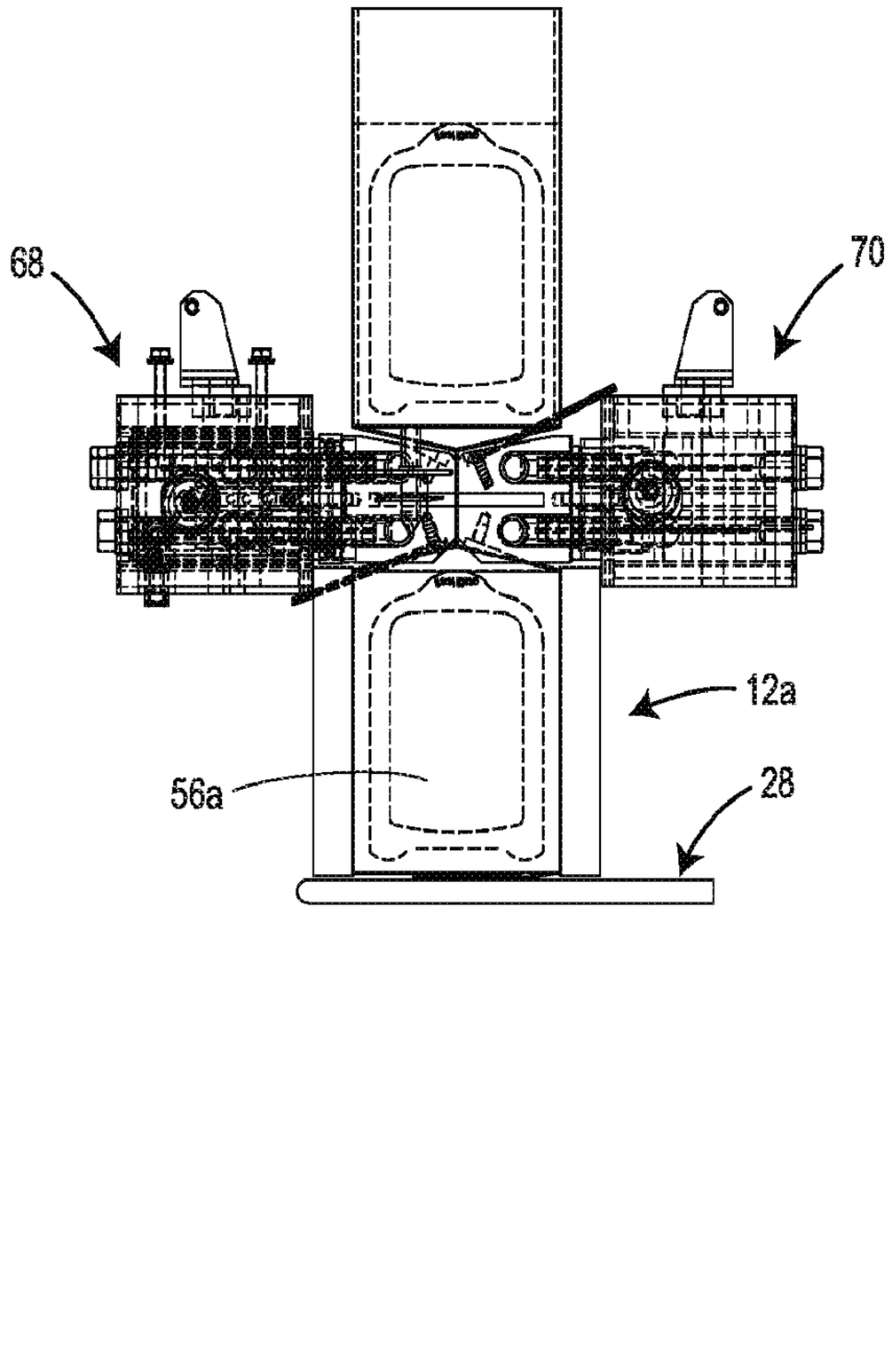


FIG. 26A-2

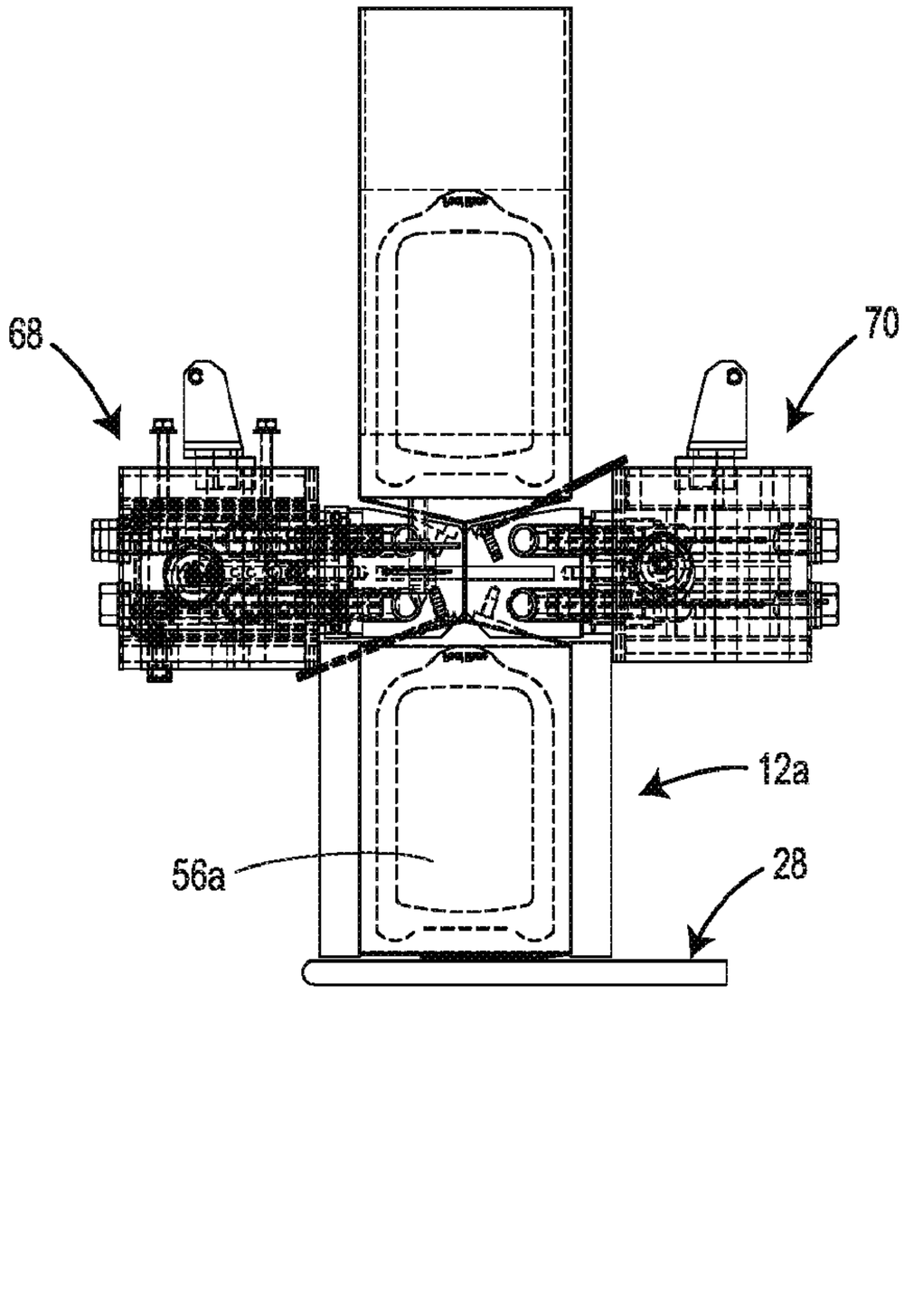


FIG. 26A-3

FIG. 26A-4

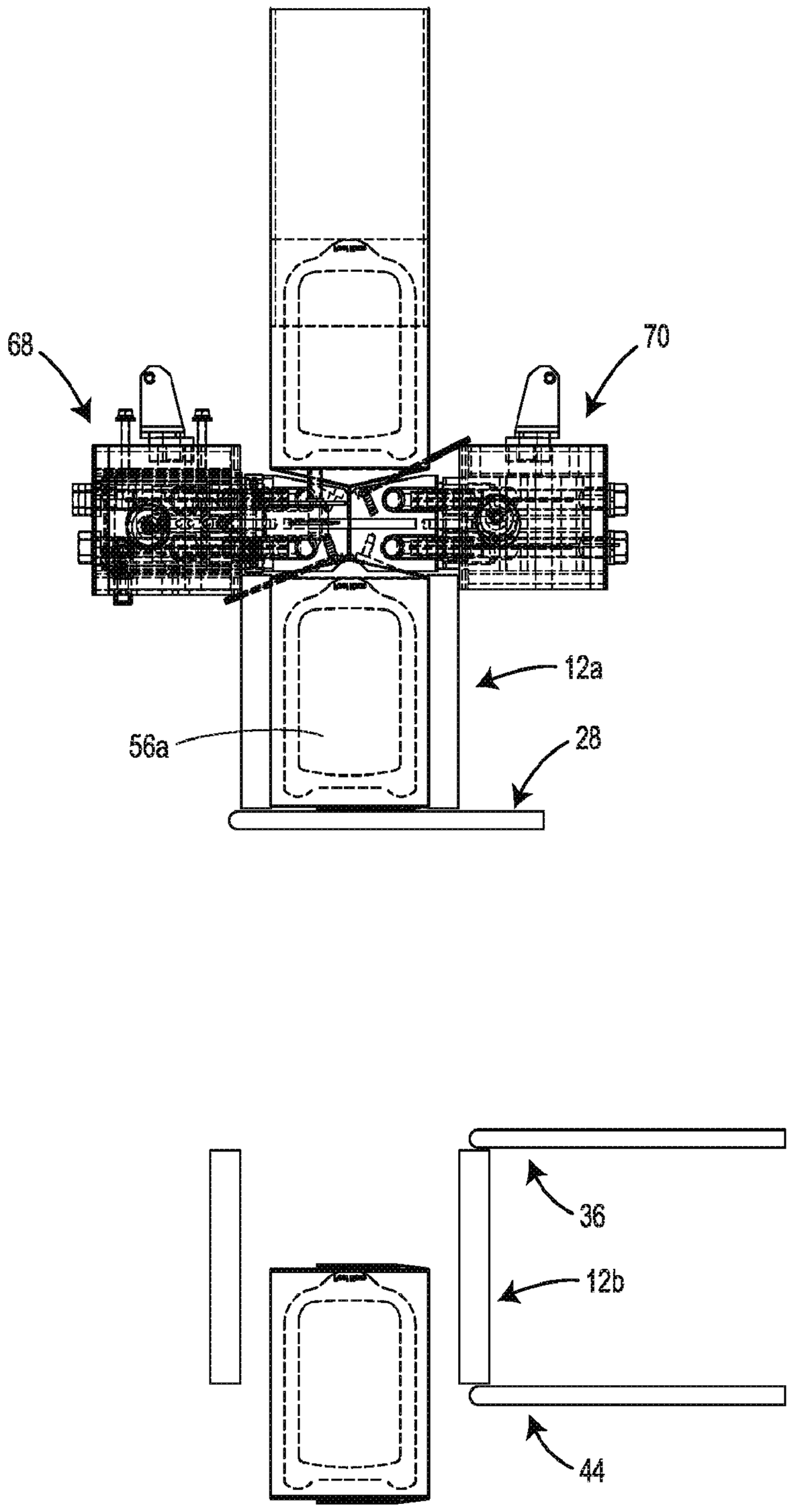


FIG. 26A-5

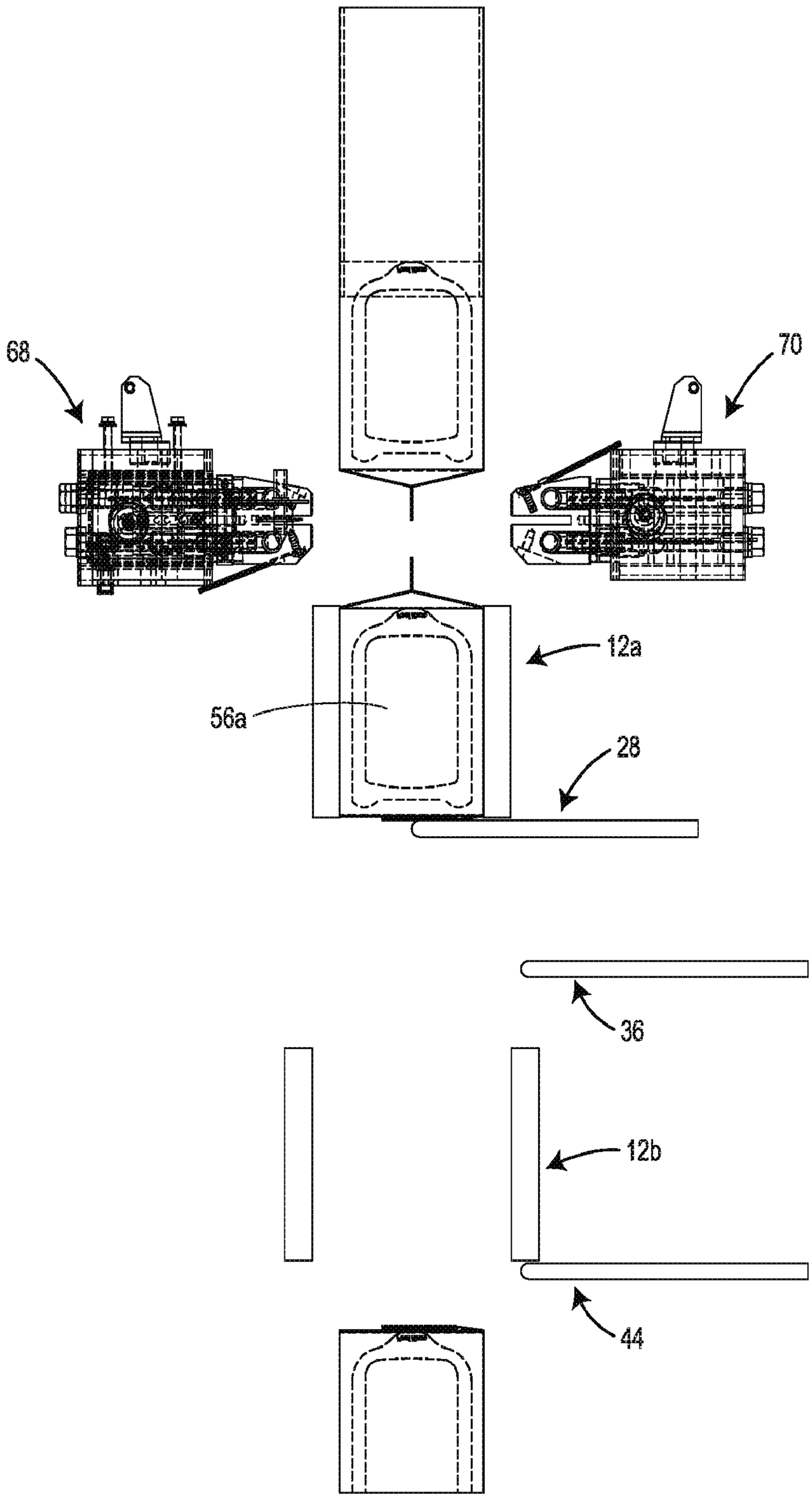


FIG. 26A-6

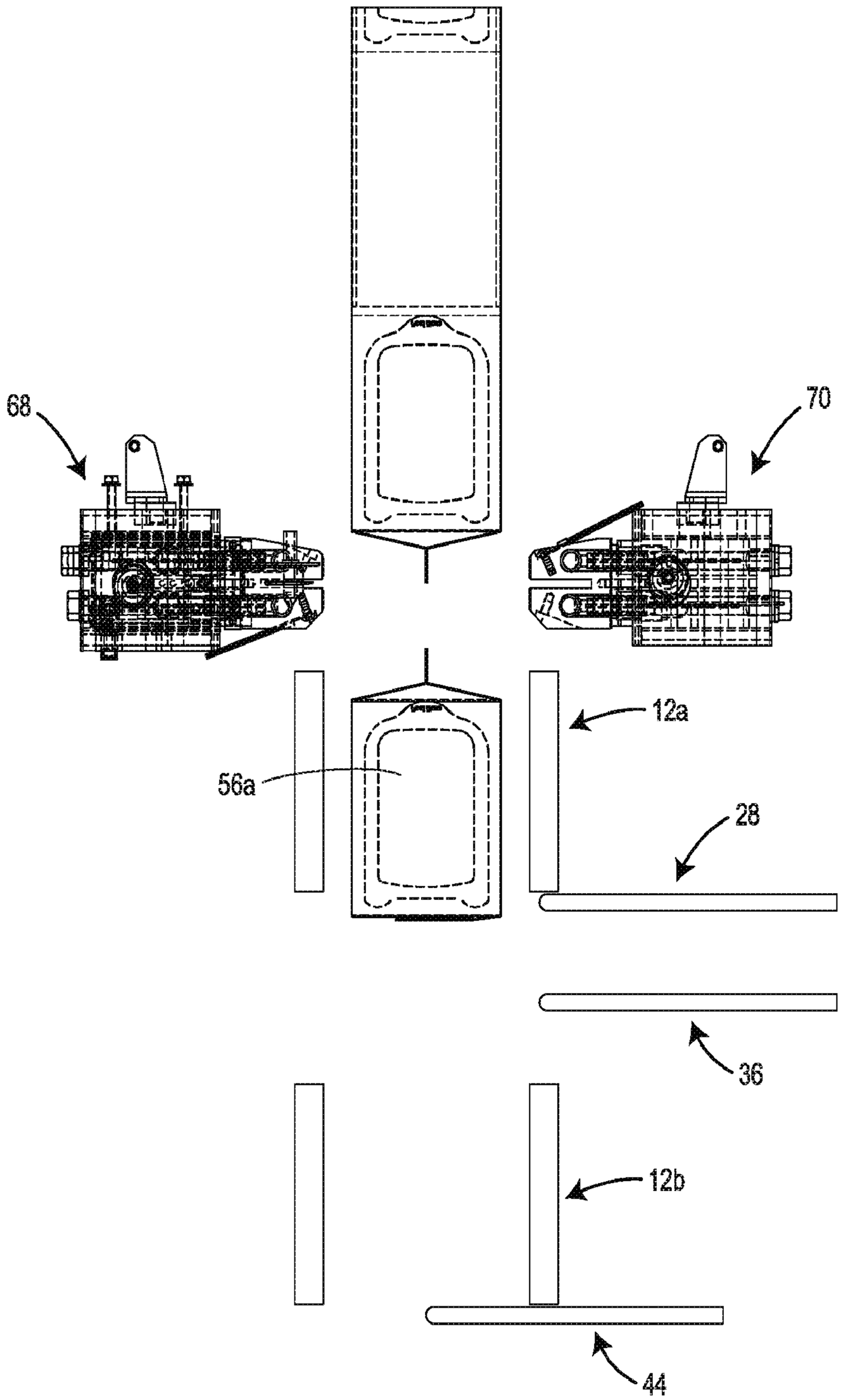


FIG. 26A-7

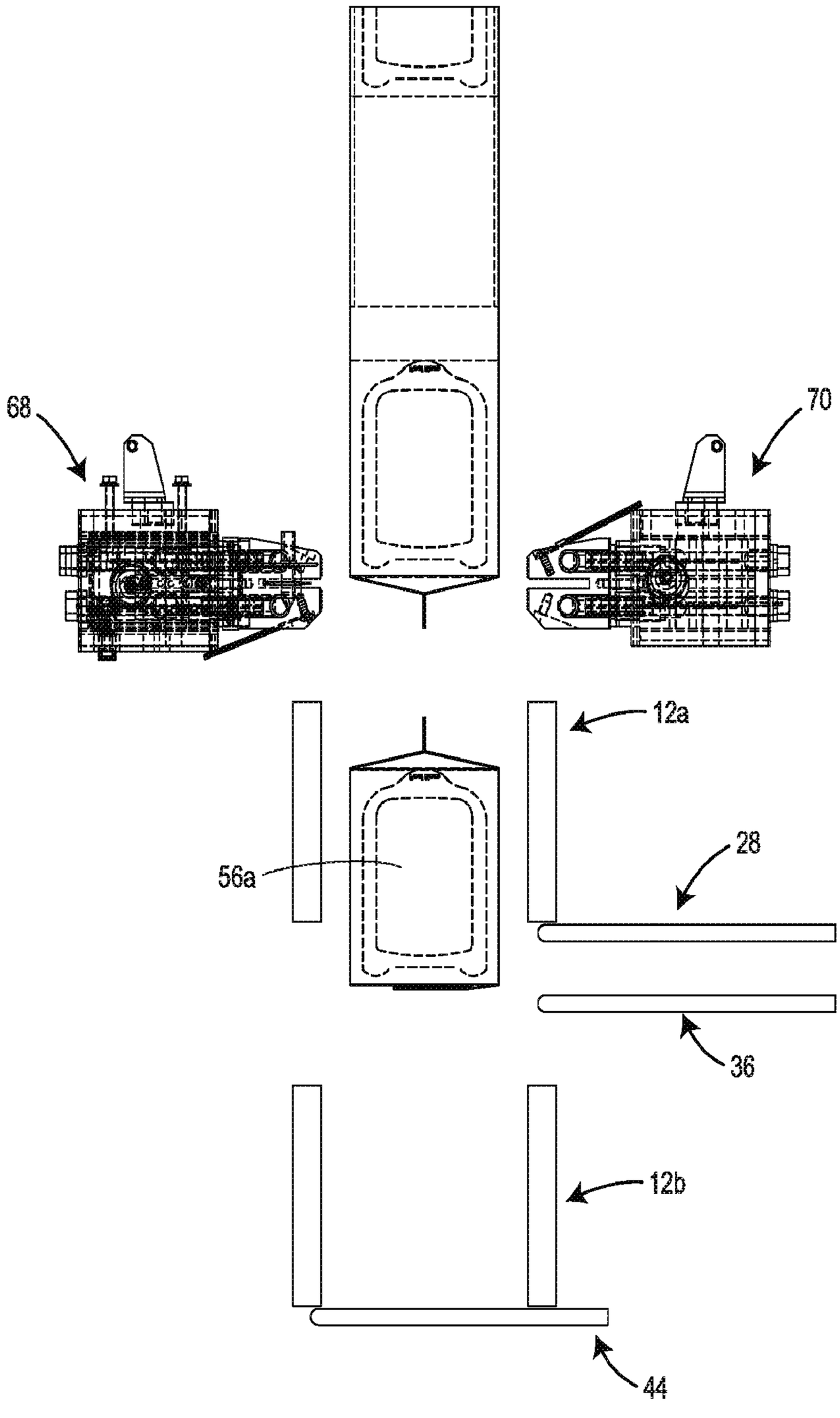


FIG. 26A-8

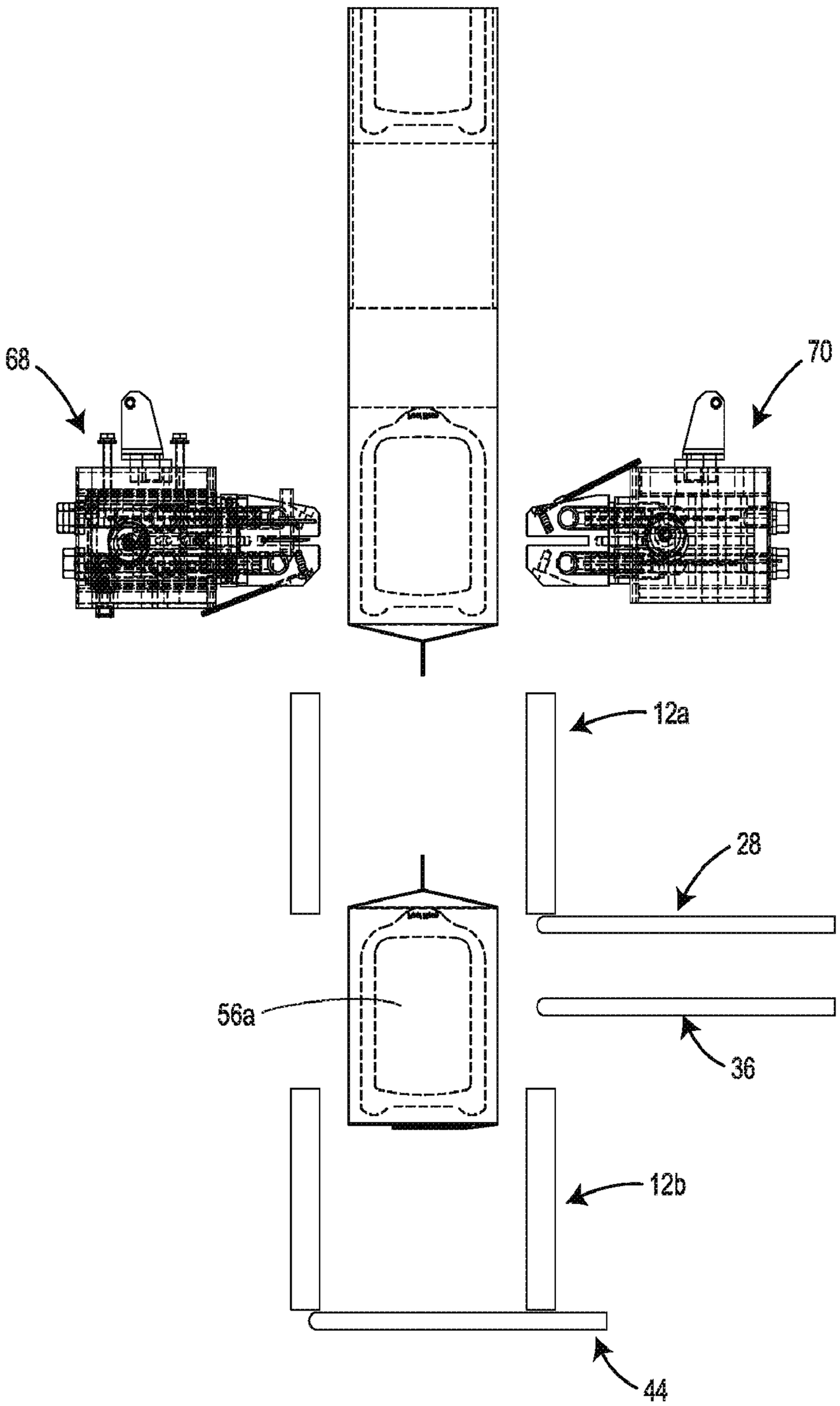


FIG. 26A-9

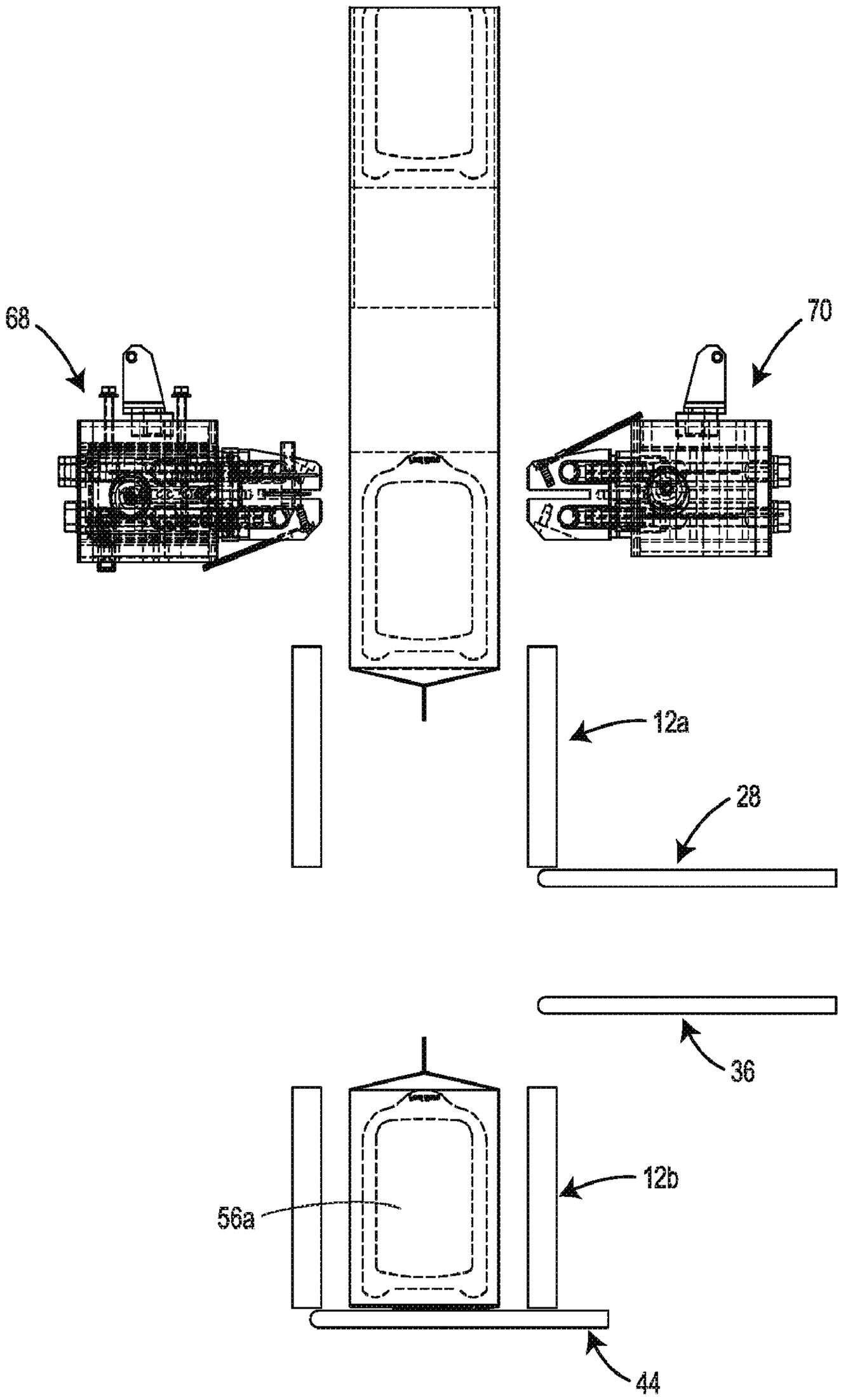


FIG. 26A-10

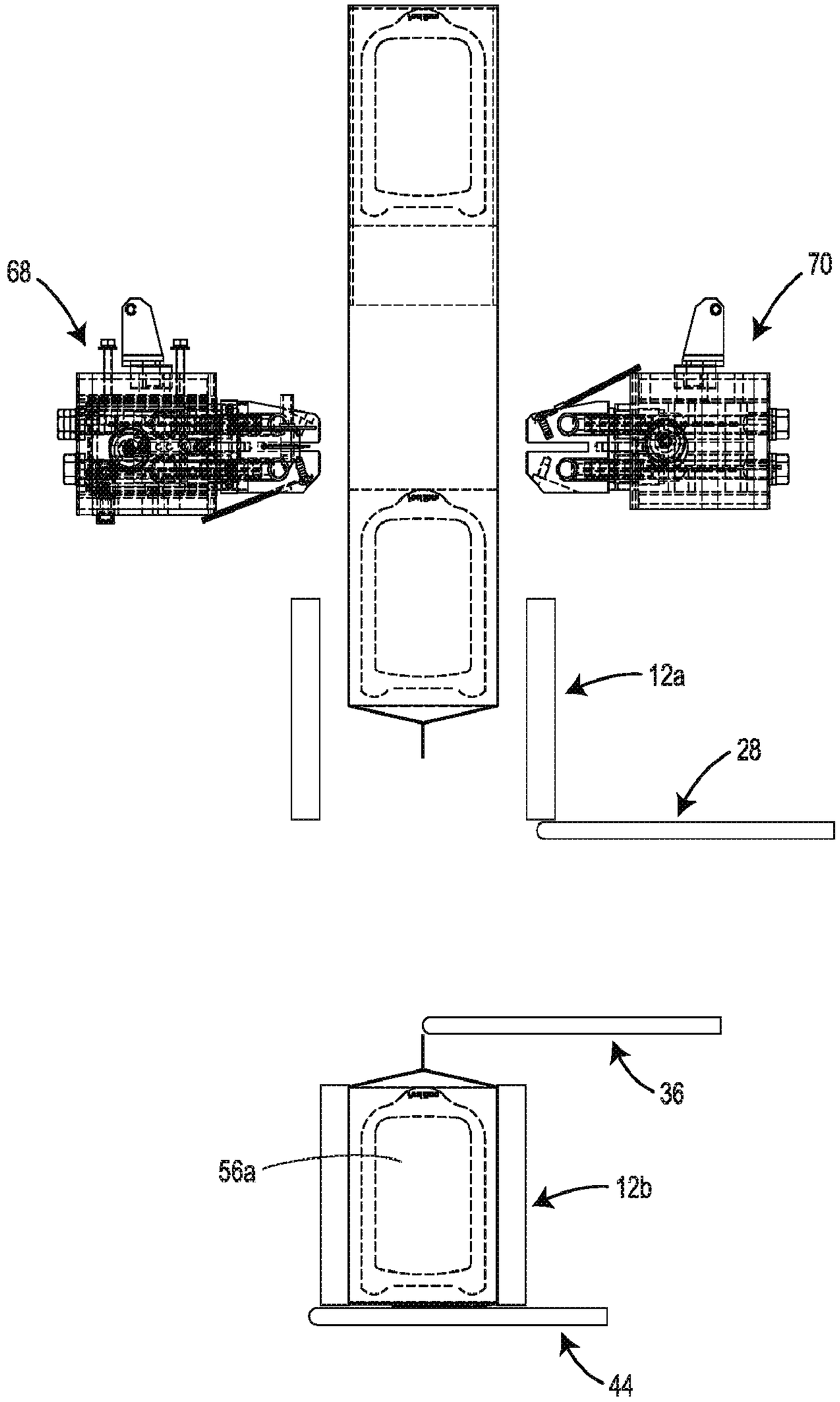


FIG. 26A-11

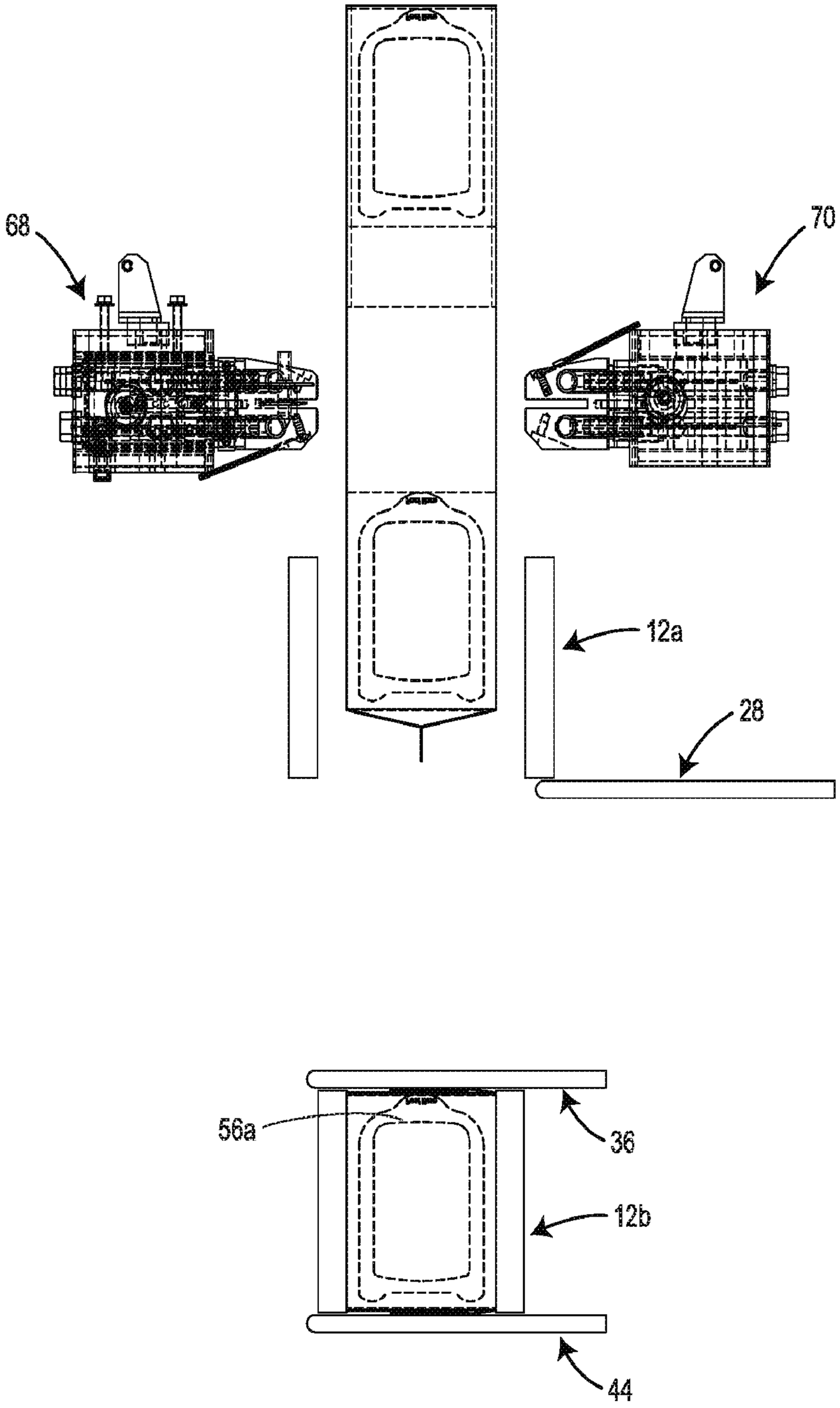


FIG. 26A-12

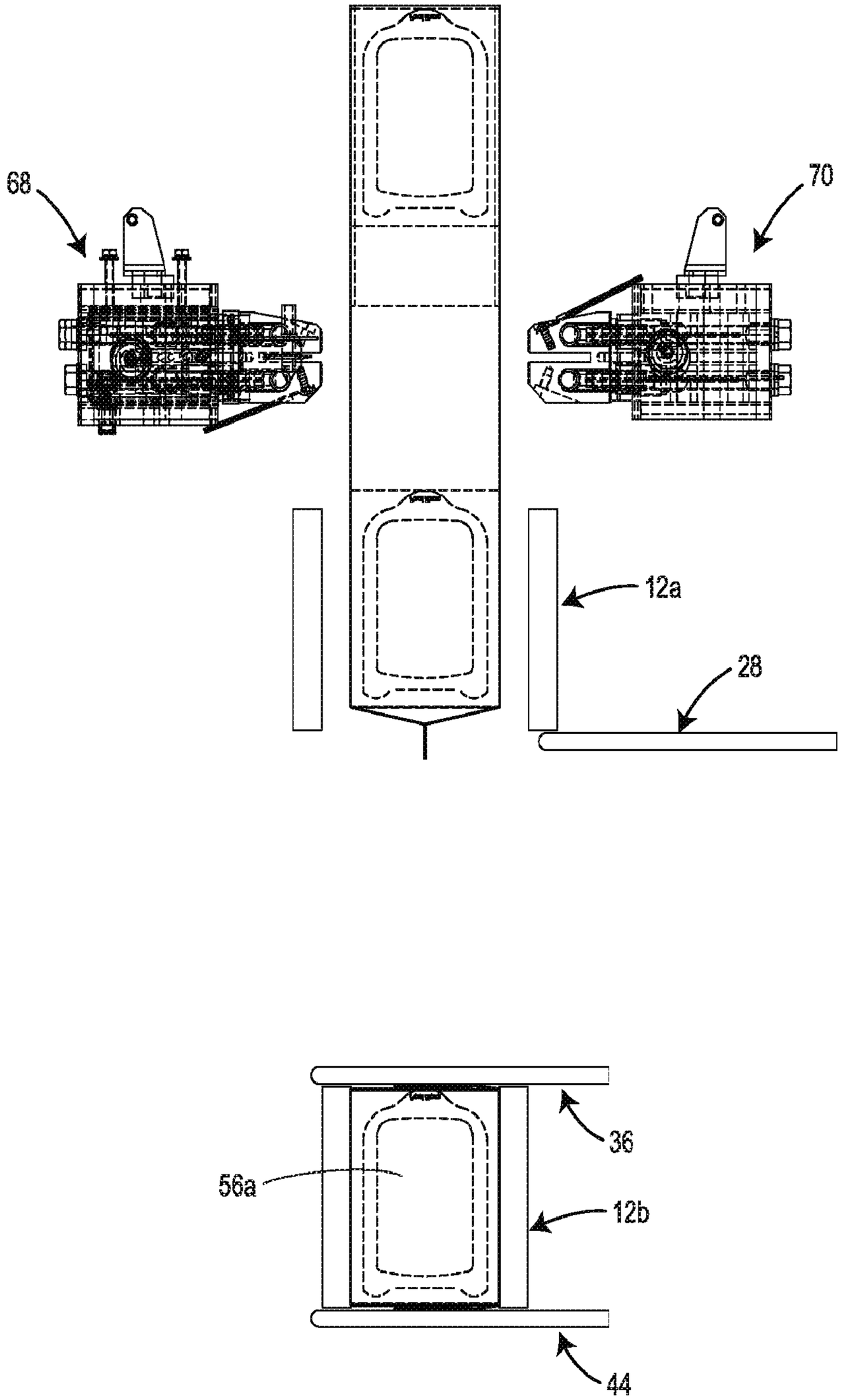


FIG. 26A-13

SUBSTITUTE SHEET (RULE 26)

							Estimated Operation Savings Using Linear Motors.	
	Parallel Timing With 1st Forming Box + 1st Bottom Folder under Seal Jaws and Independent and Stationary Top Folder, 2nd Forming Box, and 2nd Bottom Folder)							
	Continuous Motion Machine Timing, with 1st Forming Box + 1st Bottom Folder under Seal Jaws, (Parallel Timing)							Bagger Speed set to 72 PPM
Step #	Machine Operation	Start Time, (ms)	Delay Time, (ms)	Actual Start Time, (ms)	Duration Time, (ms)	Finished Time, (ms)	Starts From	Comments
0	Starting Point, (Seal Jaws at Top, Film Momentarily Stopped, 1st Forming Box Open and Down, 1st Bottom Folder Retracted and Down)	0	0	0	0	0		
2A	Seal Jaws Close	0	0	0	125	125	Beginning	
2B	1st Forming Box Closes as it moves Up	0	20	20	120	140	At Beginning of Seal Jaws Close	Figures being able to Lift Package and Fold Flap
2C	1st Bottom Folder Extends, (In) as it moves Up	0	20	20	130	150	At Beginning of Seal Jaws Close	Figures being able to Lift Package and Fold Flap
2D	Seal Time Starts	125	0	125	250	475	When Seal Jaws are Closed	
2E - 6E	Film and Seal Jaws Start Moving Down at Film Speed	125	0	125	550	675	When Seal Jaws are Closed	Includes Estimated Accel
6A	Seal Time Finishes	475	0	475	0	475	At End of Seal Time	
6B	Seal Jaws Open	475	0	475	125	600	At End of Seal Time	
6C	1st Forming Box and 1st Bottom Folder Move Down to create Gap	475	20	495	75	568	At End of Seal Time	
6D	1st Bottom Folder Retracts, (Out)	475	0	475	150	625	At End of Seal Time	Maybe we can Lead???
7A	Seal Jaws Stop Moving Open	600	0	600	75	675	At End of Seal Jaws Open	This is the Estimated Decel
7B	1st Forming Box Opens	600	0	600	120	720	At End of Seal Jaws Open	
7C	Start of Independent Folder Timing	720	0	720	0	720	At End of Forming Box Open	Timing shown is for Stationary, will be faster for moving.
7D	Package Drops from 1st to 2nd Bottom Folder	720	0	720	226.93	947	At End of Forming Box Open	
8A - 13	Seal Jaws Start Moving Up Fast	675	0	675	275	950	After Seal Jaws are Stopped	Includes Estimated Accel
8B	1st Forming Box and 1st Bottom Folder Move Down rest of the way to prepare for next cycle	675	0	675	75	750	After Seal Jaws are Stopped	
9 - 13	Film Pauses when in Position	950	0	950	0	950		
13A	Seal Jaws Stop Moving Up	950	0	950	75	1,025		This is the Estimated Decel
13B	Ready for Next Cycle	1,025	0	1,025	0	1,025		
				Total Estimated Time, (ms) =		1,025		
				Maximum Speed, (Ppm) =		58.53		

FIG. 26B-1

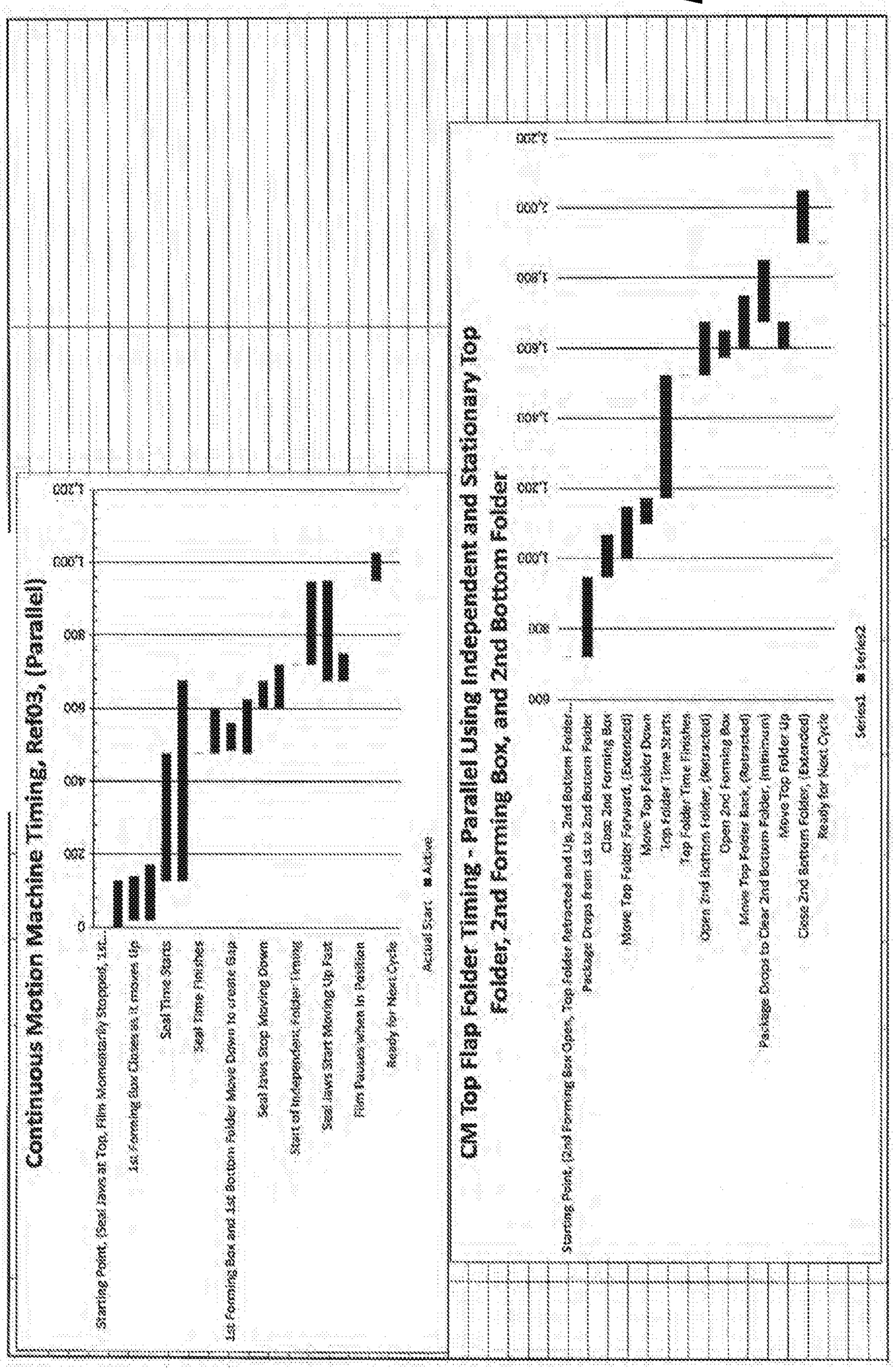
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Old Top Flap Folder Timing - Independent and Stationary Top Folder, 2nd Forming Box, and 2nd Bottom Folder, (Parallel Timing)								
Step #	Machine Operation	Start Time, (mS)	Delay Time, (mS)	Actual Start Time, (mS)	Duration Time, (mS)	Finished Time, (mS)	Starts From	Comments
7C	Starting Point, (2nd Forming Box Open, Top Folder Retracted and Up, 2nd Bottom Folder Extended or Extending)	720	0	720	0	720	From Step 7C above	2nd Forming Box and 2nd Bottom Folder are Stationary.
7D - 3B	Package Drops from 1st to 2nd Bottom Folder	720	0	720	126.82	847		Timing shown is for Stationary.
11A	Close 2nd Forming Box	947	0	947	170	1,083	End of Package Drop	
11B	Move Top Folder Forward, (Extended)	947	100	997	150	1,147	End of Package Drop	Figured 100 mS Delay to allow for package clearance
11C	Move Top Folder Down	1,147	100	1,097	75	1,172	After Top Folder is Forward	Slight Lead Time for coordinated motion.
3D	Top Folder Time Starts	1,172	0	1,172	350	1,522	After Top Folder is Down	
3H	Top Folder Time Finishes	1,522	0	1,522	0	1,522	At End of Top Folder Time	
3B	Open 2nd Bottom Folder, (Retracted)	1,522	0	1,522	150	1,672	At End of Top Folder Time	
4A	Open 2nd Forming Box	1,522	50	1,572	75	1,647	At Open 2nd Bottom Folder	
4B	Move Top Folder Back, (Retracted)	1,522	75	1,597	150	1,747	At Open 2nd Bottom Folder	Slight Delay to allow Top Folder to give Package a Downward push.
4C - 6	Package Drops to Clear 2nd Bottom Folder, (Retracted)	1,672	0	1,672	174.32	1,846	After 2nd Bottom Folder is Open	Timing shown is for Stationary.
5 or 6	Move Top Folder Up	1,597	0	1,597	75	1,672	After Top Folder starts moving Back	Lead Time OK because Package is gone.
7E	Close 2nd Bottom Folder, (Extended)	1,898	150	1,898	150	2,048	End of Package Drop	Delay to allow for package clearance
7F	Ready for Next Cycle	2,048	-150	1,898	0	1,898		Lead Time OK because next Package has to make the Drop.
				Total Estimated Time, (mS) =		1,178		
				Maximum Speed, (Ppm) =		50.93		

FIG. 26B-2

SUBSTITUTE SHEET (RULE 26)

FIG. 26C


Continuous Motion Machine Timing, Ref03, (Parallel)
Starting Point, Seal Jaws at Top, Film Momentarily Stopped, 1st...
1st Forming Box Closes as it moves Up
Seal Time Starts
Seal Time Finishes
1st Forming Box Moves Down to create Gap
Seal Jaws Stop Moving Down
Start of Independent Folder Timing
Seal Jaws Start Moving Up Fast
Film Pauses when in Position
Ready for Next Cycle
Actual Start
Actual
Top Flap Folder Timing - Parallel Using Independent and
Folder, 2nd Forming Box, and 2nd Bottom Fo
Forming Box Open, Top Folder Retracted and Up, 2nd Bottom Folder...
Package Drops from 1st to 2nd Bottom Folder
Close 2nd Forming Box
Move Top Folder Forward, (Extended)
Move Top Folder Down
Top Folder Time Starts
Top Folder Time Finishes
Open 2nd Bottom Folder, (Retracted)
Open 2nd Forming Box
Move Top Folder Back, (Retracted)
Package Drops to Clear 2nd Bottom Folder, (Minimum)
Move Top Folder Up
Close 2nd Bottom Folder, (Extended)
Ready for Next Cycle
Series1
Series2
CM Top
Starting Point, (2nd Forming

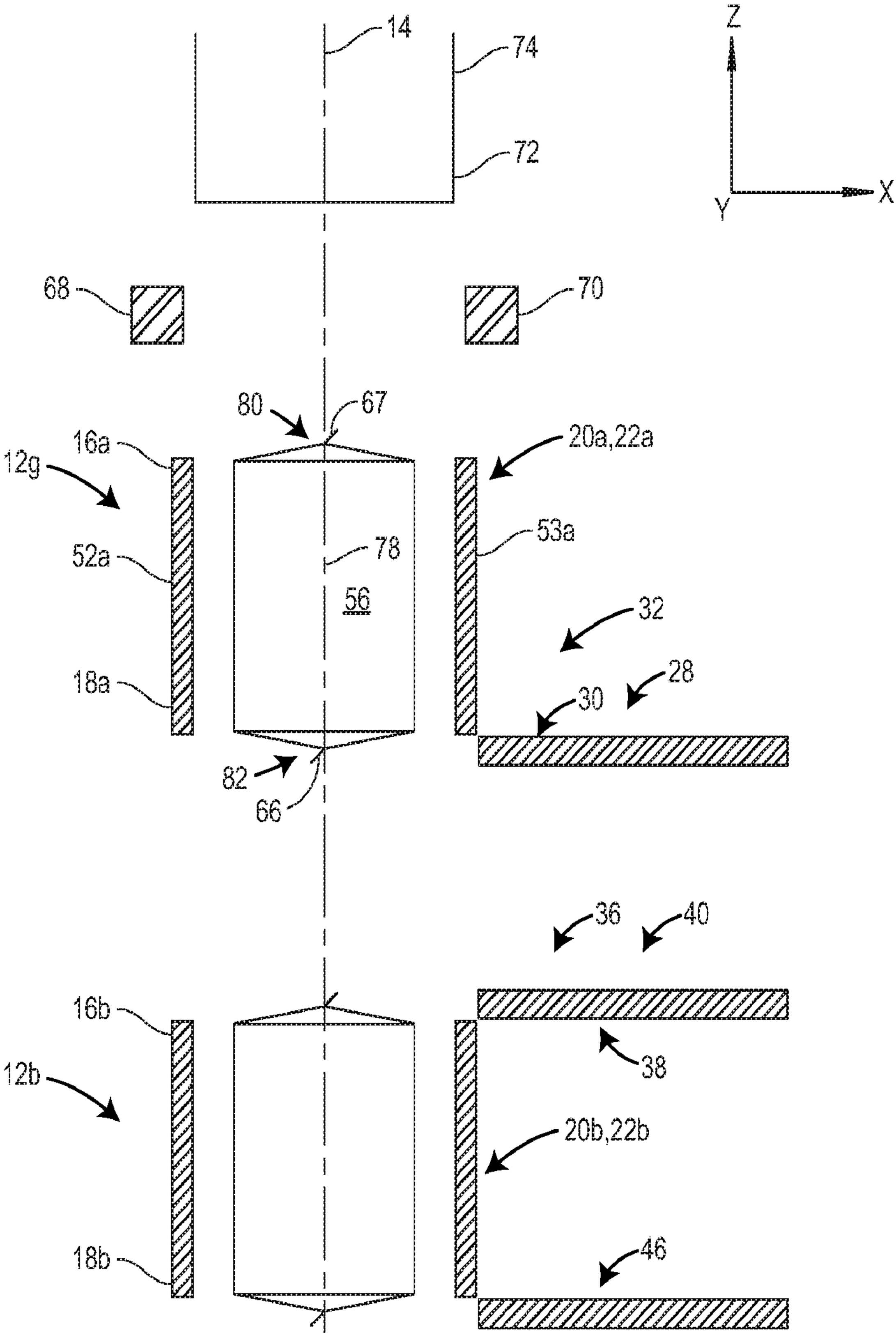

14
74
72
Z
Y
X
68
70
80
67
16a
12g
20a,22a
52a
78
53a
56
32
28
18a
30
82
66
36
40
16b
12b
38
20b,22b
18b
46
44
48

FIG. 2