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TITLE
SYSTEMS AND METHODS FOR PROVIDING GAPS IN ARTICLE OR
PACKAGE PROCESSING

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority to both U.S. Provisional Patent Application Serial Number 62/656,208, filed April 11, 2018, and U.S. Provisional Patent application Serial Number 62/657,407, filed April 13, 2018, the entire disclosures of which are incorporated by reference herein.

TECHNICAL FIELD

The subject matter disclosed herein relates generally to article and/or package processing. More particularly, the subject matter disclosed herein relates to systems and methods for providing gaps in article and/or package processing along a conveying path.

BACKGROUND

Inspection stations, which have the function of ensuring product integrity in many fields, but especially in the pharmaceutical industry, are becoming more common recently, based mostly on demand caused by the U.S. Drug Supply Chain Security Act. The inspection stations, in some cases, need to be configured to mark indicia on parcels, boxes, or cartons and inspect the indicia and other markings from the parcels, boxes, or cartons. During the inspection process, it is desirable to space apart or separate each of the parcels, boxes, or cartons the same distance such that inspection can be done properly.

Companies are being required to comply with the U.S. Drug Supply Chain Security Act (DSCSA) for serialization compliance of controlled substances, such as prescription medications. Pharmaceutical companies throughout the United States are currently working towards serialization compliance. As of November 2017, the DSCSA requires that all pharmaceutical manufacturers serialize products down to the item level, including a product identifier on labels and cases. Information on product transactions, as drugs make their way through the supply chain, must also be recorded.

Inspection stations to ensure product integrity and meet serialization requirements, such as that defined in the DSCSA, are becoming more common and in demand every day. Currently, the technologies used to separate material for inspection might include manual gapping, the use of two conveyors (e.g., one upstream and one downstream, where the downstream conveyor runs at a faster speed), or the use of expensive robotic systems that physically reposition the product. These systems can be difficult to implement, require considerably more foot print, and often require special programming with additional support equipment.

Currently, the technologies used to separate material for inspection include manual gapping, the use of two conveyors where the downstream conveyor runs at a faster speed, or the use of expensive robotic systems that physically reposition the parcels, boxes, or cartons. These systems can be difficult to implement, require considerably more foot print, and often require special programming with additional support equipment.

Current systems may also include indexing transports or belting designs that have partitions or pleats. One drawback with this technology is that the items being inspected would typically be registered against the transport flight, which would then be within the field of view of the inspection devices. A flat belt would not have this issue. Using two belts, where the downstream belt runs faster may work fine for larger boxes, but it does not address the issue where slipping can occur between them. This is what can cause a carton to skew. This solution also may introduce material handling problems between the conveyors, particularly for smaller cartons.

SUMMARY

In accordance with this disclosure, systems and methods for providing gaps in article or package processing along a conveying path are provided that do not suffer from some or all of the disadvantages of the current technology discussed above. In one embodiment, a method for article processing is provided, the method comprising: advancing, using a conveyor, a first article along a conveying path; stopping, by actuating one or more fingers into a deployed position, the first article at a first stop location along the conveying path, the one or more fingers

being located at, or adjacent to, the first stop location; releasing, by actuating the one or more fingers into a retracted position, the first article from the first stop location; advancing, using the conveyor, the first article along the conveying path from the first stop location to a second stop location; stopping, by actuating one or more paddles into a lowered position, the first article at the second stop location, the one or more paddles being located at, or adjacent to, the second stop location; releasing, by actuating the one or more paddles into a raised position, the first article from the second stop location; advancing, using the conveyor, the first article along the conveying path from the second stop location; advancing, using the conveyor, a second article along the conveying path to a first position; stopping, by actuating the one or more fingers into the deployed position, the second article at the first stop location; releasing, by actuating the one or more fingers into the retracted position, the second article from the first stop location; advancing, using the conveyor, the second article along the conveying path from the first stop location to the second stop location; stopping, by actuating the one or more paddles into the lowered position, the second article at the second stop location; releasing, by actuating the one or more paddles into the raised position, the second article from the second stop location; and advancing, using the conveyor, the second article along the conveying path from the second stop location; wherein the second article is released such that the second article is separated along the conveying path from the first article by a gap.

In another embodiment of the present disclosure, in the deployed position, the one or more fingers extend above a surface of the conveyor at a height sufficient to stop movement of the first and second articles moving along the conveying path at the first stop location and, in the retracted position, the one or more fingers are retracted to a same height as, or below the surface of, the conveyor so that the first and second articles pass over the one or more fingers at the first stop location..

In some embodiments of the present disclosure, a system for article processing is provided, the system comprising: a conveyor configured to advance a first article and a second article along a conveying path; one or more fingers located at, or adjacent to, a first stop location along the conveying path, the one or more fingers being configured to move between a deployed position and a

retracted position for stopping the first article at the first stop location and releasing the first article from the first stop location; and one or more paddles located at, or adjacent to, a second stop location along the conveying path, the one or more paddles being configured to move between a lowered position and a raised position for stopping the first article at the second stop location and releasing the first article from the second stop location, such that the first article can be advanced by the conveyor along the conveying path beyond the second stop location; wherein the one or more fingers are configured to, after the first article is released from the first stop location, stop the second article at the first stop location and then release the second article from the first stop location; wherein the one or more paddles are configured to, after the first article is released from the second stop location, stop the second article at the second stop location; and wherein the system is configured to release the second article from the second stop location to move, via the conveyor, along the conveying path such that the second article is separated along the conveying path from the first article by a gap.

Although some aspects of the subject matter disclosed herein have been stated hereinabove, and which are achieved in whole or in part by the presently disclosed subject matter, other aspects will become evident as the description proceeds when taken in connection with the accompanying drawings as best described hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present disclosure will be more readily understood from the following detailed description which should be read in conjunction with the accompanying, example figures that are given merely by way of explanatory and non-limiting example. The detailed description that follows this section references the example figures briefly described below.

FIG. 1 is a side view of a system for article and/or package processing according to an embodiment of the presently disclosed subject matter.

FIGS. 2A, 2B, 2C, 2D, 2E, and 2F are side views of the system shown in FIG. 1 at various stages of operation according to an example embodiment of a method for article and/or package processing.

FIGS. 3A, 3B, and 3C are perspective views of the system shown in FIG. 1 at various stages of operation according to an example embodiment of a method for article and/or package processing.

FIGS. 4A and 4B are top views of the system shown in FIG. 1 at various stages of operation according to an example embodiment of a method for article and/or package processing.

FIG. 5 is a perspective view of the system shown in FIG. 1 without any boxes or cartons present to better visualize the features of the system.

FIG. 6 is a perspective view from underneath the system shown in FIG. 1 to better visualize the features of the system that may not be shown in the previous figures.

FIG. 7 is a front isolated view of portions of the system shown in FIG. 1 to better visualize the features of the system.

FIG. 8 is a perspective view of an embodiment of the system shown in FIG. 1, including a scanner and other components that were omitted from previous figures for clarity.

FIG. 9 is an image of example indicia that can be etched, for example, by a laser, into some or all of the cartons, boxes, or packages that pass adjacent to the laser.

DETAILED DESCRIPTION

In accordance with this disclosure, systems, devices and methods are disclosed for providing gaps in article and/or package processing. In some aspects, the disclosure herein can be referred to and used as a carton gapper and registration system. The disclosure herein will be particularly advantageous for the increasing demands and requirement for serialization and aggregation in package processing, such as, for example, in the pharmaceutical industry. Articles or packages herein can, for example and without limitation, comprise paper or cardboard boxes or cartons that contain product(s) therein, or any other suitable object desired to be processed. The disclosure herein can be used, for example, to gap and front-end register cartons and boxes in a manner that is mechanically simple and very cost effective. The technology can be used anywhere gap control is required. The technology can advantageously be used with vision systems and

packaging applications where the success and reliability of the processing is highly dependent on product stability, e.g., having articles or packages that are properly gapped and registered.

Example features and advantages of the present subject matter will be more readily understood from the description herein.

In accordance with aspects of the disclosure herein, systems and methods are disclosed for creating a consistent gap between boxes and/or cartons and maintaining orthogonal registration to a conveyor, so that the boxes or cartons can readily be marked and/or inspected by various systems, including, for example, laser printing, imaging, and/or density measurement. In some embodiments, a four-bar linkage is used to raise lift forks and/or fingers, also referred to as fingers, lift fingers, or stops, from underneath a conveyor path into a deployed position to stop an oncoming box and/or carton. These fingers straddle a transport or conveyor belt, which is narrower than the boxes and/or cartons being transported along the conveyor path. When multiple cartons are being processed (e.g., sequentially), the fingers will first drop beneath the surface of the conveyor belt into a retracted position for a sufficient time, based on the transport speed of the conveyor belt, to allow a first carton, which is pressed against the leading surface of the fingers, to pass beyond at least the leading edge of the fingers. After the first carton has been transported beyond at least the leading edge of the fingers to such a degree that the first carton will not become partially rotated and/or overturned (e.g., in a counterclockwise direction, as shown in FIG. 1) when the fingers return to the deployed position, the fingers are moved back into the deployed position to stop the next carton on the conveyor path. The motion profile of the lift mechanism between the retracted and deployed positions smoothly raises the carton without flipping the carton over or losing drive. A registration paddle assembly is positioned after, relative to the transport direction of the cartons along the conveyor path, the fingers. The registration paddle assembly is configured to further stop and release cartons moving along the conveyor path. The registration paddle assembly can be configured to pivotably and repeatedly raise and lower to respectively release and stop cartons positioned against the registration paddle assembly. The motion profile of the registration paddle was designed to ensure no slippage between the carton and belt at the moment the

paddle lets go of the carton. This is what keeps the carton orthogonal to the belt. Without this motion profile, the carton could easily twist on the belt due to slight variations in the center of gravity or frictional differences on the belt. With this scheme, the conveyor belt transporting the box or carton can move at constant velocity, i.e. there is no need for a more complicated index profile. The timing of events is, in some embodiments, based on photocells and the precise motion profiles of the lift fingers and registration paddle assemblies.

In accordance with the disclosure and figures herein, depending on the box size, the mechanisms used to gap and register a box occupy a comparatively small footprint. Because the mechanisms are independent and, in some embodiments, photocell based, the timing is inherently robust and well suited for a cost effective programmable logic controller (PLC). While a four-bar linkage mechanism is, in one aspect, used to raise the fingers, any other suitable mechanism could be used, as can be appreciated by persons of skill in the art. The use of the four-bar linkage mechanism is, in such embodiments, advantageous by ensuring a smooth motion profile and excellent mechanical reliability. The design is based on using a relatively low-cost flat belt that runs continuously and does not, typically, have features such as pleats that might cause sensing issues. The flat belt profile is conducive to an immediate downstream inspection station. Because the carton, box, or package is momentarily stationary when it is stopped by making contact with the fingers in the deployed position, there is ample time to burn a laser image (or print) that might include a one-dimensional (1D) or two-dimensional (2D) barcode, identification number, date code, indicia, or other useful information.

The systems and methods described hereinabove will be explained in greater detail hereinbelow with reference to the figures.

Referring now to FIG. 1, the present subject matter discloses a system for article and/or package processing, referred to hereinafter as article gapping system **100**. In some embodiments, the article gapping system **100** comprises a conveyor **102** supported by a frame **130**. In some embodiments, the conveyor **102** can comprise a continuous conveyor system that travels along and/or over frame **130**, which can also be, for example, a platform, housing, table, support structure, or any other suitable structure that can hold the conveyor **102** as it moves. The

structure that the conveyor **102** moves along in some embodiments is also the structure that the articles **104**, which can be, for example, goods, packages, cartons, or any object suitable for transport along article gapping system, move along as well. Therefore, in some embodiments, the frame **130** that supports the conveyor **102** can also be built to withstand the forces and weight applied to it by any of the articles **104** on the conveyor **102**.

In some embodiments, the conveyor **102** has articles **104** arranged on top of, or otherwise riding along, the conveyor **102**. In some embodiments, the articles **104** comprise a continuous and/or random stream of cartons, boxes, packages, goods, parcels, or the like. By continuous or random stream, the present disclosure should be interpreted to mean that the articles **104** can be placed on the conveyor **102** with any distance between them before contacting the fingers **108**. Additionally, in some embodiments, there can be one or any number of articles **104** placed on the conveyor **102**, including a continuous feed of articles **104** on the conveyor **102** or articles **104** placed on the conveyor **102** randomly. For example and without limitation, the articles **104** could be introduced onto the conveyor **102** in bursts or, in some embodiments, there could be a continuous feed of articles **104** onto the conveyor **102**. Hereinafter, the articles **104** may also be referred to as cartons, boxes, packages, goods, parcels, or any other suitable term as would be understood by a person having ordinary skill in the art. In some embodiments, the articles **104** may comprise any of a plurality of different shapes and sizes. In some embodiments, the articles **104** may all have substantially similar dimensions, being defined as items that are identical within an assembly or manufacturing tolerance range.

In some embodiments, the articles **104** are small boxes designed to carry medicinal or pharmaceutical goods. In further embodiments, the articles **104** may comprise appliances or other, much larger, goods. Additionally, in some embodiments, the articles **104** may be of different sizes, shapes, weights, or any other physical characteristic. Furthermore, the dimensions, sizes, weights, lengths, widths, heights, *etc.* of any of the components of the article gapping system **100** can be altered, changed, or otherwise adjusted to meet the demands of whatever size articles **104** the article gapping system **100** is configured to process. In some aspects, the present disclosure can be described as “front-end

registering” of the articles **104**. This can mean, for example, that articles **104** are aligned to be substantially parallel with respect to each other. Furthermore, persons having ordinary skill in the art will appreciate that this phrase can also be understood to be a seriatim process. In some embodiments, the articles **104** can be wider than the conveyor **102**.

As will be discussed further hereinbelow, the conveyor **102** can comprise a conveyor belt, roller conveyor, or any other suitable conveyor system known to persons having ordinary skill in the art. In some embodiments, the conveyor **102** is a conveyor belt comprising any suitable material, such as, for example and without limitation, rubber, plastic, metal, or any other material known to persons having ordinary skill in the art to be suitable for working as a conveyor **102**. Furthermore, in this embodiment, as the conveyor **102** moves, it conveys the articles **104** in the transport direction **112**, as indicated by the arrow. In some embodiments, the conveyor **102** comprises a single conveyor belt. However, persons having ordinary skill in the art will appreciate that the conveyor **102** can comprise two or more smaller conveyor belts acting simultaneously in place of the single conveyor belt illustrated. Additionally, persons having ordinary skill in the art will appreciate that there could be one or more parallel paths that the conveyor belt could conceivably travel along. In the example embodiment shown, a single conveyor belt is shown as a non-limiting example only.

In the embodiment shown in FIG. 1, the article gapping system **100** comprises one or more rollers **106** configured to apply pressure to at least the articles **104** in contact with the one or more rollers **106**, thereby ensuring that the articles **104** do not flip or rotate (e.g., in a clockwise direction, relative to FIG. 1, over the fingers **108**) when contacting the fingers **108**. In embodiments without the one or more rollers **106**, when a line of articles **104** (or just one article **104**) contacts the fingers **108**, the force of the conveyor **102** moving underneath the article **104**, along with the force from the fingers **108** stopping the article **104**, can cause the article **104** to rotate or flip (e.g., clockwise). By putting the rollers **106** in place, at least one of which is vertically aligned over a position where a leading article **104** contacts, and is stopped at, the fingers **108**, the movement of the article **104** along the conveyor **102** is stopped and allows for the article **104**, stopped at the fingers **108**, to be serialized, for example, by being lasered and/or etched, as will be

described below. In some embodiments, a first of the rollers **106** is configured to contact the top of at least the article **104** stopped at the fingers **108**. Additionally, a second of the rollers **106** is configured to contact the top of at least the article **104** directly adjacent (e.g., “behind,” if the article **104** directly contacting the fingers **108** is “the front”) the article **104** contacting the fingers **108**. As referred to elsewhere herein, articles **104** stopped at the fingers **108** can be said to be stopped at a first location. In some embodiments, the rollers **106** can be altered, raised, lowered, or otherwise positionally adjusted, replaced, and/or removed entirely in order for the article gapping system **100** to be able to process articles **104** of any of a plurality of different sizes.

The process of article **104** movement and stoppage is described further in detail hereinbelow, including some of the components of the article gapping system **100** used to align the articles **104** relative to the conveyor **102**, as well as how such components interact to help align the articles **104** to be oriented parallel with respect to each other. In some embodiments, only one article **104** will be front end registered and, in this case, the edge of such article **104** can be aligned with the fingers **108** contacting the side of such article **104**. In this manner, all of the fingers **108** are touching such article **104** at the same time, thereby aligning the article to a desired orientation (e.g., substantially perpendicular) relative to the conveyor **102**.

In some embodiments, the fingers **108** comprise two or more elements for stopping articles **104** the article gapping system **100** is configured to process. For example and without limitation, the fingers **108** comprise metal(s), including, for example, steel, aluminum, titanium, iron, combinations and/or alloys thereof, or any other suitable metal, or combination of metals, known to persons having ordinary skill in the art. In some embodiments, the fingers **108** comprise plastic, rubber, wood, combinations thereof, or any other suitable material(s) suitable for stopping the movement of articles **104** along conveyor **102**. In some embodiments, the fingers **108** can be attached to a bracket, brace, or other suitable structure configured to lift a leading edge, relative to the direction of travel **112** of the articles **104** along the conveyor **102**, of the fingers **108** at least partially above the height of the conveyor **102** and also to lower the leading edge of the fingers **108** to the same height or lower than the conveyor **102**. In some

embodiments, as will be shown in a different view hereinbelow, the fingers **108** are configured to be laterally spaced apart from one another, for example, in a direction that is at an angle relative to the direction of transport of the articles **104** along the conveyor **102**, particularly in a substantially orthogonal orientation relative to the direction of transport of the articles **104** along the conveyor **102**. In some embodiments, for example and without limitation, the fingers **108** can be spaced apart with respect to one another by a length greater than the width of the conveyor **102**.

In some embodiments, the fingers **108** can be attached to a lifting mechanism **114**, for example by a bracket or other suitable structure. In such embodiments, the lifting mechanism **114** is configured to raise and lower the fingers **108** in order to stop the articles **104** (e.g., by raising the fingers **108**) and then allow the articles **104** to pass along the conveyor **102** (e.g., by lowering the fingers **108**) at specific times to produce the desired gap distance between the articles **104**. In the embodiment shown, the lifting mechanism **114** comprises a four-bar linkage system. In some embodiments of the present disclosure, the lifting mechanism **114** comprises arms and a motor **116** or other suitable device. In some embodiments, the motor **116** can be an intelligent motor drive, such as, for example and without limitation, a stepper or servo motor. The lifting mechanism **114**, in some embodiments, can comprise a motor **116**, engine, mechanical device, or other suitable device or system. The motor **116** can be connected to metal arms, a metal brace or bracket, or other suitable device, which is then connected or attached to the fingers **108**. In some embodiments, the arms, metal brace or bracket can be pivotably attached to the motor **116** or other device. In some embodiments, as the motor **116**, engine, or other suitable device operates, it is configured to lift and/or lower the arms or bracket, which then lifts and/or lowers the fingers **108** as well. In some embodiments, the fingers **108** are raised and lowered in a smooth fashion such that articles **104** are not significantly disturbed or thrown off the fingers **108**.

In some embodiments of the present disclosure, the fingers **108** are controlled by one or more PLCs using at least three sensors **118A**, **118B**, **118C**. In some embodiments, the sensors, **118A**, **118B**, **118C**, can comprise optical sensors, photocell sensors, proximity detectors, infrared sensors, or any

appropriate sensor known to those having ordinary skill in the art that can sense the presence of an article **104**. In this embodiment, a first sensor **118A** is used to determine if there is more than one article **104** waiting to enter and pass by the fingers **108**. When a second article **104** is behind a first article **104** passing over the fingers **108** in the retracted position, the second article **104** drives the first article **104** forward in the transport direction **112** when the first article **104** is over the fingers **108**. This ensures that each of the articles **104** moves over the fingers **108** in a predictable and repeatable amount of time to ensure smooth operation. When this drive force is missing, occasionally, an article **104** will pause on the fingers **108**, preventing the proper size article gap **120** (described hereinbelow) from being created.

In some embodiments, the article gapping system **100** can comprise a paddle **110** configured to stop and controllably release an article **104** to move along the conveyor **102** again. In the embodiments shown in the figures, the paddle **110** is spaced apart from the fingers **108** and an article **104** moving in the transport direction **112** will reach the paddle **110** after it has moved past the fingers **108**. Any article **104** stopped at the paddle **110** can be said to be stopped at a second location. The paddle **110** can be configured to raise and lower and to release and stop articles **104** as they reach the paddle **110**. The paddle **110** can be comprised of any suitable pivotably connected device that is used to stop the article **104**. For example and without limitation, the paddle **110** can comprise plastic, metal, wood, or any other suitable substance that can be used to stop and release the articles **104**. For example and without limitation, the paddle **110** can comprise a hard plastic or metal that has minimal flex, bend, or give.

If the article gap **120** is too small (e.g. articles **104** bunched together such that when the paddle **110** lowers down, the tip of the paddle **110** lands on top of an article **104** and gets jammed), the paddle **110** could jam or push the delayed article **104** into the subsequent article **104** creating an article alignment problem for scanning later on (i.e., if the article **104** is not properly aligned, it will not be properly scanned). A second sensor **118B** is provided, in some embodiments, and can be configured to determine when there is an article **104** waiting to enter the article gapping system **100**. In the embodiment shown, a third sensor **118C** is

provided and configured to signal the fingers **108** to rise above the height of the conveyor **102**.

Furthermore, in some embodiments, the paddle **110** can comprise aluminum, steel, iron, or other suitable metal or metallic alloy. In some embodiments, the paddle **110** can be operated by a controller (not shown), such as, for example, a programmable logic controller (PLC), or any other suitable device. In some embodiments, the paddle **110** can be operated by a timer or other device that may or may not be a part of the PLC. In some embodiments the paddle **110** can be operated by a motor **116**, or other suitable device, connected to the fingers **108**, the paddle **110**, and/or the PLC, such that the fingers **108** and paddle **110** operate in a synchronous manner, but not necessarily at the same time. For example, there could be a delay between when the fingers **108** lower and the paddle **110** raises, both allowing a different article **104** to pass over/under them respectively.

Moreover, in some embodiments, in addition to first sensor **118A**, second sensor **118B**, and third sensor **118C**, the article gapping system **100** can comprise fourth sensor **118D** and fifth sensor **118E**, which are configured to sense or detect the presence of the article **104** on approach to the paddle **110**. In some embodiments, the sensors, **118D** and/or **118E**, can comprise optical sensors, photocell sensors, proximity detectors, infrared sensors, or any appropriate sensor types known to those having ordinary skill in the art that can sense the presence of an article **104**. In some embodiments, the fourth sensor **118D** and fifth sensor **118E** can be configured to send a signal to a controller or other control device for the paddle **110** that the article **104** is approaching the paddle **110**. From there, the controller for the paddle **110** can raise and/or lower the paddle **110** according to the information transmitted by the fourth sensor **118D** and fifth sensor **118E**. In some other embodiments, the fourth sensor **118D** and/or fifth sensor **118E** are omitted and the paddle **110** is configured to be raised and/or lowered based on a timing system or timer. In some embodiments, the article gapping system **100** comprises a single motor **116**. In other embodiments, the article gapping system **100** comprises more than one motor **116**, including, for example and without limitation, two stepper motors, a first motor for operating the fingers **108** and a second motor for operating the paddle **110**. In such embodiments, each of the

motors can be operated based on a PLC or other device comprising one or more processors, computer readable medium, and/or executable instructions. In some embodiments, the single motor **116** is configured to operate all of the components of the article gapping system **100** that requires a motor for operation, including, for example and without limitation, the conveyor **102**, the rollers **106**, the lifting mechanism **114**, the paddle **110**, and/or any other mechanism included in the article gapping system **100**.

The timing of the fingers **108** and the paddle **110** lowering and raising is based on the first sensor **118A**, second sensor **118B**, third sensor **118C**, fourth sensor **118D**, and fifth sensor **118E** and the precise motion profiles of the fingers **108** and paddle **110** mechanisms. Persons having ordinary skill in the art will appreciate that the article gap **120** (described below) is, at least mostly, based on the motion and timing of the fingers **108** raising and lowering and the front-end registering, or aligning the articles **104** to be substantially perpendicular to the transport direction **112**, of the articles **104** is performed by the motion and timing of the paddle **110**. In some embodiments, the PLC and motor **116** can be separate devices. In some embodiments, the PLC can be incorporated into the housing of the motor **116** and/or integral to the motor.

FIG. 2A illustrates the article gapping system **100** from FIG. 1, showing a plurality of articles **104** lined up and stopped at the fingers **108**, or, in other words, at the first stop location. Three articles are specifically designated in this figure, as, first article **A**, second article **B**, and third article **C**. First article **A** is positioned such that a first portion of first article **A** is partially on the fingers **108** and a second portion of first article **A** is partially on the conveyor **102**. Prior to the first article **A** being in this position, first article **A** was in an identical position as second article **B** is presently shown. In order to release the first article **A** from the first stopping location (e.g., stopped at the fingers **108**) the lifting mechanism **114**, via the motor **116**, lowered the fingers **108** to a height equal to or lower than the conveyor **102**, allowing the first article **A** to move along the transport direction **112** on the conveyor **102** to the current position of first article **A** shown in FIG. 2A. During the time that the first article **A** moved over the fingers **108**, the fingers **108** have raised up again, with at least a portion of the first article **A** still contacting the fingers **108** and the remaining portion of first article **A** still on the conveyor **102** such that the

fingers **108** are able to stop the second article **B** and the first article **A** is able to continue moving along the path. As shown in FIG. 2A, the first article **A** is slightly at an incline with respect to the conveyor **102**, the incline caused by the fingers **108**, and a surface of the first article **A** is not fully contacting the conveyor **102**.

In this particular view, although it is difficult to see, second article **B** is covering up or blocking the second sensor **118B**, causing a registration timer in the motor **116** or a PLC to start. The timer allows a skewed article **104** such as, for example second article **B** to turn by being driven by the conveyor **102** to contact at least two fingers **108** and thus become front-end registered. After the registration timer runs out, the motor **116** or the PLC checks the first sensor **118A** to see if another article **104** is behind the second article **B**. If there is another article **104** such as, for example and without limitation, third article **C**, the fingers **108** will be lowered to allow second article **B** to begin moving on the conveyor **102**. At the same time, while the fingers **108** are being lowered, a cycle timer is started in the motor **116** or PLC that is used to define the article gap **120** to be created. If there is no other article **104** behind the second article **B**, (e.g., the articles **104**, including third article **C**, after second article **B** are not present) the article gapping system **100** will wait for a certain amount of time for another article **104**, such as for example, third article **C**, to arrive in behind the second article **B**. If another article **104** does not arrive in behind the second article **B** during the amount of time given, the fingers **108** will lower to let the second article **B** through. However, in such a case, the fingers **108** will stay down since there is not another article **104** behind the second article **B** to provide drive. The fingers **108** will remain down until another article **104** moving along the conveyor **102** blocks or triggers the first sensor **118A**. This ensures that the fingers **108** can move back to the deployed position in time to prevent another article **104** from going through the article gapping system **100** prematurely without being front-end registered by the fingers **108**, first.

As described above, in some embodiments, the fingers **108** are configured to be raised and lowered smoothly such that the article **104** moving over the fingers **108** is not flipped, or significantly disturbed other than being inclined and/or lifted slightly relative to the conveyor **102**. The fingers **108** lower to a height below the conveyor **102** to allow the articles **104** to pass over them and then rise

smoothly to stop the next article **104** in line on the conveyor **102**. When the fingers **108** lower and/or rise, there is at least a portion of an article **104**, carton, package, or good that always touches the conveyor **102**. This is achieved by adapting the size of the fingers **108** or the timing in which the fingers **108** are raised/lowered based on the size of the article **104** being transported on the conveyor **102**. In some embodiments, this is necessary to ensure that the velocity, V_c , of the leading edge of the article **104**, at the point of separation, is the same as the velocity, V_B , of the conveyor **102**.

As illustrated in FIG. 2A, second article **B** and third article **C** are stopped by the fingers **108** and are contacted on the top surface thereof by the rollers **106** such that the second article **B** and third article **C** are not flipped about by the conveyor **102** moving underneath them. In some embodiments, the articles **104** can be fed into the article gapping system **100**, toward the fingers **108**, with random, different, or approximately the same spacing between them, or in a line contacting each other.

FIG. 2B illustrates the same features as FIG. 2A, except here, first article **A** is stopped at the paddle **110** (e.g., the second stopping position), which is shown in a stop position in this figure, and the second article **B** is stopped at the fingers **108** (e.g., the first stopping position), which are shown in the deployed position. As shown in FIG. 2A and 2B, in some embodiments, while second article **B** is stopped at the fingers **108**, the conveyor **102** continues to move along the conveying path at a constant velocity, as evidenced by the first article **A** continuing to move along until it contacts the paddle **110** in FIG. 2B. In some embodiments, first article **A** continues to move along the conveyor **102** at velocity V_c , which is the same as the velocity, V_B , of the conveyor **102**, until the first article **A** is stopped at the second stopping location, the paddle **110**. At this point, both the second article **B** and the first article **A** are stopped with a velocity of 0 m/s, while the conveyor **102** continues to move in the transport direction **112** at velocity V_B m/s. While second article **B** is stopped at the fingers **108**, a laser, etching device, printing device, or other suitable device etches, engraves, and/or prints on the second article **B** indicia or other marking on the article **104**. The laser or other suitable device is better shown in FIG. 3A. In this side view of FIG. 2B, the laser is behind second article **B**.

FIG. 2C illustrates that, in some embodiments of the present disclosure, at a time after the first article **A** has been stopped at the paddle **110**, either by sensing the presence of the first article **A** by the fourth sensor **118D** shown or by a timer, the paddle **110** is raised smoothly to a release position to allow the first article **A** to start moving again along the conveyor **102** in the transport direction **112**. As discussed above, the paddle **110** is configured to operate based on a motor **116** and/or a PLC. The paddle **110** can be configured, in some embodiments, to operate based on the fourth sensor **118D** and/or the fifth sensor **118E**. In some embodiments, when one end of a skewed article **104** touches the paddle **110** and blocks the fourth sensor **118D**, a second registration timer starts. This allows the article **104** to be front-end registered, such as that illustrated in FIG. 2B above with respect to the first article **A**. In some embodiments, once the first article **A** has been front-end registered, the paddle **110** will rise to a release position. Persons having ordinary skill in the art will appreciate that the paddle **110** is raised smoothly enough to allow the first article **A** to smoothly accelerate to have the same velocity V_B of the conveyor **102** without slipping on the conveyor **102**. Furthermore, the raising of the paddle **110** is configured so as to not affect the position or alignment of the first article **A** as the first article **A** passes underneath the raised paddle **110**. Additionally, second article **B** remains stopped at the first stopping point by the fingers **108**. In some embodiments, once the first article **A** goes under the paddle **110**, the fifth sensor **118E** is blocked. This does two things: it triggers the paddle **110** to begin lowering to the stop position, and it permits the release of the second article **B** behind first article **A** (e.g., it allows the fingers **108** to lower to the retracted position). In some embodiments, once the fifth sensor **118E** becomes unblocked, the trailing edge of first article **A** has been identified and the paddle **110** lowers. In some embodiments, the paddle **110** lowers on the trailing edge of first article **A** so that fifth sensor **118E** will work with any article **104** width.

Referring to FIG. 2D, once the first article **A** is released by the paddle **110**, the fingers **108** are lowered to the retracted position by the lifting mechanism **114** and all of the articles **104** begin moving at the velocity V_B of the conveyor **102**. As shown in FIG. 2D, second article **B** is entirely on the conveyor **102** as the fingers **108** are lowered to the retracted position, allowing the second article **B** to start moving. Furthermore, third article **C** moves towards the fingers **108**. However, as

shown, the edge of third article **C** has not reached the fingers **108** yet. The fingers **108** are raised between FIG. 2D and FIG. 2E to stop the third article **C** before it can move any further. As the fingers **108** are lowered, so is the paddle **110**. In FIG. 2C, the paddle **110** is raised such that it is almost parallel to the conveyor **102**. However, in FIG. 2D, the paddle **110** is shown in movement, lowering to become perpendicular to the conveyor **102**.

Also shown in FIG. 2D is first article **A** and fourth article **D**. An important aspect of the present disclosure is that first article **A** and fourth article **D** are separated by an article gap **120**, which can be defined as either or both of a predetermined time and distance. Some embodiments are configured such that, after leaving the paddle **110**, when there is more than one article **104** passing through the system **100**, the articles **104** are spaced apart by the same length. In other words, the article gap **120** between each article **104** after passing the paddle **110** is substantially identical. In some embodiments, the article gap **120** can be based on the throughput of the article gapping system **100**, the speed of the conveyor **102**, and/or the size of the articles **104** traveling through the system **100**. For example and without limitation, in some embodiments, the system **100** can be configured to front-end register about 100 articles **104** per minute, or register one article **104** in 0.6 seconds. However, those of ordinary skill in the art will appreciate that the system **100** can be configured to handle any number of articles **104**, but less than 100 and greater than 100. In some embodiments, the system **100** can be configured to have a conveyor **102** velocity V_B of about 10 inches/second (or 10in/sec). In such an embodiment, this would mean that a leading edge to leading edge distance between of the articles **104** would be about 6 inches. In some embodiments, the velocity of the conveyor **102** can be configured to be lower or higher than 10 in/sec. The higher the velocity of the conveyor **102**, the higher the leading edge to leading edge distance. With that being said, the article gap **120** is determined based on the leading edge distance minus the width of the article **104** in the transport direction **112**. For example and without limitation, with a conveyor **102** velocity V_B of about 10 in/sec and a throughput of the system **100** at about 100 articles **104** per minute, the article gap **120** will be about 6in-X, where X is the width of the article **104** in the transport direction. For example and without limitation, if an article **104** had a width in the transport direction **112** of about 2in,

the article gap **120** would be between about 3.8in and 4.3in in length. More specifically, in some embodiments, the article gap **120** would be about 4 in. Again, those of ordinary skill in the art will appreciate that the length of the article gap **120** can vary or be adjusted above and below 4in, depending on many factors, including the speed or velocity of the conveyor **102**, the throughput of the system **100**, and the various dimensions of the articles **104**, in particular the width of the articles **104** in the transport direction. The article gap **120** can be adjusted and varied depending on the what needs to be done with the articles **104** after they are front-end registered (i.e., if they need to be scanned, or otherwise processed). In that case, the specifications of the scanner **128** or other device that needs to process the articles **104** can determine the minimum article gap **120**.

Furthermore, the alignment of the articles **104**, after passing the paddle **110**, are substantially parallel with respect to each other. Once the fingers **108** have been lowered, as shown in FIG. 2D, the second article **B** will start moving down the conveyor **102** over the lowered fingers **108**. In some embodiments, once the leading edge of the second article **B** blocks the third sensor **118C**, the fingers **108** raise with the second article **B** still on them, as shown in FIG. 2E. In some embodiments, a width of the conveyor **102** (i.e., the conveyor belt(s), rollers, etc.) can be altered, changed, or otherwise adjusted to accommodate any size article **104**.

Referring to FIG. 2E, first article **A** has completely passed from the paddle **110** and the paddle **110** has completely lowered down, ready to stop the second article **B**. The second article **B** is currently raised by the fingers **108** at a rear portion of the second article **B**. Persons having ordinary skill in the art will appreciate that, in some embodiments, the placement of the third sensor **118C** is very critical in triggering the fingers **108** to rise at the appropriate time to stop the third article **C** and to cause the appropriate smooth lift. In some embodiments, the third sensor **118C** is positioned such that the center of mass of, for example, the second article **B**, is over the fingers **108** before being raised, but not too far past the edge of the fingers **108** because the fingers **108** need to rise in time to stop the next article **104** transported along the conveyor **102** (e.g., third article **C**). In some embodiments, the fingers **108** are not lowered until the cycle timer discussed above has elapsed and the previous article **104** has triggered fifth sensor **118E** to

ensure that the minimum gap necessary has been created. Third article **C** is now stopped by the fingers **108** and is being etched or engraved in some embodiments by the laser **124**. The third article **C** also has at least one roller **106** contacting the top of it, keeping the third article **C** from rotating or flipping. In this figure, second article **B** is now travelling at the same velocity, V_B , as the conveyor **102**, as is first article **A**. Persons having ordinary skill in the art will appreciate that the separation of the articles **104** occur at two points: the fingers **108** and then again at the paddle **110**.

FIG. 2F is substantially the same as FIG. 2E, except that it includes first article **A** and fourth article **D** and shows the article gap **120** length again between first article **A** and fourth article **D**. Additionally, persons having ordinary skill in the art will appreciate that, as the second article **B** is transported down the backside of the fingers **108**, there is no guarantee that it will remain front-end registered. In some embodiments, the paddle **110** provides the extra registration step discussed above to ensure all of the articles **104** are front-end registered. Persons having ordinary skill in the art will appreciate that according to some embodiments of the present disclosure, the process of front-end registering, as described, will continue from this stage until all of the articles **104** are front-end registered.

Furthermore, persons having ordinary skill in the art will appreciate that some embodiments of the present disclosure can have a distance between the fingers **108** and the paddle **110** to accommodate articles **104** of any size or dimension.

Referring to FIG. 3A, example embodiments of the present disclosure can also comprise a laser **124** or other suitable device for engraving or etching indicia or unique identifiers on the articles **104**. FIG. 3A shows the laser **124** or other device that performs the engraving, etching, or printing. The engraving, etching, or printing can be applied directly on the surface of the article **124** in some embodiments. As shown in the figure, the laser **124** is in line with the article **104** that is stopped at the fingers **108** (e.g., the first stop location) and is configured to laser the article **104** that is stopped. Moreover, as shown in FIG. 3B, according to some embodiments, the system can comprise one or more rollers **106**, including for example four rollers **106** for better stability. Note, in this figure, first sensor

118a, second sensor **118b**, and third sensor **118c** are not visible. However, ordinarily, they would be between the two sets of two rollers **106**.

Referring to FIG. 3C, the article **104** stopped at the fingers **108** can have an indicia area **126** on it as shown after the laser **124**, etching device, or printer has placed indicia **126** on the article. FIG. 9 is an example embodiment of indicia **126** etched, printed, or placed on the article **104**. The indicia **126** can comprise for example, a label comprising a Global Trade Identification Number (GTIN) number, a serial number, an expiration date, a QR code, or any other suitable indicia **126**. In some embodiments of the present disclosure, the indicia **126** are unique to the article **104** to which the indicia **126** are applied. In further embodiments of the present disclosure, the indicia **126** information can be saved in a database or other suitable format to be used for later lookup or searching.

FIG. 4A illustrates a top view of the article gapping system **100** showing most of the features discussed above. In some embodiments, the paddle **110** can be configured such that it can be raised by the motor **116** or other suitable device, as discussed above. As shown in FIG. 4A, the paddle **110** can be pivotably affixed to a rod or other object of the article gapping system **100** that is turned by the motor **116**, lifting the paddle **110** to allow the article **104** to move forward. FIG. 4B illustrates a top view of the article gapping system **100**, very close to that shown in FIG. 4A. Additionally, FIG. 4B shows where the laser **124** is located in this context and it also shows the paddle **110** down, getting ready to stop the next article **104**.

FIG. 5 illustrates another perspective view of the article gapping system **100** as disclosed hereinabove. In particular, FIG. 5 highlights how the fingers **108** are spaced apart with respect to one another by at least the same width as the width of the conveyor **102**. In some embodiments, the distance between the two fingers **108** can be altered, based on the bracket they are attached to, in order to fit any dimension article **104** that can fit on the conveyor **102**.

FIG. 6 illustrates a perspective view of an underside of the article gapping system **100** depicting a different perspective than the other figures hereinabove. As illustrated in the figure, the article gapping system **100** is supported by a frame **130**. The frame **130** can be made from a metal or any suitable substance that can hold up and support the article gapping system **100**. In some embodiments, the

frame **130** can lower and raise the entire conveyor **102** in order to fit different sized articles **104**. As shown in the figure, the lifting mechanism **114** can comprise an arm connected between the bracket and connected to the fingers **108**, and the motor **116**. As the motor **116** operates, the lifting mechanism **114** goes up and down to make the fingers **108** raise and lower to the various positions discussed above.

FIG. 7 illustrates a schematic view of several components of the article gapping system **100**, including the fingers **108**, the paddle **110**, the motor **116**, and the lifting mechanism **114**. This view helps to further illustrate how these components are connected within the article gapping system **100**.

FIG. 8 illustrates another view of the article gapping system **100** and includes a scanner **128** beyond the paddle **110** in the transport direction **112**. In some embodiments, the scanner **128** can comprise sensors, an x-ray scanner, cameras, thermal imaging devices, or other suitable scanning devices. In some embodiments, the scanner **128** is configured to inspect the articles **104** as they pass through it. In some embodiments, after the articles **104** leave the paddle **110**, they are scanned in the scanner **128**. In some embodiments, the scanning process can include scanning the indicia **126** on the article **104**, x-ray scanning, or other suitable scanning for security purposes, quality control purposes, or the like.

FIG. 9 illustrates example indicia **126** that were printed or etched onto an example article **104**. The indicia **126** can comprise for example and without limitation, a label comprising a Global Trade Identification Number (GTIN) number, a serial number, an expiration date, a QR code, a lot number, or any other suitable indicia **126**. In some embodiments of the present disclosure, the indicia **126** are unique to the article **104** onto which the indicia **126** is applied. In further embodiments of the present disclosure, the indicia **126** information can be saved in a database or other suitable format to be used for later lookup or searching.

Persons having ordinary skill in the art will appreciate that the systems, devices, and methods described herein can be scaled or be made scalable for any use or purpose.

While the subject matter has been described herein with reference to specific aspects, features, and illustrative embodiments, it will be appreciated that the utility of the subject matter is not thus limited, but rather extends to and

encompasses numerous other variations, modifications, and alternative embodiments, as will suggest themselves to persons having ordinary skill in the field of the present subject matter, based on the disclosure herein.

Various combinations and sub-combinations of the structures and methods described herein are contemplated and will be apparent to a skilled person having knowledge of this disclosure. Any of the various features and elements as disclosed herein can be combined with one or more other disclosed features and elements unless indicated to the contrary herein. Correspondingly, the subject matter as hereinafter claimed is intended to be broadly construed and interpreted, as including all such variations, modifications, and alternative embodiments, within its scope and including equivalents of the claimed features.

CLAIMS

What is claimed is:

1. A method for article processing, the method comprising:
 - advancing, using a conveyor, a first article along a conveying path;
 - stopping, by actuating one or more fingers into a deployed position, the first article at a first stop location along the conveying path, the one or more fingers being located at, or adjacent to, the first stop location;
 - releasing, by actuating the one or more fingers into a retracted position, the first article from the first stop location;
 - advancing, using the conveyor, the first article along the conveying path from the first stop location to a second stop location;
 - stopping, by actuating one or more paddles into a lowered position, the first article at the second stop location, the one or more paddles being located at, or adjacent to, the second stop location;
 - releasing, by actuating the one or more paddles into a raised position, the first article from the second stop location;
 - advancing, using the conveyor, the first article along the conveying path from the second stop location;
 - advancing, using the conveyor, a second article along the conveying path to a first position;
 - stopping, by actuating the one or more fingers into the deployed position, the second article at the first stop location;
 - releasing, by actuating the one or more fingers into the retracted position, the second article from the first stop location;
 - advancing, using the conveyor, the second article along the conveying path from the first stop location to the second stop location;
 - stopping, by actuating the one or more paddles into the lowered position, the second article at the second stop location;
 - releasing, by actuating the one or more paddles into the raised position, the second article from the second stop location; and
 - advancing, using the conveyor, the second article along the conveying path from the second stop location;
- wherein the second article is released such that the second article is separated along the conveying path from the first article by a gap.

2. The method of claim 1, wherein, in the deployed position, the one or more fingers extend above a surface of the conveyor at a height sufficient to stop movement of the first and second articles moving along the conveying path at the first stop location and, in the retracted position, the one or more fingers are retracted to a same height as, or below the surface of, the conveyor so that the first and second articles pass over the one or more fingers at the first stop location.
3. The method of claim 2, wherein the one or more fingers comprise at least two fingers that are movable to elevate at least a portion of an article.
4. The method of claim 1, wherein the conveyor comprises one or more conveying belts.
5. The method of claim 4, wherein the one or more conveying belts continue moving when the first article is in the first stop location and when the second article is in the first stop location.
6. The method of claim 1, wherein the one or more paddles are movable and/or pivotable between the lowered position, in which the one or more paddles obstruct, at least partially, the conveying path to stop movement of the first and second articles along the conveying path at the second stop location, and a raised position, in which the one or more paddles do not obstruct the conveying path at the second stop location.
7. The method of claim 1, comprising applying indicia to the first article while the first article is stopped at the first stop location and to the second article while the second article is stopped at the first stop location.
8. The method of claim 7, wherein comprising applying indicia to the first article comprises using a laser to engrave data on the first article.

9. The method of claim 1, comprising advancing the second article along the conveying path to contact and/or abut the first article while the first article is stopped at the first stop location.
10. The method of claim 1, further comprising applying pressure to the first article with one or more rollers while the first article is stopped at the first stop location.
11. The method of claim 1, wherein the gap is determined by either or both of a predetermined time and distance between when the first and second articles are released from the second stop location.
12. The method of claim 1, comprising:
 - detecting a presence of the first article in the second stop location; and
 - releasing the first article from the second stop location when the presence of the first article is detected at the second stop location.
13. The method of claim 1, comprising front-end registering, using the one or more fingers, the first and second articles when the first and second articles are present at the first stop location.
14. The method of claim 1, comprising stabilizing the first article at the first stop location on at least three sides of the first article.
15. The method of claim 1, comprising advancing the first article from the first stop location and elevating only a first portion of, and not all of, the first article.
16. The method of claim 15, wherein at least a second portion of the first article maintains contact with the conveyor.
17. The method of claim 1, wherein the first and second articles are cartons or boxes.

18. The method of claim 1, wherein the second article is released from the first stop location at a time corresponding to when the first article is released from the second stop location.

19. The method of claim 1, comprising:

advancing, using the conveyor, a third article along the conveying path;

stopping, by actuating the one or more fingers into the deployed position, the third article at the first stop location;

releasing, by actuating the one or more fingers into the retracted position, the third article from the first stop location;

advancing, using the conveyor, the third article from the first stop location to the second stop location;

stopping, by actuating the one or more paddles into the lowered position, the third article at the second stop location;

releasing, by actuating the one or more paddles into the raised position, the third article from the second stop location; and

moving, using the conveyor, the third article along the conveying path from the second stop location;

wherein the third article is released such that the third article is separated along the conveying path from the second article by the gap that is consistent and at least substantially identical to the gap between the first and second articles.

20. The method of claim 1, wherein the first and second articles are advanced by the conveyor from the first stop location such that a velocity of the first and second articles, upon being released from the first stop location, matches a velocity of the conveyor.

21. The method of claim 1, wherein, as the first article is stopped at the second stop location, the second article is stopped at the first stop location or the second article is not stopped at the first stop location and is advanced by the conveyor towards the second stop location.

22. A system for article processing, the system comprising:
- a conveyor configured to advance a first article and a second article along a conveying path;
 - one or more fingers located at, or adjacent to, a first stop location along the conveying path, the one or more fingers being configured to move between a deployed position and a retracted position for stopping the first article at the first stop location and releasing the first article from the first stop location; and
 - one or more paddles located at, or adjacent to, a second stop location along the conveying path, the one or more paddles being configured to move between a lowered position and a raised position for stopping the first article at the second stop location and releasing the first article from the second stop location, such that the first article can be advanced by the conveyor along the conveying path beyond the second stop location;
- wherein the one or more fingers are configured to, after the first article is released from the first stop location, stop the second article at the first stop location and then release the second article from the first stop location;
- wherein the one or more paddles are configured to, after the first article is released from the second stop location, stop the second article at the second stop location; and
- wherein the system is configured to release the second article from the second stop location to move, via the conveyor, along the conveying path such that the second article is separated along the conveying path from the first article by a gap.
23. The system of claim 22, wherein, in the deployed position, the one or more fingers extend above a surface of the conveyor at a height sufficient to stop movement of the first and second articles moving along the conveying path at the first stop location and, in the retracted position, the one or more fingers are retracted to a same height as, or below the surface of, the conveyor so that the first and second articles pass over the one or more fingers at the first stop location.
24. The system of claim 23, wherein the one or more fingers comprise at least two fingers that are movable to elevate at least a portion of an article.

25. The system of claim 22, wherein the conveyor comprises one or more conveying belts.

26. The system of claim 25, wherein the one or more conveying belts continue moving when the first article is in the first stop location and when the second article is in the first stop location.

27. The system of claim 22, wherein the one or more paddles are movable and/or pivotable between the lowered position, in which the one or more paddles obstruct, at least partially, the conveying path to stop movement of the first and second articles along the conveying path at the second stop location, and a raised position, in which the one or more paddles do not obstruct the conveying path at the second stop location.

28. The system of claim 22, further comprising a laser or other indicia applicator configured to apply indicia to the first article or the second article while the first or second articles are stopped, respectively, at the first stop location.

29. The system of claim 22, wherein the system is configured to advance the second article along the conveying path to contact and/or abut the first article while the first article is stopped at the first stop location.

30. The system of claim 22, comprising one or more rollers configured to apply pressure to the first article or the second article while the first or second articles are stopped, respectively, at the first stop location.

31. The system of claim 22, wherein the system is configured to determine the gap by either or both of a predetermined time and distance between when the first and second articles are released from the second stop location.

32. The system of claim 22, comprising a detector or sensor to detect a presence of the first article in the second stop location, wherein the system is configured to release the first article from the second stop location when the presence of the first article at the second stop location.

33. The system of claim 22, wherein the one or more fingers are configured to front-end register the first and second articles when the first and second articles are present at the first stop location.

34. The system of claim 22, wherein the system is configured to stabilize the first article at the first stop location on at least three sides of the first article.

35. The system of claim 22, wherein the system is configured advance the first article from the first stop location and to elevate only a first portion of, and not all of, the first article.

36. The system of claim 35, wherein the system is configured such that at least a second portion of the first article maintains contact with the conveyor.

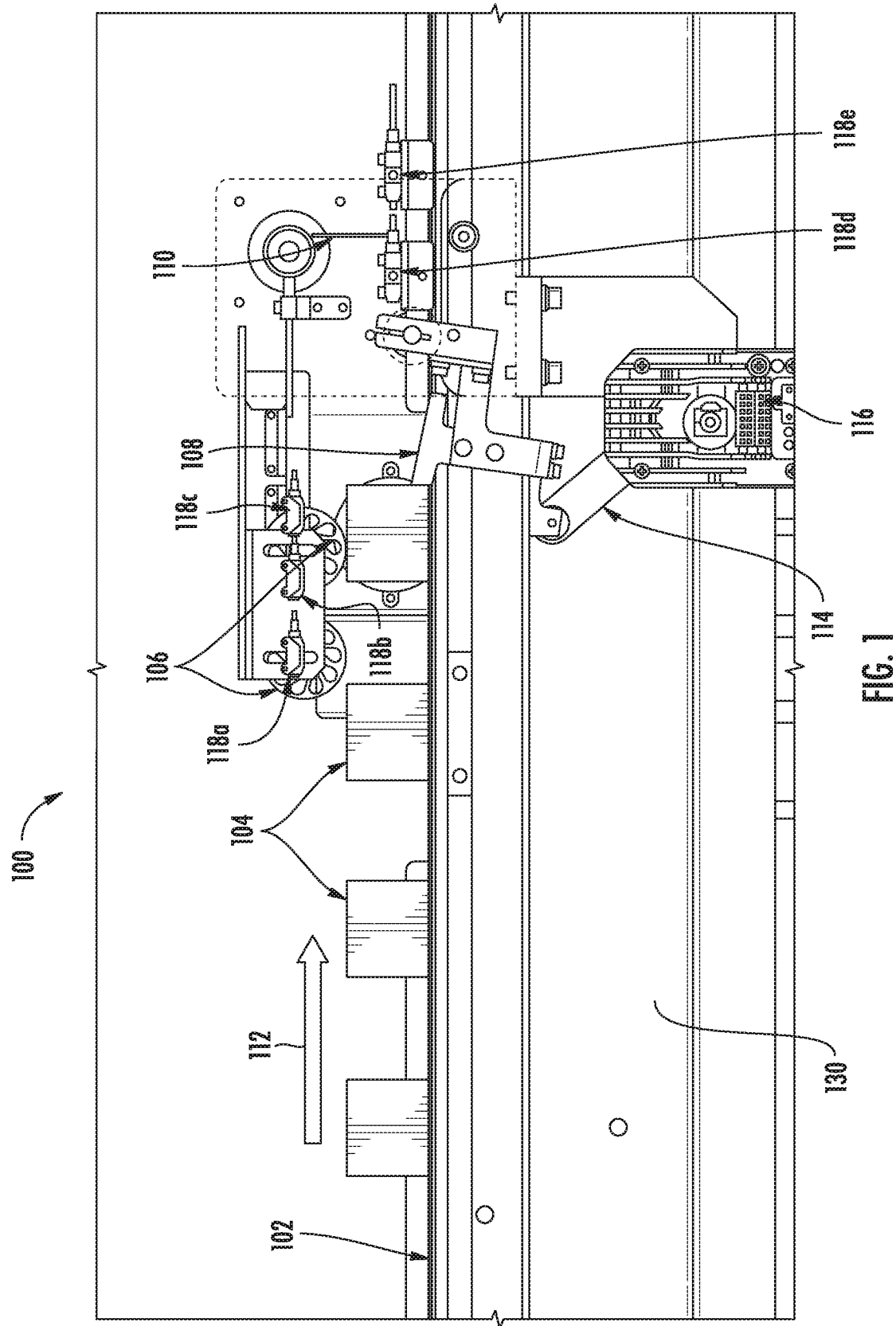
37. The system of claim 22, wherein the first and second articles are cartons or boxes.

38. The system of claim 22, wherein the conveyor is configured to advance the first and second articles from the first stop location such that a velocity of the first and second articles, upon being released from the first stop location, matches a velocity of the conveyor.

39. The system of claim 22, wherein, as the first article is stopped at the second stop location, the second article is stopped at the first stop location or the second article is not stopped at the first stop location and is advanced by the conveyor towards the second stop location.

40. The system of claim 22, wherein the system is configured to advance a third article along the conveying path that is stopped at the first stop location, released from the first stop location, advanced to the second stop location, stopped at the second stop location, released from the second stop location, and moved along the conveying path from the second stop location, wherein the third article is released such that the third article is separated along the conveying path

from the second article by the gap that is consistent and at least substantially identical to the gap between the first and second articles.



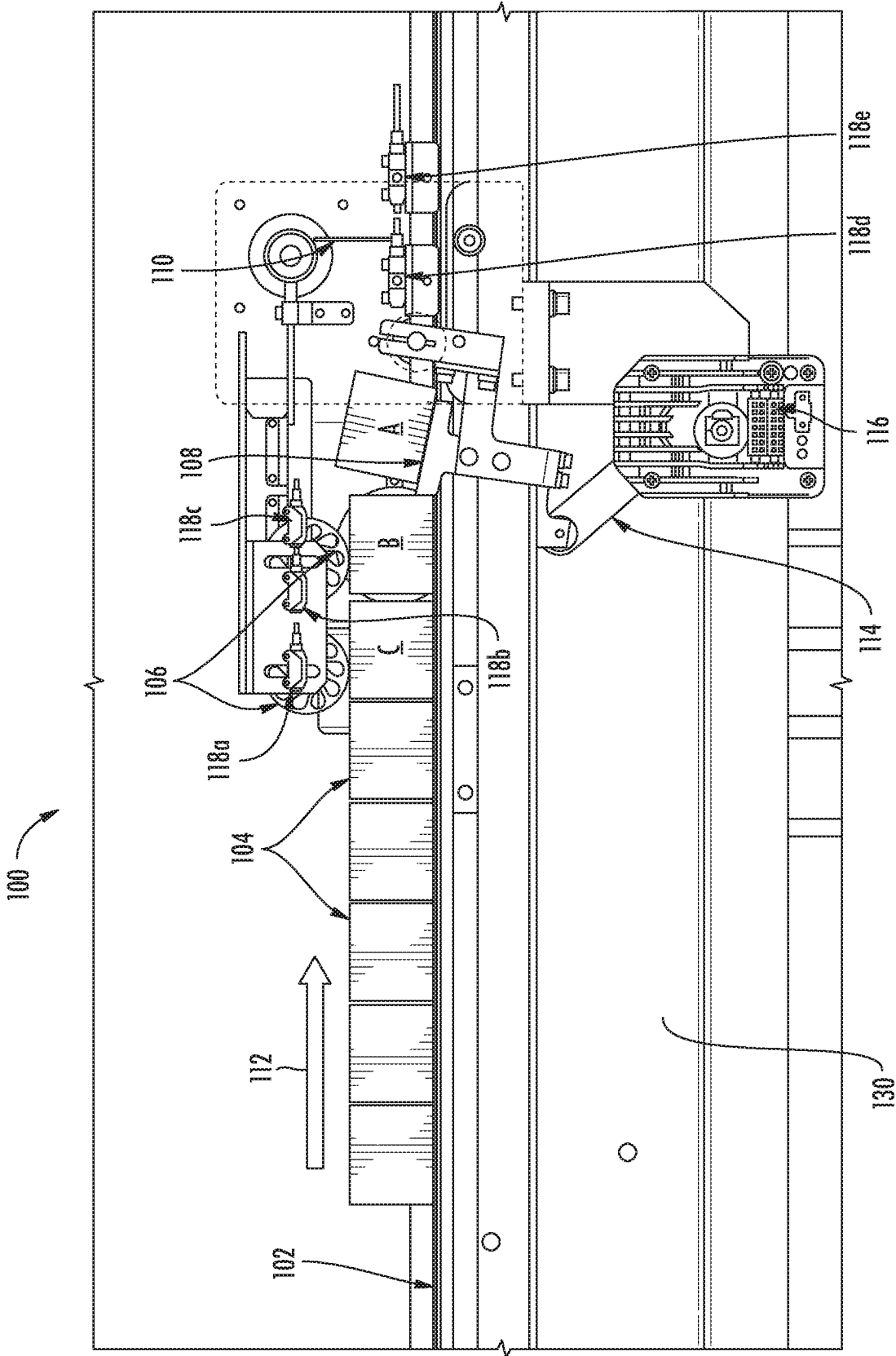


FIG. 2A

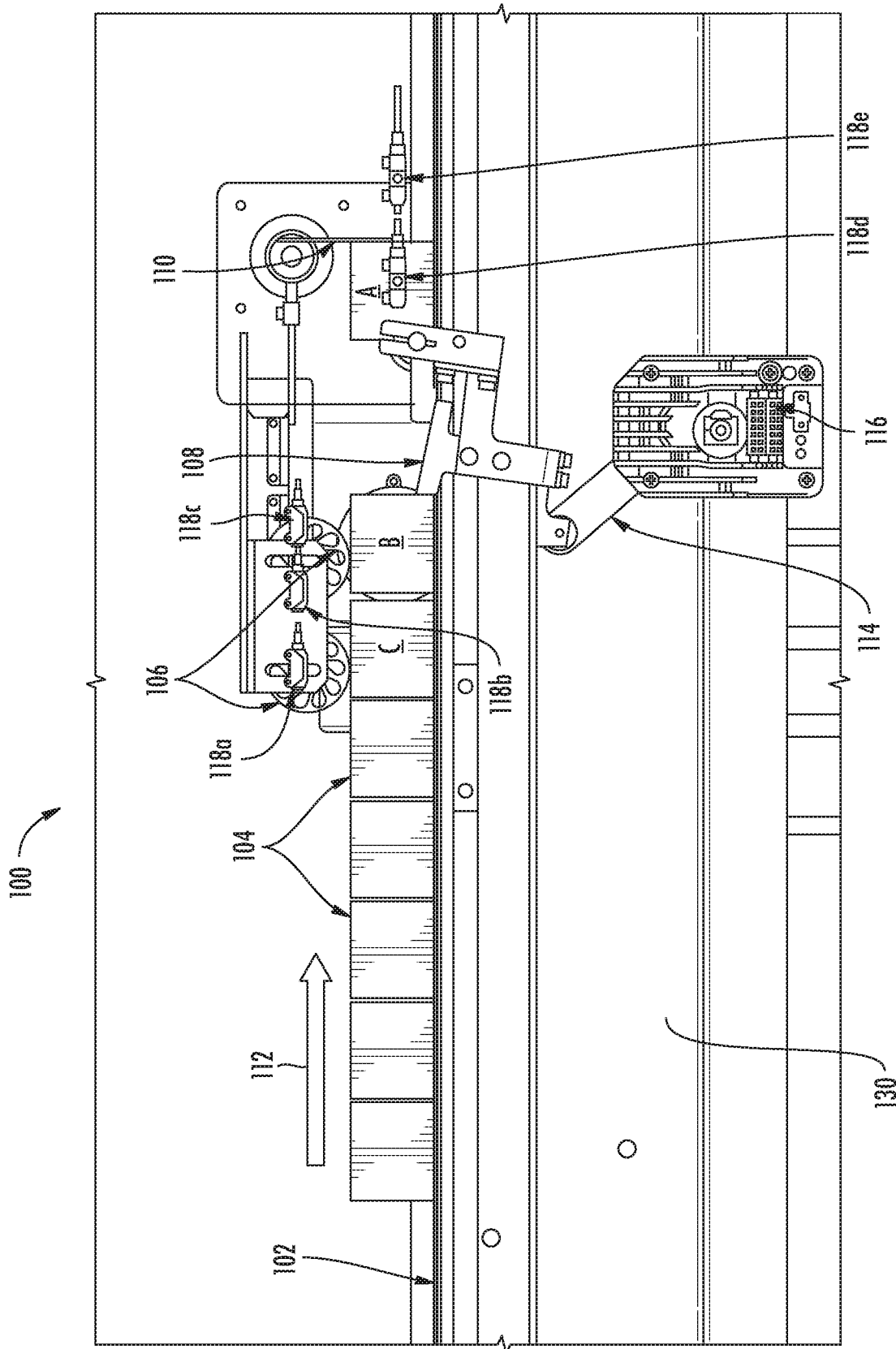


FIG. 2B

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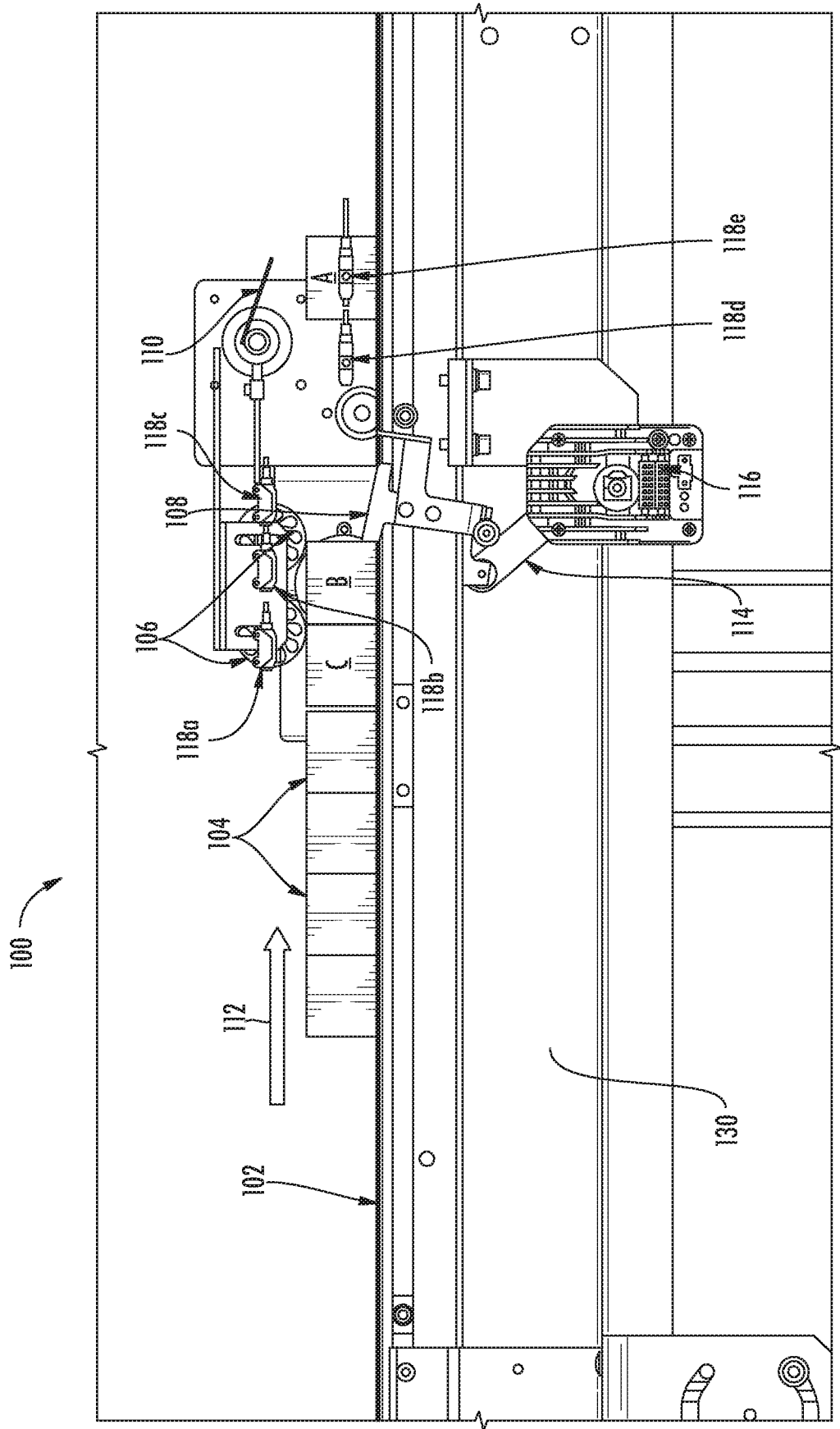


FIG. 2C

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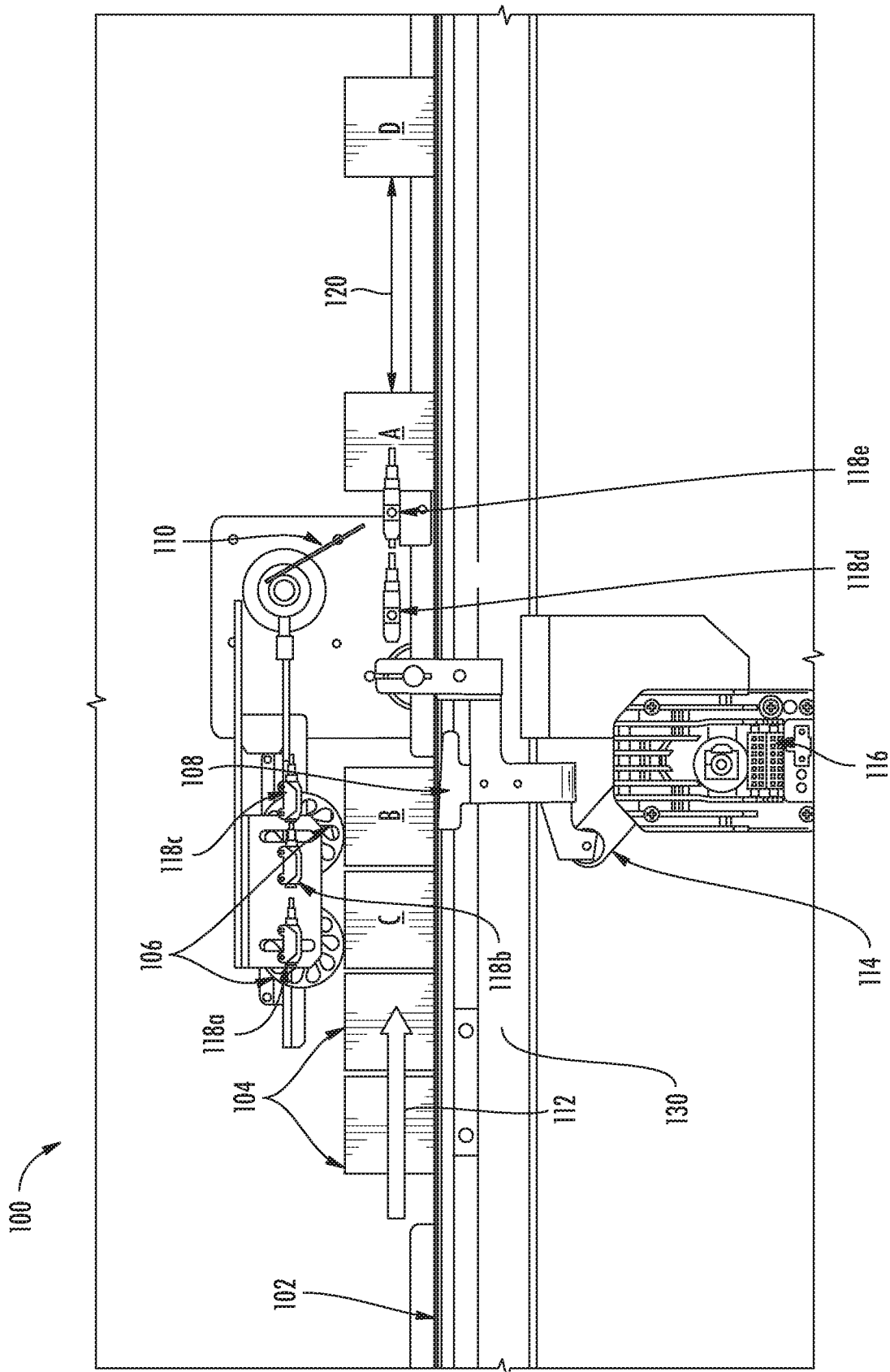


FIG. 2D

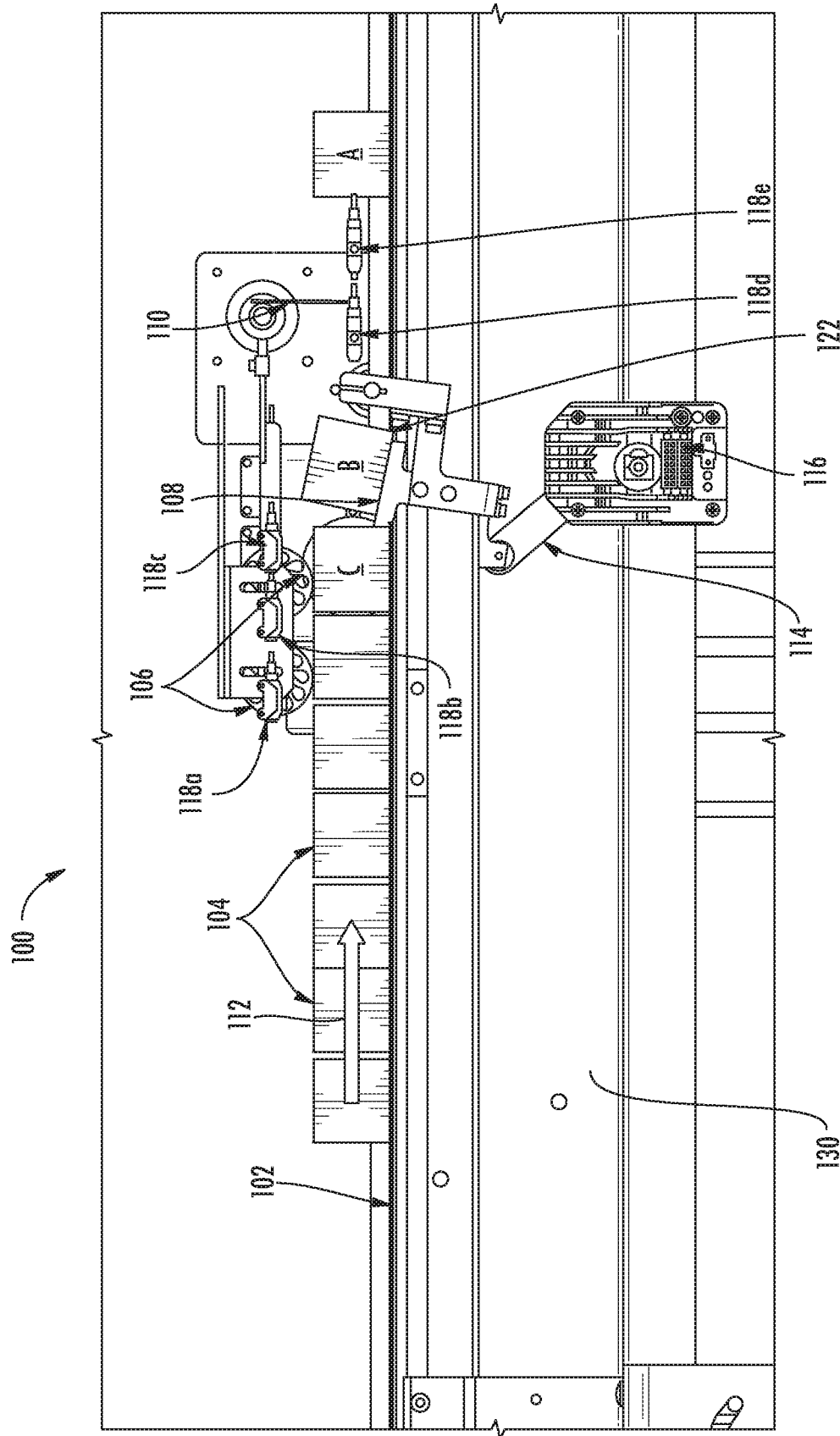


FIG. 2E

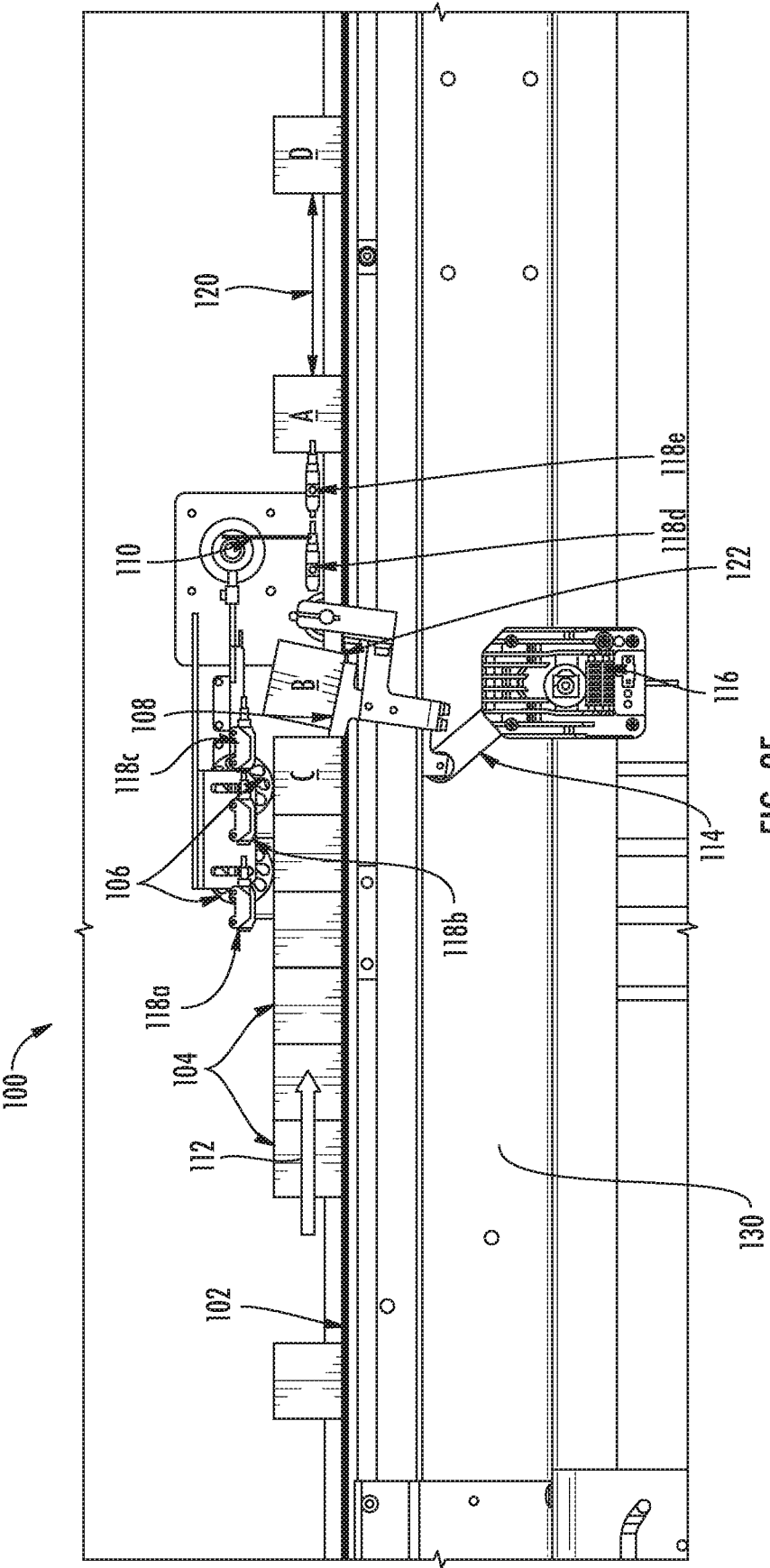
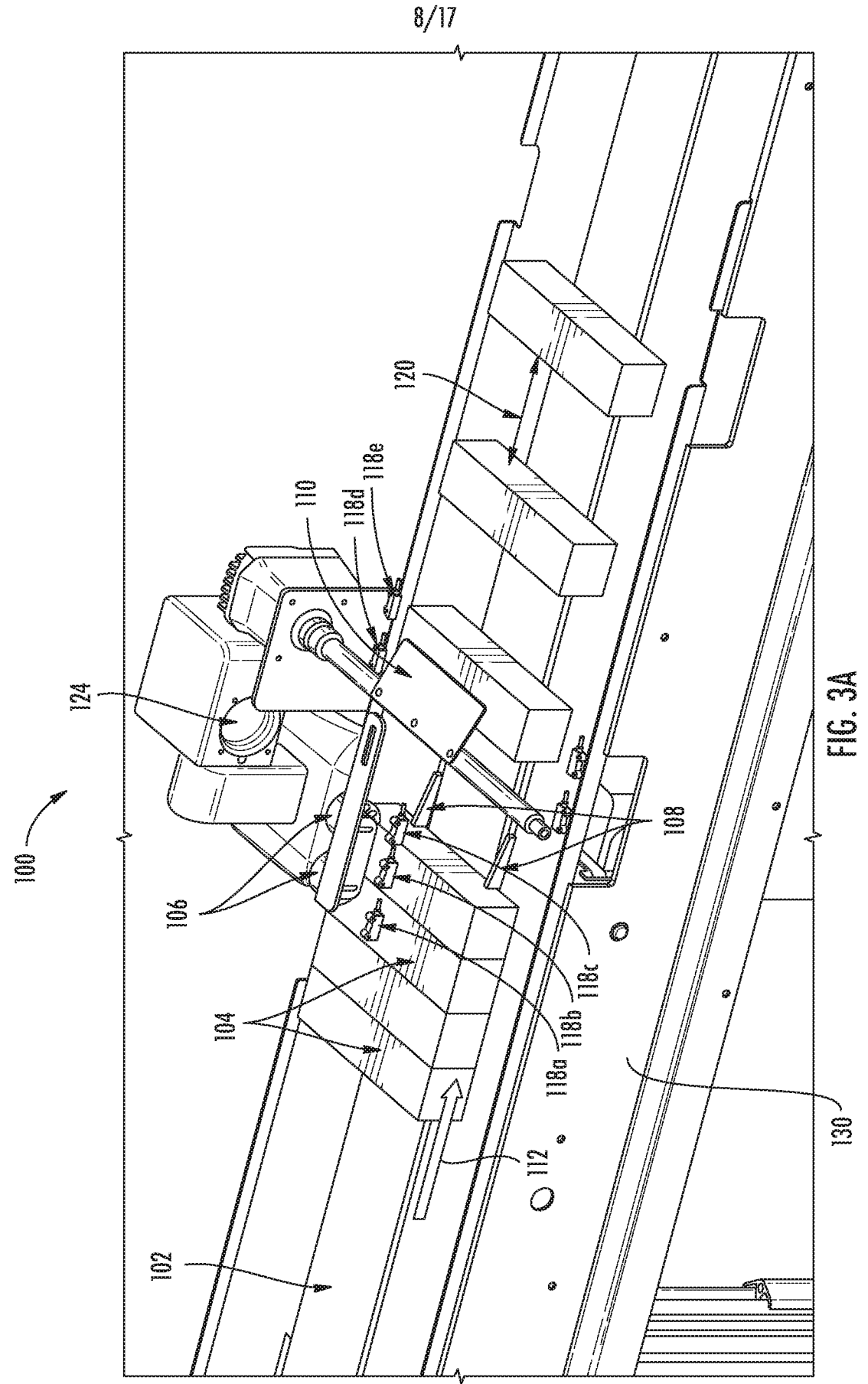


FIG. 2F



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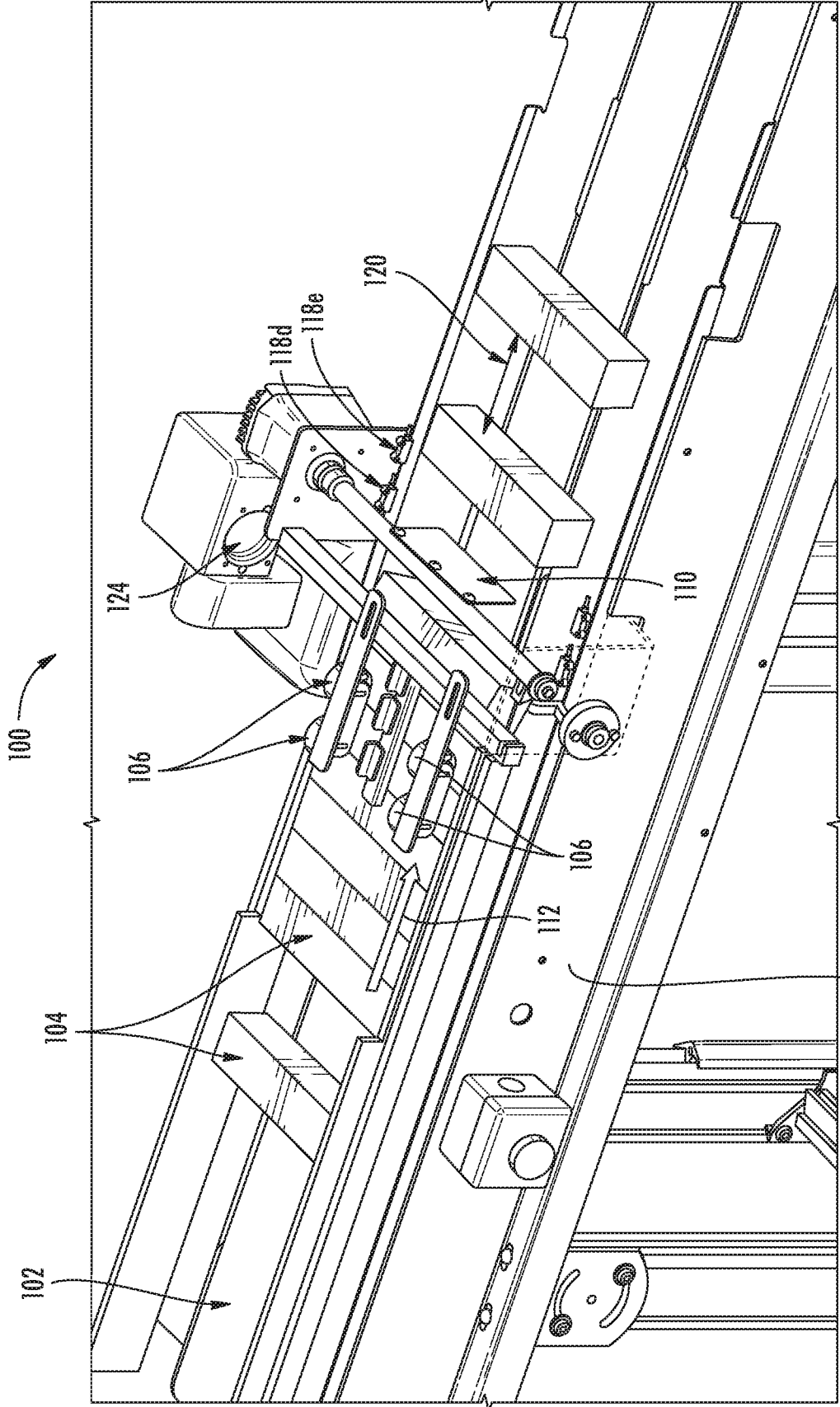


FIG. 3B

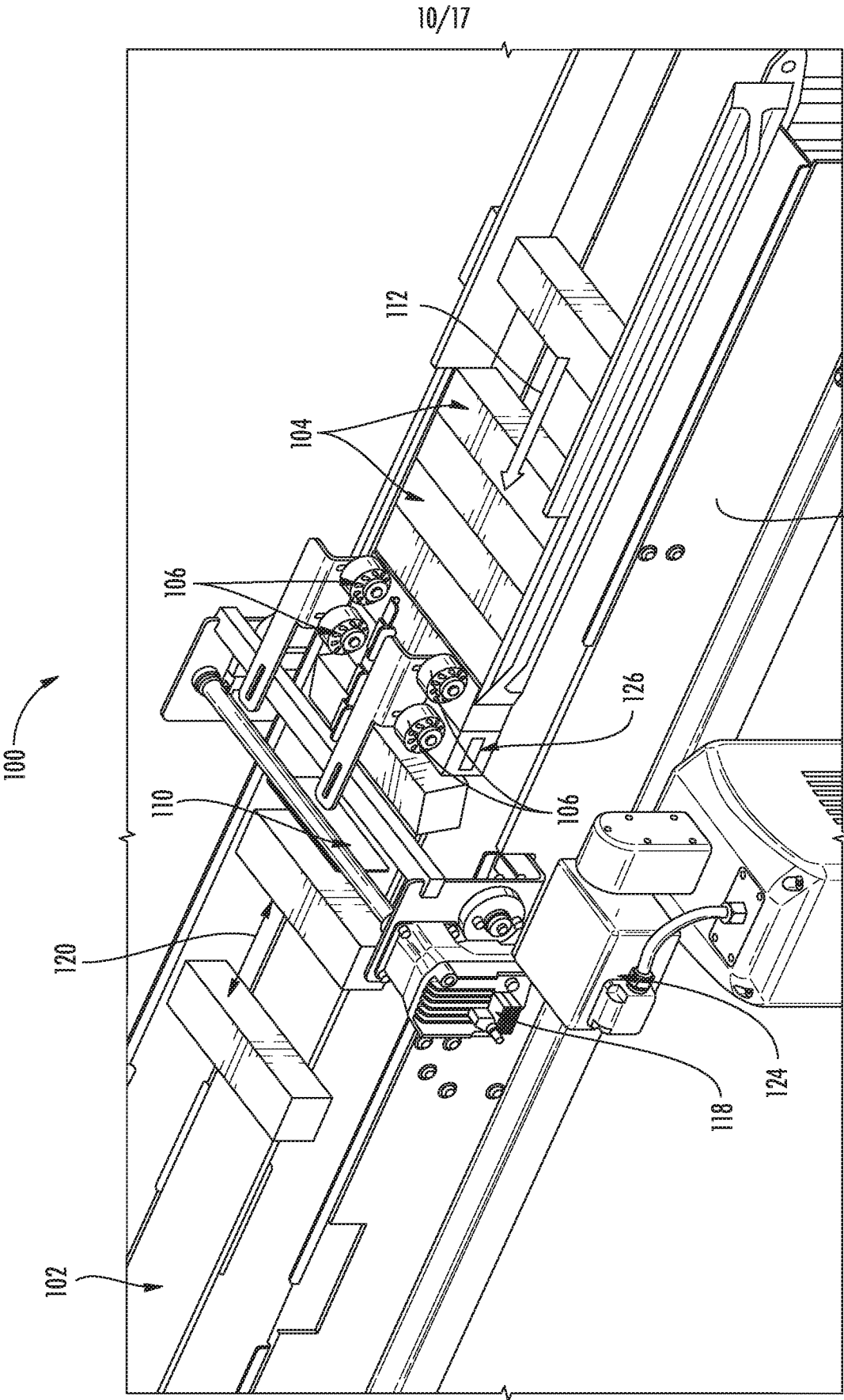
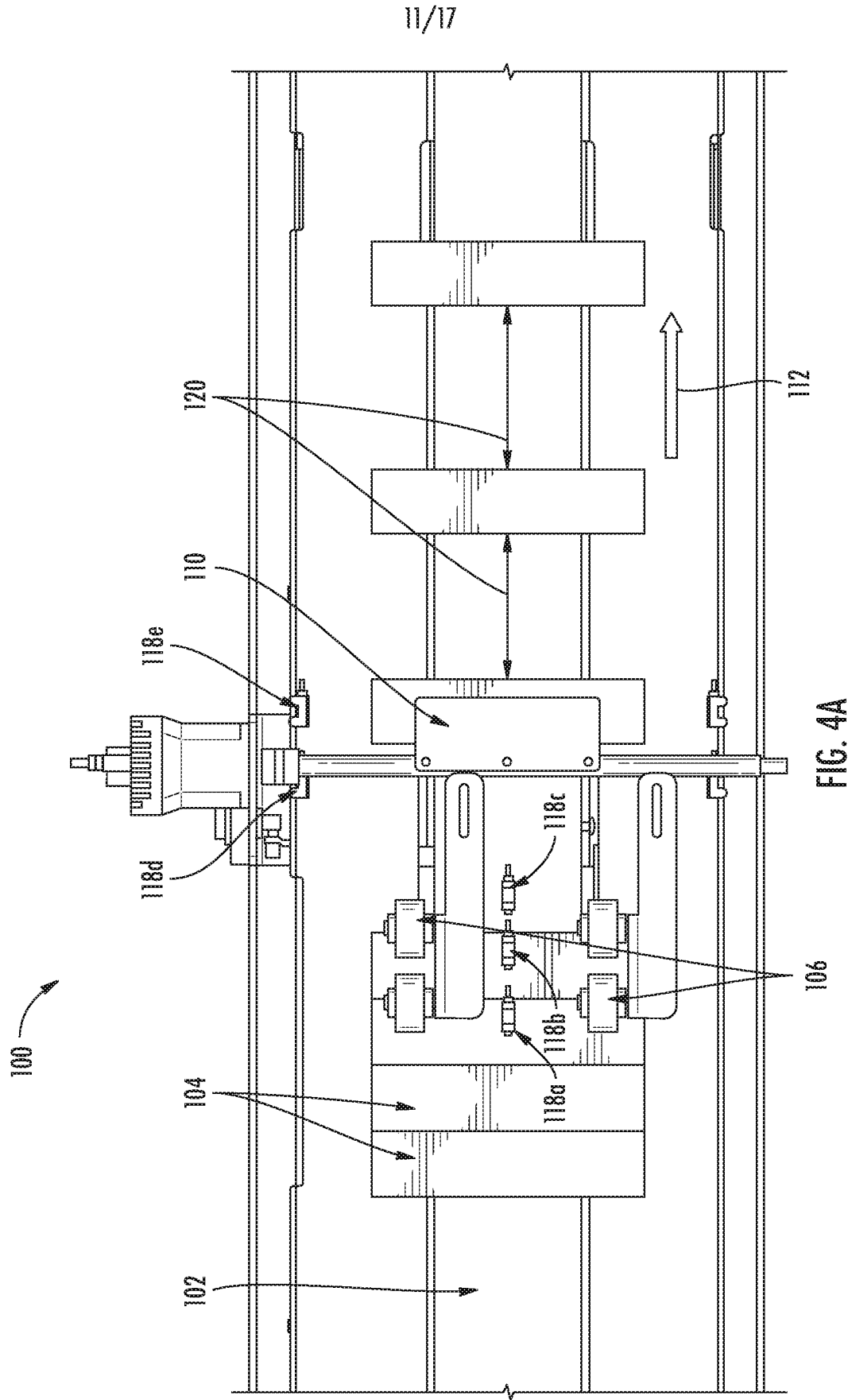


FIG. 3C



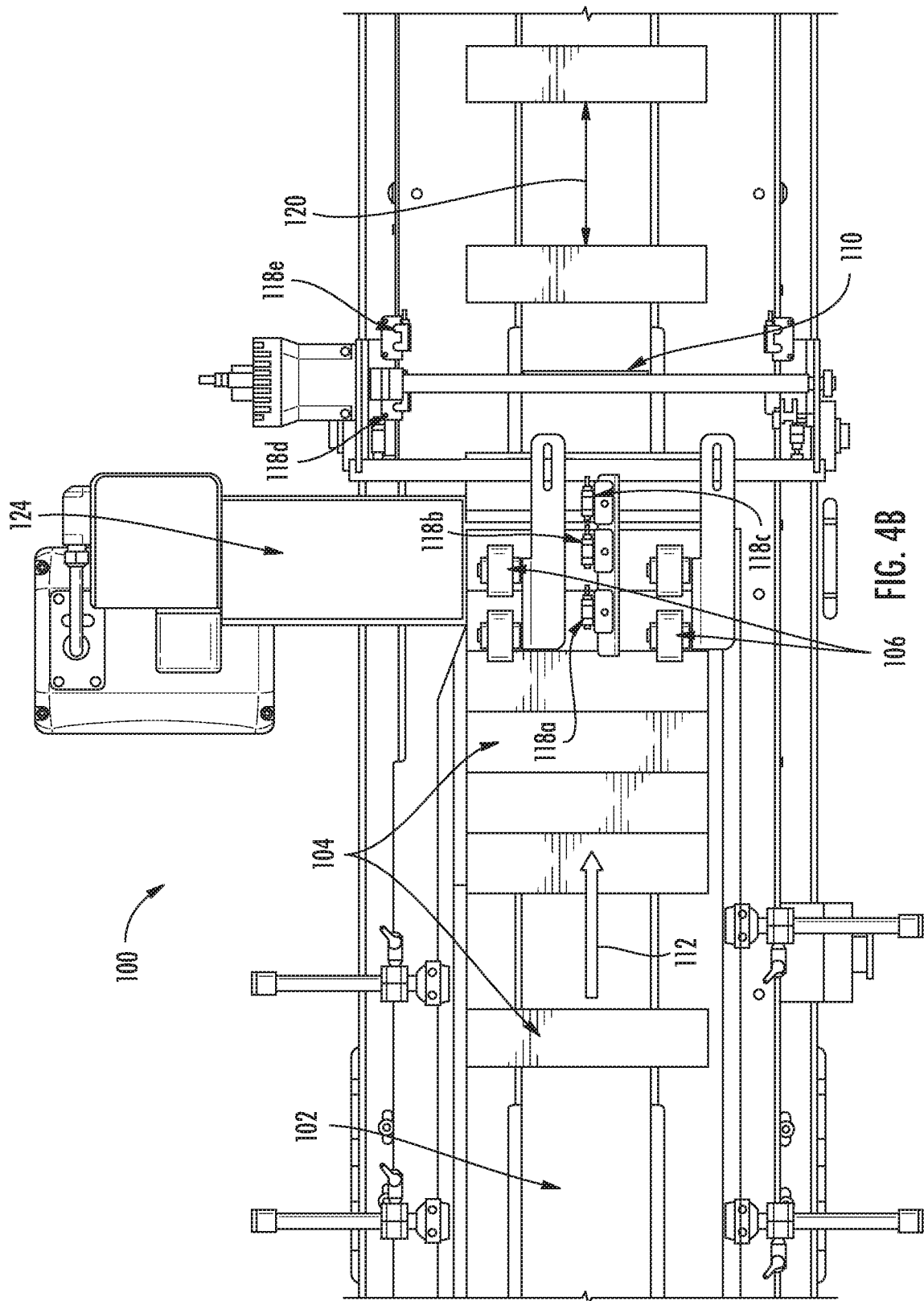
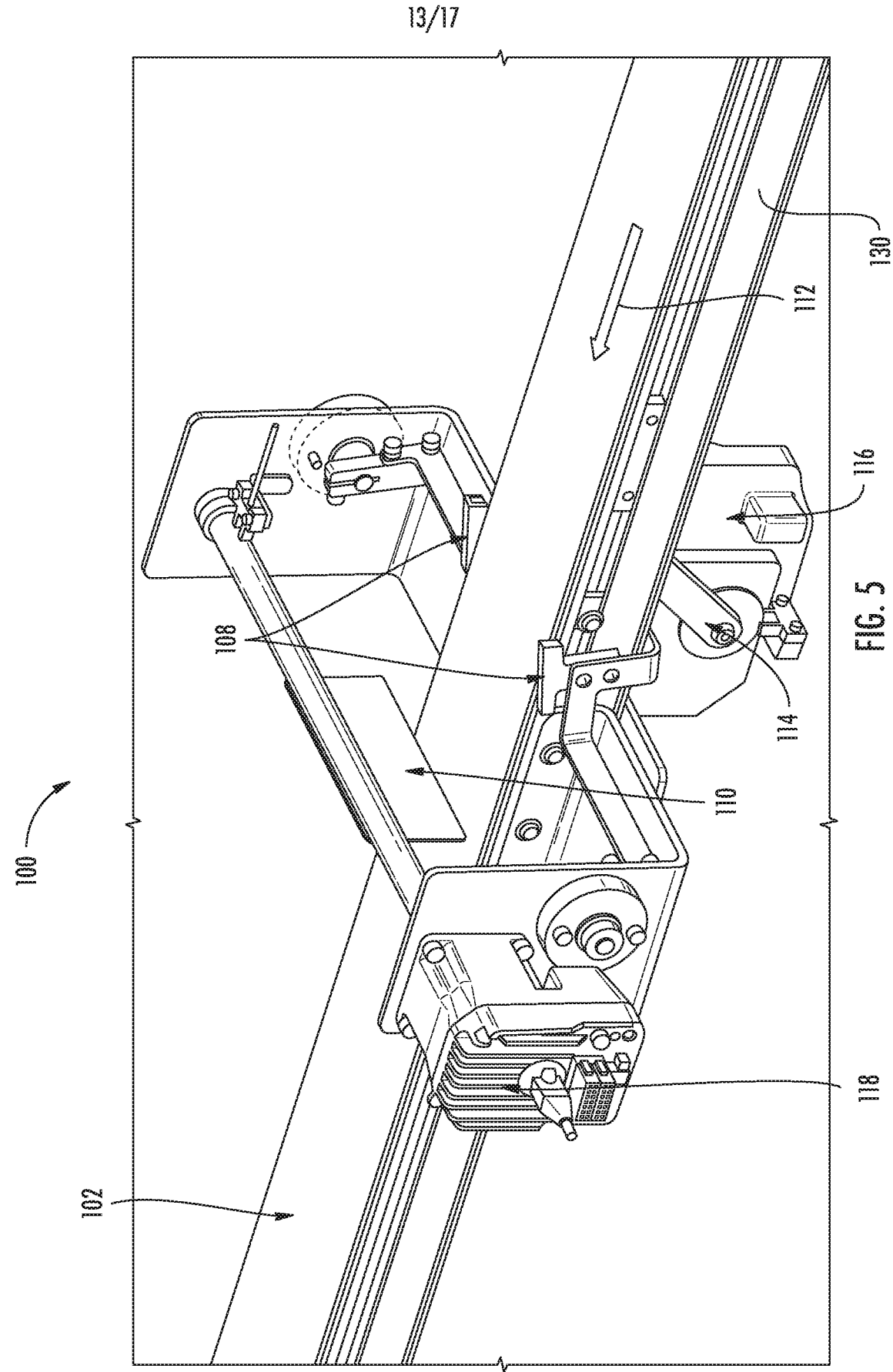
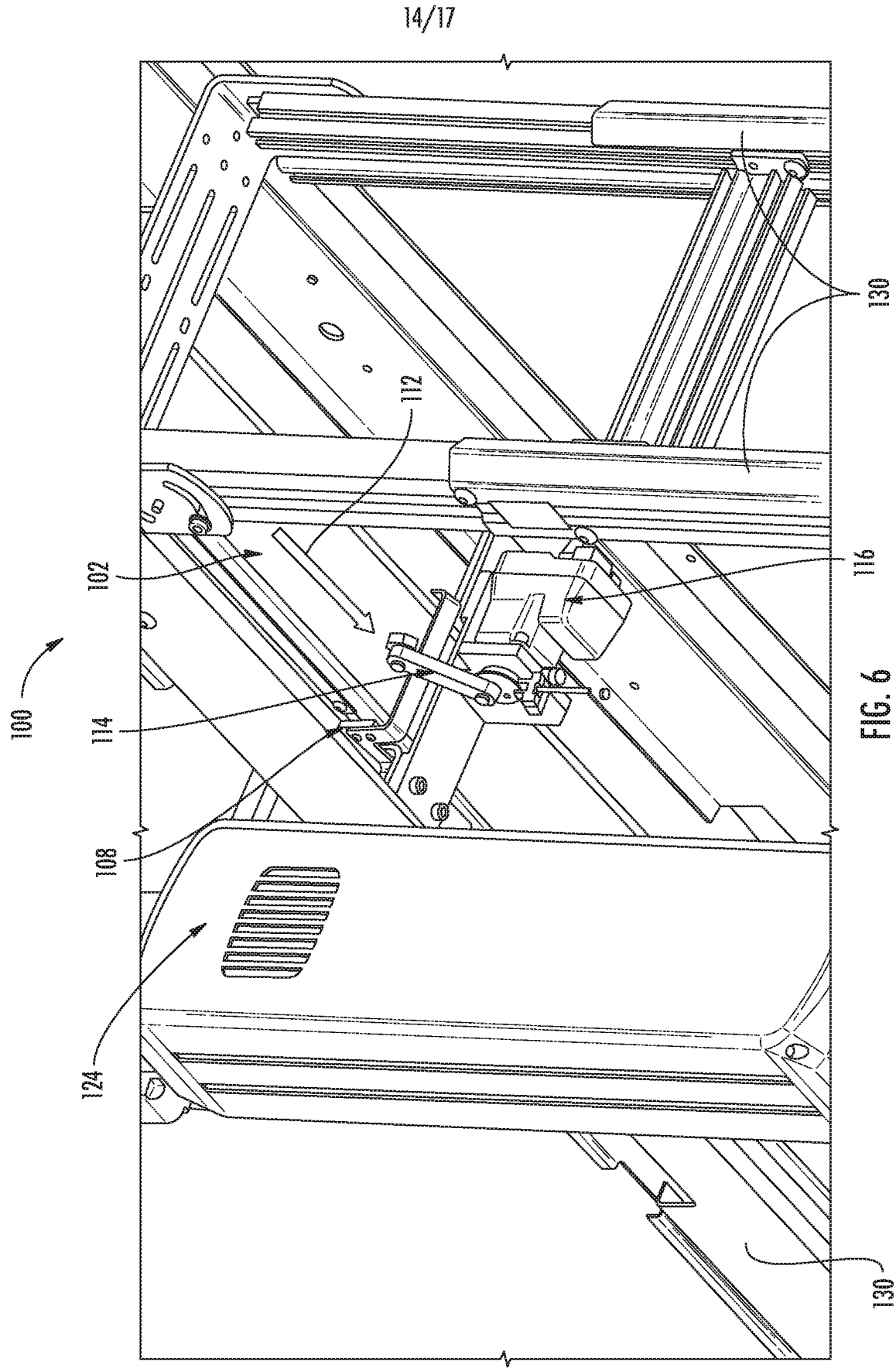


FIG. 4B





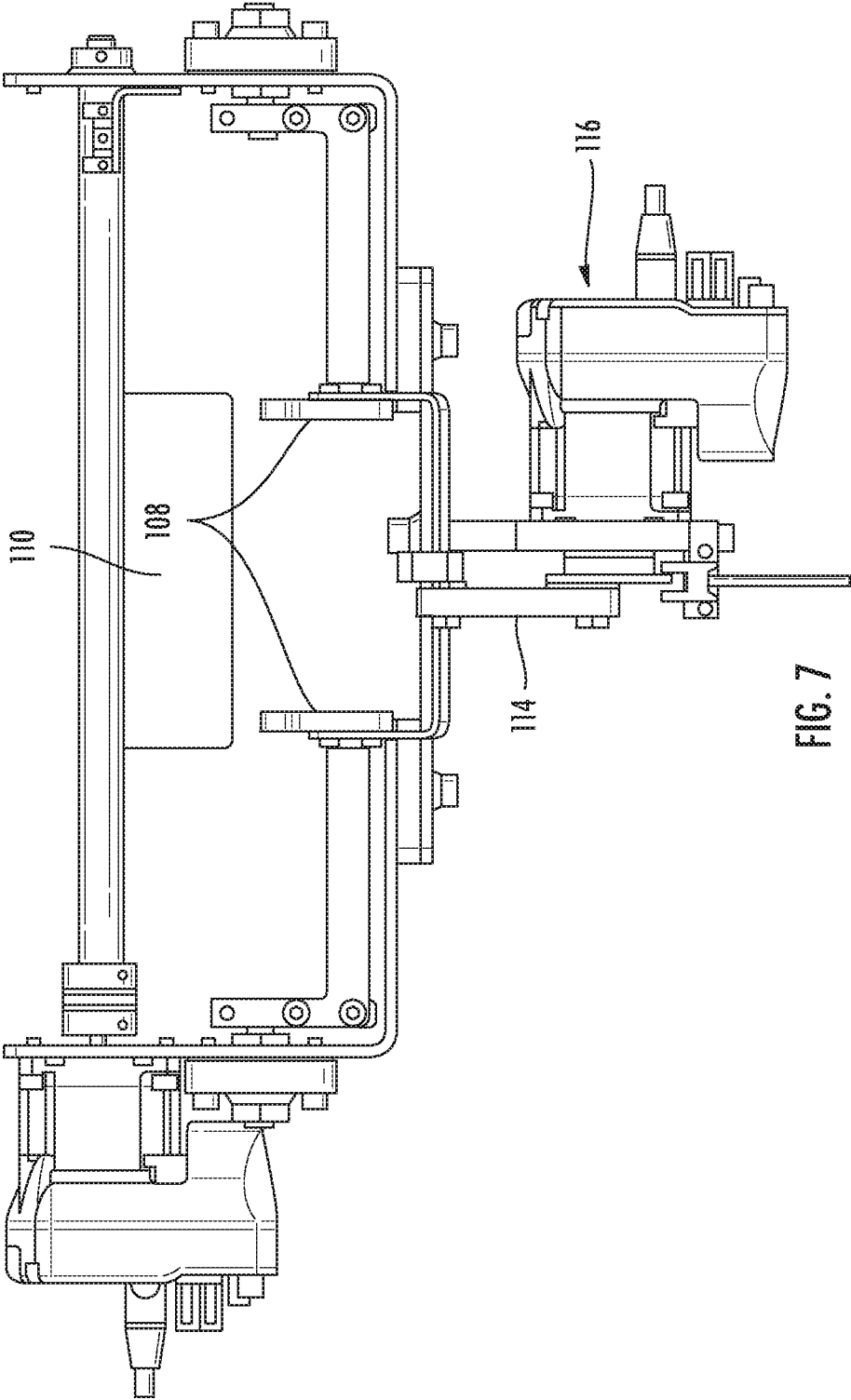
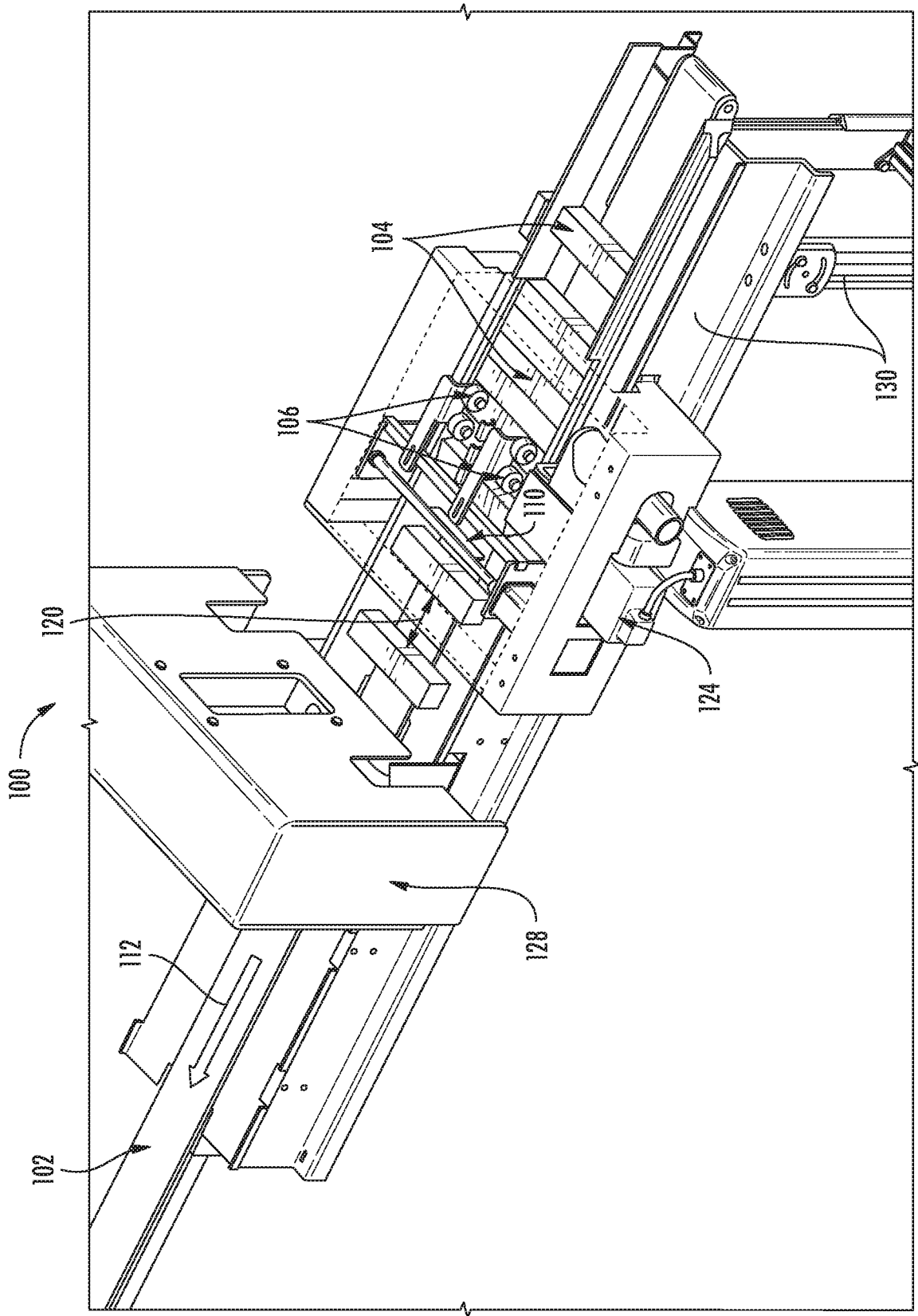


FIG. 7

FIG. 8



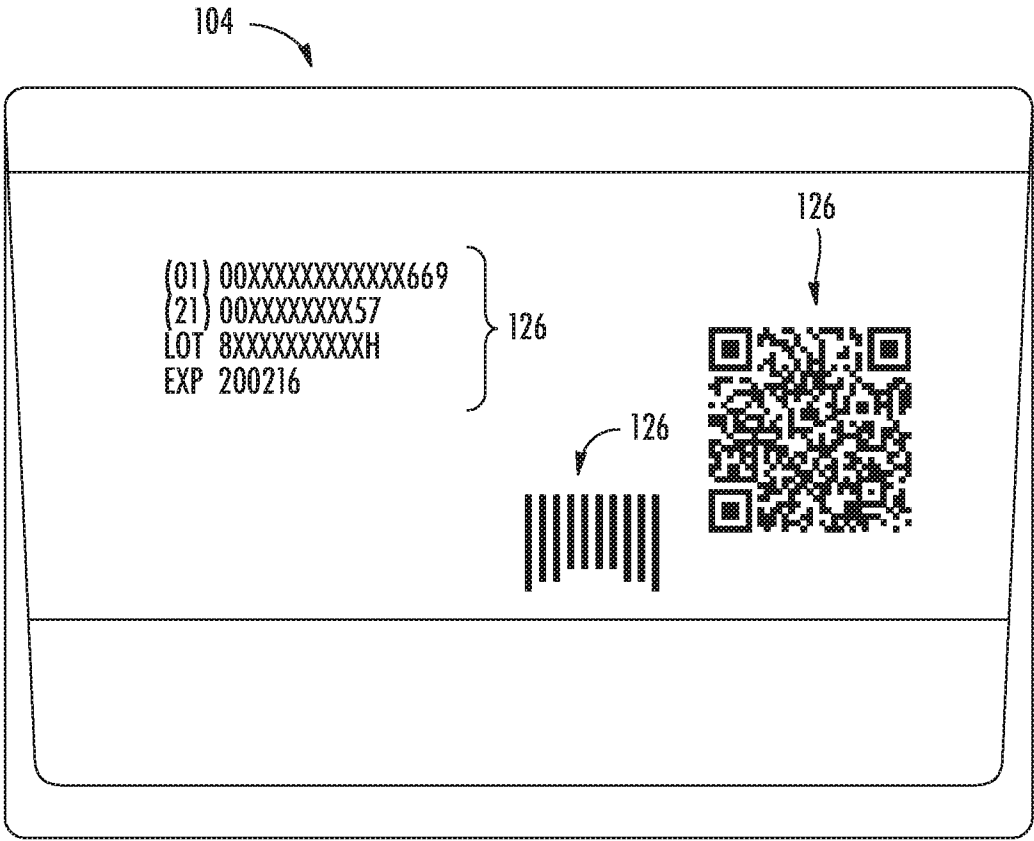


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/026982

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65G47/29 B65G47/88
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 070 992 A (BONKOWSKI LORNE [US]) 10 December 1991 (1991-12-10) column 2, line 50 - column 6, line 15; claims; figures -----	1-40
A	US 4 041 677 A (REID LAURIE M) 16 August 1977 (1977-08-16) column 1, line 60 - column 10, line 9; claims; figures -----	1-40
A	EP 0 747 304 A2 (HITECH ELECTROCONTROLS LTD [GB]) 11 December 1996 (1996-12-11) column 3, line 11 - column 5, line 37; claims; figures -----	1-40
A	US 2 771 177 A (CUTTER RICHARD W ET AL) 20 November 1956 (1956-11-20) column 1, line 43 - column 3, line 75; claims; figures -----	1-40



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

4 July 2019

Date of mailing of the international search report

16/07/2019

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Authorized officer

Hoffert, Rudi

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2019/026982

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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US 4041677	A	16-08-1977	NONE	

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			GB 2301808 A	18-12-1996

US 2771177	A	20-11-1956	NONE	
