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Applicant: Life Fitness, LLC
Franklin Park, IL 60131 (US)
- (72)

Inventors:
 - DeKnock, Byron T.
Des Plaines, 60016 (US)
 - Zhao, Ellen
Lake Zurich, 60047 (US)
- (74)

Representative: Håmsø Patentbyrå AS
P.O. Box 9
4068 Stavanger (NO)
- (30)

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EXERCISE MACHINES AND METHODS OF ASSEMBLING EXERCISE MACHINES HAVING AN ADJUSTABLE CONSOLE ASSEMBLY
- (57)

An exercise machine has a frame for supporting a user of the exercise machine, and a console assembly comprising a handlebar for engagement by the user and a display for displaying and/or controlling an operational
- characteristic of the exercise machine to the user. The console assembly is coupled to the frame and longitudinally adjustable relative to the frame. Methods for assembling the exercise machine are provided.

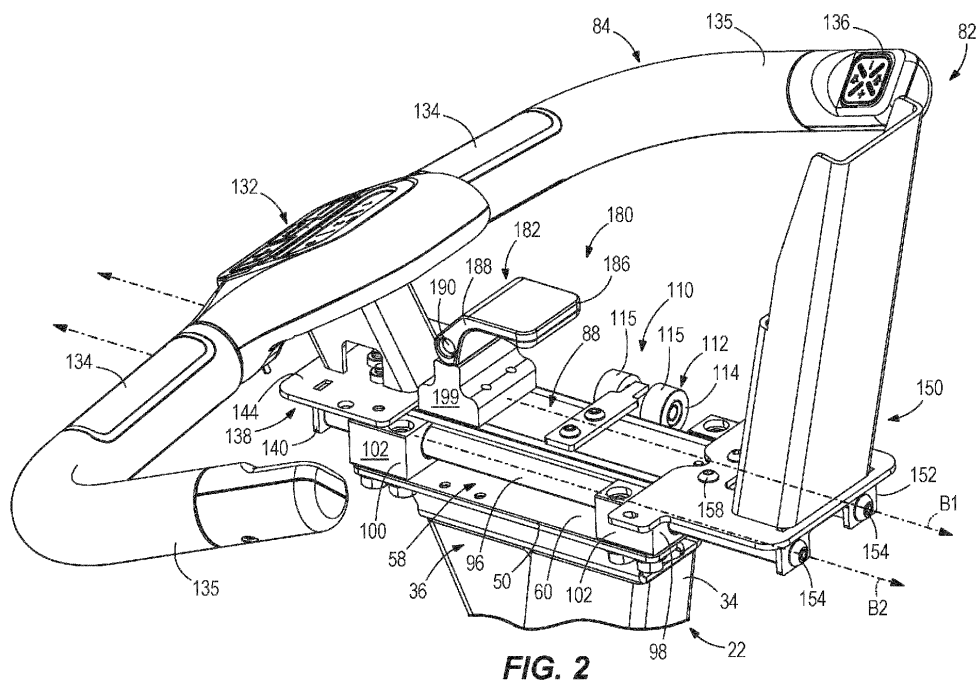


FIG. 2

Description

FIELD

[0001] The present disclosure generally relates to exercise machines including but not limited to stationary cycles, elliptical machines, arc trainers, and/or the like. The present disclosure further relates to methods for assembling such exercise machines.

BACKGROUND

[0002] Relevant background information can be found in the following U.S. patent documents.

[0003] U.S. Pat. No. 10,843,038 discloses an exercise machine having a first frame member, a second frame member that is movable with respect to the first frame member, and a locking device configured to retain the second frame member in position which frees the second frame member for movement with respect to the first frame member.

[0004] U.S. Pat. Nos. 8,496,297 and 7,874,615 disclose exercise bicycles and several mechanisms for permitting a user to adjust the seat on an exercise bicycle. The described mechanisms can be used to adjust the height of the seat or the fore and aft positioning of the seat on an upright-type bicycle.

SUMMARY

[0005] This Summary is provided to introduce a selection of concepts that are further described herein below in the Detailed Description. This Summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter.

[0006] The present disclosure provides examples of exercise machines comprising a frame for supporting a user of the exercise machine, and a console assembly comprising a handlebar for engagement by the user and a display for displaying and/or controlling an operational characteristic of the exercise machine, wherein the console assembly is coupled to and longitudinally movable relative to the frame to facilitate adjustment of the handlebar and the display relative to the user.

[0007] In independent aspects, the console assembly may be longitudinally slidable relative to the frame. The console assembly may be longitudinally adjustable into and between a forwardmost position relative to the frame and a rearwardmost position relative to the frame and may further comprise a locking device configured to lock the console assembly in place relative to the forwardmost position and the rearwardmost position.

[0008] In independent aspects, a locking device may be configured to lock the console assembly in position relative to the frame. The locking device may be configured to clamp the console assembly in position relative to the frame. The locking device may be manually oper-

able by the user. The locking device may comprise a pivot lever and a cam that causes the locking device to clamp the console assembly to the frame upon pivoting the pivot lever. The locking device may further comprise a clamp block; a clamp arm coupled to the cam and extending through the clamp block, the carriage, and the base member; and a clamp head on the clamp arm, wherein pivoting the pivot lever applies a camming force on the clamp head that clamps the carriage between the base member and the clamp head.

[0009] In independent aspects, the display may comprise a screen that extends upwardly at an angle relative to the handlebar, wherein said angle remains constant as the console assembly is longitudinally moved relative to the frame. The console assembly may further comprise a wireless charger.

[0010] In independent aspects, the frame may comprise a base member and the console assembly may comprise a carriage that is longitudinally slidable back and forth relative to the base member. The handlebar may be rigidly coupled to the carriage along two planes that are transverse to each other, and the display may be rigidly coupled to the carriage along two planes that are transverse to each other. The respective planes may be perpendicular to each other or non-perpendicular to each other. The carriage may comprise a forward end, a rearward end, and a body that extends between the forward end and the rearward end, wherein the display is fastened to the forward end and separately fastened to the body, and the handlebar is fastened to the rearward end and separately fastened to the body.

[0011] In independent aspects, the carriage may be coupled to the base member by opposing slide rails and opposing slide bearings that support sliding of the opposing slide rails. A stop device may prevent sliding of the carriage past a forwardmost position of the carriage and may prevent sliding of the carriage past a rearwardmost position of the carriage. The carriage may be coupled to the base member by opposing slide rails and opposing slide bearings supporting sliding of the opposing slide rails. The stop device may comprise a bumper that operatively engages at least one slide bearing of the opposing slide bearings to prevent sliding of the carriage past the forwardmost position and that operatively engages at least one slide bearing of the opposing slide bearings to prevent sliding of the carriage past the rearwardmost position.

[0012] In independent examples, a cable assembly for providing power and/or electrical communication to the console assembly is disposed in the frame and is coupled to and moves with the carriage relative to the base member.

[0013] The present disclosure further provides examples of a console assembly for an exercise machine, the console assembly may comprise a carriage, a handlebar for engagement by the user, and a display for displaying and/or controlling an operational characteristic of the exercise machine. The handlebar and the display are cou-

pled to the carriage and the carriage is configured to be coupled to a frame of the exercise machine such that the carriage is movable relative to the frame and thus facilitates integrated adjustment of the handlebar and the display relative to a user of the exercise machine.

[0014] In independent aspects, a locking device is configured to lock the carriage in position relative to the frame. The handlebar may be rigidly coupled to the carriage along two planes that are transverse to each other. The planes may be perpendicular or non-perpendicular. The display may be rigidly coupled to the carriage along two planes that are transverse to each other. The planes may be perpendicular or non-perpendicular. The carriage may comprise a forward end, a rearward end, and a body that extends between the forward end and the rearward end, and the display may be fastened to the forward end and separately fastened to the body, and the handlebar may be fastened to the rearward end and separately fastened to the body. The display may comprise a screen that extends upwardly at an angle relative to the handlebar, wherein the console assembly is configured such that said angle remains constant as the carriage is longitudinally moved relative to the frame. The console assembly may further comprise a wireless charger.

[0015] The present disclosure further provides methods of assembling an exercise machine, the methods comprising:

- (a) providing a frame for supporting a user of the exercise machine, and a base member disposed on or integrated with the frame,
- (b) providing a carriage that is slidable relative to the base member along an adjustment axis,
- (c) providing a first slide bearing apparatus for supporting sliding of a first lateral side of the carriage along a first slide bearing axis,
- (d) providing a second slide bearing apparatus for supporting sliding of an opposite, second lateral side of the carriage along a second slide bearing axis,
- (e) laterally clamping the carriage between the first slide bearing apparatus and the second slide bearing apparatus such that the first slide bearing axis and the second slide bearing axis are substantially parallel to each other,
- (f) rigidly coupling the first slide bearing apparatus to the base member such that the first slide bearing axis is substantially parallel to the adjustment axis, and
- (g) thereafter fastening the second slide bearing apparatus to the base member.

As further described herein, steps (e) through (g) may advantageously be configured to ensure that the first slide bearing axis is substantially parallel to the second slide bearing axis and substantially parallel to the adjustment axis such that in use the carriage is freely slidable along the adjustment axis relative to the first slide bearing

apparatus and the second slide bearing apparatus.

[0016] In independent aspects, the first slide bearing apparatus comprises a first plurality of slide bearings and the second slide bearing apparatus comprises a second plurality of slide bearings. In independent aspects, the first plurality of slide bearings comprises a front slide bearing and a rear slide bearing that is spaced apart from and substantially aligned with the front slide bearing, and the second plurality of slide bearings comprises a front slide bearing and a rear slide bearing that is spaced apart from and substantially aligned with the front slide bearing.

[0017] In independent aspects, the frame comprises a pedestal, and the method further comprises coupling the base member to the pedestal.

[0018] In independent aspects, step (f) comprises fixing the first slide bearing apparatus to the base member by engaging a first plurality of fasteners in a first plurality of apertures that is substantially parallel to the adjustment axis. Each aperture in the first plurality of apertures may be a round hole, and each fastener in the first plurality of fasteners may comprise a conical head that operatively engages and is centered respect to the round hole during fastening.

[0019] In independent aspects, step (g) comprises fixing the second slide bearing apparatus to the base member by engaging a second plurality of fasteners in a second plurality of fastener apertures.

[0020] In independent aspects, step (h) comprises coupling a handlebar to the carriage and coupling a display to the carriage, wherein the handlebar and the display are longitudinally adjustable relative to the frame.

[0021] Various other features, objects and advantages of the disclosure will be made apparent from the following description taken together with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The present disclosure includes the following drawing Figures.

FIG. 1 is a perspective view of an example exercise machine according to the present disclosure.

FIG. 2 is a perspective view of portions of a frame and a console assembly of the exercise machine.

FIG. 3 is a perspective view looking up at the frame and the console assembly shown in Fig. 2.

FIG. 4 is an exploded view of portions of the frame and portions of the console assembly.

FIG. 5 is a view of Section 5-5, taken in Fig. 1

FIGS. 6-11 is a series of views depicting assembly of portions of the exercise machine.

FIG. 12 is a detail view of Section 12-12, taken in Fig. 9.

FIG. 13 is an exploded view showing assembly of a handlebar and a display of the console assembly.

FIGS. 14 and 15 depict movement of the console assembly relative to the frame.

DETAILED DESCRIPTION

[0023] During research and development in the field of exercise machine, the present inventors have identified a need for improved machines having adjustability for accommodating differently sized users. The present inventors have also identified a need for improved assembly methods for such exercise machines which are efficient and effective, including without compromising alignment and long-term reliable functionality of the assembled components. The present disclosure is a result of these efforts.

[0024] The following detailed description refers to an example stationary exercise bike shown in the appended drawing figures. However, it should be understood that the present disclosure is applicable to a wide variety of other types and configurations of exercise machines, including but not limited to elliptical machines, treadmills, arc trainers, and/or the like. The present disclosure is also applicable to a wide variety of other types and configurations of exercise bikes, including but not limited to upright bikes and recumbent bikes. The illustrated stationary exercise bike is provided for discussion purposes only and is not intended to limit the scope of this disclosure or the appended claims.

[0025] FIG. 1 depicts an exercise machine, which in the illustrated example is a stationary exercise bike 20. The bike 20 extends in three dimensions, including between a front and a rear in a longitudinal direction LO, between a first side and an opposite, second side in a lateral direction LA that is perpendicular to the longitudinal direction LO, and between a top and a bottom in a vertical direction V that is perpendicular to the longitudinal direction LO and perpendicular to the lateral direction LA. The bike 20 has a frame 22 (see Fig. 2), which is clad by a shroud 23 such that only limited portions of the frame 22 are visible. The frame 22 provides a rigid framework or other structure for supporting components of the bike 20 and for supporting a user seated on the bike 20 while performing a pedaling exercise motion. A seat post 24 and seat 26 extend upwardly from the frame 22 and are for supporting the user in a seated position. Pedals 28 are located on opposite sides of the bike 20 and are configured for engagement by the user's feet and performance of the noted pedaling exercise motion. Although not shown in the figures, the pedals 28 may be operatively coupled to a resistance mechanism such as a flywheel and/or brake and/or the like, configured to resist rotation the pedals 28. The height of the seat 26 may be adjustable relative to the pedals 28 to accommodate users of different height, for example according to examples shown the above-referenced patents.

[0026] The frame 22 has front and rear legs 30 that laterally extend from opposite sides of the bottom of the bike 20. The front and rear legs 30 are configured to support the bike 20 and prevent tipping of the bike 20 relative to the ground or other supporting surface. Adjustable feet 32 may be provided on the bottom of each

of the front and rear legs 30 for engaging and leveling the bike 20 relative to the ground or supporting surface.

[0027] Referring to FIGS. 2-5, the frame 22 has a support column 34. The support column 34 is a rigid elongated member that extends upwardly at the front of the bike 20. The upper end of the support column 34 has a pedestal 36. The pedestal 36 is provided by a base bracket 38 having opposite sides 40 that extend upwardly and laterally outwardly relative to the support column 34. A trough 42 is defined laterally between the sides 40. The bottom 44 of the trough 42 defines an opening 47 (see FIG. 4) to the interior 48 of the support column 34. Opposing mounting flanges 50 extend laterally outwardly from the angled sides 40. Apertures 52 are defined through one of the mounting flanges 50. Each aperture 52 is a round hole. Apertures 55 are defined through the other mounting flange 50. Each aperture 55 is a laterally elongated slot. Alignment holes 46 are also defined in the mounting flanges 50.

[0028] A base member 58 is mounted on the pedestal 36. In the illustrated example, the base member 58 is a plate member that extends over the trough 42 and has laterally opposite sides 60 that are fastened to the mounting flanges 50 of the pedestal 36. A centrally raised portion 62 protrudes upwardly relative to the opposite sides 60 and has a longitudinally elongated slot 64 formed therein. Fasteners 66 extend through the apertures 52 in the mounting flange 50 and through corresponding apertures 68 in the base member 58. Each fastener 66 has a threaded shaft 70 and conical head 72, which, as further described herein below, is self-centering relative to the round hole during tightening of the fastener 66. Fasteners 74 extend through the apertures 55 in the mounting flange 50 and through corresponding apertures 76 in the base member 58. Each fastener 74 has a threaded shaft 78 and a hex flat head 80. Alignment pins 81 (see FIG. 6) protrude from the bottom of the opposite sides 60 of the base member 58 and are received in the noted alignment holes 46 in the mounting flanges 50 of the pedestal 36 for initially aligning the base member 58 on the pedestal 36 prior to tightening of fasteners 66, 74, as will be further described herein below. In other examples, the base member 58 may be integral with the pedestal 36 or coupled to the pedestal 36 by other means than what is shown and described.

[0029] With continued reference to FIGS. 1-5, a console assembly 82 is coupled to the frame 22 and is advantageously longitudinally movable (i.e., longitudinally adjustable) relative to the frame 22 along the noted adjustment axis A shown in FIG. 1. The position of the console assembly 82 can be adjusted by the user seated on the seat 26. Among other things, console assembly 82 includes a handlebar 84 for manual engagement by the user and a display 86 (see FIG. 1) for displaying and/or controlling an operational characteristic of the bike 20. The display 86 may include a generally flat liquid crystal and/or any other type of screen 87 for displaying operational characteristics of the bike 20. The screen 87 may

be a conventional touch screen configured to receive touch inputs from the user for input to a computer controller having a processor and/or software for controlling one or more operational characteristics of the bike 20. In other examples, the display 86 may include other types and configurations of displays such as more than one screen, more than one touch screen, one or more curved screens, a combination of flat and curved screens, lighted displays, and/or the like. The display 86 may further include audio speakers. The handlebar 84 and the display 86 are each fixed to a carriage 88, which as described herein below is longitudinally slidable back and forth relative to the base member 58 along an adjustment axis A (see FIGS. 1, 8-11) extending in the longitudinal direction LO. As will be further described herein below, note that the above-described apertures 52 comprising round holes are substantially aligned with each other along an axis C (see FIG. 6, described herein below) in the longitudinal direction LO, substantially parallel to the adjustment axis A. As will be described below this permits the round holes to provide a reference line (axis C) to ensure that the carriage 88 and remainder of the console assembly 82, once installed onto the frame 22, are substantially aligned with and will slide along the desired direction of axis A.

[0030] Referring to FIG. 4, the carriage 88 has a carriage body 90 with a rearward end 94 and a forward end 92 that is longitudinally opposed to the rearward end 94. Slide rails 96 longitudinally extend along opposite sides of the carriage body 90. In the illustrated example, the carriage body 90 is plate-like member and the slide rails 96 are elongated cylindrical members that are integrally formed with the plate-like member. However, the carriage body 90 may have another shape, and/or the slide rails 96 may be fastened or otherwise attached to the carriage body 90 instead of being integrally formed therewith. The slide rails 96 protrude downwardly from the carriage body 90 such that a channel 97 is defined below the carriage body 90 and between the slide rails 96. The channel 97 is sized to receive the raised portion 62 protruding upwardly from the base member 58 when the carriage 88 is slidably mounted on the base member 58.

[0031] The carriage 88 is supported on the base member 58 by opposing slide bearings, including opposing front slide bearings 98 and opposing rear slide bearings 100. The opposing front and rear slide bearings 98, 100 are configured to support longitudinal sliding motion of the slide rails 96. The type and configuration of slide bearing can vary from what is shown and described. In the illustrated example, each slide bearing 98, 100 has a bearing body 102 that defines a bearing passage 104 in which one of the slide rails 96 is nested and freely longitudinally slidable therein. Each bearing 98, 100 has linear bearings 105 in the bearing passage 104 for engaging and permitting said longitudinal sliding motion of the noted slide rail 96 relative to the respective bearing 98, 100. Suitable bearings for use with the illustrated example may be purchased from igus®, linear guide rail, model

WJ200UM-01. Each bearing body 102 is fastened to the base member 58 and pedestal 36 via threaded engagement with respective fasteners 66, 74, such that the opposite sides 60 of the base member 58 are vertically sandwiched between the mounting flanges 50 on the pedestal 36 and the slide bearings 98, 100.

[0032] Referring to FIGS. 4, 14, and 15, a stop device 110 is configured to prevent forward sliding of the carriage 88 past a forwardmost position relative to the base member 58, as shown in FIG. 14, and to prevent rearward sliding of the carriage 88 past a rearwardmost position relative to the base member 58, as shown in Fig. 15. The type and configuration of the stop device 10 may vary from what is shown and described. In the illustrated example, the stop device 110 includes a bumper 112 that laterally extends from one side of the carriage body 90 and has front and rear engagement surfaces 114, 116 that face and are configured to abut or otherwise engage with the front and rear slide bearings 98, 100 on that side of the carriage body 90, respectively. Sliding of the carriage 88 forwardly to the forwardmost position brings the front engagement surface 114 into engagement with the front slide bearing 98 and thus stops further forward movement of the carriage 88. Sliding of the carriage 88 rearwardly to the rearwardmost position brings the rear engagement surface 116 into engagement with the rear slide bearing 100 and thus stops further rearward movement of the carriage 88. The type and configuration of the bumper 112 can vary from what is shown and described. In the illustrated example, the bumper 112 includes a pair of washers 115 made of a resilient material such as soft rubber to provide a low impact engagement with the front and rear bearings 98, 100. The washers 115 are coupled to ends of a cylindrical spacer 117 by fasteners 118 extending there through. A mounting bracket 119 couples the cylindrical spacer 117 to the carriage body 90 via fasteners 120.

[0033] Referring to FIGS. 1, 5 and 13, in the illustrated example, the handlebar 84 is an elongated and generally U-shaped member having a keypad 132 having input buttons, and/or sensors 134 for sensing a physical characteristic of the user, such as heart rate. The opposing ends of the handlebar 84 provide handles 135 for grasping by the user. Additional keypads 136 may be provided on the handles 135. It should be understood however that the shape and configuration of the handlebar 84 and user options provided by the handlebar 84 are exemplary and may widely vary from what is shown and described.

[0034] A handlebar mounting bracket 138 couples the handlebar 84 to the carriage 88 along two planes that are transverse to each other. The transverse planes may be perpendicular or non-perpendicular. This advantageously provides a robust mounting connection of the handlebar 84 to the carriage 88, which as described above is movable component. In the illustrated example, the two planes are perpendicular. The first plane extends in the lateral direction LA and the longitudinal LO direction. The second plane extends in the lateral LA direction

and the vertical V direction. However, this is not limiting, and in other embodiments connections of the handlebar 84 along different transversely oriented planes may be employed. To facilitate the two-plane mounting, the handlebar mounting bracket 138 has a rear bracket plate 140 that is fastened to the rearward end 94 of the carriage body 90, particularly via fasteners 142 (see FIGS. 3 and 13) longitudinally extending through the rear bracket plate 140 and engaged with end bores in the rear ends of slide rails 96, and a top bracket plate 144 that is fastened to the top of the carriage body 90 via fasteners 146 engaged with bores in the carriage body 90 and extending through the top bracket plate 144. As such the handlebar 84 is rigidly coupled to the carriage 88 in the noted two-plane arrangement and configured to move along with the carriage 88 relative to the frame 22.

[0035] Referring to FIG. 2, a display mounting bracket 150 couples the display 86 to the carriage 88 along two planes that are transverse to each other. The planes may be perpendicular or non-perpendicular. This advantageously provides a robust mounting connection of the display 86 to the carriage 88. In the illustrated example, the two planes are perpendicular to each other. The first plane extends in the lateral direction LA and the longitudinal LO direction. The second plane extends in the lateral LA direction and the vertical V direction. However, this is not limiting, and other embodiments connections of the display 86 along different transversely oriented planes may be employed. In the illustrated example, the display mounting bracket 150 has a front bracket mounting plate 152 that is fastened to the forward end 92 of the carriage body 90, particularly via fasteners 154 (see Fig. 13) longitudinally extending through the front bracket mounting plate 152 and engaged with end bores in the slide rails 96, and a top bracket 156 that is fastened to the top of the carriage body 90 via fasteners 158 vertically extending through the top bracket 156 and engaged with bores in the top of the carriage body 90. As such, the display 86 is rigidly coupled to the carriage 88 and configured to move along with the carriage 88 relative to the frame 22.

[0036] Referring to FIG. 1, a wireless charger 171 may be incorporated into the console assembly 82 and conveniently located longitudinally between the handlebar 84 and the display 86. In the illustrated example the wireless charger 171 is located in an "activity zone" defined within the U-shape of the handlebar 84. The wireless charger 171 defines a generally flat tray on which the user may set and wirelessly charge their personal wireless device, for example tablet or phone. The type and configuration of the wireless charger 171 may vary from what is shown.

[0037] Referring now to FIG. 5, a cable assembly 160 is configured to provide power and/or electrical communication to the keypad 132 and/or input buttons 133, and/or sensors 134 on the handlebar 84, and/or to the display 86, and/or wireless charger 171, and/or to any other electrical components of the console assembly 82.

The cable assembly 160 is disposed inside the frame 22, particularly inside the support column 34 and is coupled to and moves with the carriage 88 relative to the base member 58 and relative to the frame 22. The manner of connection of the cable assembly 160 to the carriage 88 may vary from what is shown and described. In the illustrated example, a connection bracket 166 couples the cable assembly 160 to the bottom of the carriage 88. The cable assembly 160 is advantageously routed along a curved shape 168 inside the support column 34. As the carriage 88 is moved relative to the frame 22 in the longitudinal direction LO, the portion of the cable assembly 160 that is attached to the carriage 88 via the connection bracket 166 will move relative to the portion of the cable assembly 160 located in the support column 34. The curved shape 168 of the cable assembly 160 advantageously will compress or expand (e.g., in the longitudinal direction) upon movement of the carriage 88, which limits movement of the cable assembly 160 relative to the interior surfaces of the frame 22, and thus limits chafing that otherwise would occur by dragging the cable assembly 160 along the interior surfaces.

[0038] Referring to FIGS. 1, 4 and 5, a locking device 180 is configured to lock the carriage 88 and console assembly 82 in position relative to the frame 22. The type and configuration of the locking device 180 can vary from what is shown and described. In the illustrated example, the locking device 180 includes a pivot lever 182 having an elongated body 184 with a first end 186 for manually grasping by the user and an opposite, second end 188 that is pivotable about a pivot shaft 190. The pivot lever 182 is pivotable upwardly and downwardly about the pivot shaft 190, as shown by the double-headed arrow in FIG. 5. As further described herein below, pivoting the pivot lever 182 into the lowered position shown in solid line in FIG. 5 securely locks the carriage 88 and the remainder of the console assembly 82 in a longitudinal position relative to the frame 22. Conversely, pivoting the pivot lever 182 into the raised position shown in dashed lines in FIG. 5 frees the carriage 88 and remainder of the console assembly 82 for longitudinal movement relative to the frame 22, into and anywhere between a forwardmost position shown in FIG. 14 and a rearwardmost position shown in FIG. 15. The pivot lever 182 is advantageously centered on the console assembly 82 and located just forwardly of the handlebar 84 for easy and ergonomic access and operation by the user. A user seated on the seat 26 can easily use his or her fingers to grasp and pull the first end 186 of the pivot lever 182 towards the handlebar 84 into the raised position, and conversely can easily use his or her fingers or palm to push the first end 186 of the pivot lever 182 away from the handlebar 84, into the lowered position.

[0039] The locking device 180 includes a cam 192 that is configured to apply a clamping force on the base member 58 and carriage 88 which prevents longitudinal movement of the carriage 88 relative to the base member 58. The cam 192 is provided via camming engagement be-

tween an eccentric outer profile 194 on the second end 188 of the pivot lever 182 and a curved laterally elongated recess 196 on a cam block 199 fixedly coupled to the carriage 88. A cam shaft 198 extends through a through-bore 200 in the cam block 199 and a hole 202 in the carriage 88. Between the cam block 199 and the carriage 88, the cam shaft 198 also extends through the elongated slot 64 in the base member 58. As will be further explained herein below, the elongated slot 64 is shaped and sized such that the cam shaft 198 is free to move along the elongated slot 64 during longitudinal adjustment of the carriage 88 and remainder of the console assembly 82.

[0040] The cam shaft 198 has a first end 206 extending into the second end 188 of the pivot lever 182 and fixed to the pivot shaft 190, and a second end 207 having a clamp head 208 configured to apply an axial clamping force on the bottom of the base member 58 when the locking device 180 is moved into the locked position. In the illustrated example, the clamp head 208 has a friction washer 210 for frictionally engaging the bottom of the base member 58 and a pair of jam nuts 212 that retain the friction washer 210 on the cam shaft 198. As shown in FIG. 5, the clamp head 208 is generally located in a channel 214 (see FIG. 4) defined by the raised portion 62 of the base member 58 and the friction washer 210 is configured to frictionally engage the inner top wall therein on opposite sides of the elongated slot 64. The type and configuration of the clamp head 208 can vary from what is shown and described. An alignment pin 218 extends from the pivot shaft 190 into a bore 220 in the cam block 199 and is configured to prevent twisting movement of the pivot lever 182 relative to the cam block 199. Cylindrical bearings 222 seated in the through-bore 200 and bore 220 support axial movement of the cam shaft 198 and the alignment pin 218 during rotation of the pivot lever 182 about the pivot shaft 190.

[0041] It will thus be understood that the locking device 180 is manually operable by a user operating or preparing to operate the bike 20 and is configured to rigidly clamp the console assembly 82 in position relative to the frame 22, thus accommodating users of different sizes to ergonomically operate the same bike 20. Pivoting of the pivot lever 182 into the lowered position shown in solid lines in FIGS. 14 and 15 rotates the eccentric outer profile 194 at the second end 188 of the pivot lever 182 and causes the cam 192 to raise the clamp head 208 into axial and frictional engagement with the base member 58, thereby securely clamping the base member 58, carriage 88 and cam block 199 between the clamp head 208 and the second end 188 of the pivot lever 182. The locking device 180 is thus configured to facilitate locking of the position of the carriage 88 and the remainder of the console assembly 82 in any position relative to the forwardmost position and rearward most positions shown in FIGS. 14 and 15. Conversely, pivoting of the pivot lever 182 into the raised position shown in dashed lines in FIGS. 14 and 15 rotates the eccentric outer profile 194 in the opposite direction, which causes the cam 192 to lower the

clamp head 208 out of axial and frictional engagement with the base member 58, thus freeing the carriage 88 and the remainder of the console assembly 82 into another position. As discussed above, the cam shaft 198 is free to move along the elongated slot 64 of the base member 54 during longitudinal adjustment of the carriage 88 and remainder of the console assembly 82. Also as discussed above, the stop device 110 prevents forward sliding of the carriage 88 past a forwardmost position relative to the base member 58, as shown in FIG. 14, and prevents rearward sliding of the carriage 88 past a rearwardmost position relative to the base member 58, as shown in Fig. 15. The handlebar 84 and the display 86 are securely and rigidly fixedly coupled to the carriage 88 in two planes, thus preventing rattling or misalignment of the assembly during use. Fixing both the handlebar 84 and the display 86 to the carriage 88 advantageously retains the display 86 at a constant angle (see FIG. 1) relative to the remainder of the console assembly 82 during and after adjustment of the position of the console assembly 82 relative to the frame 22. Also as discussed above, the cable assembly 160 is advantageously coupled to the carriage 88 and circuitously routed within the supporting frame 22 so that the cable assembly 160 efficiently moves within the supporting frame 22 during movement of the console assembly 82, both contracting and expanding, thus preventing frictional engagement with the interior of the frame 22 and wear of the cables in the cable assembly 160 that otherwise would result.

[0042] It is also contemplated that the exercise machine may incorporate a sensor arrangement, such as disclosed in detail in the above-referenced U.S. Provisional Patent Application No. 63/447,535. As described in that document, the sensor arrangement may be configured to sense movement of the console assembly 82 relative to the frame 22 for use by a computer controller for the bike 20, all as is disclosed in the incorporated provisional application.

[0043] FIGS. 6-13 depict a method of assembling the bike 20 in a manner that ensures secure connection and accurate mounting and alignment of components of the frame 22 and console assembly 82 components, in particular ensuring secure mounting and accurate alignment of the bearings 98, 100 and carriage 88 relative to each other and relative to the frame 22, thus improving adjustability of the console assembly 82. In particular, the present inventors determined it would be desirable to provide improved methods of assembling the opposing slide bearings 98, 100 and carriage 88 onto the pedestal 36 so that slide bearings 98, 100 define slide bearing axes B1, B2 (see FIGS. 2, 8-11) that are substantially parallel to each other and to the adjustment axis A. This includes embodiments like what is illustrated wherein the slide bearing axes B1, B2 are exactly parallel to each other and/or to the adjustment axis A, as well as embodiments like what is illustrated wherein the slide bearing axes B1, B2 are within a range of plus or minus five degrees of parallel to each other and/or to the adjustment axis A,

and more preferably are within a range of plus or minus two degrees of parallel to each other and/or the adjustment axis A. With respect to the illustrated embodiment, the present inventors determined that the closer the respective axes are made to exactly parallel, the better the performance. The present inventors determined that applying a predetermined lateral clamping (preload) force on the opposing slide bearings 98 and carriage 88 prior to their assembly onto the frame 22 advantageously ensures that the slide bearings 98, 100 are securely engaged with the slide rails 96 and also aligns the noted slide bearing axes B1, B2 substantially parallel to each other and substantially parallel to the adjustment axis A. This advantageously provides an assembled console assembly 82 having smooth and reliable sliding movement relative to the frame 22.

[0044] Referring to FIG. 6, the base member 58 is initially placed on the pedestal 36 such that the alignment pins 81 are inserted into the alignment holes 46 in the mounting flanges 50. This locates the base member 58 in the position shown in FIG. 7. Next, the fasteners 66 having the conical head 72 are loosely inserted into the apertures 52 from below the mounting flanges 50 and through the corresponding apertures 68 in the base member 58, as shown in FIG. 7. The opposing slide bearings 98, 100 are also longitudinally slid onto the slide rails 96 of the carriage 88. Next, the carriage 88 is lowered onto the base member 58 and the fasteners 66, 74 are initially threaded into engagement with the slide bearings 98, 100 so the base member 58, slide bearings 98 and carriage 88 are loosely held in position on the pedestal 36 of the frame 22. As shown in FIG. 8, the fasteners 74 are also inserted through the apertures 55 from below the mounting flange 50 and through corresponding apertures 76 in the base member 58 and initially threaded into engagement with the slide bearings 98, 100.

[0045] With further reference to FIG. 8, a clamp device 300 is positioned on the assembly shown in FIG. 7. The type and configuration of clamp device 300 may vary from what is shown and described. In the illustrated example the clamp device 300 is a C-clamp having opposing arms 302 and a threaded rod 304 that laterally extends through one of the arms 302. The threaded rod 304 has a handle 306 on one end and one or more clamp heads 308 on the other end. An opposing clamp head 310 is located on the other arm 302. A compression block assembly 309 is disposed laterally between the clamp head(s) 308, 310 and the slide bearings 98, 100. Rotation of the handle 306 causes the clamp heads 308, 310 to apply opposing uniform clamping forces on the compression block assembly 309 which in turn applies uniform clamping forces on both sets of front and rear slide bearings 98, 100. Rotating the handle 306, as shown by the arrow in FIG. 8, causes laterally inward translation of the threaded rod 304 and the clamp head 308, which closes the clamp head 308 (such as shown in FIG. 8) onto the compression block assembly 309 and moves the compression block assembly 309 laterally inwardly against

the slide bearings 98, 100. The opposing clamp head 308 and compression block assembly 309 in turn applies a reactive compression force onto the slide bearings 98, 100 on the opposite side of the carriage 88. This securely clamps the carriage 88 between the slide bearings 98, 100 and advantageously substantially aligns and holds the first slide bearing axis B1 and the second slide bearing axis B2 defined by the slide bearings 98, 100 substantially parallel to each other.

[0046] The present inventors determined that by applying a desired predetermined clamp force or "preload" on the bearings 98, 100 it is possible to substantially align the opposing front and rear slide bearings 98, 100 relative to each other prior to their mounting to the base member 54 and pedestal 36. This facilitates a smooth sliding operation of the slide rails 96 along the slide bearings 98, 100. The amount of clamping force or preload force that achieves the best (i.e., most reliably smooth sliding operation) will vary based on the type of bearing and overall configuration of the assembly and can be determined by trial and error and then recorded and thereafter used as a target value.

[0047] Referring to FIG. 9, with the clamp device 300 actuated, the fasteners 66 having the conical head 72 are further rotated to securely tighten the threaded connection between the fasteners 66 and the slide bearings 98, 100, which vertically clamps the illustrated components together. Advantageously, as shown in FIG. 12, during tightening of the fasteners 66, the conical heads 72 engage with the circular perimeter of the round holes 52 which causes the fasteners 66 to be laterally and longitudinally centered or to "self-center" in the apertures 52, increasing the precision of alignment between the noted slide bearing axis B1 and the desired sliding axis A for the carriage 88. Referring to FIG. 10, thereafter the opposing fasteners 74 are rotated to further tighten the threaded connection between the fasteners 74 and the opposing slide bearings 98, 100, thus vertically clamping the illustrated components and providing precision of alignment between the noted slide bearing axis B2 and the desired sliding axis A for the carriage 88. Thereafter, referring to FIG. 11, rotating the handle 306 in the opposite direction opens the clamp device 300 (see FIG. 11), i.e., relieves the clamping preload force from the bearings 98, 100 and carriage 88. The clamp device 300 can then be removed from the assembly.

[0048] Referring to FIG. 13, the handlebar mounting bracket 138 and handlebar 84 may then be mounted to the carriage 88. The display mounting bracket 150 and display 86 may then also be mounted to the carriage 88. A next step may include assembling the wireless charger 171, as well as a lower shroud 91 for enclosing the carriage 88. It is also possible before or after the above steps to assemble various components of the sensor assembly, as described in the above-referenced provisional patent application.

[0049] Thus it will be understood that examples of the method according to the present disclosure may include

(a) providing a frame 22 for supporting a user of the bike 20, and a base member 54 disposed on or integrated with the frame 22, (b) providing a carriage 88 that is slidable relative to the base member 54 along an adjustment axis A, (c) providing a first slide bearing apparatus (98, 100) for supporting sliding of a first lateral side of the carriage 88 along a first slide bearing axis B1 (see FIGS. 2 and 8-11), (d) providing a second slide bearing apparatus (98, 100) for supporting sliding of an opposite, second lateral side of the carriage 88 along a second slide bearing axis B1 (See FIGS. 2 and 8-11), (e) laterally clamping the carriage 88 between the first slide bearing apparatus and the second slide bearing apparatus such that the first slide bearing axis B1 and the second slide bearing axis B2 are substantially parallel to each other, (f) rigidly coupling the first slide bearing apparatus to the base member 54 such that the first slide bearing axis B1 is fixed substantially parallel to the adjustment axis A, and (g) thereafter fastening the second slide bearing apparatus to the base member 54. As described herein above, steps (e) through (g) are advantageously configured to ensure that the first slide bearing axis B1 is substantially parallel to the second slide bearing axis B2 and also substantially parallel to the adjustment axis A after assembly, such that in use the carriage 88 is freely slidable along the adjustment axis A relative to the first slide bearing apparatus and the second slide bearing apparatus.

[0050] In the illustrated example, the first slide bearing apparatus comprises a first set of slide bearings 98, 100 and the second slide bearing apparatus also comprises a second set of slide bearings 98, 100. The first and second sets of bearings are laterally opposed to each other. The first set of slide bearings comprises a front slide bearing and a rear slide bearing that is spaced apart from and substantially aligned with the front slide bearing, and the second set of slide bearings comprises a front slide bearing and a rear slide bearing that is spaced apart from and substantially aligned with the front slide bearing.

[0051] As described above, step (f) may include fixing the first slide bearing apparatus to the base member 54 by engaging the fasteners 66 in the apertures 52 which are aligned substantially parallel to the adjustment axis A. Each aperture 52 may be a round hole, and each fastener 66 may have a conical head 72 that operatively engages and is self-centered respect to the round hole during fastening, thus further improving alignment.

[0052] This written description uses examples to disclose the invention and to enable any person skilled in the art to make and use the invention. Certain terms have been used for brevity, clarity and understanding. No unnecessary limitations are to be inferred therefrom beyond the requirement of the prior art because such terms are used for descriptive purposes only and are intended to be broadly construed. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the

claims if they have features or structural elements that do not differ from the literal language of the claims, or if they include equivalent features or structural elements with insubstantial differences from the literal languages of the claims.

[0053] The present disclosure comprises the subject matter described in the following clauses which may form the basis for claim amendments or future divisional applications:

Clause 1. An exercise machine that extends between a front and a rear in a longitudinal direction, between a first side and an opposite, second side in a lateral direction that is perpendicular to the longitudinal direction, and between a top and a bottom in a vertical direction that is perpendicular to the longitudinal direction and perpendicular to the lateral direction, the exercise machine comprising:

a frame for supporting a user of the exercise machine, and
a console assembly comprising a handlebar for engagement by the user and a display for displaying and/or controlling an operational characteristic of the exercise machine, wherein the console assembly is coupled to and longitudinally movable relative to the frame to facilitate adjustment of the handlebar and the display relative to the user.

Clause 2. The exercise machine according to clause 1, wherein the console assembly is longitudinally slidable relative to the frame.

Clause 3. The exercise machine according to clause 1, further comprising a locking device configured to lock the console assembly in position relative to the frame.

Clause 4. The exercise machine according to clause 3, wherein the locking device is configured to clamp the console assembly in position relative to the frame.

Clause 5. The exercise machine according to clause 3, wherein the locking device is manually operable by the user.

Clause 6. The exercise machine according to clause 1, wherein the locking device comprises pivot lever and a cam that causes the locking device to clamp the console assembly to the frame upon pivoting the pivot lever.

Clause 7. The exercise machine according to clause 1, wherein the display comprises a screen that extends upwardly at an angle relative to the handlebar, wherein said angle remains constant as the console

assembly is longitudinally moved relative to the frame.

Clause 8. The exercise machine according to clause 1, wherein the console assembly further comprises a wireless charger. 5

Clause 9. The exercise machine according to clause 1, wherein the console assembly is longitudinally adjustable into and between a forwardmost position relative to the frame and a rearwardmost position relative to the frame, and further comprising a locking device configured to lock the console assembly in place relative to the forwardmost position and the rearwardmost position. 10 15

Clause 10. The exercise machine according to clause 1, further comprising a base member and wherein the console assembly comprises a carriage that is longitudinally slidable back and forth relative to the base member. 20

Clause 11. The exercise machine according to clause 10, wherein the handlebar and the display are coupled to the carriage. 25

Clause 12. The exercise machine according to clause 10, wherein the handlebar is rigidly coupled to the carriage along two planes that are transverse to each other. 30

Clause 13. The exercise machine according to clause 10, and wherein the display is rigidly coupled to the carriage along two planes that are transverse to each other. 35

Clause 14. The exercise machine according to clause 10, wherein the carriage comprises a body having a first end and a second end, and wherein the display is fastened to the first end and separately fastened to the body, and wherein the handlebar is fastened to the second end and separately fastened to the body. 40

Clause 15. The exercise machine according to clause 10, wherein the carriage is coupled to the base member by opposing slide rails and opposing slide bearings that support sliding of the opposing slide rails. 45 50

Clause 16. The exercise machine according to clause 10, further comprising a stop device that prevents sliding of the carriage past a forwardmost position relative to the base member and that prevents sliding of the carriage past a rearwardmost position relative to the base member. 55

Clause 17. The exercise machine according to

clause 16, wherein the carriage is coupled to the base member by opposing slide rails and opposing slide bearings supporting sliding of the opposing slide rails, and wherein the stop device comprises a bumper that operatively engages at least one slide bearing of the opposing slide bearings to prevent sliding of the carriage past the forwardmost position and that operatively engages at least one slide bearing of the opposing slide bearings to prevent sliding of the carriage past the rearwardmost position.

Clause 18. The exercise machine according to clause 10, further comprising a locking device configured to lock the carriage in position relative to the base member.

Clause 19. The exercise machine according to clause 18, wherein the locking device is configured to clamp the console assembly in position relative to the frame, and wherein the locking device is manually operable by the user.

Clause 20. The exercise machine according to clause 19, wherein the locking device comprises a pivot lever and a cam that causes the locking device to clamp the console assembly to the frame upon pivoting of the pivot lever.

Clause 21. The exercise machine according to clause 20, wherein the locking device further comprises a cam block, a cam shaft coupled to the cam and extending through the cam block, the carriage, and the base member, and a clamp head on the cam shaft, wherein pivoting the pivot lever applies a camming force on the clamp head that clamps the carriage between the base member and the clamp head.

Clause 22. The exercise machine according to clause 10, further comprising a cable assembly for providing power and/or electrical communication to the console assembly, wherein the cable assembly is disposed in the frame and is coupled to and moves with the carriage relative to the base member.

Clause 23. A console assembly for an exercise machine, the console assembly comprising:

a carriage,
a handlebar for engagement by a user,
a display for displaying and/or controlling an operational characteristic of the exercise machine, wherein the handlebar and the display are coupled to the carriage and further wherein the carriage is configured to be coupled to a frame of the exercise machine such that the carriage is movable relative to the frame and thus facilitates integrated adjustment of the handlebar and the

display relative to a user of the exercise machine.

Clause 24. The console assembly according to clause 23, further comprising a locking device configured to lock the carriage in position relative to the frame. 5

Clause 25. The console assembly according to clause 23, wherein the handlebar is rigidly coupled to the carriage along two planes that are transverse to each other. 10

Clause 26. The console assembly according to clause 23, and wherein the display is rigidly coupled to the carriage along two planes that are transverse to each other. 15

Clause 27. The console assembly according to clause 23, wherein the carriage comprises a forward end, a rearward end, and a body that extends between the forward end and the rearward end, and wherein the display is fastened to the forward end and separately fastened to the body, and wherein the handlebar is fastened to the rearward end and separately fastened to the body. 20 25

Clause 28. The console assembly according to clause 23, wherein the display comprises a screen that extends upwardly at an angle relative to the handlebar, wherein the console assembly is configured such that said angle remains constant as the carriage is longitudinally moved relative to the frame. 30

Clause 29. The console assembly according to clause 23, wherein the console assembly further comprises a wireless charger. 35

Clause 30. A method of assembling an exercise machine, the method comprising: 40

- (a) providing a frame for supporting a user of the exercise machine, and a base member disposed on or integrated with the frame,
- (b) providing a carriage that is slidable relative to the base member along an adjustment axis,
- (c) providing a first slide bearing apparatus for supporting sliding of a first lateral side of the carriage along a first slide bearing axis,
- (d) providing a second slide bearing apparatus for supporting sliding of an opposite, second lateral side of the carriage along a second slide bearing axis,
- (e) laterally clamping the carriage between the first slide bearing apparatus and the second slide bearing apparatus such that the first slide bearing axis and the second slide bearing axis are substantially parallel to each other, 55

(f) rigidly coupling the first slide bearing apparatus to the base member such that the first slide bearing axis is substantially parallel to the adjustment axis, and

(g) thereafter fastening the second slide bearing apparatus to the base member.

Clause 31. The method according to clause 30, wherein steps (e) through (g) are configured to ensure that the first slide bearing axis is substantially parallel to the second slide bearing axis and substantially parallel to the adjustment axis such that in use the carriage is freely slidable along the adjustment axis relative to the first slide bearing apparatus and the second slide bearing apparatus.

Clause 32. The method according to clause 30, wherein the first slide bearing apparatus comprises a first plurality of slide bearings and wherein the second slide bearing apparatus comprises a second plurality of slide bearings.

Clause 33. The method according to clause 32, wherein the first plurality of slide bearings comprises a front slide bearing and a rear slide bearing that is spaced apart from and substantially aligned with the front slide bearing, and wherein the second plurality of slide bearings comprises a front slide bearing and a rear slide bearing that is spaced apart from and substantially aligned with the front slide bearing.

Clause 34. The method according to clause 32, wherein the frame comprises a pedestal, and further comprising coupling the base member to the pedestal.

Clause 35. The method according to clause 30, wherein (f) comprises fixing the first slide bearing apparatus to the base member by engaging a first plurality of fasteners in a first plurality of apertures that is aligned substantially parallel to the adjustment axis.

Clause 36. The method according to clause 35, wherein each aperture in the first plurality of apertures is a round hole, and wherein each fastener in the first plurality of fasteners comprises a conical head that operatively engages and is centered respect to the round hole during fastening.

Clause 37. The method according to clause 36, wherein (g) comprises fixing the second slide bearing apparatus to the base member by engaging a second plurality of fasteners in a second plurality of fastener apertures.

Clause 38. The method according to clause 30, further comprising:

(h) coupling a handlebar to the carriage and coupling a display to the carriage, wherein the handlebar and the display are longitudinally adjustable relative to the frame.

Claims

1. An exercise machine that extends between a front and a rear in a longitudinal direction, between a first side and an opposite, second side in a lateral direction that is perpendicular to the longitudinal direction, and between a top and a bottom in a vertical direction that is perpendicular to the longitudinal direction and perpendicular to the lateral direction, the exercise machine comprising:

a frame for supporting a user of the exercise machine, and

a console assembly comprising a handlebar for engagement by the user and a display for displaying and/or controlling an operational characteristic of the exercise machine, wherein the console assembly is coupled to and longitudinally movable relative to the frame to facilitate adjustment of the handlebar and the display relative to the user.

2. The exercise machine according to claim 1, wherein the console assembly is longitudinally slidable relative to the frame; and/or wherein the locking device comprises pivot lever and a cam that causes the locking device to clamp the console assembly to the frame upon pivoting the pivot lever.
3. The exercise machine according to claim 1 or 2, further comprising a locking device configured to lock the console assembly in position relative to the frame.
4. The exercise machine according to claim 3, wherein the locking device is configured to clamp the console assembly in position relative to the frame; and/or wherein the locking device is manually operable by the user.
5. The exercise machine according to any preceding claim, wherein the display comprises a screen that extends upwardly at an angle relative to the handlebar, wherein said angle remains constant as the console assembly is longitudinally moved relative to the frame.
6. The exercise machine according to any preceding claim, wherein the console assembly further comprises a wireless charger.

7. The exercise machine according to any preceding claim, wherein the console assembly is longitudinally adjustable into and between a forwardmost position relative to the frame and a rearwardmost position relative to the frame, and further comprising a locking device configured to lock the console assembly in place relative to the forwardmost position and the rearwardmost position.

8. The exercise machine according to any preceding claim, further comprising a base member and wherein the console assembly comprises a carriage that is longitudinally slidable back and forth relative to the base member.

9. The exercise machine according to claim 8, wherein the handlebar and the display are coupled to the carriage; and/or

wherein the handlebar is rigidly coupled to the carriage along two planes that are transverse to each other; and/or

wherein the display is rigidly coupled to the carriage along two planes that are transverse to each other; and/or

wherein the carriage comprises a body having a first end and a second end, and wherein the display is fastened to the first end and separately fastened to the body, and wherein the handlebar is fastened to the second end and separately fastened to the body; and/or

wherein the carriage is coupled to the base member by opposing slide rails and opposing slide bearings that support sliding of the opposing slide rails; and/or

the exercise machine further comprises a cable assembly for providing power and/or electrical communication to the console assembly, wherein the cable assembly is disposed in the frame and is coupled to and moves with the carriage relative to the base member.

10. The exercise machine according to claim 8 or 9, further comprising a stop device that prevents sliding of the carriage past a forwardmost position relative to the base member and that prevents sliding of the carriage past a rearwardmost position relative to the base member.

11. The exercise machine according to claim 10, wherein the carriage is coupled to the base member by opposing slide rails and opposing slide bearings supporting sliding of the opposing slide rails, and wherein the stop device comprises a bumper that operatively engages at least one slide bearing of the opposing slide bearings to prevent sliding of the carriage past the forwardmost position and that operatively engages at least one slide bearing of the op-

posing slide bearings to prevent sliding of the carriage past the rearwardmost position.

12. The exercise machine according to any of claims 8 to 11, further comprising a locking device configured to lock the carriage in position relative to the base member. 5
13. The exercise machine according to claim 12, wherein the locking device is configured to clamp the console assembly in position relative to the frame, and wherein the locking device is manually operable by the user. 10
14. The exercise machine according to claim 13, wherein the locking device comprises a pivot lever and a cam that causes the locking device to clamp the console assembly to the frame upon pivoting of the pivot lever. 15
15. The exercise machine according to claim 14, wherein the locking device further comprises a cam block, a cam shaft coupled to the cam and extending through the cam block, the carriage, and the base member, and a clamp head on the cam shaft, wherein pivoting the pivot lever applies a camming force on the clamp head that clamps the carriage between the base member and the clamp head. 20 25

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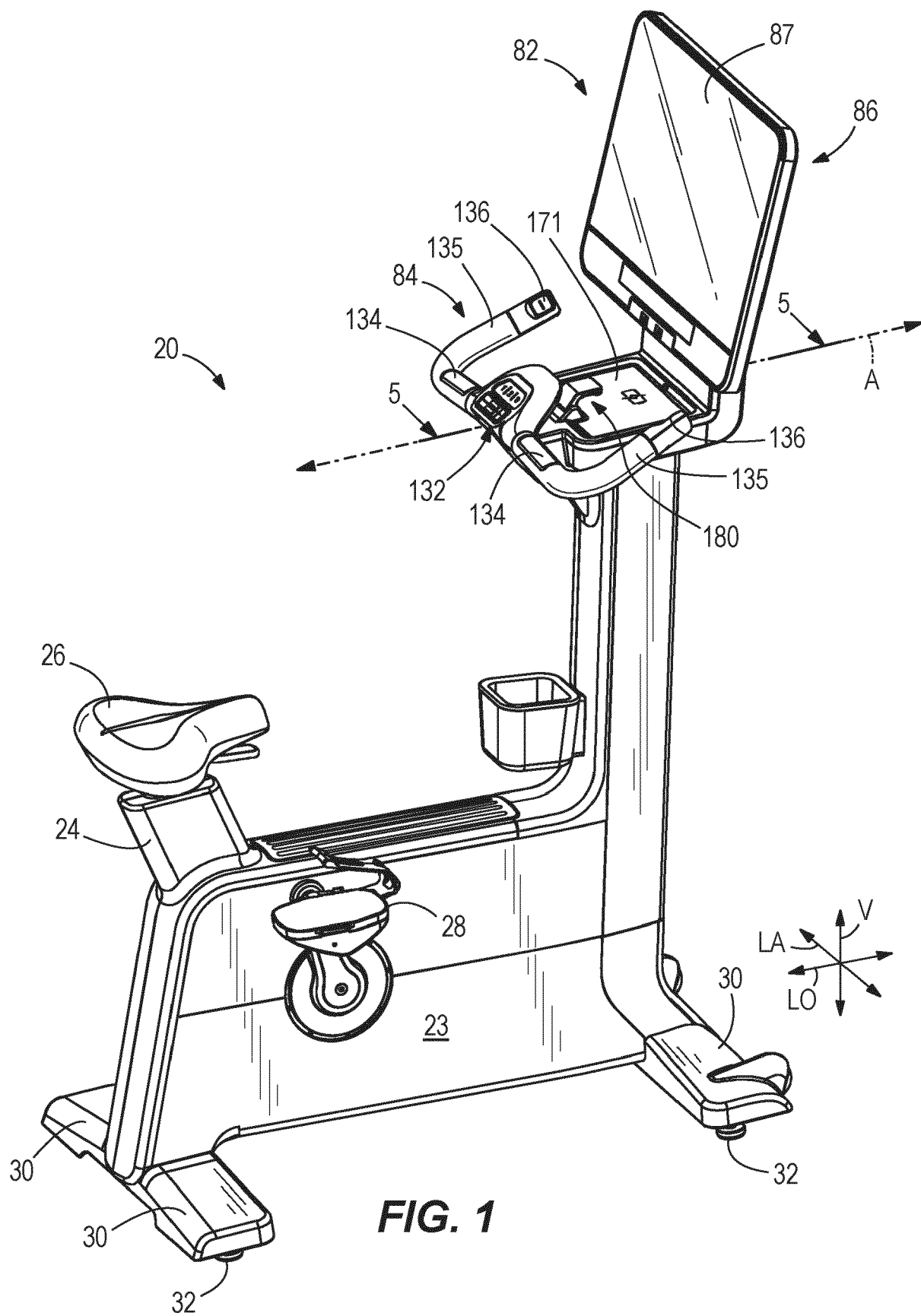


FIG. 1

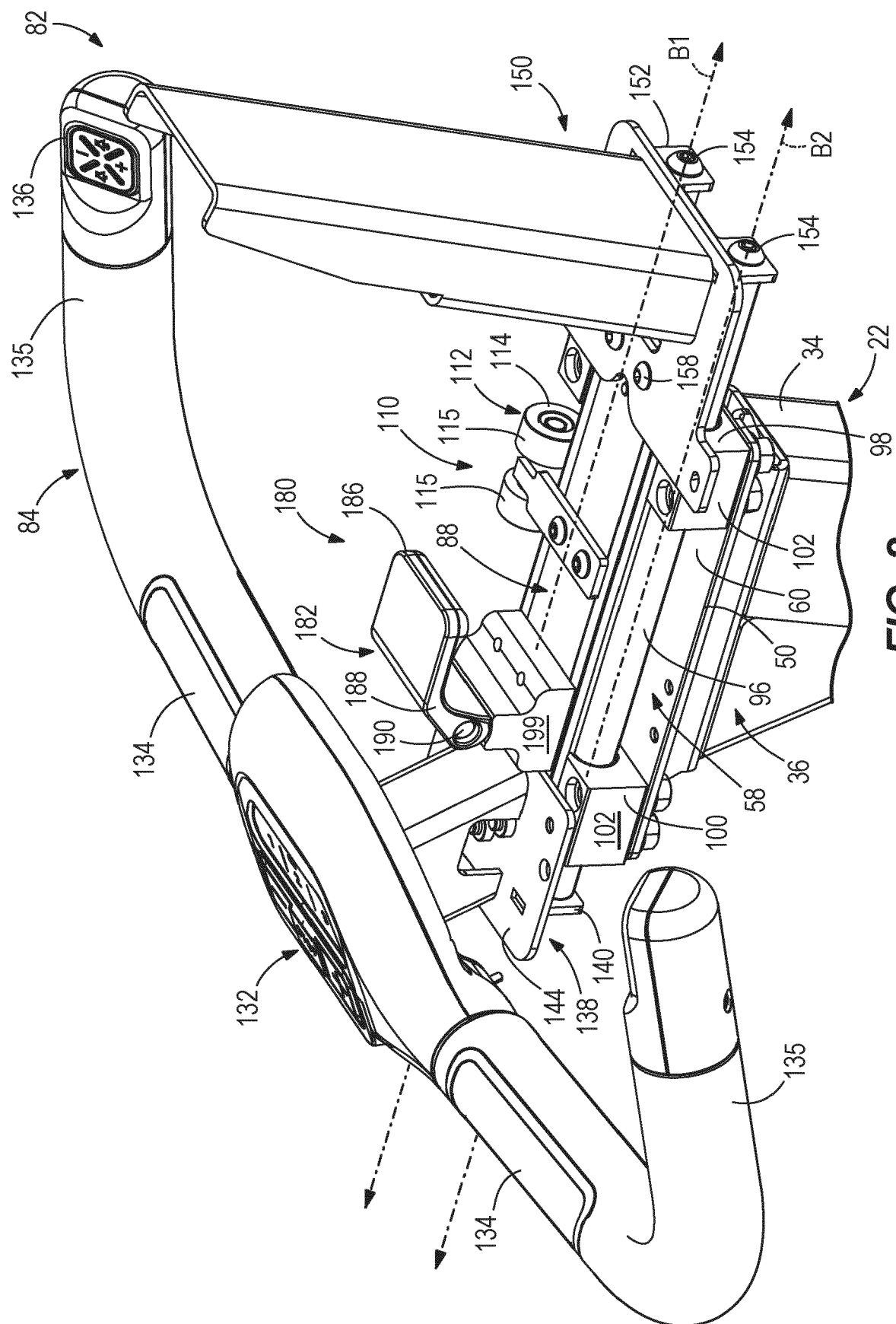
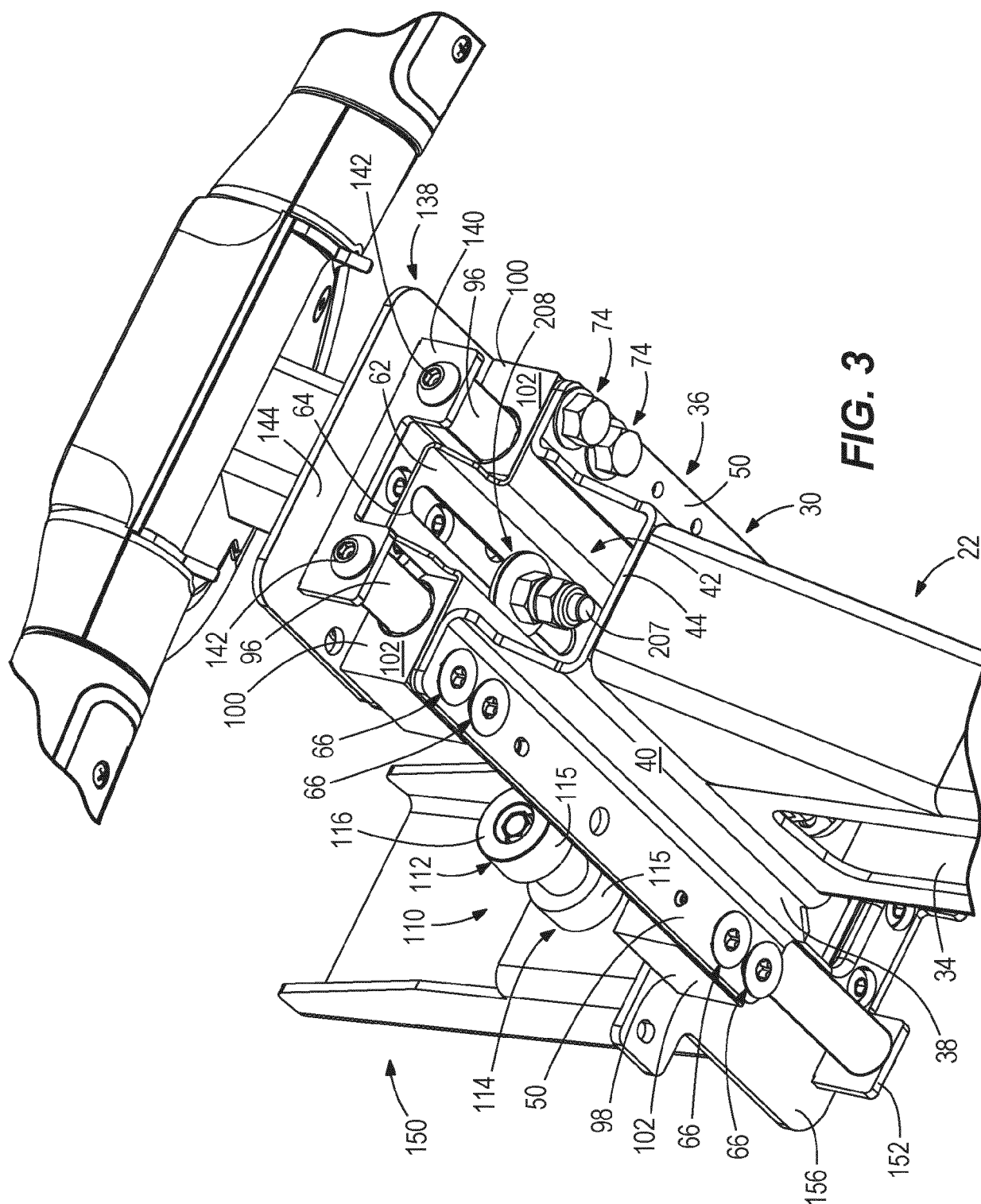


FIG. 2



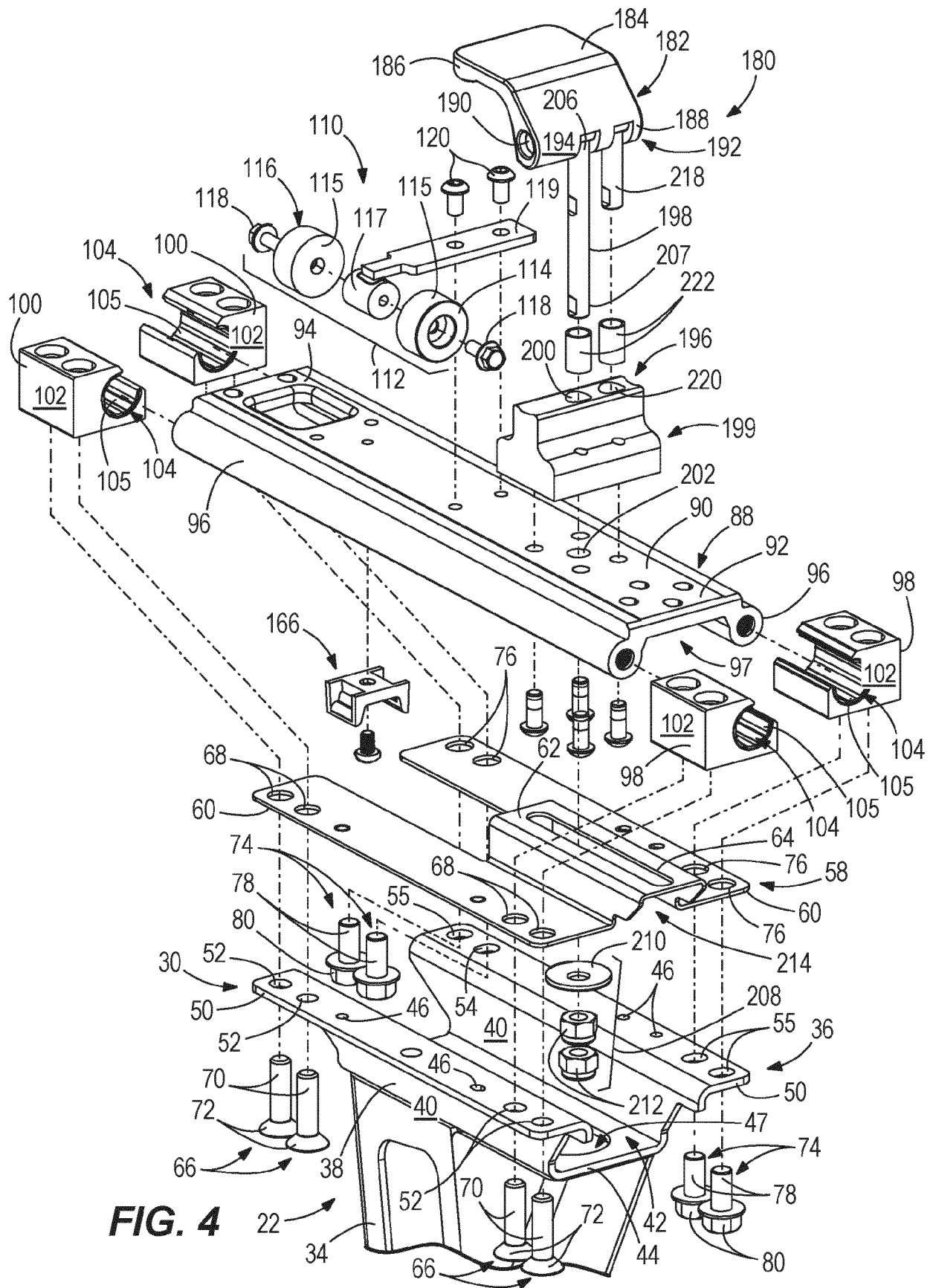


FIG. 4

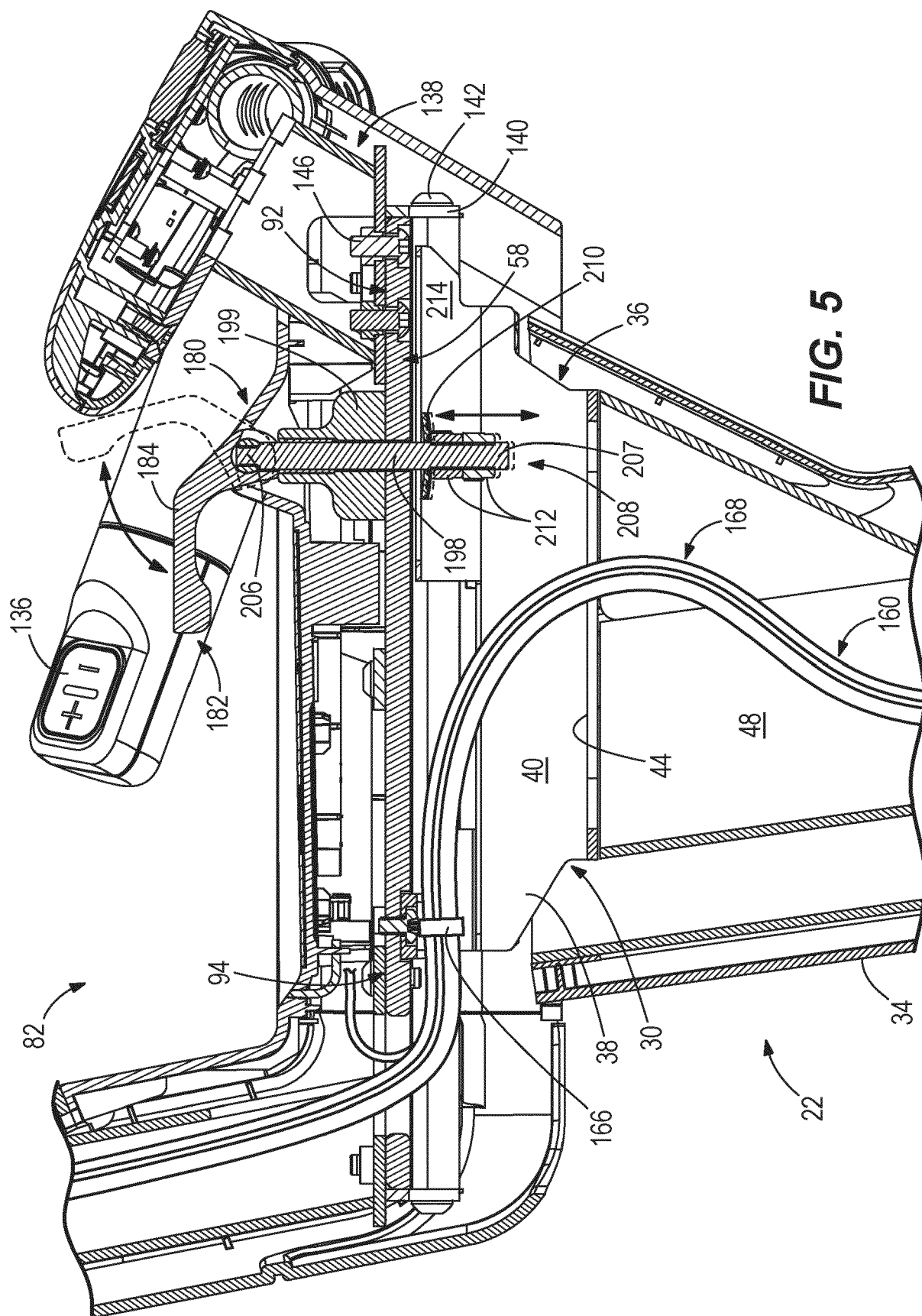
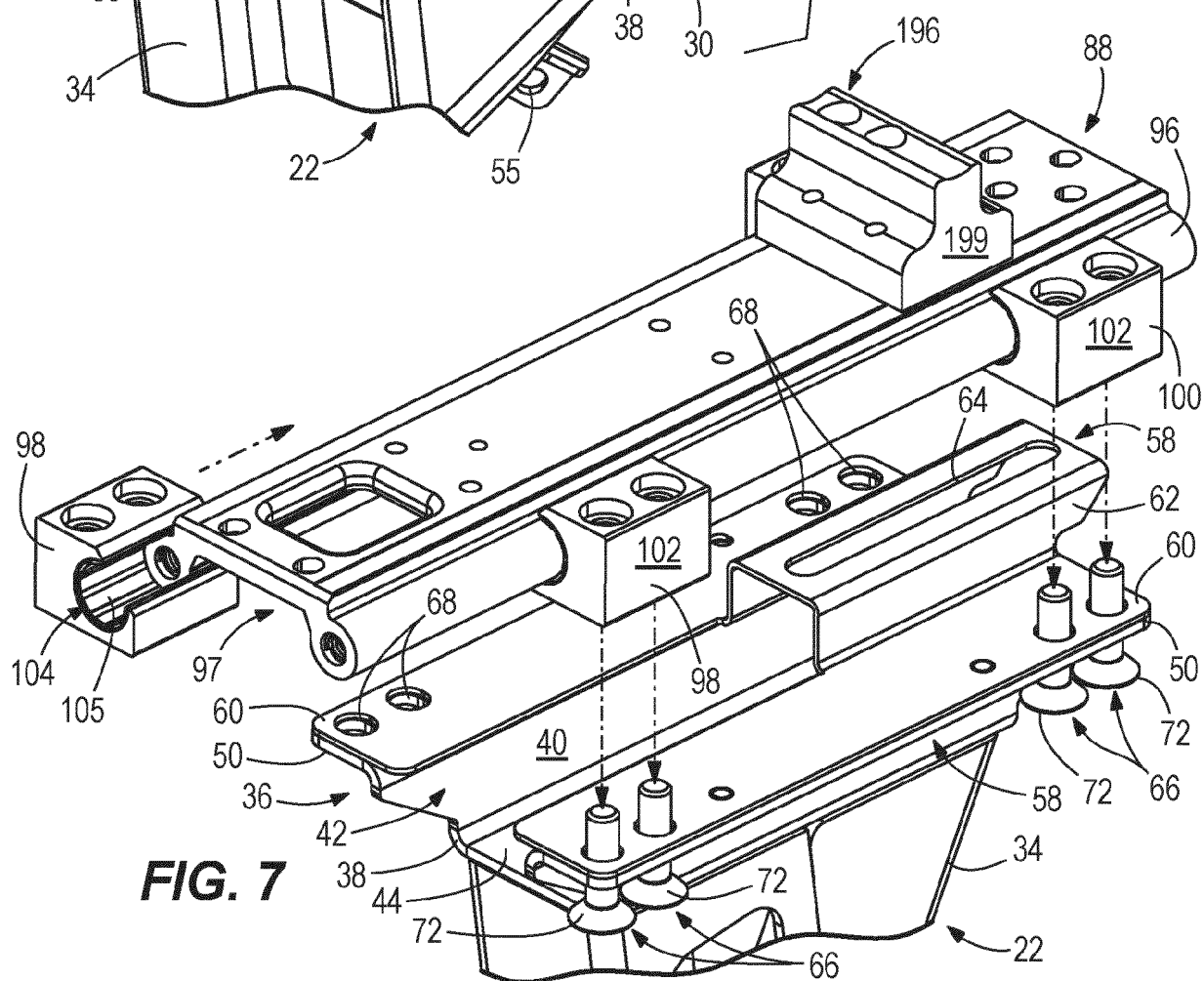
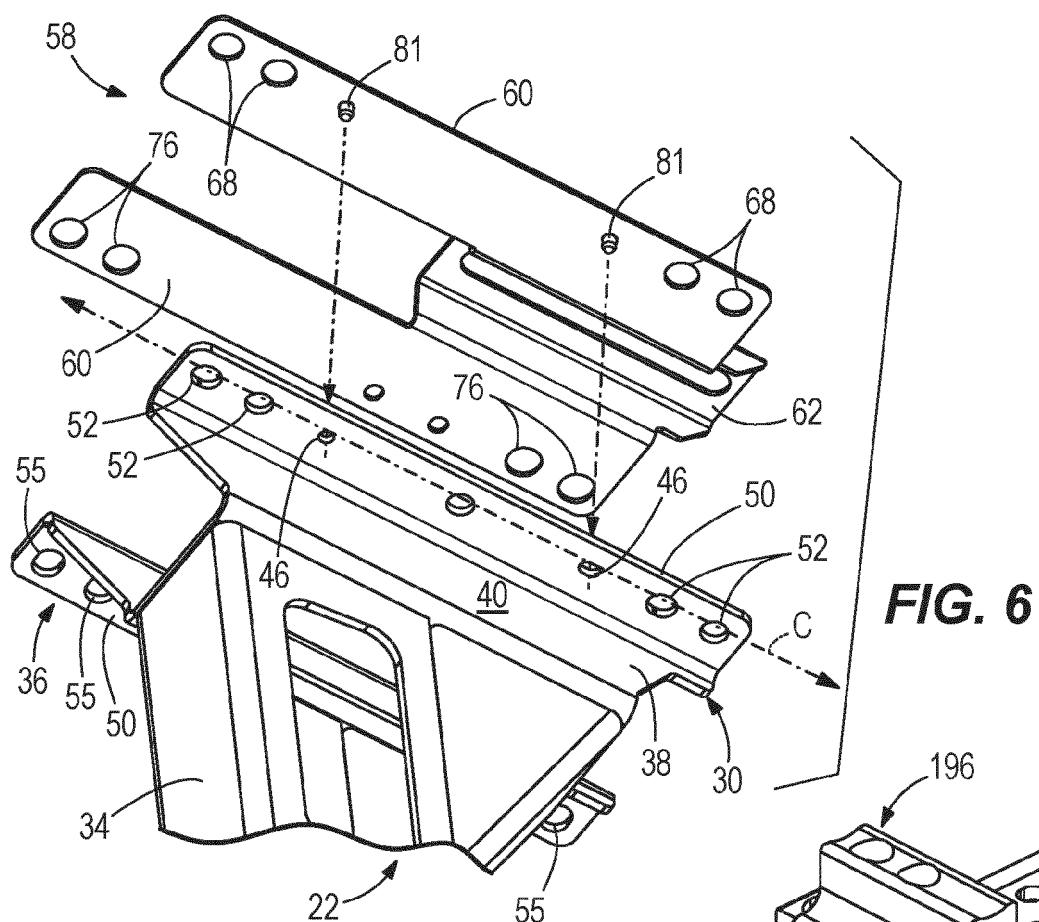
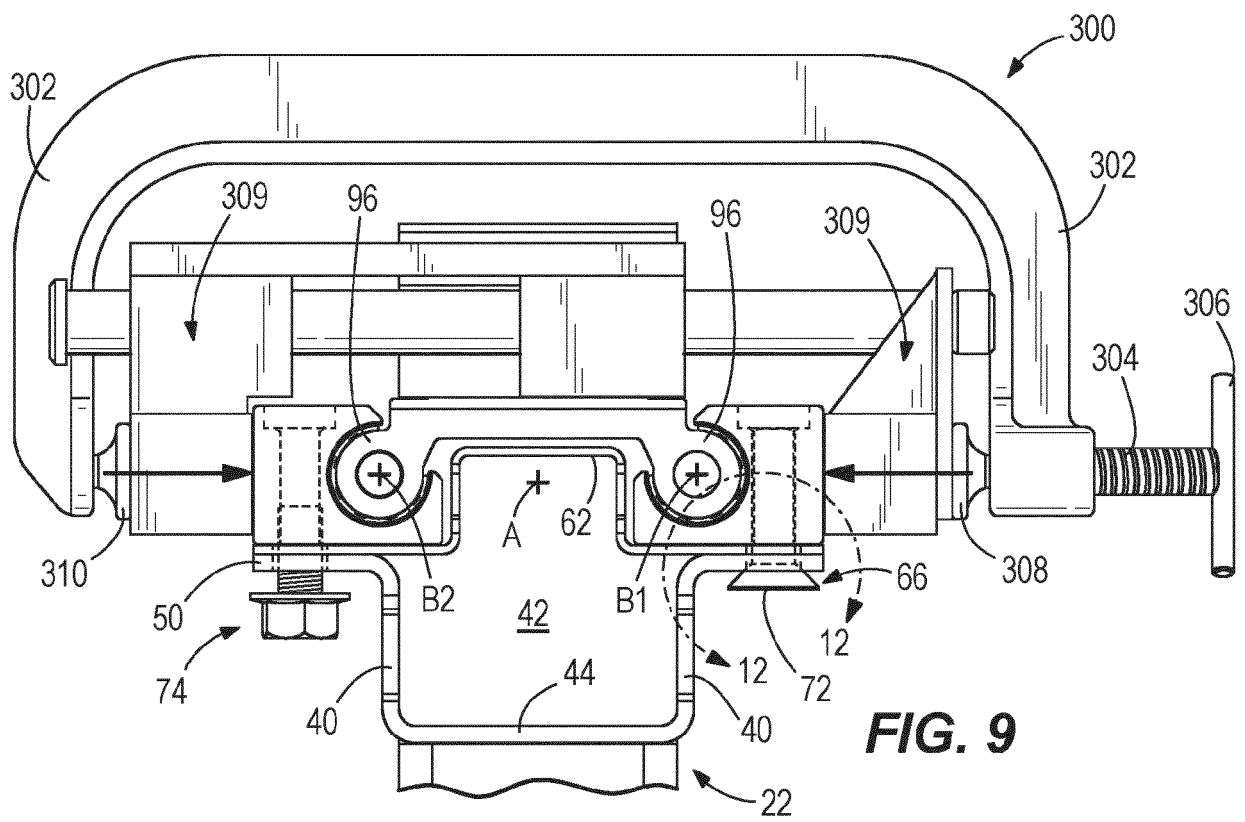
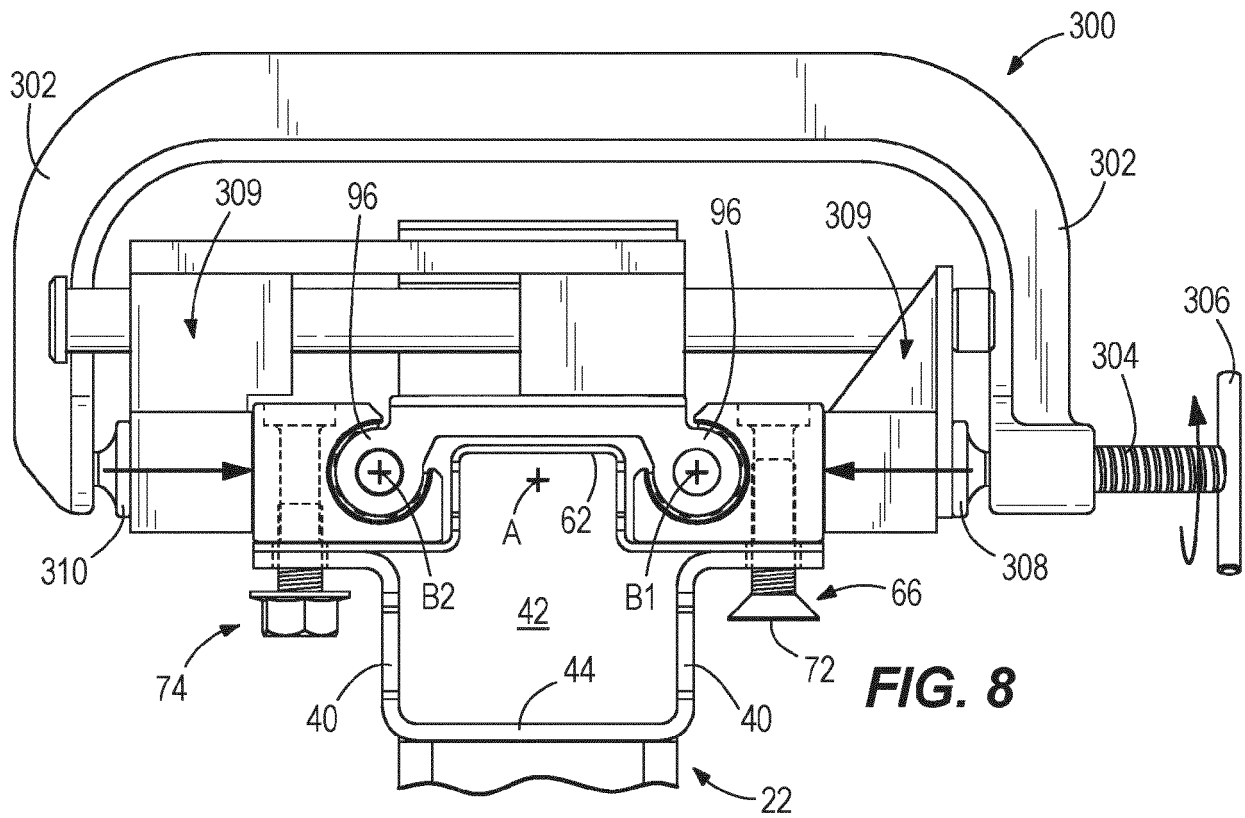
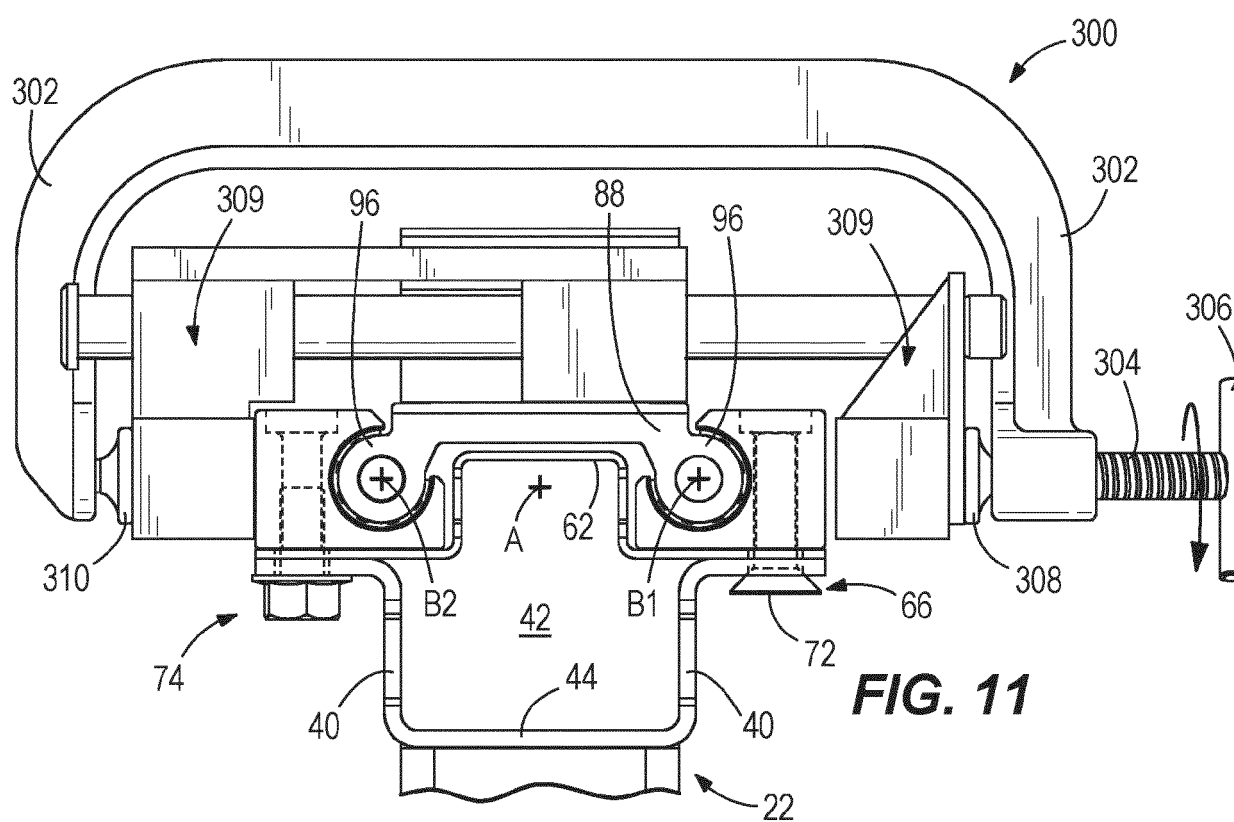
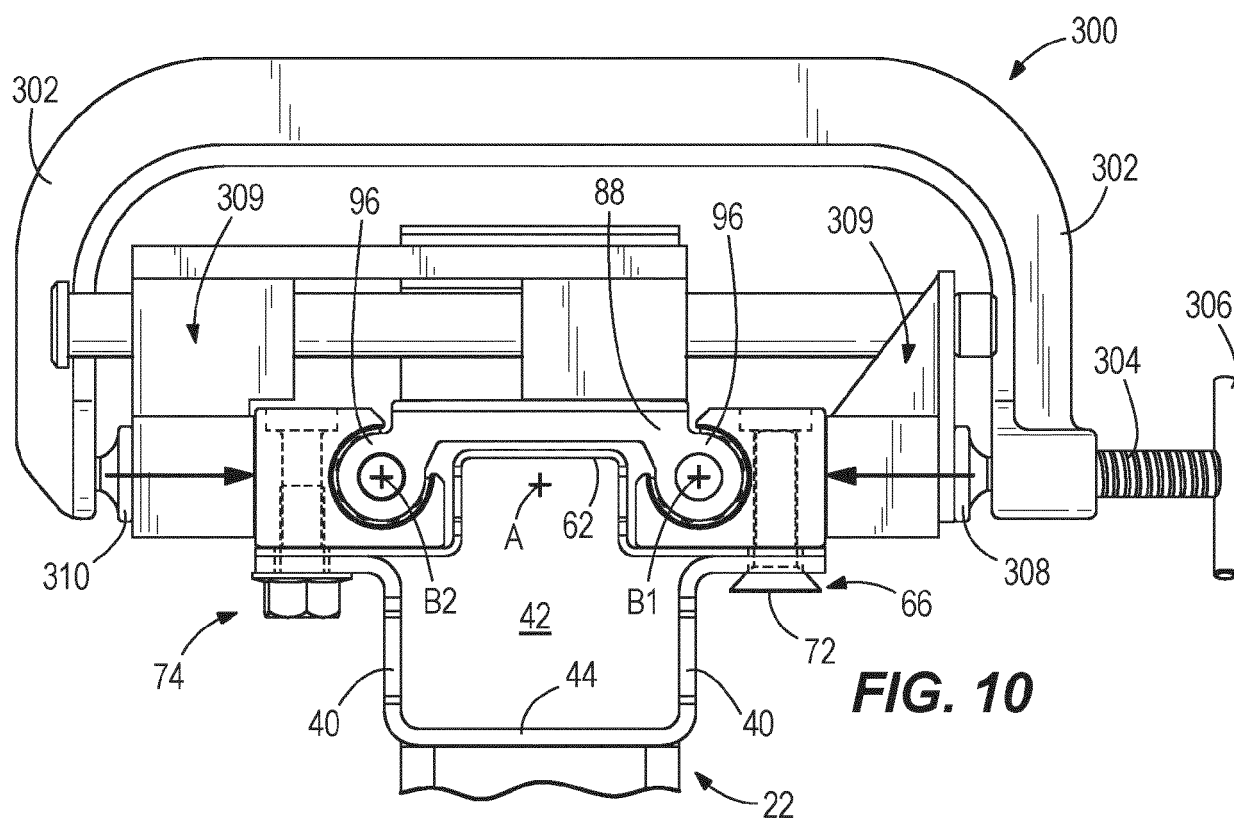


FIG. 5







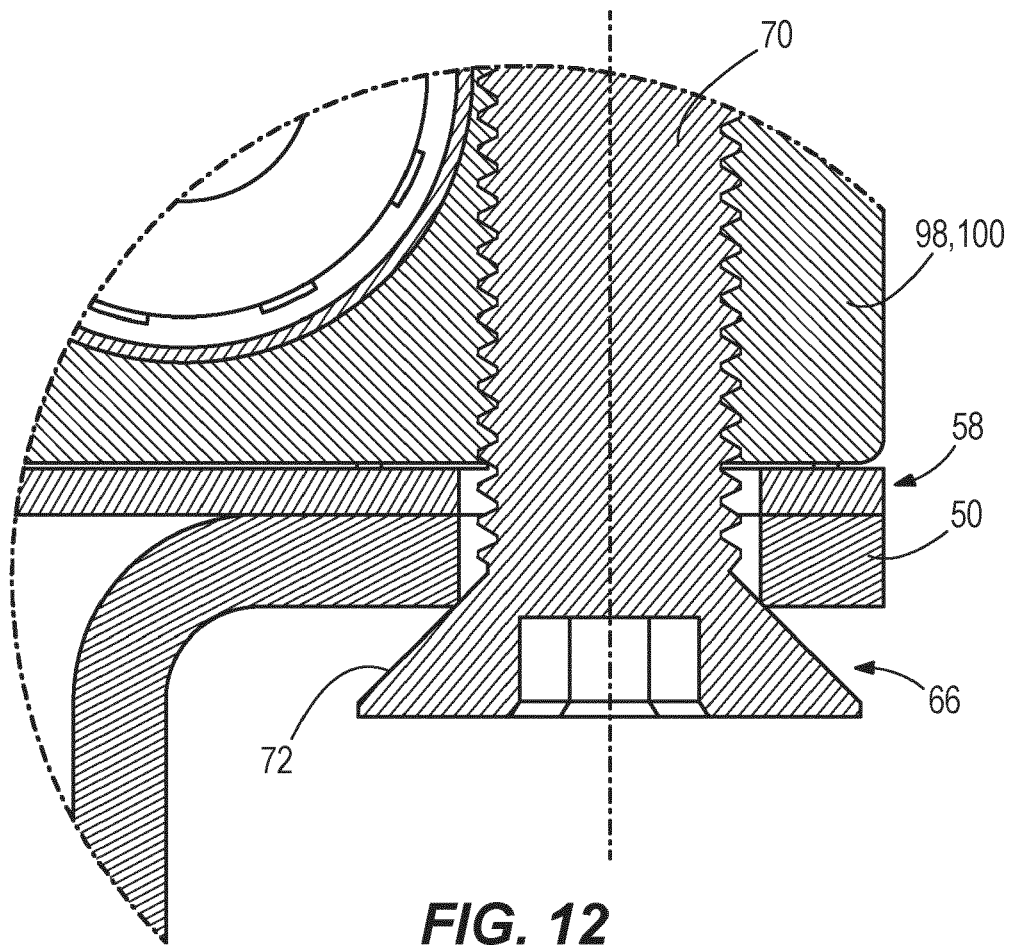
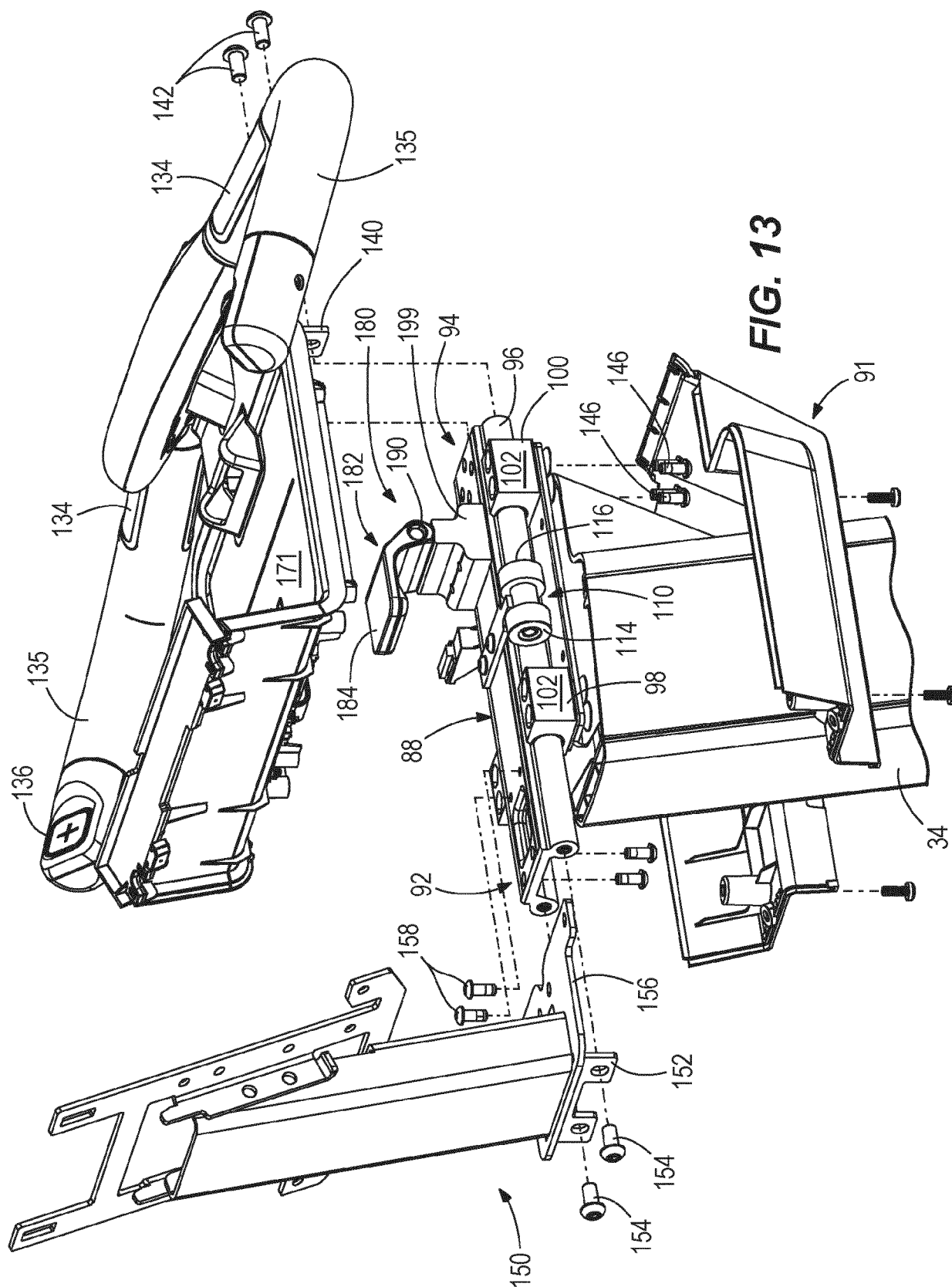


FIG. 12



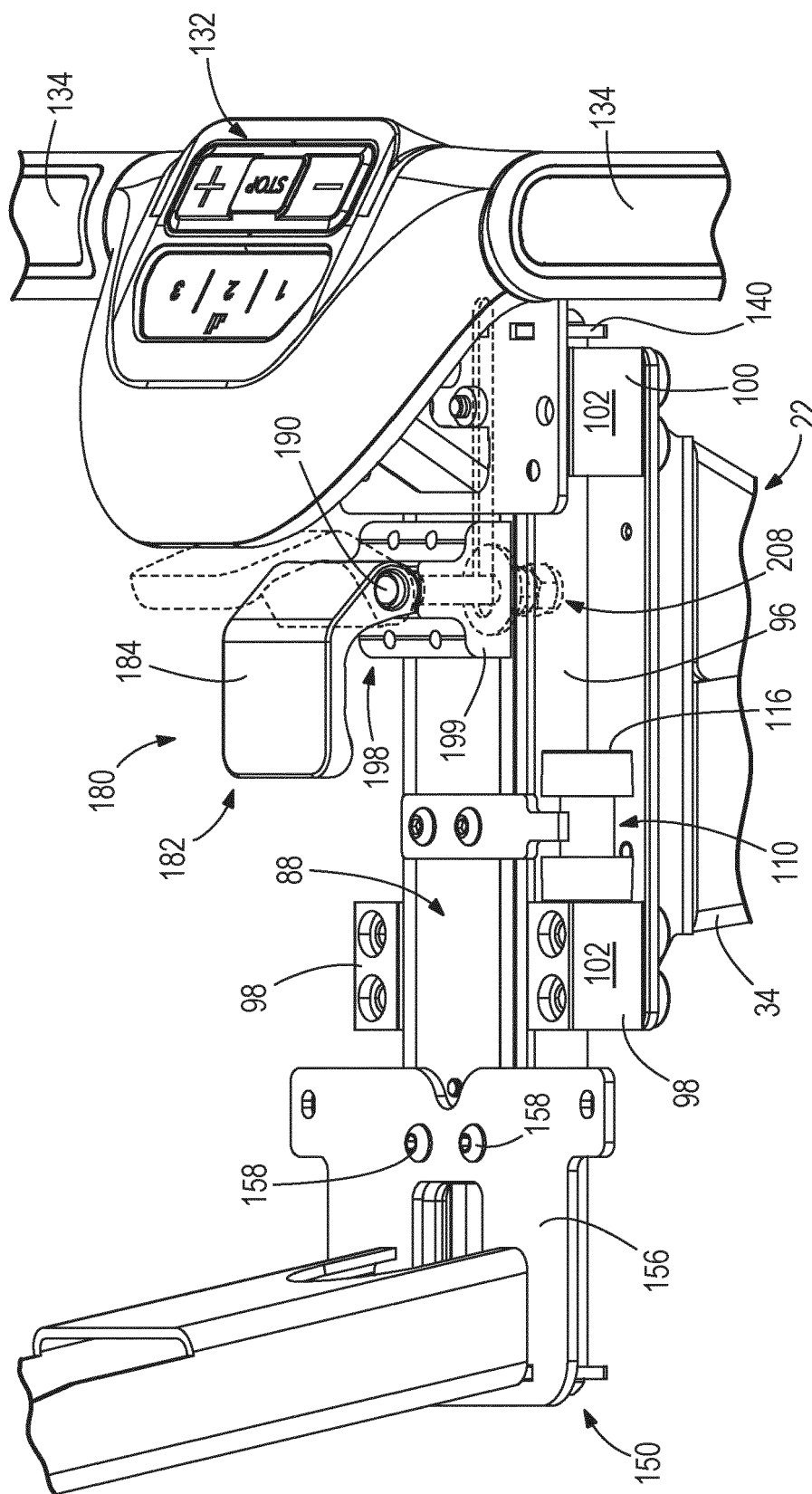


FIG. 14

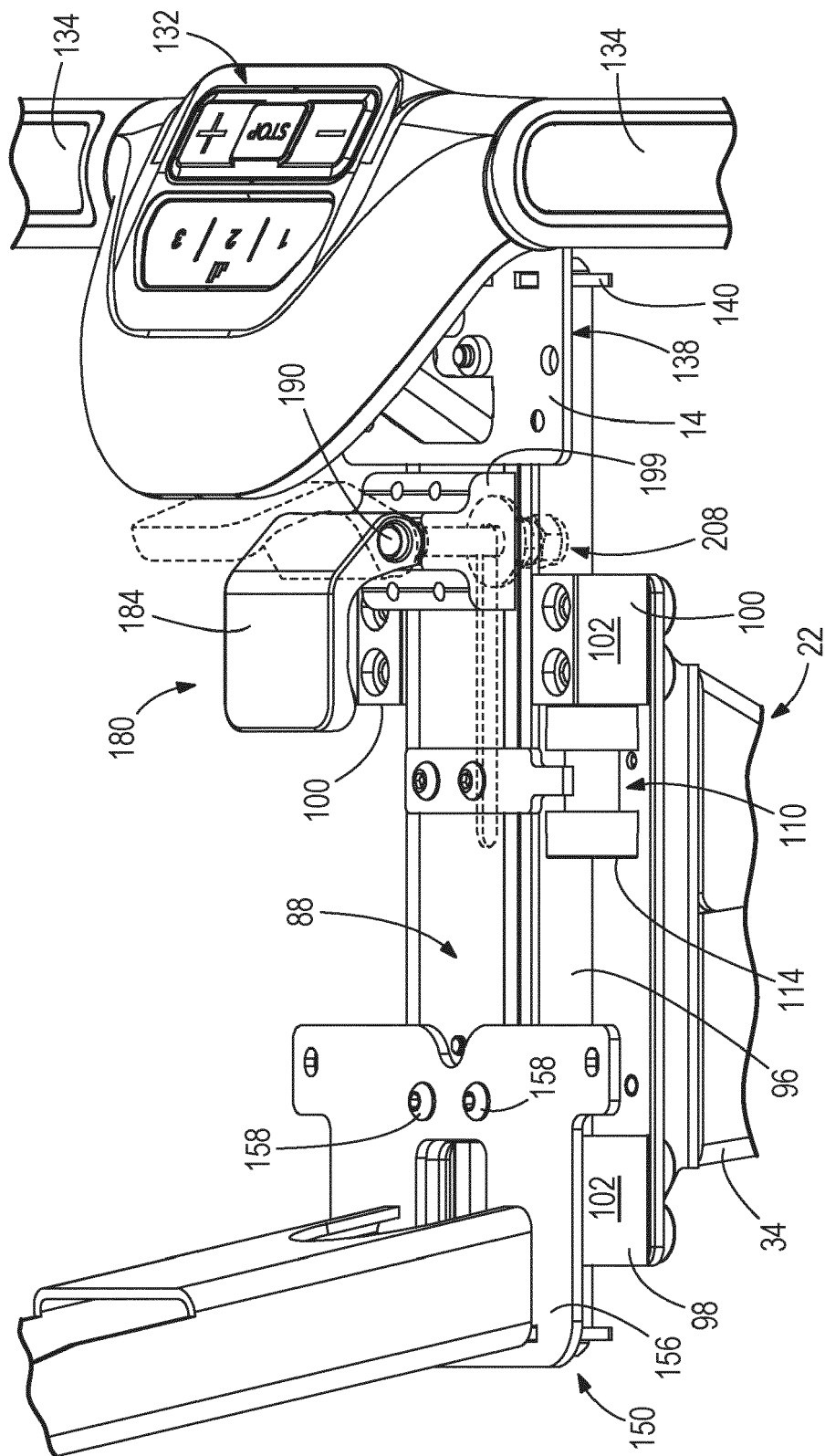


FIG. 15



EUROPEAN SEARCH REPORT

Application Number

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Y	* paragraph [0054] - paragraph [0057]; figures *	13-15	

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			A63B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 19 June 2024	Examiner Borrás González, E
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