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(54) **ADJUSTABLE PERSON SUPPORT SYSTEM WITH EXPANSION WINGS DRIVEN BY DUAL LEADSCREWS AND CENTER MOUNTED MOTORS**

ANPASSBARES PERSONENSTÜTZSYSTEM MIT DURCH ZWEI LEITSPINDELN UND ZENTRAL MONTIERTE MOTOREN ANGETRIEBENE FLÜGEL

SYSTÈME DE SUPPORT DE PERSONNE RÉGLABLE AVEC DES SUPPORTS LATÉRAUX EXTENSIBLES ENTRAÎNÉS PAR DES VIS SANS FIN ET DES MOTEURS MONTÉS SUR LE SUPPORT CENTRAL

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(56) References cited:
EP-A2- 2 762 122
WO-A1-2014/144593
US-A1- 2008 000 028
US-A1- 2013 298 331

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Description

[0001] This disclosure relates to adjustable person support systems. More particularly, but not exclusively, one contemplated embodiment relates to a person support apparatus and mattress configurable to increase and decrease in length and/or width to accommodate a person supported thereon. While various length and/or width adjusting person support systems have been developed, there is still room for improvement. Thus, a need persists for further contributions in this area of technology.

[0002] US 2013/0298331 discloses a bed comprising a fixed width deck section having a width and an outboard edge, a wing movably coupled to the fixed width section, a motor assembly mechanically grounded to one of the fixed width section and the wing, a lead screw having a rotational axis, the lead screw being coupled to the motor assembly and to a lead screw receiver nonmovably associated with the other of the fixed width section and the wing, wherein operation of the motor is capable of moving the wing between a deployed position in which a lateral extremity thereof is outboard of the outboard edge and a stored position in which the lateral extremity is inboard of its deployed position.

[0003] The invention is defined by the claims.

[0004] .

[0005] The invention will now be further described by way of example with reference to the accompanying drawings, in which:

FIG. **1** is a perspective view of an adjustable width person support system, constructed according to one or more of the principles disclosed herein;

FIG. **2** is a perspective view of the upper frame base, deck sections, and deck extensions as seen by an observer looking from beneath the upper frame;

FIGS. **3A** and **3B** are perspective views showing a side of the upper body deck section with a head deck section extension in its deployed or extended state (FIG. **3A**) and in its stored or retracted state (FIG. **3B**) as seen by an observer looking from above the segment. A deck panel which rests atop the deck framework is absent from the illustration in order to expose to view components that would otherwise be obscured;

FIG. **4** is a perspective bottom view of the upper body deck section showing the power extension/retraction system and manual release assembly;

FIG. **5** is an exploded view of the manual release assembly according to one contemplated embodiment;

FIG. **6** is a perspective bottom view of the clasps in an engaged position where the clasps engage the lead screw and allow for powered extension/retraction of the deck extension;

FIG. **7** is a perspective bottom view of the clasps in an disengaged position where one of the clasps doesn't engage the lead screw and the deck extension is movable independent of the lead screw;

FIG. **8** is a perspective top view of the manual release assembly;

FIG. **9** is a side perspective view of a mattress and fluid supply system configured to be supported on the person support apparatus;

FIG. **10** is a schematic plan view of the mattress configured to be used with changeable width person support apparatus, constructed according to one or more of the principles disclosed herein;

FIG. **11** is a block diagram of one embodiment of a system configured to change width of a person support apparatus, constructed according to one or more of the principles disclosed herein;

FIG. **12** is a block diagram of another embodiment of a system configured to change width of a person support apparatus, constructed according to one or more of the principles disclosed herein;

FIG. **13** is a view of a control interface having a retract button and an extend button that a user uses to reduce or expand respectively the width of the person support apparatus;

FIGS. **14A** and **14B** are schematic views of deck extensions staggered according to one or more principles disclosed, wherein the upper body deck extension lags the lower body deck extensions when the deck extensions are extended (FIG. 14A) and leads the lower body deck extensions when the deck extensions are retracted (FIG. 14B);

FIG. **15** is a flow chart of a method of monitoring a connection between a bed controller and a mattress controller.

FIGS. **16-17** show a flowchart showing a first method of changing width of a person support apparatus, constructed according to one or more of the principles disclosed herein; and

FIGS. **18, 18B, 19 and 19B** are flowcharts showing a second method of changing the width of a person support apparatus.

FIG. **20** is a view showing an upper body deck section framework as seen from underneath, the section

comprised of laterally extending supports configured as C-channels and longitudinally extending beams, and also showing portions of a deck extension comprised of spars which nest within the C-channels.

FIG. **21** is view similar to that of FIG. **20** but slightly rotated.

FIG. **22** is a schematic view of a motor assembly.

FIG. **23** is a view of a leadscrew.

FIG. **24** is a schematic plan view of a bed architecture having four deck sections each of which includes a left side motor assembly, a left wing or deck extension driven by the left motor assembly by way of a left leadscrew, a right side motor assembly, and a right wing or deck extension driven by the right motor assembly by way of a right leadscrew.

FIG. **25** is a schematic plan view of a bed architecture having four deck sections and shared left and right motor assemblies mounted on one of the sections such that left and right deck width extensions of that section are directly driven by the respective left and right motor assemblies and such that left and right width extensions of adjacent deck sections are indirectly driven by the motor assemblies as a result of links connecting the directly driven extensions to the indirectly driven extensions.

FIG. **26** is a schematic plan view of a bed architecture having four deck sections and shared left and right motor assemblies mounted on one of the sections such that left and right deck width extensions of that section are directly driven by the respective left and right motor assemblies and such that left and right proximate width extensions are indirectly driven by the motor assemblies as a result of links connecting the directly driven extensions to the proximate indirectly driven extensions and such that left and right remote width extensions are indirectly driven by the motor assemblies as a result of links connecting the remote extensions to the proximate extensions.

[0006] A variable width person support system 100 according to one contemplated embodiment is shown in FIGS. **1-19**. U.S. patent applications 11/774847, 11/775083, 13/468424, and 14/168538 disclose variable width person support apparatus, related systems and methods of use. The person support system **100** includes an adjustable width person support apparatus 110, an adjustable width person support surface or mattress **112** configured to be supported on the person support apparatus **110**, and a control system **114** configured to control the adjustment of the width of the person support apparatus **110** and mattress **112**. One contemplated embodiment of the person support apparatus **110** is shown in FIG.**1** as a bed frame, however, in other embodiments the person support apparatus **110** may be a wheelchair, stretcher or any other apparatus configured to support a person thereon. In another contemplated embodiment, the length of the person support apparatus **110** and mattress **112** can be adjusted. In one example, the length of the person support apparatus **110** and mattress **112** can be adjusted using the Flexafoot™ feature sold by Hill-Rom.

[0007] The person support apparatus **110** comprises a lower frame **116**, an upper frame **118** movably supported above a lower frame **116** by supports (not shown) coupled to the lower frame **116**, a head board **120** at the head end **124** of the person support apparatus **110**, and a foot board **122** at the foot end **126** of the person support apparatus **110** as shown in FIGS. **1** & **2**. The supports are configured to raise and lower at least a portion of the upper frame **118** with respect to the lower frame **116**. The lower frame 116 rests on at least one caster wheel **128** in this embodiment, allowing the person supported apparatus **110** to be transported. The upper frame **118** includes an upper frame base **130** coupled to the supports, a plurality of deck sections **132**, a plurality of deck extensions **134**, a plurality of deck panels **136** supported on the deck sections **132** and deck extensions **134**, and siderails **138**. The siderails **138** are coupled to the deck extensions **134** and cooperate to define a portion of the perimeter of the person support apparatus **110**.

[0008] The deck sections **132** are movably coupled to the upper frame base **130** and are configured to be articulated with respect to one another and the upper frame base **130** between a number of configurations including a substantially co-planar configuration, a reclined configuration, a chair configuration, and various other configurations. The deck sections **132** include an upper body deck section **140**, seat deck section **142**, thigh deck section **144** and foot deck section **146** as shown in FIGS. **1** & **2**. Each of the deck sections **132** includes a corresponding extension **134** (an upper body deck extension **148**, seat deck extension **150**, thigh deck extension **152** and foot deck extension **154**) that can be extended and retracted from the deck sections **132** to increase and decrease the width of the person support apparatus **110**. In this embodiment, the seat, thigh, and foot deck extensions **150**, **152**, and **154** are connected to one another and configured to be extended and retracted together; however, in other embodiments the seat, thigh, and foot deck extensions **150**, **152**, and **154** can be extended/retracted independently.

[0009] In one contemplated embodiment, a user can choose to extend/retract the deck extensions **134** using a powered extension/retraction system **156** by providing an input to the control system **114** or to manually extend/retract the deck extensions **134** by actuating a manual release assembly **158** to disengage the deck extension **134** from the powered extension/retraction system **156**. The powered extension/retraction system **156** includes lead screws **160** rotatably coupled to the deck

sections **132** and configured to be rotated by motors **162**. In one contemplated embodiment, the seat, thigh, and foot deck extensions **150**, **152**, and **154** are connected together and a single motor **162** and lead screw **160** are used to extend/retract them as shown in FIGS. **14A** & **14B**. In one example, a motor **162** is coupled to the upper body deck section **140** and rotates a lead screw **160** when activated by the control system **114** in response to an input from a user to extend/retract the upper body deck extension **148**.

[0010] The manual release assembly **158** includes a separable threaded clasp **164**, a clasp separator **166**, a cable **168**, and a handle **170** as shown in FIGS. **4-8**. In some contemplated embodiments, the clasp **164** is not threaded and is configured to engage and retain a carrier that includes a threaded bore configured to engage the lead screw **160**. The threaded clasp **164** includes a first clasp member **172** and a second clasp member **174** that are aligned substantially perpendicular to the lead screw **160** and are configured to engage the lead screw **160** in an engaged position (FIG. **6**) when adjacent to one another, and configured to disengage the lead screw **160** in a disengaged position (FIG. **7**) when separated from one another. The clasp **164** is moved from the engaged position to the disengaged position by the clasp separator **166** upon actuation of the manual release handle **170** and allows the deck extension **134** to be manually extended/retracted independent of the motion of the lead screw **160**. The first clasp member **172** includes a main body portion **176**, a first guide **178** protruding from the top of the body **176**, a second guide **180** protruding from the top of the body **176**, a lead screw engaging portion **182**, and a guide shaft **184**. The first guide **178** is configured to move along a guide slot **186A** in the deck extension frame **188** as the first clasp member **172** is moved with respect to the second clasp member **174**. In some contemplated embodiments, the first clasp member **172** moves along a path that is substantially perpendicular to the rotational axis of the lead screw **160**. The first guide **178** cooperates with the slot **186A** to maintain alignment of the first and second clasp members **172** and **174**. The second guide **180** is configured to move within a guide slot **190** in the second clasp member **174** and is configured to cooperate with the second clasp guide slot **190** to maintain alignment of the first and second clasp members 172 and 174. The lead screw engaging portion **182** extends from the main body portion 176 and includes a curved end **192** with threads cut therein that are configured to engage the threads on the lead screw **160**. The guide shaft **184** extends opposite the threaded body portion **182** and is configured to move within a bore **194** in the deck extension frame **188** as the first clasp member **172** is moved between the engaged position and the disengaged position. A spring **196** is disposed around the guide shaft **184** and is configured to bias the first clasp member **172** toward the engaged position where the first clasp member **172** and second clasp member **174** engage the lead screw **160**. When the manual release assembly **158** is actuated, the first clasp member **172** is moved away from the second clasp member **174** toward the disengaged position which causes the spring **196** to compress between the main body portion **176** and the deck extension frame **188**. When the manual release assembly is no longer being actuated, the spring **196** expands and biases the first clasp member **172** to move toward the second clasp member **174** and re-engage the lead screw **160.**

[0011] The second clasp member **174** is secured to the deck extension **134** and includes a main body portion **198,** a first guide **200** protruding from the top of the main body portion **198,** a guide slot **190** recessed along the top of the main body portion **198,** and a receiving portion **202** as shown in FIGS. **5-7.** Similar to the first guide **178**, the first guide **200** cooperates with slot **186B** to maintain alignment of the first and second clasp members **172** and **174**. The receiving portion **202** is U-shaped and defines a slot **204** with a non-threaded base **206** recessed into the main body portion **198**. The base **206** Is not threaded like end **192** of the first clasp member **172** because the second clasp member **174**, in this embodiment, is secured to the deck extension **134** and the lead screw **160** remains positioned adjacent to the base **206**. Since the lead screw **160** remains positioned adjacent to the base **206**, it must be able to rotate freely with respect to the second clasp member **174** when the first clasp member **172** is disengaged from the lead screw **160**. The lead screw engaging portion **182** is positioned in the slot **204**, the second guide **180** is positioned in the guide slot **190**, and end **192** and base **206** engage the lead screw **160** when the first and second clasp members **172** and **174** are in the engaged position. In some contemplated embodiments, the first and second clasp members **172** and **174** can both move with respect to the deck extension frame **188** and, in that embodiment, the base **206** could be threaded to engage the lead screw **160**.

[0012] The clasp separator **166** is rotatably coupled to the deck extension frame **188** and is configured to move the first clasp member 172 with respect to the deck extension frame **188** and the second clasp member **174** as the clasp separator **166** is rotated as shown in FIGS. **4-8.** In one contemplated embodiment, the clasp separator **166** and the threaded clasp **164** are coupled to opposite sides of the deck extension frame **188** (i.e., top and bottom). The clasp separator **166** In this embodiment is semi disc-shaped and includes a curved guide **208** that a follower **210** (such as a fastener coupled to the first guide **178**) travels along as the clasp separator **166** rotates thus causing the first clasp member **172** to move with respect to the deck extension frame **188**. In some contemplated embodiments, the clasp separator **166** is disc shaped and Includes two curved guides that engage followers coupled to the first clasp member **172** and the second clasp member **174** and cause the first and second clasp members **172** and **174** to both move with respect to the deck extension frame **188** and disengage the lead screw **160**. A spring **212** is coupled between the clasp separator

166 and a portion of the deck extension frame **188** and configured to help return the clasp separator **166** to the engaged position (where the first clasp portion **172** engages the lead screw **160**) from a disengaged position (where the first clasp portion **172** is disengaged from the lead screw **160**) when the manual release assembly 158 is no longer being actuated.

[0013] The handle **170** is pivotably coupled to the deck extension frame **188** such that it can be easily accessed by a user as shown in FIGS. **4-8**. The cable **168** is connected to the handle **170** and to a side of the clasp separator **166** and is configured to cause the clasp separator **166** to rotate with respect to the deck extension frame **188** by creating a rotational moment about the rotational axis of the clasp separator **166** when the handle **170** is pulled by a user. When the user releases the handle **170**, the rotational moment caused by the cable **168** is relieved and spring **196** expands (and spring **212** contracts), creating a reverse rotational moment about the rotational axis of the clasp separator **166** and moving the first clasp member **172** into engagement with the lead screw **160**. In some contemplated embodiments, the cable **168** could be connected directly to the first clasp member **172** and configured to move it with respect to the deck extension frame **188**.

[0014] The mattress **112** includes a mattress core **214** and mattress side bolsters **216** on either side of the mattress core **214**, and a cover **218** enclosing the mattress core **214** and side bolsters **216** as shown in FIGS. **9** and **10**. In some contemplated embodiments, the mattress **112** also includes length bolsters at the foot end of the mattress **112** (such as those used with the Flexafoot™ feature sold by Hill-Rom). In some contemplated embodiments, the mattress **112** is part of a mattress replacement system (MRS system). One example of a mattress replacement system is the Envison® E700 Low-Air Loss Therapy Surface sold by Hill-Rom. In one contemplated embodiment, the mattress core **214** includes a combination of static components (i.e., static fluid bladders or foam) and dynamic components (i.e., inflatable fluid bladders **220**), and the mattress side bolsters **216** include at least one inflatable fluid bladder **220** or chamber.

[0015] The fluid bladders **220** are in fluid communication with a fluid supply system **222** configured to supply fluid to inflate the bladders **220,** or create a vacuum to deflate the bladders **220**. In one contemplated embodiment, the fluid supply system **222** is configured to inflate/deflated the fluid bladders **220** in the mattress side bolsters **216** in response to the control system **114** sensing an increase/decrease in the width of the person support apparatus **110** or receiving an input from a user indicating a desire for the width of the person support apparatus **110** or the mattress **112** to be increased/decreased. The fluid supply system **222** includes a fluid supply or gas blower **224** that is connected to the fluid bladders **220** by hoses **226**. In some contemplated embodiments, the fluid supply **224** may be a compressor or a pump. The fluid supply **224** is contained within a mattress control box **228** that is hung from the footboard **122**.

[0016] The control system **114** shown in FIGS. **11-13** is configured to control operation of the powered extension/retraction system **156** and fluid supply system **222** in response to an input from the user corresponding to a desired change in width of the person support structure **100** in order to extend/retract the deck extensions **134** and inflate/deflate the side bolsters **220**, respectively. In some contemplated embodiments, other functions of the person support apparatus **110** and/or the mattress **114** may be controlled by the control system **114**, such as, for example, articulation and height adjustment, therapies and alarms. The control system **114** includes a person support apparatus controller or bed controller **230**, a person support apparatus control interface or bed control interface **232**, person support apparatus sensors or bed sensors **234**, a mattress controller **236**, mattress control interface **238**, and mattress sensors **240**. The bed controller 230 is configured to control at least one function of the person support apparatus **110** in response to a user input received via the bed control interface **232** or in response to manual operation to alter the width of a deck section **134** (e.g., a person actuating the manual release assembly **158** and pushing or pulling on the deck extension 134 or the siderail **138** to extend/retract the deck extension **134** manually). The bed controller **230** includes a bed controller processor **242** and a bed controller memory **244**. The bed control interface **232** is in communication with the bed controller processor **242** which is configured to receive a signal indicative of selection of the button **248**. The bed controller memory **244** is configured to store procedures to be executed by the bed controller processor **242** and information regarding the status of the person support apparatus **110**, including the position of at least one of the deck extensions **134**, threshold values of position which would indicate full extension or retraction, and information received from the bed sensors **234** and bed control interface **232**. In one contemplated embodiment, when the deck extension **134** is fully retracted or extended it hits a mechanical stop causing a surge in electric current to the motor **162** which is recorded by the bed controller **230** and used to determine whether the deck extensions **134** are completely extended or retracted.

[0017] The bed sensors **234** are configured to sense characteristics of the bed components, such as, the position of the deck extensions **134** (fully extended/retracted), the position of the siderail **138** (deployed/storage), and the orientation of the deck sections **132**. The bed sensors **234** can include potentiometers, limit switches, hall-effect sensors, or other similar sensing devices and techniques. The bed sensors **234** can be coupled to the extensions **134** and/or the motors **162** or sense the position of the deck extensions **134** with respect to the deck sections **132**. In one contemplated embodiment, potentiometers are mounted on the shafts of the motors **162** to sense the motion of the deck extensions **134** and allow the bed controller **230** to track the position of the exten-

sions **134**. In some contemplated embodiments, the sensors **234** also include force sensors, pressure sensors, and other sensors configured to sense characteristics and statuses of other systems and components of the person support apparatus **110**.

[0018] The bed control interface **232** shown in FIGS. **1** and **11-13** is removably mounted on the siderail **138** in one contemplated embodiment. The bed control interface **232** includes a display **246** configured to display alerts and visual messages to a viewer, and at least one button **248** to control the extension and retraction of at least one deck extension **134**. The display **246** in one embodiment is a Liquid Crystal Display (LCD) screen although any other technology could is used in other embodiments. The button **248** is a physical push button while in another embodiment the display **246** is a touch sensitive screen and button **248** is displayed on the touch sensitive screen. The bed control interface **232** shown in FIG. **13** may employ a button **248** for commanding both extension and retraction while in other embodiments the bed control interface **232** may comprise one button for commanding extension **248E** and a separate button for commanding retraction **248R**. The control interface **232** also has indicator lights **250E** and **250R**. When the extensions **134** are fully extended, light **250E** glows steady green and light 250R is off. When the extensions **134** are fully retracted, light **250R** glows steady green and light **250E** is off. When the extensions **134** are in an intermediate state (neither fully extended nor fully retracted) one or both of the lights **250E** and **250R** flashes amber.

[0019] The mattress control interface **238**, as shown in FIGS. **11** & **12**, is coupled to the mattress control box 228 and is configured to display alerts and visual messages to a viewer. In some contemplated embodiments, the alerts and visual messages provide information about the status of the mattress **112**, the fluid supply **224**, and therapies being provided by the mattress **112**. In one contemplated embodiment, the mattress control interface **238** is constructed like the bed control interface **232** above and includes a display **256** and at least one button **258** to control the extension and retraction of the side bolsters **216**. The mattress control interface **238** can also include buttons for controlling other functions of the mattress **112**, including, activating/deactivating therapies and increasing/decreasing pressure within the fluid bladders **220**.

[0020] The mattress controller **236** is configured to control the fluid supply system **222** in response to a user input provided via the mattress control interface **238** (or via the bed control interface **232** when the mattress controller **236** and the bed controller **230** are in communication with one another). The mattress controller **236** includes a mattress controller processor **252** and mattress controller memory **254** as shown in FIGS. **11** & **12**. The mattress controller memory **254** is configured to store procedures that may be executed by processor **252** and information regarding the status of the mattress **112**, including the pressure within the side bolsters **216**, threshold values of pressure which would indicate full inflation or deflation of the side bolsters **216**, and information received the mattress sensors **240** or mattress control interface **238**. The mattress controller **236** is enclosed in the mattress control box **228** and is electrically coupled to the fluid supply **224**, the mattress control interface **238**, and the mattress sensors 240. In some contemplated embodiments where the mattress 112 is integrated with the person support apparatus 110, the mattress controller 236 may be located with the bed controller 230, or combined with the bed controller 230 such that the bed controller 230 may be used to control functions of both the person support apparatus 110 and the mattress 112.

[0021] The mattress sensors 240 are configured to sense various characteristics of the mattress components, such as, the fluid pressure within the side bolsters 216 (fully extended/retracted), and to provide the sensed information to the mattress controller 236. In one contemplated embodiment, the mattress sensors **240** include pressure transducers that are configured to provide a signal indicative of the pressure inside the side bolsters **216** so that the mattress controller **236** can determine the inflation level of the side bolsters **216** (i.e., when they are fully deflated or fully inflated or partially inflated). In other contemplated embodiments, the mattress sensors **240** include temperature sensors, moisture sensors, force sensors, and other sensors, coupled to the mattress **112** to sense characteristics of the mattress **112**, the fluid bladders **220**, and/or the person positioned on the mattress **112**. When the deck extensions **134** are retracted manually, the side rails **138** apply pressure on the side bolsters **216** as a user pushes the siderail **138** against the mattress **112**, which causes a signal from the pressure transducer **240** to indicate a spike in pressure. If the mattress controller **236** determines that the spike is greater than a predetermined threshold, then the mattress controller **236** causes the fluid supply **224** to initiate deflation of the side bolsters **216**.

[0022] The mattress controller **236** and the bed controller **230** are configured to communicate with one another to affect the extension/retraction of the deck extensions **134** and side bolsters **216**. In some contemplated embodiments, the mattress controller **236** is configured to use the bed controller **230** as a communication hub to communicate information about the mattress **112** to caregivers via nurse call systems, to electronic medical record systems, and to other devices and systems. In the case of a mattress replacement system, the mattress controller **236** is in electrical communication with the bed controller **230** via a wired or wireless connection. In one contemplated embodiment, the mattress controller **236** communicates alarm signals to the bed controller **230** so that, instead of an alarm on the control box **228** being activated to alert people in or near the patient's room, a remote caregiver can be notified by the nurse call system of the alert. In other contemplated embodiments, the mattress controller **236** can communicate patient position information, therapy history (which can be used for com-

pliance tracking), cushion pressures (which can indicate a fluid supply **32** issue or a leak), and/or other information about the mattress **16** or patient positioned thereon to a caregiver over a nurse call system or other caregiver alert system, an electronic medical record system, or the person support apparatus **110** or other medical devices in communication with the person support apparatus **110**.

[0023] In one contemplated embodiment, when the mattress controller **236** is in electrical communication with the bed controller **230**, the mattress control interface **238** on the control box **228** is disabled and the bed control interface **232** is used to control the functions of both the person support apparatus **110** and the mattress **112**. In some contemplated embodiments, the mattress control interface **238** on the control box **228** does not display any information when it is deactivated. In another contemplated embodiment, the mattress control interface **238** can display information and/or errors, but control functions are locked out so that the user cannot control the operation of the mattress **112** from it. In some contemplated embodiments, the bed control interface **232** could be locked out instead of the mattress control interface **238**. In some contemplated embodiments, the controls for inflating/deflating the side bolsters **216** from the bed control interface **232** and the mattress control interface **238** are disabled since the function is controlled as part of the width adjustment algorithm.

[0024] The mattress controller **236** and bed controller **230** periodically exchange a status signal to determine if they are connected. When communication between the bed controller **230** and the mattress controller **236** is interrupted, the mattress control interface **238** on the control box **228** is enabled (or re-activated) and allows the user to control the operation of the mattress **112**. In some contemplated embodiments, visual and/or audible indicators are used to indicate when communication between the bed controller **230** and the mattress controller **236** is lost or interrupted; the loss of communication is sensed as an event, not a status. In another contemplated embodiment, when communication between the bed controller **230** and the mattress controller **236** is interrupted, the side bolsters **216** are deflated and retracted. A user may, subsequently, extend the side bolsters **216** to a desired position by pressing the corresponding button **258** on the mattress control interface **238**. In another contemplated embodiment when communication between the bed controller **230** and the mattress controller **236** is lost, the deck extension/retraction function is locked out to prevent the user from using the powered extension/retraction system **156** to retract the deck section **134** and the mattress controller **236** maintains the mattress **112** in the state it was in prior to the mattress controller **236** losing communication with the bed controller **230**.

[0025] In operation, the bed controller **230** and mattress controller **236** determine whether they are connected and, if so, the mattress controller **236** disables the mattress control interface **238** and routes all mattress control functions to the bed control interface **232**. When the bed control interface **232** receives input indicative of a user's desire to increase or decrease the width of the person support apparatus **110** and mattress **112**, the bed controller **230** activates the powered extension/retraction system **156** on the person support apparatus **110** to move the deck extensions **134** in the desired manner, and provides the mattress controller **236** with the information corresponding to the user's desired action. The mattress controller **236** uses the information from the bed controller **230** to control the operation of the fluid supply **224** to inflate/deflate the side bolsters 216. If the user does not fully extend or retract the deck extensions **134**, the bed controller **230** sends a signal to the mattress controller **236** and the mattress controller **236** causes the side bolsters **216** to deflate and retract (or to maintain the fully retracted position). The user can manually override the deflation/retraction of the side bolsters **216** by controlling the mattress **112** directly through the mattress control interface **238**. In some contemplated embodiments, if communication between the controllers is interrupted at any time, the side bolsters **216** are deflated and retracted.

[0026] A flow chart **260** of a method of monitoring the connection between the bed controller 230 and the mattress controller **236** according to one contemplated embodiment is shown in FIG. **15**. In one contemplated embodiment, the procedure for monitoring the connection between the bed controller **230** and mattress controller **236** loops continuously. At operation **262**, a determination is made the bed controller **230** and mattress controller 236 as to whether the controllers are in communication with one another. This can be accomplished when either controller fails to receive a periodic status signal from the other controller. If the controllers are in communication, then the mattress **112** is controlled through the mattress control interface **238** and the person support apparatus **110** is controlled through the bed interface **232** at step **264**. The controllers return to monitoring the status of the connection between them at operation **262**.

[0027] If the controllers are in communication, then the mattress control interface **238** is disabled (or at least the function control buttons are deactivated while information and alerts are still able to be displayed) and the mattress **112** is controlled through the bed control interface **232** at step **266**. The controllers return to monitoring the status of the connection between them in operation **268** to determine if communications between the controllers is interrupted. If the communication between the controllers is not interrupted, the mattress control interface **238** remains disabled and the mattress **112** continues to be controlled through the bed control interface **232** at step **270**, and the controllers return to monitoring the status of the communication connection at operation **268**. In one contemplated embodiment, if the communication is interrupted, then a visual and/or audible alert is generated to indicate that communications have been interrupted between the controllers at operation **272**, the mattress controller **238** maintains the status of the mattress **112**

just prior to communication between the controllers being interrupted, and the bed controller **230** disables the powered width expansion function at operation **274** before proceeding to operation **264**. In another contemplated embodiment, if communication is interrupted, a visual and/or audible alert is generated to indicate that communications have been interrupted between the controllers and the mattress controller **236** retracts the side bolsters **216** by deflating them before proceeding to operation **264**.

[0028] A flowchart **276** of a method of decreasing and increasing the width of a person support apparatus **110** according to one contemplated embodiment is shown in FIGS. 16 and **17**, respectively. At operation **278**, a determination is made by the bed controller **230** as to whether the deck extensions **134** are completely extended. If the deck extensions **134** are completely extended, the bed controller **130** senses selection of the retraction button **248R** in operation **280** after which the system waits for a predetermined time, in one embodiment 2 seconds, in other embodiments, any amount of time in operation **282**. The bed controller **230** sends a signal to the mattress controller **236** to deflate the mattress side bolsters **216** in operation **284**. Mattress controller **236** monitors deflation of the mattress side bolsters **216** in operation **286**. Mattress controller **236** determines if the mattress side bolsters **216** are completely deflated in operation **288**. In one embodiment the mattress controller **236** makes this determination by comparing a pressure derived from the signal supplied by pressure transducer **240** with a predetermined threshold which in one embodiment may be defined by a user though control interface **232**. In another embodiment the mattress controller **236** determines if the mattress side bolsters **216** are completely deflated by tracking the time spent deflating the mattress side bolsters **216**. If the mattress controller **236** determines that the mattress side bolsters **216** are not completely deflated it sends a corresponding signal to the bed controller **230** at operation **290**. The bed controller **230** sends the signal to the control interface **232** through which an audio indication and / or a visual indication on display **246** of ongoing mattress side bolster **216** deflation is communicated. If mattress controller **236** determines that deflation is complete at block **290** it communicates with the bed controller **230**. The bed controller **230** sends a signal to the control interface **232** through which an audio indication and / or a visual indication on display **246** of completion of mattress side bolster **216** deflation is communicated in operation **292**. The bed controller **230** now checks to determine whether retraction button **248R** is selected at operation **294**. If not, the bed controller 230 communicates a signal to the control interface **232** to display a message indicating that the mattress side bolsters **216** are deflated. If the bed controller **58** determines that the retraction button 248R is selected, it sends a signal to motors **162** coupled to the upper body deck section **140** and the lower body deck sections **142**, **144**, and **146** to begin retracting the deck extensions **134**; the bed controller **230** monitors actuation of the deck extensions **134** in operation **296**. In one contemplated embodiment, the deck extensions **134** are prevented from retracting if the deck sections **132** are in an articulated configuration. In another contemplated embodiment, articulation of the deck sections **132** is disabled while the extensions **134** are being extended/retracted. In another contemplated embodiment, extension/retraction of the deck extensions **134** and inflation/deflation of the side bolsters **216** are performed substantially simultaneously.

[0029] During actuation of the deck extensions **134**, the bed controller **230** determines whether the deck extensions **134** are staggered in operation **298**. In one contemplated embodiment, the bed controller **230** can determine whether the deck extensions **134** are staggered based on information sensed by the bed sensors **234** (for example, in one embodiment the bed sensors **234** include limit switches, while in another embodiment the bed sensor **234** include a potentiometer coupled to the motors **162** which the controller **230** can use to calculate the positions of the extensions **134**). In another contemplated embodiment, the bed controller **230** can determine whether the deck extensions **134** are staggered by examining whether the motors **162** are synchronized where actuation of one extension **134** was delayed when compared the other extension **134**. Staggering of the deck sections **134** can be achieved a number of ways. In one contemplated embodiment, the upper body deck extension **148** is retracted at faster speed than the lower body deck sections **150**, **152**, and **154**, and extended at a slower speed than the lower body deck sections **150**, **152**, and **154** to stagger the extensions **134** such that the siderails **138** coupled thereto are not co-planar until the extensions **134** are fully extended. In another contemplated embodiment, the lower body deck extension **150**, **152**, and **154** and the upper body deck extension **148** are extended/retracted at substantially the same speed, but retraction of the lower body deck extensions **150**, **152**, and **154** are started a predetermined amount of time after retraction of the upper body deck extension **148**, and extension of the lower body deck extensions **150**, **152**, and **154** are started at a predetermined time before extension of the upper body deck extension **148**. Staggering the movement of the deck sections **134** helps to prevent potential interferences between the siderails **138** coupled to the deck sections **134** when the person support apparatus **110** is articulated.

[0030] The bed controller **230** monitors whether the end of travel indicative of complete retraction of deck extensions **134** has been reached based on signals from the potentiometer and/or current readings from the motors **162** in operation **300**. In one contemplated embodiment, each extension **134** is extended/retracted to its limit irrespective of the staggering of the extensions **134**. In another contemplated embodiment, the extensions **134** are extended/retracted until the first extension **134** reaches its limit, which maintains the extensions **134** in a staggered state. If the bed controller **230** determines

complete extension/retraction of the deck extensions **134** has been reached, the bed controller **230** sends a signal to the motors **162** to stop actuation. If the bed controller **230** determines that the deck extensions **134** have not been completely extended/retracted upon the occurrence of a condition, the bed controller **230** can cause the person support apparatus **110** or mattress **112** to perform or lock out various functions. In one contemplated embodiment, the conditions include the user releasing the button **248** prior to the extensions **134** being fully extended/retracted, a bed power cord being unplugged, or the person support apparatus 110 being powered by a battery system (in one contemplated embodiment, the mattress controller **236** and fluid supply 224 are not powered by the person support apparatus **110** battery and the side bolsters **216** cannot be deflated or inflated when the person support apparatus **110** is running on the battery). When one of the aforementioned conditions occur it can cause the bed controller **230** to lock out articulation of the deck sections **132**, generate an audible alarm, and/or flash an amber colored light **250** on the bed control interface **232**. The bed controller **230** is also configured to generate fault codes for display on the bed control interface **232** or using diagnostic LEDs when, for example, the extension and retraction limits are not reached within a predetermined time, movement of the extension **134** is not sensed after the bed controller **230** sends a signal to the motor **162** to extend/retract the extension **134**, the motor **162** is disconnected from the circuit, the bed sensors **234** or mattress sensors **240** signals are outside of an expected range, or the extend and retract limits are simultaneously met. When the fault codes are generated, the bed controller **230** can lock out the width expansion function and/or generate an audible alert or flash the light **250** to alert the user. In some contemplated embodiments, the sensors **234** and **240** are monitored real time and the position of each extension **134** is calculated at all times whether moving or stationary. In this embodiment, if the deck extensions **134** are not extended/retracted completely, the control system **114** determines whether the extensions **134** are substantially aligned. If they are not, then articulation of the deck sections **132** is prevented (specifically raising the upper body deck section **140** is prevented).

[0031] At operation **302**, a determination is made by the bed controller **230** as to whether the deck extensions **134** are completely retracted. In one contemplated embodiment, if the deck extensions **134** are not completely extended or retracted, then the bed controller **230** generates an audible and/or visual alert and disables articulation of the deck sections **132**. In this embodiment, raising the upper body deck section **140** can be disabled while lowering the upper body deck section **140** can still enabled. In another contemplated embodiment, if the deck extensions **134** are not completely extended or retracted, then the bed controller **230** sends a signal to the mattress controller **236** to cause the side bolsters **216** to retract. If the deck extensions **134** are completely retracted, the bed controller **230** checks to determine whether extension button **248E** is selected at operation **306**. If the bed controller **230** determines that the extension button **248E** is selected, it sends a signal to upper body deck width motor **162** and lower body deck width motor **162** to begin extending the deck extensions **134**; the bed controller **230** monitors actuation of the deck extensions **134** in operation **308**. During actuation of the deck extensions **134**, the bed controller **230** determines whether the deck extensions **134** are staggered in operation **310**. If the bed controller **230** determines that the deck extensions **134** are not staggered, it sends a signal to the control interface **232** to display an error message. In some contemplated embodiments, the controller **230** can modify the speed at which the motors **162** are extending or retracting the extensions **134** to generate the desired stagger. If the bed controller **230** determines that the deck extensions **134** are staggered, the bed controller **230** monitors whether the end of travel indicative of complete extension has been reached based on signals from the potentiometer **234** and/or current readings from the motors **162** in operation **144**. If the bed controller **230** determines that complete extension of each deck extension **134** has been reached, the bed controller **230** sends a signal to the motors **162** to stop actuation. If the bed controller **230** determines that the deck extensions **134** have not been completely extended, the bed controller **230** continues to monitor whether the motors **162** are staggered in step **310**.

[0032] In operation **312** if it is determined by the bed controller **230** that the deck extensions **134** are completely extended, the bed controller senses selection of the extension button **248E** in operation **314** after which the system waits for a predetermined time, in one embodiment 2 seconds, in other embodiments, any amount of time in operation **316**. The bed controller **230** sends a signal to the mattress controller **236** to inflate the mattress side bolsters **216** in operation **318**. Mattress controller **236** monitors inflation of the mattress side bolsters **216** in operation **320**. Mattress controller **236** determines if the mattress side bolsters **216** are completely inflated in operation **322**. In one embodiment the mattress controller **236** makes this determination by comparing a pressure derived from the signal supplied by pressure transducer **240** with a predetermined threshold which in one embodiment may be defined by a user though control interface **232**. In another embodiment the mattress controller **236** determines if the mattress side bolsters **216** are completely inflated by tracking the time spent inflating the mattress side bolsters **216**. In operation **322** if the mattress controller **236** determines the mattress side bolsters **216** are not completely inflated, it sends a corresponding signal to the bed controller **230**. The bed controller **230** sends a signal to the control interface **232** through which an audio indication and / or a visual indication on display **246** of ongoing mattress side bolster **216** inflation is communicated in operation **324**. If mattress controller **236** determines that inflation is complete it communicates

with the bed controller **230**. The bed controller **230** sends a signal to the control interface **232** through which an audio indication and / or a visual indication on display **246** of completion of mattress side bolster **216** inflation is communicated in operation **326**.

[0033] In this embodiment the mattress side bolsters **216** are configured to toggle between a fully inflated state and a fully deflated state. In one embodiment the pressure indicative of full inflation is variable based on weight of the patient supported by the mattress **112** to a predetermined pressure relief set point. In another embodiment the pressure indicative of full inflation may be input by a user via the control interface **232**. In another contemplated embodiment, pressure indicative of full inflation is a function of the position of the extension **134**.

[0034] FIGS. **18** and **19** are block diagrams **328** showing a second method of altering the width of the bed **110** according to another contemplated embodiment. In FIG. **18**, block **330** tests whether or not the bed controller **230** senses that retract button **248R** is being pressed. If not the method proceeds to block **358** of FIG. **19** and tests whether or not the bed controller **230** senses that extend button **248E** is being pressed. However if the test at block 202 reveals that the retract button **248R** is being pressed the method proceeds to block **332**. Pressing either button **248R** or **248E** generates a command to alter the width of the bed **110**. The commands are of opposite polarity, i.e. one is to retract, the other is to extend.

[0035] Block **332** tests whether or not the deck extensions **134** are at their limit of retraction. If so, the method stops except for continuing the tests of blocks **330** (FIG. **18**) and **358** (FIG. **19**). If the deck extensions **134** are not at their limit of retraction the method proceeds along paths **334A** and **334B** to blocks **352** (FIG. **18B**) and **336** (FIG. **18**) respectively. First considering path **334A**, at block **352** the bed controller **230** monitors whether the deck extensions **134** (which are being moved as a result of a user continuing to press the retract button **248R**) are staggered. If not the method proceeds to block **356** and changes the motors **162** speed to stagger the deck sections **134**. If so the method branches to block **350** (FIG. **18**). Now considering path **334B**, at block **336** the method pauses or delays for a brief time interval (a second or two) while continuing to monitor whether or not the retract button **248R** is still being pressed. If the user has continued to apply pressure to the retract button **248R** throughout the pause interval, the method proceeds to block **338**. However if user pressure on the retract button **248R** is discontinued during the pause interval the method does not proceed to block **338**. The pause interval enables the method to distinguish between a genuine user command and a brief inadvertent touch of the retract button **248R.**

[0036] Block **338** tests whether or not deflation of the side bolsters **216** has begun. If not the bed controller **230** issues a "deflate" command to the mattress controller **236** at block **340**. The mattress controller **236** responds by beginning deflation of the side bolsters **216**. At block **342** the mattress controller **236** monitors deflation progress and proceeds to block **344**. At block **344** the method tests whether or not deflation is complete either as a result of the actions at blocks **340** and **342** or as a result of having arrived directly at block **344** from block **338**. If the test at block **344** reveals that deflation is not complete the method continues the deflation process and sends a visual and/or aural indication of the ongoing deflation. One example of a visual indication is the flashing yellow illumination of one of lights **250E** and **250R** as described above. If the test at block **344** reveals that deflation is complete the method proceeds to block 348 where the mattress controller **236** signals the bed controller **230** that deflation is complete and sends a visual and/or aural indication of the fact that deflation is complete. One example of a visual indication is the steady green illumination of light **250R** as described above.

[0037] Irrespective of whether the method has followed path **334A** through blocks **352** and **354** or has followed path **334B** through the appropriate blocks beyond block **336**, the method arrives at block **350** where it tests whether or not the deck extensions **134** are at their limit of retraction. If not, the method returns to block **330**. If so, the method stops, except for continuing to monitor for whether or not the extend and retract buttons 248E and 248R are being pressed.

[0038] The portion of the method outlined in FIG. **19** is similar to the portion of the method disclosed in FIG. **18** but shows how the method responds to user pressure applied to the extend button **248E**. In FIG. **19**, block **358** tests whether or not the bed controller **230** senses that extend button **248E** is being pressed. If not the method stops, although the test of block **358** (and of block **330** in FIG. **18**) continues to be made. However if the test at block **358** reveals that the extend **248E** button is being pressed the method proceeds to block **360**.

[0039] Block **360** tests whether or not the deck extensions **134** are at their limit of extension. If so, the method stops except for continuing the tests of blocks **330** and **358**. If the deck extensions 134 are not at their limit of retraction the method proceeds along paths **362A** and **362B** to blocks **380** (FIG. **19B**) and **364** (FIG. **19**) respectively. First considering path **362A**, at block **380** the bed controller **230** monitors whether the deck extensions **134** (which are being moved as a result of a user continuing to press the extend button **248E**) are staggered. If not the method proceeds to block **384** and changes the speed of the motors **162** to stagger the deck sections 134. If so the method branches to block **378** (FIG. **19**). Now considering path **362B**, at block **364** the method pauses or delays for a brief time interval (a second or two) while continuing to monitor whether or not the extend button **248E** is still being pressed. If the user has continued to apply pressure to the extend button **248E** throughout the pause interval, the method proceeds to block **366**. However if user pressure on the extend button **248E** is discontinued during the pause interval the method does not proceed to block **366**. The pause interval enables the method to distinguish between a genuine user command

and a brief inadvertent touch of the retract button **248E**.

[0040] Block **366** tests whether or not inflation of the side bolsters **216** has begun. If not the bed controller **230** issues a "inflate" command to the mattress controller **236** at block **368**. The mattress controller **236** responds by beginning inflation of the side bolsters **216**. At block **370** the mattress controller **236** monitors inflation progress and proceeds to block **372**. At block **372** the method tests whether or not inflation is complete either as a result of the actions at blocks **368** and **370** or as a result of having arrived directly at block **372** from block **366**. If the test at block **372** reveals that inflation is not complete the method continues the inflation process and sends a visual and/or aural indication of the ongoing inflation. One example of a visual indication is the flashing yellow illumination of one of lights **250E** and **250R** as described above. If the test at block **372** reveals that inflation is complete the method proceeds to block **376** where the mattress controller **236** signals the bed controller **230** that inflation is complete and sends a visual and/or aural indication of the fact that inflation is complete. One example of a visual indication is the steady green illumination of light **250E** as described above.

[0041] Irrespective of whether the method has followed path **362A** through blocks **380** and **382** or has followed path **362B** through the appropriate blocks beyond block **364**, the method arrives at block **378** where it tests whether or not the deck extensions **134** are at their limit of extension. If not, the method returns to block **358**. If so, the method stops, except for continuing to monitor for whether or not the extend and retract buttons **248E** and **248R** are being pressed.

[0042] As previously noted the deck extensions 134 can be extended and retracted manually. In the case of manual operation the step of determining whether or not the extend or retract buttons **248E** or **248R** are pressed (blocks **330** and **358**) will not yield a "yes" answer. However the bed controller **230** is still able to monitor current readings or potentiometer **240** signals to track the position of the deck extension **134**, including whether or not the deck extension **134** is at its extend limit or retract limit. As a result the method for manual operation is the same except that instead of being initiated by the bed controller **230** sensing whether or not the retract or extend button **248E** or **248R** is being pressed (blocks **330**, **358**) it is initiated by changes in the current readings or potentiometer signals. Similar to the case of push-button operation, manual operation generates a width alteration command. If a user pushes on the deck extensions **134** (or a component attached to the deck extensions **134**) to cause the deck extensions **134** to retract, the command is a retract command. If a user pulls on the deck extensions **134** (or a component attached to the deck extensions **134**) to cause the deck extensions **134** to extend, the command is an extend command. The retract and extend commands are of opposite polarity.

[0043] The foregoing description and associated FIGS. **18** and **19** address retraction and extension explicitly. More generally the method monitors for a command to alter the width of the deck and determines the polarity of the command (blocks **330**, **358**). The method ensures that the deck extension **134** is not at a limit inconsistent with the polarity of the command (blocks **330**, **358**), operates powered extension/retraction system **156** to move the deck extension **134** in a direction consistent with the polarity of the command (implicit in blocks **352**, **380**) and issues a fluid supply control signal (not explicitly shown, but a consequence of blocks **340**, **368**) to operate the fluid supply **224** in a manner consistent with the polarity of the command. The fluid supply control signal is issued in response to a mattress control signal (output of blocks **340**, **368**). The mattress control signal is generated in response to the command.

[0044] The method monitors response of the mattress 112 to operation of the fluid supply 224 at blocks 342, 370. The method of curtails operation of powered extension/retraction system 156 in response to the deck extension 134 reaching a limit consistent with the polarity of the command. The issuing step is conditioned on continued presence of the command during a pause interval (blocks 336, 364). The method also includes the step of providing an indication distinguishing between completion and incompletion of width adjustment (blocks 346, 374).

[0045] Referring principally to FIGS. **5** and **8**, an embodiment of upper body section deck extension **148**, also referred to as a wing, includes laterally extending spars **402** and a laterally outboard, longitudinally extending rail **404**. A bridge **406** spans between the two longitudinally innermost spars **402B**, **402C**. As already described clasp **164** and clasp separator **166** are mounted to the wing.

[0046] Referring to FIGS. **4-8** and **20-23** an embodiment of the upper frame **118** of a person support apparatus includes an upper body deck section **140** having a framework which includes laterally extending supports configured as C-channels **410**. One of each of the wing spars **402A**, **402B**, **402C**, **402D** nests within a corresponding C-channel **410A**, **410B, 410C**, **410D** so that the spars are laterally translatable with respect to the channels. The illustrated embodiment includes four wing spars and four C-channels, however other quantities of spars and channels in a one to one correspondence may be used depending on design requirements. Friction reducing elements such as rollers (not visible in the illustrations) are used to reduce friction between the spars and the C-channels. The upper body deck section framework also includes longitudinally extending beams **412**. Beam **412C** coincides with deck section centerline **416** and may be referred to as a center beam.

[0047] A bearing block **418** projects upwardly from each of the beams except for the center beam. Two bearing blocks **418B**, **418D** are partially visible in FIG. **20**, one extending from a flange portion of beam **412B**, the other extending from a flange portion of beam **412D**. Two additional bearing blocks, **418A**, **418E**, are partially visible in FIG. **21**, one extending from beam **412A**, the other

extending from beam **412E**. A hole, not visible, extends through each bearing block such that the hole axis is parallel to the leadscrew axis which is shown in FIG. **23**. A bushing, also not visible, resides in each bearing block hole. One or more motor mount brackets **422** supports left and right motor assemblies **424L**, **424R** from the center beam (left and right are taken from the vantage point of a person lying face up on the person support system with his head nearer to the head end of the person support system and his feet nearer the foot end of the person support system.

[0048] Due to symmetry it will suffice to describe only one representative motor assembly (the right motor assembly) and the elements associated with it. Accordingly, the suffixes **L** and **R** will be appended to the reference numerals only as needed in the remainder of this description. Referring to FIG. **22** representative motor assembly **424** includes a motor **162** with an output shaft **426** and a worm gear **428** at the end of the shaft. The shaft and worm are rotatable about a motor axis **432** which extends substantially parallel to centerline **416**. The motor assembly also includes a pinion **434** engaged with the worm and having a pinion shaft **436** rotatable about a pinion shaft rotational axis **438**. Taken together the worm and pinion define a gear train.

[0049] Referring to FIG. **23** an inboard end of leadscrew **160** includes a spline **450**. The leadscrew also includes a drive thread **452** interrupted by inboard and outboard unthreaded segments **454**, **456**. The terms "inboard" and "outboard" refer to locations laterally closer to or laterally more distant from centerline **416**. The spline is engaged with the pinion shaft **436**. The leadscrew extends away from the motor assembly and through a clasp **164** on the same lateral side of the bed so that drive threads **452** engage the threads on threaded end **192** of clasp member **172** (FIG. 5). The leadscrew also extends through the bushings in the two bearing blocks **418** on the same lateral side of the bed.

[0050] As seen best in FIG. **20** an inboard ring **464** circumscribes the inboard unthreaded segment **454** of the leadscrew. An outboard ring **466** circumscribes the outboard unthreaded segment **456** of the leadscrew. The unthreaded segments, and therefore the rings, are located on the leadscrew so that outboard ring **466** resides immediately inboard of an outboard bearing block such as bearing block **418A** (visible in FIG. **21**) or **418E,** and so that inboard ring **464** resides immediately outboard of an inboard bearing block such as bearing block **418B** or **418D** as seen in FIG. **20**. The diameter of each ring is large enough that the ring will not pass through the bushing in the adjacent bearing block. As a result the rings prevent the leadscrew from moving parallel to its own axis **420**.

[0051] When clasp **164** is engaged as seen in FIG. **6**, the clasp acts as a leadscrew receiver. Operation of a motor in a first or forward rotational direction moves the corresponding clasp, and therefore the wing to which the clasp is secured, in a laterally outboard direction. Operation of the motor in a second or reverse rotational direction, opposite that of the first rotational direction, moves the corresponding clasp and wing in a laterally inboard direction. The terms "forward" and "reverse" are used merely to distinguish between opposite rotational senses.

[0052] FIG. **24** is a schematic representation of an architecture having four deck sections, an upper body section **140**, a seat section **142** a thigh section **144** and a foot section **146**, all four of which are rendered width adjustable by corresponding extension wings **148**, **150**, **152**, **154b.** Each deck section has a width **W** and an outboard edge **472**. The architecture includes eight motor assemblies **424**, two mounted on each of the four deck sections. Two motor assemblies are associated with and dedicated to one and only one of the four sections such that one of the two motor assemblies drives the left leadscrew and the left wing of the section and the other of the two motor assemblies drives the right leadscrew and the right wing of that same section. In general, in a bed having at least two deck sections, and in which at least two of those sections are width adjustable sections, each section is serviced by its own pair of motor assemblies. Each motor can move its corresponding wing between a deployed position in which the lateral extremity **470** of the wing is outboard of the outboard edge **472** of the corresponding deck section and a stored position in which the lateral extremity **470** is inboard of its deployed position as shown in phantom in FIG. **24** for one of the foot section extensions **154**. When the wing is stored its outboard extremity **470** may be outboard of, inboard of, or substantially laterally aligned with outboard edge **472** of the corresponding deck section.

[0053] FIG. **25** shows an alternative in which the wings of at least two of the deck sections are movable by a common or shared motor assembly. For example, a right motor assembly **424R** is connected to thigh deck segment **144**. Wing **152R** of section **144** is a directly driven wing because it is driven directly by the motor assembly. Wing **150R** of the seat section is an indirectly driven wing connected to the directly driven wing **152R** by a link **474** which conveys the lateral motion of the directly driven wing **152R** to the indirectly driven wing **150R**. Wing **154R** of the foot section is similarly an indirectly driven wing. Motor assembly **424R** of section **144** is considered to be a shared motor assembly because its driving energy is shared by at least two wings, the directly driven wing **152R** and the indirectly driven wings **150R** and/or **154R**. Wings **150R**, **154R** are also considered to be proximate indirectly driven wings because they are immediately adjacent to a directly driven wing. Section **144** may be referred to as a directly driven section. Section **140** may also be referred to as a directly driven section, and its wings **148** as directly driven wings even though wings **148** are not connected to longitudinally adjacent wings such as wings **150**. Sections **142**, **146** may be referred to as indirectly driven sections or as indirectly driven proximate sections.

[0054] FIG. **26** shows another alternative in which the wings of at least two of the width adjustable segments are movable by a common or shared motor assembly. A motor assembly **424R** is mounted on seat deck segment **142**. Wing **150R** of section **142** is a directly driven wing because it is driven directly by motor assembly **424R**. Wing **152R** of the thigh section is an indirectly driven wing connected to directly driven wing **150R** by a link **474** which conveys the lateral motion of the directly driven wing **150R** to the indirectly driven wing **152R**. Wing **154R** of the foot section is also an indirectly driven wing, but because it is adjacent to another indirectly driven wing (wing **152R**) rather than adjacent to a directly driven wing (wing **150R**) wing **154R** is considered to be a remote indirectly driven wing. Section **142** may be referred to as a directly driven section. Section **140** may also be referred to as a directly driven section, and its wings **148** as directly driven wings even though wings **148** are not connected to longitudinally adjacent wings such as wings **150**. Section **144** may be referred to as an indirectly driven section or as an indirectly driven proximate section to distinguish it from section **146**. Wings **152** may similarly be referred to as indirectly driven wings or, to distinguish them from wings **154**, as indirectly driven proximate wings. Section **146** may be referred to as an indirectly driven section or, in order to distinguish it from section **144**, as an indirectly driven remote section.

Claims

1. A bed comprising a deck section (132, 140, 142, 144, 146) having a width and left and right outboard deck edges, a left side wing (134, 148, 150, 152, 154) and a right side wing (134, 148, 150, 152, 154), both movably coupled to the deck section (132, 140, 142, 144, 146) and each having a laterally outboard extremity, a left leadscrew receiver (164) mounted on the left wing (134, 148, 150, 152, 154) and a right leadscrew receiver (164) mounted on the right wing (134, 148, 150, 152, 154), a left motor assembly (424) and a right motor assembly (424), a left leadscrew (160) coupled to the left motor assembly (424) and to the left leadscrew receiver, and a right leadscrew (160) coupled to the right motor assembly (424) and to the right leadscrew receiver, wherein motor operation is capable of moving the wing (134, 148, 150, 152, 154) to which it is coupled between a deployed position in which the lateral extremity of the wing (134, 148, 150, 152, 154) is outboard of the respective outboard edge of the deck section (132, 140, 142, 144, 146) and a stored position in which the lateral extremity of the wing (134, 148, 150, 152, 154) is inboard of its deployed position, **characterized in that** the left motor assembly (424) and the right motor assembly (424) are both mounted on the deck section (132, 140, 142, 144, 146).

2. The bed of claim 1 in which when the wing (134, 148, 150, 152, 154) is in its stored position the lateral extremity thereof is outboard of the outboard edge, or the lateral extremity thereof is substantially aligned with the outboard edge, or the lateral extremity thereof is inboard of the outboard edge.

3. The bed of either claim **1** or claim **2** wherein each motor assembly (424) includes a gear train.

4. The bed of any preceding claim wherein the wings of the deck section (140, 142) are directly driven wings (148, 150) and the bed comprises at least one adjacent deck section (144, 146) having left and right indirectly driven wings (152, 154) coupled to the directly driven wings (148, 150) such that lateral translation of the directly driven wings (148, 150) causes lateral translation of the indirectly driven wings (152, 154).

5. The bed of any preceding claim wherein the deck section is a directly driven section (142) and the wings of the directly driven deck section are directly driven wings (150), and the bed comprises at least one proximate deck section (144) adjacent to the directly driven deck section (142), the proximate section (144) having left and right indirectly driven proximate wings (152) coupled to the directly driven wings (150) such that lateral translation of the directly driven wings (150) causes lateral translation of the indirectly driven proximate wings (152), and at least one remote deck section (146) non-adjacent to the directly driven deck section (142) and adjacent to the indirectly driven proximate section (144), the remote section having left and right indirectly driven remote wings (154) coupled to the indirectly driven proximate wings (152) such that lateral translation of the directly driven wings (150) causes lateral translation of the indirectly driven proximate wings (152) and of the indirectly driven remote wings (154).

6. The bed of any preceding claim wherein the leadscrew receiver is a clasp (164) which can be engaged with and disengaged from the leadscrew (160).

7. The bed of any preceding claim comprising a release unit including a clasp (164) comprising a first clasp portion (172) movably coupled to the wing (134, 148, 150, 152, 154) and a second clasp portion (174) fixedly coupled to the wing (134, 148, 150, 152, 154), the release unit configured to transition between:

a) an engaged state in which the release unit engages a portion of the leadscrew (160) and is moved by the leadscrew (160) to cause the wing (134, 148, 150, 152, 154) to translate relative to the deck section (132, 140, 142, 144, 146); and
b) a disengaged state in which the release unit

is disengaged from the portion of the leadscrew (160).

8. The bed of any preceding claim comprising a control system (114) configured to sense the position of the wings (134, 148, 150, 152, 154) and alert a user when the wings (134, 148, 150, 152, 154) are in the deployed position and the stored position.

9. The bed of any preceding claim comprising a first controller (232) configured to control a function of a person support apparatus (110), the first controller (230) configured to receive a first input corresponding to a function of the person support apparatus (110) via a first user interface (232), and a second controller (236) configured to control a function of a person support surface (112), the second controller (236) configured to:

a) receive a second input corresponding to a function of the person support surface (112) via a second user interface (238) when the first controller (230) is not in communication with the second controller (236), and to
b) receive a third input corresponding to a function of the person support surface (112) via the first controller (230) when the first controller (230) is in communication with the second controller (236), wherein the second controller (236) is configured to control a function of the person support surface (112) in accordance with the third input when the first controller (230) is in communication with the second controller (236).

10. The bed of claim **9**, wherein the first controller (230) is configured to receive a fourth input corresponding to a function of the person support surface (112) via the first user interface (232) when the first controller (230) is in communication with the second controller (236).

11. The bed of either claim **9** or claim **10**, wherein the second user interface (238) is disabled when the first controller (230) is in communication with the second controller (236) and/or wherein the second user interface (238) is enabled when communication between the first controller (230) and the second controller (236) is interrupted.

12. The bed of any one of claims **9** to **11**, wherein the second user interface (238) is configured to display information when the first controller (230) is in communication with the second controller (236).

13. The bed of any one of claims **7** to **12**, wherein the second user interface (238) is configured to lock out function controls when the first controller (230) is in communication with the second controller (236).

14. The bed of any one of claims **7** to **13**, wherein the first user interface (232) does not include function controls for the person support surface.

15. The bed of any one of claims **7** to **14**, wherein at least one of the first user interface (232) and the second user interface (238) displays an error when the first controller (230) is not in communication with the second controller (236).

16. The bed of any preceding claim wherein the deck section (132, 140, 142, 144, 146) and its left and right wings (134, 148, 150, 152, 154) are elements of a person support apparatus (110) and the bed further comprises a person support surface (112) configured to be supported on the person support apparatus (110) and including a width extension assembly (216, 224), and a controller (230) configured to control the wings (134, 148, 150, 152, 154) and the width extension assembly (216, 224) in response to an input from a user, such that the width extension assembly (216, 224) of the person support surface (112) retracts to a retracted position or remains in the retracted position if the corresponding wings of the person support apparatus are not positioned in one of a fully retracted position and a fully extended position.

17. The bed of claim **16** wherein an alarm is generated if the width extension assembly (216, 224) is not in one of a fully extended position or a fully retracted position.

Patentansprüche

1. Bett, das einen Auflageabschnitt (132, 140, 142, 144, 146), der eine Breite und linke und rechte Auflageaußenkanten aufweist, einen linken Seitenflügel (134, 148, 150, 152, 154) und einen rechten Seitenflügel (134, 148, 150, 152, 154), die beide beweglich an den Auflageabschnitt (132, 140, 142, 144, 146) gekoppelt sind und jeweils ein seitliches Außenende aufweisen, eine linke Gewindespindelaufnahme (164), die an dem linken Flügel (134, 148, 150, 152, 154) angebracht ist, und eine rechte Gewindespindelaufnahme (164), die an dem rechten Flügel (134, 148, 150, 152, 154) angebracht ist, eine linke Motorbaugruppe (424) und eine rechte Motorbaugruppe (424), eine linke Gewindespindel (160), die an die linke Motorbaugruppe (424) und an die linke Gewindespindelaufnahme gekoppelt ist, und eine rechte Gewindespindel (160) umfasst, die an die rechte Motorbaugruppe (424) und an die rechte Gewindespindelaufnahme gekoppelt ist, wobei der Motorbetrieb in der Lage ist, den Flügel (134, 148, 150, 152, 154), an den er gekoppelt ist, zwischen einer ausgefahrenen Stellung, in der das seitliche Ende des

Flügels (134, 148, 150, 152, 154) sich außerhalb der entsprechenden Außenkante des Auflageabschnitts (132, 140, 142, 144, 146) befindet, und einer Lagerungsstellung zu bewegen, in der das seitliche Ende des Flügels (134, 148, 150, 152, 154) sich innerhalb seiner ausgefahrenen Stellung befindet, **dadurch gekennzeichnet, dass** die linke Motorbaugruppe (424) und die rechte Motorbaugruppe (424) beide an dem Auflageabschnitt (132, 140, 142, 144, 146) angebracht sind.

2. Bett nach Anspruch 1, wobei, wenn der Flügel (134, 148, 150, 152, 154) sich in seiner Lagerungsstellung befindet, das seitliche Ende davon sich außerhalb der Außenkante befindet oder das seitliche Ende davon im Wesentlichen mit der Außenkante ausgerichtet ist oder das seitliche Ende davon sich innerhalb der Außenkante befindet.

3. Bett nach entweder Anspruch 1 oder Anspruch 2, wobei jede Motorbaugruppe (424) einen Getriebezug einschließt.

4. Bett nach irgendeinem der vorhergehenden Ansprüche, wobei die Flügel des Auflageabschnitts (140, 142) direkt angetriebene Flügel (148, 150) sind und das Bett mindestens einen benachbarten Auflageabschnitt (144, 146) umfasst, der linke und rechte indirekt angetriebene Flügel (152, 154) aufweist, die derart an die direkt angetriebenen Flügel (148, 150) gekoppelt sind, dass die seitliche Translationsbewegung der direkt angetriebenen Flügel (148, 150) die seitliche Translationsbewegung der indirekt angetriebenen Flügel (152, 154) bewirkt.

5. Bett nach irgendeinem der vorhergehenden Ansprüche, wobei der Auflageabschnitt ein direkt angetriebener Abschnitt (142) ist und die Flügel des direkt angetriebenen Auflageabschnitts direkt angetriebene Flügel (150) sind und das Bett mindestens einen nahegelegenen Auflageabschnitt (144), der dem direkt angetriebenen Auflageabschnitt (142) benachbart ist, wobei der nahegelegene Abschnitt (144) linke und rechte indirekt angetriebene nahegelegene Flügel (152) aufweist, die derart an die direkt angetriebenen Flügel (150) gekoppelt sind, dass die seitliche Translationsbewegung der direkt angetriebenen Flügel (150) die seitliche Translationsbewegung der indirekt angetriebenen nahegelegene Flügel (152) bewirkt, und mindestens einen entfernten Auflageabschnitt (146) umfasst, der dem direkt angetriebenen Auflageabschnitt (142) nicht benachbart ist und dem indirekt angetriebenen nahegelegenen Abschnitt (144) benachbart ist, wobei der entfernte Abschnitt linke und rechte indirekt angetriebene entfernte Flügel (154) aufweist, die derart an die indirekt angetriebenen nahegelegenen Flügel (152) gekoppelt sind, dass die seitliche Translationsbewegung der direkt angetriebenen Flügel (150) die seitliche Translationsbewegung der indirekt angetriebenen nahegelegenen Flügel (152) und der indirekt angetriebenen entfernten Flügel (154) bewirkt.

6. Bett nach irgendeinem der vorhergehenden Ansprüche, wobei die Gewindespindelaufnahme eine Klammer (164) ist, die mit der Gewindespindel (160) in Eingriff und davon außer Eingriff gebracht werden kann.

7. Bett nach irgendeinem der vorhergehenden Ansprüche, das eine Freigabeeinheit umfasst, die eine Klammer (164) einschließt, die einen ersten Klammerabschnitt (172), der beweglich an den Flügel (134, 148, 150, 152, 154) gekoppelt ist, und einen zweiten Klammerabschnitt (174) umfasst, der fest an den Flügel (134, 148, 150, 152, 154) gekoppelt ist, wobei die Freigabeeinheit ausgebildet ist, um zwischen Folgendem überzugehen:

a) einem Eingriffszustand, in dem die Freigabeeinheit mit einem Abschnitt der Gewindespindel (160) ineinandergreift und durch die Gewindespindel (160) bewegt wird, um zu bewirken, dass der Flügel (134, 148, 150, 152, 154) sich in Bezug zu dem Auflageabschnitt (132, 140, 142, 144, 146) translatorisch bewegt; und
b) einem Außereingriffszustand, in dem die Freigabeeinheit von dem Abschnitt der Gewindespindel (160) entkoppelt wird.

8. Bett nach irgendeinem der vorhergehenden Ansprüche, das ein Steuersystem (114) umfasst, das ausgebildet ist, um die Stellung der Flügel (134, 148, 150, 152, 154) abzutasten und einen Benutzer zu warnen, wenn die Flügel (134, 148, 150, 152, 154) sich in der ausgefahrenen Stellung und der Lagerungsstellung befinden.

9. Bett nach irgendeinem der vorhergehenden Ansprüche, das ein erstes Steuergerät (232), das ausgebildet ist, um eine Funktion einer Personenunterstützungsvorrichtung (110) zu steuern, wobei das erste Steuergerät (230) ausgebildet ist, um eine erste Eingabe, die einer Funktion der Personenunterstützungsvorrichtung (110) entspricht, über eine erste Benutzerschnittstelle (232) zu empfangen, und ein zweites Steuergerät (236) umfasst, das ausgebildet ist, um eine Funktion einer Personenunterstützungsfläche (112) zu steuern, wobei das zweite Steuergerät (236) für Folgendes ausgebildet ist:

a) Empfangen einer zweiten Eingabe, die einer Funktion der Personenunterstützungsfläche (112) entspricht, über eine zweite Benutzerschnittstelle (238), wenn das erste Steuergerät (230) nicht mit dem zweiten Steuergerät (236)

in Verbindung steht, und

b) Empfangen einer dritten Eingabe, die einer Funktion der Personenunterstützungsfläche (112) entspricht, über das erste Steuergerät (230), wenn das erste Steuergerät (230) mit dem zweiten Steuergerät (236) in Verbindung steht, wobei das zweite Steuergerät (236) ausgebildet ist, um eine Funktion der Personenunterstützungsfläche (112) gemäß der dritten Eingabe zu steuern, wenn das erste Steuergerät (230) mit dem zweiten Steuergerät (236) in Verbindung steht.

10. Bett nach Anspruch 9, wobei das erste Steuergerät (230) ausgebildet ist, um eine vierte Eingabe, die einer Funktion der Personenunterstützungsfläche (112) entspricht, über die erste Benutzerschnittstelle (232) zu empfangen, wenn das erste Steuergerät (230) mit dem zweiten Steuergerät (236) in Verbindung steht.

11. Bett nach entweder Anspruch 9 oder Anspruch 10, wobei die zweite Benutzerschnittstelle (238) deaktiviert ist, wenn das erste Steuergerät (230) mit dem zweiten Steuergerät (236) in Verbindung steht, und/oder wobei die zweite Benutzerschnittstelle (238) aktiviert wird, wenn die Verbindung zwischen dem ersten Steuergerät (230) und dem zweiten Steuergerät (236) unterbrochen wird.

12. Bett nach irgendeinem der Ansprüche 9 bis 11, wobei die zweite Benutzerschnittstelle (238) ausgebildet ist, um Informationen anzuzeigen, wenn das erste Steuergerät (230) mit dem zweiten Steuergerät (236) in Verbindung steht.

13. Bett nach irgendeinem der Ansprüche 7 bis 12, wobei die zweite Benutzerschnittstelle (238) ausgebildet ist, um Funktionsbedienelemente zu sperren, wenn das erste Steuergerät (230) mit dem zweiten Steuergerät (236) in Verbindung steht.

14. Bett nach irgendeinem der Ansprüche 7 bis 13, wobei die erste Benutzerschnittstelle (232) keine Funktionsbedienelemente für die Personenunterstützungsfläche einschließt.

15. Bett nach irgendeinem der Ansprüche 7 bis 14, wobei mindestens eine von der ersten Benutzerschnittstelle (232) und der zweiten Benutzerschnittstelle (238) einen Fehler anzeigt, wenn das erste Steuergerät (230) nicht mit dem zweiten Steuergerät (236) in Verbindung steht.

16. Bett nach irgendeinem der vorhergehenden Ansprüche, wobei der Auflageabschnitt (132, 140, 142, 144, 146) und seine linken und rechten Flügel (134, 148, 150, 152, 154) Elemente einer Personenunterstützungsvorrichtung (110) sind und das Bett ferner eine Personenunterstützungsfläche (112), die ausgebildet ist, um auf der Personenunterstützungsvorrichtung (110) unterstützt zu werden, und eine Breitenerweiterungsbaugruppe (216, 224) einschließt, und ein Steuergerät (230) umfasst, das ausgebildet ist, um die Flügel (134, 148, 150, 152, 154) und die Breitenerweiterungsbaugruppe (216, 224) als Reaktion auf eine Eingabe von einem Benutzer zu steuern, derart, dass die Breitenerweiterungsbaugruppe (216, 224) der Personenunterstützungsfläche (112) sich in eine eingefahrene Stellung einfährt oder in der eingefahrenen Stellung bleibt, wenn die entsprechenden Flügel der Personenunterstützungsvorrichtung nicht in einer vollständig eingefahrenen Stellung und einer vollständig ausgefahrenen Stellung positioniert sind.

17. Bett nach Anspruch 16, wobei ein Alarm erzeugt wird, wenn die Breitenerweiterungsbaugruppe (216, 224) sich nicht in einer von einer vollständig ausgefahrenen Stellung oder einer vollständig eingefahrenen Stellung befindet.

Revendications

1. Lit comprenant une section de plateforme (132, 140, 142, 144, 146) ayant une largeur et des bords extérieurs de plateforme gauche et droit, une aile côté gauche (134, 148, 150, 152, 154) et une aile côté droit (134, 148, 150, 152, 154), toutes les deux couplées de manière mobile à la section de plateforme (132, 140, 142, 144, 146) et chacune ayant une extrémité extérieure latérale, un récepteur de vis sans fin gauche (164) monté sur l'aile gauche (134, 148, 150, 152, 154) et un récepteur de vis sans fin droit (164) monté sur l'aile droite (134, 148, 150, 152, 154), un ensemble de moteur gauche (424) et un ensemble de moteur droit (424), une vis sans fin gauche (160) couplée à l'ensemble de moteur gauche (424) et au récepteur de vis sans fin gauche, et une vis sans fin droite (160) couplée à l'ensemble de moteur droit (424) et au récepteur de vis sans fin droit, dans lequel l'opération du moteur peut déplacer l'aile (134, 148, 150, 152, 154) à laquelle il est couplé entre une position déployée, dans laquelle l'extrémité latérale de l'aile (134, 148, 150, 152, 154) est extérieure au bord extérieur respectif de la section de plateforme (132, 140, 142, 144, 146) et une position rangée, dans laquelle l'extrémité latérale de l'aile (134, 148, 150, 152, 154) est intérieure à sa position déployée, **caractérisé en ce que** l'ensemble de moteur gauche (424) et l'ensemble de moteur droit (424) sont tous les deux montés sur la section de plateforme (132, 140, 142, 144, 146).

2. Lit selon la revendication 1 dans lequel quand l'aile

(134, 148, 150, 152, 154) est dans sa position rangée, l'extrémité latérale de celle-ci est extérieure au bord extérieur, ou l'extrémité latérale de celle-ci est sensiblement alignée avec le bord extérieur, ou l'extrémité latérale de celle-ci est intérieure au bord extérieur.

3. Lit selon la revendication 1 ou la revendication 2, dans lequel chacun des ensembles de moteur (424) comprend un train d'engrenages.

4. Lit selon l'une quelconque des revendications précédentes, dans lequel les ailes de la section de plateforme (140, 142) sont des ailes entraînées directement (148, 150) et le lit comprend au moins une section de plateforme adjacente (144, 146) ayant des ailes entraînées indirectement gauche et droite (152, 154) couplées aux ailes entraînées directement (148, 150) de sorte que la translation latérale des ailes entraînées directement (148, 150) provoque la translation latérale des ailes entraînées indirectement (152, 154).

5. Lit selon l'une quelconque des revendications précédentes, dans lequel la section de plateforme est une section entraînée directement (142) et les ailes de la section de plateforme entraînée directement sont des ailes entraînées directement (150), et le lit comprend au moins une section de plateforme proximale (144) adjacente à la section de plateforme entraînée directement (142), la section proximale (144) ayant des ailes proximales entraînées indirectement gauche et droite (152) couplées aux ailes entraînées directement (150) de sorte que la translation latérale des ailes entraînées directement (150) provoque la translation latérale des ailes proximales entraînées indirectement (152), et au moins une section de plateforme distante (146) non adjacente à la section de plateforme entraînée directement (142) et adjacente à la section proximale entraînée indirectement (144), la section distante ayant des ailes distantes entraînées indirectement gauche et droite (154) couplées aux ailes proximales entraînées indirectement (152) de sorte que la translation latérale des ailes entraînées directement (150) provoque la translation latérale des ailes proximales entraînées indirectement (152) ainsi que celle des ailes distantes entraînées indirectement (154).

6. Lit selon l'une quelconque des revendications précédentes, dans lequel le récepteur de vis sans fin est un fermoir (164) qui peut se mettre en prise avec la vis sans fin (160) et être libéré de celle-ci.

7. Lit selon l'une quelconque des revendications précédentes comprenant une unité de libération comprenant un fermoir (164) comprenant une première partie de fermoir (172) couplée de manière mobile à l'aile (134, 148, 150, 152, 154) et une seconde partie de fermoir (174) couplée de manière fixe à l'aile (134, 148, 150, 152, 154), l'unité de libération étant configurée pour commuter entre :

a) un état de mise en prise dans lequel l'unité de libération est mis en prise avec une partie de la vis sans fin (160) et est déplacée par la vis sans fin (160) pour amener l'aile (134, 148, 150, 152, 154) à effectuer un mouvement de translation par rapport à la section de plateforme (132, 140, 142, 144, 146) ; et
b) un état de désengagement dans lequel l'unité de libération est désengagée de la partie de vis sans fin (160).

8. Lit selon l'une quelconque des revendications précédentes comprenant un système de commande (114) configuré pour détecter la position des ailes (134, 148, 150, 152, 154) et alerter un utilisateur quand les ailes (134, 148, 150, 152, 154) se trouvent dans la position déployée et dans la position rangée.

9. Lit selon l'une quelconque des revendications précédentes comprenant un premier contrôleur (232) configuré pour commander une fonction d'un dispositif de support de personne (110), le premier contrôleur (230) étant configuré pour recevoir une première entrée correspondant à une fonction du dispositif de support de personne (110) par l'intermédiaire d'une première interface utilisateur (232), et un second contrôleur (236) configuré pour commander une fonction d'une surface de support de personne (112), le second contrôleur (236) étant configuré pour :

a) recevoir une deuxième entrée correspondant à une fonction de la surface de support de personne (112) par l'intermédiaire d'une seconde interface utilisateur (238) quand le premier contrôleur (230) n'est pas en communication avec le second contrôleur (236), et pour
b) recevoir une troisième entrée correspondant à une fonction de la surface de support de personne (112) par l'intermédiaire du premier contrôleur (230) quand le premier contrôleur (230) est en communication avec le second contrôleur (236), dans lequel le second contrôleur (236) est configuré pour commander une fonction de la surface de support de personne (112) conformément à la troisième entrée quand le premier contrôleur (230) est en communication avec le second contrôleur (236).

10. Lit selon la revendication 9, dans lequel le premier contrôleur (230) est configuré pour recevoir une quatrième entrée correspondant à une fonction de la surface de support de personne (112) par l'intermédiai-

re de la première interface utilisateur (232) quand le premier contrôleur (230) est en communication avec le second contrôleur (236).

11. Lit selon la revendication 9 ou la revendication 10, dans lequel la seconde interface utilisateur (238) est désactivée quand le premier contrôleur (230) est en communication avec le second contrôleur (236) et/ou dans lequel la seconde interface utilisateur (238) est activée quand la communication entre le premier contrôleur (230) et le second contrôleur (236) est interrompue.

12. Lit selon l'une quelconque des revendications 9 à 11, dans lequel la seconde interface utilisateur (238) est configurée pour afficher des informations quand le premier contrôleur (230) est en communication avec le second contrôleur (236).

13. Lit selon l'une quelconque des revendications 7 à 12, dans lequel la seconde interface utilisateur (238) est configurée pour bloquer les commandes de fonctions quand le premier contrôleur (230) est en communication avec le second contrôleur (236).

14. Lit selon l'une quelconque des revendications 7 à 13, dans lequel la première interface utilisateur (232) ne comprend pas des commandes de fonction pour la surface de support de personne.

15. Lit selon l'une quelconque des revendications 7 à 14, dans lequel au moins une parmi la première interface utilisateur (232) et la seconde interface utilisateur (238) affiche une erreur quand le premier contrôleur (230) n'est pas en communication avec le second contrôleur (236).

16. Lit selon l'une quelconque des revendications précédentes dans lequel la section de plateforme (132, 140, 142, 144, 146) et ses ailes gauche et droite (134, 148, 150, 152, 154) sont des éléments d'un dispositif de support de personne (110) et le lit comprend en outre une surface de support de personne (112) configurée pour être supportée sur le dispositif de support de personne (110) et comprenant un ensemble d'extension de largeur (216, 224) et un contrôleur (230) configuré pour commander les ailes (134, 148, 150, 152, 154) et l'ensemble d'extension de largeur (216, 224) en réponse à une entrée provenant d'un utilisateur, de sorte que l'ensemble d'extension de largeur (216, 224) de la surface de support de personne (112) se rétracte vers une position rétractée ou reste dans la position rétractée si les ailes correspondantes du dispositif de support de personne ne sont pas positionnées dans une position parmi une position entièrement rétractée et une position entièrement déployée.

17. Lit selon la revendication 16, dans lequel une alarme est générée si l'ensemble d'extension de largeur (216, 224) n'est pas dans une position parmi une position entièrement déployée ou une position entièrement rétractée.

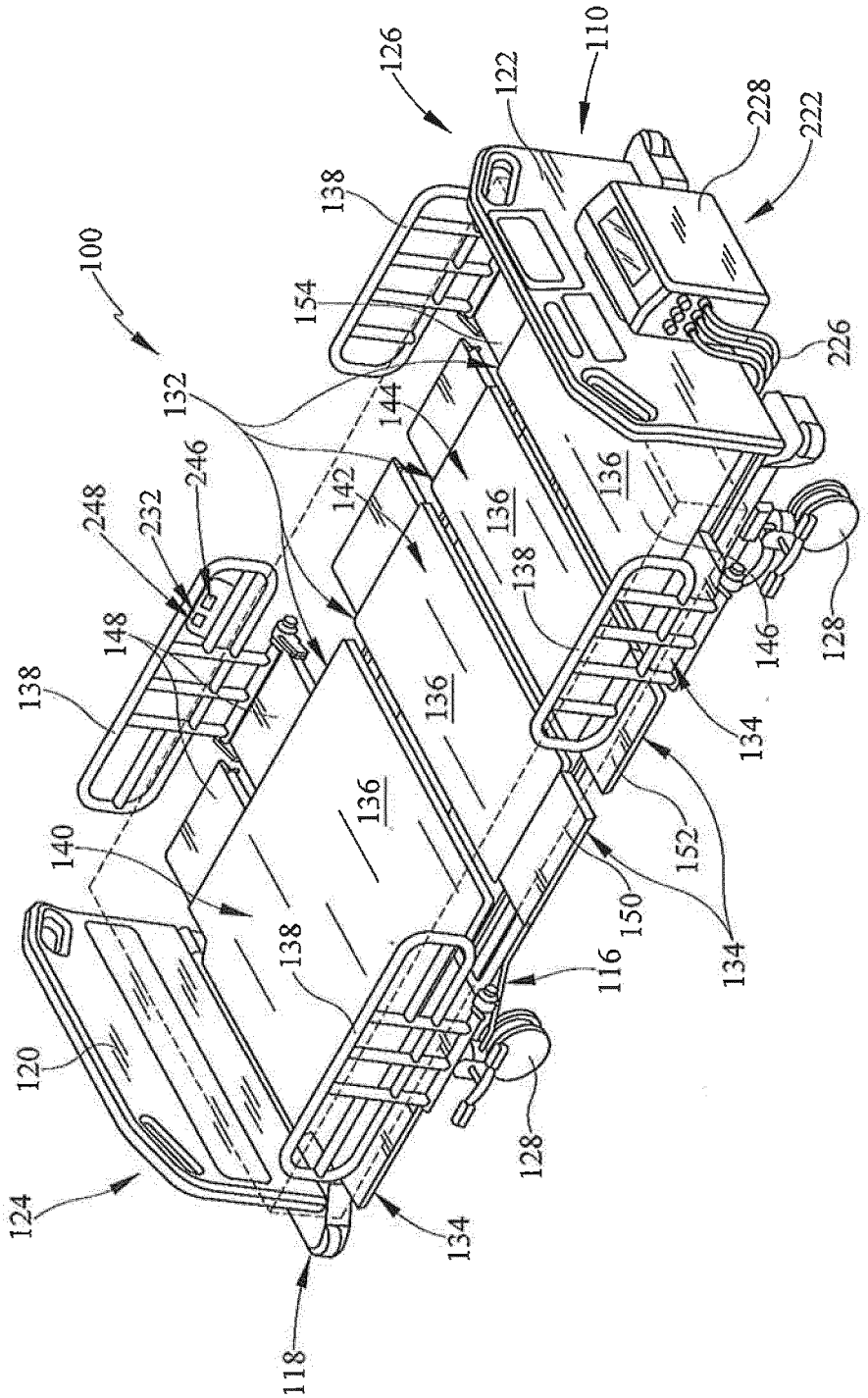

100
110
120
122
124
126
128
132
134
136
138
140
142
144
146
148
150
152
154
222
226
228
232
246
248
116
118

FIG. 1

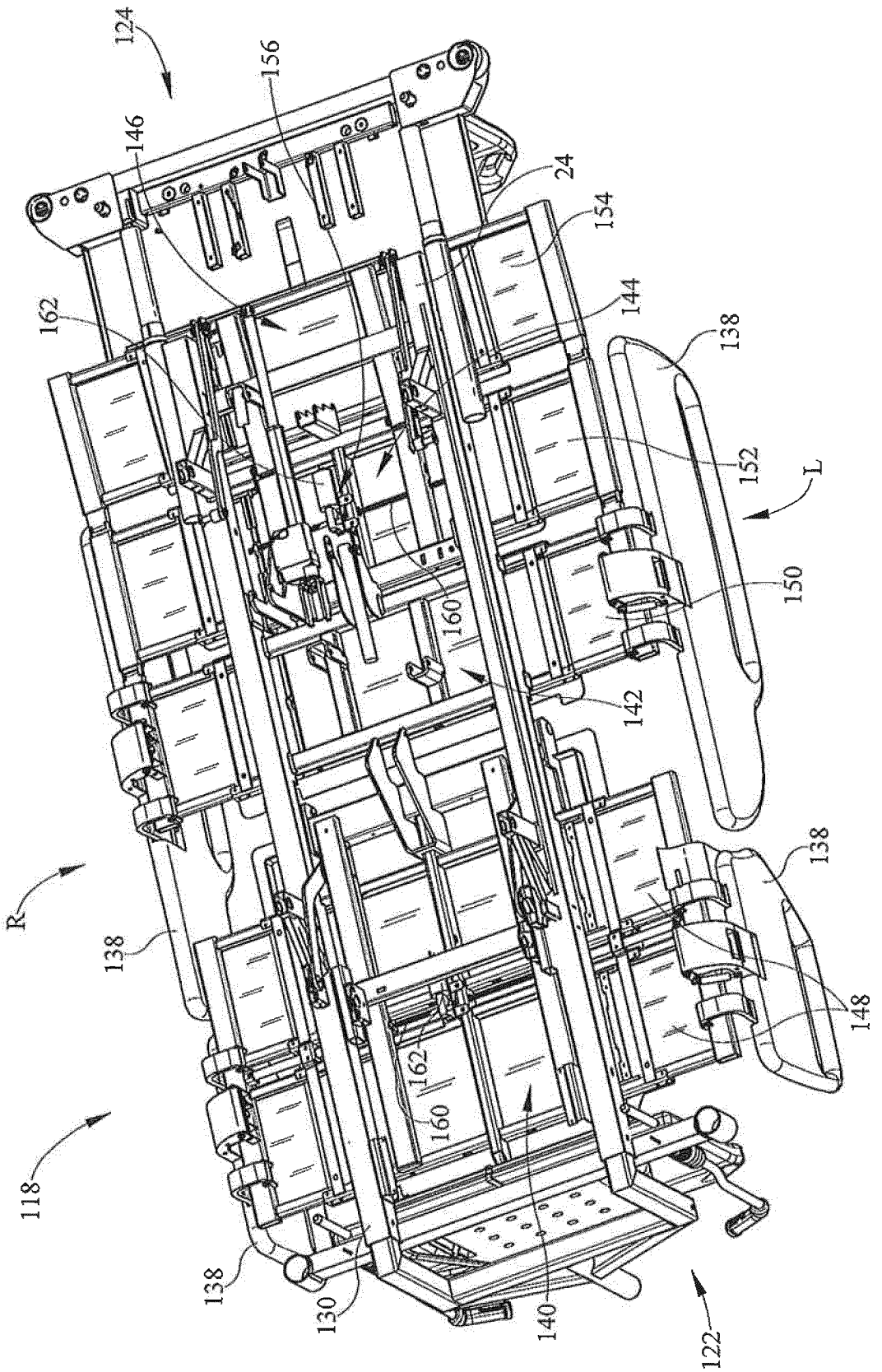

124
156
146
24
154
144
162
138
152
L
150
160
142
138
R
138
148
162
160
118
138
130
140
122

FIG. 2

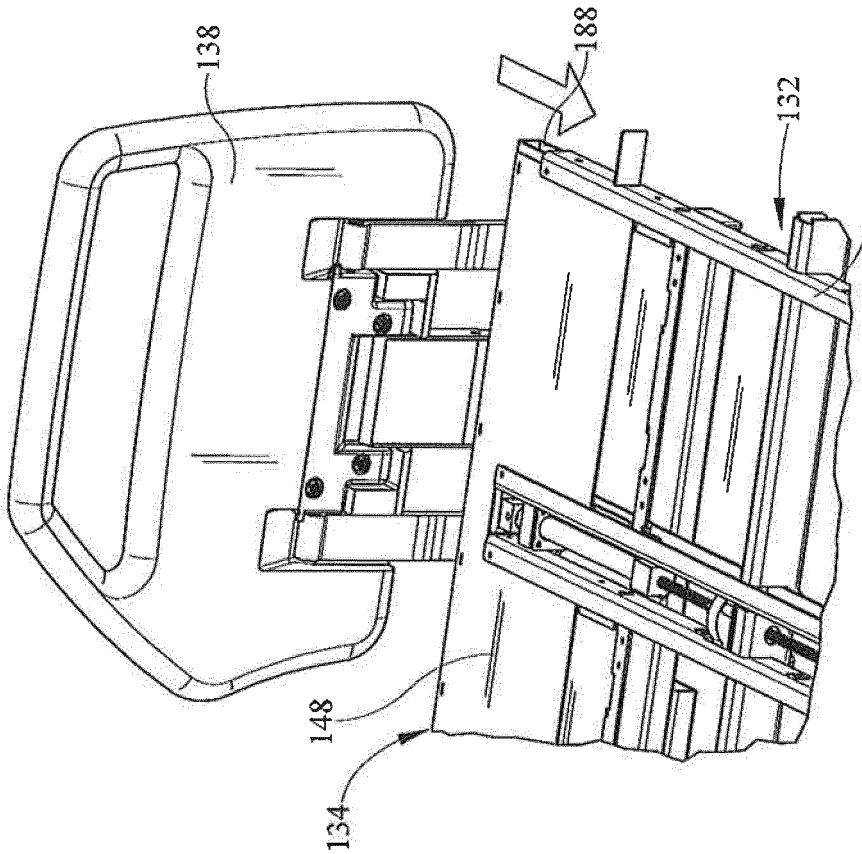


FIG. 3B

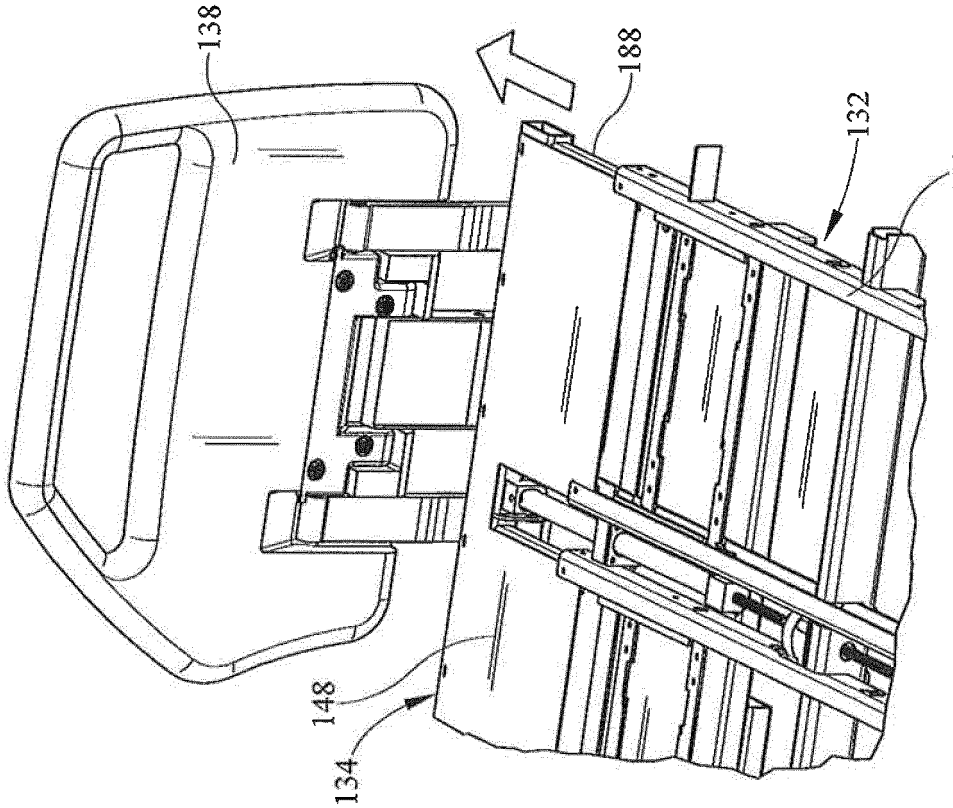


FIG. 3A

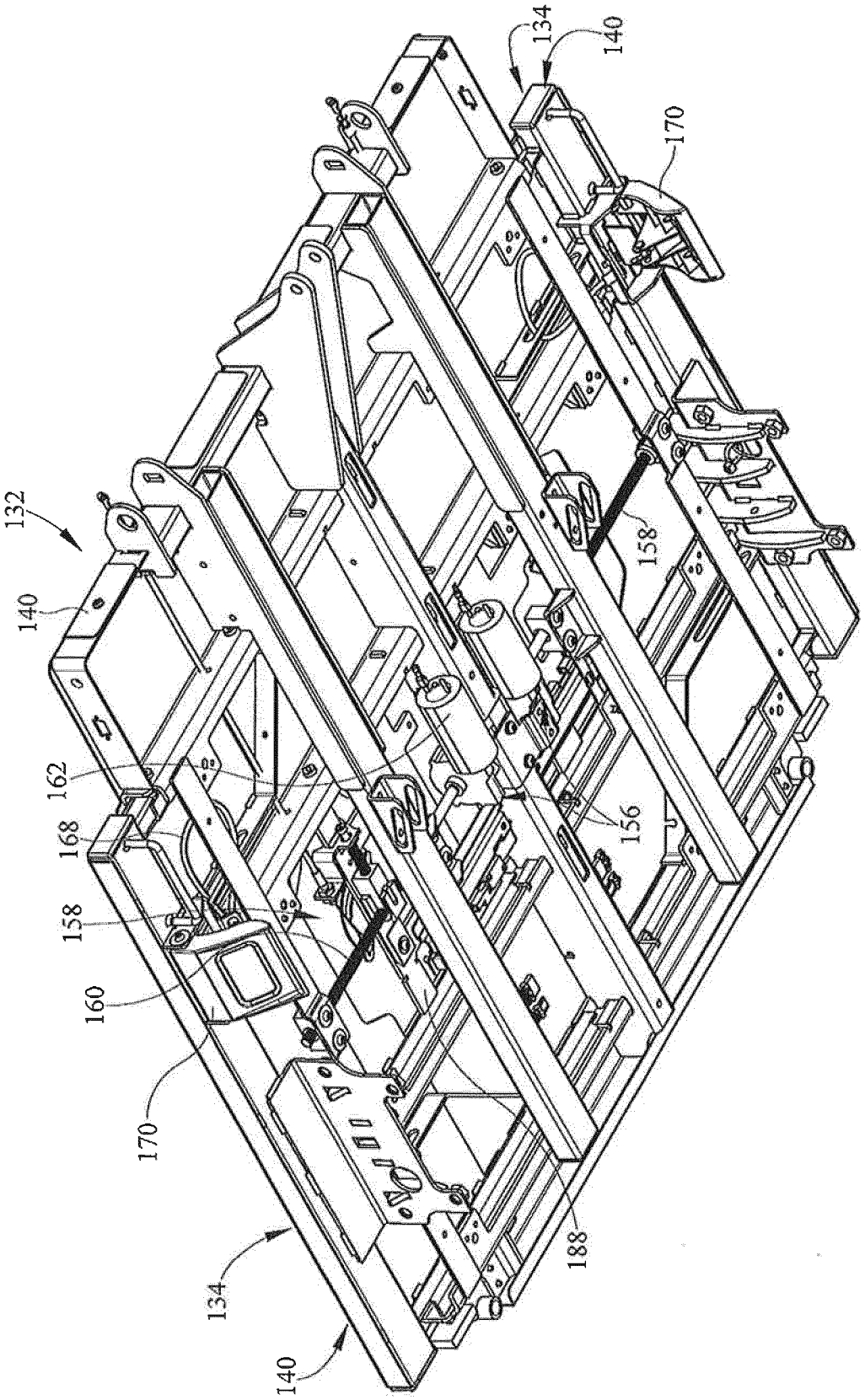


FIG. 4

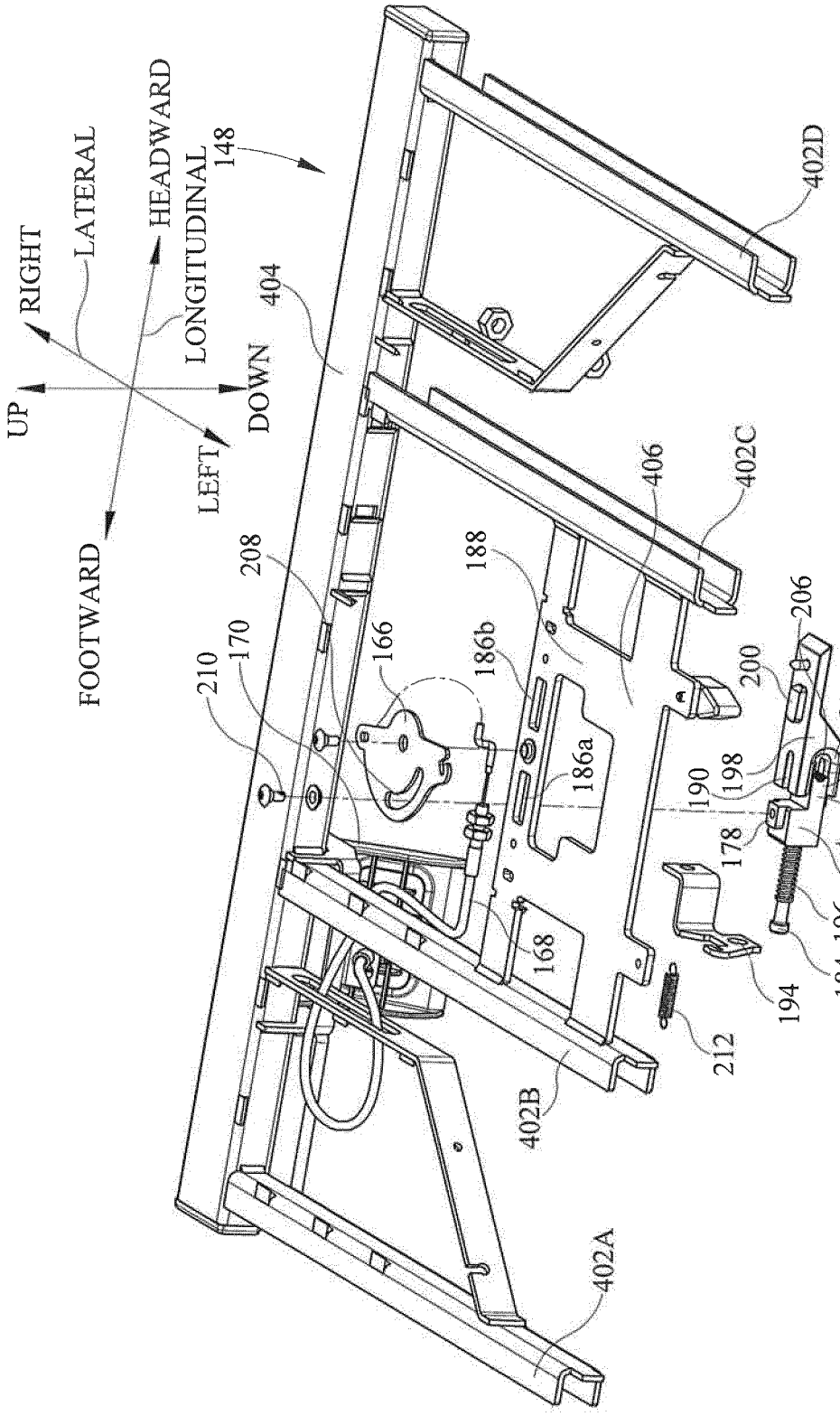

RIGHT
LATERAL
HEADWARD
LONGITUDINAL
148
UP
DOWN
LEFT
FOOTWARD
404
402D
406
402C
208
188
206
174
210
170
166
186b
200
206
202
204
192
198
190
186a
164
182
178
172
176
196
184
168
194
212
402B
158
402A

FIG. 5

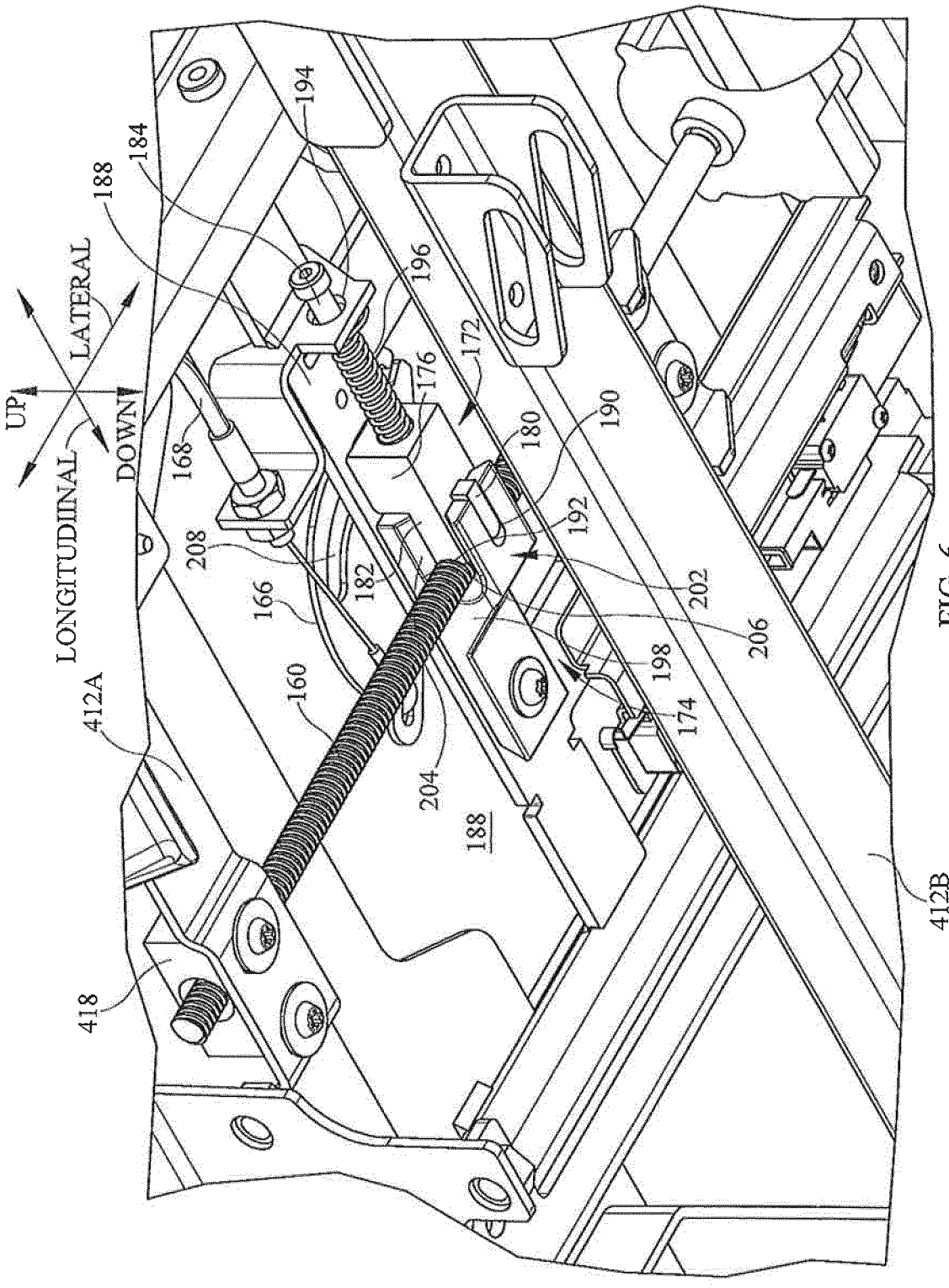

UP
LATERAL
LONGITUDINAL
DOWN
184
188
194
196
172
176
168
180
190
192
208
182
166
202
206
160
198
174
204
188
418
412A
412B

FIG. 6

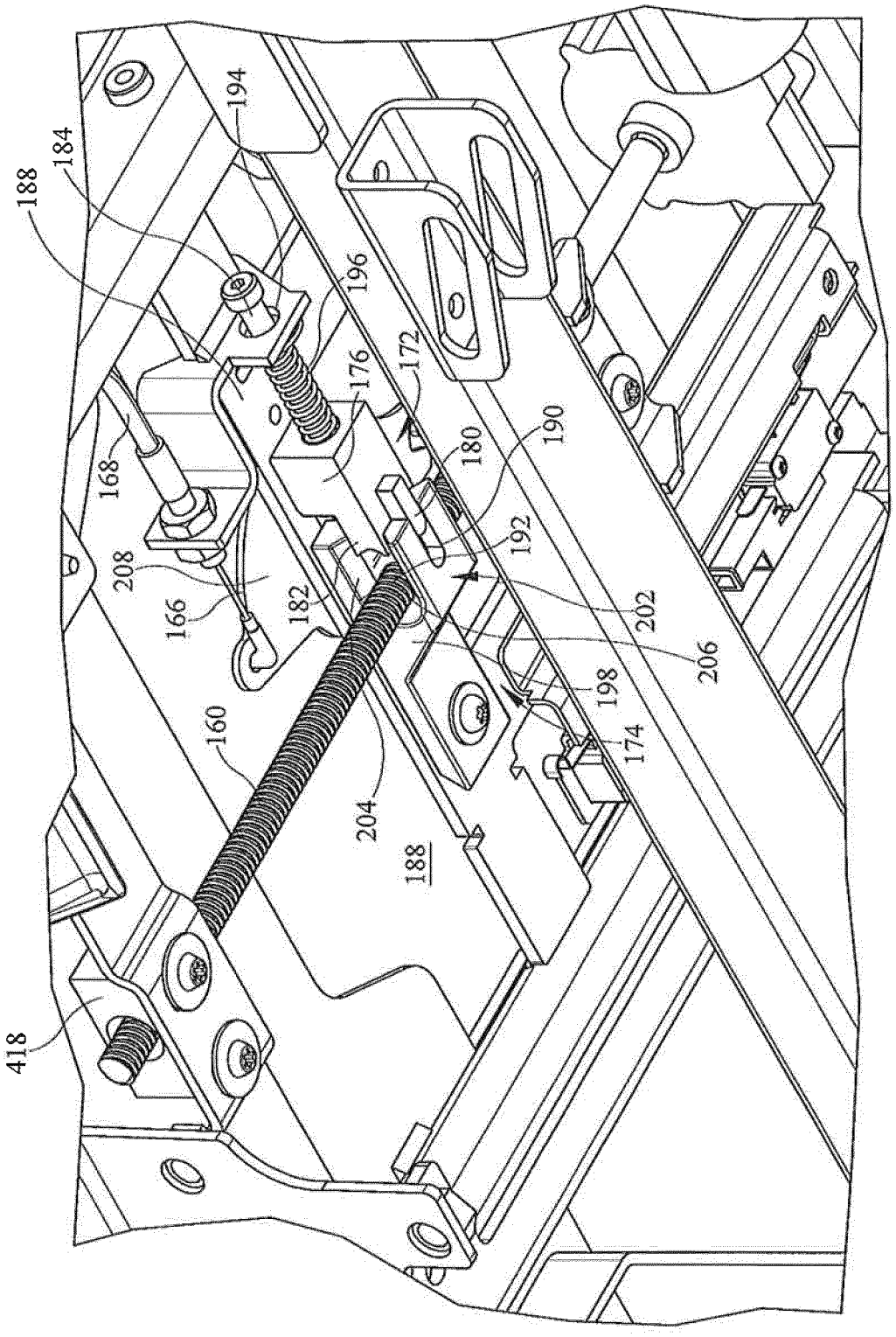

188
184
194
196
172
176
168
180
190
208
192
166
182
202
206
198
160
174
204
188
418

FIG. 7

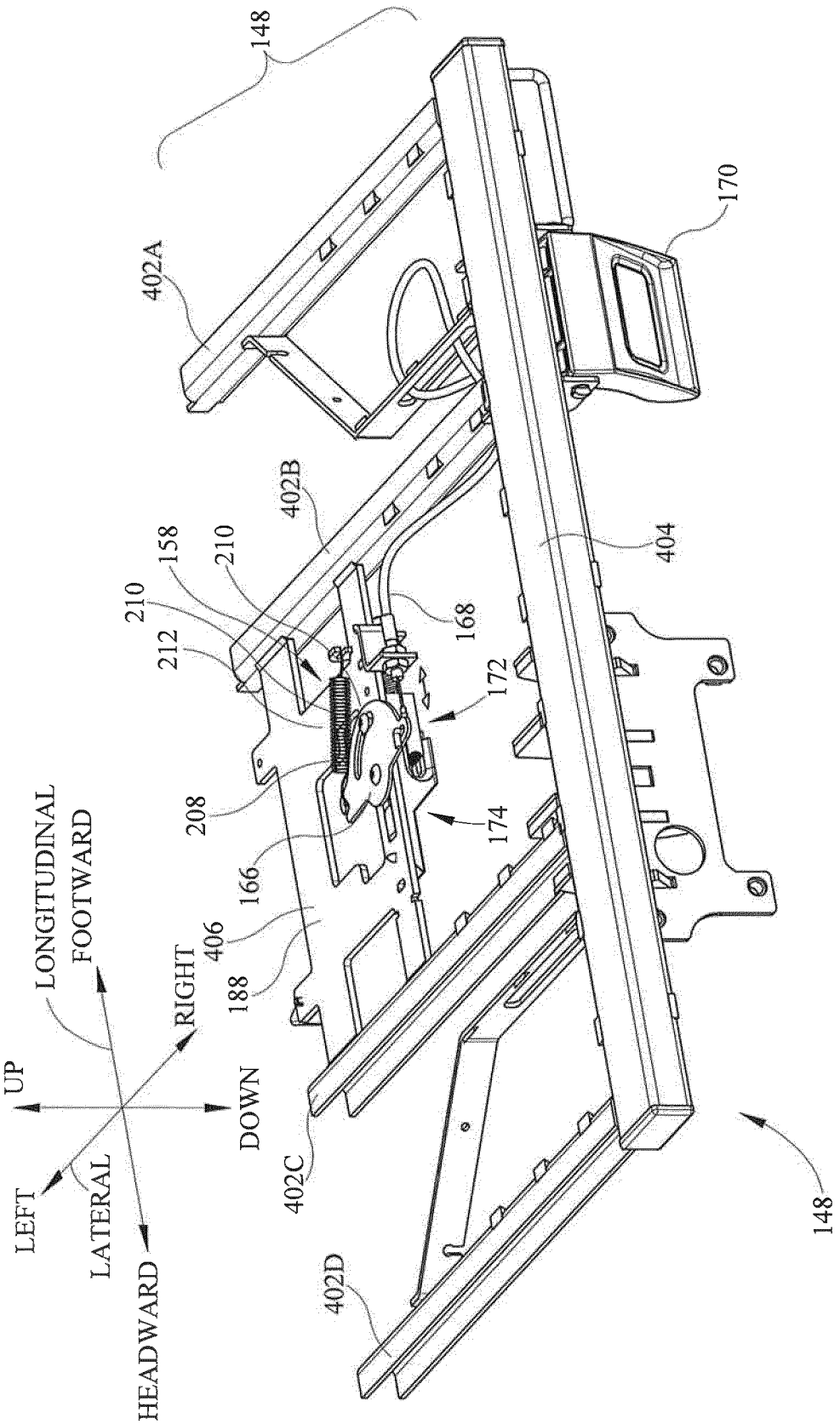

148
170
402A
402B
158
210
210
212
168
404
172
208
174
166
406
188
LONGITUDINAL
FOOTWARD
RIGHT
UP
DOWN
LEFT
LATERAL
HEADWARD
402C
402D
148

FIG. 8

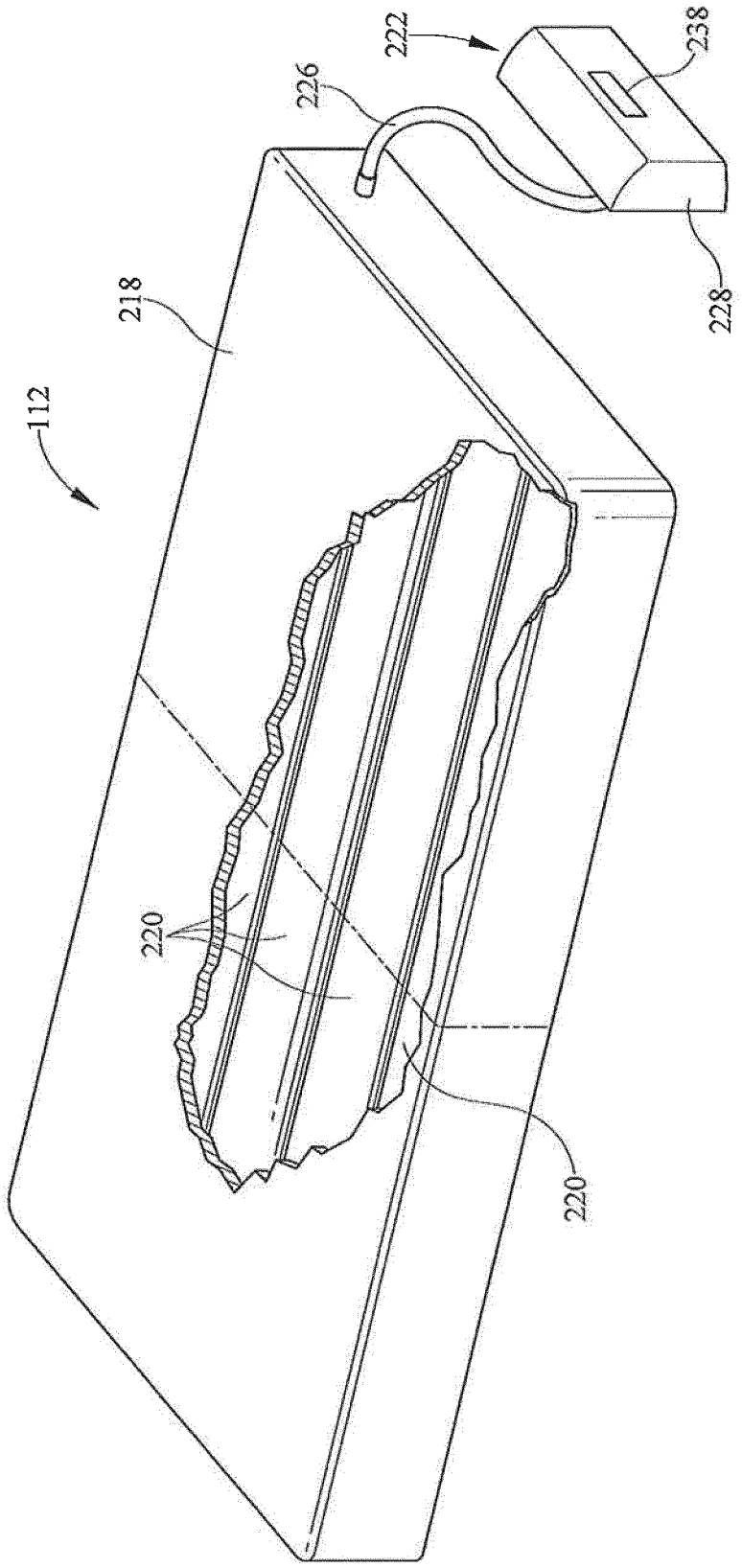


FIG. 9

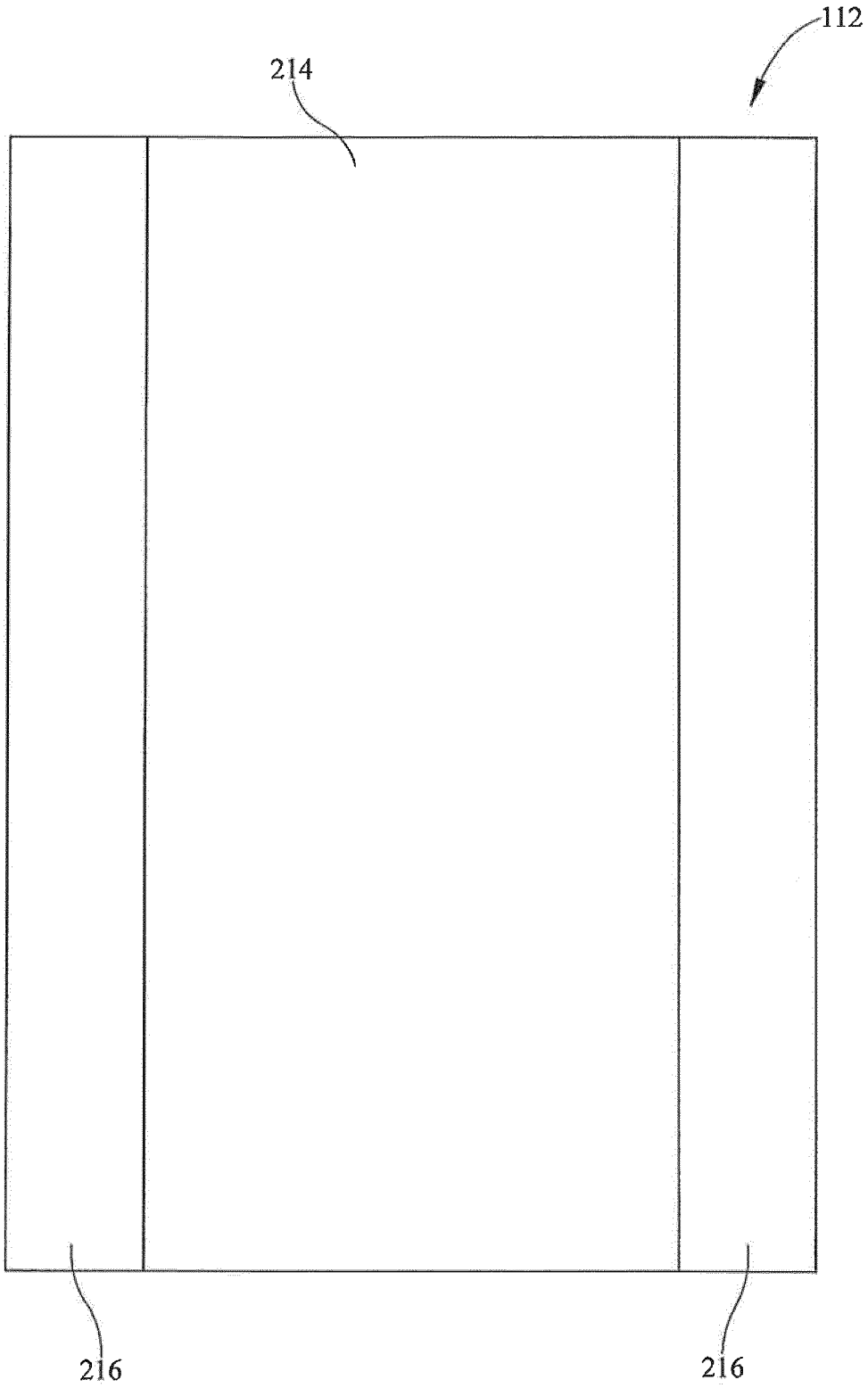


FIG. 10

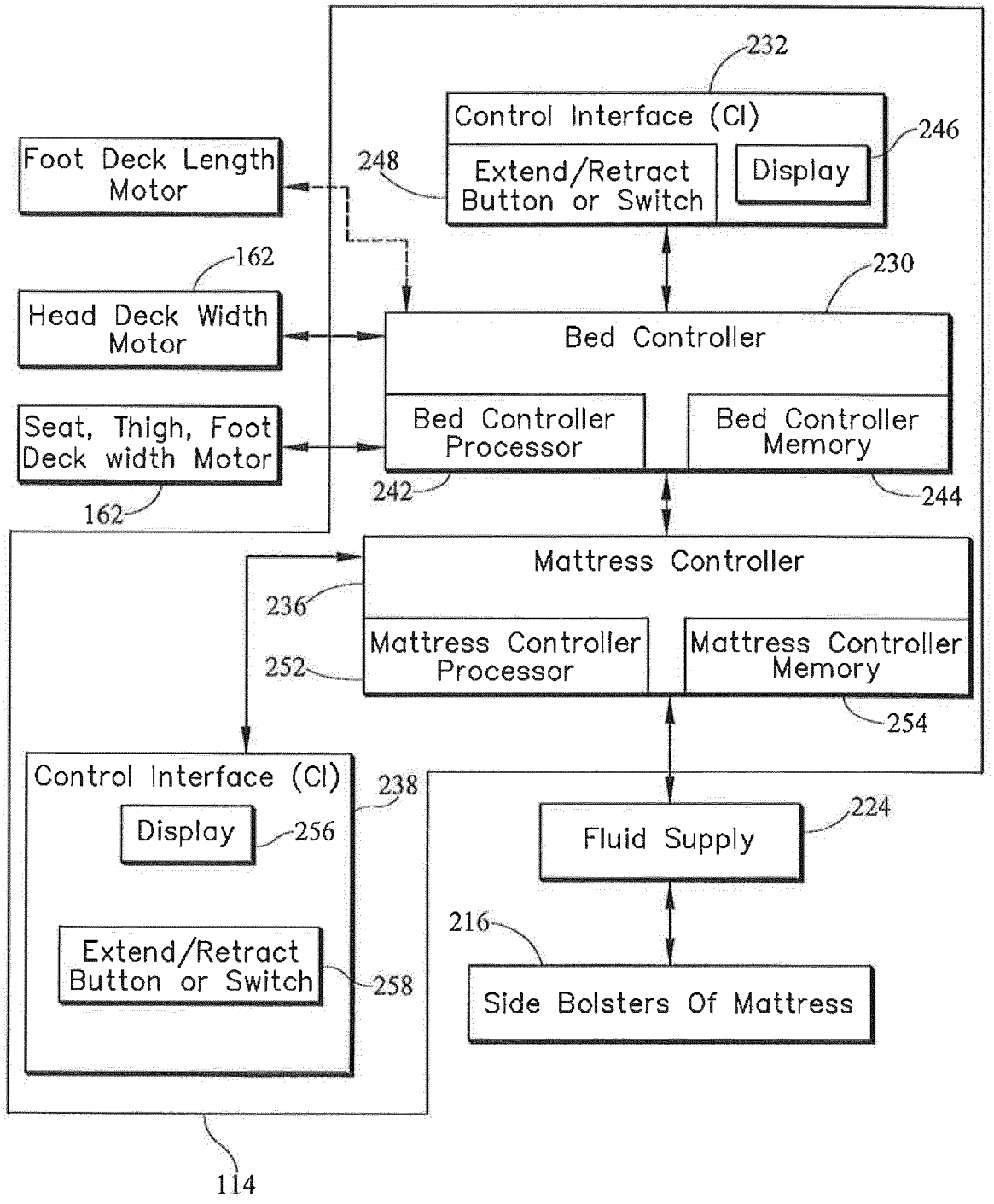

232
Control Interface (CI)
246
Foot Deck Length Motor
248
Extend/Retract Button or Switch
Display
162
230
Head Deck Width Motor
Bed Controller
Seat, Thigh, Foot Deck width Motor
Bed Controller Processor
Bed Controller Memory
162
242
244
Mattress Controller
236
Mattress Controller Processor
Mattress Controller Memory
252
254
Control Interface (CI)
238
Display
256
224
Fluid Supply
216
Extend/Retract Button or Switch
258
Side Bolsters Of Mattress
114

FIG. 11

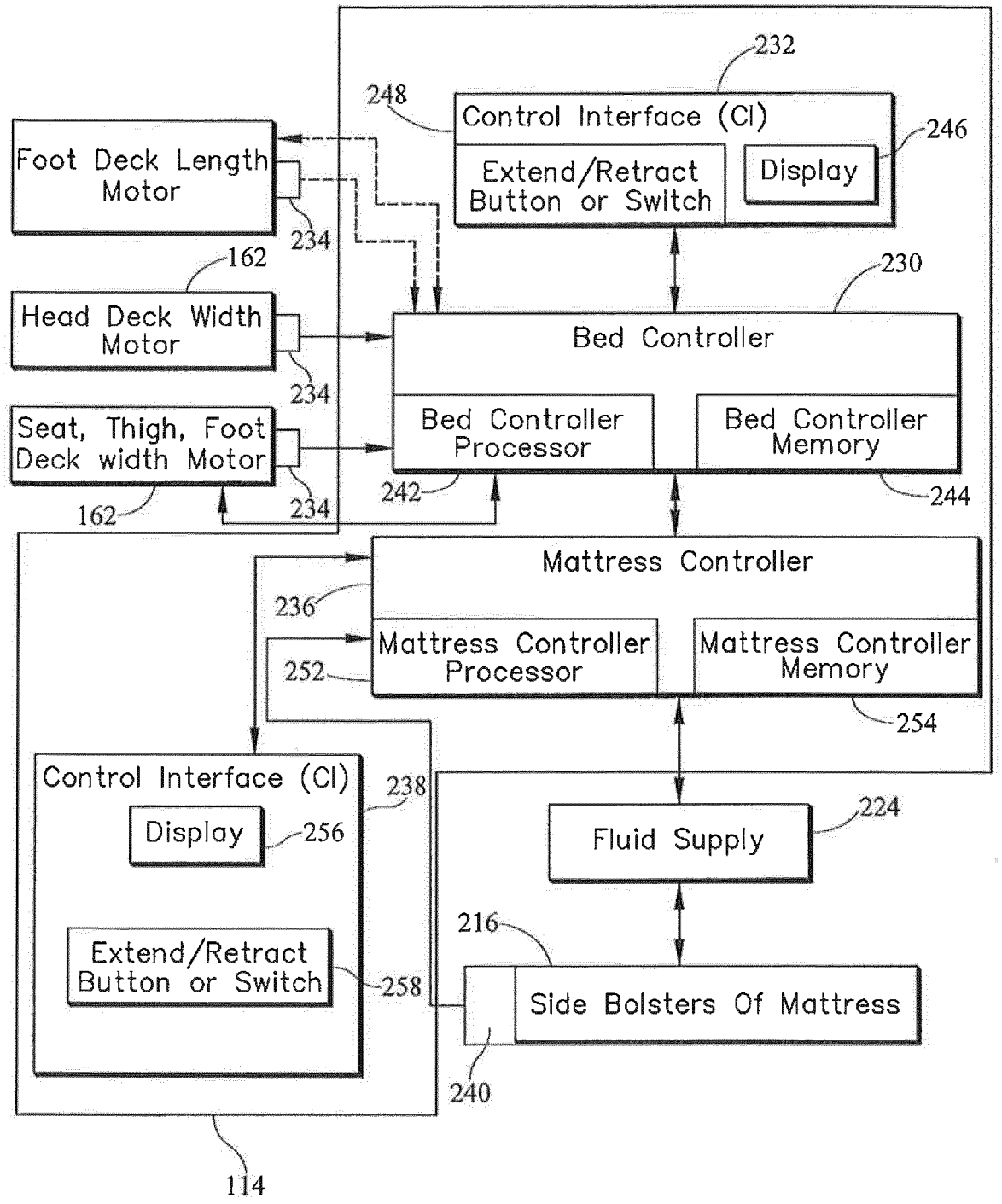

232
248
Control Interface (CI)
246
Foot Deck Length Motor
Extend/Retract Button or Switch
Display
234
162
230
Head Deck Width Motor
Bed Controller
234
Bed Controller Processor
Bed Controller Memory
Seat, Thigh, Foot Deck width Motor
242
244
162
234
Mattress Controller
236
Mattress Controller Processor
Mattress Controller Memory
252
254
Control Interface (CI)
238
Display
256
224
Fluid Supply
216
Extend/Retract Button or Switch
258
Side Bolsters Of Mattress
240
114

FIG. 12

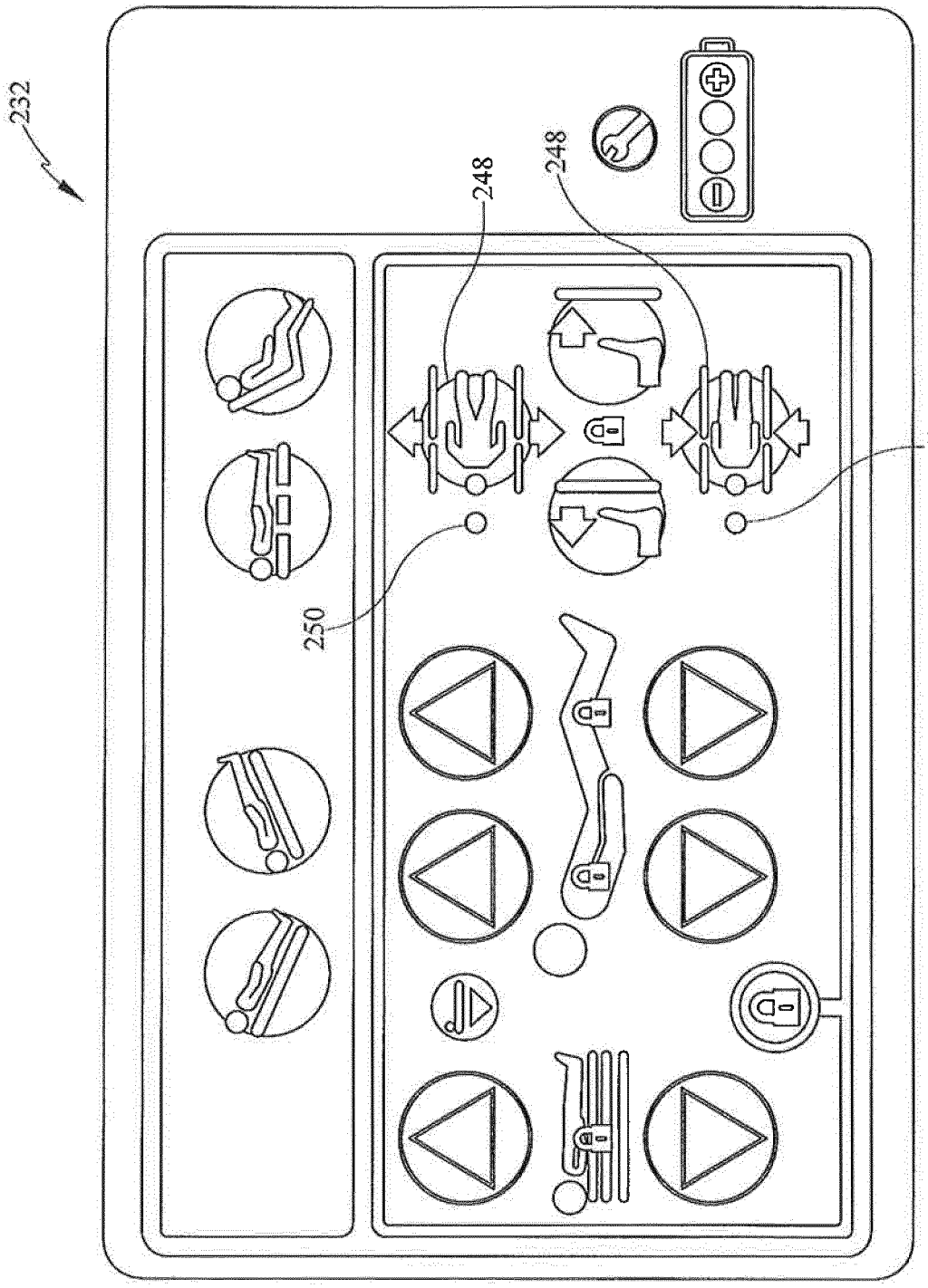


FIG. 13

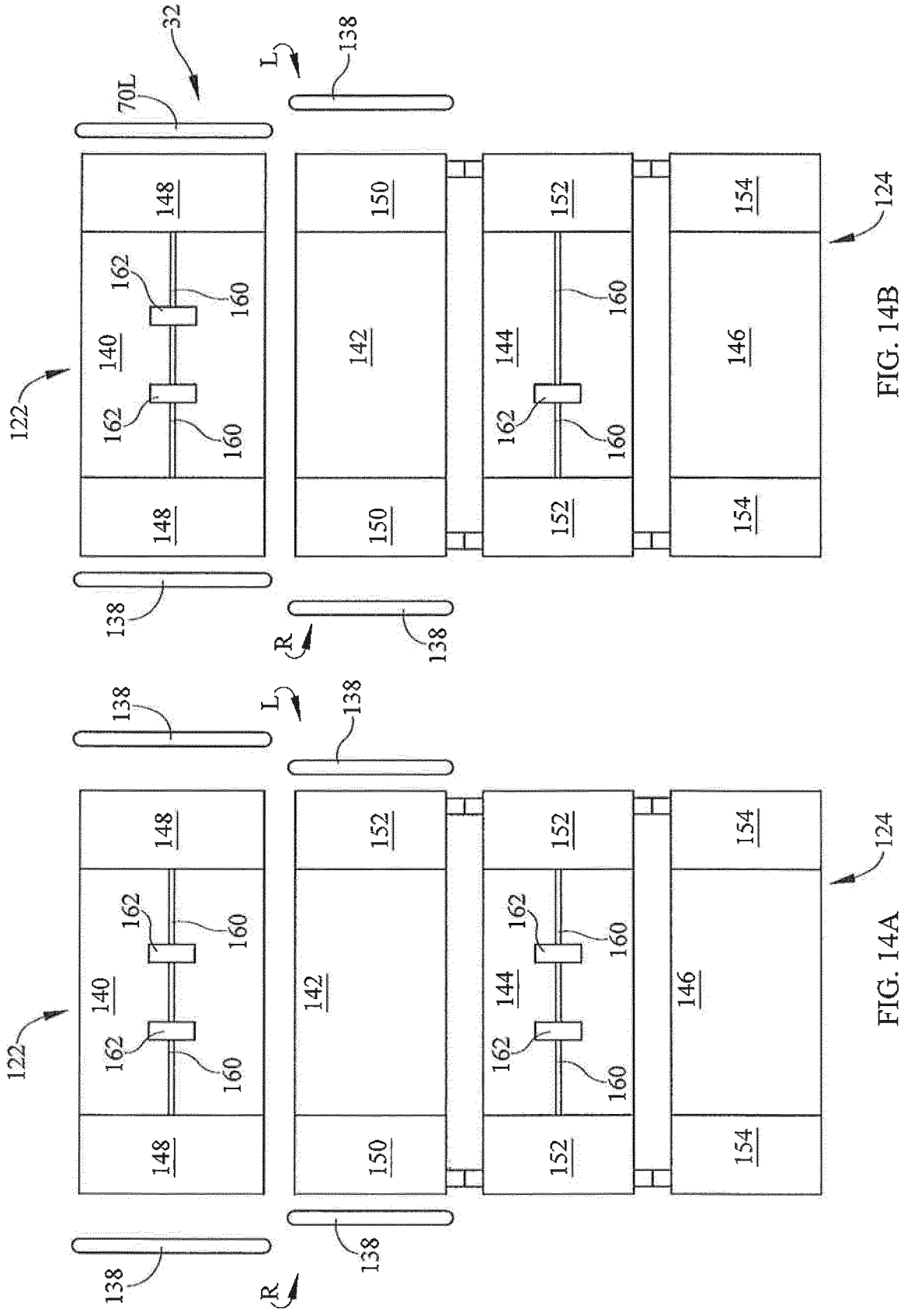


FIG. 14B

FIG. 14A

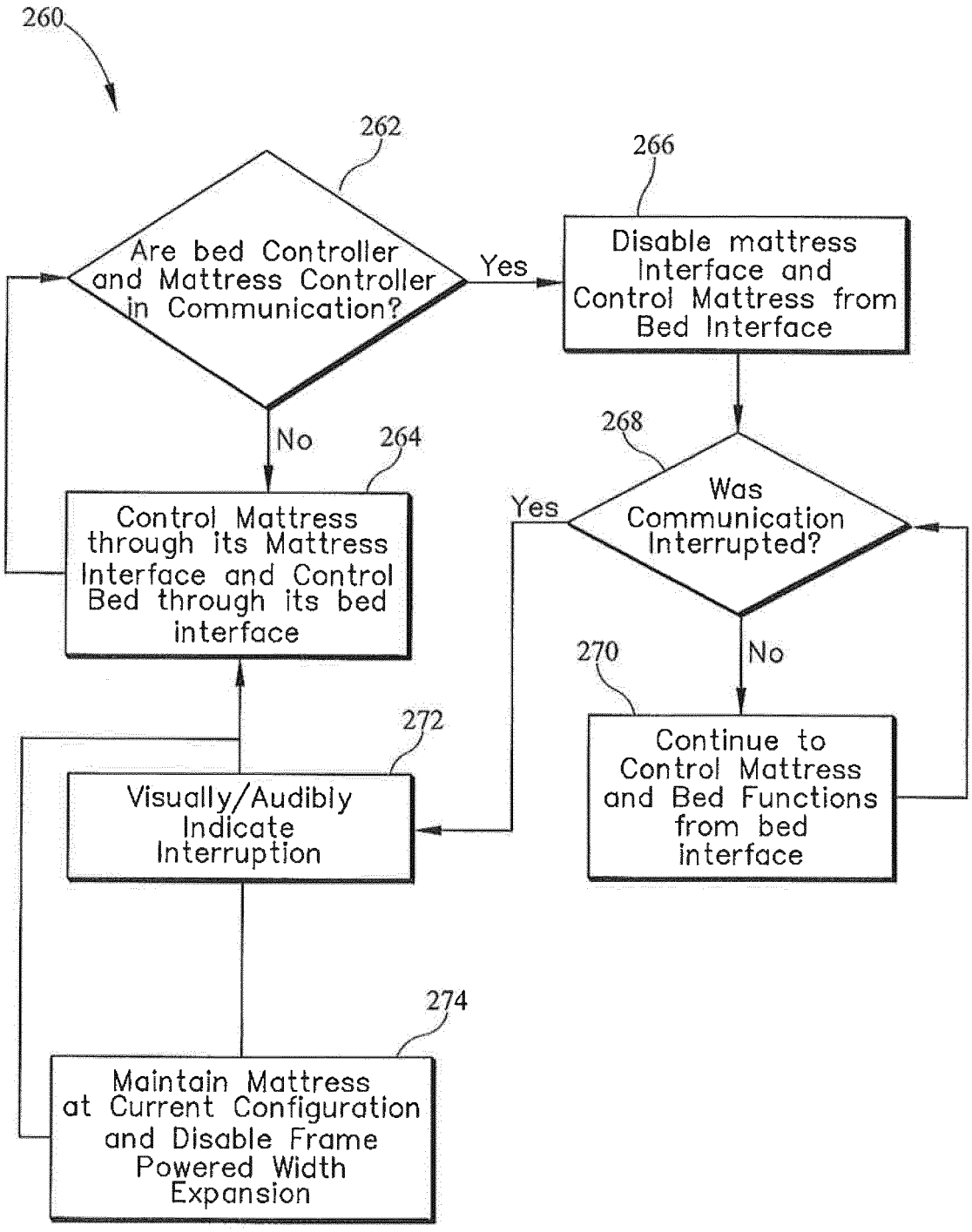

260
262
Are bed Controller and Mattress Controller in Communication?
Yes
No
266
Disable mattress Interface and Control Mattress from Bed Interface
268
Was Communication Interrupted?
Yes
No
264
Control Mattress through its Mattress Interface and Control Bed through its bed interface
270
Continue to Control Mattress and Bed Functions from bed interface
272
Visually/Audibly Indicate Interruption
274
Maintain Mattress at Current Configuration and Disable Frame Powered Width Expansion

FIG. 15

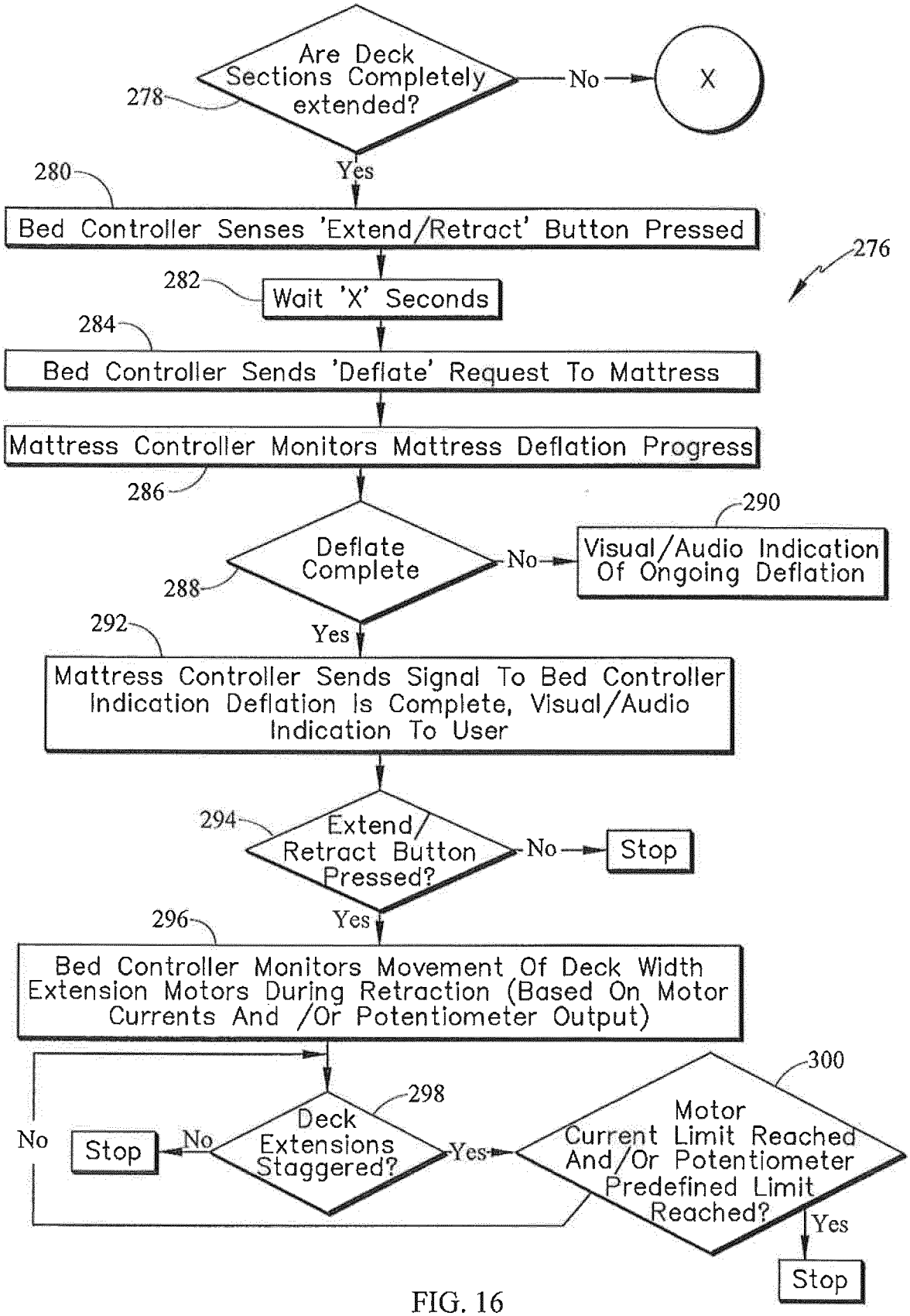

Are Deck Sections Completely extended?
278
No
X
Yes
280
Bed Controller Senses 'Extend/Retract' Button Pressed
276
282
Wait 'X' Seconds
284
Bed Controller Sends 'Deflate' Request To Mattress
Mattress Controller Monitors Mattress Deflation Progress
286
290
Deflate Complete
288
No
Visual/Audio Indication Of Ongoing Deflation
Yes
292
Mattress Controller Sends Signal To Bed Controller Indication Deflation Is Complete, Visual/Audio Indication To User
294
Extend/ Retract Button Pressed?
No
Stop
Yes
296
Bed Controller Monitors Movement Of Deck Width Extension Motors During Retraction (Based On Motor Currents And /Or Potentiometer Output)
300
298
Deck Extensions Staggered?
No
Stop
No
Yes
Motor Current Limit Reached And/Or Potentiometer Predefined Limit Reached?
Yes
Stop

FIG. 16

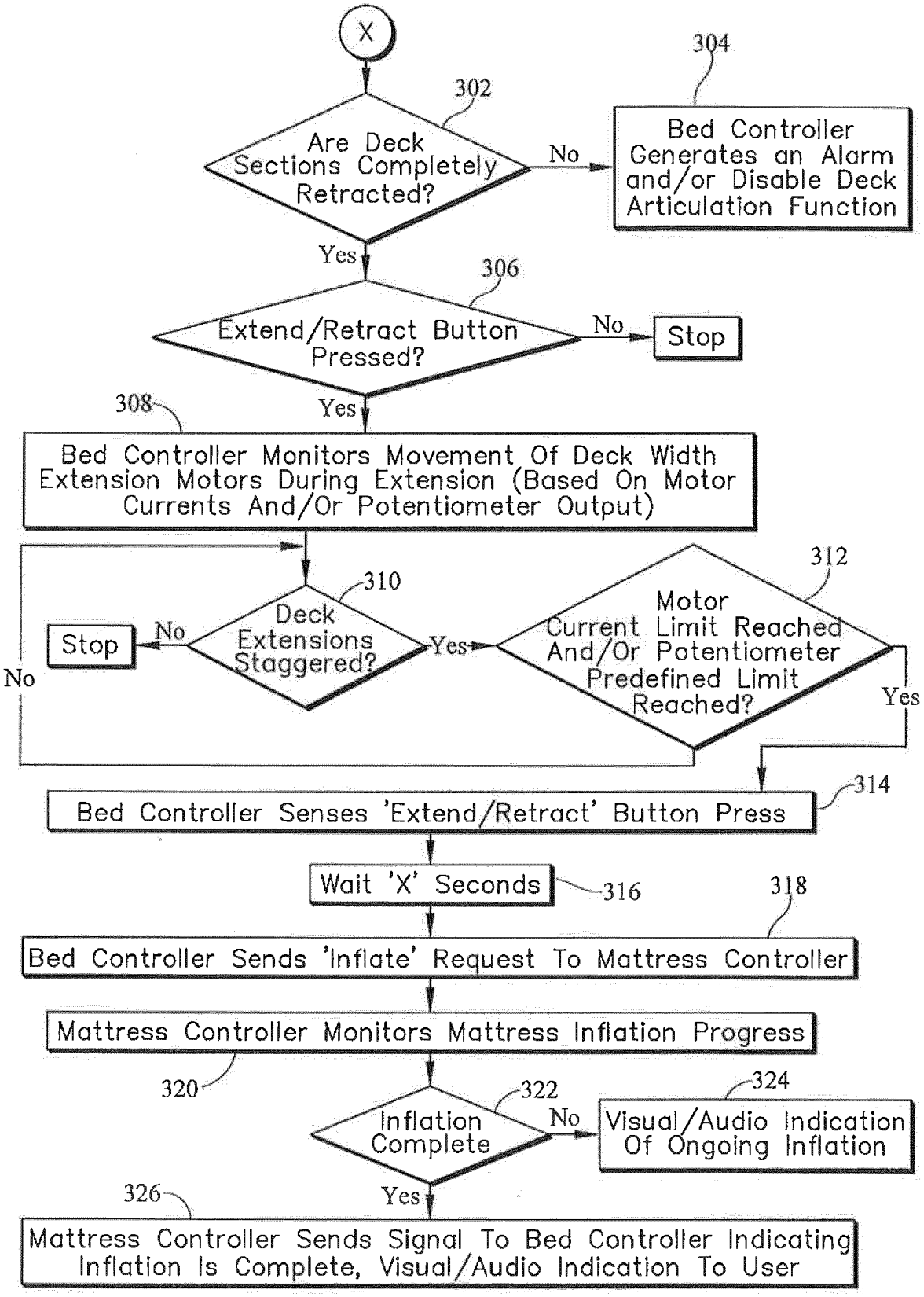

X
302
Are Deck Sections Completely Retracted?
No
304
Bed Controller Generates an Alarm and/or Disable Deck Articulation Function
Yes
306
Extend/Retract Button Pressed?
No
Stop
Yes
308
Bed Controller Monitors Movement Of Deck Width Extension Motors During Extension (Based On Motor Currents And/Or Potentiometer Output)
310
Deck Extensions Staggered?
No
Stop
Yes
312
Motor Current Limit Reached And/Or Potentiometer Predefined Limit Reached?
No
Yes
314
Bed Controller Senses 'Extend/Retract' Button Press
Wait 'X' Seconds
316
318
Bed Controller Sends 'Inflate' Request To Mattress Controller
Mattress Controller Monitors Mattress Inflation Progress
320
322
Inflation Complete
No
324
Visual/Audio Indication Of Ongoing Inflation
Yes
326
Mattress Controller Sends Signal To Bed Controller Indicating Inflation Is Complete, Visual/Audio Indication To User

FIG. 17

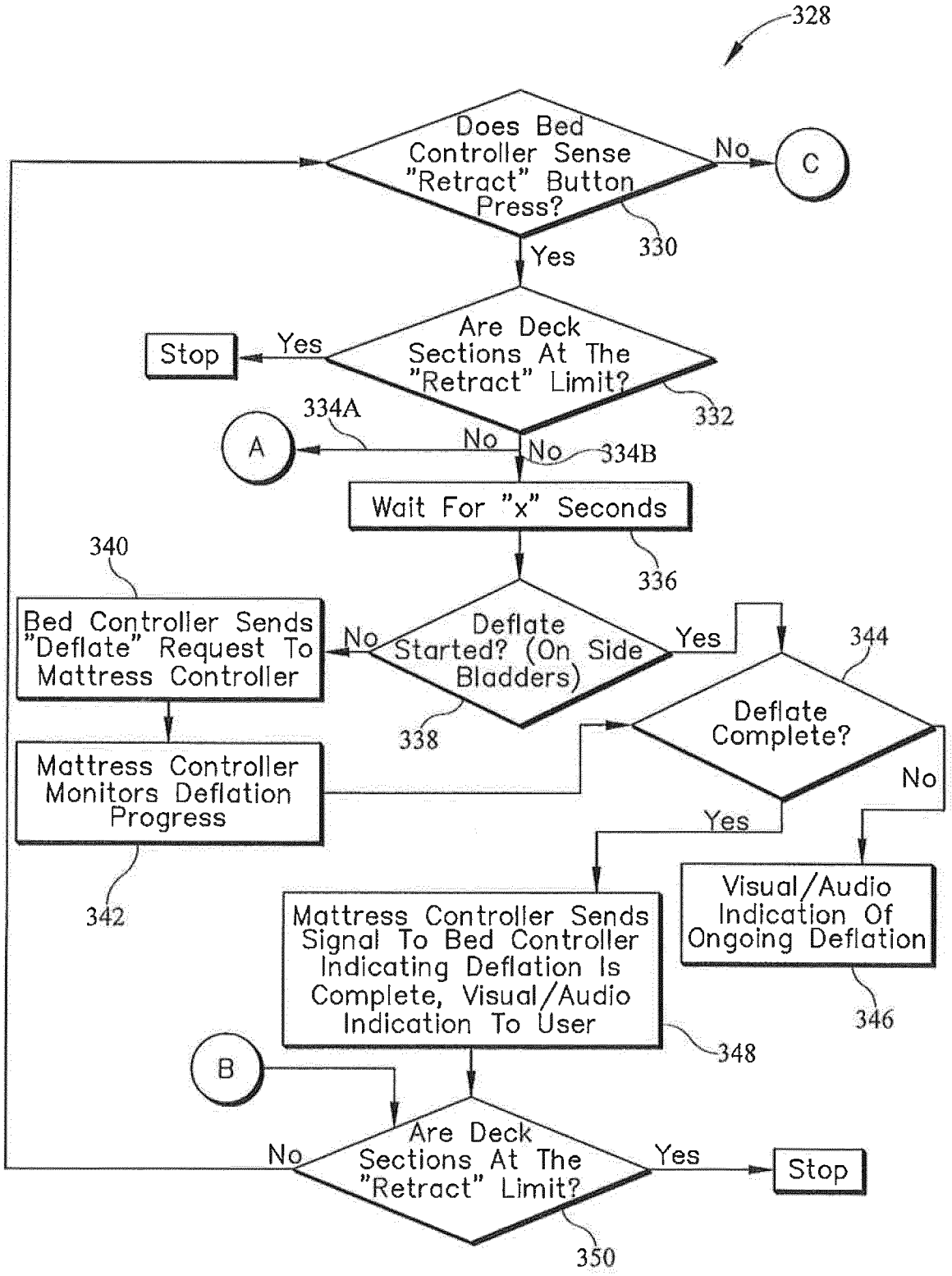

328
Does Bed Controller Sense "Retract" Button Press?
No
C
330
Yes
Are Deck Sections At The "Retract" Limit?
Yes
Stop
332
334A
A
No
No
334B
Wait For "x" Seconds
336
340
Bed Controller Sends "Deflate" Request To Mattress Controller
No
Deflate Started? (On Side Bladders)
Yes
338
344
Deflate Complete?
No
Yes
Mattress Controller Monitors Deflation Progress
342
Mattress Controller Sends Signal To Bed Controller Indicating Deflation Is Complete, Visual/Audio Indication To User
348
Visual/Audio Indication Of Ongoing Deflation
346
B
Are Deck Sections At The "Retract" Limit?
No
Yes
Stop
350

FIG. 18

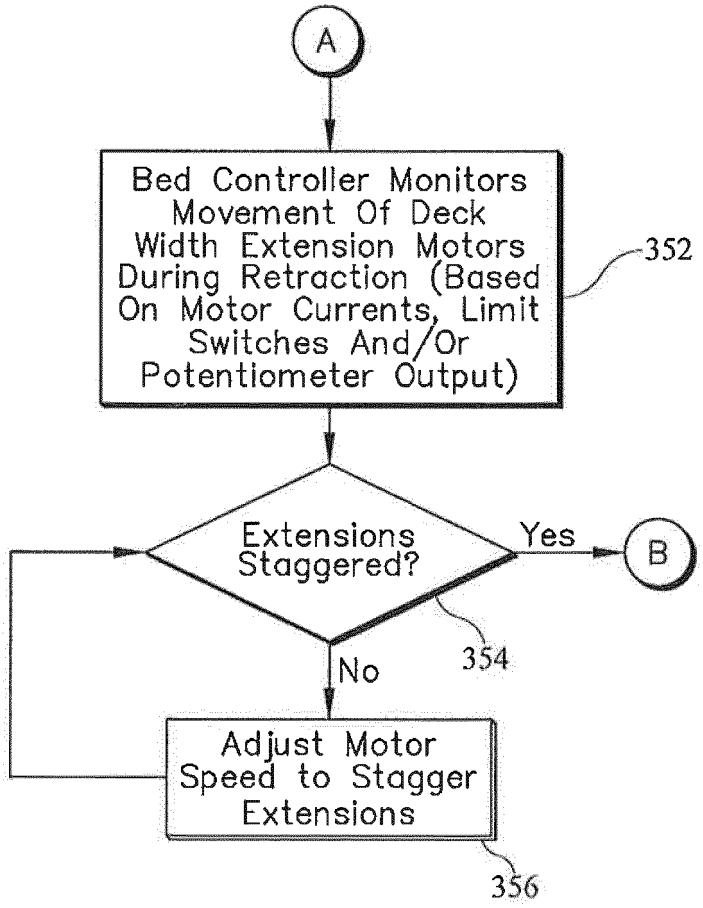

A
Bed Controller Monitors Movement Of Deck Width Extension Motors During Retraction (Based On Motor Currents, Limit Switches And/Or Potentiometer Output)
352
Extensions Staggered?
Yes
B
354
No
Adjust Motor Speed to Stagger Extensions
356

FIG. 18B

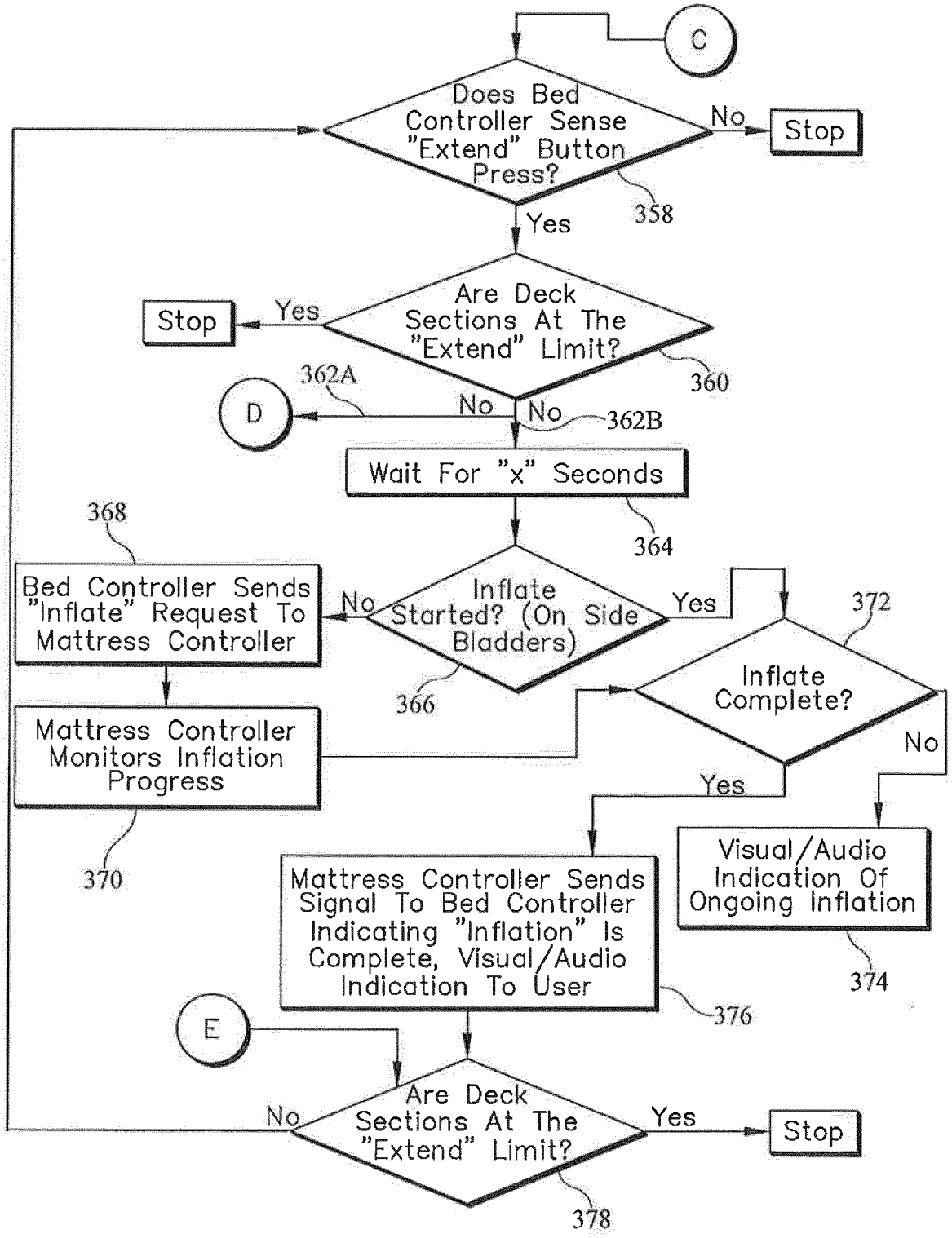

C
Does Bed Controller Sense "Extend" Button Press?
No
Stop
358
Yes
Are Deck Sections At The "Extend" Limit?
Yes
Stop
360
362A
D
No
No
362B
Wait For "x" Seconds
364
368
Bed Controller Sends "Inflate" Request To Mattress Controller
No
Inflate Started? (On Side Bladders)
Yes
366
372
Inflate Complete?
No
Yes
Mattress Controller Monitors Inflation Progress
370
Mattress Controller Sends Signal To Bed Controller Indicating "Inflation" Is Complete, Visual/Audio Indication To User
376
Visual/Audio Indication Of Ongoing Inflation
374
E
Are Deck Sections At The "Extend" Limit?
No
Yes
Stop
378

FIG. 19

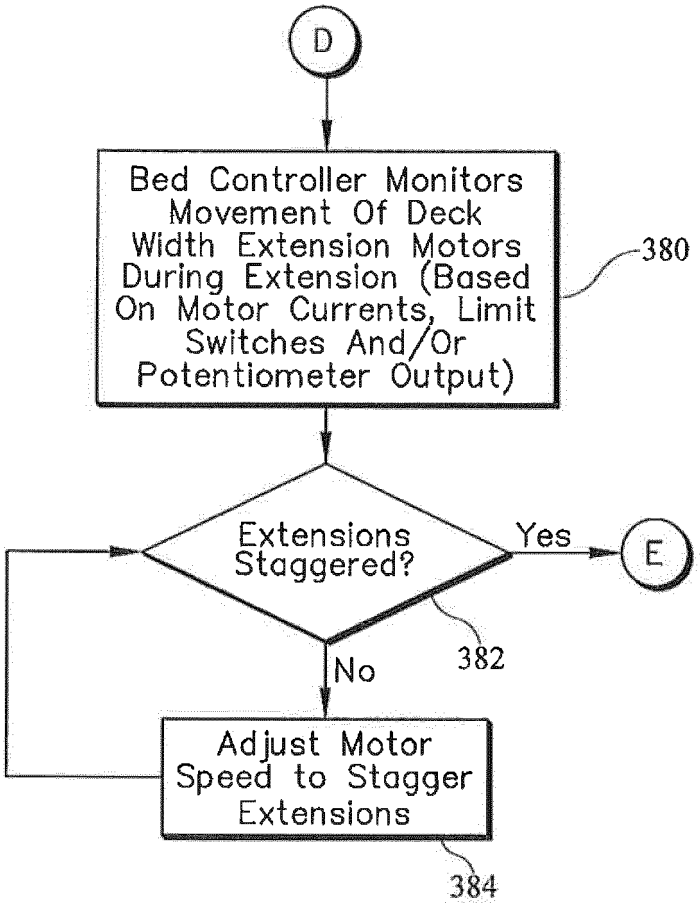

D
Bed Controller Monitors Movement Of Deck Width Extension Motors During Extension (Based On Motor Currents, Limit Switches And/Or Potentiometer Output)
380
Extensions Staggered?
Yes
E
382
No
Adjust Motor Speed to Stagger Extensions
384

FIG. 19B

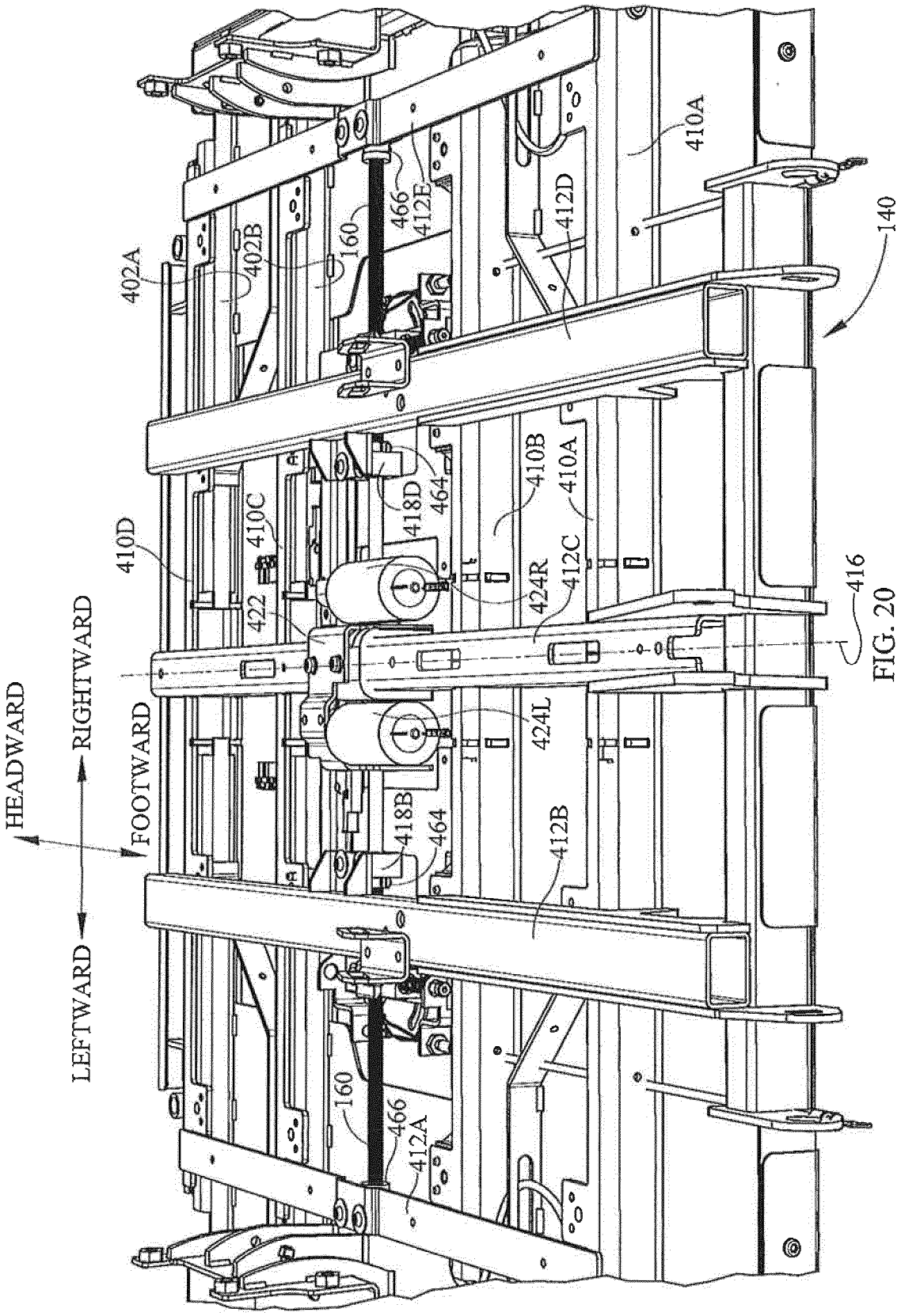

HEADWARD
FOOTWARD
RIGHTWARD
LEFTWARD
402A
402B
160
466
412E
412D
410A
140
410D
410C
422
418D
464
410B
410A
424R
412C
416
424L
418B
464
412B
160
466
412A

FIG. 20

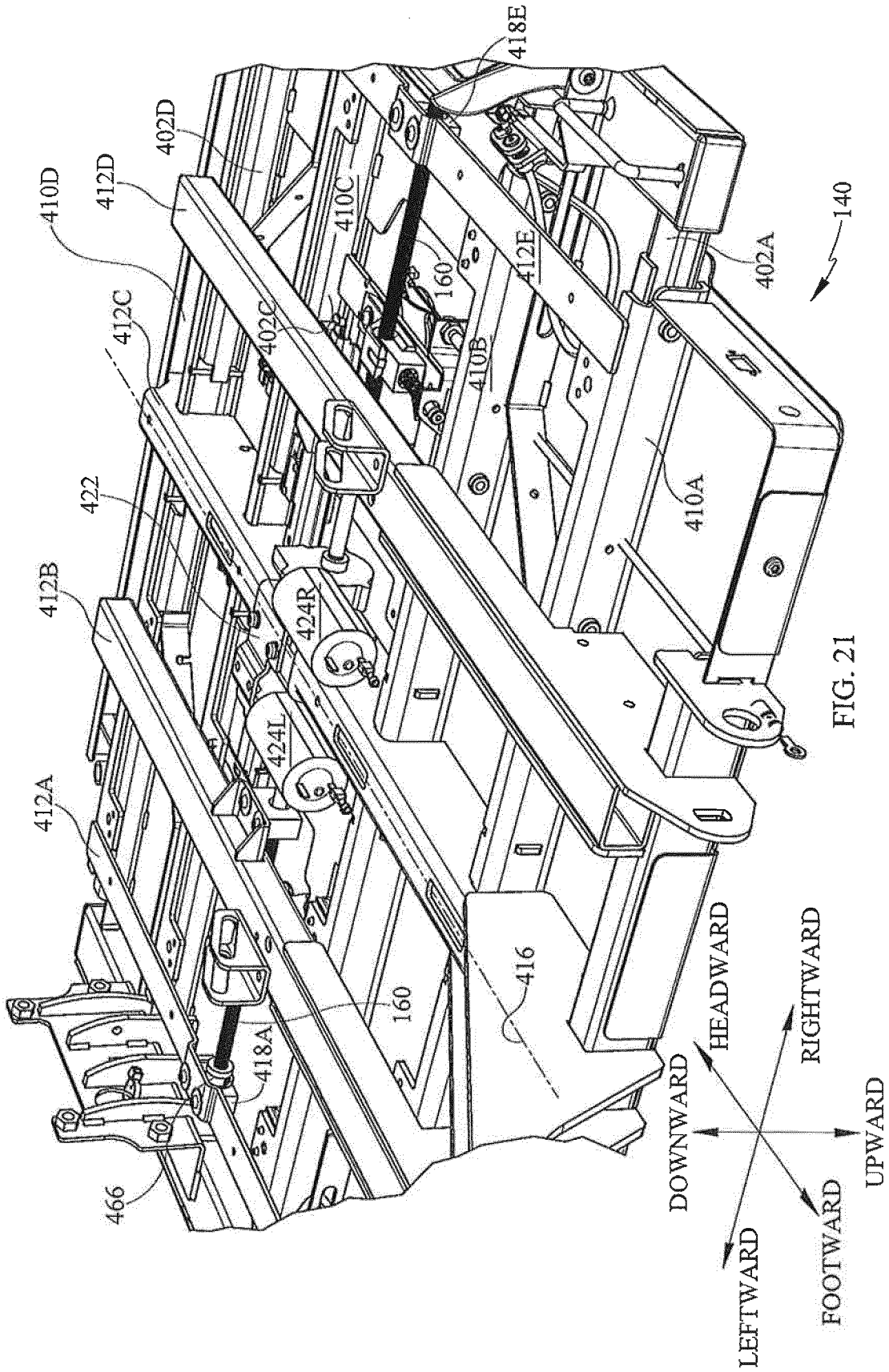

418E
402D
412D
410D
410C
160
412E
402A
140
412C
402C
410B
422
410A
412B
424R
424L
412A
416
160
418A
466
HEADWARD
RIGHTWARD
DOWNWARD
UPWARD
LEFTWARD
FOOTWARD

FIG. 21

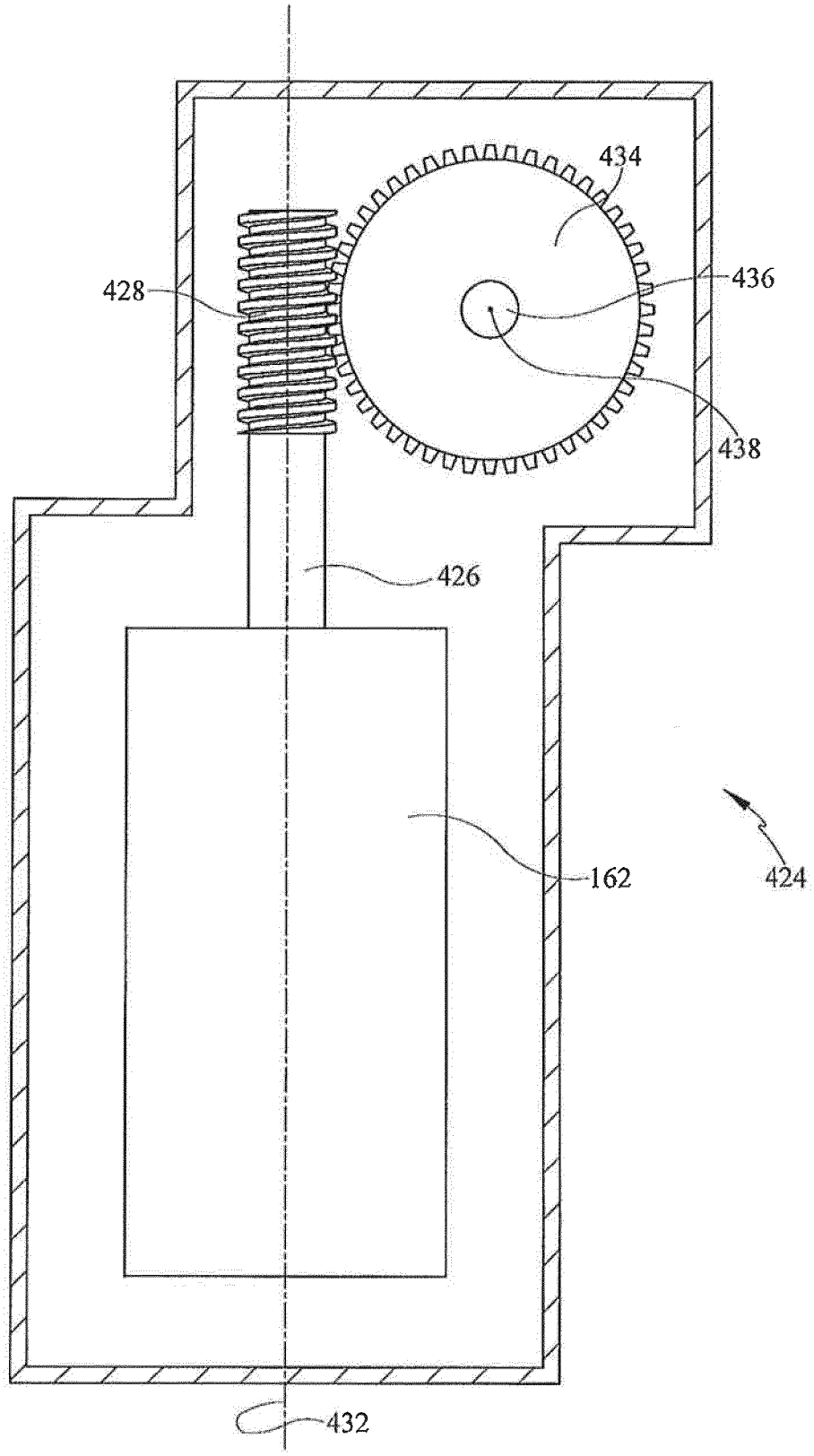


FIG. 22

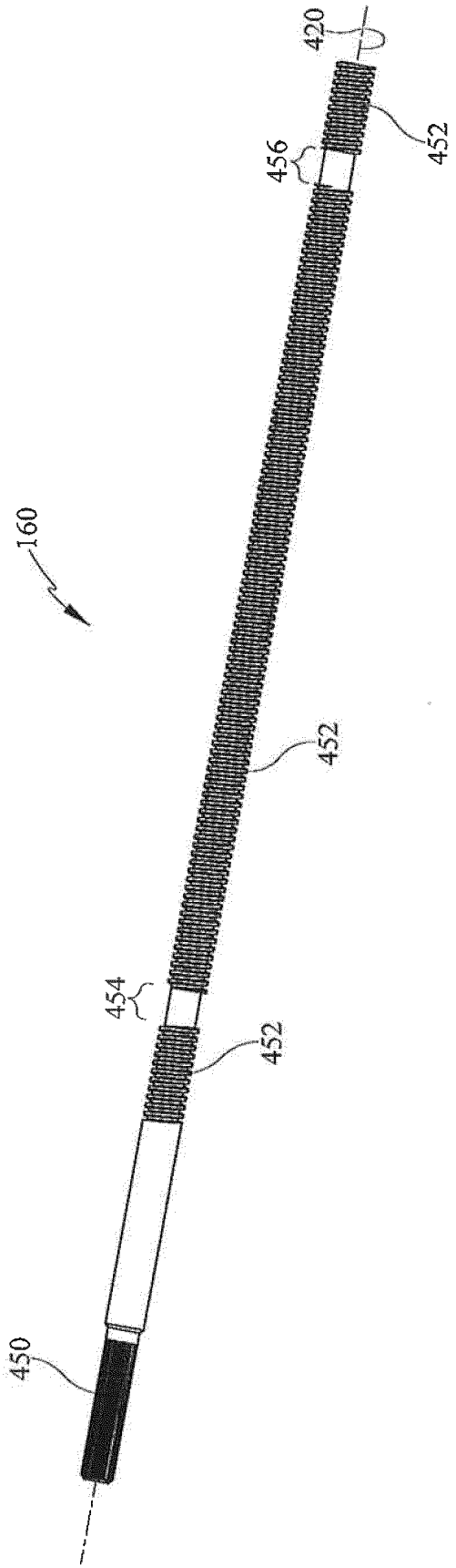


FIG. 23

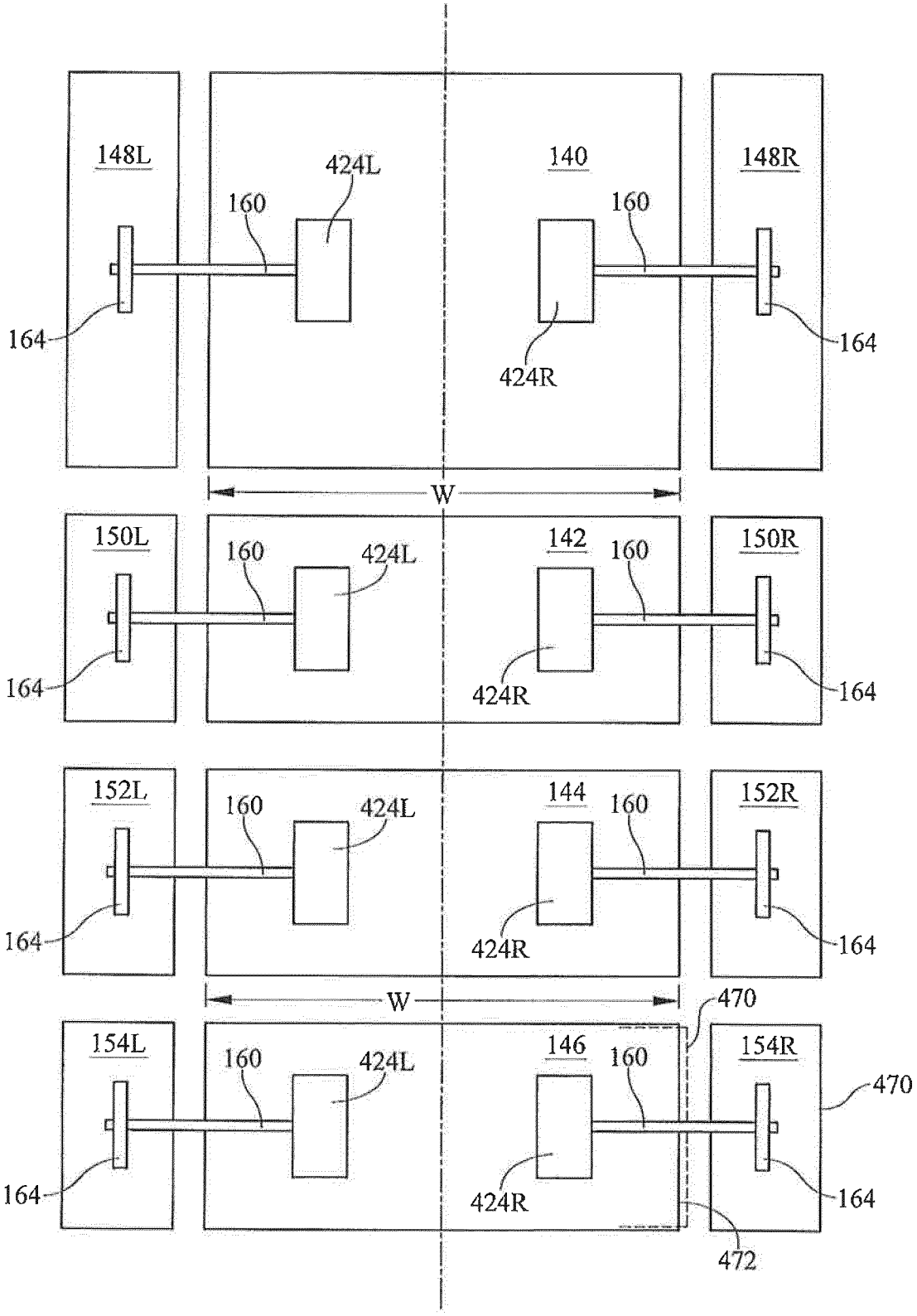

148L
424L
140
148R
160
160
164
164
424R
W
150L
160
424L
142
160
150R
164
164
424R
152L
160
424L
144
160
152R
164
164
424R
W
470
154L
160
424L
146
160
154R
470
164
164
424R
472

FIG. 24

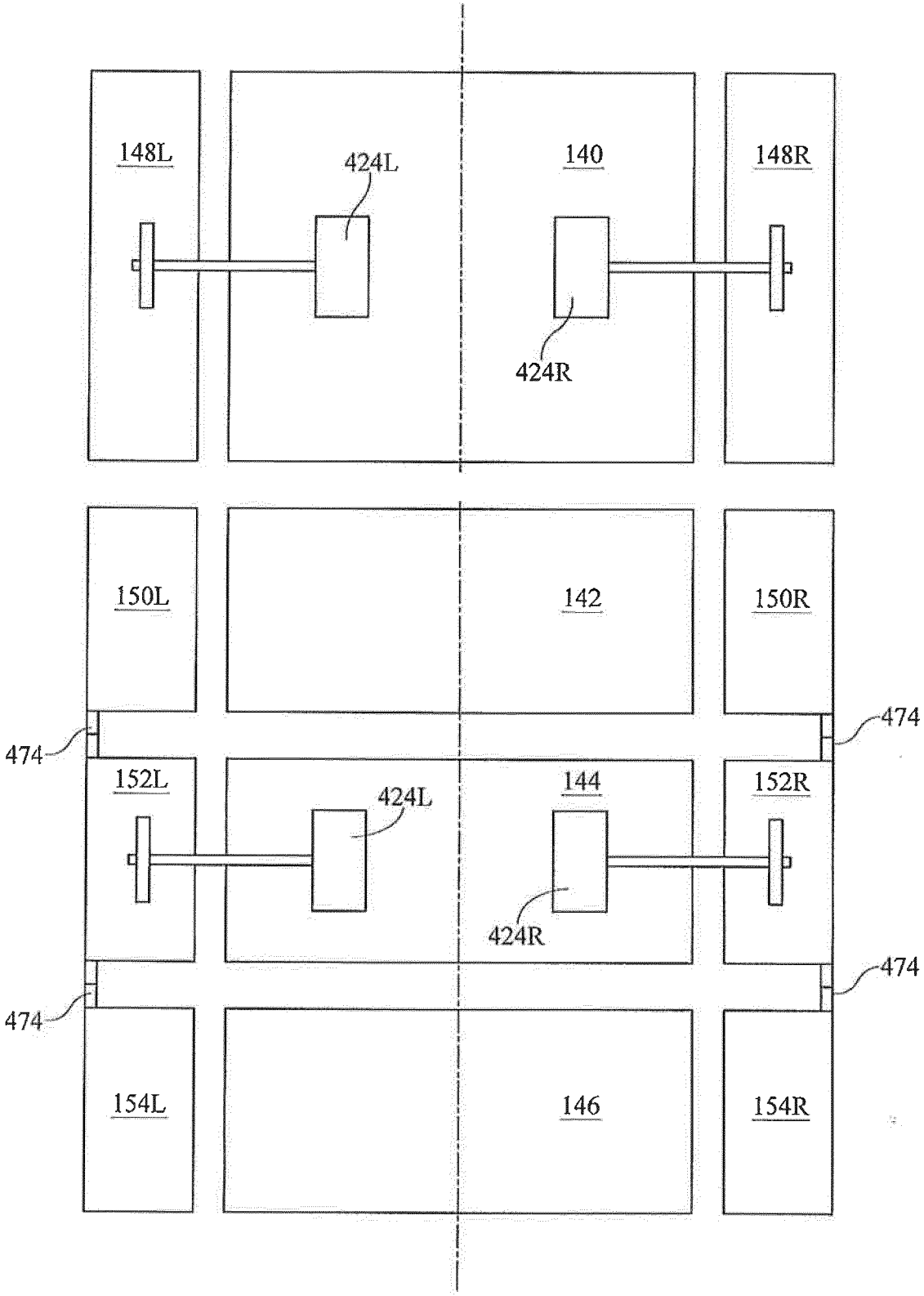

148L
424L
140
148R
424R
150L
142
150R
474
474
152L
424L
144
152R
424R
474
474
154L
146
154R

FIG. 25

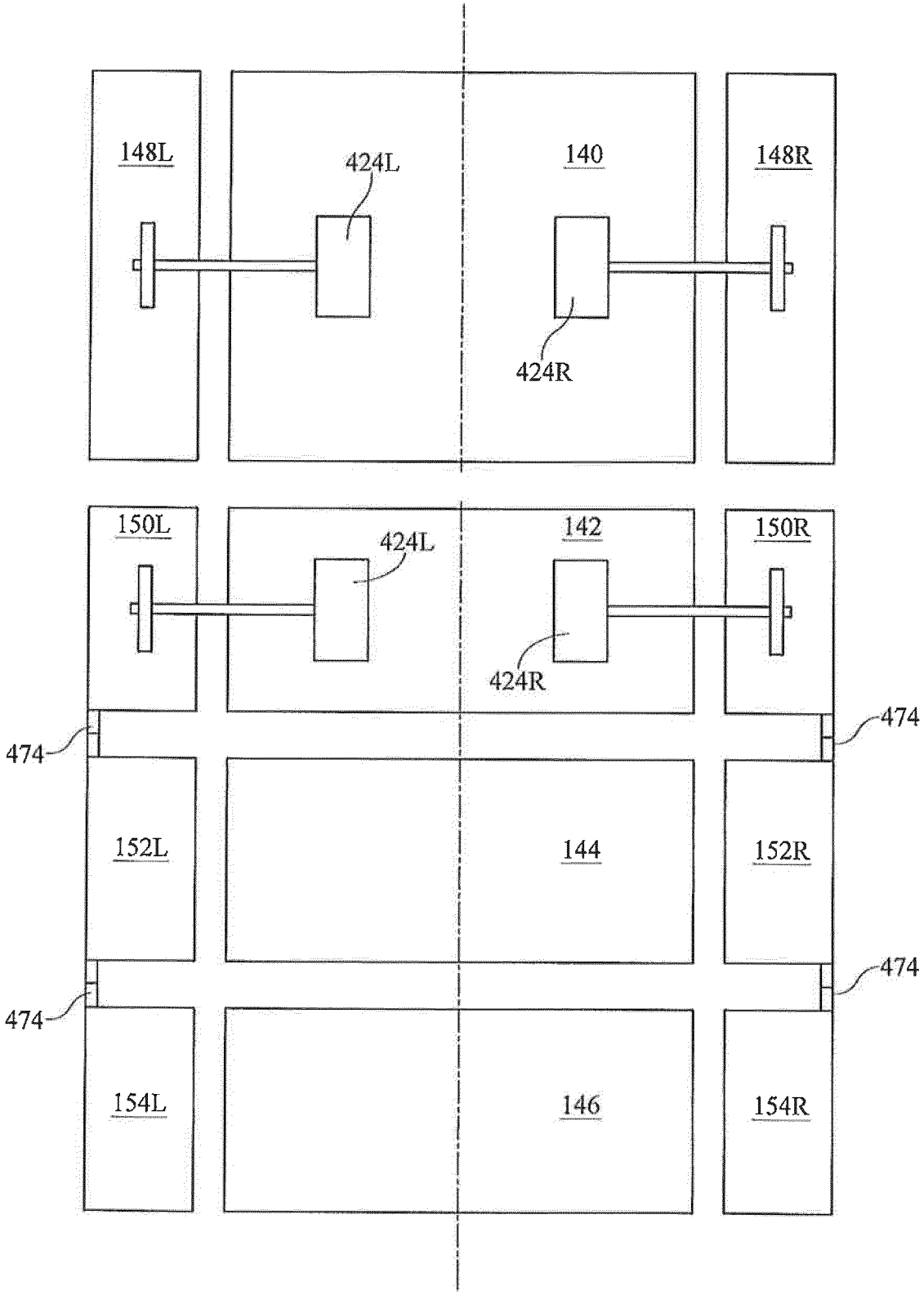

148L
424L
140
148R
424R
150L
424L
142
150R
424R
474
474
152L
144
152R
474
474
154L
146
154R

FIG. 26

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20130298331 A **[0002]**
- US 774847 A **[0006]**
- US 11775083 B **[0006]**
- US 13468424 B **[0006]**
- US 14168538 B **[0006]**