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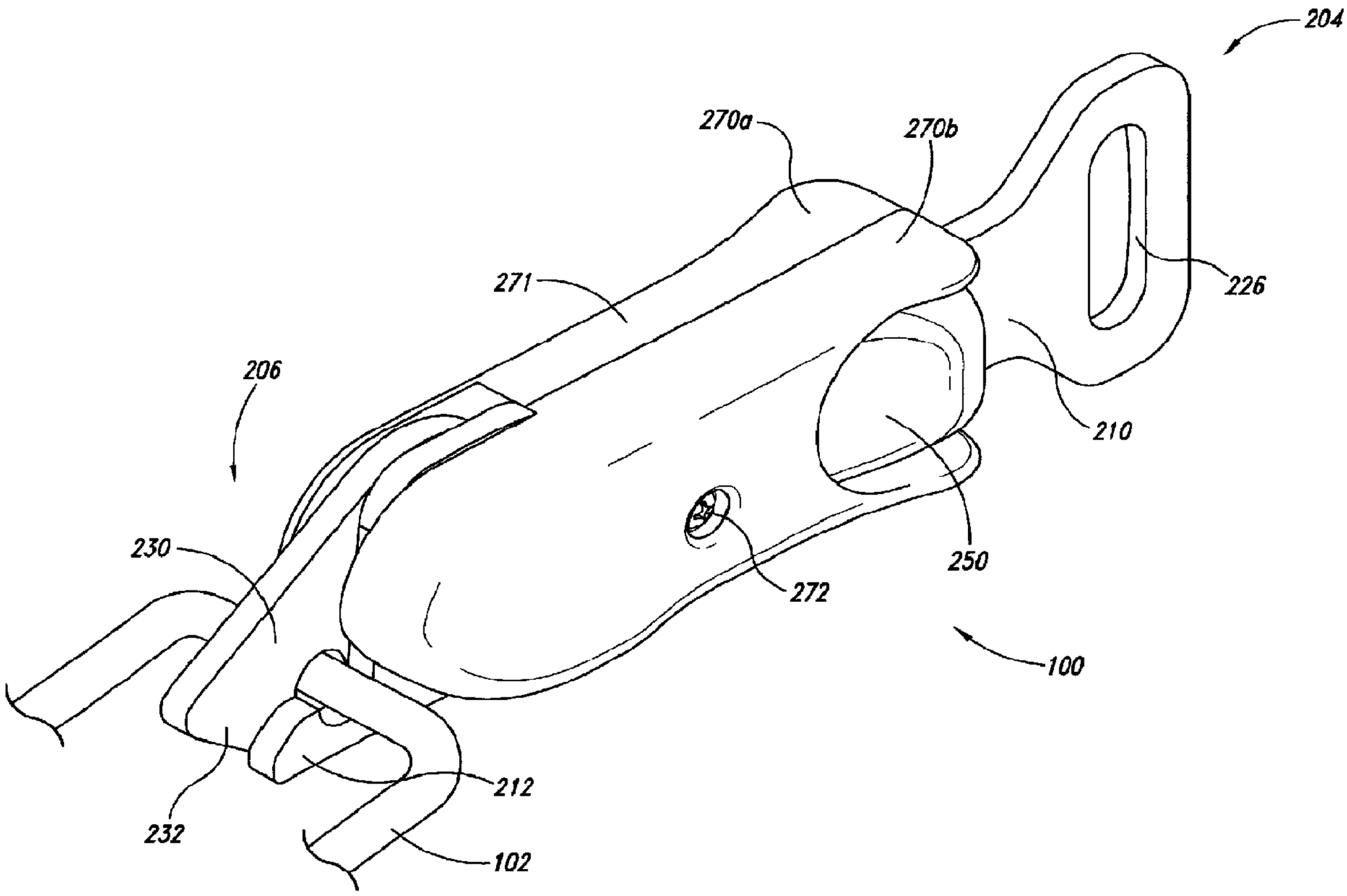

(57) Abrégé/Abstract:
Multi-pivot latch assemblies for releasably engaging anchors and other attachment points in vehicles are disclosed herein. A latch assembly configured in accordance with one embodiment of the disclosure includes a latch and a release actuator movably coupled to a frame. In operation, movement of the release actuator causes the latch to rotate from a first position to a second position about a first pivot point, and from the second position to a third position about a second pivot point to open the latch. In some embodiments, a blocker holds the latch in the open position prior to attachment to an anchor member. In other embodiments, a biasing member holds the latch in the open position.

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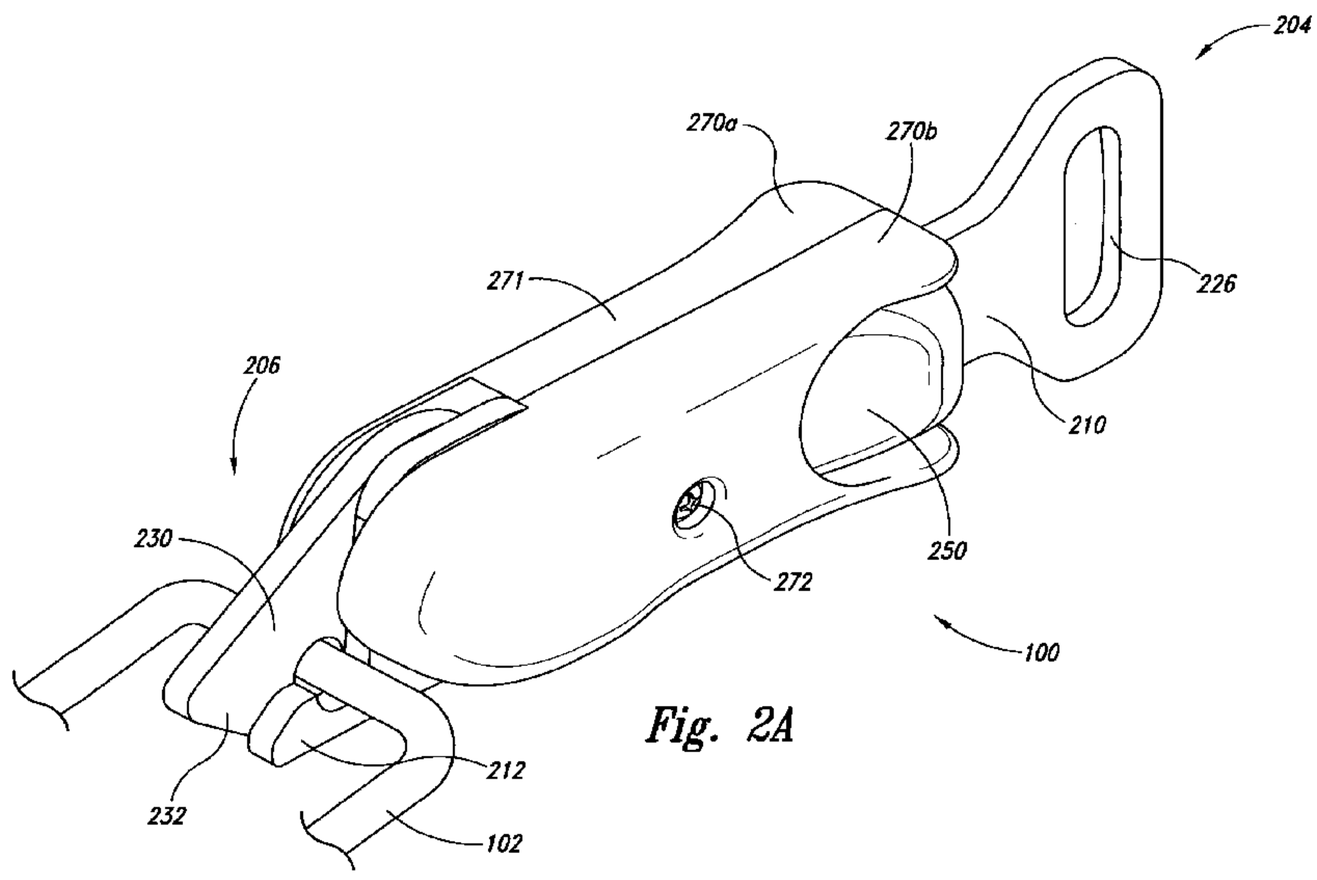

Fig. 2A

(57) **Abstract**: Multi-pivot latch assemblies for releasably engaging anchors and other attachment points in vehicles are disclosed herein. A latch assembly configured in accordance with one embodiment of the disclosure includes a latch and a release actuator movably coupled to a frame. In operation, movement of the release actuator causes the latch to rotate from a first position to a second position about a first pivot point, and from the second position to a third position about a second pivot point to open the latch. In some embodiments, a blocker holds the latch in the open position prior to attachment to an anchor member. In other embodiments, a biasing member holds the latch in the open position.

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MULTI-PIVOT LATCH ASSEMBLIES

TECHNICAL FIELD

[0002] The present disclosure relates generally to latch assemblies for use with restraint systems and, more particularly, to latch assemblies for releasably coupling webs for child seats and other personal restraint systems to anchors and other attach points in vehicles.

BACKGROUND

[0003] There are many types of personal restraint systems used in automobiles and other vehicles. One type of personal restraint system used for children is a portable child seat. Portable child seats are typically secured to seats in automobiles.

[0004] One method of securing the child seat includes attaching a web or belt from the child seat to a metal bar or an anchor in the vehicle with a releasable latch assembly. To accommodate different types of child seats, automobiles typically include several anchors at various locations. A lower anchor, for example, is typically positioned at the intersection between an upper seat back portion and a lower seat portion so that it does not interfere with a passenger sitting in the seat. The lower anchor is accessible, however, so that the latch assembly can be easily engaged with the anchor to secure the child seat in position.

SUMMARY

[0005] The following summary is provided for the benefit of the reader only, and is not intended to limit the disclosure as set forth by the claims in any way.

[0006] The present disclosure is directed generally to latch assemblies and other couplings for securing child seats and/or other passenger restraint systems to anchors and/or other structures in vehicles. A latch assembly configured in accordance with one embodiment of the disclosure includes a frame, a latch movably coupled to the frame, and an actuator operably coupled to the latch. In this embodiment, movement of the actuator from a first actuator position toward a second actuator position rotates the latch from a first latch position toward a second latch position about a first pivot point. Continued movement of the actuator from the second actuator position toward a third actuator position rotates the latch from the second latch position toward a third latch position about a second pivot point spaced apart from the first pivot point. In one aspect of this embodiment, the latch assembly further includes a blocker movably coupled to the frame proximate the latch. The blocker moves from a first blocker position toward a second blocker position when the latch rotates from the second latch position toward the third latch position. When the blocker is in the second blocker position, the blocker prevents rotation of the latch from the third latch position toward the second latch position.

[0007] A latch assembly configured in accordance with another embodiment of the disclosure includes a frame and a latch. The frame has a first non-circular opening and a second non-circular opening. The latch has a first guide feature movably received in the first non-circular opening and a second guide feature moveably received in the second non-circular opening to moveably couple the latch to the frame. In one aspect of this embodiment, the latch assembly further includes an actuator and a blocking member. The actuator is operably coupled to the latch and movable relative to the frame. When the actuator moves the latch from a closed position to an open position, the blocking member moves into a position that prevents the latch from moving from the open position to the closed position.

[0008] A latch assembly configured in accordance with a further embodiment of the disclosure includes a latch pivotally coupled to a frame, an ejector movably coupled to the frame, and a release actuator operably coupled to the latch.

Movement of the actuator from a first actuator position toward a second actuator position rotates the latch from a closed first latch position toward a second latch position about a first pivot point, and continued movement of the actuator from the second actuator position toward a third actuator position rotates the latch from the second latch position toward an open third latch position about a second pivot point spaced apart from the first pivot point. The latch assembly of this embodiment can also include a biasing member operably coupled between the latch and the ejector. Movement of the latch from the second latch position toward the open third latch position drives the biasing member against the ejector, causing the ejector to move outwardly relative to the frame from a first ejector position toward a second ejector position. In one aspect of this embodiment, the actuator can include a flexible strap for manual release of the latch assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1 is an isometric view of a child seat secured in a vehicle with a latch assembly configured in accordance with an embodiment of the disclosure.

[0010] Figure 2A is an isometric view of a latch assembly configured in accordance with an embodiment of the disclosure with the latch assembly in a closed position, and Figure 2B is an isometric view of the latch assembly in an open position.

[0011] Figure 2C is a partially exploded isometric view of the latch assembly of Figure 2B.

[0012] Figures 3A and 3B are side views, Figure 3C is a rear view, and Figures 3D and 3E are isometric views, of various components of the latch assembly of Figures 2A-2C.

[0013] Figures 4A-4C are a series of side views illustrating various stages of operation of the latch assembly of Figures 2A-2C in accordance with an embodiment of the disclosure.

[0014] Figure 5A is an isometric view of a latch assembly configured in accordance with another embodiment of the disclosure, and Figure 5B is an isometric view of the latch assembly with part of the housing removed for purposes of illustration.

[0015] Figure 6 is an exploded isometric view of a latch, frame, and guide features from the latch assembly of Figures 5A and 5B.

[0016] Figures 7A-7C are enlarged rear isometric, front isometric, and rear end views, respectively, of a latch blocker from the latch assembly of Figures 5A and 5B.

[0017] Figure 8 is an isometric view illustrating installation of the latch blocker of Figures 7A-7C on the latch assembly of Figures 5A and 5B.

[0018] Figures 9A and 9B are enlarged rear and front isometric views, respectively, of a latch actuator from the latch assembly of Figures 5A and 5B.

[0019] Figure 10 is an isometric view illustrating installation of the latch actuator of Figures 9A-9B on the latch assembly of Figures 5A and 5B.

[0020] Figures 11A-11F are a series of left and right side views illustrating various stages of operation of the latch assembly of Figures 5A and 5B in accordance with an embodiment of the disclosure.

[0021] Figure 12A is an isometric view of a latch assembly configured in accordance with another embodiment of the disclosure, and Figure 12B is an isometric view of the latch assembly with the housing removed for purposes of illustration.

[0022] Figure 13 is an exploded isometric view of the latch assembly of Figure 12A.

[0023] Figures 14A-14F are a series of left and right side views illustrating various stages of operation of the latch assembly of Figures 12A and 12B in accordance with an embodiment of the disclosure.

DETAILED DESCRIPTION

[0024] The following disclosure describes various types of latch assemblies and systems, and methods of using such latch assemblies and systems. Certain details are set forth in the following description and in Figures 1-14F to provide a thorough understanding of various embodiments of the disclosure. Other details describing well-known structures and systems often associated with latch assemblies, child seats, and related vehicle structures, however, are not set forth below to avoid

unnecessarily obscuring the description of the various embodiments of the disclosure.

[0025] Many of the details and features shown in the Figures are merely illustrative of particular embodiments of the disclosure. Accordingly, other embodiments can have other details and features without departing from the spirit and scope of the present disclosure. In addition, those of ordinary skill in the art will understand that further embodiments can be practiced without several of the details described below. Furthermore, various embodiments of the disclosure can include structures other than those illustrated in the Figures and are expressly not limited to the structures shown in the Figures. Moreover, the various elements and features illustrated in the Figures may not be drawn to scale.

[0026] In the Figures, identical reference numbers identify identical or at least generally similar elements. To facilitate the discussion of any particular element, the most significant digit or digits of any reference number refer to the Figure in which that element is first introduced. For example, element 110 is first introduced and discussed with reference to Figure 1.

[0027] Figure 1 is an isometric view of a portable passenger restraint 110 (e.g., a child car seat) secured to a seat 104 in a vehicle 116 by a latch assembly 100 configured in accordance with an embodiment of the disclosure. The latch assembly 100 is coupled to the passenger restraint 110 by a web or belt 112 and an adjustable buckle 114. The latch assembly 100 is attached to the seat 104 by an anchor 102. In the illustrated embodiment, the anchor 102 is a metal bar or loop mounted between an upper seat portion 104 and a lower seat portion 106. In other embodiments, however, the latch assembly 100 can be attached to anchors or other structures positioned at other locations in the vehicle 116. For example, although a rear facing child car seat is shown in the embodiment illustrated in Figure 1, the latch assemblies disclosed herein can also be used with other types of portable passenger restraints including, for example, forward facing child car seats. In the illustrated embodiment, only a single latch assembly 100 is shown. One skilled in the art will appreciate, however, that in other embodiments more than one latch assembly 100 may be used to secure the passenger restraint 110 to the seat 104 in accordance with the present disclosure. Moreover, one skilled in the art will appreciate that the latch assembly 100 can be used with various types of vehicles

(e.g., automobiles, aircraft, rotorcraft, watercraft, etc.), and with other types of restraint systems (e.g., passenger, cargo, etc.).

[0028] Figure 2A is an enlarged isometric view of the latch assembly 100 of Figure 1. In the illustrated embodiment, the latch assembly 100 is in a closed position engaged with the anchor 102. The latch assembly 100 includes a latch 230 and an actuator 250 movably coupled to a frame 210. The latch assembly 100 also includes a body or housing 271 having a first housing portion 270a attached to a second housing portion 270b by a fastener 272 (e.g., a screw, bolt, rivet, etc.). The housing 271 at least partially covers the frame 210, the latch 230, and the actuator 250. The frame 210 includes a web opening 226 at a proximal end portion 204 of the latch assembly 100. The web opening 226 is configured to receive the belt 112 extending from the passenger restraint 110 (Figure 1). Although the web opening 226 is configured to receive the belt 112 in the illustrated embodiment, in other embodiments the web opening 226 can be configured to be attached to or otherwise operably coupled to other structures. For example, in certain embodiments the web opening 226 can be configured to be releasably attached directly to the passenger restraint 110 or to a rigid structure carried by the passenger restraint 110. In still further embodiments, the web opening 226 can be fixedly attached directly to the passenger restraint 110. In the illustrated embodiment, the frame also 210 includes a first jaw 212 at a distal end portion 206 of the latch assembly 100. As shown in Figure 2A, the first jaw 212 is configured to cooperate with a second jaw 232 of the latch 230 to releasably engage the anchor 102.

[0029] In Figure 2B, the second jaw 232 has moved to the open position to release the anchor 102. As described in greater detail below with reference to Figures 4A-4C, when the actuator 250 is moved toward the proximal end portion 204 of the latch assembly 100 in a direction indicated by arrow 203, the latch 230 pivots to move the second jaw 232 away from the first jaw 212 in a direction indicated by arrow 205.

[0030] Figure 2C is a partially exploded isometric view of the latch assembly 100 of Figures 2A and 2B illustrating certain features of the latch assembly 100 in more detail. For example, a first guide pin or guide feature 246 projects from the latch 230 and is movably received in a corresponding first opening 216 in the frame 210. A second guide pin or guide feature 248 also projects from the latch 230 and is

movably received in a corresponding second opening 218 in the frame 210. The actuator 250 includes a hook end portion 252 that engages the first guide feature 246 when the actuator 250 is moved toward the proximal end portion 204 of the latch assembly 100 in the direction indicated by arrow 203.

[0031] The latch assembly 100 also includes a biasing member 274 (e.g., a compression spring) operably coupled between the frame 210 and actuator 250. When the actuator 250 is moved toward the proximal end portion 204, the biasing member 274 is compressed thereby providing resistance to the movement of the actuator 250 in the direction of arrow 203. When the actuator 250 is released, the biasing member 274 urges the actuator 250 in a direction opposite to arrow 203 to move the second jaw 232 toward the closed position.

[0032] Figure 3A is a side view of the frame 210, Figure 3B is a side view of the latch 230, Figure 3C is a rear view of the latch 230, and Figures 3D and 3E are isometric views of the actuator 250 of the latch assembly 100 illustrated in Figures 2A-2C. Referring first to Figure 3A, the first jaw 212 includes a first inclined surface 313 and a first engagement surface 314. In the illustrated embodiment, the first engagement surface 314 has a generally hemispherical shape configured to receive an anchor having a corresponding cross sectional shape. In other embodiments, however, the first engagement surface 314 can have other shapes. For example, the first engagement surface 314 can have a rectilinear shape and/or include grooves or other features corresponding to the shape of the anchor and/or facilitating attachment thereto. In still further embodiments, the first engagement surface 314 can be generally flat and not include any retention features.

[0033] The first opening 216 and second opening 218 extend through a distal end portion 311 of the frame 210. In the illustrated embodiment, the first opening 216 is a slot having a generally "V" shape, and the second opening 218 is a slot having a generally linear shape. In other embodiments, however, the first opening 216 and second opening 218 can have different shapes to accommodate different motions of the first guide feature 246 and second guide feature 248, respectively.

[0034] The frame 210 also includes an aperture 323 that receives the fastener 272 illustrated in Figures 2A-2C that secures the first and second housing portions 270 to the latch assembly 100. The frame 210 also includes a first recess 322 and a

stop 324 along an edge portion 321. The recess 322 receives the biasing member 274 (Figure 2C) which presses against the stop 324 and urges the actuator 250 toward the distal end portion 311 of the frame 210. In the illustrated embodiment, the medial portion of the frame has a reduced height in relation to the distal end portion 311 and the proximal end portion 325. In other embodiments, however, the frame 210 can have other shapes and/or configurations.

[0035] Figure 3B is a side view of the latch 230. In the illustrated embodiment, the second jaw 232 has a second inclined surface 333 to facilitate inserting the anchor 102 into the latch assembly 100 (Figures 2A-2C). For example, as the latch assembly 100 is pressed against the anchor 102, the anchor 102 contacts the first inclined surface 313 of the first jaw 212 and the second inclined surface 333 of the second jaw 232 and moves the second jaw 232 away from the first jaw 212 so that the anchor 102 can be received between the two jaws. The second jaw 232 also has a second engagement surface 334 configured to engage the anchor 102 with the first engagement surface 314 of the first jaw 212. In the illustrated embodiment, the second engagement surface 334 includes a generally hemispherical shape (similar to the first engagement surface 314 shown in Figure 3A) corresponding to an anchor with a generally circular cross section. The latch assembly 230 further includes a first aperture 342 positioned to receive at least a portion of the first guide feature 346, and a second aperture 344 positioned to receive at least a portion of the second guide aperture 348.

[0036] Figure 3C is a rear view of the latch 230 illustrating the first guide feature 246 and the second guide feature 248 projecting from the latch 230. In the illustrated embodiment, the first guide feature 246 and the second guide feature 248 each includes a shaft portion 247 and a head portion 249. Each shaft portion 247 is at least partially inserted into the latch 230. Each head portion 249 is spaced apart from the latch 230 and configured to retain the corresponding first guide feature 246 in the first opening 216 in the frame 210, and the second guide feature 248 in the second opening 248 in the frame 210. In certain embodiments, the first guide feature 246 and second guide feature 248 can include, for example, pins, posts, studs, and any other types of suitable guide features projecting from the latch 230. Moreover, in certain embodiments, the first guide feature 246 and the second guide feature 248 can be fixedly retained in the latch 230 (e.g., with a press-fit). In other

embodiments, however, the first guide feature 246 and the second guide feature 248 can be rotatably retained in the latch 230 to allow them to spin with reference to the latch 230. Accordingly, the present disclosure is not limited to the particular types of guide features described above or shown in the Figures.

[0037] Figures 3D and 3E are isometric views of the actuator 250. Referring to Figures 3D and 3E together, in the illustrated embodiment the hook end portion 252 has a generally "U"-shaped configuration to engage the first guide feature 246 (Figure 2C). More specifically, the hook end portion 252 includes a first abutment surface 354 and an opposing second abutment surface 355. The hook end portion 252 extends from one side of a medial portion 356 of the actuator 250 and has a reduced width with reference to the medial portion 356.

[0038] The medial portion 356 of the actuator 250 includes a cavity 368 configured to receive the biasing member 274. A first end portion 376 of the biasing member 274 presses against a corresponding contact surface 366 of the cavity 368. The cavity 368 intersects a channel 364 extending through the medial portion 356 as well as a proximal end portion 361 of the actuator 250. The medial portion 356 also includes a first cut-away portion 357a extending from the hook end portion 252, and a second cut-away portion 357b extending from a side surface 358 that is generally perpendicular to the hook end portion 252.

[0039] The width of the actuator 250 gradually increases from the medial portion 356 toward the proximal end portion 361 forming a raised grip surface 362. The grip surface 362 enables a user to manually slide or otherwise move the actuator 250 in the direction of the arrow 203 to facilitate operation of the latch assembly 100 (Figure 2C). For example, a user can open the latch assembly 100 by pulling the actuator 250 in the direction of the arrow 203. One skilled in the art will appreciate that the actuator 250 can be any type of button, trigger, pull, etc. that can be actuated to open the latch assembly 100.

[0040] In the illustrated embodiment, the actuator 250 is configured to cooperate with the frame 210 and the latch 230 within the first and second housing portions 270. When the actuator 250 is positioned over the frame 210 as shown in, for example, Figure 2C, the frame 210 can movably slide through the channel 364 of the actuator 250. Moreover, the stop 324 of the frame 210 can also movably slide

through the cavity 368 of the actuator 250. The reduced width of the hook end portion 252 extending from the side surface 358 of the actuator 250 allows the first and second housing portions 270 to accommodate the actuator 250, the latch 230, and the frame 210. Moreover, the cut-away portions 357 allow the actuator 250 to slide within the first and second housing portions 270 without interfering with the fastener 272 holding the first and second housing portions 270 together.

[0041] Figures 4A-4C are a series of side views illustrating the latch assembly 100 in various stages of opening. In the embodiment illustrated in Figures 4A-4C, the latch 230 rotates with reference to the frame 210 about two different pivot points. Referring first to Figure 4A, when the latch assembly 100 is closed, the actuator 250 biases the latch 230 toward a first position 410 in which the first jaw 212 and the second jaw 232 capture and retain the anchor 102. More specifically, the biasing member 274 pushes against the contact surface 366 of the actuator 250 to urge the actuator 250 toward the latch 230. This causes the second abutment surface 355 of the actuator 250 to drive the first guide feature 246 toward an upper left portion of the "V"-shaped first opening 216 in the frame 210. When the first guide feature 246 is in this location, the second guide feature 248 is positioned toward an upper portion of the second opening 218 in the frame 210. With the latch 230 in this position, the actuator 250 is at position A in which latch assembly 100 retains the anchor 102 between the frame 210 and latch 230 until a user operates the actuator 250 to release the anchor 102.

[0042] In Figure 4B, the latch assembly 100 is still closed (e.g., the anchor is retained between the first jaw 212 and second jaw 232), but the operator (not shown) has moved the actuator 250 from position A to position B causing the latch 230 to rotate about a first pivot point 404 at the anchor 102. As the actuator 250 moves in the direction of arrow 203a to the intermediate position B, the latch 230 rotates in the direction of an arrow 405 from the first position 410 shown in Figure 4A to the second position 412 shown in Figure 4B. As the latch 230 rotates toward the second position 412, the first guide feature 246 slides along the first abutment surface 354, and the latch 230 pivots about the first pivot point 404. In the illustrated embodiment, the first pivot point 404 is at least proximate to the anchor 102. As the latch 230 rotates about the first pivot point 404, the first guide feature 246 moves through the first opening, and the second guide feature 248 moves through the

second openings 218 until the second guide feature 248 contacts the pivot surface 319 of the second opening 218. Although the latch 230 has rotated into the second position 412, the latch assembly 100 still retains the anchor 102 between the frame 210 and latch 230.

[0043] In Figure 4C, the operator has moved the actuator 250 to position C to rotate the latch 230 to a third position 414 and open the latch assembly 100. In the third position 414, the second jaw 232 is rotated in the direction indicated by arrow 407 to be spaced apart from the first jaw 212. To rotate the latch 230 into the third position 414, the actuator 250 continues to move in the direction of arrow 203b from the intermediate position B to an unlocked position C. During this movement, the first abutment surface 354 continues to contact the first guide feature 246 and drives it toward an upper right portion of the "V"-shaped first opening 216. As the latch 230 pivots to the third position 414, however, the second guide feature 248 does not slide through the second opening 218. Instead, the second guide feature 248 remains at the pivot surface 319 of the second opening 218 and the latch 230 pivots about the second guide feature 248. In the illustrated embodiment, the second guide feature 248 represents a second pivot point 406. Accordingly, as the latch 230 rotates about the second pivot point 406, the first guide feature 246 moves through the first opening 216.

[0044] The embodiments of the latch assembly 100 described above provide several advantages over conventional latch assemblies. One advantage, for example, is that the latch 230 has to move through two different motions to release the anchor 102 from the latch assembly 100. For example, when a user operates the actuator 250, the latch 230 rotates from the first position 410 to the second position 412 about the first pivot point 404. During this first movement, however, the anchor 102 remains engaged between the first jaw 212 and the second jaw 232. To release the anchor 102, the latch 230 must be rotated again from the second position 412 to the third position 414 about the second pivot point 406. Rotating the latch 230 about multiple pivot points accordingly provides an increased number of movements to release the anchor 102 from the latch assembly 100. Pivoting the latch 230 about the multiple pivot points also helps to at least partially prevent an unintentional release of the anchor 102, as the second jaw 232 remains engaged

with the anchor 102 when the latch 230 is in the first position and the second position 412.

[0045] Figure 5A is an isometric view of a latch assembly 500 configured in accordance with another embodiment of the disclosure, and Figure 5B is an isometric view of the latch assembly 500 with a portion of a housing 571 removed for purposes of illustration. The latch assembly 500 can be used in a number of different restraint systems and in a number of different ways. For example, in one embodiment the latch assembly 500 can be used in place of the latch assembly 100 shown in Figure 1 to secure the passenger restraint 110 to the seat 104. More specifically, the latch assembly 500 can be attached to the passenger restraint 110 by means of the belt 112 and the adjustable buckle 114 (or a suitable web retractor). The latch assembly 500 can then be releasably coupled to the anchor 102, and a similar latch and anchor arrangement can be used on the other side of the passenger restraint 110, to securely attach the passenger restraint 110 to the seat 104. In other embodiments, however, the latch assembly 500 can be attached to other anchors or structures in other arrangements and at other locations in the vehicle 116. Moreover, those skilled in the art will appreciate that the latch assembly 500 can be used with various types of vehicles (e.g., automobiles, aircraft, watercraft, military vehicles, etc.), and with other types of restraint systems (e.g., adult passenger, cargo, etc.).

[0046] Referring to Figures 5A and 5B together, the latch assembly 500 includes a pivotable member or latch 530 and a latch release actuator 550 operably coupled to a frame 510. The housing 571 at least partially covers the frame 510, the latch 530, and the actuator 550, and includes a first housing portion 570a attached to a second housing portion 570b by a fastener 572 (e.g., a screw, bolt, rivet, etc.) that extends through an aperture 523 in the frame 510. The latch 530 and the frame 510 can be formed from suitable types of metallic materials including, for example, steel or steel alloy sheet or plate that is stamped, forged, cut, machined, cast, or otherwise formed to shape. In other embodiments, the latch 530 and/or the frame 510 can be formed from other suitable metallic materials (e.g., aluminum, titanium, etc.), other suitable non-metallic materials (e.g., fiber-reinforced resin materials such as carbon fiber, etc.), and/or other suitable materials known in the art. The actuator 550 and the housing portions 570 can be manufactured from various types of

injection molded plastics (e.g., polypropylene or other thermoplastic polymers), thermosetting resins, fiber-reinforced resins, Delrin®, and/or other suitable materials known in the art.

[0047] The latch assembly 500 includes a proximal end portion 504 and a distal end portion 506. The proximal end portion 504 includes a web aperture or opening 526 configured to receive and be securely attached to, for example, a conventional seat belt, strap or web (e.g., a woven fiber web), such as the belt 112 illustrated in Figure 1. Although the web opening 226 of the illustrated embodiment is configured to be attached to a web, those of ordinary skill in the art will appreciate that in other embodiments the web opening 526 can be configured to be attached to other members or structures. For example, in some embodiments the web opening 526 can be attached directly to a child seat or other passenger restraint, or to a structural member carried by the passenger restraint. Accordingly, the latch assembly 500 described herein is not limited to the particular embodiments illustrated in the accompanying Figures, but can be utilized in a wide variety of applications to secure persons, cargo, equipment, etc. in moving vehicles.

[0048] The distal end portion 506 of the latch assembly 500 includes a mouth 580 configured to receive a metal bar or anchor 502. The anchor 502 can be at least generally similar in structure and function to the anchor 102 described above with reference to Figure 1. As described in greater detail below, a latch blocking member or blocker 590 holds the latch 530 in the open position as illustrated in Figures 5A and 5B until the mouth 580 is pushed over the anchor 502 and the anchor 502 pushes the latch blocker 590 back in a direction indicated by arrow 503. When the blocker 590 has moved back a sufficient amount, it allows the latch 530 to rotate downwardly in a direction indicated by arrow 505. The frame 510 includes a first jaw 512 and the latch 530 includes a corresponding second jaw 532. When the latch 530 rotates downwardly, the first jaw 512 cooperates with the second jaw 532 to engage the anchor 502 and attach the latch assembly 500 to the anchor 502.

[0049] As described in greater detail below, the latch assembly 500 further includes a first guide feature 546a and a second guide feature 546b that project outwardly from a side portion of the latch 530. The first guide feature 546a is movably received in a first guide track or opening 516 in the frame 510. The second

guide feature 546b is similarly received in a second guide track or opening 518 in the frame 510. In the illustrated embodiment, the actuator 550 includes an end portion with a hook-shaped engagement feature 552 that operably engages the first guide feature 546a.

[0050] Figure 6 is an exploded isometric view of the frame 510, the latch 530 and the guide features 546. The frame 510 includes a proximal end portion 625, a distal end portion 611, and a medial portion 613 therebetween. The first jaw 512 is positioned toward the distal end portion 611 and includes a first engagement surface 614 configured to at least partially engage the anchor 502 (Figures 5A and 5B). In the illustrated embodiment, the first engagement surface 614 forms a raised lip on the first jaw 512 having a radius of curvature that is at least generally similar to the cross-sectional radius of the bar forming the anchor 502. In other embodiments, however, the first engagement surface 614 can have other shapes. For example, the first engagement surface 614 can have rectilinear and/or other shapes to facilitate retention of the anchor 502 in the mouth 580 of the latch assembly 500. The frame 510 further includes a first recess 628 configured to slidably retain the latch blocker 590 (Figures 5A and 5B) adjacent to the first engagement surface 614. In the illustrated embodiment, the first recess 628 includes parallel first and second side surfaces 630 and 632, respectively, terminating in a contact surface 626.

[0051] The first opening 516 and the second opening 518 extend through the frame 510 proximate the distal end portion 611. In the illustrated embodiment, the first opening 516 is a non-circular opening that forms a slot having a generally "V" shape with a first semi-circular end portion 650a and a second semi-circular end portion 650b. The second opening 518 is a non-circular opening that forms a slot having a generally straight or linear shape with a first semi-circular end portion 652a and a second semi-circular end portion 652b. As described in greater detail below, the first end portion 652a of the second opening 518 forms a pivot surface 619. In other embodiments, however, the first opening 516 and the second opening 518, and the corresponding first and second end portions 650 and 652, can have other shapes to, for example, accommodate different motions of the first guide feature 546a and the second guide feature 546b.

[0052] An edge portion 621 of the frame 510 includes a second recess 622 and a stop 624. As described in greater detail below, the second recess 622 receives a

biasing member (e.g., a coil spring; not shown in Figure 6) that presses against the stop 624 and urges the actuator 550 (Figures 5A and 5B) toward the distal end portion 611 of the frame 510. In the illustrated embodiment, the medial portion 613 of the frame 510 has a reduced height in relation to the distal end portion 611 and a proximal end portion 625. In other embodiments, however, the frame 510 can have other shapes and/or configurations.

[0053] Referring next to the latch 530, the latch 530 of the illustrated embodiment is a pivotal member (e.g., a lever, catch, etc.) having second jaw 532 that includes a projection or tip portion with a second engagement surface 634 configured to cooperate with the first engagement surface 614 of the first jaw 512 to engage and retain the anchor 502 within the mouth 580 when the latch 530 is in the closed position. In the illustrated embodiment, the second engagement surface 634 includes a recess having a generally semi-circular shape with a radius of curvature that is at least generally similar to the radius of curvature of the first engagement surface 614. As a result, when closed together the first engagement surface 614 and the second engagement surface 634 can at least approximate the cross-sectional shape of the bar forming the anchor 502. In other embodiments, however, the second engagement surface 634 can have other shapes including, for example, other circular and non-circular (e.g., rectilinear) shapes.

[0054] In another aspect of this embodiment, the latch 530 includes a finger or tab 635 that extends downwardly between the second engagement surface 634 and a clearance recess 638. The tab 635 includes an abutment surface 636 on a distal portion thereof. As described in greater detail below, a side portion of the blocker 590 includes a corresponding blocking surface that contacts the abutment surface 636 and holds the latch 530 in the open position until an anchor or other structure pushes the blocker 590 inwardly in the direction of arrow 503 (Figure 5B). When that happens, the side portion of the blocker 590 moves into the clearance recess 638 and allows the latch 530 to rotate downwardly in the direction of arrow 505 (Figure 5B) into the closed position.

[0055] The latch 530 can also include a first aperture 642a configured to receive at least a portion of the first guide feature 546a, and a second aperture 642b configured to receive at least a portion of the second guide feature 546b. More

specifically, in the illustrated embodiment, the first and second guide features 546 each include a cylindrical shaft portion 647 (identified individually as a first shaft portion 647a and a second shaft portion 647b) and a corresponding head portion 649 (identified individually as a first head portion 649a and a second head portion 649b) that is larger than the shaft portion 647. The first shaft portion 647a is configured to be inserted through the first opening 516 in the frame 510 and then into the first aperture 642a in the latch 530. Similarly, the second shaft portion 647b is configured to be inserted through the second opening 518 and into the second aperture 642b. In certain embodiments, the guide features 546 can be fixedly retained in the latch apertures 642 by, for example, a press-fit. In other embodiments, the guide features 546 can be fixed to the latch 530 by other suitable means known in the art (e.g., adhesives, swaging, welding, lock rings, etc.), or the latch 530 can be machined, cast, or otherwise formed so that the guide features 546 (or portions thereof) are integral parts of the latch 530. Although the shaft portions 647 and the head portions 649 of the illustrated embodiment are cylindrical, in other embodiments one or both of these features can have other shapes. In still further embodiments, the guide features 546 can be rotatably retained in the latch apertures 642 to allow them (or portions thereof) to spin with reference to the latch 530 to facilitate movement of the latch 530 relative to the frame 510.

[0056] In the foregoing manner, the guide features 546 movably attach the latch 530 to the frame 510, and enable pivotal movement of the latch 530 via movement of the guide features 546 through the corresponding openings 516 and 518. The guide features 546 can include, for example, metal (e.g., steel) pins, posts, studs, and/or other types of suitable features projecting from the latch 530 to movably couple the latch 530 to the frame 510. In yet other embodiments, it is contemplated that the latch 530 can include non-circular openings similar to the openings 516 and 518, and guide features similar to the guide features 546 can be fixedly attached to the frame 510 to enable the desired pivotal movement of the latch 530. Accordingly, the present disclosure is not limited to the particular embodiments of guide features or guide feature arrangements described above or shown in the corresponding Figures.

[0057] Figures 7A-7C are enlarged rear isometric, front isometric, and rear end views, respectively, of the latch blocker 590 configured in accordance with an

embodiment of the disclosure. Referring to Figures 7A-7C together, the blocker 590 includes a first side portion 702 spaced apart from a second side portion 704 by a channel 712 extending therebetween. An inner surface of the first side portion 702 includes a first recess or cutout 710a, and an opposing inner surface of the second side portion 704 includes a corresponding second cutout 710b. The cutouts 710 are cylindrical in shape and are configured to accommodate a biasing member (e.g., a coil spring; not shown in Figures 7A-7C) positioned in the channel 712 with one end supported by a contact surface 708. An upper guide surface 714 extends from the contact surface 708 to a flange 719, and a lower guide surface 716 extends from the contact surface 708 to a forward edge 718. A bearing surface 724 for contacting anchors and other attach structures extends upwardly from the forward edge 718.

[0058] As shown to good effect in Figure 7B, the second side portion 704 includes a blocking surface 706 extending at least generally horizontally between an angled front surface 720 and an angled rear surface 722. As described in greater detail below, the blocking surface 706 is configured to contact the abutment surface 636 on the latch tab 635 (Figure 6) and hold the latch 530 in the open position, until an anchor or other structure pushes the blocker 590 back into the mouth 580 (Figure 5A) and allows the latch 530 to rotate downwardly to the closed position.

[0059] The blocker 590 can be manufactured from various types of plastic (e.g., polypropylene or other thermoplastic polymers), thermosetting resins, fiber-reinforced resins, Delrin®, and/or other suitable materials known in the art. In other embodiments, the blocker 590 can be formed from suitable metals including, for example, steel, aluminum, etc. that is stamped, forged, cut, machined, cast, or otherwise formed to shape.

[0060] Figure 8 is an isometric view illustrating the blocker 590 installed on the frame 510 in accordance with an embodiment of the disclosure. Referring to Figures 6, 7A-7C, and 8 together, to install the blocker 590 on the frame 510, a first biasing member 820 (e.g., a coil spring) is inserted between the cutouts 710 in the blocker 590. With the biasing member 820 in place, the blocker 590 is slid into the first recess 628 in the frame 510 so that the lower guide surface 716 on the blocker 590 contacts the first side surface 630 of the recess 628, and the upper guide surface 714 on the blocker 590 contacts the second side surface 632 of the recess 628. The blocker 590 is pushed into the first recess 628 until the forward edge 718

of the blocker 590 contacts the first engagement surface 614 of the first jaw 512. In this configuration, the biasing member 820 is compressed between the contact surface 708 on the blocker 590 and the opposing contact surface 626 on the frame 510.

[0061] As described in greater detail below, when an anchor or other structure moves into the mouth 580 and pushes against the bearing surface 724 of the blocker 590, the blocker 590 moves back in the direction of arrow 503 and further compresses the biasing member 820. This allows the latch 530 to pivot in the direction of arrow 505 to the closed position. Conversely, the compressed biasing member 820 urges the blocking member 590 outwardly in the direction of arrow 805 to release the anchor when the latch 530 pivots in the direction of arrow 807 to the open position shown in Figure 8.

[0062] Figures 9A and 9B are enlarged rear and front isometric views, respectively, of the actuator 550 configured in accordance with an embodiment of the disclosure. Referring to Figures 9A and 9B together, the actuator 550 includes a proximal end portion 961, a distal end portion 951, and a medial portion 956 therebetween. The proximal end portion 961 includes a first side portion 982 spaced apart from a second side portion 984 by a longitudinal channel 964 extending therebetween. A cavity 968 having a contact surface 966 extends downwardly between the first side portion 982 and the second side portion 984 and opens into the channel 964. As described in greater detail below, the cavity 968 is configured to receive a second biasing member (e.g., a coil spring) that presses against the contact surface 966.

[0063] The first side portion 982 and the second side portion 984 each include a grip surface 962 (identified individually as a first grip surface 962a and a second grip surface 962b). In the illustrated embodiment, the grip surfaces 962 flare outwardly toward the proximal end portion 961 to facilitate manipulation of the actuator 550 by a user (not shown). More specifically, the grip surfaces 962 facilitate grasping the actuator 550 and moving it in the direction of arrow 503 (Figure 5B) to release the latch assembly 500 from the anchor 502. The first side portion 982 includes a first cut-out or cut-away portion 957a extending between the first grip surface 962a and the distal end portion 951. The second side portion 984

terminates in a second cut-away portion 957b that transitions to a perpendicular face 958.

[0064] As shown to good effect in Figure 9B, the distal end portion 951 extends from the first side portion 982. In the illustrated embodiment, the engagement feature 952 has a generally "U"-shaped configuration that movably engages the first guide feature 546a (Figure 5B). More specifically, the engagement feature 552 includes a first abutment surface 954 (Figure 9A) and an opposing second abutment surface 955 (Figure 9B), which alternately bear against the first guide feature 546a in operation depending on the direction of movement of the actuator 550.

[0065] Figure 10 is an isometric view illustrating the actuator 550 installed on the frame 510 in accordance with an embodiment of the disclosure. As this view illustrates, the engagement feature 552 is operably coupled to the first guide feature 546a, and the channel 964 is positioned over the medial portion 621 of the frame 510. A second biasing member 1074 is installed in the cavity 968 and compressed between the contact surface 966 on the actuator 550 and an opposing contact surface on the frame stop 624. During operation of the latch assembly 500, the actuator 550 can slide back and forth on the frame 510.

[0066] After the actuator 550 has been installed on the frame 510 as shown in Figure 10, the first and second housing portions 570 can be joined together as shown in Figure 5A. The fastener 572 can then be inserted through an aperture in the second housing portion 570b and the aperture 523 in the frame 510, and engaged with the first housing portion 570a (by, e.g., threading the fastener 572 into a corresponding threaded hole in the first housing portion 570a, a nut, etc.). The reduced width of the distal end portion 951 of the actuator 550 allows the first and second housing portions 570 to accommodate the actuator 550, the latch 530, and the frame 510. Moreover, the cut-away portions 957 allow the actuator 550 to slide within the first and second housing portions 570 without interfering with the fastener 572.

[0067] Figures 11A-11F are a series of side views illustrating various stages of operation of the latch assembly 500 in accordance with an embodiment of the disclosure. Figures 11A, 11C, and 11E are left side views with the second housing portion 570b removed for purposes of illustration, and Figures 11B, 11D, and 11F

are corresponding right side views with the first housing portion 570a removed for purposes of illustration. In the embodiment illustrated in Figures 11A-11F, the latch 530 rotates about two different pivot points during operation.

[0068] In Figures 11A and 11B, the anchor 502 has pushed the blocker 590 back in the direction of arrow 503, and the actuator 550 has biased the latch 530 toward a first position 1110 in which the first jaw 512 and the second jaw 532 capture and retain the anchor 502. More specifically, the biasing member 1074 (Figure 10) pushes against the contact surface 966 of the actuator 550 and urges the actuator 550 in the direction of arrow 805 to position A. This causes the second abutment surface 955 of the engagement feature 552 to drive the first guide feature 546a toward the first end portion 650a of the "V"-shaped first opening 516. When the first guide feature 546a is in this location, the second guide feature 546b is positioned toward the second end portion 652b of the second opening 518.

[0069] When the actuator 550 is at position A, the latch 530 is in the first position 1110 and the latch assembly 500 is closed. Moreover, the latch assembly 500 will remain closed and attached to the anchor 502 until a user (not shown) moves the actuator 550 in the direction of arrow 503 as described below with reference to Figures 11C-11F.

[0070] In Figures 11C and 11D, the latch assembly 500 is still closed (i.e., the anchor 502 is still retained between the first jaw 512 and second jaw 532), but the user has moved the actuator 550 in the direction of arrow 503 from position A to position B. As the actuator 550 moves in this manner, the first abutment surface 954 of the engagement feature 552 pulls the first guide feature 546a away from the first end portion 650a of the first opening 516. At the same time, the second guide feature 546b moves downwardly through the second opening 518 until it contacts the pivot surface 619. This movement causes the latch 530 to rotate about the anchor 502 in the direction of arrow 1105 from the first position 1110 (Figure 11A) to a second position 1112. Accordingly, in the illustrated embodiment a cross-sectional center portion 1104 of the anchor 502 can represent a first pivot point of the latch 530. Although the latch 530 rotates to the second position 1112 when the actuator is moved to position B, the latch assembly 500 still remains attached to the anchor 502.

[0071] Referring next to Figures 11E and 11F, to fully release the latch assembly 500 from the anchor 502, the user continues moving the actuator 550 in the direction of arrow 503 from position B toward position C. As the actuator 550 moves in this manner, the first abutment surface 954 continues to contact the first guide feature 546a and drive it toward the second end portion 650b of the first opening 516. The second guide feature 546b, however, remains at the first end portion 652a of the second opening 518 in contact with the pivot surface 619. As a result, the latch 530 rotates about the second guide feature 546b in the direction of arrow 807 from the second position 1112 (Figure 11C) to a third position 1114. Accordingly, when the second guide feature 546b is positioned at the pivot surface 619, a cross-sectional center portion 1106 of the second guide feature 546b can represent a second pivot point of the latch 530. When the actuator 550 is at position C, the latch 530 is in the third position 1114 and the latch assembly 500 is open.

[0072] As shown by comparing Figure 11D to Figure 11F, when the actuator 550 is moved back to position C and the latch assembly 500 is moved away from the anchor 502, the first biasing member 820 drives the blocker 590 forward in the direction of arrow 805 until the blocking surface 706 moves under the abutment surface 636 and holds the latch 530 in the open position. The forward movement of the blocker 590 can help eject the anchor 502 from the latch mouth 580. The first guide feature 546a holds the actuator 550 back in position C against the compressive force of the second biasing member 1074. The latch 530 will remain in the open position until the anchor 502 or other structure pushes the blocking surface 706 back in the direction of arrow 503 and out from under the abutment surface 636.

[0073] Returning to Figures 11C and 11D, when the anchor 502 presses against the blocker 590 and pushes it back in the direction of arrow 503, the blocking surface 706 moves back toward the clearance recess 638 of the latch 530 and out of the way of the abutment surface 636. This allows the latch 530 to rotate downwardly in the direction of arrow 505 and capture the anchor 502 between the latch engagement surface 634 and the frame engagement surface 614. More specifically, the second biasing member 1074 (Figure 10) urges the second abutment surface 955 of the engagement feature 552 against the first guide feature 546a. This drives the first guide feature 546a from the second end portion 650b of the "V"-shaped first opening 516 toward the vertex of the first opening 516. As the first guide feature

546a moves along this path, the latch 530 rotates about the second pivot point 1106 in the direction of arrow 505 and the actuator 550 moves from position C to position B.

[0074] Returning next to Figures 11A and 11B, the second biasing member 1074 continues to drive the actuator 550 in the direction of arrow 805 from position B to position A. This causes the first guide feature 546a to move toward the first end portion 650a of the first opening 516 and the second guide feature 546b to move toward the second end portion 652b of the second opening 518. As the guide features 546 move along these paths, the latch 530 rotates about the first pivot point 1104 in the direction of arrow 1107 to the first position 1110. When the latch 530 is in this position, the actuator 550 is at position A and the latch assembly 500 is closed about the anchor 502.

[0075] Figure 12A is an isometric view of a latch assembly 1200 configured in accordance with another embodiment of the disclosure, and Figure 12B is an isometric view of the latch assembly 1200 with a housing 1271 removed for purposes of illustration. As with the latch assemblies 100 and 500 described in detail above, the latch assembly 1200 can be used for a number of different restraint systems and in a number of different arrangements. In one embodiment, for example, the latch assembly 1200 can be used in place of the latch assembly 100 (or the latch assembly 500) to secure the passenger restraint 110 to the seat 104 as shown in Figure 1. In other embodiments, however, the latch assembly 1200 can be attached to other anchors in other arrangements in the vehicle 116 as well as other types of vehicles.

[0076] Referring to Figures 12A and 12B together, many features of the latch assembly 1200 are at least generally similar in structure and function to corresponding features of the latch assembly 500 described above with reference to Figures 5A-11F. For example, the latch assembly 1200 includes a pivotable member or latch 1230 operably coupled to a frame 1210. Like their counterparts described above, the latch 1230 and the frame 1210 can be formed from suitable types of metals including, for example, steel, stainless steel, or steel alloy plate or sheet that is stamped, forged, cut, machined, cast and/or otherwise formed to shape. In other embodiments, the latch 1230 and/or the frame 1210 can be formed from other suitable metallic materials (e.g., aluminum, titanium, etc.), other suitable

non-metallic materials (e.g., fiber-reinforced resin materials such as graphite epoxy, carbon fiber, etc.), and/or other materials having suitable strength, manufacturing, cost and/or other characteristics known in the art. The housing 1271 includes a bottom or first portion 1270a that fits together with a top or second portion 1270b. The housing portions 1270 can be manufactured from various types of injection-molded plastic (e.g., polypropylene or other thermal plastic polymers), thermal-setting resins, fiber-reinforced resins, and/or other suitable materials known in the art.

[0077] As described in greater detail below, in one aspect of this embodiment the latch assembly 1200 further includes a release actuator in the form of a lanyard-type pull web or pull strap 1250. The pull strap 1250 extends through an aperture in the second housing portion 1270b and is fixedly attached to the latch 1230. The pull strap 1250 can be formed from various types of strong and flexible materials, including woven fabric materials typically used for seat belts or webbing (e.g., woven nylon, polypropylene, polyester, etc.). In other embodiments, the pull strap can be manufactured from plastics, nylon, leather, and/or other materials having suitable strength.

[0078] The latch assembly 1200 includes a proximal end portion 1204 and a distal end portion 1206. The proximal end portion 1204 includes a web aperture or opening 1226 configured to receive and be securely attached to, for example, a conventional seatbelt, strap or web (e.g., a woven fiber web), such as the belt 112 illustrated in Figure 1. A web or other structure can be attached to the frame 1210 via the opening 1226 using any number of different techniques known in the art (e.g., by passing an end portion of the web through the opening 1226 and then stitching the end portion to the web to form a closed loop). In addition, those of ordinary skill in the art will appreciate that in other embodiments a web can be attached to the frame 1210 using other known techniques, such as fasteners. Moreover, in still further embodiments, the web opening 1226 can be configured to be attached to other members and/or other structures. For example, in some embodiments the web opening 1226 can be attached directly to a child seat or other passenger restraint, or to a structural member carried by the child seat, passenger restraint or vehicle. Accordingly, the latch assembly 1200 described herein is not limited to the particular methods of use illustrated in the accompanying figures and

described herein, but can be utilized in a wide variety of applications to secure persons, cargo, equipment, etc. in moving vehicles without departing from the spirit or scope of the present disclosure.

[0079] The distal end portion 1206 of the latch assembly 1200 includes a mouth 1280 configured to receive a structural member such as a metal bar or anchor 1202. The anchor 1202 can be at least generally similar in structure and function to the anchors 102 and 502 described above with reference to Figures 1, 5A and 5B, respectively.

[0080] In another aspect of this embodiment, the latch assembly 1200 includes a first guide feature 1246a and a second guide feature 1246b that project outwardly from a side portion of the latch 1230. The first guide feature 1246a is movably received in a first guide track or opening 1216 in the frame 1210. The second guide feature 1246b is similarly received in a second guide track or opening 1218 in the frame 1210. In the illustrated embodiment, the guide features 1246 include pins that extend through the respective openings 1216 and 1218 and allow the latch 1230 to pivot back and forth as the guide features 1246 travel from one end of their respective opening to the other.

[0081] An ejector 1290 is biased forward in the mouth 1280 by a first biasing member 1220. In the illustrated embodiment, the first biasing member 1220 is a torsion spring having one or more windings which extend around a cylindrical stud 1222 that protrudes outwardly from a side portion of the frame 1210. The first biasing member 1220 includes a first end portion 1224a that operably bears against the first guide feature 1246a, and a second end portion 1224b that operably bears against a contact surface 1208 on an aft portion of the ejector 1290.

[0082] As described in greater detail below, a second biasing member (not shown in Figures 12A and 12B) holds the latch 1230 in the open position illustrated in Figures 12A and 12B until the anchor 1202 pushes the ejector 1290 back in the direction indicated by arrow 1203. As the ejector 1290 moves back, the contact surface 1208 pushes against the second end portion 1224b of the first biasing member 1220. This creates a torsional force in the first biasing member 1220 that causes the first end portion 1224a to press against the first guide feature 1246a and drive the first guide feature 1246a forward and downward in the first opening 1216.

The torsional force provided by the first biasing member 1220 overcomes the spring force (in the second biasing member) holding the latch 1230 in the open position. As a result, continued movement of the ejector 1290 in the direction indicated by arrow 1203 causes the first guide feature 1246a to continue moving forward and upward in the first opening 1216 until the latch 1230 fully closes about the anchor 1202.

[0083] The frame 1210 includes a first jaw 1212 and the latch 1230 includes a corresponding second jaw 1232. When the latch 1230 rotates downwardly, the first jaw 1212 cooperates with the second jaw 1232 to capture and retain the anchor 1202. These and other details of the latch assembly 1200 are described in greater detail below.

[0084] Figure 13 is an exploded rear isometric view of the latch assembly 1200 configured in accordance with an embodiment of the disclosure. In the illustrated embodiment, the first jaw 1212 includes a first engagement surface 1314 configured to at least partially engage the anchor 1202 (Figures 12A and 12B). The first engagement surface 1314 forms a raised lip on the first jaw 1212 having a radius of curvature that is at least generally similar to the cross-sectional radius of the bar forming the anchor 1202. In other embodiments, however, the first engagement surface 1314 can have other shapes.

[0085] Turning next to the latch 1230, the second jaw 1232 includes a second engagement surface 1334 configured to cooperate with the first engagement surface 1314 to engage and retain the anchor 1202 within the mouth 1280 when the latch 1230 is in the closed position. In the illustrated embodiment, the second engagement surface 1334 has a generally semi-circular shape with a radius of curvature that is at least generally similar to the radius of curvature of the first engagement surface 1314. As a result, the first engagement surface 1314 and the second engagement surface 1334 can at least approximate the cross-sectional shape of the anchor 1202 when closed together. In other embodiments, however, the second engagement surface 1334 can have other shapes including, for example, other circular and non-circular (e.g., rectilinear) shapes.

[0086] In another aspect of this embodiment, the latch 1230 includes a first aperture 1342a configured to receive at least a portion (e.g., a distal end portion) of

the first guide feature 1246a, and a second aperture 1342b configured to receive at least a portion of the second guide feature 1246b. More specifically, in the illustrated embodiment, the first and second guide features 1246 each include a cylindrical shaft portion 1347 (identified individually as a first shaft portion 1347a and a second shaft portion 1347b) and a corresponding head portion 1349 (identified individually as a first head portion 1349a and a second head portion 1349b) that is larger than the corresponding shaft portion 1347. The first shaft portion 1347a is inserted through the first opening 1216 in the frame 1210 and then into the first aperture 1342a in the latch 1230. Similarly, the second shaft portion 1347b is inserted through the second opening 1218 and into the second aperture 1342b. As with the guide features 546 described above with reference to, e.g., Figure 6, the guide features 1246 can be fixedly retained in the apertures 1342 by a number of suitable methods known in the art including, for example, press-fit, staking, adhesive, welding, lock rings, etc. In addition to the foregoing features, in the illustrated embodiment, the proximal end portion of the latch 1230 includes a flange 1380 having an aperture 1382 formed therein to receive a distal end portion 1358a of the pull strap 1250. As described in greater detail below, the distal end portion 1358a of the pull strap 1250 passes through the aperture 1382 to fixedly attach the pull strap 1250 to the latch 1230.

[0087] In the illustrated embodiment, the first opening 1216 in the frame 1210 is a non-circular opening that forms a slot or track having a generally "V"-shape with a first semi-circular end portion 1350a and a second semi-circular end portion 1350b. The second opening 1218 is similarly a non-circular opening that forms a slot having a straight, or an at least approximately straight shape with a first semi-circular end portion 1352a and a second semi-circular end portion 1352b. In other embodiments, the first opening 1216 and the second opening 1218, and the corresponding first and second end portions 1350 and 1352, respectively, can have other shapes to, for example, accommodate different motions of the first guide feature 1246a and/or the second guide feature 1246b.

[0088] As mentioned above, the latch assembly 1200 also includes a second biasing member 1374. In the illustrated embodiment, the second biasing member 1374 is a coil spring having a first end portion 1378a formed in the shape of a hook, and a second end portion 1378b that is also formed into a hook shape. The first end

portion 1378a is engaged with a spring aperture 1376 in the frame 1210, and the second end portion 1378b is engaged with the proximal end portion of the latch 1230 via the aperture 1382. In operation, the second biasing member 1374 is stretched in tension and biases the latch 1230 toward the open position (Figures 12A and 12B). In other embodiments, the second biasing member 1374 can have other configurations and/or be made from other materials. For example, in one embodiment the second biasing member 1374 can be a rubber or other elastic member, or a torsion spring that biases the latch 1230 toward the open position. Moreover, in other embodiments the second biasing member 1374 can be operably coupled between the latch 1230 and the frame 1210 (or other member) in other ways, such as with fasteners rather than hooks.

[0089] The latch assembly 1200 can be assembled in one embodiment as follows. First, the distal end portion 1358a of the pull strap 1250 can be inserted through the aperture 1382 in the latch flange 1380 and sewn or otherwise fixedly attached to the latch flange 1380. The latch 1230 can then be moveably coupled to the frame 1210 via the guide features 1246. Next, the second biasing member 1374 can be operably extended between the aperture 1382 in the latch flange 1380 and the spring aperture 1376 in the frame 1210. The first biasing member 1220 can then be positioned over the stud 1222 as illustrated in Figure 12B. The ejector 1290 can then be positioned in its forward location in the first housing portion 1270a, followed by the frame 1210 and latch 1230 sub-assembly. Once these components are properly positioned in the first housing portion 1270a, the pull strap 1250 can be fed through a strap aperture 1362 in the second housing portion 1270b, and the second housing portion 1270b can be mated to the first housing portion 1270a so that the frame 1210 fits neatly into a slot 1364 formed in a proximal end portion of the second housing portion 1270b. Once the first and second housing portions 1270 are properly fit together as shown in Figure 12A, a screw or other suitable fastener(s) 1372 can be inserted through a suitable aperture in the first housing portion 1370a and threadably engaged with corresponding socket on the second housing portion 1370b to complete assembly.

[0090] Figures 14A-14F are a series of views illustrating various stages of operation of the latch assembly 1200 with the housing 1271 removed for purposes of illustration and clarity. Figures 14A, 14C and 14E are left side views of the latch

assembly 1200, and Figures 14B, 14D and 14F are corresponding right side views of the latch assembly 1200. In the embodiment illustrated in Figures 14A-14F, the latch 1230 rotates about two different pivot points during operation.

[0091] Referring first to Figures 14A and 14B together, the anchor 1202 has pushed the ejector 1290 back in the direction of arrow 1203, and the resulting torsional force on the first biasing member 1220 has caused the first end portion 1224a to drive the latch 1230 toward a first position 1410 in which the first jaw 1212 and the second jaw 1232 capture and retain the anchor 1202. More specifically, the first end portion 1224a of the first biasing member 1220 pushes against the first guide feature 1246a, and drives the first guide feature 1246a toward the first end portion 1350a of the "V"-shaped first opening 1216. When the first guide feature 1246a is in this location, the second guide feature 1246b is positioned toward the second end portion 1352b of the second opening 1218.

[0092] When a proximal end portion 1358b of the pull strap 1250 is in position A and the latch 1230 is in the first position 1410, the latch assembly 1200 is closed. Moreover, the latch assembly 1200 will remain closed and attached to the anchor 1202 until a user (not shown) grasps the pull strap 1250 and pulls it in the direction of arrow 1203 as described below with reference to Figures 14C-14F.

[0093] As shown in Figure 14B, when the latch assembly 1200 is in the first and closed position 1410, the second biasing member 1374 is extended in tension. Although the tension force tends to pull the latch 1230 back in the direction of arrow 1203 and pivot the latch about the anchor 1202, the torsional resistance applied by the first biasing member 1220 (Figure 14A) overcomes the tension in the second biasing member 1374 and, as a result, holds the latch 1230 in the closed position 1410.

[0094] Referring next to Figures 14C and 14D, in these views the latch assembly 1200 is still closed (i.e., the anchor 1202 is still retained between the first jaw 1212 and the second jaw 1232), but the user has pulled the proximal end portion 1358b of the pull strap 1250 back in the direction of arrow 1203 from position A to position B. As the pull strap 1250 moves in this direction, it pulls on the latch 1230 and overcomes the torsional resistance of the first biasing member 1220, causing the first guide feature 1246a to move away from the first end portion 1350a of the

first opening 1216. At the same time, the second guide feature 1246b moves downwardly through the second opening 1218 until it contacts the pivot surface at the first end portion 1352a. This movement causes the latch 1230 to rotate about the anchor 1202 in the direction of arrow 1405 from the first position 1410 (Figure 14A) to a second position 1412. Although the latch 1230 rotates to the second position 1412 when the pull strap is moved to position B, the latch assembly 1200 still remains attached to the anchor 1202.

[0095] Referring next to Figures 14E and 14F, to fully release the latch assembly 1200 from the anchor 1202, the user continues pulling the proximal end portion 1358b of the pull strap 1250 in the direction of arrow 1203 from position B toward position C. As the pull strap 1250 moves in this direction, it pulls on the latch 1230, causing the first guide feature 1246a to move toward the second end portion 1350b of the first opening 1216. The second guide feature 1246b, however, remains at the first end portion 1352a of the second opening 1218. As a result, the latch 1230 rotates or pivots about the second guide feature 1246b in the direction of arrow 1407 from the second position 1412 (Figure 14C) to a third position 1414. When the proximal end portion 1358b of the pull strap 1250 is in position C, the latch 1230 is in the third position 1414 and the latch assembly 1200 is open.

[0096] As illustrated by comparing Figure 14C to Figure 14E, when the pull strap 1250 is moved back to position C and the latch assembly 1200 is moved away from the anchor 1202, the torsional force in the first biasing member 1220 causes the second end portion 1224b of the first biasing member 1220 to drive the ejector 1290 forward in the direction of arrow 1408 and push the anchor 1202 away from the latch mouth 1280 (or, conversely, push the latch assembly 1200 away from the anchor 1202). The second biasing member 1374 holds the latch 1230 back in the open position 1414, and the latch 1230 will remain in this position until the anchor 1202 or another structure pushes the ejector 1290 back in the direction of arrow 1203.

[0097] Returning to Figures 14C and 14D, when the anchor 1202 presses against the ejector 1290 and pushes it back in the direction of arrow 1203, the torsional force in the first biasing member 1220 overcomes the tension in the second biasing member 1374 and drives the first guide feature 1246a forward in the first opening 1216. This causes the latch 1230 to rotate downwardly in the direction of

arrow 1409 and capture the anchor 1202 between the latch engagement surface 1334 and the frame engagement surface 1314 (Figure 13). More specifically, the first end portion 1224a of the first biasing member 1220 urges the first guide feature 1246a from the second end portion 1350b of the "V"-shaped first opening 1216 toward the vertex of the first opening 1216. As the first guide feature 1246a moves along this path, the latch 1230 rotates in the direction of arrow 1409 about the second guide feature 1246b and the pull strap 1250 moves from position C to position B.

[0098] Returning next to Figures 14A and 14B, the first biasing member 1220 continues to drive the first guide feature 1246a toward the first end portion 1350a of the first opening 1216. Concurrently, the second guide feature 1246b moves toward the second end portion 1352b of the second opening 1218. As the guide features 1246 move along their respective paths, the latch 1230 rotates about the anchor 1202 in the direction of arrow 1406 to the first position 1410. When the latch 1230 is in this position, the proximal end portion 1358b of the pull strap 1250 has returned to position A and the latch assembly 1200 is fully closed about the anchor 1202.

[0099] From the foregoing, it will be appreciated that specific embodiments of the disclosure have been described herein for purposes of illustration, but that various modifications may be made.

For example, the latch assemblies can include a different number of pivot points or pivot points in different locations. Moreover, the latch assemblies can also be coupled to different portable passenger restraints, including, for example, forward facing child car seats.

CLAIMS

1. A latch assembly for releasably engaging an anchor in a vehicle, the latch assembly comprising:

a frame having a first jaw;

a latch movably coupled to the frame and having a second jaw with a tip portion, wherein the first and second jaws cooperate to retain the anchor when the latch is in a first latch position;

an actuator operably coupled to the latch, wherein movement of the actuator from a first actuator position toward a second actuator position rotates the latch away from the first latch position toward a second latch position about a first pivot point, and wherein continued movement of the actuator from the second actuator position toward a third actuator position rotates the latch away from the second latch position toward a third latch position about a second pivot point spaced apart from the first pivot point; and

a blocker movably coupled to the frame proximate the latch, wherein the blocker moves from a first blocker position toward a second blocker position when the latch rotates from the second latch position toward the third latch position, and wherein the blocker prevents rotation of the latch from the third latch position toward the second latch position when the blocker is in the second blocker position.

2. The latch assembly of claim 1 wherein the second jaw is spaced apart from the first jaw to permit the anchor to pass therebetween when the latch is in the third latch position.

3. The latch assembly of claim 1 wherein the blocker permits rotation of the latch about the first pivot point and the second pivot point when the blocker is in the first blocker position.

4. The latch assembly of claim 1 wherein the latch includes an abutment surface and the blocker includes a blocking surface, and wherein the blocking surface contacts the abutment surface and prevents rotation of the latch when the latch is in the third latch position and the blocker is in the second blocker position.

5. The latch assembly of claim 1 wherein the blocker is slidably coupled to the frame, and wherein the blocker slides from the first blocker position to the second blocker position when the actuator rotates the latch from the second latch position to the third latch position about the second pivot point.

6. The latch assembly of claim 1, further comprising a biasing member operably coupled between the frame and the blocker, wherein the biasing member urges the blocker from the first blocker position toward the second blocker position when the actuator moves the latch from the second latch position to the third latch position.

7. The latch assembly of claim 1, further comprising a biasing member operably coupled between the frame and the blocker, wherein the biasing member urges the blocker from the first blocker position toward the second blocker position when the actuator moves the latch from the second latch position to the third latch position, and wherein the anchor holds the blocker in the first blocker position when the anchor is engaged with the latch assembly.

8. The latch assembly of claim 1, further comprising:

a first biasing member operably coupled between the frame and the blocker, wherein the first biasing member urges the blocker from the first blocker position toward the second blocker position when the actuator moves the latch from the second latch position to the third latch position; and

a second biasing member operably coupled between the frame and the actuator, wherein the second biasing member urges the actuator from the third actuator position toward the second actuator position when the anchor moves the blocker back from the second blocker position toward the first blocker position.

9. The latch assembly of claim 1:

wherein the frame includes a first opening and a second opening; and

wherein the latch includes a first guide feature and a second guide feature, wherein the first guide feature is movably received in the first opening of the frame, and wherein the second guide feature is movably received in the second opening of the frame.

10. The latch assembly of claim 1:

wherein the frame includes a first opening and a second opening, wherein the first opening has a generally "V" shape and the second opening has a generally linear shape; and

wherein the latch includes a first guide pin and a second guide pin fixedly attached to the latch, wherein the first guide pin moves through the first opening and the second guide pin moves through the second opening as the latch rotates from the first latch position to the second latch position.

11. The latch assembly of claim 1:

wherein the latch includes a guide feature projecting therefrom; and

wherein the actuator includes a distal end portion that operably engages the guide feature to move the latch between the first, second and third latch positions.

12. The latch assembly of claim 1:

wherein the frame includes a first non-circular opening and a second non-circular opening;

wherein the latch includes a first guide feature and a second guide feature, wherein the first guide feature extends through the first non-circular opening and the second guide feature extends through the second non-circular opening to moveably couple the latch to the frame; and

wherein the actuator includes a distal end portion that is operably coupled to the first guide feature, wherein movement of the actuator moves the first guide feature through the first non-circular opening and the second guide feature through the second non-circular opening as the latch rotates from the first latch position to the second latch position.

13. A latch assembly for releasably securing a web to an anchor in a vehicle, the latch assembly comprising:

a frame having a first non-circular opening and a second non-circular opening shaped differently than the first non-circular opening;

a latch having a first guide feature and a second guide feature, wherein the first guide feature is movably received in the first non-circular opening and the second guide feature is moveably received in the second non-circular opening to moveably couple the latch to the frame;

an actuator operably coupled to the latch and movable relative to the frame between a first actuator position and a second actuator position, wherein at least one of the first and second guide features bears against a portion of the corresponding first and second non-circular opening to prevent the

latch from moving away from a closed position when the actuator is in the first actuator position, wherein movement of the actuator from the first actuator position to the second actuator position moves the latch from the closed position to an open position, and wherein the first guide feature remains within the first non-circular opening and the second guide feature remains within the second non-circular opening when the latch is in the closed position and the open position; and

a blocking member movably coupled to the frame, wherein the blocking member moves into a blocking position when the actuator moves the latch from the closed position to the open position, and wherein the blocking member prevents the latch from moving from the open position to the closed position when the blocking member is in the blocking position.

14. The latch assembly of claim 13 wherein the first non-circular opening is curved.

15. The latch assembly of claim 13 wherein the first non-circular opening is generally "V" shaped and the second non-circular opening is generally straight.

16. The latch assembly of claim 13 wherein movement of the actuator moves the first guide feature through the first non-circular opening and the second guide feature through the second non-circular opening.

17. The latch assembly of claim 13 wherein the frame has a proximal end portion and a distal end portion, wherein the proximal end portion includes a web aperture configured to receive and retain the web.

18. The latch assembly of claim 13 wherein the second opening has a pivot surface that supports the second guide feature as the latch rotates about the second guide feature from the closed position to the open position.

19. A latch system for releasably coupling a web to an anchor in a vehicle, the latch system comprising:

a frame having a proximal end portion for receiving the web and a distal end portion for receiving the anchor;

a latch movably coupled to the frame toward the distal end portion;

means for holding the latch open prior to engaging the latch with the anchor;

means for pivoting the latch about a first location and a second location spaced apart from the first location to engage the latch with the anchor;

an actuator operably coupled to the latch; and

means for moving the actuator in a single general direction to pivot the latch about the second location and then the first location to release the latch from the anchor.

20. The latch system of claim 19 wherein the means for holding the latch open prior to engaging the latch with the anchor includes a movable blocking member that abuts the latch when the latch is open.

21. A latch assembly for releasably engaging an anchor in a vehicle, the latch assembly comprising:

a frame having a first jaw;

a latch movably coupled to the frame and configured to having a second jaw with a tip portion, wherein the first and second jaws cooperate to retain the anchor when the latch is in a closed first latch position;

an actuator operably coupled to the latch, wherein movement of the actuator from a first actuator position toward a second actuator position rotates the

latch away from the closed first latch position toward a second latch position about a first pivot point, and wherein continued movement of the actuator from the second actuator position toward a third actuator position rotates the latch from the second latch position toward an open third latch position about a second pivot point spaced apart from the first pivot point;

an anchor ejector movably coupled to the frame proximate the latch; and

a biasing member operably coupled between the latch and the ejector, wherein movement of the latch from the second latch position toward the open third latch position drives the biasing member against the ejector, causing the ejector to move outwardly relative to the frame from a first ejector position toward a second ejector position, and wherein the latch remains in the open third latch position when the ejector is in the second ejector position.

22. The latch assembly of claim 21 wherein the actuator includes a flexible strap having a distal end portion fixedly attached to the latch and a proximal end portion configured to be manipulated by a user to release the latch assembly from the anchor.

23. The latch assembly of claim 21 wherein the biasing member is a first biasing member, and wherein the latch assembly further comprises a second biasing member operably coupled between the frame and the latch and biasing the latch toward the open third latch position.

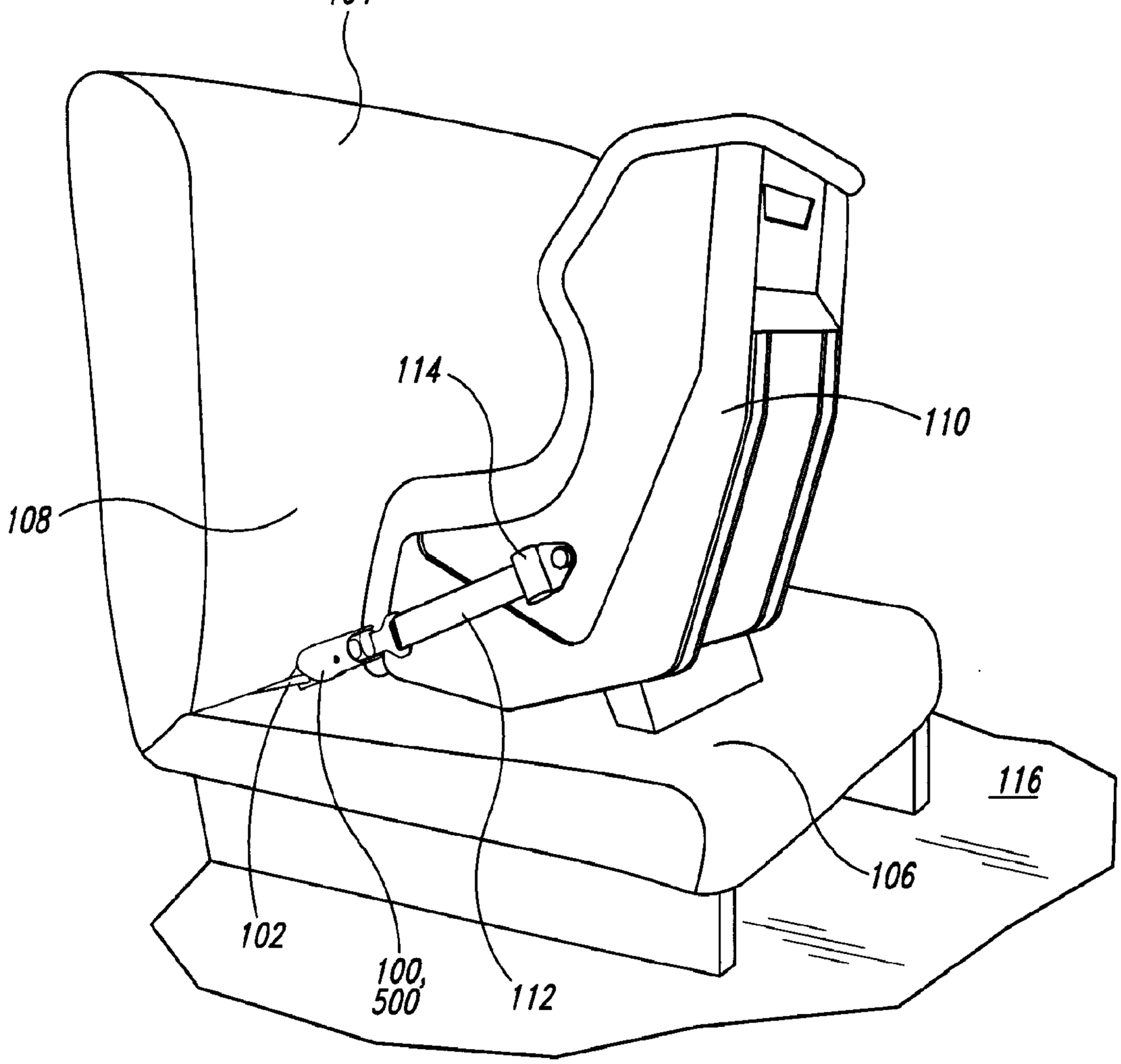

Fig. 1

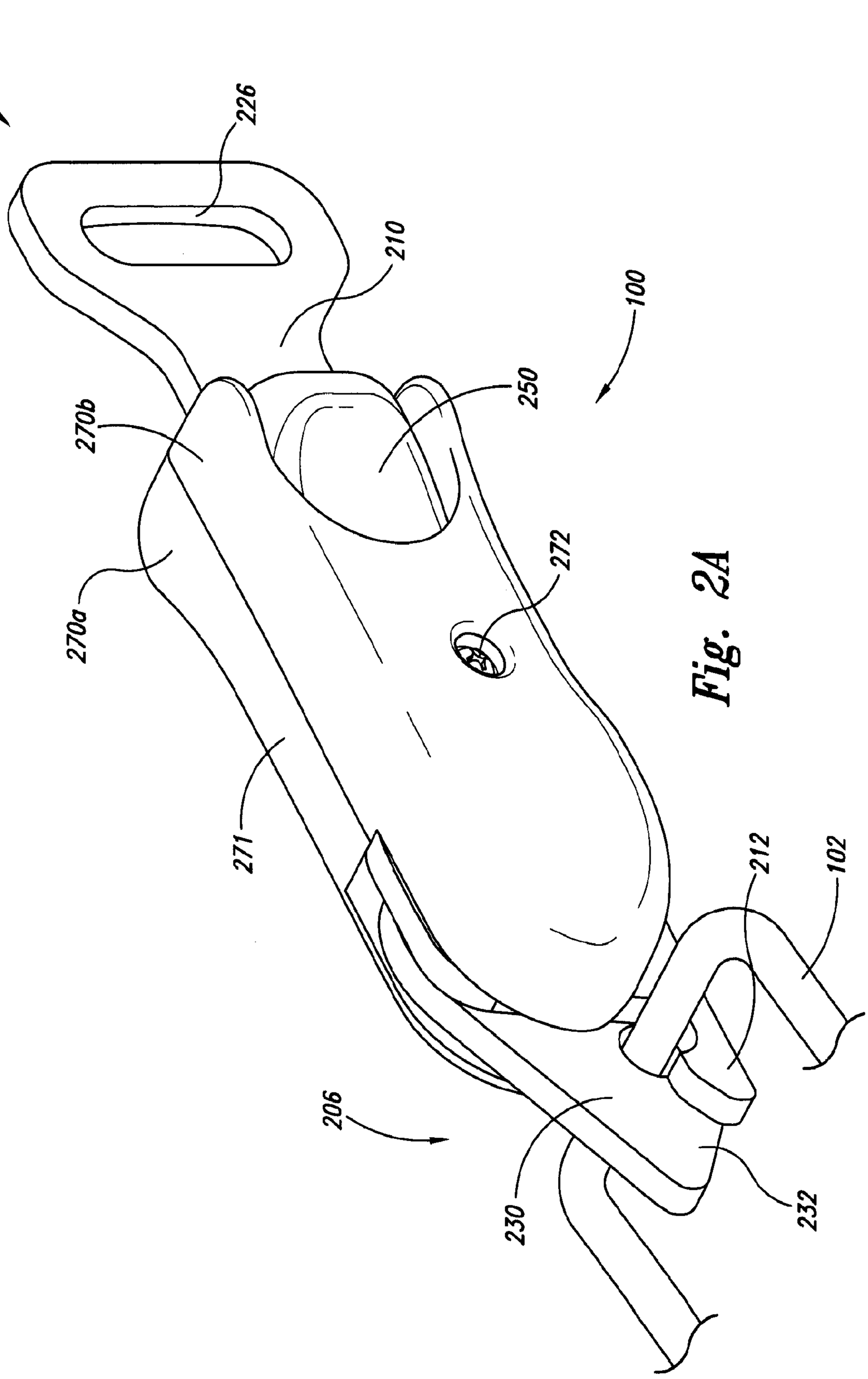

Fig. 2A

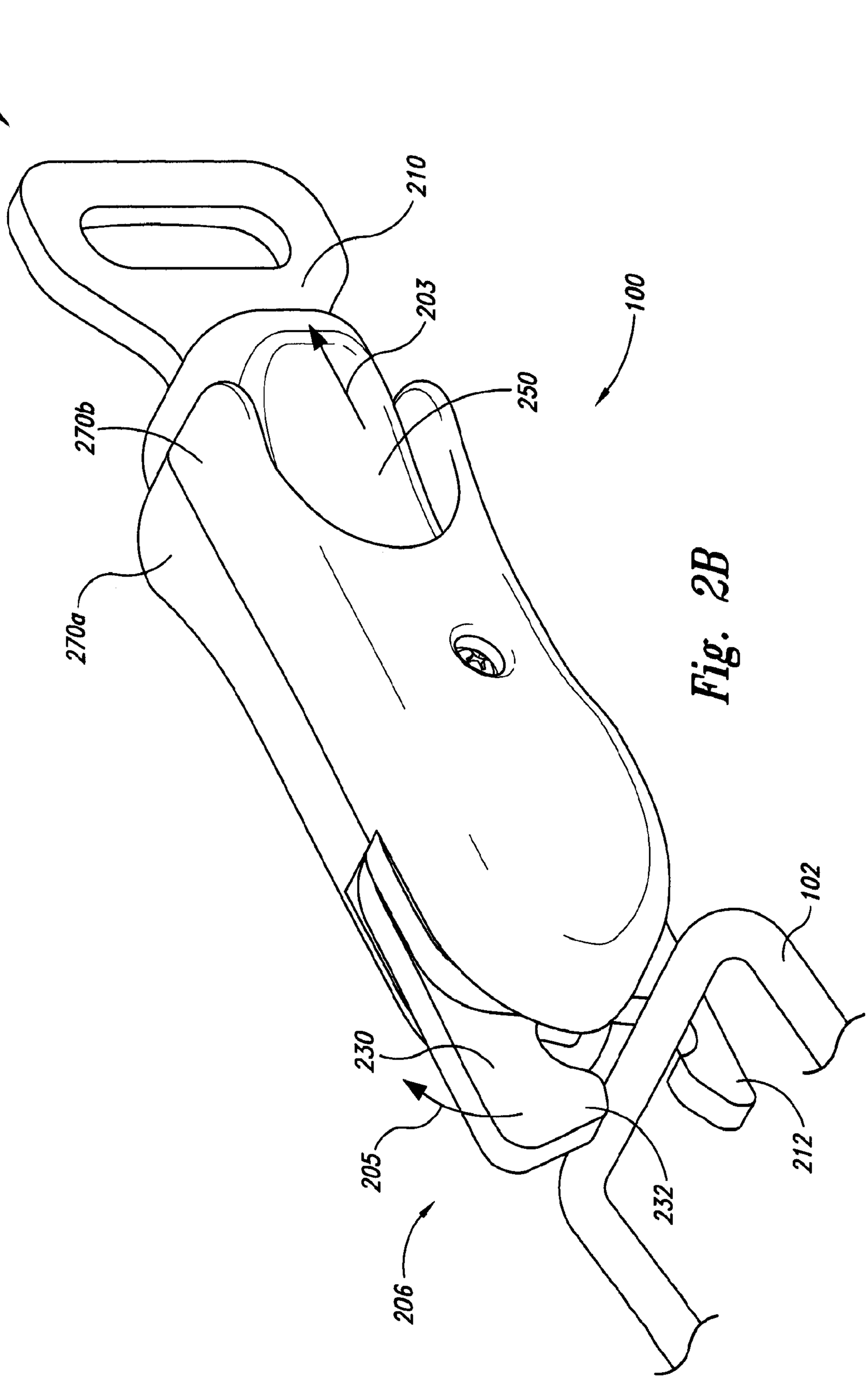

Fig. 2B

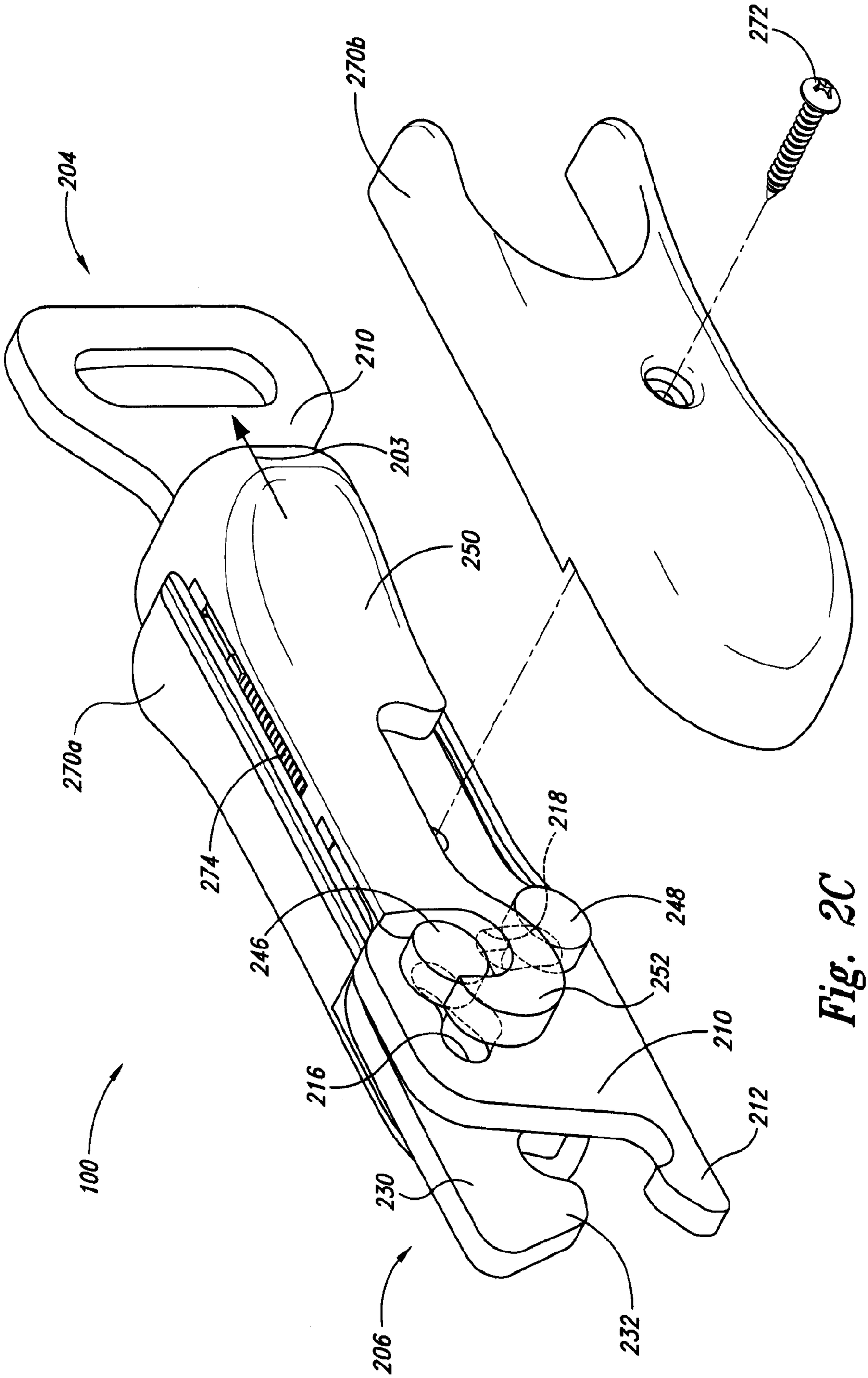
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Fig. 2C

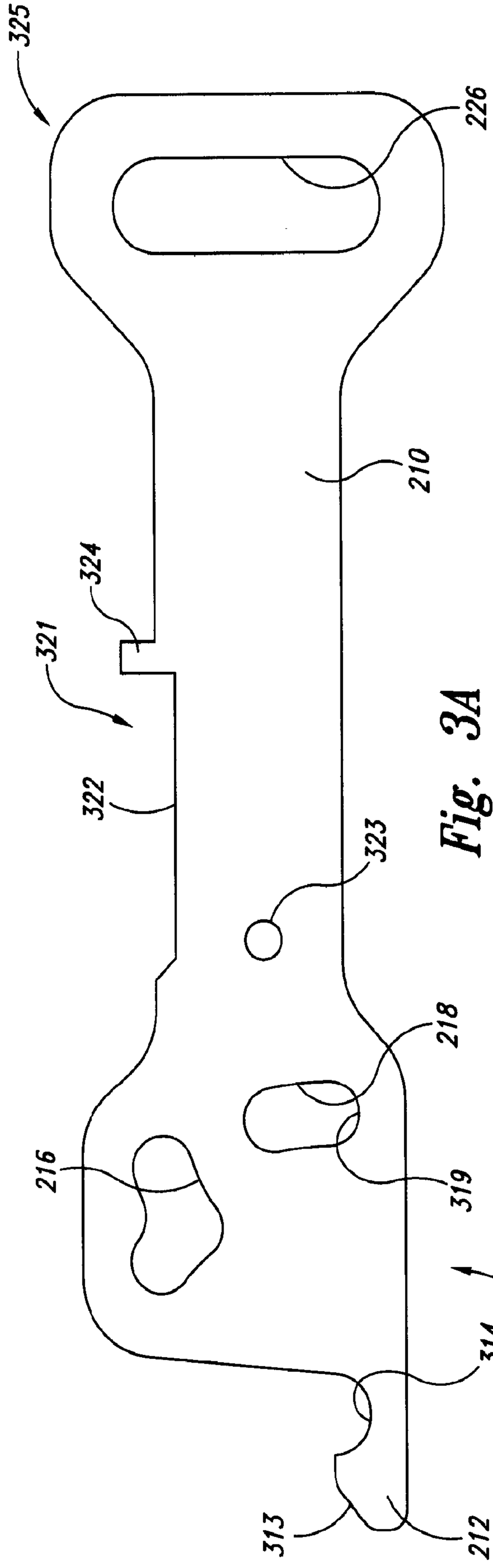

Fig. 3A

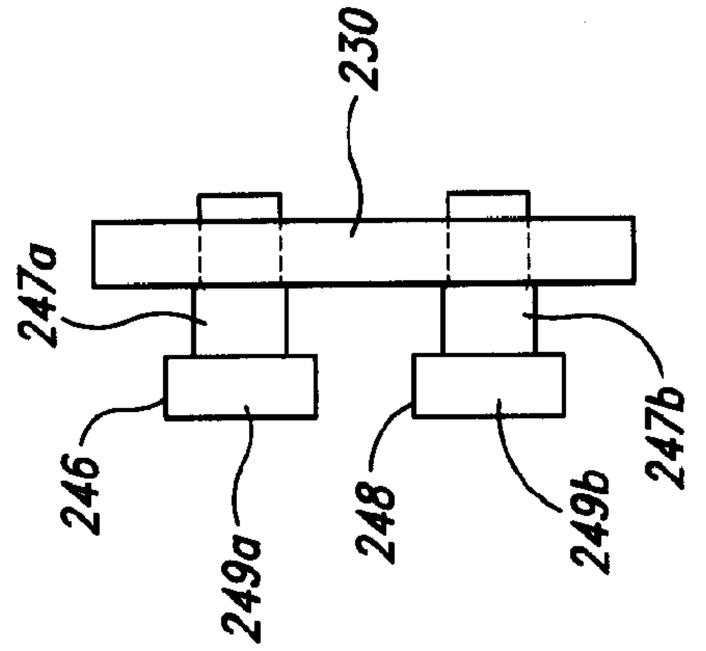

Fig. 3C

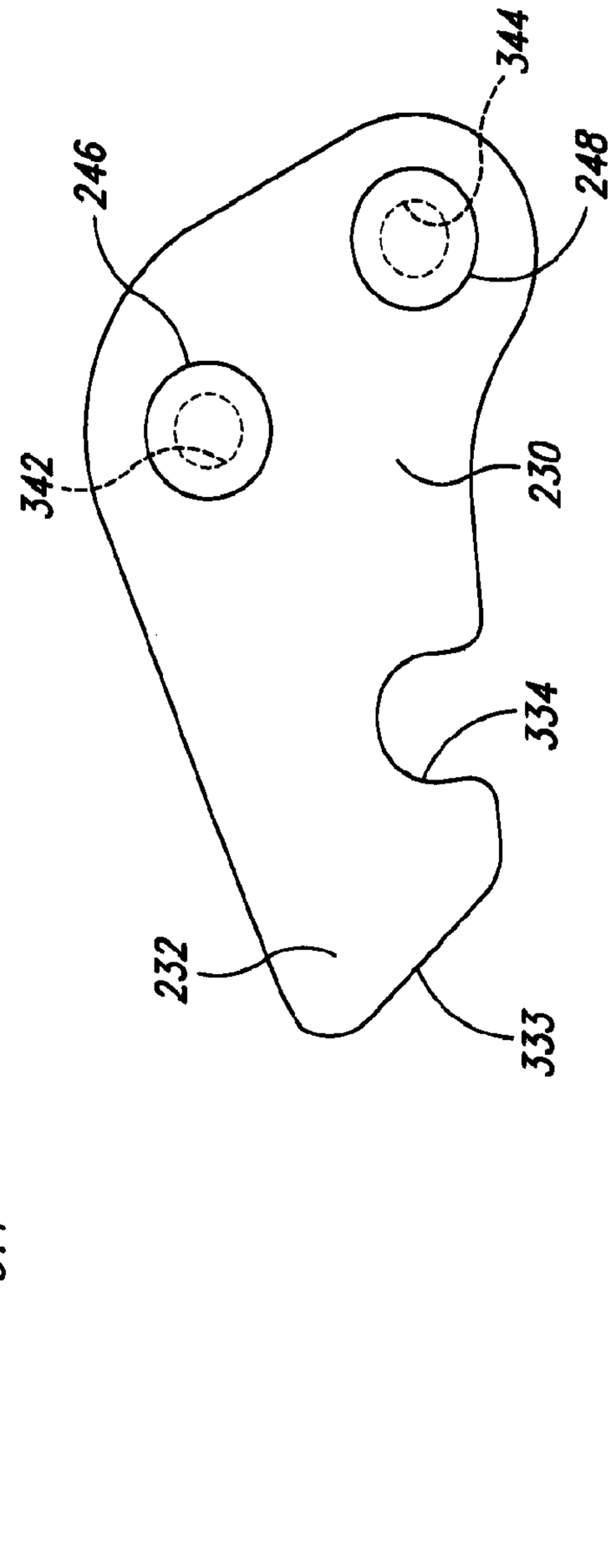

Fig. 3B

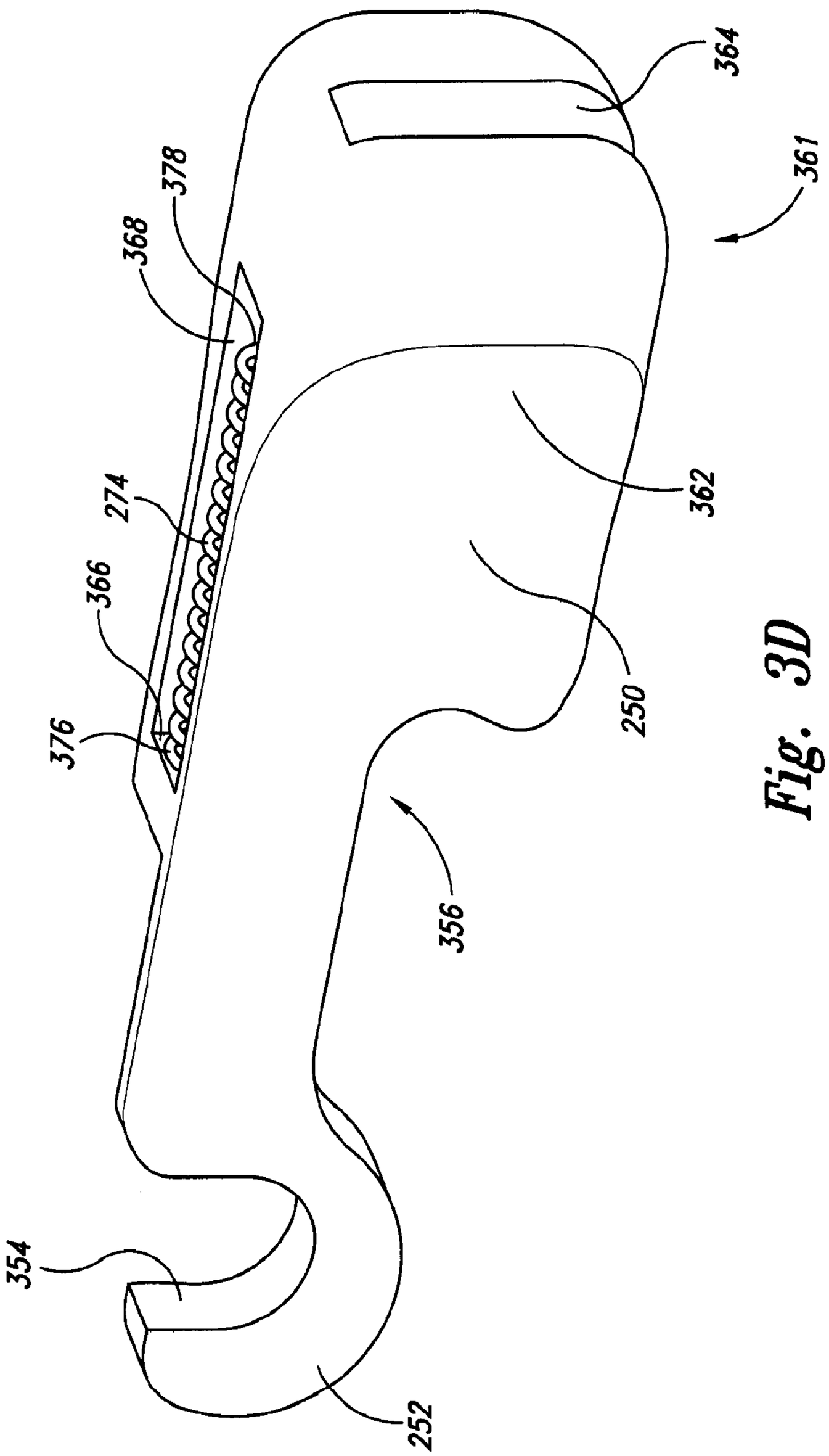

Fig. 3D

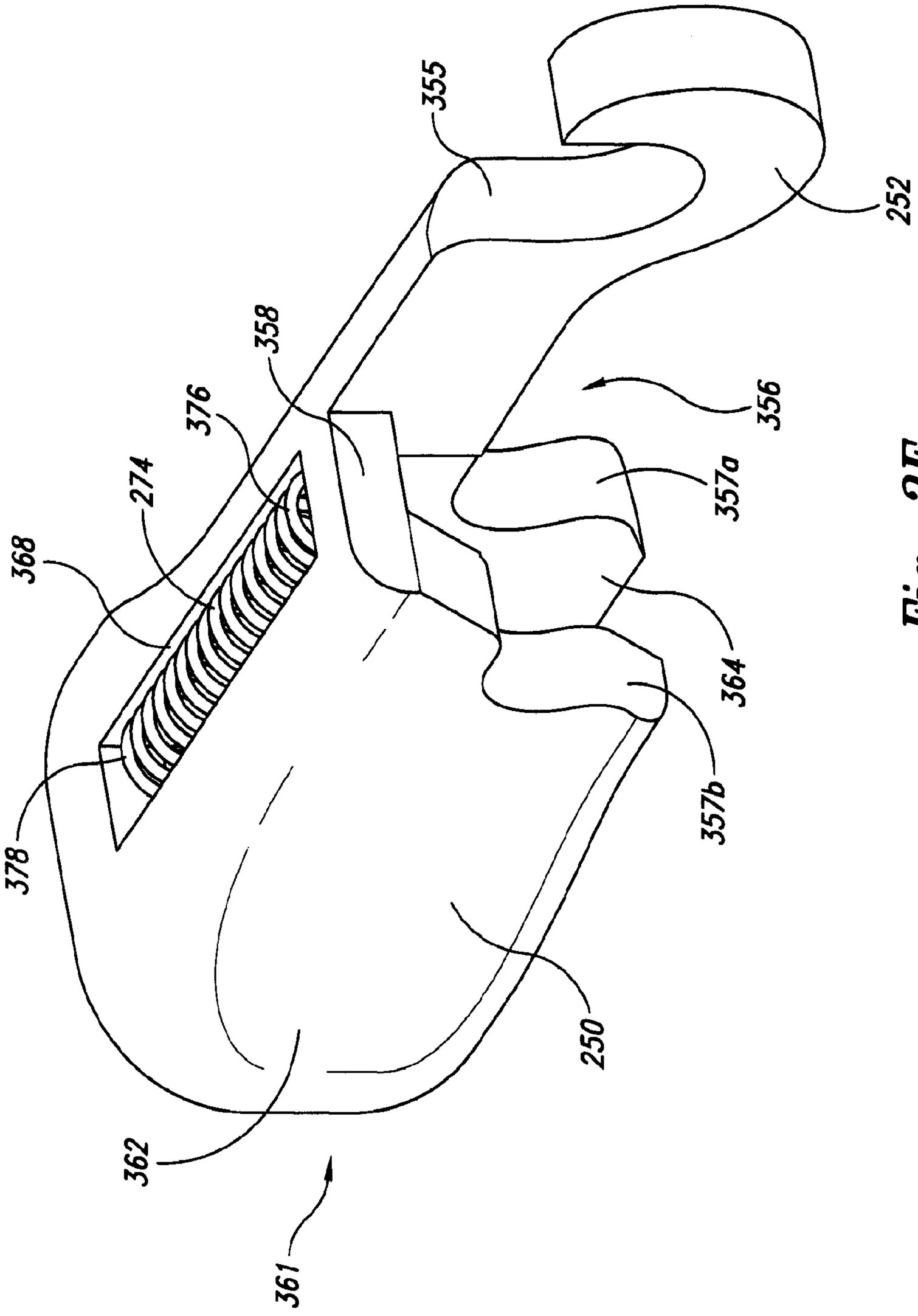

Fig. 3E

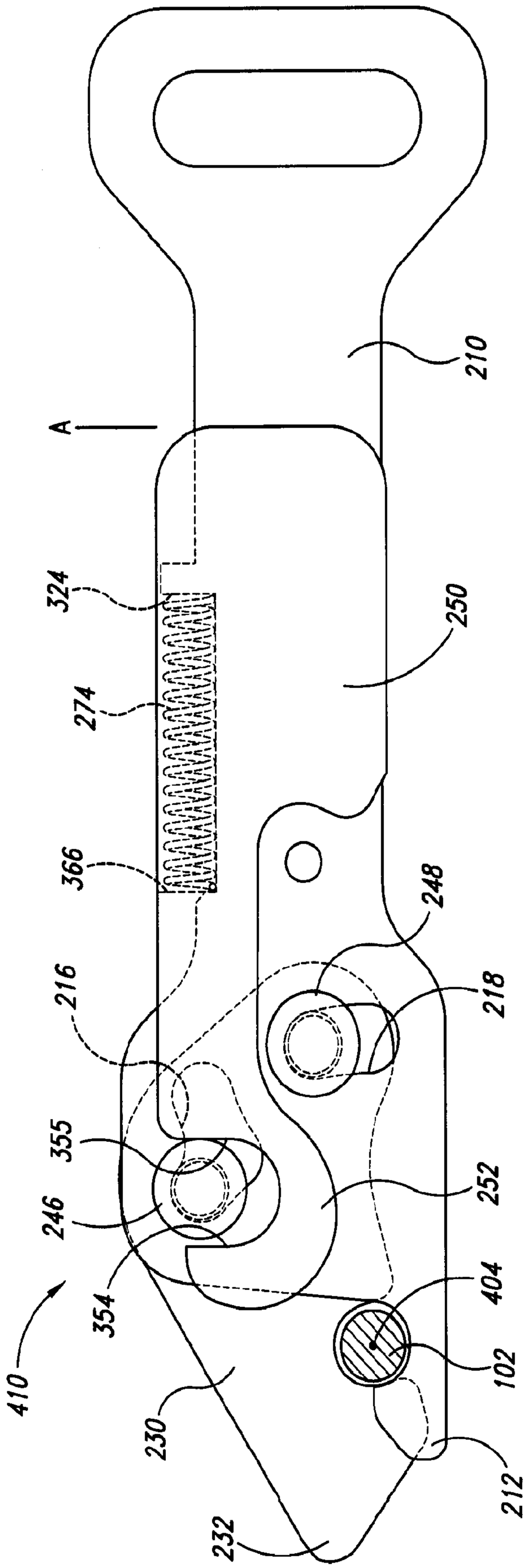
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Fig. 4A

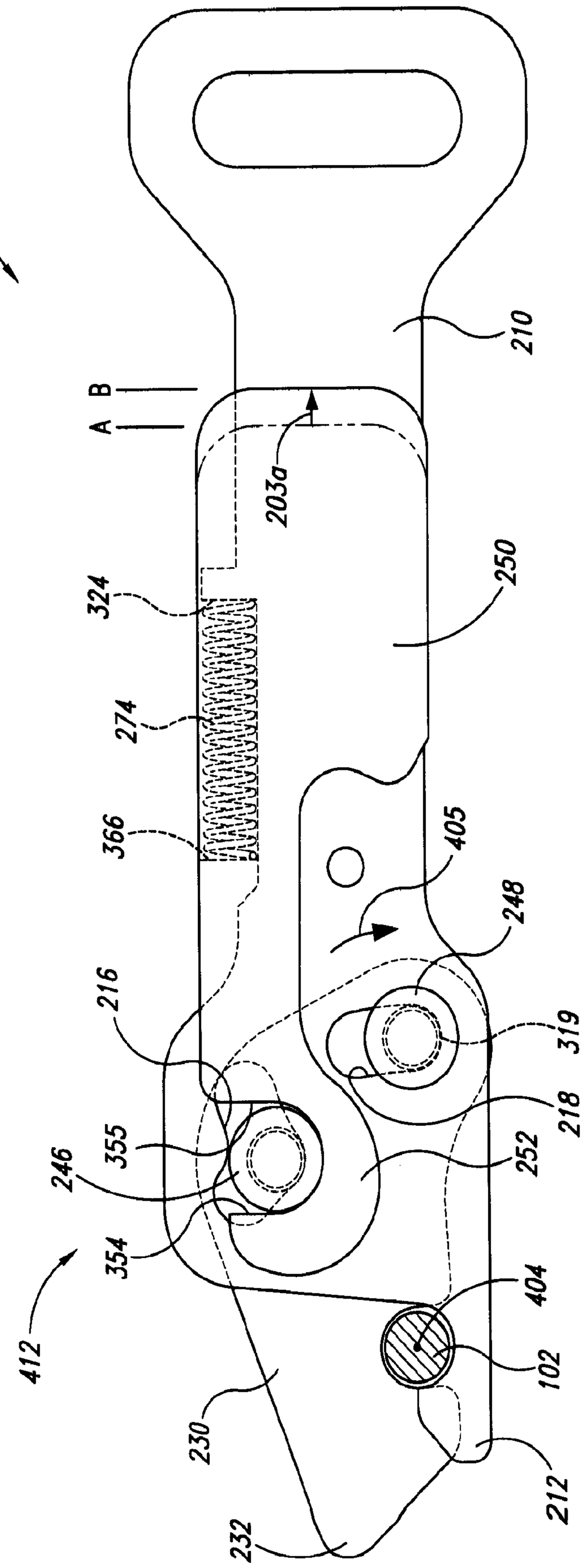
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Fig. 4B

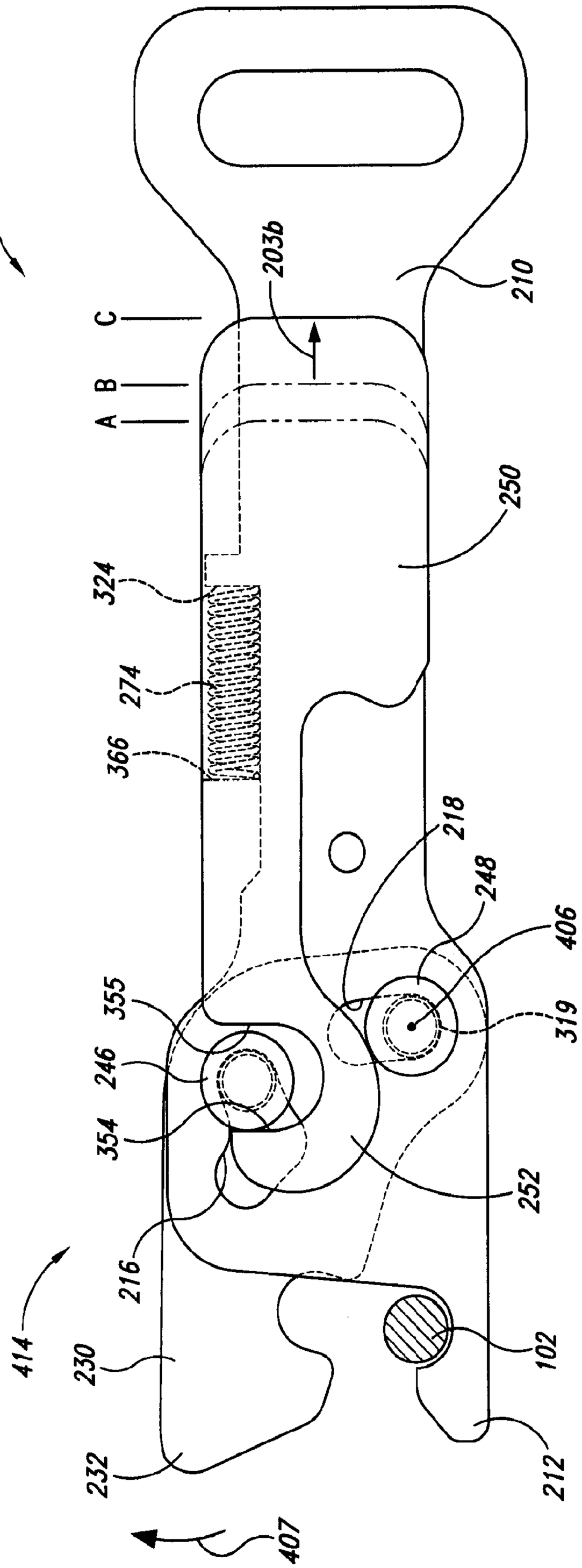
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Fig. 4C

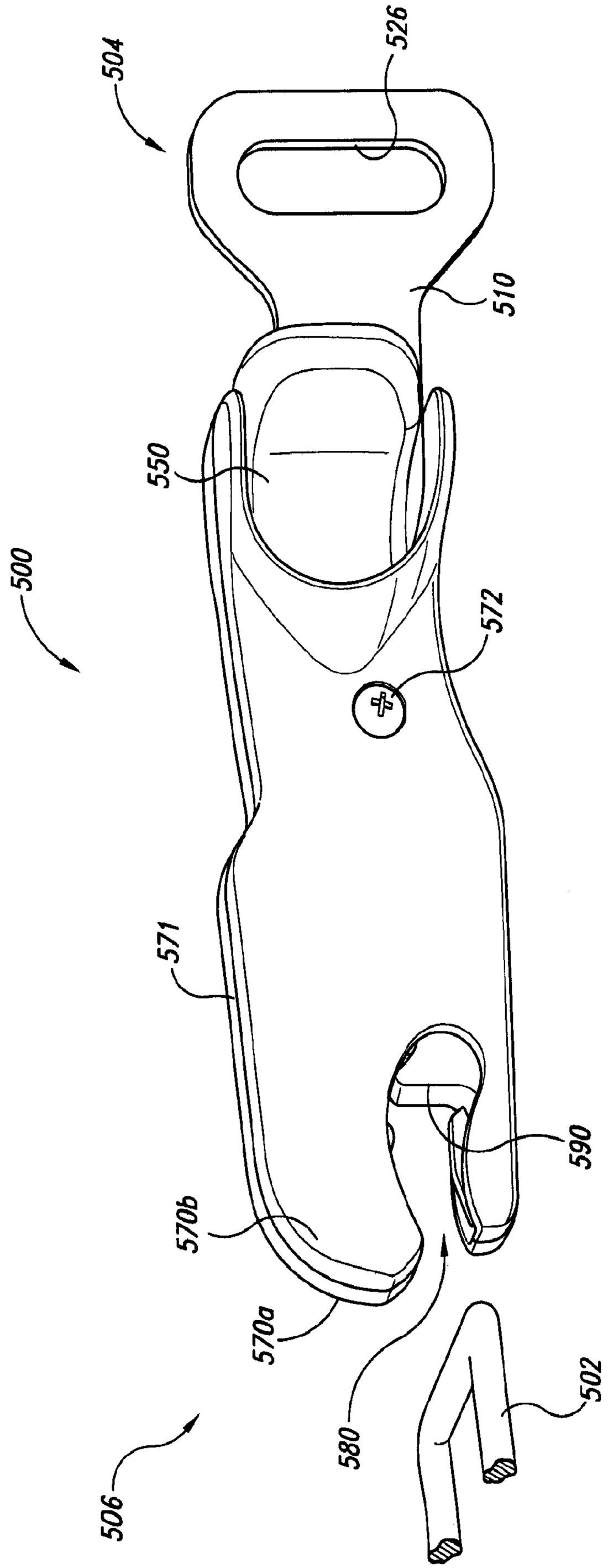

Fig. 5A

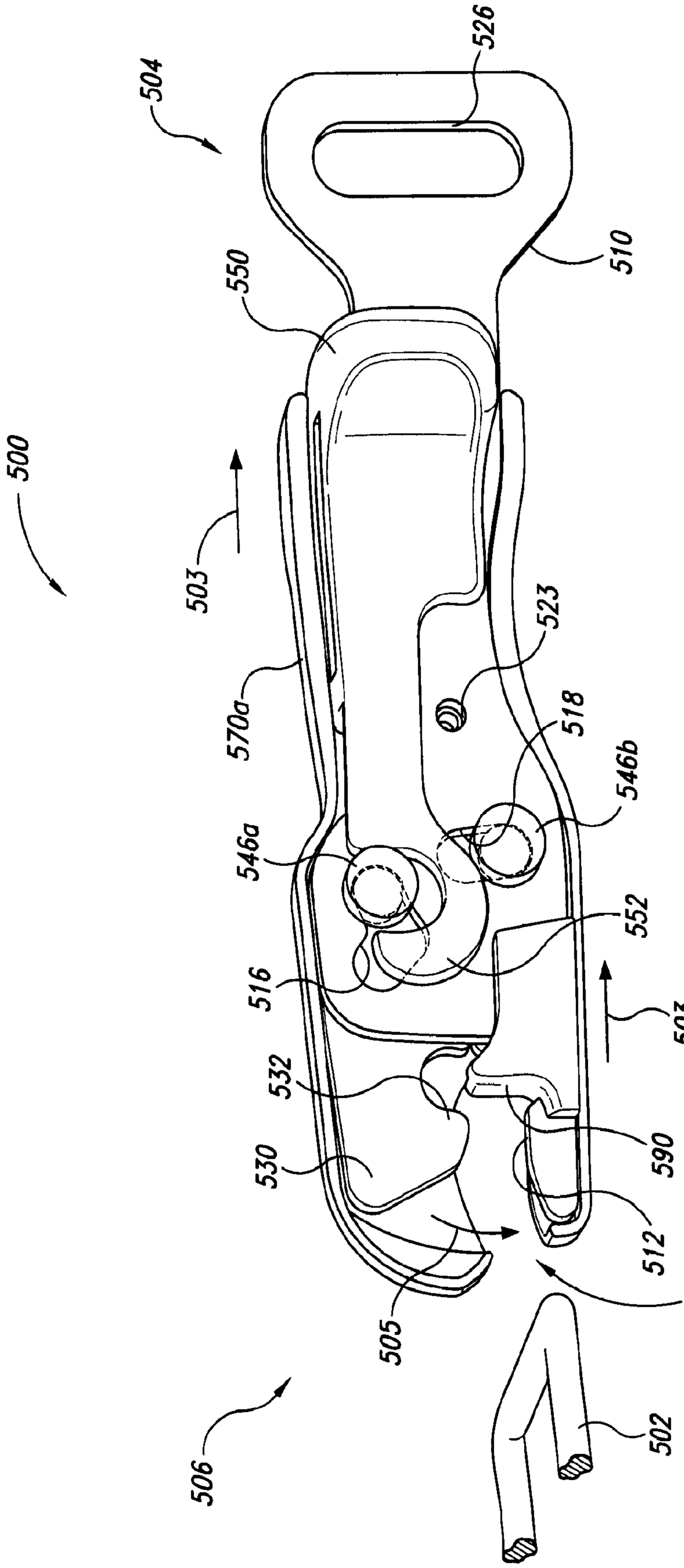
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Fig. 5B

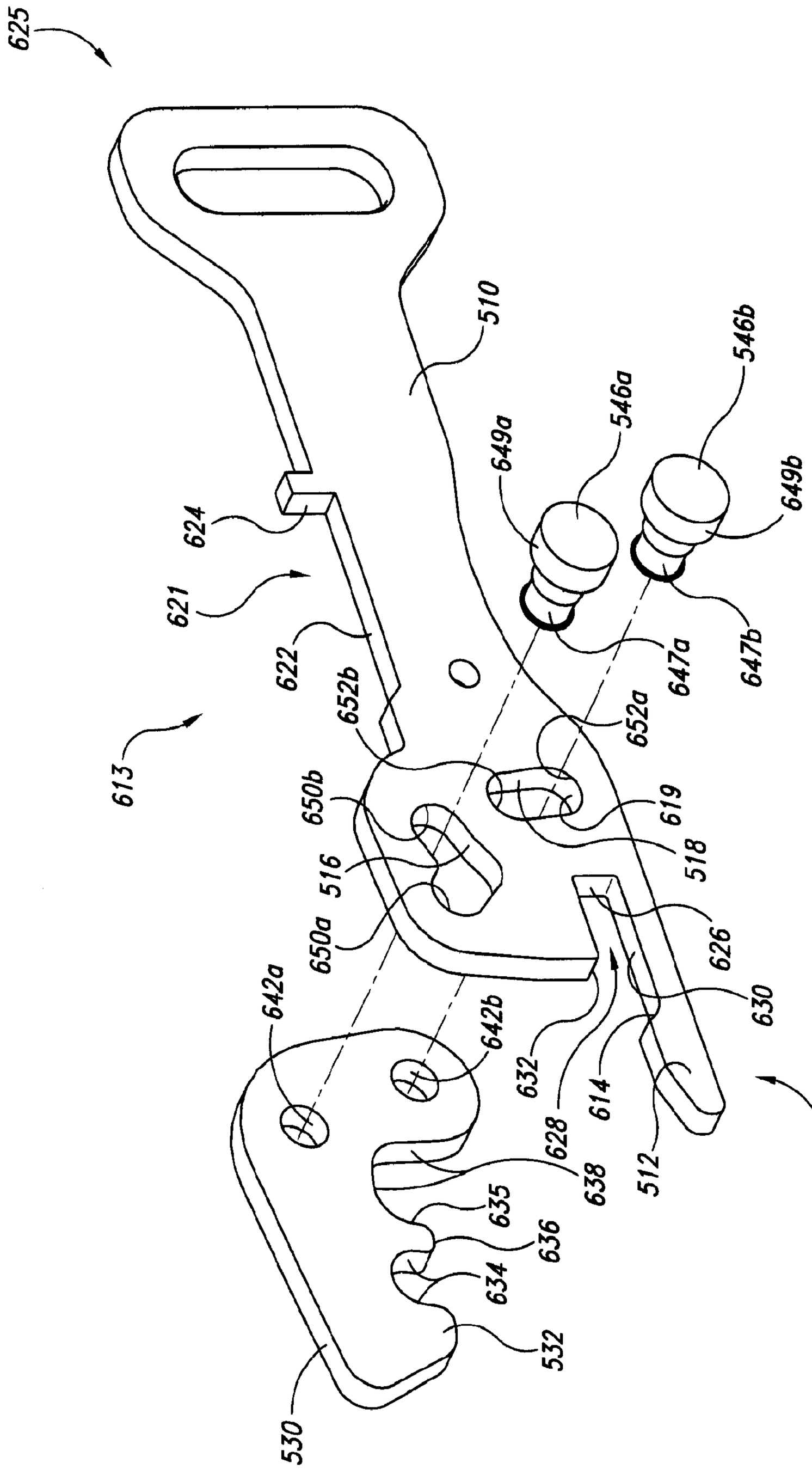
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Fig. 6

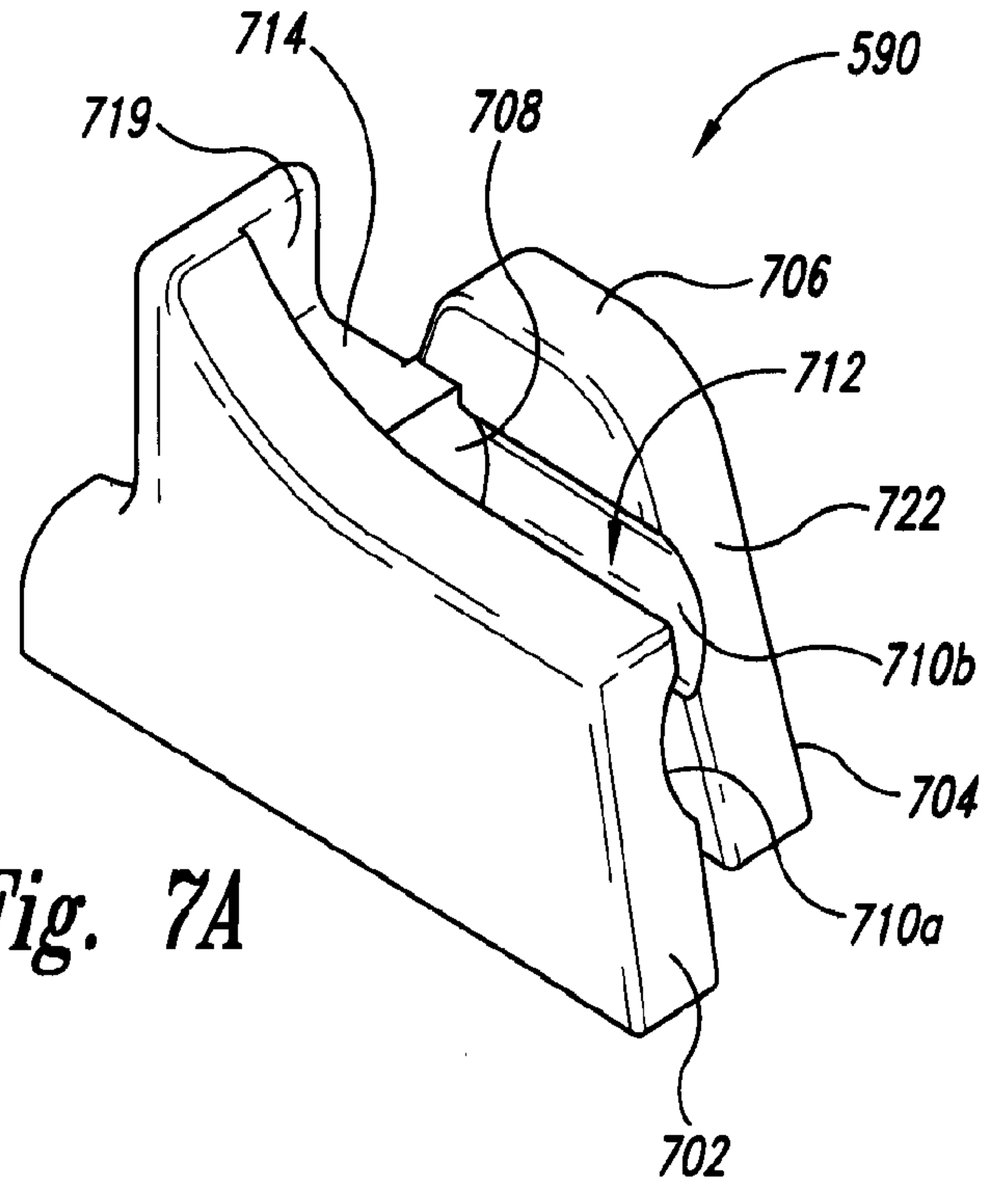

Fig. 7A

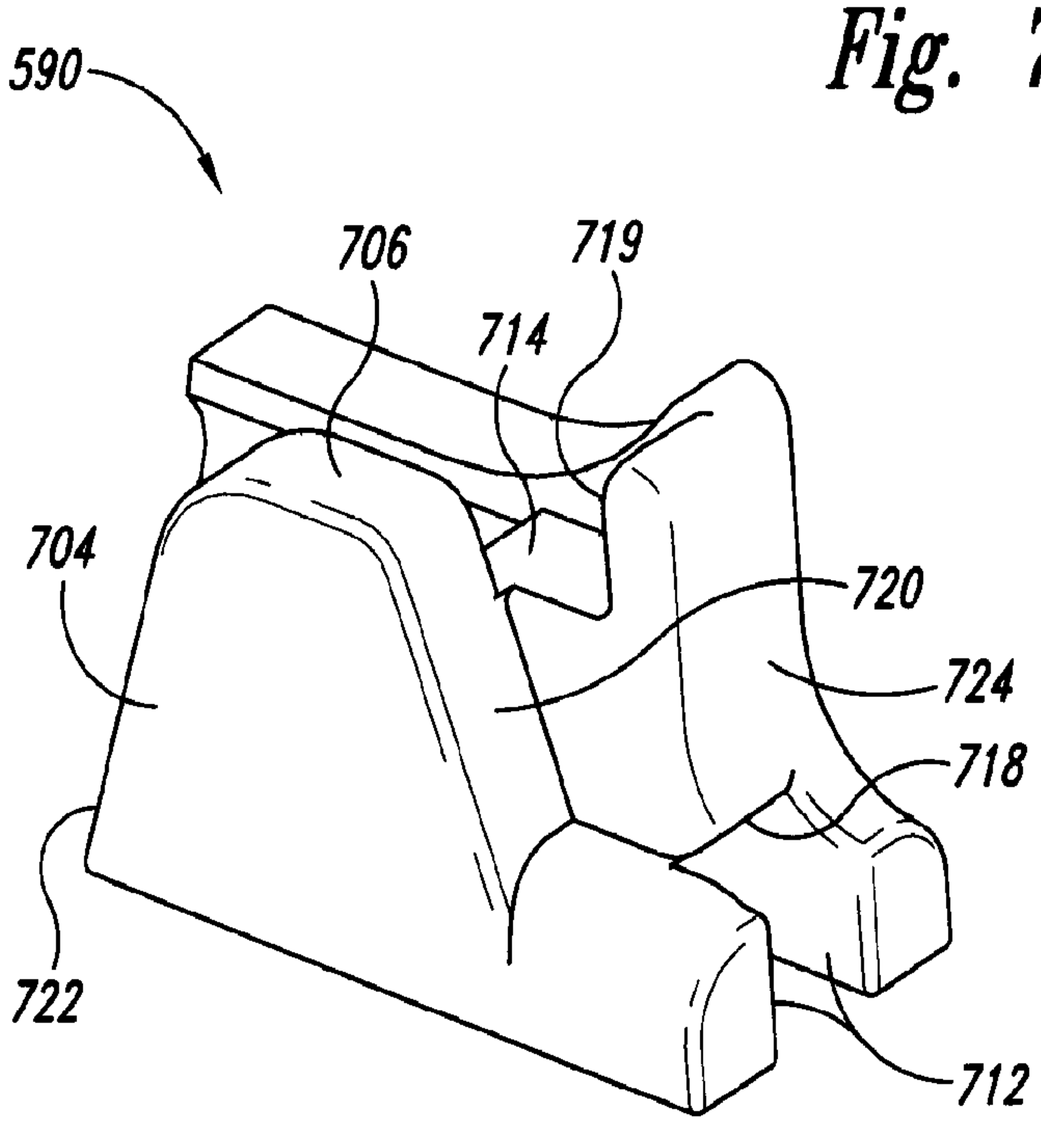

Fig. 7B

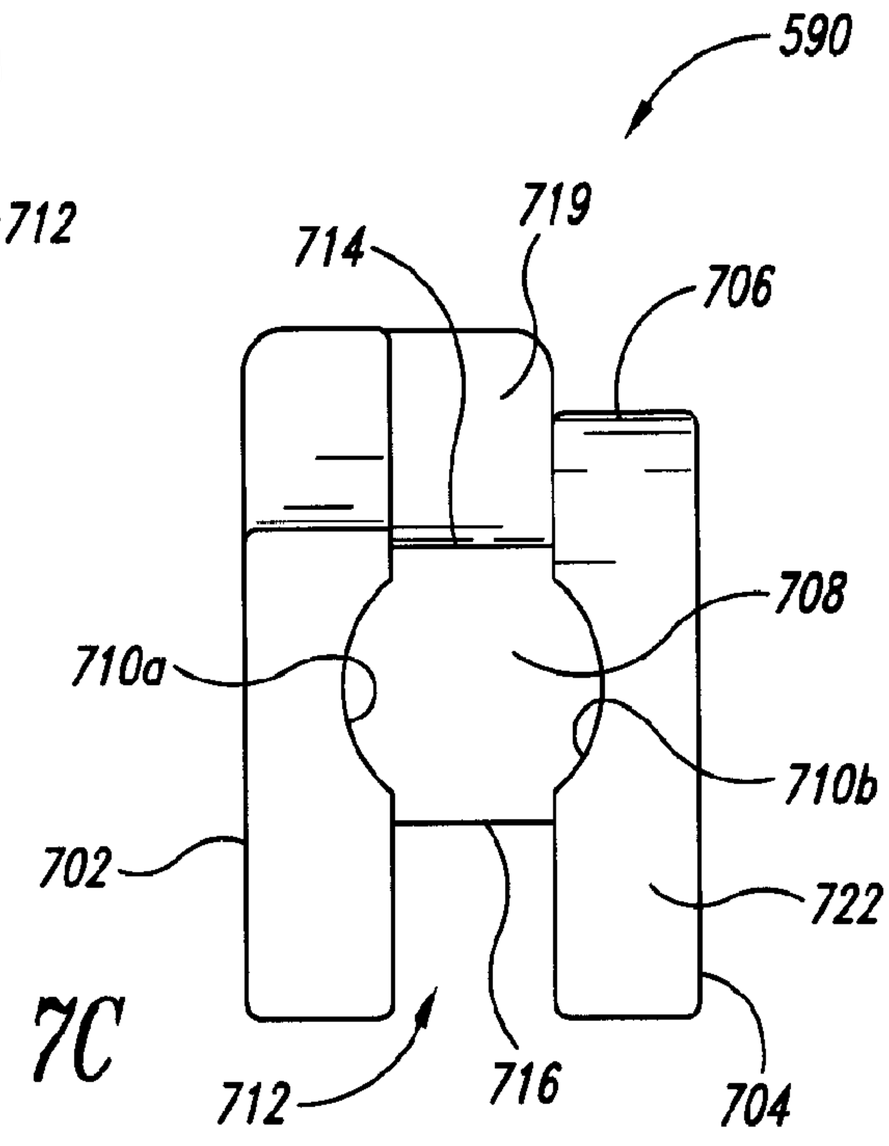

Fig. 7C

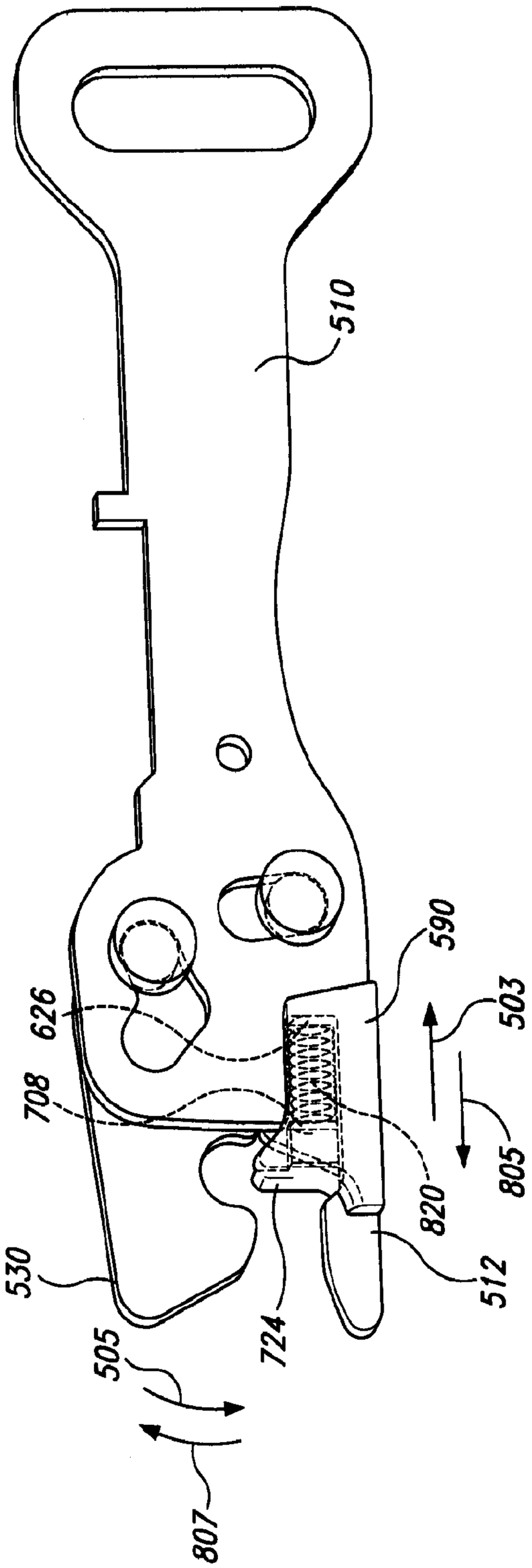

Fig. 8

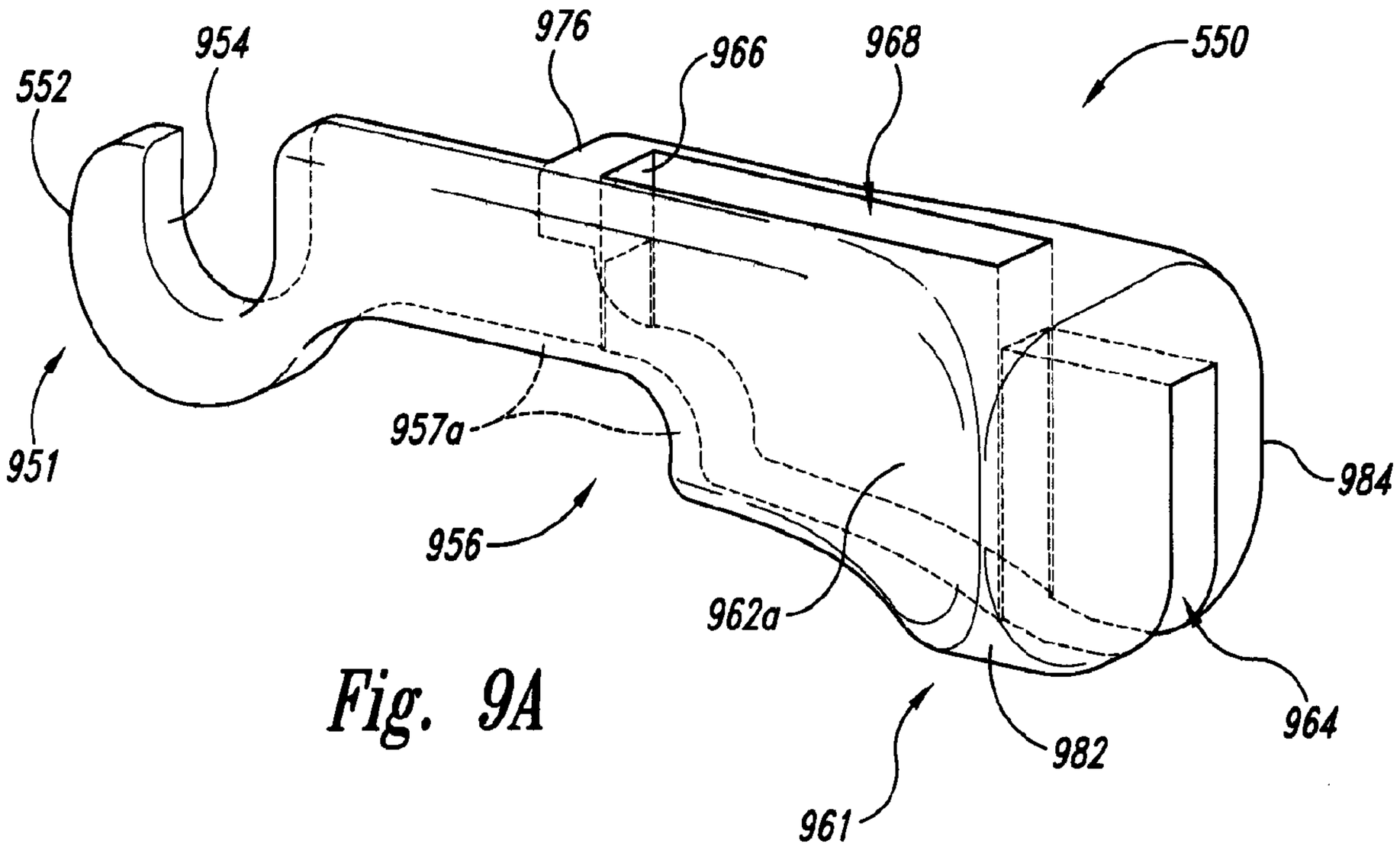
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Fig. 9A

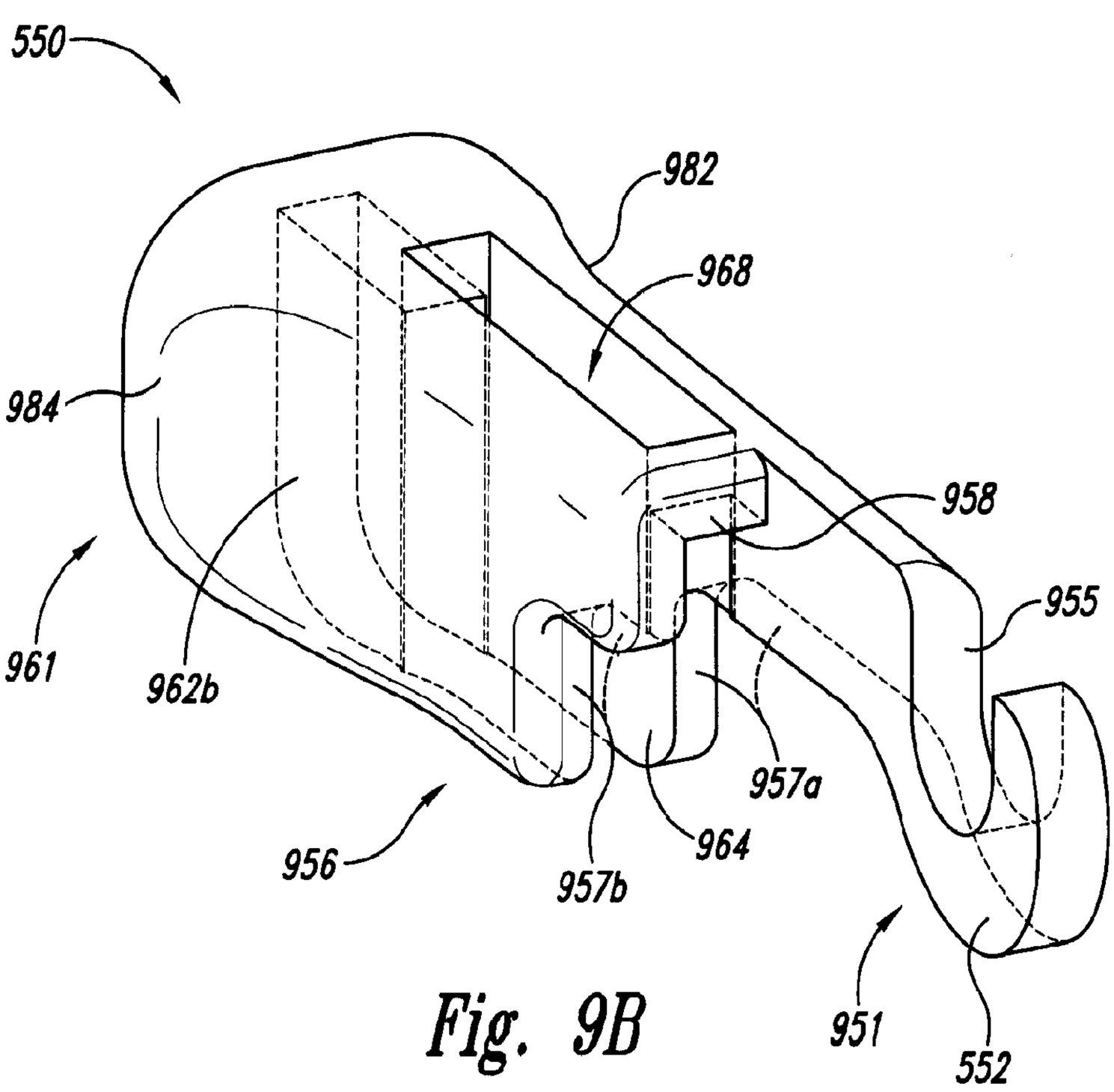
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Fig. 9B

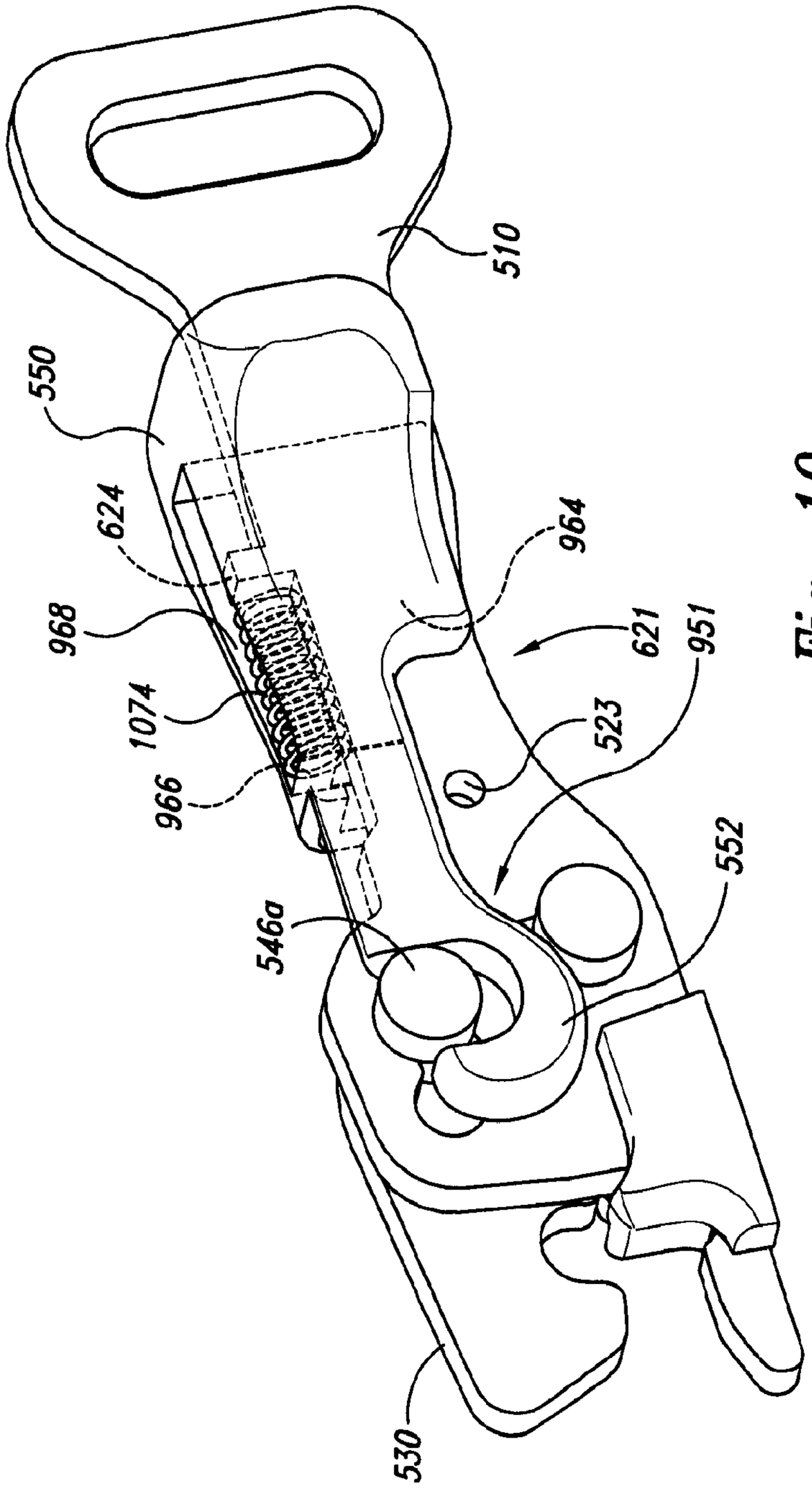

Fig. 10

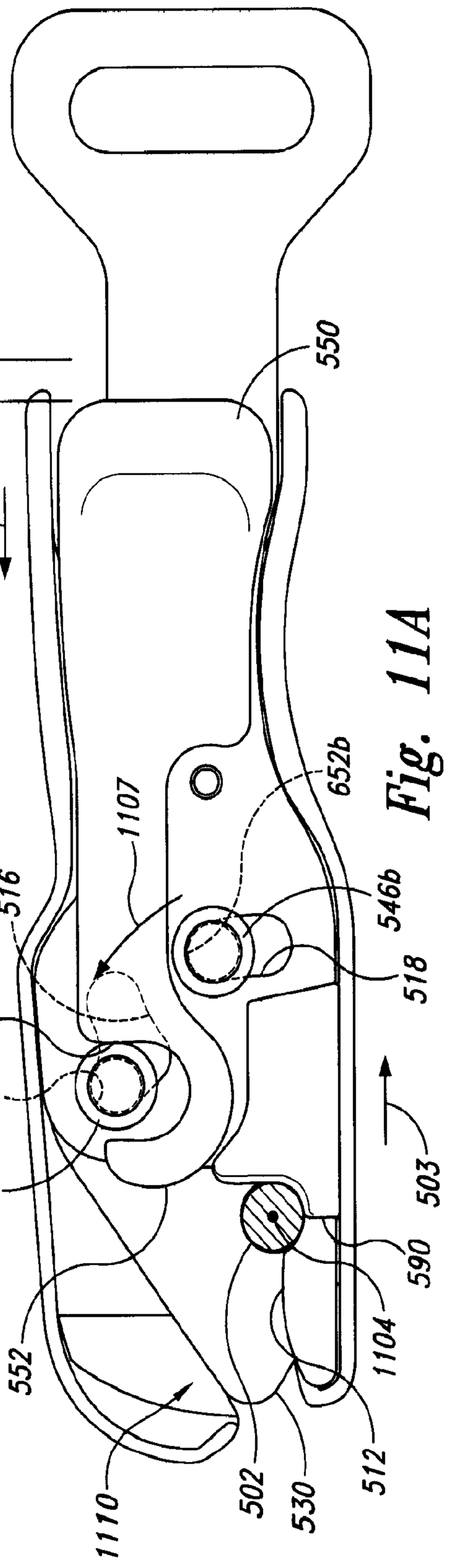

Fig. 11A

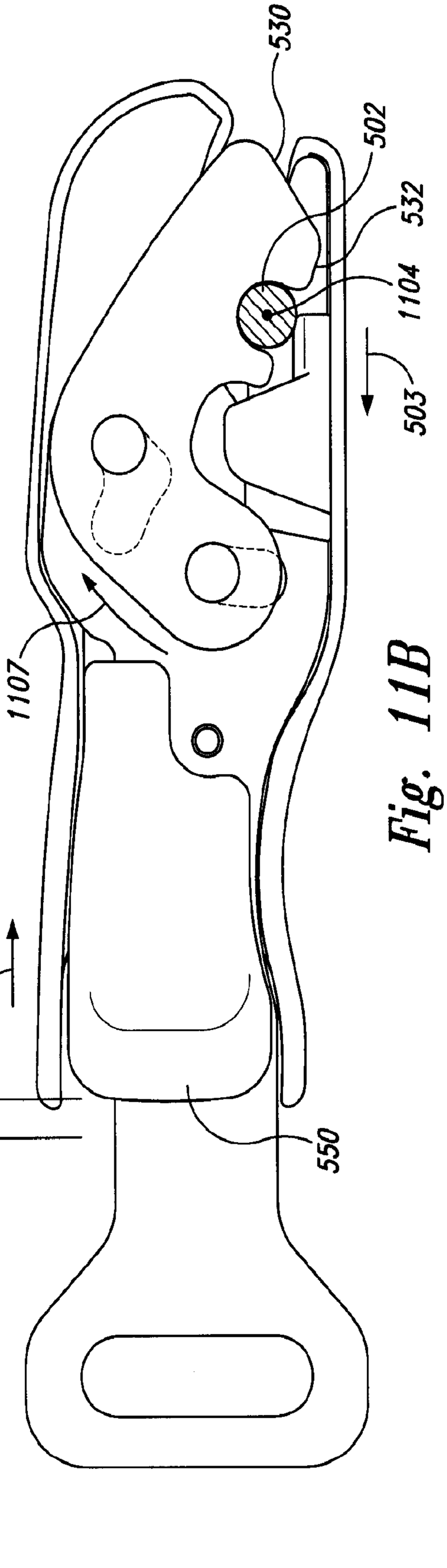

Fig. 11B

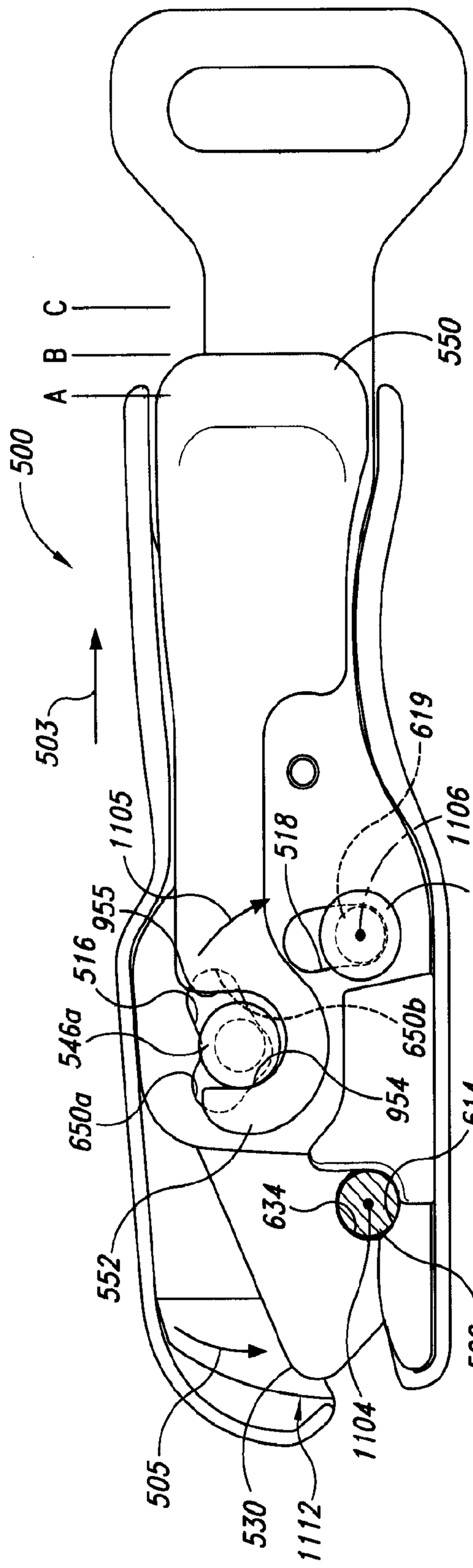

Fig. 11C

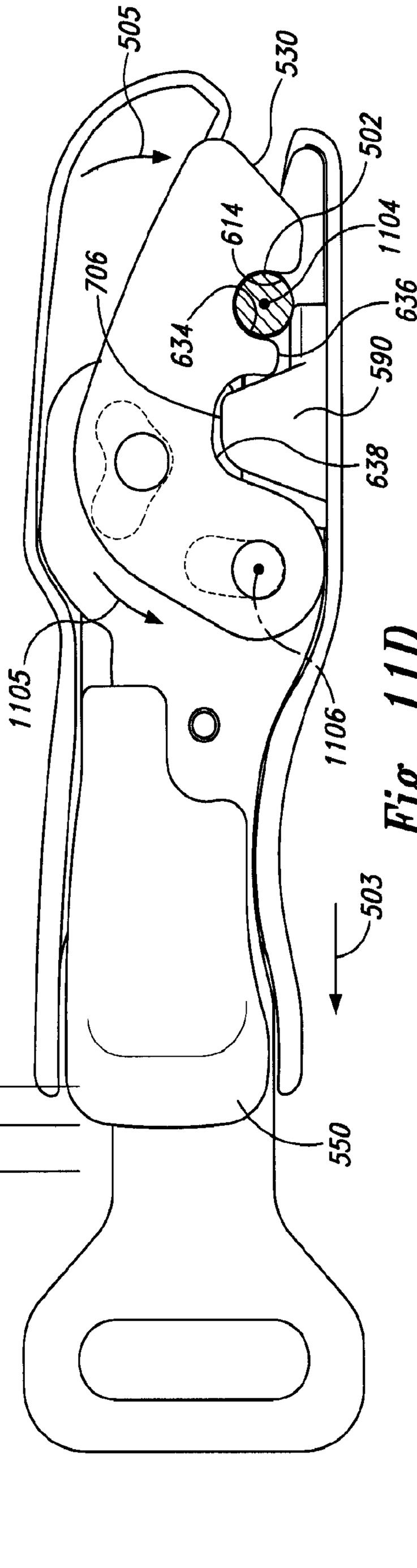

Fig. 11D

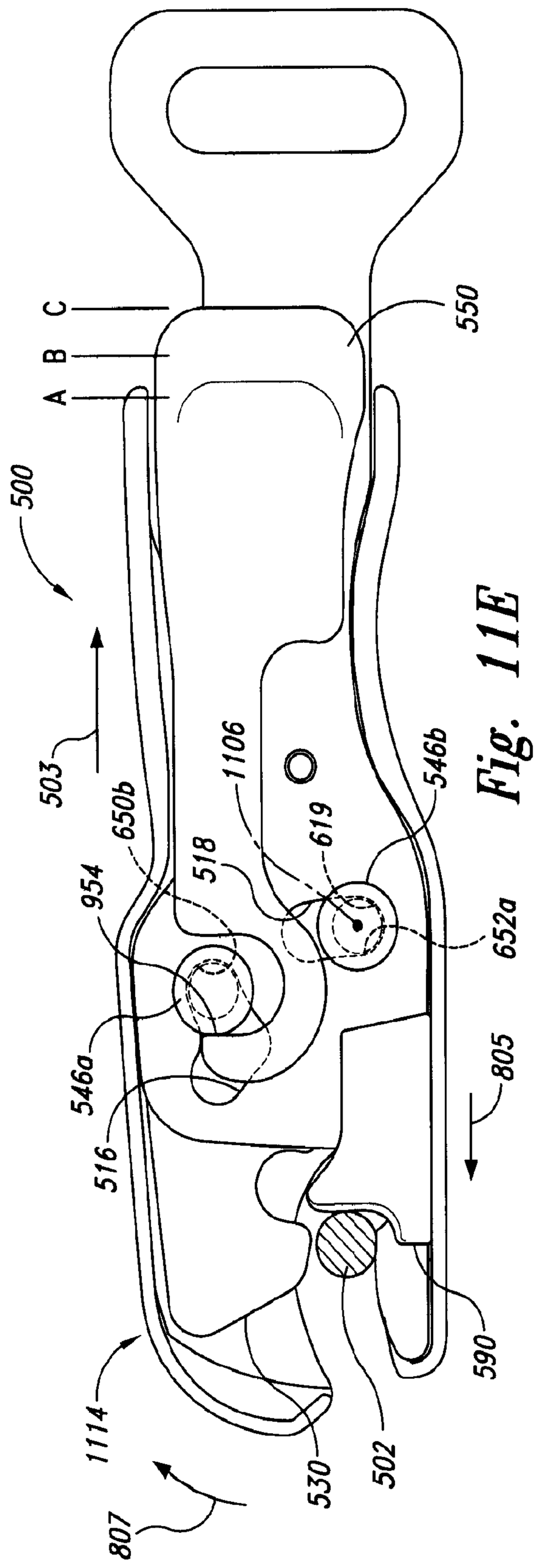

Fig. 11E

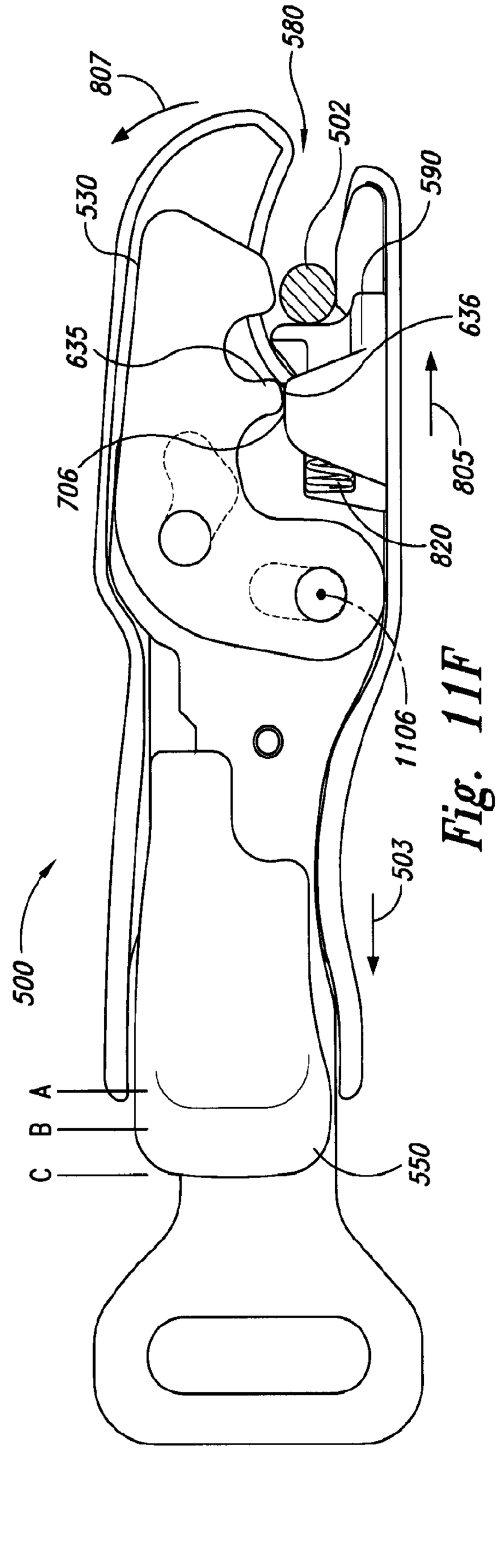

Fig. 11F

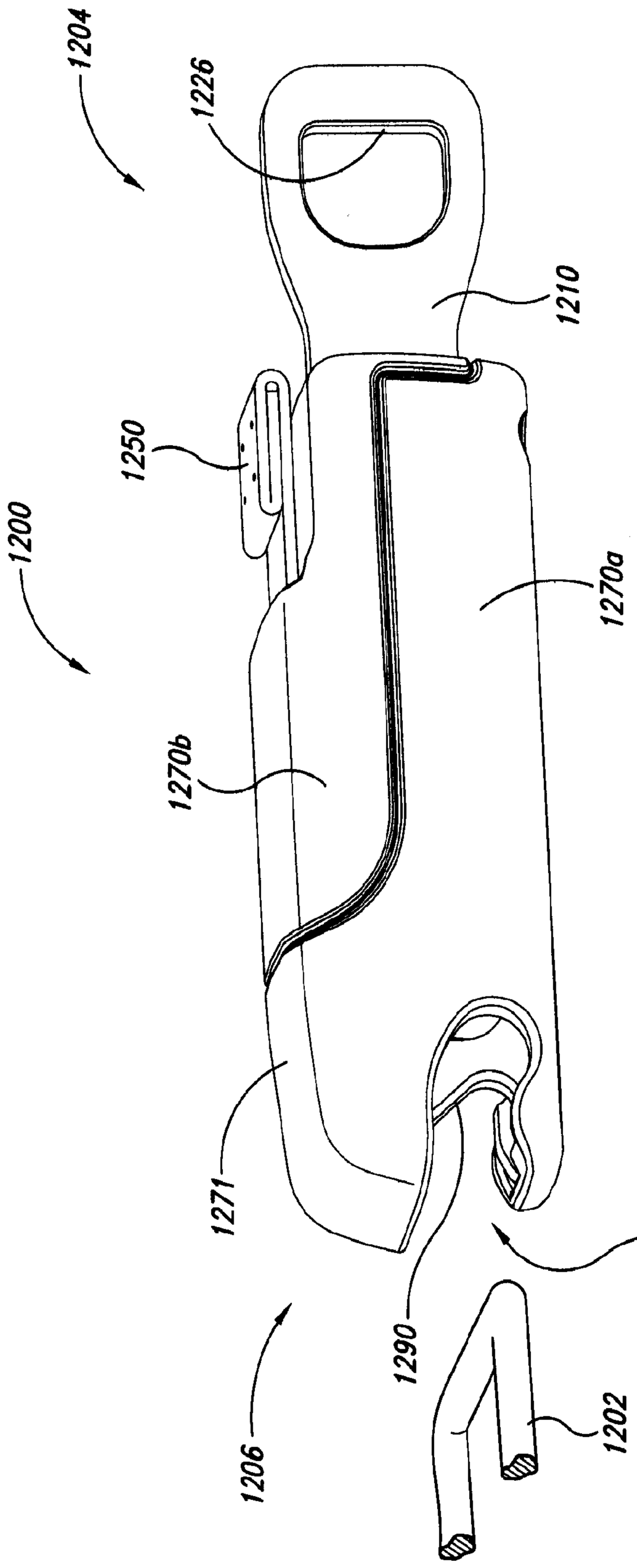
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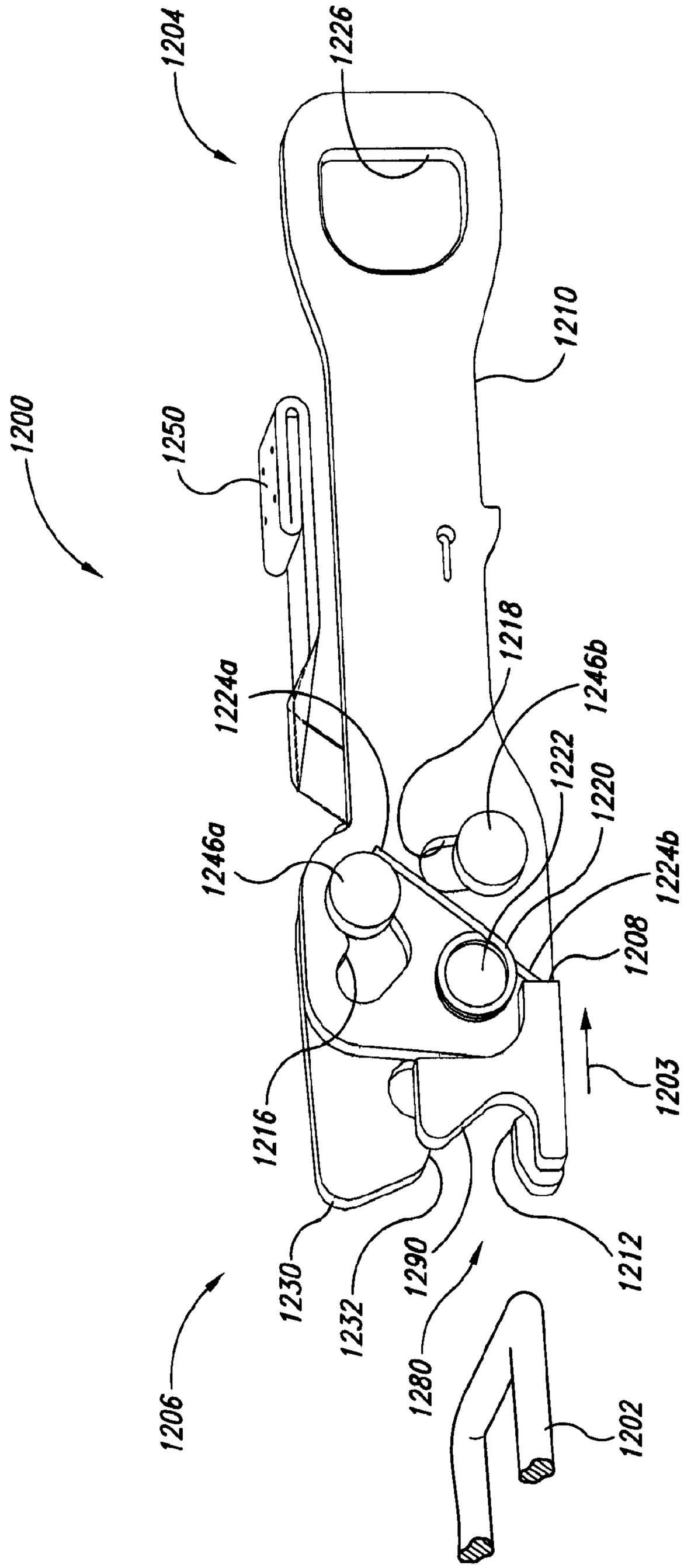
Fig. 12A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1246b
1222
1220
1246a
1224b
1208
1216
1203
1230
1232
1290
1212
1206
1280
1202

Fig. 12B

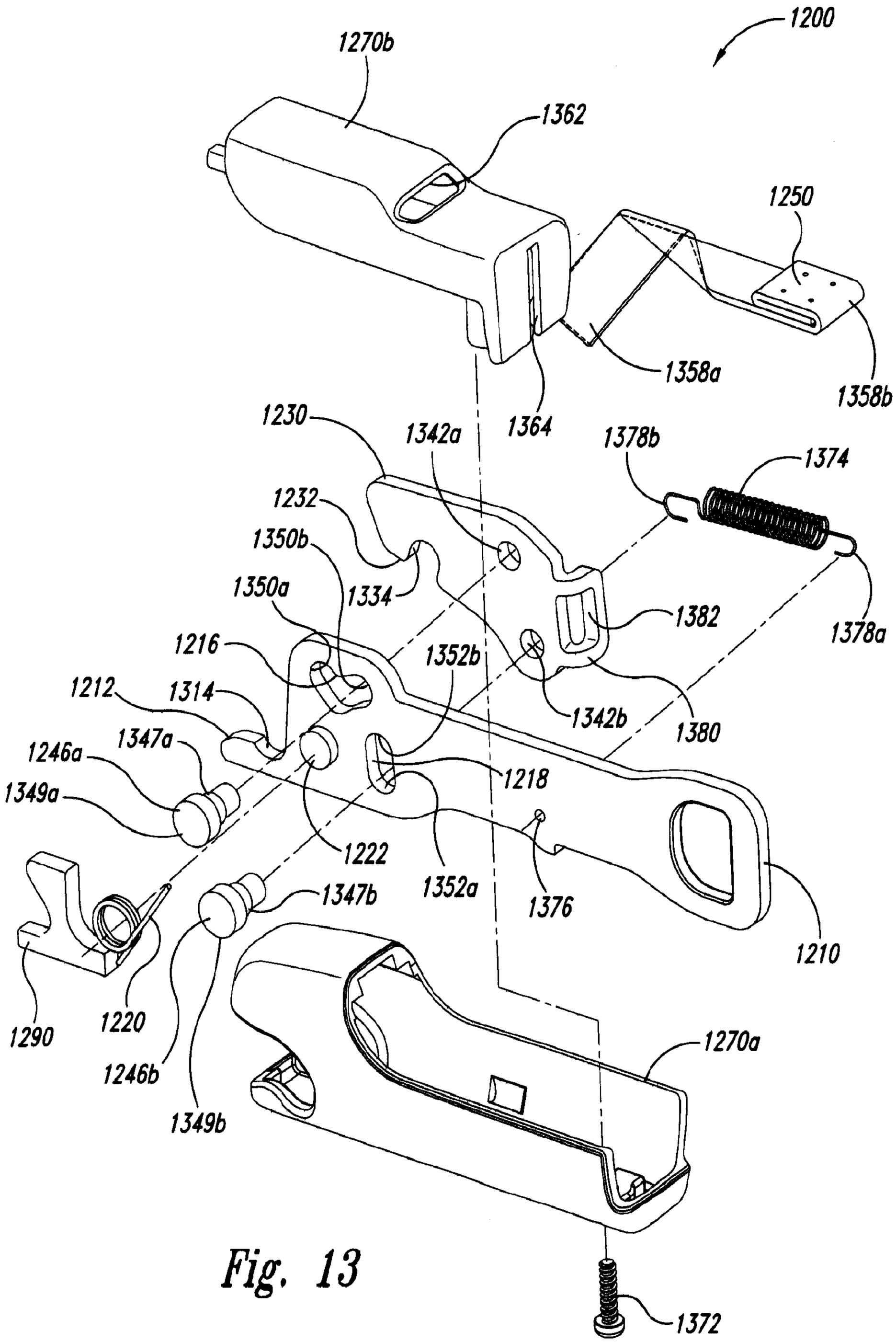

1200
1270b
1362
1250
1358a
1358b
1364
1230
1342a
1378b
1374
1232
1350b
1350a
1334
1382
1378a
1216
1352b
1212
1314
1342b
1380
1347a
1246a
1218
1349a
1222
1352a
1376
1347b
1210
1290
1220
1246b
1270a
1349b
1372

Fig. 13

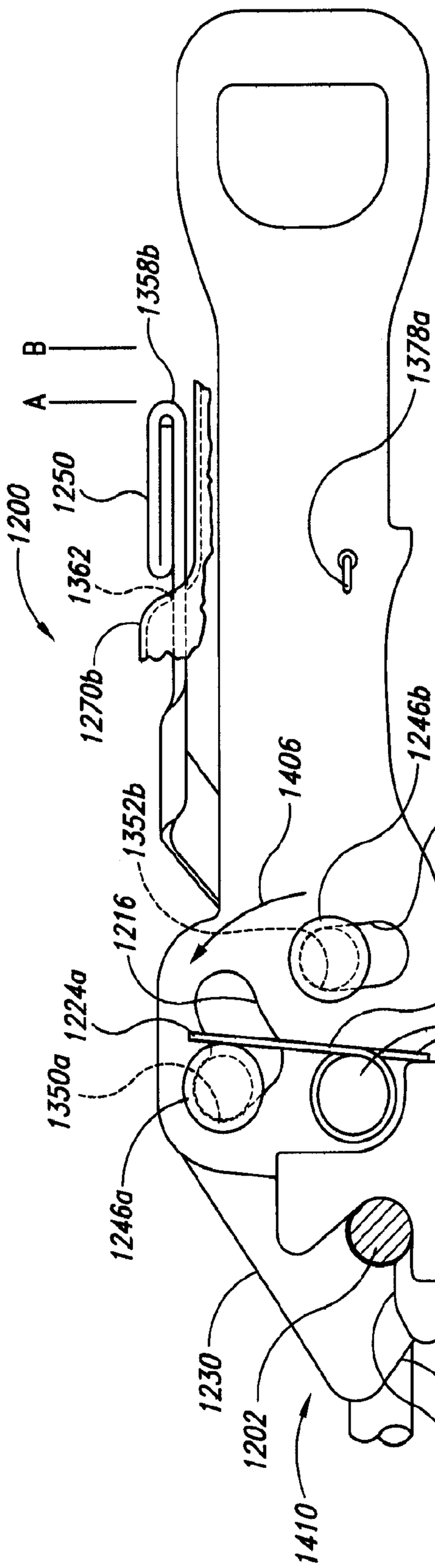


Fig. 14A

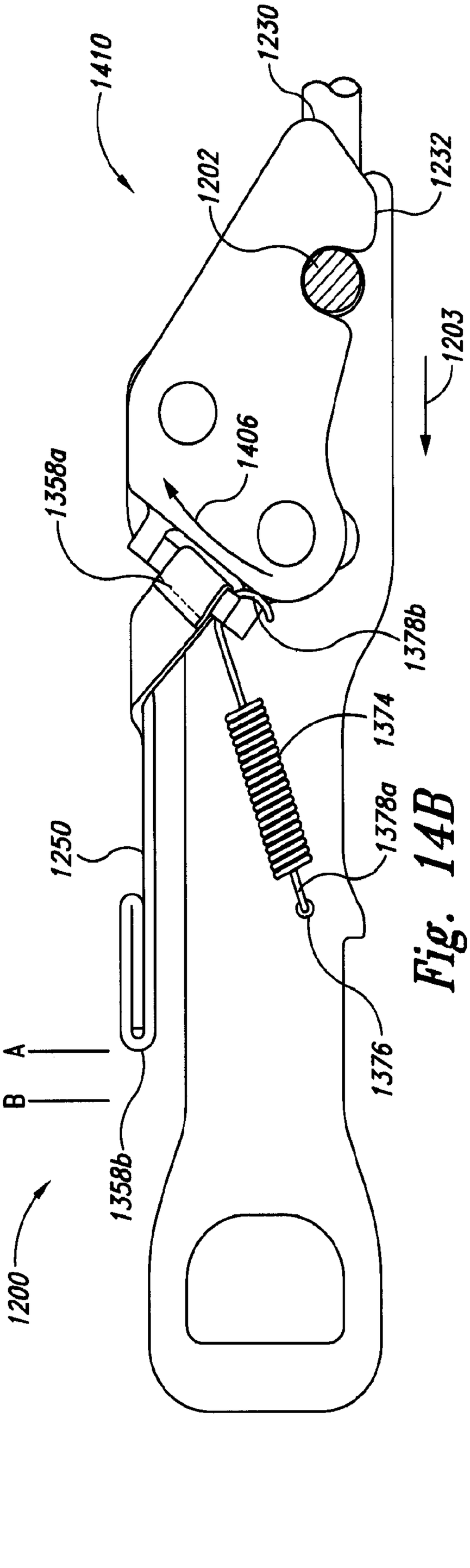


Fig. 14B

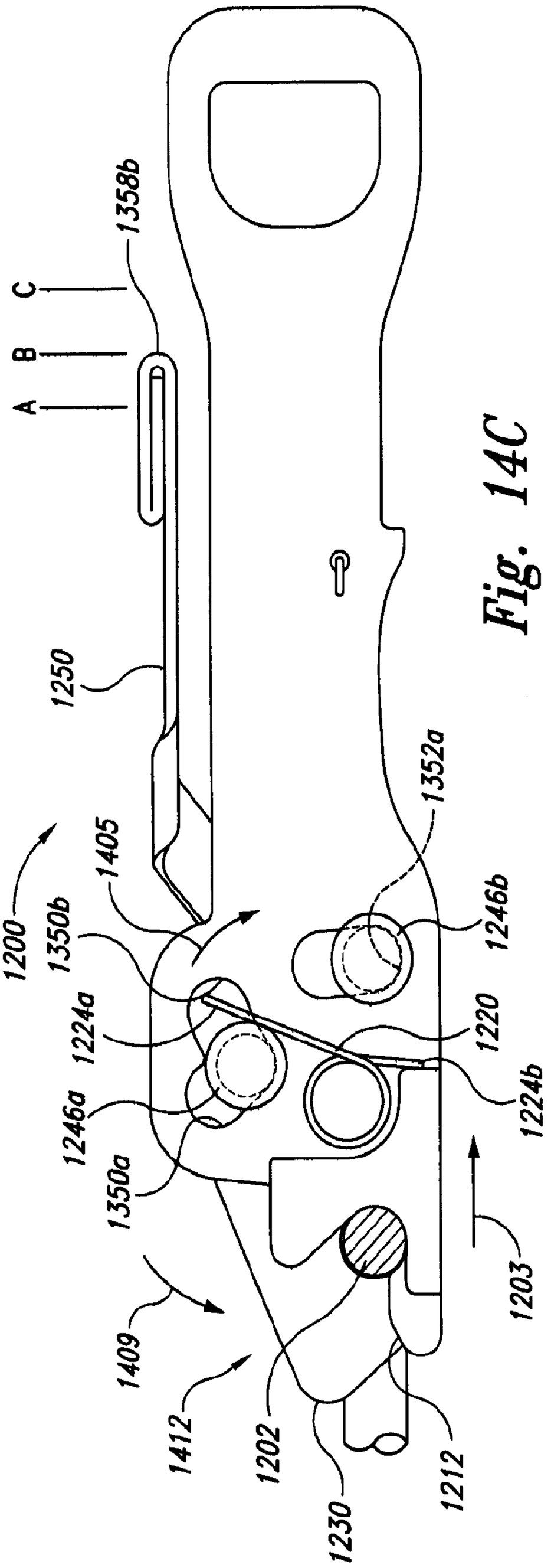


Fig. 14C

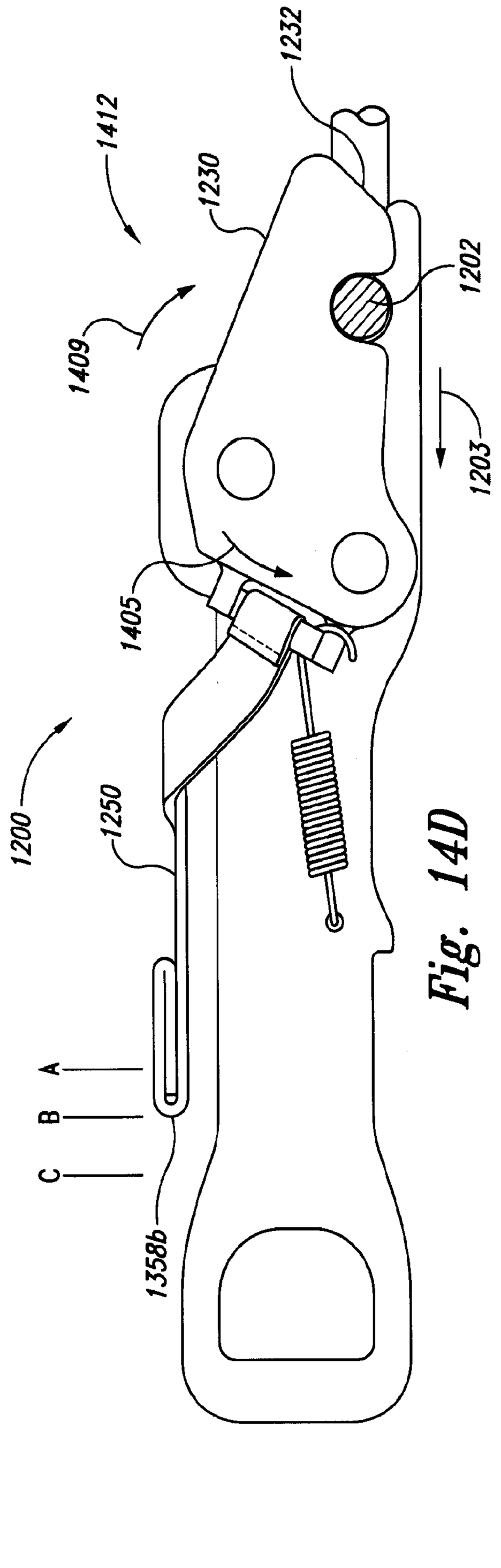


Fig. 14D

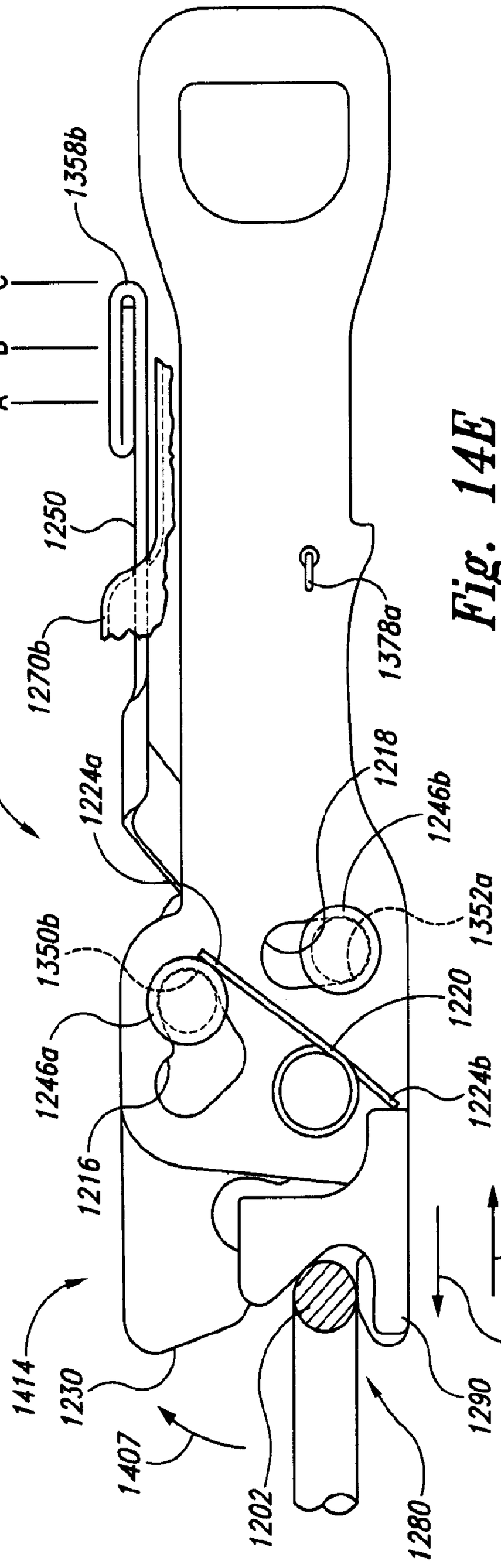


Fig. 14E

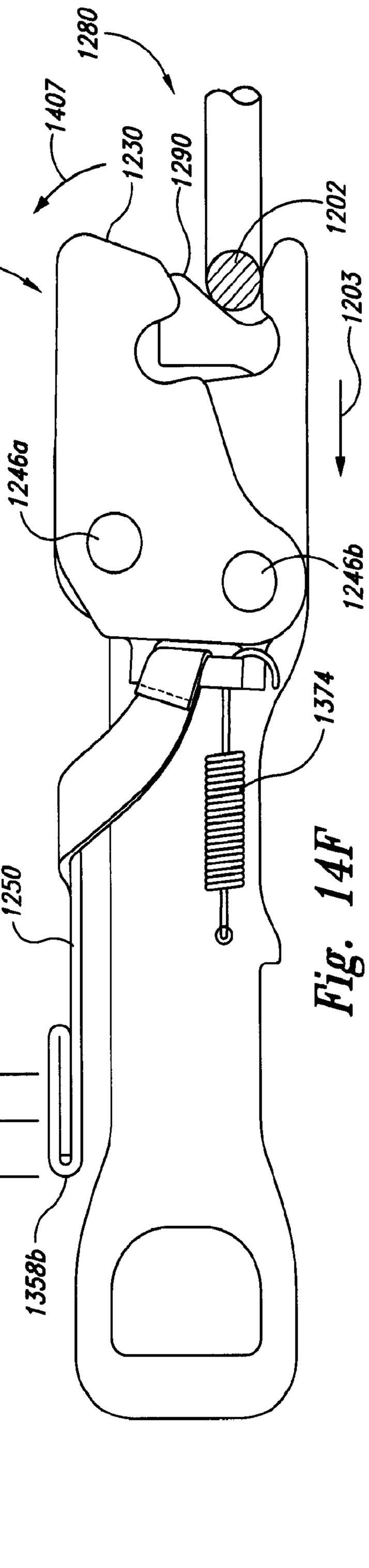
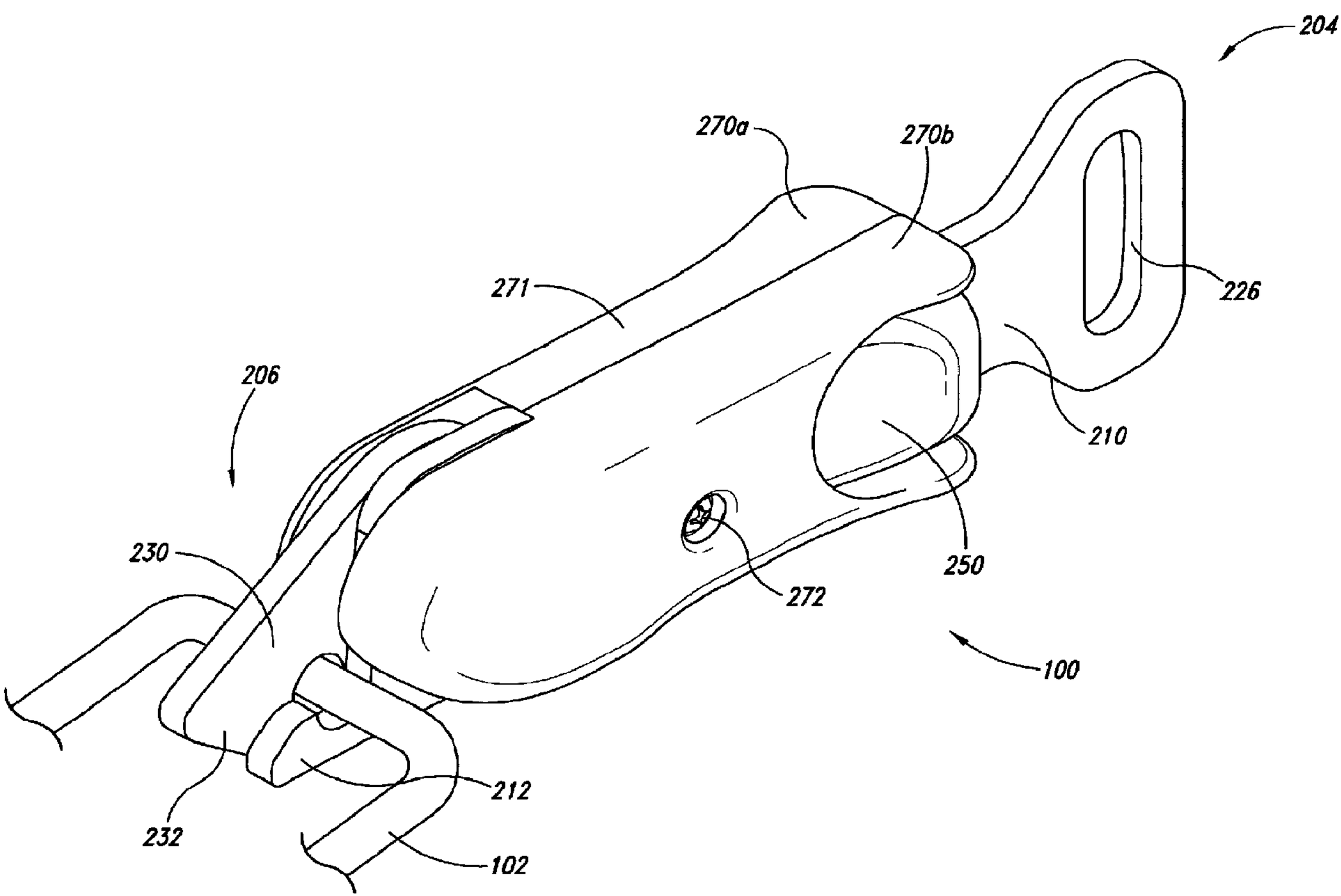


Fig. 14F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270a
270b
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206
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232
102