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(54) Title: **PERSONAL DESCENT SYSTEM**

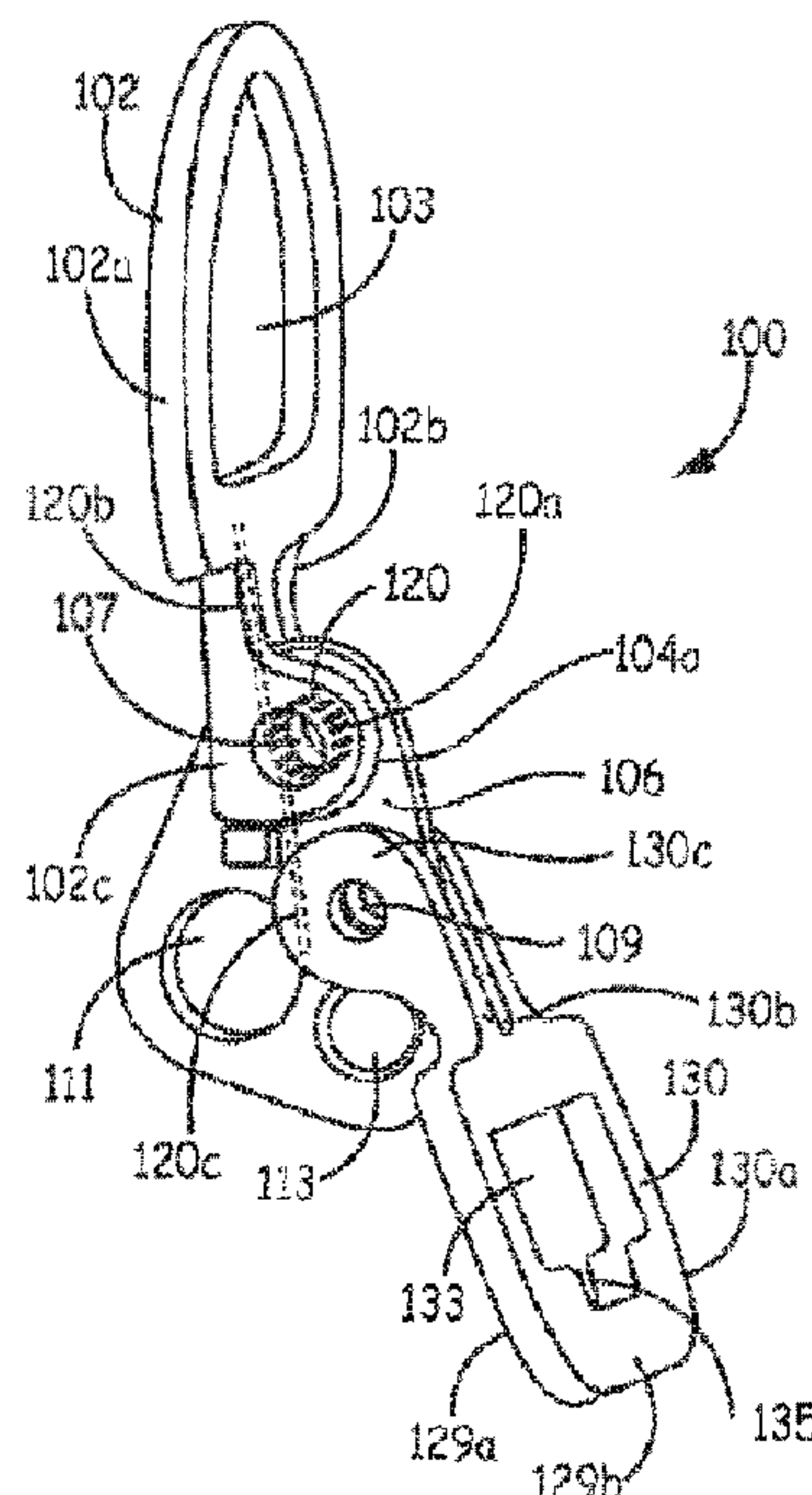


FIG. 1

(57) **Abrégé/Abstract:**

A personal descent system is provided. The personal descent system includes a support structure coupling assembly and a control descent device. The support structure coupling assembly is configured and arranged to be coupled to a descent lifeline. The support structure coupling assembly includes an adaptor connection member. The adaptor connection member is configured and arranged to couple different types of lifelines and lanyards to the support structure coupling assembly. The control descent device is selectively coupled to the support structure coupling assembly. The control descent device is configured and arranged to be coupled to a safety harness donned by a user. The control descent device is further configured to detach from the support structure coupling assembly during a descent operation while controlling a payout of the descent lifeline.



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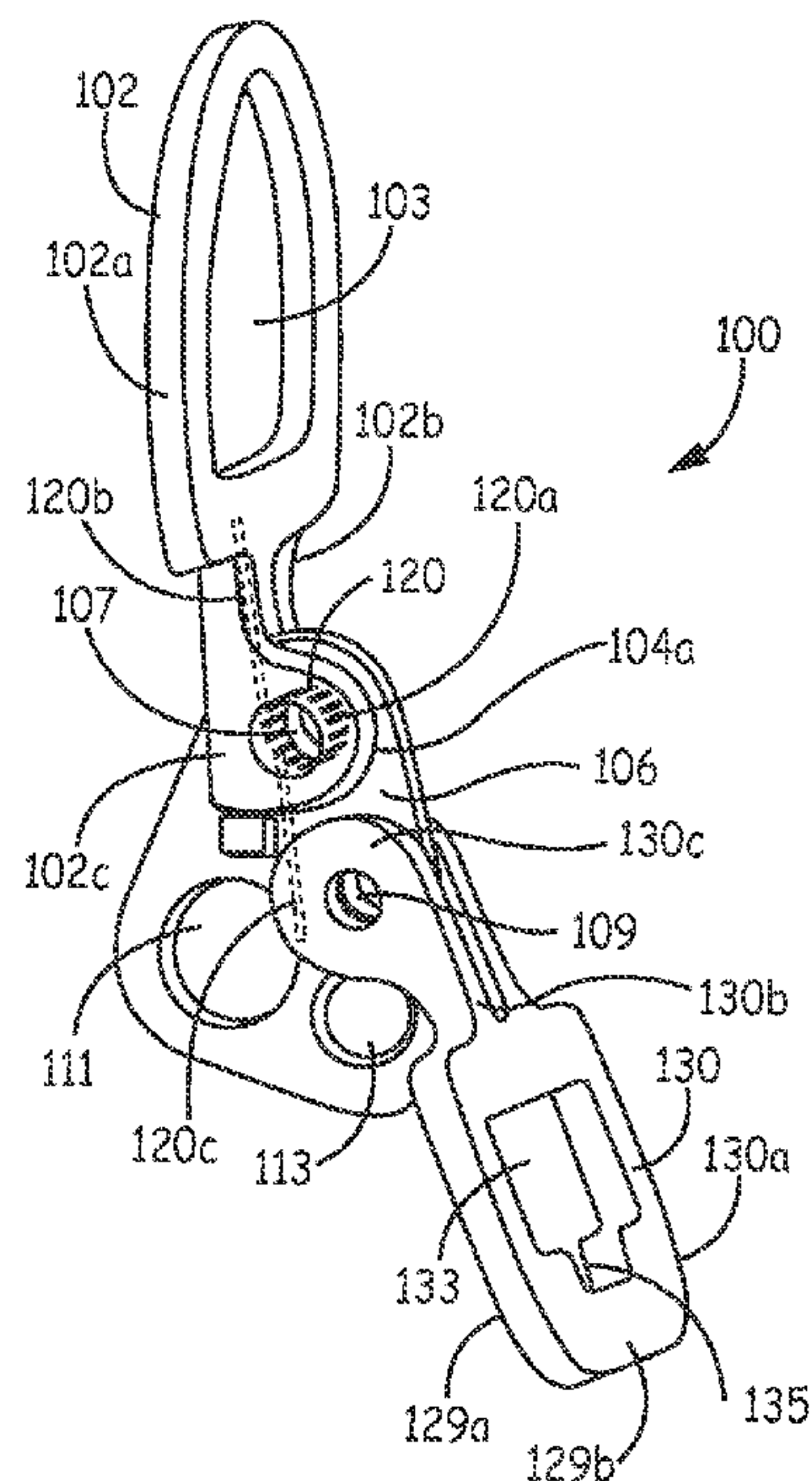


FIG. 1

(57) Abstract: A personal descent system is provided. The personal descent system includes a support structure coupling assembly and a control descent device. The support structure coupling assembly is configured and arranged to be coupled to a descent lifeline. The support structure coupling assembly includes an adaptor connection member. The adaptor connection member is configured and arranged to couple different types of lifelines and lanyards to the support structure coupling assembly. The control descent device is selectively coupled to the support structure coupling assembly. The control descent device is configured and arranged to be coupled to a safety harness donned by a user. The control descent device is further configured to detach from the support structure coupling assembly during a descent operation while controlling a payout of the descent lifeline.

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PERSONAL DESCENT SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This Application claims priority to U.S. Provisional Application Serial No. 62/049,629, same title herewith, filed on September 12, 2014, which is incorporated in its entirety herein by reference.

BACKGROUND

[0002] Workers who perform their tasks at heights utilize various types of safety gear to protect against fall events. Commonly used safety gear includes a safety harness that is donned by the worker and a self-retracting lifeline system that interconnects the safety harness to a support structure. If the worker experiences a fall event, a braking system in the self-retracting lifeline stops the fall. Once, the fall has stopped, however, an effective system is needed to deliver the worker to a safe location for rescue to prevent the worker from being suspended in the safety harness for an extended period of time. Moreover, in a situation where the worker is unconscious, a system is needed that allows a rescue worker to safely deliver the worker to a safe location for rescue.

[0003] For the reasons stated above and for other reasons stated below which will become apparent to those skilled in the art upon reading and understanding the present specification, there is a need in the art for an effective and efficient system to deliver a worker, who has encountered a fall event, to a safe location for rescue.

SUMMARY OF INVENTION

[0004] The above-mentioned problems of current systems are addressed by embodiments of the present invention and will be understood by reading and studying the following specification. The following summary is made by way of example and not by way of limitation. It is merely provided to aid the reader in understanding some of the aspects of the invention.

[0005] In one embodiment, a personal descent system is provided. The personal descent system includes a support structure coupling assembly and a control descent device. The support structure coupling assembly is configured and arranged to be coupled to a descent lifeline. The support structure coupling assembly includes an adaptor connection member. The adaptor connection member is configured and arranged to couple different types of lifelines and lanyards to the support structure coupling assembly. The control descent device is selectively coupled to the support structure coupling assembly. The control descent device is configured and arranged to be coupled to a safety harness donned by a user. The control descent device is further configured to detach from the support structure coupling assembly during a descent operation while controlling a payout of the descent lifeline.

[0006] In another embodiment, another personal descent system is provided. The personal descent system includes a descent lifeline, a support structure coupling assembly and a control descent device. The support structure coupling assembly includes a main connection member and a D-ring. The main connection member includes a latch arm mounting aperture. The descent lifeline is coupled to the main connection member. The D-ring is coupled to the main connection member. The control descent device includes a housing, a latch arm, a brake assembly and a self-deployment system. The housing is configured and arranged to be coupled to a safety harness donned by a user. The latch arm is pivotally coupled to the housing. The latch arm is selectively received within the latch arm mounting aperture of the main connection member to selectively couple the support structure coupling assembly to the control descent device. The brake assembly is received within the housing. The brake assembly is engaged with the descent lifeline to control a payout of the descent lifeline. The self-deployment system is configured and arranged to selectively release the latch arm to allow the latch arm to pivot in relation to the housing therein causing the latch arm to be removed from the latch arm mounting aperture of the main connection member.

[0007] In another embodiment, still another personal descent system is provided. The personal descent system includes a descent lifeline, a support structure coupling assembly, a control descent device and a spool. The support structure coupling assembly includes a main connection member and an adaptor connection member, the main connection member has a latch arm mounting aperture. The descent lifeline is coupled to the main connection member.

The adaptor connection member is coupled to the main connection member. The adaptor connection member is configured and arranged to couple a support lifeline to the support structure coupling assembly. The control descent device includes a housing, a latch arm and a brake system. A pair of spaced descent connecting arms extend from the housing. The pair of spaced descent connection arms have aligned routing apertures. The latch arm is pivotally coupled between the descent connection arms. The latch arm is selectively received with the latch arm mounting aperture of the main connection member to selectively couple the support structure coupling assembly to the control descent device. The brake system is contained within the housing. The brake assembly is engaged with the descent lifeline to at least in part control a payout of the descent lifeline. The spool is used to hold at least a portion of the descent lifeline. The descent lifeline is routed from the spool into an entry to the housing, through the brake system in the housing, out an exit in the housing, through the aligned routing apertures in the descent connection arms to the main connector member.

[0008] In further still another embodiment, another personal descent system is provided. In this embodiment the personal descent system includes a descent lifeline, a support structure and a control descent device, a spool and a sealing container. The support structure coupling assembly is configured and arranged to be coupled to a descent lifeline. The control descent device is selectively coupled to the support structure coupling assembly. The control descent device includes a housing, a breakaway seal, a brake assembly and a self-deployment system. The housing is configured and arranged to be coupled to a safety harness donned by a user. The housing has an entry passage for the descent lifeline to enter the housing and an exit passage to exit the housing. The breakaway seal is positioned near the exit to the housing. The brake assembly is received within the housing. The brake assembly is engaged with the descent lifeline to control a payout of the descent lifeline. The self-deployment system is configured and arranged to selectively disconnect the control descent device from the support structure coupling assembly. The spool is configured and arranged to hold at least a portion of the descent line. The descent lifeline passes from the spool into the entry passage to the housing. The sealing container is positioned around the spool to prevent moisture and debris from reaching the descent lifeline on the spool.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The present invention can be more easily understood and further advantages and uses thereof will be more readily apparent, when considered in view of the detailed description and the following figures in which:

[0010] Figure 1 is a side perspective view of a support structure coupling assembly of one embodiment of the present invention;

[0011] Figure 2A is a front perspective view of a personal descent system of an embodiment of the present invention including the support structure coupling assembly of Figure 1;

[0012] Figure 2B is a rear perspective view of the personal descent system of Figure 2A;

[0013] Figure 2C is a partial front cut away view of the personal descent system of Figure 2A illustrating the braking components of the control descent device in one embodiment of the present invention;

[0014] Figure 3A is a partial front cut away view of the personal descent system of Figure 2A before deployment in an embodiment;

[0015] Figure 3B is a partial front cut away view of the personal descent system of Figure 2A after deployment in an embodiment of the present invention;

[0016] Figure 4A is a partial front cut away view of the personal descent system of Figure 2A during a buddy pull deployment in an embodiment of the present invention;

[0017] Figure 4B is a partial front cut away view of the personal descent system of Figure 2A after a buddy pull deployment in an embodiment of the present invention;

[0018] Figure 5 is a partial front perspective view of a portion of a control descent device of one embodiment of the present invention;

[0019] Figure 6A is a front view of the personal descent system of Figure 2A illustrating a rope routing before deployment in an embodiment of the present invention;

[0020] Figure 6B is a front view of the personal descent system of Figure 2A illustrating the rope routing after deployment in an embodiment of the present invention;

[0021] Figure 7A is a front perspective view of the personal descent system of Figure 2A coupled to a self-retracting lifeline connector of one embodiment of the present invention;

[0022] Figure 7B is a front perspective view of the personal descent system of Figure 2A coupled to another self-retracting lifeline connector of another embodiment of the present invention;

[0023] Figure 8 is a front perspective view of the personal descent system of Figure 2A coupled to a safety harness in one embodiment of the present invention;

[0024] Figure 9 is a partial front perspective view of the control descent device and rope dispensing spool in one embodiment of the present invention;

[0025] Figure 10 is a side perspective view of a personal descent system of another embodiment of the present invention;

[0026] Figure 11 is a side perspective partial unassembled view of the personal descent system of Figure 10;

[0027] Figure 12A is side perspective view of a support structure coupling assembly of one embodiment of the present invention;

[0028] Figure 12B is a side view of the support structure coupling assembly of Figure 12A;

[0029] Figure 12C is a side perspective unassembled view of the support structure coupling assembly of Figure 12A;

[0030] Figure 13A is a partial front view of the personal descent system of Figure 10;

[0031] Figure 13B is a close up view of a portion of Figure 13A;

[0032] Figure 14 is a partial front view of the personal descent system of Figure 10;

[0033] Figure 15 is a back view of the personal descent system of Figure 10;

[0034] Figure 16A is a front view of the personal descent system of Figure 10 during activation at a first period of time;

[0035] Figure 16B is a front view of the personal descent system of Figure 10 during activation at a second period of time;

[0036] Figure 17 is a front view of a containment system of one embodiment of the present invention;

[0037] Figure 18 is an illustration of the containment system of Figure 17 coupled to a safety harness donned by a worker;

[0038] Figure 19 is a partial side view of a containment system of another embodiment of the present invention;

[0039] Figure 20 is a partial view of an inside chamber of the containment system of Figure 19; and

[0040] Figure 21 is a front view of the containment system of Figure 19.

[0041] In accordance with common practice, the various described features are not drawn to scale but are drawn to emphasize specific features relevant to the present invention. Reference characters denote like elements throughout Figures and text.

DETAILED DESCRIPTION

[0042] In the following detailed description, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration specific embodiments in which the inventions may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilized and that changes may be made without departing from the spirit and scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined only by the claims and equivalents thereof.

[0043] Embodiments of the present invention provide a personal descent system 200 that can be used in a rescue situation. Referring to Figure 1, a side perspective view of a support structure coupling assembly 100 which makes up part of the personal descent system 200 in an embodiment illustrated. The support structure coupling assembly 100 includes a D-ring 102. The D-ring 102 has a rescue portion 102a that forms a rescue aperture 103 and a neck portion 102b in this embodiment. A lifeline (not shown) or the like can be attached to the rescue portion 102a in a rescue situation. The neck portion 102b of the support structure coupling assembly 100 extends from the rescue portion 102a. The neck portion 102b leads to

a D-ring connection portion 102c. In particular, the neck portion 102b of the D-ring 102 is positioned between the rescue portion 102a and the D-ring connection portion 102c of the support structure coupling assembly 100. The D-ring connection portion 102c includes a pair of arms 104a and 104b that are illustrated best in Figure 2A. A portion of a main connection member 106 is positioned between the pair of arms 104a and 104b of the support structure coupling assembly 100. A pivot connection pin 105 pivotally couples the D-ring 102 to the main connection member 106 via apertures through the arms 104a and 104b of the D-ring connection portion 102c of the D-ring 102 and a D-ring connection aperture 107 (illustrated in Figure 1) of the main connection member 106. The main connection member 106 is shaped to position various connection apertures 107, 109, 111 and 113 in relation to each other. In the embodiment of Figure 1, the main connection member 106 has generally a triangular shape with rounded corners. The spaced connection apertures 107, 109, 111 and 113 include the D-ring connection aperture 107 discussed above, an adapter member aperture 109, a latch arm mounting aperture 111 and a descent lifeline termination aperture 113. The support structure coupling assembly 100 further includes a D-ring biasing member 120, which in the embodiment of Figure 1 is a spring. The D-ring biasing member 120 includes a coil portion 120a that, in the embodiment shown, is positioned around at least a portion of the pivot connection pin 105. The D-ring biasing member 120 includes a first arm portion 120b received within a cavity of the neck portion 102b of the D-ring 102 and a second arm portion 120c received within a cavity in the main connection member 106. The D-ring biasing member 120 biases the D-ring 102 in an access position so that the rescue portion 102a is accessible, extending in an upward position, when the support structure coupling assembly 100 is attached to a safety harness 600 (illustrated in Figure 8). The D-ring 102 not only is used during rescue situations, as described above, it is also intended to be used as an attachment point of a lanyard to be used as the wearer's primary lifeline if the user chooses to use a lanyard instead of a SRL.

[0044] Referring back to Figure 1, also attached to the main connection member 106 of the support structure coupling assembly 100 is an adaptor connection member 130. The adaptor connection member 130 includes a receiving head portion 130a, a neck portion 130b and a base connector portion 130c. The neck portion 130b is positioned between the receiving head portion 130a and the base connector portion 130c. The base connector portion

130c includes a first arm 131a and a second arm 131b best shown in Figure 2A. A connector pin 132 passing through aligned apertures in the first arm 131a and the second arm 131b of the adaptor connection member 130 and the adapter member aperture 109 of the main connection member 106, pivotally couples the adaptor connection member 130 to the main connection member 106. The receiving head portion 130a of the adaptor connection member 130 includes a receiving passage 133 that is shaped to receive a self-retracting lifeline (SRL) coupling member as described below in detail. The shape of the receiving passage 133 in this example embodiment is generally rectangular shaped with a notch 135 in one edge that forms part of the rectangle shape. The receiving head portion 130a of the adaptor connection member 130 further includes a first surface 129a and an opposed second surface 129b.

[0045] Selectively attached to the support structure coupling assembly 100 is a control descent device 140 that makes up the personal descent system 200. The personal descent system 200 is illustrated in the front perspective view of Figure 2A and the rear perspective side view of Figure 2B. The control descent device 140 is used in case of a rescue situation to provide a controlled descent. The control descent device 140 pays out a descent lifeline 202 (rope, cable, etc. shown in Figures 6A and 6B) at a select rate once activated to lower the worker to a desired location for rescue. This is further discussed below. As illustrated in Figure 2B, a latch arm 142 of the control descent device 140 passes through the latch arm mounting aperture 111 of the main connection member 106 to selectively couple the control descent device 140 to the support structure coupling assembly 100. The latch arm 142 includes a first end portion 142a that is pivotally coupled between descent connection arms 141a and 141b of a housing 141 of the control descent device 140 via pivot connector 144. The latch arm 142 further has a second end portion 142b. The second end portion 142b of the latch arm 142 includes a lock aperture 143 in which a lock pin 252 is selectively received to selectively lock the latch arm 142 in relation to the control descent device 140 which is also further discussed below. The descent housing further includes fuse connecting arms 146a and 146b. The fuse connecting arms 146a and 146b have aligned fuse bores 148a and 148b in which a fuse 150 is held. The fuse 150 prevents unintentional deployment of the control descent device 140. The rear perspective view of Figure 2B also illustrates a safety harness connecting assembly 170 that includes a pair of spaced harness connection arms 172a and 172b that extend out from the rear of the housing 141. A housing connect pin 174 passes

through aligned passages in the harness connection arms 172a and 172b. Safety harness webbing 602 and 604 (or straps) of a safety harness 600 (illustrated in Figure 8) are positioned between the housing connect pin 174 and the descent housing 141 to couple the personal descent system 200 to the safety harness 600. In one embodiment, the location where the webbings 602 and 604 of the safety harness 600 cross in the back of a user is where the webbings 602 and 604 are coupled to the personal descent system 200.

[0046] Also illustrated in Figures 2A and 2B is a self-deployment system 250 (generally referred to as a deployment system 250). The user deployment system 250 includes an end looped portion 250a that allows the user to grasp the user deployment system 250 and pull to activate the user deployment system 250. In one embodiment, the user deployment system 250 is made from a wire cable. Referring to the front view of Figure 2C, the control descent device 140 also includes a brake system 300 that helps control the payout rate of speed of the descent lifeline 202 (illustrated in Figure 6A). The brake system 300 in this embodiment includes a main gear 302 that is rotationally coupled to a center rotor 304 via a rotor gear (not shown). Pivotaly coupled to the center rotor 304 is a pair of braking pawls 306a and 306b. The braking pawls 306a and 306b rotationally engage an inner surface 307 of the housing 141 to create friction to slow the payout of the descent lifeline 202. A brake pulley 310 is coupled to rotate with the main gear 302. Moreover, the brake pulley 310 is in turn engaged with the rope as shown in Figure 6A and described in detail below.

[0047] A front cutaway portion of the personal descent system 200 before deployment is shown in Figure 3A. As illustrated in Figure 3A, the elongated portion 250b (self elongated portion) of the deployment system 250 is coupled to a lock pin 252. The lock pin 252 includes a first lock end 252a that is designed to be selectively received within the lock aperture 143 of the latch arm 142 to selectively lock the latch arm 142 in a static location in relation to the housing 141 of the control descent device 140 as illustrated in Figure 3A. The lock pin 252 further includes a second connecting end 252b that is coupled to the elongated portion 250b of the deployment system 250. The lock pin 252 and a portion of the elongated portion 250b of the deployment system 250 are received within a deployment passage 256 of the housing 141. In particular, in this embodiment, the deployment passage 256 has a first portion 256a that has a first diameter and a second portion 256b that has a second larger diameter. A deployment passage shoulder 256c is at the transition between the first portion

256a and the second portion 256b. The first lock end 252a of the lock pin 252 has a first diameter that allows the first lock end 252a to be received snugly in the second portion 256b of the deployment passage 256 and the lock aperture 143 of the latch arm 142. The second connection end 252b of the lock pin 252 has a second smaller diameter. A lock pin shoulder 252c is formed at the transition between the first lock end 252a and the second connecting end 252b of the lock pin 252. A lock biasing member 254 is received around the second connecting end 252b of the lock pin 252. In particular, the lock biasing member 254 (which is a spring in this embodiment) has a first end that abuts the lock pin shoulder 252c of the lock pin 252 and a second end that abuts the deployment passage shoulder 256c to bias the lock pin 252 into the lock aperture 143 of the latch arm 142.

[0048] Figure 3B illustrates a front cutaway section of a portion of the personal descent system 200 after deployment. In particular, Figure 3A shows the deployment system 250 being pulled to counter the biasing force of the lock biasing member 254. In use, this is typically done by the user pulling on the end looped portion 250a of the deployment system 250. This action causes the first lock end 252a of the lock pin 252 to come out of the lock aperture 143 of the latch arm 142. Weight on the latch arm 142 (which would be the weight of the user during a fall event) causes the latch arm 142 to rotate on pivot connection 144 with the housing 141. When the latch arm 142 rotates, it is pulled out of the latch arm mounting aperture 111 of the main connection member 106 (shown in Figure 3A) to release the control descent device 140 from the main connection member 106. In an embodiment, if the weight is not enough to break the fuse 150 (shown in Figure 2B), the latch arm will not pivot open even though the lock pin is removed from the lock aperture 143 of the latch arm 142. This situation could occur when the deployment system 250 is accidentally pulled (i.e. gets caught on something) without a fall event occurring. The location of the main connection member 106 of the support structure coupling assembly 100 in relation to the latch arm 142 reduces the load on the lock pin 252 (biased towards the center of the latch arm 142) so it is easier to pull the deployment system 250. Moreover, the bottom surface of the latch arm 142 is angled so it slides easier out of the latch arm mounting aperture 111 of the main connection member 106 of the support structure coupling assembly 100 when the control descent device 140 is deployed.

[0049] Embodiments also include a buddy deployment system 320 that interacts with the self-deployment system 250 (deployment system 250). The buddy deployment system 320 is used in a situation where the user is unable to activate the self-deployment system 250. This may occur if the user is unconscious or is otherwise unable to activate the deployment system 250. The buddy deployment system 320 is illustrated in Figure 4A. In particular, Figure 4A illustrates buddy deployment system 320 deploying the latch arm 142. The buddy deployment system 320 includes a buddy activating base member 322, a stop 330 and an engagement loop 324. The buddy activating base member 322 includes a first activation portion 322a, a second connection portion 322b and a central ramp portion 322c with a ramp surface 323 that transitions between the first activation portion 322a and the second connection portion 322b. The ramp surface 323, in an embodiment, has a cam surface that allows for an easy activation at any angle. The stop 330 is coupled to the self-deployment system 250 at a select location. The first activation portion 322a further includes a slot 326 and seat 328 (illustrated in Figure 3B). The elongated portion 250b of the deployment system 250 is received within the slot 326 of the buddy activating base member 322. The diameter of the stop 330 is greater than the width of the slot 326. In an embodiment, the stop 330 rests in the seat 328 of the buddy activating base member 322 between the first activation portion 322a and the second connection portion 322b of the buddy activating base member 322 under tension provided by lock biasing member 254. To activate the buddy deployment system 320, the engagement loop 324, which is coupled to the second connection portion 322b of the buddy activating base member 322, is pulled. This can be done with use of a hook and pole arrangement, or the like, that is manipulated by a rescue person. When the engagement loop 324 is pulled, the stop 330 is forced along the ramp surface 323 of the central ramp portion 322c of the buddy activating base member 322 to the first activation portion 322a. Since the width of the first activation portion 322a is greater than the distance the lock pin 252 has to move to disengage the lock aperture 143 of the latch arm 142, movement of the stop 310, which is connected to the elongated member 250b, along the ramp surface 323 disengages the latch arm 142 as illustrated in Figure 4A. The central ramp portion 322c of the buddy activating base member 322 has a curvature selected so that the lock biasing member 254, under normal conditions, does not force the stop 330 up the ramp surface 323 while allowing the stop 330 to ride up on the ramp surface 323 when the buddy deployment system 320 is

activated. One feature of the buddy deployment system 320 is that the buddy activating base member 322 breaks away from the personal descent system 200 after deployment as illustrated in Figure 4B. This ensures the buddy activating base member 322 and engagement loop 324 portions of the buddy deployment system 320 as well as a rescue hook and pole arrangement (not shown) will not be pulled out of the rescuer's hands during deployment.

[0050] Referring to Figure 5, a portion of the housing 141 is illustrated. In this illustration, an opening to the deployment passage 256 in an embodiment is shown. In this embodiment the opening includes a conical mouth 257 having a select curvature so that no matter which direction the elongated member 250b of the deployment system 250 is pulled for activation in relation to the descent housing 141, the opening configuration does not impede movement of the deployment system 250.

[0051] Routing of the descent lifeline 202 is illustrated in Figure 6A. In particular, Figure 6A illustrates the descent lifeline 202 routing before deployment of the personal descent system 200. Descent lifeline 202 that is stored on a spool 700 in a pouch 702 of a safety harness 600 (shown in Figure 9) is routed through routing bracket 147, around brake pulley 310 of the brake system 300, it is then looped through routing apertures 145 in the descent connection arms 141a and 141b of the descent housing 141 and then tied to a descent lifeline termination aperture 113 of the main connection member 106 as illustrated in Figure 6A. Referring to Figure 6B, rope routing after deployment is illustrated. As illustrated in Figure 6B, the latch arm 142 is released by the deployment system 250. Hence, the latch arm 142 no longer engages the main connection member 106 therein allowing the main connection member to separate from the housing 141. The rate of separation of the main connection member 106 (and D-ring 102) is controlled by the descent lifeline 202 passing through the brake system 300 and the routing path as set out above. The routing path provides friction on the descent lifeline 202. In other embodiments, the descent lifeline 202 is stored via other means than a spool, such as but not limited to, being flaked in a bag, tucking multiple folds of the descent lifeline into elastic, etc.

[0052] As discussed above, the adaptor connection member 130 that is coupled to the main connection member 106 can be used to couple different types of SRLs or other suitable lifelines or lanyards to the base plate 106. Referring to Figure 7A, an example of the adaptor

connection member 130 being used to connect a Nano-Lok™ edge attachment system 400 for a DBI-SALA® SRL (not shown) from the Capital Safety USA of Red Wing, Minnesota is illustrated. The Nano-Lok™ Edge attachment system 400 includes a coupling member 402. The coupling member 402 has a first portion 402a that is sized to pass through the receiving passage 133 (shown in Figure 1) of the adaptor connection member 130 while a second plate portion 402b of the coupling member 402 is designed to engage the first surface 129a (indicated in Figure 1) of the adaptor connection member 130. A locking pin 406 of a connector 404 is received in a holding aperture in the first portion 402a of the coupling member 402 to lock the connector 404 to the adaptor connection member 130. In particular, the configuration positions the connector 404 to engage the second surface 129b of the adaptor connection member 130. Since the connector is sized larger than the receiving passage 133 of the adaptor connection member 130, and therefore cannot be pulled through the receiving passage 133, the connector 404 is locked to the adaptor connection member 130. An example of a different attachment system is illustrated in Figure 7B. This example attachment system is a Nano-Lok™ attachment system 500 for a DBI-SALA® Nano-Lok™ SRL (not shown) from Capital Safety USA of Red Wing, Minnesota. This attachment system 500 includes a coupling member 502 that has a first portion 502a that passes through the receiving passage 133 (shown in Figure 1) of the adaptor connection member 130. A second portion 502b of the coupling member 502, which does not fit through the receiving passage 133, engages the first surface 129a of the adaptor connection member 130. The attachment system further includes connector 506. The connector 506 includes a connection portion 507 that is designed to be received within a bore of the first portion 502a of the coupling member 131. Since connector 506 is larger than the receiving passage 133 of the adaptor connection member 130, the connector 506 cannot be pulled through the receiving passage 133 therein locking Nano-Lok™ attachment system 500 to the adaptor connection member 130. It is recognized that other suitable coupling members could be used to accommodate other types of lifelines or lanyards.

[0053] As discussed above, Figure 8 illustrates an embodiment of the personal descent system 200 attached to a safety harness 600. As illustrated in Figure 8, the rescue portion 102a of the D-ring 102 is biased up in a position so that it can be easily accessed in a rescue situation. Hence, the personal descent device 200 provides two methods of rescue, the first

being via engagement of the D-ring 102 to move the worker to safety and the second is through the deployment of the control descent device 140 to lower the worker to safety. In addition, the self-deployment system 250 may be operationally coupled to the shoulder strap for ease of use. Moreover, as discussed above, as shown in Figure 9, a pouch 702 is attached to the safety harness 600 in an embodiment to hold the spool 700 of the descent lifeline 202 that is provided to the control descent device.

[0054] Referring to Figure 10, a second embodiment of a personal descent system 900 is provided. This embodiment includes a support structure coupling assembly 800, a control descent device 840 and descent lifeline 902. The support structure coupling assembly 800 generally includes a D-ring 802, a main connection member 906, and an adaptor connection member 930 as discussed below. The control descent device 840 generally includes a housing 841, a self-deployment system 950, a buddy deployment system 960 with a buddy activation base member 1322. The personal descent system 900 in this embodiment further includes a spool bracket 1100 and a spool 1000 to hold the descent lifeline 902. A partial unassembled view of the personal descent system 900 is illustrated in Figure 11. This view illustrates the control descent device 840 which includes a first housing portion 841a and a second housing portion 841b that make up a housing 841. In one embodiment, the first housing portion 841a and the second housing portion 841b are hermetically sealed to each other with a housing seal 750. Housed within a cavity formed by the first housing portion 841a and the second housing portion 841b, is a brake assembly that is generally designated as 861. The brake assembly 861 includes a main gear 852. The main gear 852 includes outer teeth 852a and a central main gear passage 851 that has a select shape. In this embodiment, the select shape is a hexagon. The brake assembly 861 further includes a center rotor 854. Coupled to the center rotor 854 are rotor teeth 854a that are designed and position to engage the outer teeth 852a of the main gear 852. The center rotor 854 is mounted within the first housing portion 841a and the second housing portion 841b via router shaft 862. The router shaft 862 is received in respective housing seats in the first housing portion 841a and the second housing portion 841b. Further, rotor shaft bearings 860a and 860b are positioned within the respecting housing seats to engage respective ends of the rotor shaft 862. Pivotaly coupled to the oppositely extending arms of the center rotor 854 is a pair of braking pawls 856a and 856b. Brake pads 857a and 857b are coupled to the respective braking pawls 856a

and 856b. The braking pads 857a and 857b engage a braking chamber 837 that is formed in the first housing portion 841a of the personal descent system 900.

[0055] The brake assembly 861 further includes a brake pulley 812. The brake pulley 812 includes a gear engaging portion 812a that is designed to be received in the central main gear passage 851 of the main gear 852. The brake pulley 812 further includes a central passage 813 through which a pulley shaft 814 rotationally couples the brake pulley 812 and the main gear 852 to the first housing portion 841a and the second housing portion 841b. In particular, pulley shaft 814 is received in respective seats in the respective first housing portion 841a and the second housing portion 841b. In the embodiment shown, bearings 858a and 858b are received on respective ends of the pulley shaft 814. Rotationally coupled within the first housing portion 841a and the second housing portion 841b near the brake pulley 812 is a routing pulley 810. The descent lifeline 902 is routed around the routing pulley 810 and the brake pulley 812 as illustrated in Figure 14.

[0056] The descent lifeline 902 passes through a bottom portion of the first housing portion 841a via threaded entry passage generally designated as 845 in Figure 11. A sealing bolt 872 having a central lifeline passage 872a is threadably engaged with the threaded entry passage 845 in the first housing portion 841a to couple the spool bracket 1100 to the first housing portion 841a. A sealing washer 874 is used to provide a sealed connection. The descent lifeline 902 passes through the central lifeline passage 872a of the sealing bolt 872 as best illustrated in Figure 14. In an embodiment, a sealing container 1200 such as poly bag surrounds the spool 1000 and the spool bracket 1100 (illustrated below in Figure 14). The sealing bolt 872 positioned around the descent lifeline 902, is first routed through the spool bracket 1100 and then through a hole in the poly bag 1200. The sealing washer 874 is then placed in position and the threads of the sealing bolt 872 are engaged with threads in passage 845. This configuration provides a sealed connection between the spool 1000 of descent lifeline 902 and the brake assembly 861 in the housing 841 discussed below. The descent lifeline 902 further passes through an exit passage 843 of the first housing portion 841a. In one embodiment, a breakaway seal 870 is used to prevent debris and moisture from entering the housing 841. The personal descent system 900 in this embodiment also includes a first deployment seal 752 and a second deployment seal 754. The first deployment seal 752 is positioned around a lock pin 1252 of the self-deployment system 950 as shown in Figure

13A and the second deployment seal 754 is positioned in the deployment passage 740 proximate the a conical mouth 757 of the housing 841 as shown in Figures 13A and 13B. These deployment seals 752 and 754 prevent debris and moisture from getting within the housing 841.

[0057] As illustrated in Figure 11, the spool bracket 1100 includes a central mid-plate 1110a with opposably extending side plates 1110b and 1110c that generally form a U-shape. The mid-plate 1110a includes a lifeline passage 1111c through which the descent lifeline 902 extends through. Each of the extending side plates 1110b and 1110c includes a mounting aperture 1111a and 1111b (shown in Figure 15). Spool bearings 1020a and 1020b passing through the respective mounting apertures 1111a and 1111b rotationally couple the spool 1000 to the spool bracket 1100. The spool 1000 includes a central hub 1000c and opposably mounted first and second disks 1000a and 1000b. The central hub 1000c includes a central spool passage 1001 in which the respective spool bearings 1020a and 1020b are received.

[0058] A latch arm 842 is coupled to the second housing portion 841b of the housing 841 via pivot connection 844 that passes through descent connecting arms 847a and 847b similar to personal descent system 200 discussed above. The personal descent system 900 of this embodiment further includes a self-deployment system 950 including an elongated portion 950b (self elongated portion) and an end looped portion 250a to allow a user to grasp the self-deployment system 950. This is similar to deployment system 250 discussed above. Moreover, similar to personal descent system 200 discussed above, personal descent system 900 employs a stop 923 on the elongated portion 950b and buddy activating base member 1322. In this embodiment, a buddy deployment system 960 includes an elongated portion 960a (elongate buddy portion) that has one end coupled to the buddy activating base member 1322 and the other end coupled to a buddy activation portion 961. The buddy activation portion 961 includes an activation base 961a and an activation connection portion 961b which are further discussed below.

[0059] Figure 11 further illustrates a ratchet arm 762 and a pin 764. The ratchet arm 762 is held in place by a pocket (not shown) formed by the first housing portion 841a and the second housing portion 841b. The ratchet arm 762 engages the outer teeth 852a of the main gear 852. Initially during assembly, although the ratchet arm 762 engages the outer teeth

852a of the main gear 852, the configuration of the ratchet arm 762 and the pocket that holds ratchet arm 762 allows the main gear 852 to rotate in both directions. This allows the builders of the personal descent system 900 to properly position the descent lifeline 902 in relation to the spool 1000 and housing 841. Once, the descent lifeline 902 is properly position, the pin 764 is installed through a pin aperture 761 in the second housing portion 841b. The pin 764, once installed, engages the ratchet arm 762 in such a manner that the ratchet arm prevents the main gear 852 from rotation in a direction that winds the descent lifeline 902 back up on the spool 1000 after a deployment. This feature prevents the personal descent system 900 from being used more than one time.

[0060] The support structure coupling assembly 800 is further illustrated in detail in Figures 12A through 12C. The support structure coupling assembly 800 includes a D-ring 802. The D-ring 802 has a rescue portion 802a, a neck portion 802b and a D-ring connection portion 802c. The rescue portion 802a includes a rescue aperture 803. The D-ring connection portion 802c includes spaced first and second arms 804a and 804b. The first and second arms 804a and 804b include respective aligned connecting apertures 807a and 807b. The support structure coupling assembly 800 further includes a biasing member 820. The biasing member 820 includes a first coil portion 820a, a second coil portion 820b and an engaging portion 820c that extends between the first coil portion 820a and the second coil portion 820b. The support structure coupling assembly 800 further includes a main connection member 906. The main connection member 906, in this embodiment, includes three spaced apertures. In particular, the main connection member 906 includes a latch arm mounting aperture 911, an adapter member aperture 907 and a descent lifeline termination aperture 913. The latch arm mounting aperture 911 selectively receives the latch arm 842 of the personal descent system 900 to selectively couple the support structure coupling assembly 800 to the housing 841. One feature of this design is that the latch arm 842 is free to rotate within the latch arm mounting aperture 911. Hence, if a fall event occurs, the support structure coupling assembly 800 is allowed to move (i.e. rotate) in relation to the housing 841 due to the sudden load. The descent lifeline termination aperture 913 is used to couple the descent lifeline 902 to the main connector member 906. The support structure coupling assembly 800 further includes an adapter connection member 930. The adapter connection member 930, in this embodiment, includes a base portion 932 having a central connection

member passage 931. Extending from one side of the base portion 932 are spaced D-ring connector arms 932a and 932b having aligned D-ring connection apertures 929a and 929b. Extending from an opposite side of the base portion 932 are spaced device connecting arms 932c and 932d. The spaced device connecting arms 932c and 932d include respective aligned device connecting apertures 933a and 933b. A D-ring rivet 920 passing through the D-ring connection apertures 929a and 929b of the adapter connection member 930, the connecting apertures 807a and 807b of the D-ring 802 and the adapter member aperture 907 of the main connector member 906 couple the D-ring 802, the main connection member 906 and the adapter connection member 930 together. Further, the coil portions 820a and 820b of the biasing member 820 are received around the D-ring rivet 920 in such a manner that the engaging portion 820c of the biasing member 820 engages the neck portion 802b of the D-ring 802. This configuration biases the D-ring 802 to a desired position.

[0061] Referring to Figure 13A, a partial front view of the personal descent system is illustrated. In this view a portion of the second housing portion is removed to illustrate some of the internal components. In particular, Figure 13A illustrates a lock pin 1252 that is coupled to the elongated portion 950b of the self-deployment system 950 (which can be generally referred to as the deployment system 950). As illustrated a portion of both the elongated portion 950b and the lock pin 1252 are received in the deployment passage 740 of the housing 841. The lock pin 1252 is further selectively received in a lock aperture 842a of the latch arm 842 to lock the latch arm 842 in a static position in relation to the housing 841. A lock biasing member 1254 received around a portion of the elongated portion 950b within the deployment passage 740 is positioned to assert a biasing force on the lock pin 1252 to bias at least a portion of the lock pin 1252 within the lock aperture 842a. In activating the personal descent device 900 the elongated portion 950b (self elongated portion) is pulled in a direction to counter the bias force of the lock biasing member 1254 therein allowing the portion of the lock pin 1252 to be removed from the lock aperture 842a of the latch arm 842. Also illustrated in Figure 13A is a fuse 997 that is similar to fuse 150 discussed above. With this configuration, even if the self-deployment system 950 or the buddy deployment system 960 is pulled and the lock pin 1252 is removed from the lock aperture 842a of the latch arm 842, the personal descent device 900 will not be activated unless a select amount of force by the latch arm 842 is asserted on the fuse 997 to break the fuse 997 which in turn allows the

latch arm 842 to pivot. This prevents the un-intentional activation of the personal descent device 900. The select amount of force is related to the amount of force the latch arm 842 provides when the personal descent device 900 is subjected to the weight of a user who is suspended after a fall.

[0062] A close up view of area 990 is illustrated in Figure 13B. Here again, a portion of the components are removed to illustrate how the device is constructed. The buddy activation base member 1322 is constructed similar to the buddy activation base member 322 discussed above. During normal operations, the stop 923 is at rest in a seat 1323 of the buddy activation base member 1322. In this embodiment, the buddy elongated portion 960a of the buddy deployment system 960 extends through a buddy connection passage 1321 in the buddy activation base member 1322. A buddy stop 959 coupled at a terminal end of the buddy elongated portion 960a connects the buddy deployment system 960 to the buddy activation base member 1322. When the buddy deployment system 960 is used to activate the personal descent device 900, the movement of the buddy elongated portion 960a causes the stop 923 (self stop) of the self-deployment system 950 to ride up ramp section 1322a of the buddy activation base member 1322. This action counters the bias force of the lock biasing member 1254 therein allowing the portion of the lock pin 1252 to be removed from the lock aperture 842a of the latch arm 842. A slot 1319 in the buddy activation base member 1322 allows the elongated portion 950b of the self-deployment system 950 to become detached from the buddy activation base member 1322 once the personal descent device 900 has been activated. This configuration prevents the buddy deployment system 960 from interfering with the personal descent device 900 as payout of the descent lifeline 902 occurs during a rescue descent. It also prevents a rescue hook and pole arrangement, used to engage the buddy deployment system 960, from being pulled out of the rescuer's hands during deployment of the personal descent device 900. This embodiment also includes a conical mouth 757, similar to conical mouth 257 discussed above.

[0063] Figure 14 illustrates another partial front view of the personal descent device 900 with portions of the components removed to further illustrate the personal descent device 900 construction. This view illustrates the routing of the descent lifeline 902. As illustrated, the descent lifeline 902 is wound around the spool 1000 that in this example embodiment is housed in a sealing container 1200, such as but not limited to, a poly bag covering. Further,

the descent lifeline 902 could be flaked in a bag, held with web loops, vacuum sealed in a pack etc. The descent lifeline 902 is then routed into the housing 841. As illustrated, the descent lifeline 902 is routed around the routing pulley 810 and then the brake pulley 812. The descent lifeline 902 then leaves the housing 841 and is routed through a routing aperture 1145 in the connecting arms 847a and 847b (only 847b is illustrated in Figure 14) of the housing 841 and then around the connecting arms 847a and 847b to the main connection member 906. Figure 14 also illustrates the seals that protect the brake assembly 861 within the housing 841. In particular, Figure 14 illustrates sealing bolt 872 and sealing washer 874 coupling the spool bracket 1110 to the housing 841 as well as providing a passage into the housing 841 for the descent lifeline 902. The other seal at a passage within the housing is the breakaway seal 870. Breakaway seal 870 is pointed around the descent lifeline 902 where the descent lifeline 902 leaves the housing 841. The breakaway seal 870 is designed to break away from the housing 841 when the personal descent device 900 is activated. Figure 15 illustrates a back view of the personal descent device 900. This view illustrates spaced harness connecting arms 1172a and 1172b that extend from the housing 841 and a housing connect pin 1174 that is coupled between the harness connecting arms 1172a and 1172b. In use, webbing from a safety harness (not shown) is routed between the housing connect pin 1174 and the housing 841 to couple the personal descent device 900 to the safety harness.

[0064] Figures 16A and 16B illustrate the personal descent device 900 during different stages of an initial activation. In use, the personal descent device 900 is coupled to a safety harness donned by a worker as discussed above. A support structure lifeline (not shown) that coupled to a support structure is then coupled to the personal descent device 900. In one embodiment the lifeline is coupled to the D-ring 802 of the support structure coupling assembly 800. In another embodiment the support structure lifeline is coupled to the adaptor connection member 930 of the support structure coupling assembly 800. The support structure lifeline may be a self-retracting lifeline or any other type lifeline known in the art. In Figure 16A, the self-deployment system 950 has been pulled which releases the lock pin 1252 from the lock aperture 842a of the latch arm 842 as discussed above. If a force by the latch arm 842 on the fuse 997 is great enough to break the fuse 997, as discussed above, the latch arm 842 pivots as illustrated in Figure 16A. As the latch arm 842 pivots, it slides out of the latch arm mounting aperture 911 of the main connection member 906. As discussed

above, the support structure coupling assembly 800 is coupled to a support structure lifeline (not shown). Figure 16B illustrates the latch arm 842 clearing the latch arm mounting aperture 911 in the main connection member 906 allowing the support structure coupling assembly 800 to separate from the housing 841 which is coupled to the safety harness donned by a worker.

[0065] Referring to Figure 17 an example of a containment system 1225 to house the personal descent system 900 as described above. The containment system 1225 includes a backpack 1220 (pouch) that is used to house at least a portion of the personal descent system 900. Extending from a side of the backpack 1220 is a self deployment sleeve 1224 that is designed to contain at least a portion of the self-deployment system 950. Attached proximate the end of the self deployment sleeve 1224 is a connection strap 1226 that is used to connect the self deployment sleeve 1224 to a webbing of the safety harness 1275 donned by the worker 1250. An illustration of the containment system 1225 used in conjunction with a personal descent system 900 attached to a safety harness 1275 donned by a worker 1250 is illustrated in Figure 18. In one embodiment, the connection strap 1226 uses a connection system, such as but not limited to, a hook and loop arrangement to couple itself to the webbing of the safety harness 1275. The self deployment sleeve 1224 is positioned on the safety harness 1275 so the worker 1250 can reach the looped portion 950a of the self-deployment system 950.

[0066] An illustration of another embodiment of a backpack 1230 of a containment system is shown in Figure 19. In this embodiment, the backpack 1230 includes a side passage 1231 through which the activation connection portion 961b of the buddy deployment system 960 passes through. This allows access to the buddy deployment system 960 for a rescuer. Hence, a rescuer can activate the buddy deployment system 960 via grasping the activation connection portion 961b with a hook or the like. Figure 20 illustrate a portion of an inside chamber of the backpack 1230 that houses at least a portion of the personal descent system 900. In particular, this illustration shows that a pocket 1233 is used to hold the activation base 961a of the buddy activation portion 961 in place. Figure 21 further illustrates a front pocket cover 1240 of backpack 1230. The front pocket cover 1240 is used to cover an existing dorsal D-ring that would come with a harness. An example of an existing D-ring 1241 is illustrated in Figure 8. The front pocket cover is used to prevent a user from

accidentally hooking into the existing harness dorsal D-ring 1241 instead of D-ring 802 of the personal descent device 900. Also illustrated in Figure 21 are bottom straps 1260 and 1262. The bottom straps 1260 and 1262 include respective buckles 1261 and 1263 that are coupled to webbing of the harness 1275. The bottom straps 1260 and 1262 control the bottom of the backpack 1230 on the webbing of the harness 1275.

[0067] Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement, which is calculated to achieve the same purpose, may be substituted for the specific embodiment shown. This application is intended to cover any adaptations or variations of the present invention. Therefore, it is manifestly intended that this invention be limited only by the claims and the equivalents thereof.

CLAIMS

1. A personal descent system comprising:
 - a support structure coupling assembly configured and arranged to be coupled to a descent lifeline, the support structure coupling assembly including,
 - an adaptor connection member configured and arranged to couple different types of lifelines and lanyards to the support structure coupling assembly; and
 - a control descent device selectively coupled to the support structure coupling assembly, the control descent device configured and arranged to be coupled to a safety harness donned by a user, the control descent device further configured to detach from the support structure coupling assembly during a descent operation while controlling a payout of the descent lifeline.
2. The personal descent system of claim 1, further comprising:
 - a D-ring coupled to the support structure coupling assembly; and
 - a biasing member configured and arranged to biasing the D-ring in a desired position in relation to the control descent device.
3. The personal descent system of claim 2, the support structure coupling assembly further including:
 - a main connection member having an adapter member aperture configured to couple the adaptor connection member to the main connection member, the main connection member further having at least a descent lifeline termination aperture configured to couple an end of the descent lifeline to the support structure coupling assembly.
4. The personal descent system of claim 1, wherein the control descent device further comprises:
 - a brake assembly engaged with the descent lifeline to control a payout of the descent lifeline;

a housing, the brake assembly received within the housing, the housing having an entry passage for the descent lifeline to enter the housing and brake assembly and an exit passage to exit the housing; and

a break away seal configured and arranged to seal the exit passage.

5. The personal descent system of claim 4, further comprising:

a sealing bolt having a central passage, the sealing bolt received in the entry passage of the housing, the descent lifeline passing through the central passage of the sealing bolt.

6. The personal descent system of claim 1, further comprising:

a latch arm pivotally coupled to the control descent device, the latch arm selectively received within a latch arm mounting aperture in the main connection member to selectively couple the control descent device to the main connection member of the support structure coupling assembly.

7. The personal descent system of claim 6, wherein the main connection member of the support structure coupling assembly engages the latch arm at a location on the latch arm that reduces a load on an activation lock pin that holds the latch arm in a static location in relation to the main connection member to ease activation of the control descent device.

8. The personal descent system of claim 6, further comprising:

a deployment system configured and arranged to selectively lock and unlock the latch arm to the control descent device to the main connection member, a portion of the deployment system positioned to be activated by the user of the safety harness.

9. The personal descent system of claim 6, further comprising:

a buddy deployment system configured and arranged to activate the deployment system by a rescue person.

10. The personal descent system of claim 9, further comprising:

the buddy deployment system configured to break away from the personal descent system after activation of the deployment system.

11. The personal descent system of claim 6, further comprising:
 - a fuse pin configured and arranged to keep the latch arm in the latch arm mounting aperture in the main connection member during non-fall events.
12. The personal descent system of claim 1, further comprising:
 - a spool to hold the descent lifeline; and
 - a sealing container, the spool received within the sealing container.
13. The personal descent system of claim 1, further comprising:
 - the control descent device including a descent housing, the descent housing having a deployment passage and a conical mouth opening to the deployment passage; and
 - a deployment system configured and arranged to deploy the control descent device to detach from the support structure coupling assembly during a descent operation, the deployment system including an elongated portion passing through the deployment passage in the descent housing, the deployment system configured and arranged to deploy the control descent device by pulling the elongated portion, the curvature of the conical mouth opening being configured to not impede the pulling of the elongated portion regardless which direction the elongated portion is being pulled.
14. A personal descent system comprising:
 - a descent lifeline;
 - a support structure coupling assembly including,
 - a main connection member including a latch arm mounting aperture, the descent lifeline coupled to the main connection member, and
 - a D-ring coupled to the main connection member; and
 - a control descent device including,
 - a housing, the housing configured and arranged to be coupled to a safety harness donned by a user,

a latch arm pivotally coupled to the housing, the latch arm selectively received within the latch arm mounting aperture of the main connection member to selectively couple the support structure coupling assembly to the control descent device,

a brake assembly received within the housing, the brake assembly engaged with the descent lifeline to control a payout of the descent lifeline, and

a self-deployment system configured and arranged to selectively release the latch arm to allow the latch arm to pivot in relation to the housing therein causing the latch arm to be removed from the latch arm mounting aperture of the main connection member.

15. The personal descent system of claim 14, wherein the support structure coupling assembly further includes:

an adaptor connection member coupled to the main connection member, at least one of the D-ring and the adaptor connection member configured and arranged to couple a support lifeline to the support structure coupling assembly.

16. The personal descent system of claim 14, wherein the self-deployment system further comprises:

a self elongated portion, a portion of the self elongated portion being received within a deployment passage within the housing;

a lock pin coupled to an end of the self elongated portion, the lock pin selectively received with a lock aperture of the latch arm to selectively lock the latch arm in a static position in relation to the housing; and

a biasing member received within the deploy passage of the housing, the biasing member positioned to assert a biasing force on the lock pin into the lock aperture of the latch arm.

17. The personal descent system of claim 16, further comprising:

a stop coupled to the self elongated portion;

a buddy activation base member including a seat, the stop received within the seat, the buddy activation base member further including a ramp surface; and

a buddy elongated portion having a first end and a second end, the first end of the buddy elongated portion coupled to the buddy activation base member, the second end of the buddy elongated portion coupled to a buddy activation portion that is configured and arranged to be engaged by a rescue person.

18. The personal descent system of claim 17, further comprising:

a containment system to house the control descent device, the containment system having a slot, the containment system including a side passage in which a portion of the buddy activation portion extends through, the containment system further having a pocket to hold another portion of the buddy activation portion proximate the side passage.

19. A personal descent system comprising:

a descent lifeline;

a support structure coupling assembly including,

a main connection member including a latch arm mounting aperture, the descent lifeline coupled to the main connection member, and

an adaptor connection member coupled to the main connection member, the adaptor connection member configured and arranged to couple a support lifeline to the support structure coupling assembly;

a control descent device including,

a housing, a pair of spaced descent connecting arms extending from the housing, the pair of spaced descent connection arms having aligned routing apertures,

a latch arm pivotally coupled between the descent connection arms, the latch arm selectively received with the latch arm mounting aperture of the main connection member to selectively couple the support structure coupling assembly to the control descent device, and

a brake system contained within the housing, the brake assembly engaged with the descent lifeline to at least in part control a payout of the descent lifeline; and

a spool to hold at least a portion of the descent lifeline, the descent lifeline routed from the spool into an entry to the housing, through the brake system in the housing, out an

exit in the housing, through the aligned routing apertures in the descent connection arms to the main connector member.

20. The personal descent system of claim 19, further comprising:

a self-deployment system configured and arranged to selectively allow the latch arm to pivot in relation to the housing to detach the control descent device from the support structure coupling assembly; and

a buddy deployment system configured and arranged to selectively allow the latch arm to pivot in relation to the housing to detach the control descent device from the support structure coupling assembly by a rescue person.

21. The personal descent system of claim 19, further comprising:

the housing having a deployment passage and a conical mouth opening to the deployment passage; and

a self-deployment system configured and arranged to selectively allow the latch arm to pivot in relation to the housing to detach the control descent device from the support structure coupling assembly, the self-deployment system including a self elongated portion that passes through the deployment passage in the housing, a radius of a curvature of the conical mouth opening being configured to not impede a pulling of the self elongated portion regardless of a direction the self elongated portion is pulled.

22. The personal descent system of claim 19, further comprising:

a break away seal positioned near an exit of the housing; and

a fuse positioned to prevent the latch arm from rotating in relation to the housing until a select amount of force is applied.

23. A personal descent system comprising:

a descent lifeline;

a support structure coupling assembly configured and arranged to be coupled to a descent lifeline;

a control descent device selectively coupled to the support structure coupling assembly, the control descent device including,

a housing, the housing configured and arranged to be coupled to a safety harness donned by a user, the housing having an entry passage for the descent lifeline to enter the housing and an exit passage to exit the housing;

a break away seal positioned near the exit to the housing;

a brake assembly received within the housing, the brake assembly engaged with the descent lifeline to control a payout of the descent lifeline, and

a self-deployment system configured and arranged to selectively disconnect the control descent device from the support structure coupling assembly;

a spool configured and arranged to hold at least a portion of the descent line, the descent lifeline passing from the spool into the entry passage to the housing; and

a sealing container positioned around the spool to prevent moisture and debris from reaching the descent lifeline on the spool.

24. The personal descent system of claim 23, further comprising:

a sealing bolt having a central passage, the sealing bolt received in the entry passage of the housing, the descent lifeline passing through the central passage of the sealing bolt.

25. The personal descent system of claim 23, further comprising:

the housing having a first housing portion and a second housing portion, the housing further having a deployment passage to receive the self-deployment system;

a housing seal positioned between the first housing portion and the second housing portion;

as first seal positioned proximate a first end of the deployment passage; and

a second seal positioned proximate the second end of the deployment passage.

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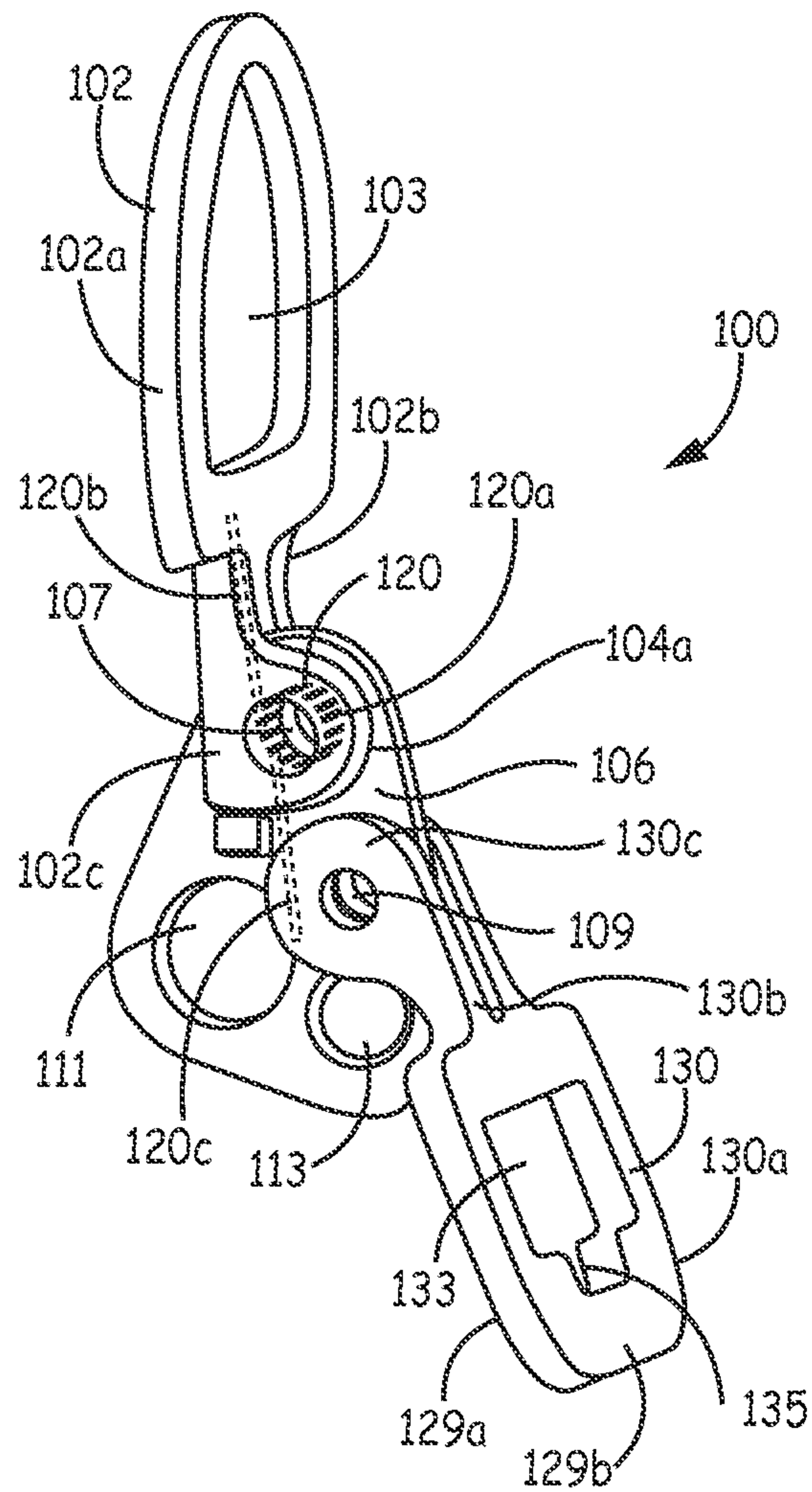


FIG. 1

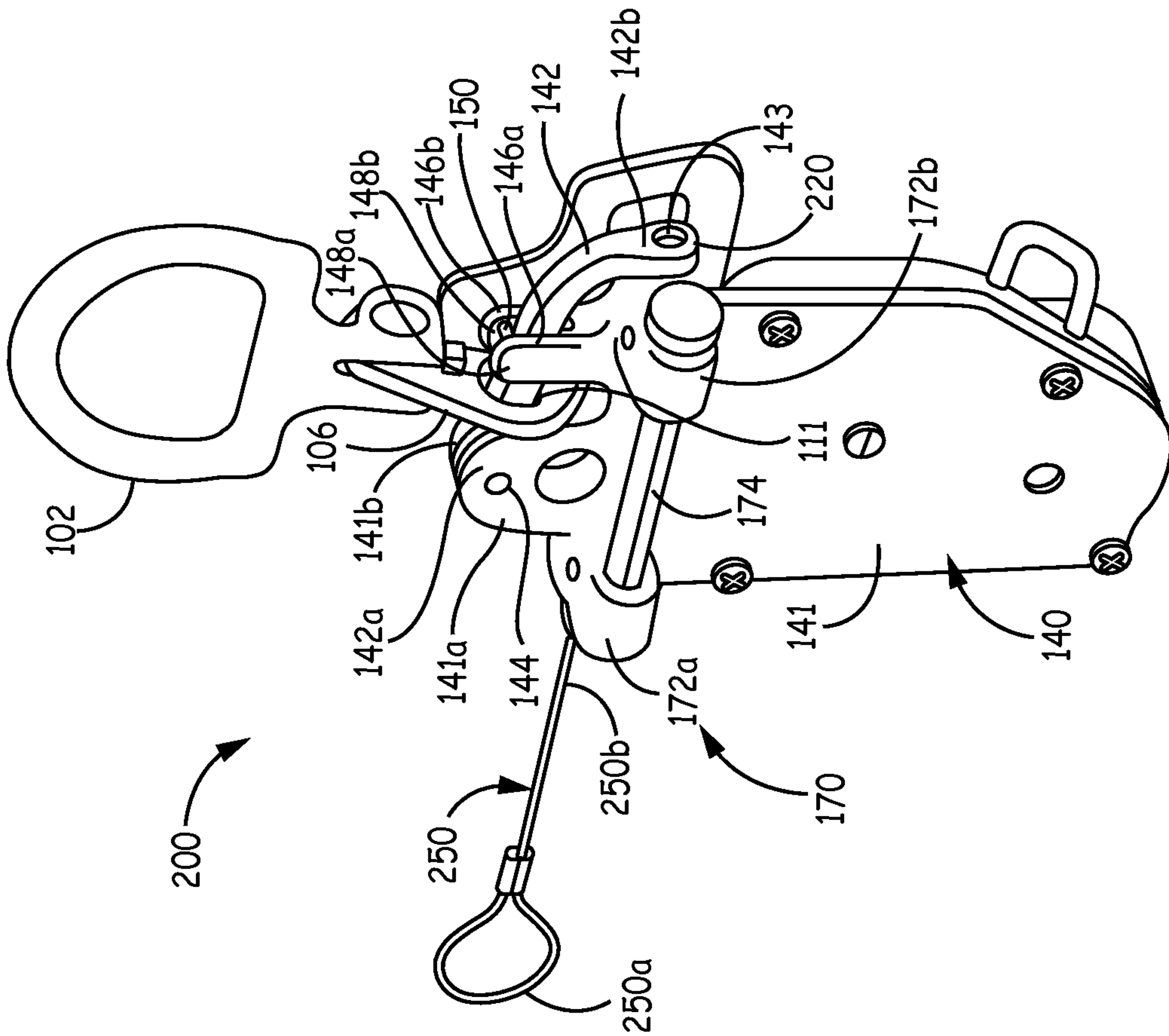


FIG. 2B

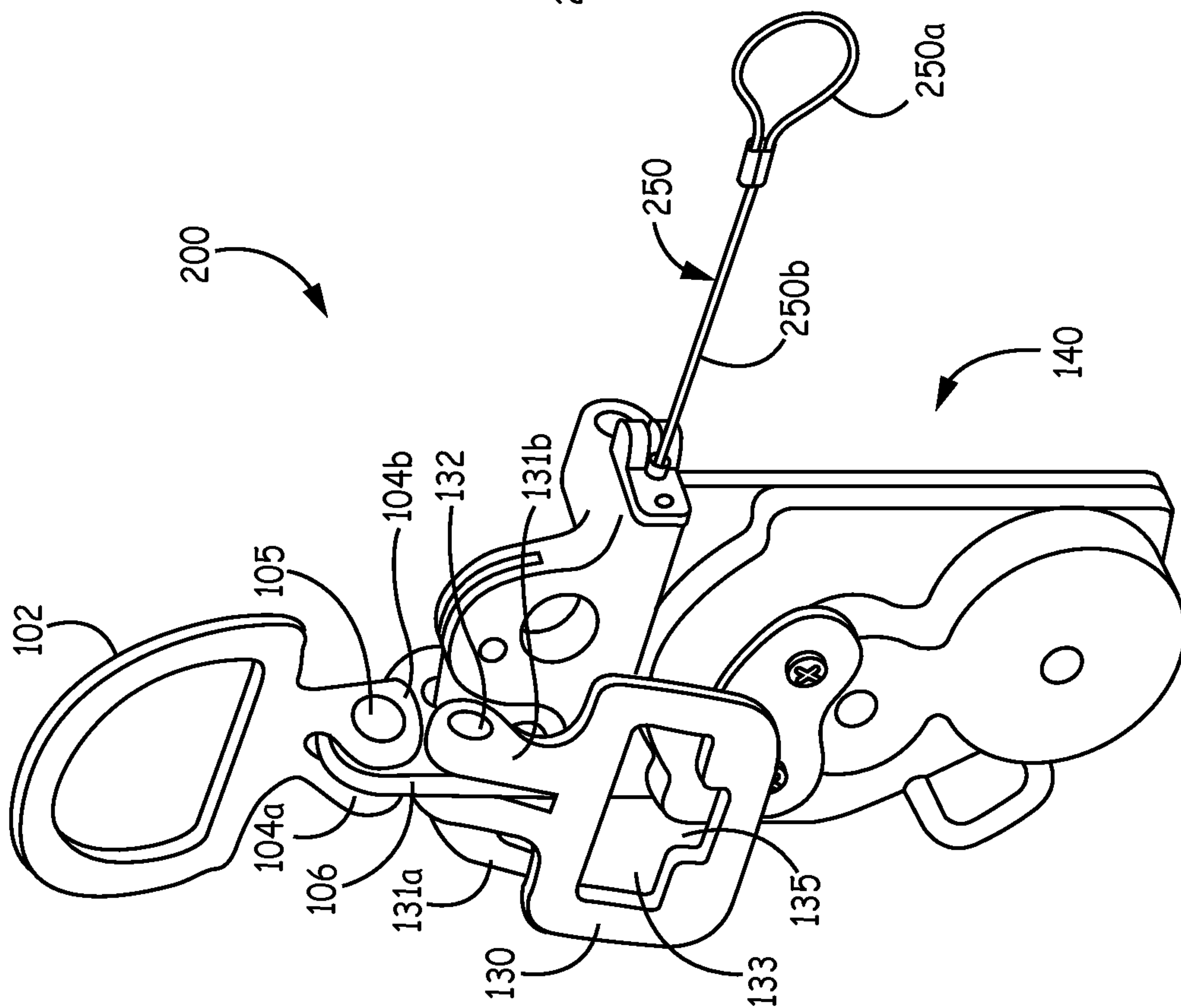


FIG. 2A

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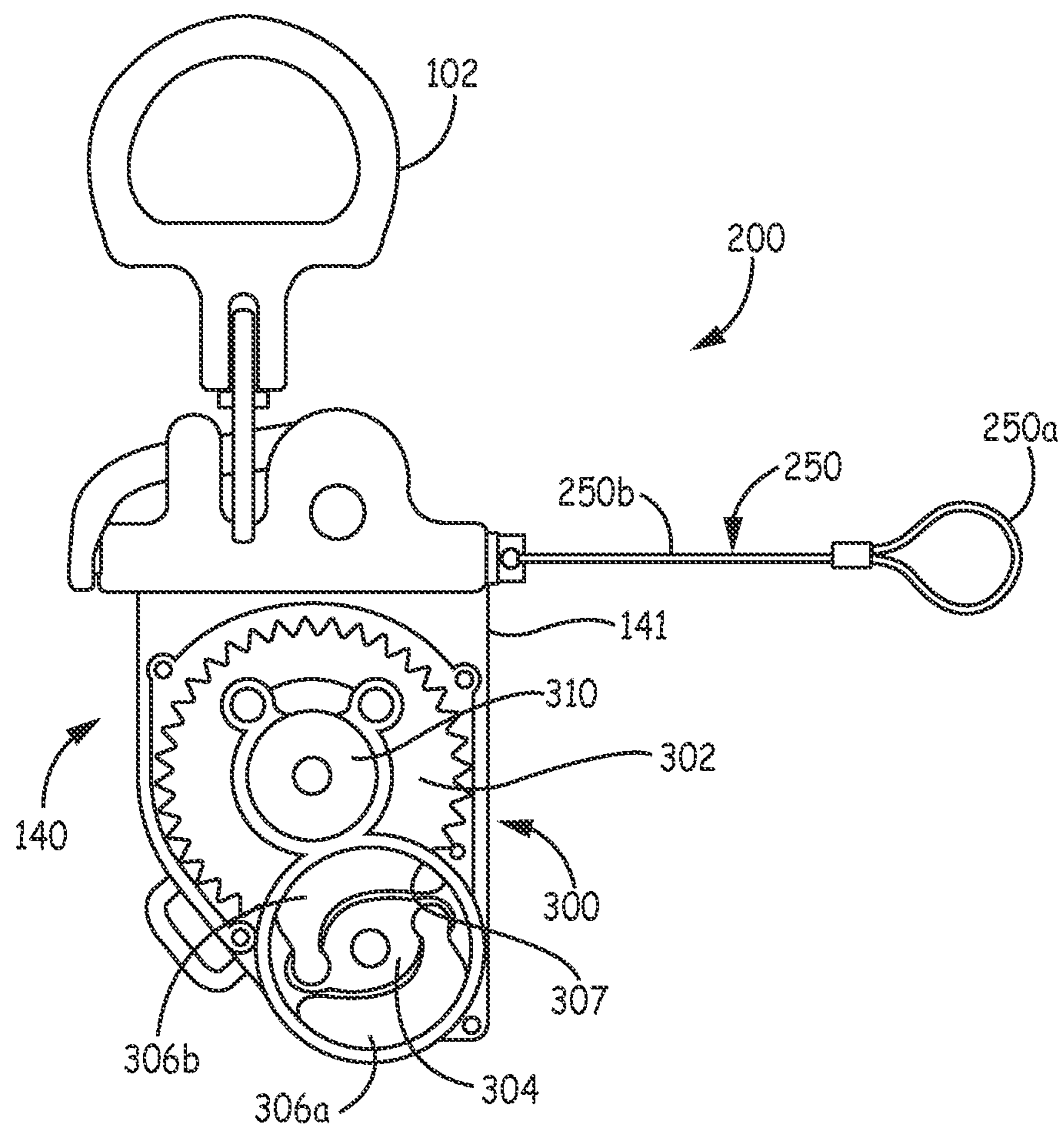


FIG. 2C

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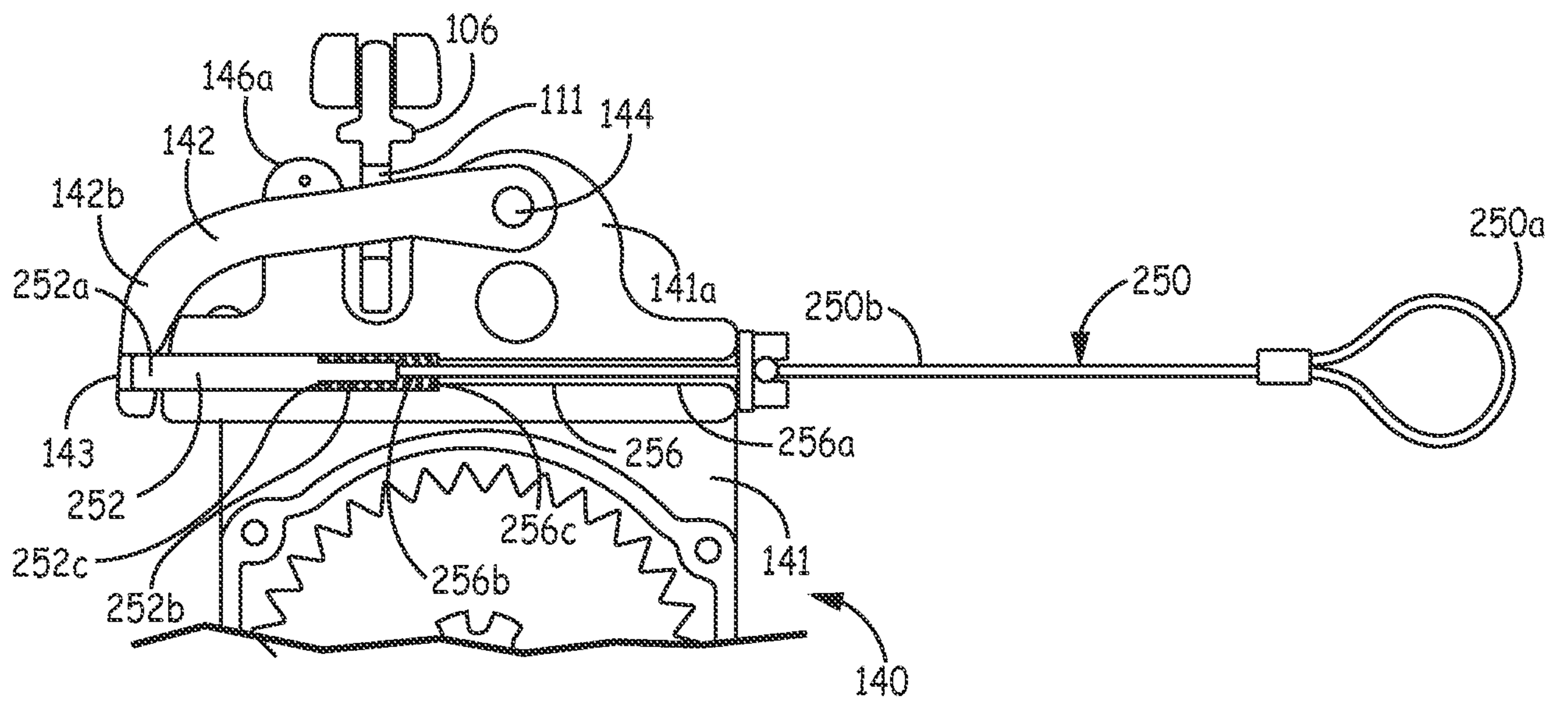


FIG. 3A

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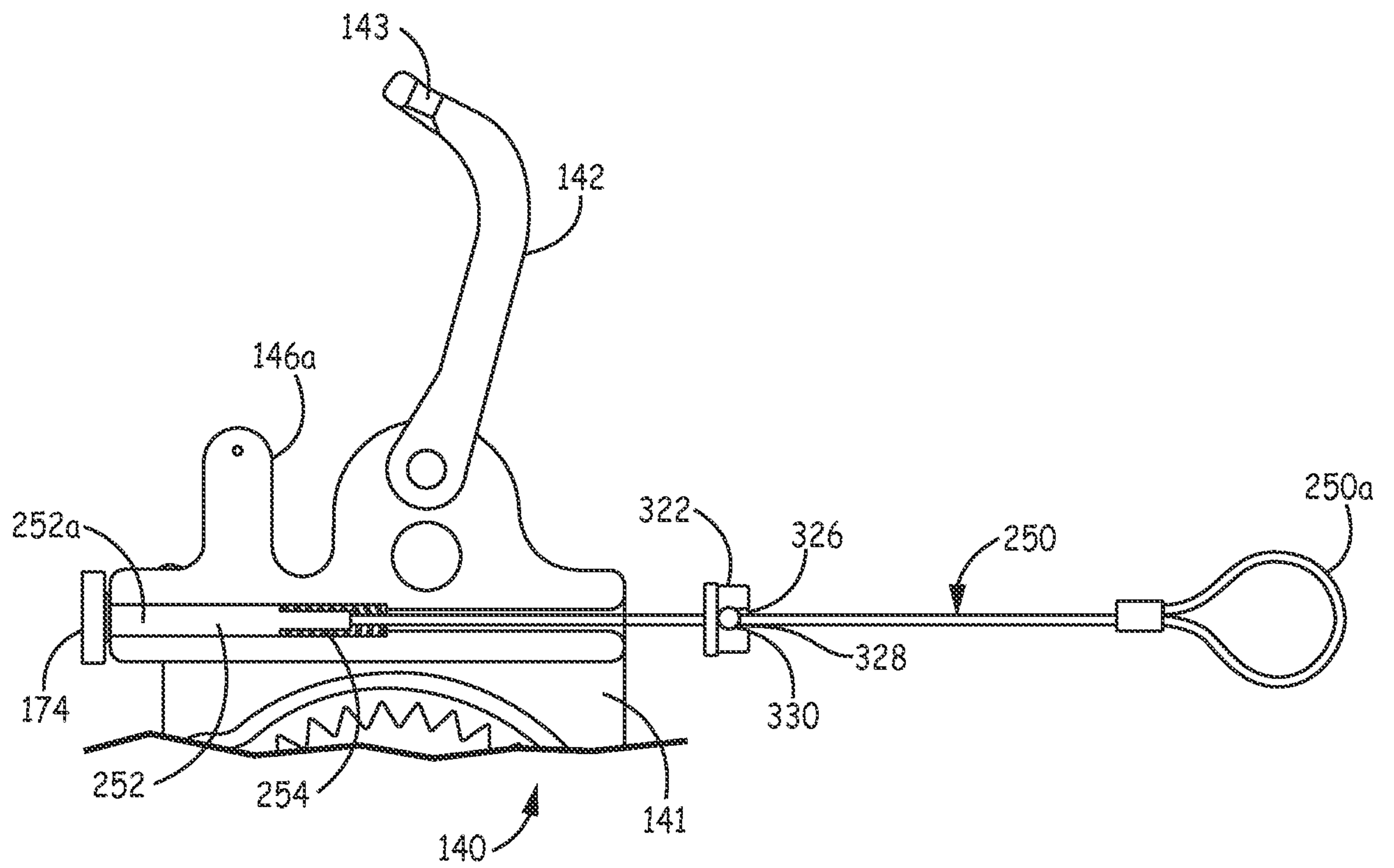


FIG. 3B

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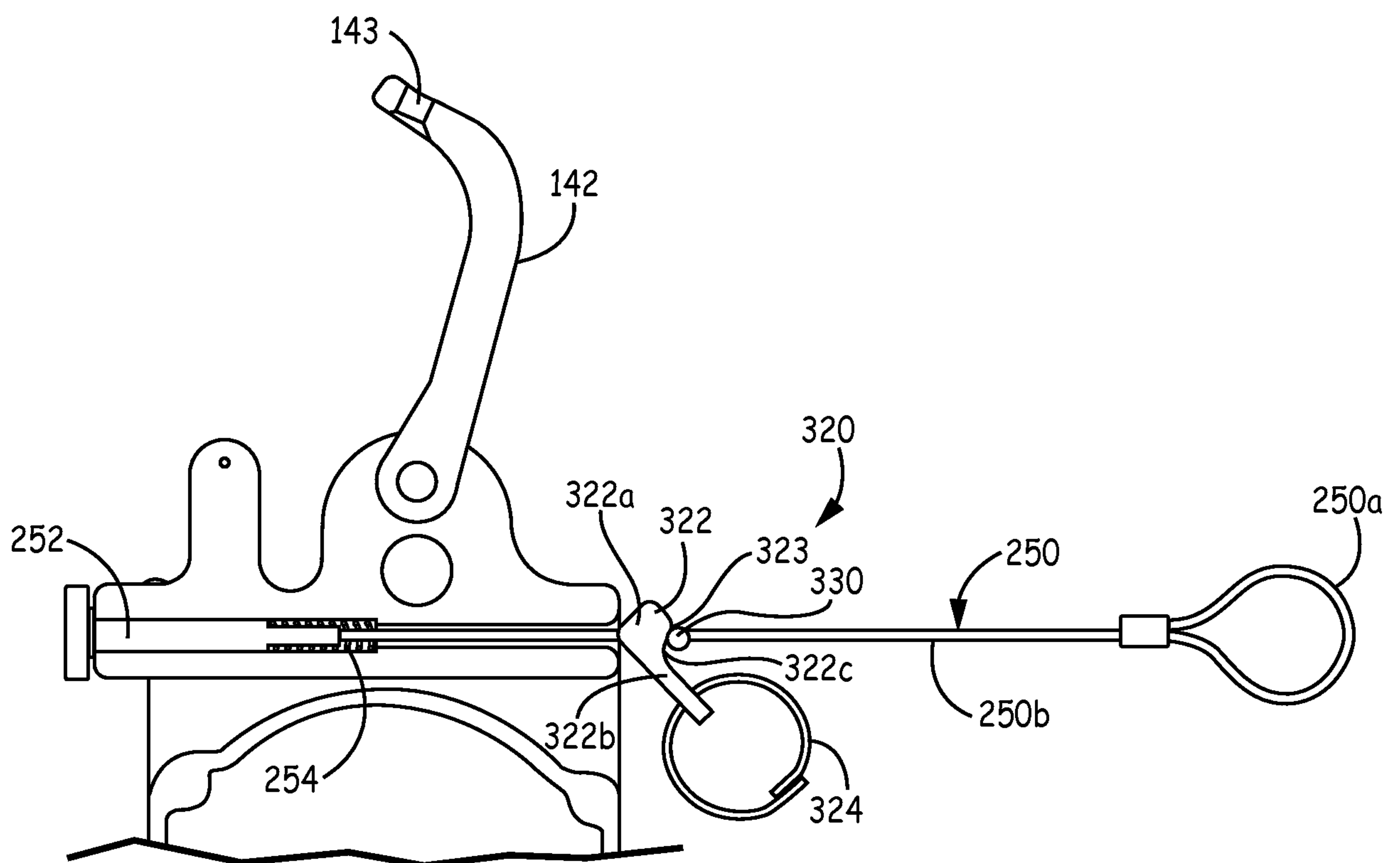


FIG. 4A

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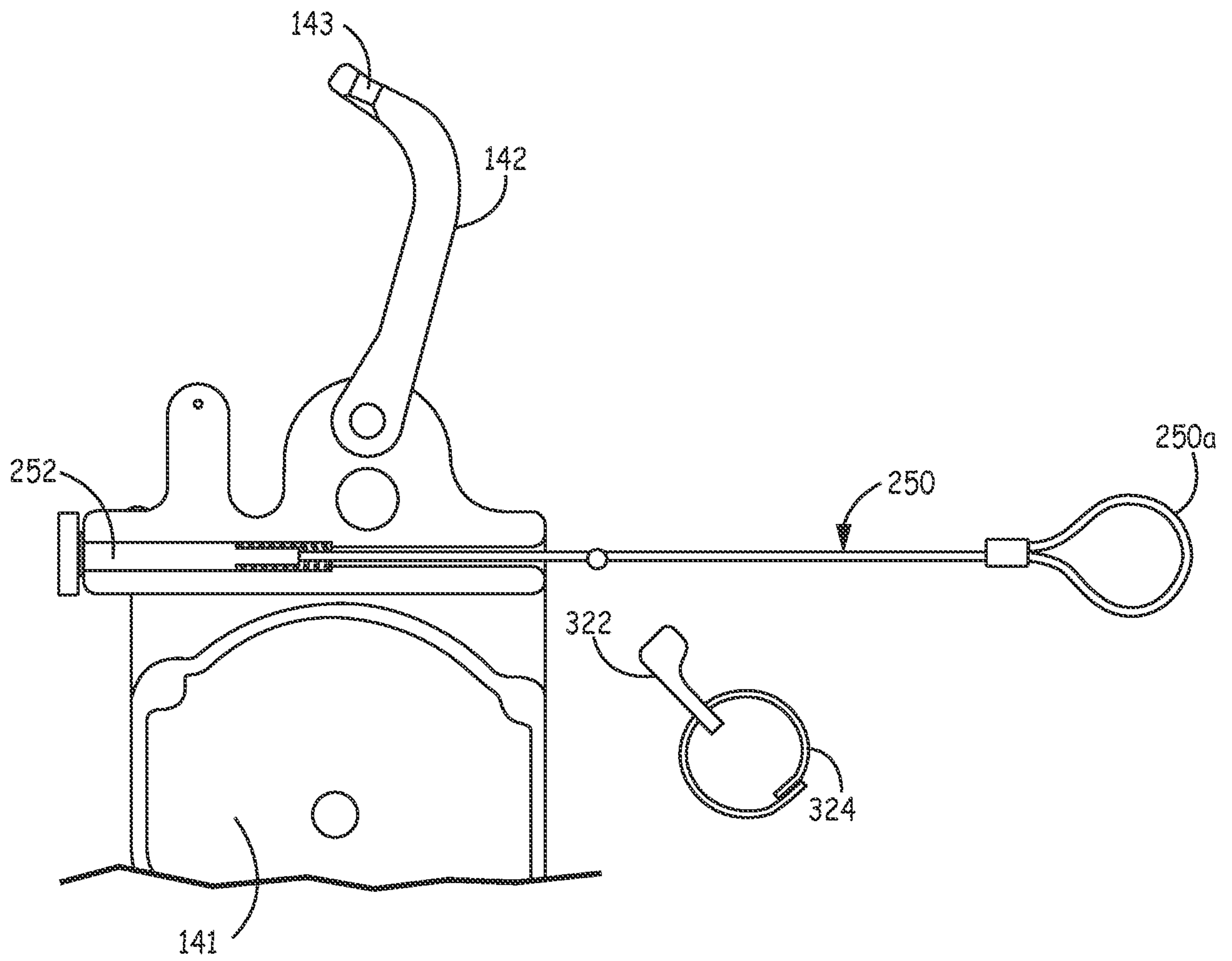


FIG. 4B

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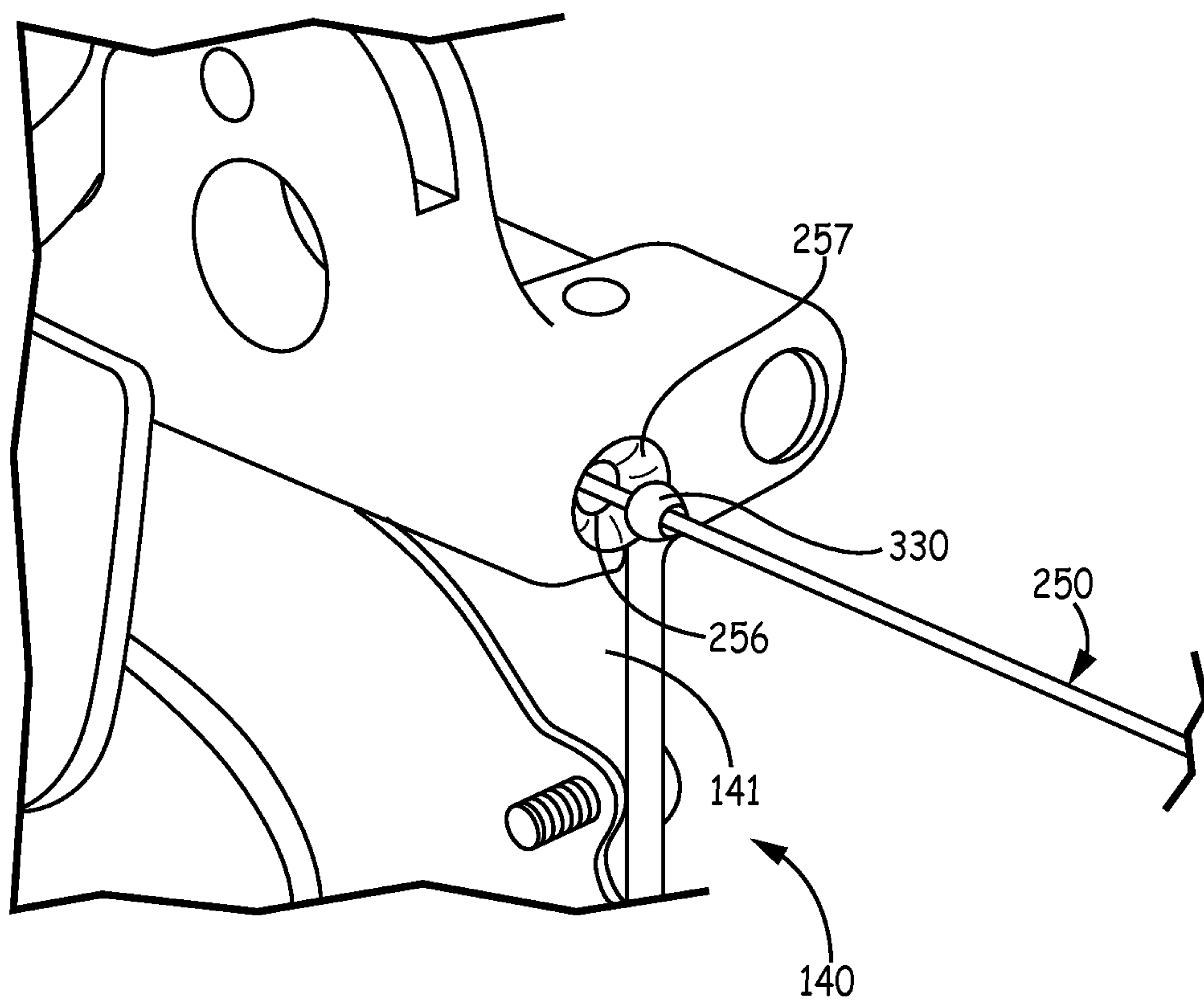


FIG. 5

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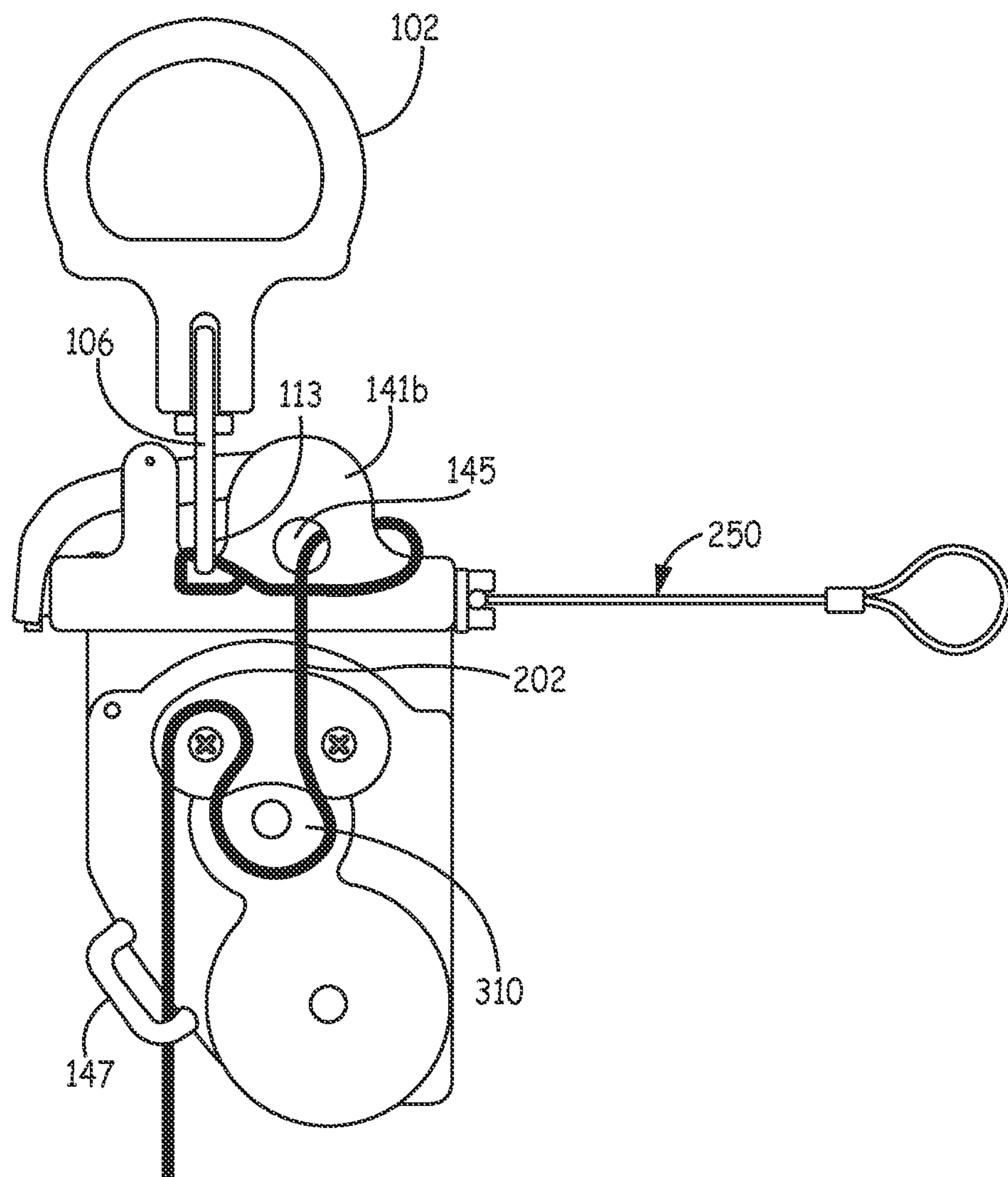


FIG. 6A

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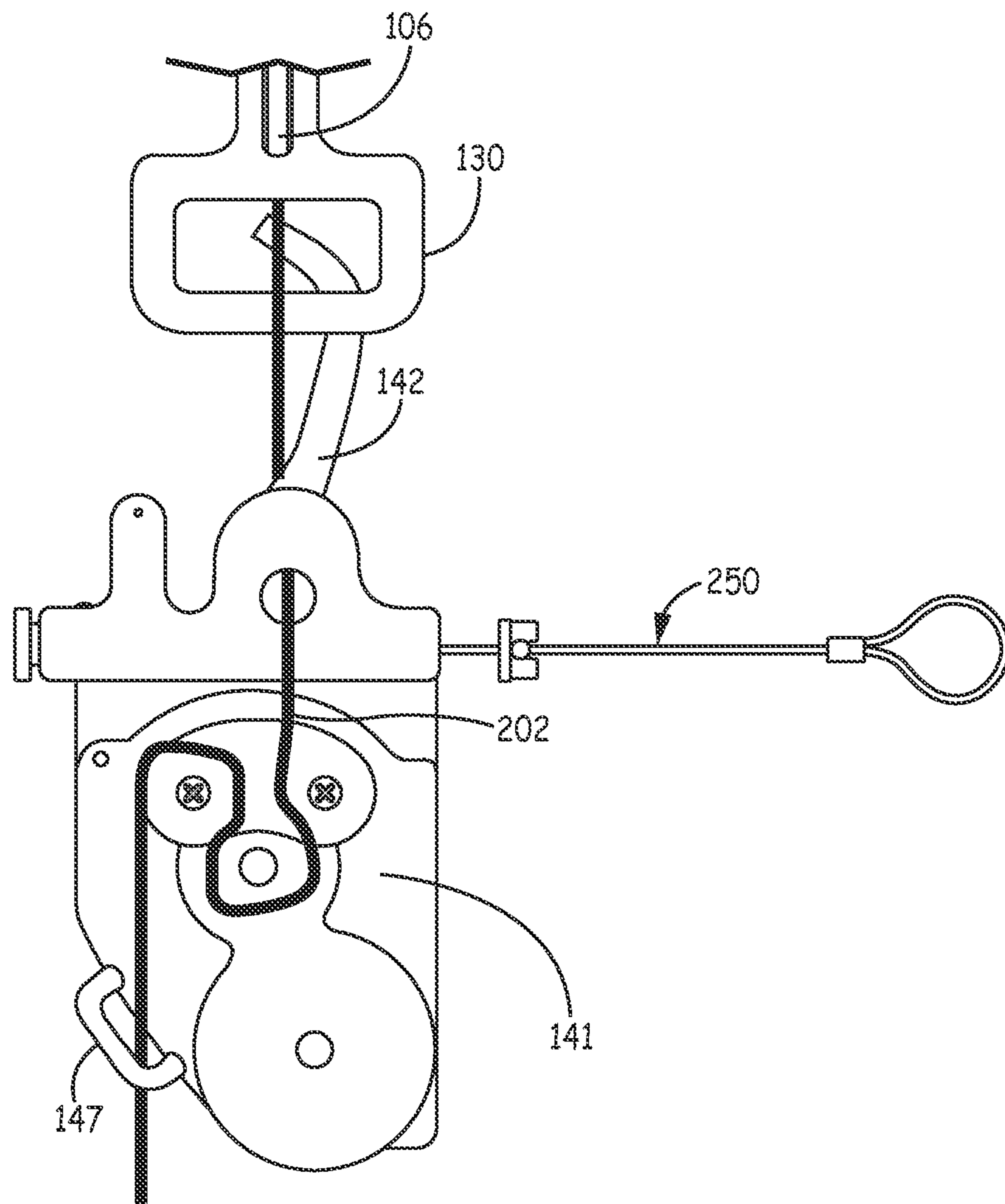


FIG. 6B

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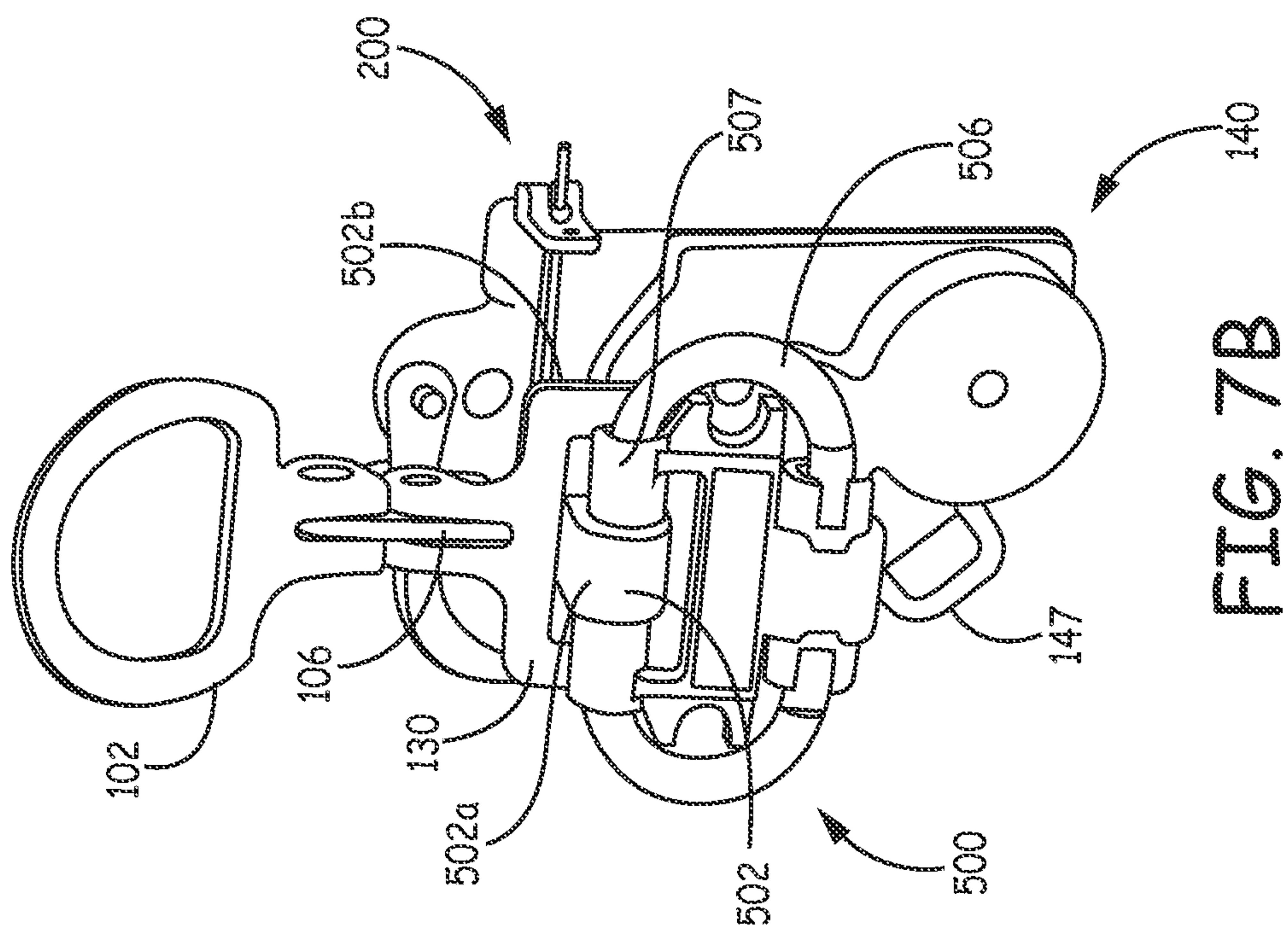


FIG. 7B

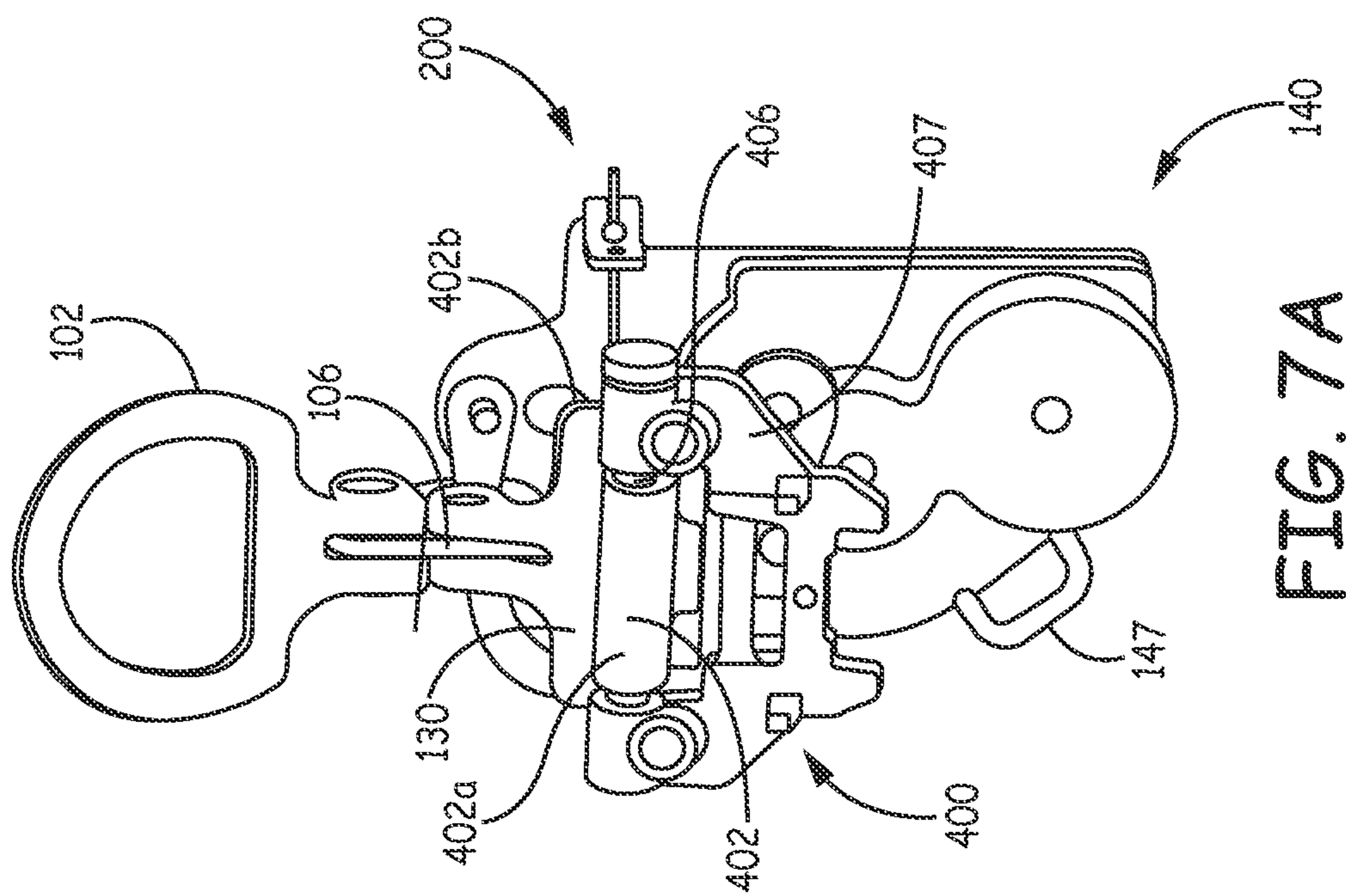


FIG. 7A

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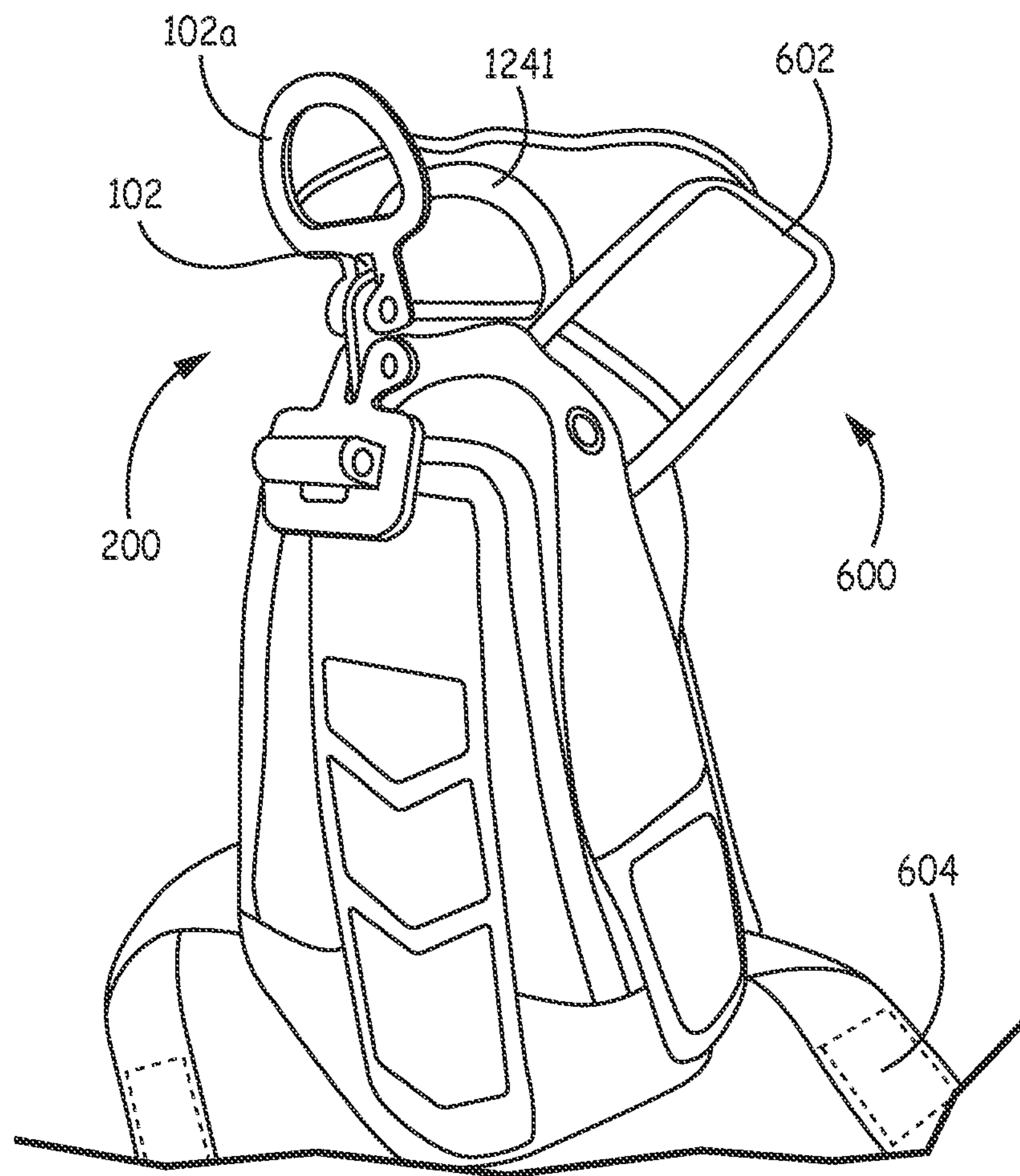


FIG. 8

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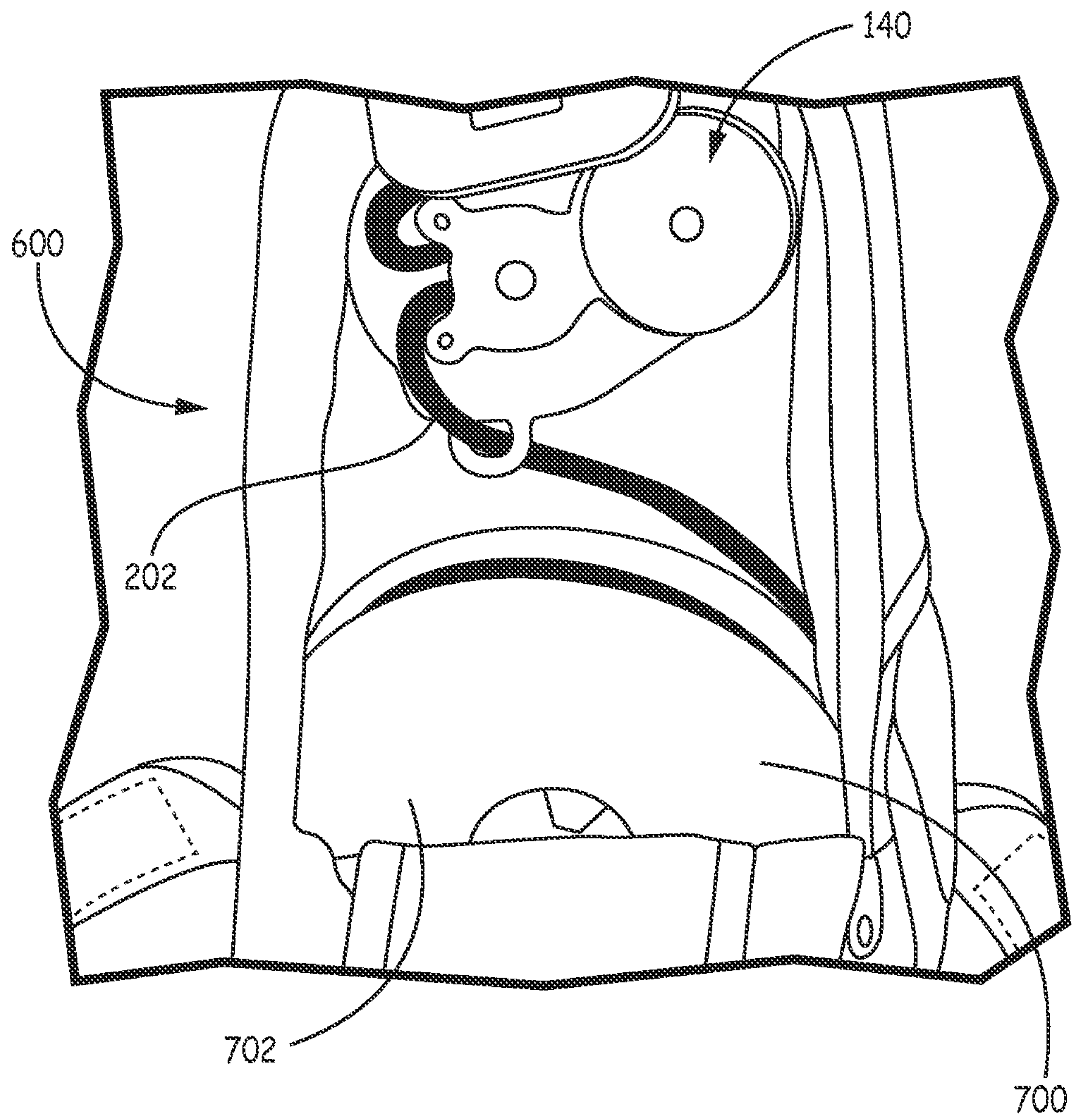


FIG. 9

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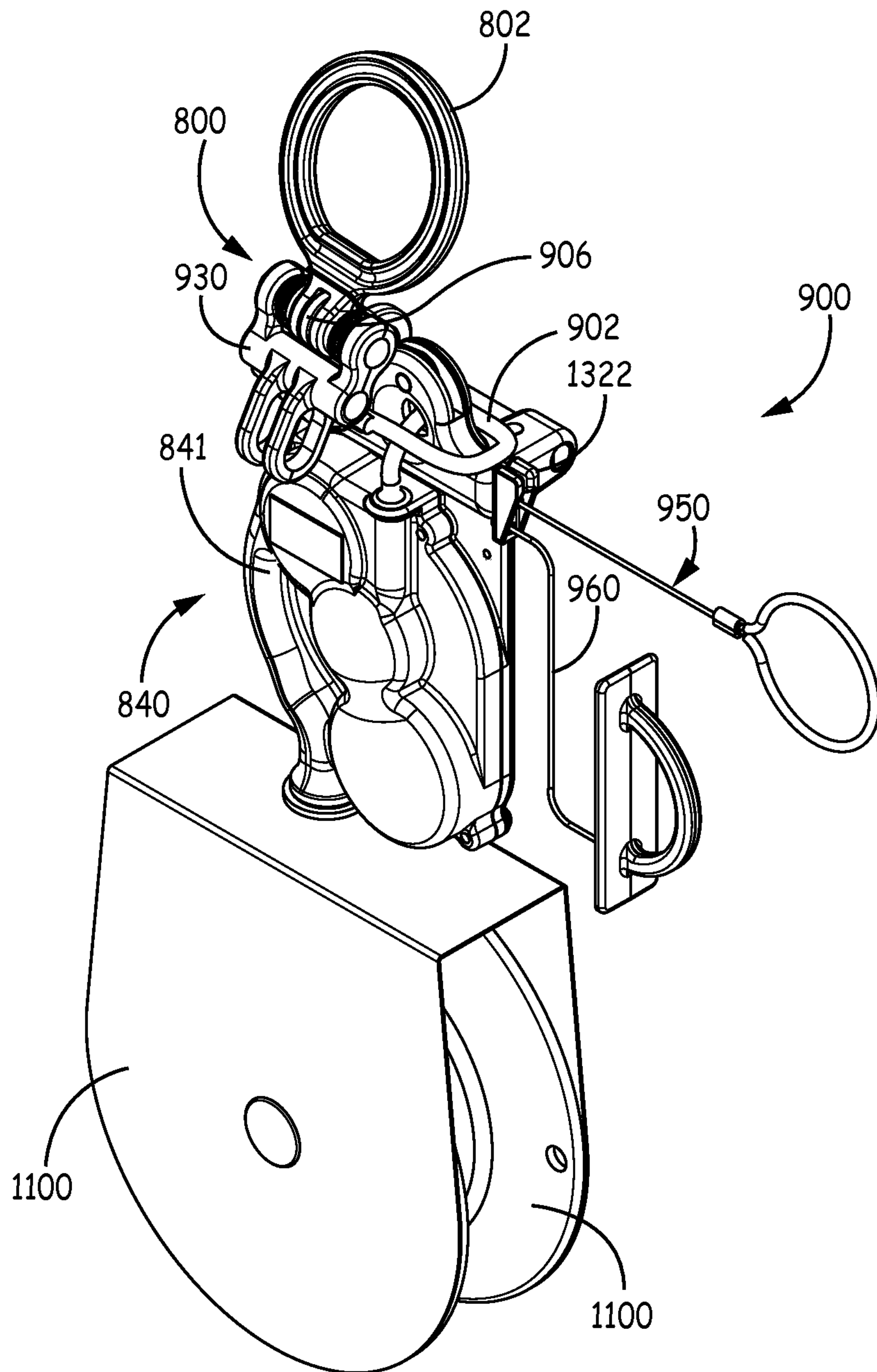


FIG. 10

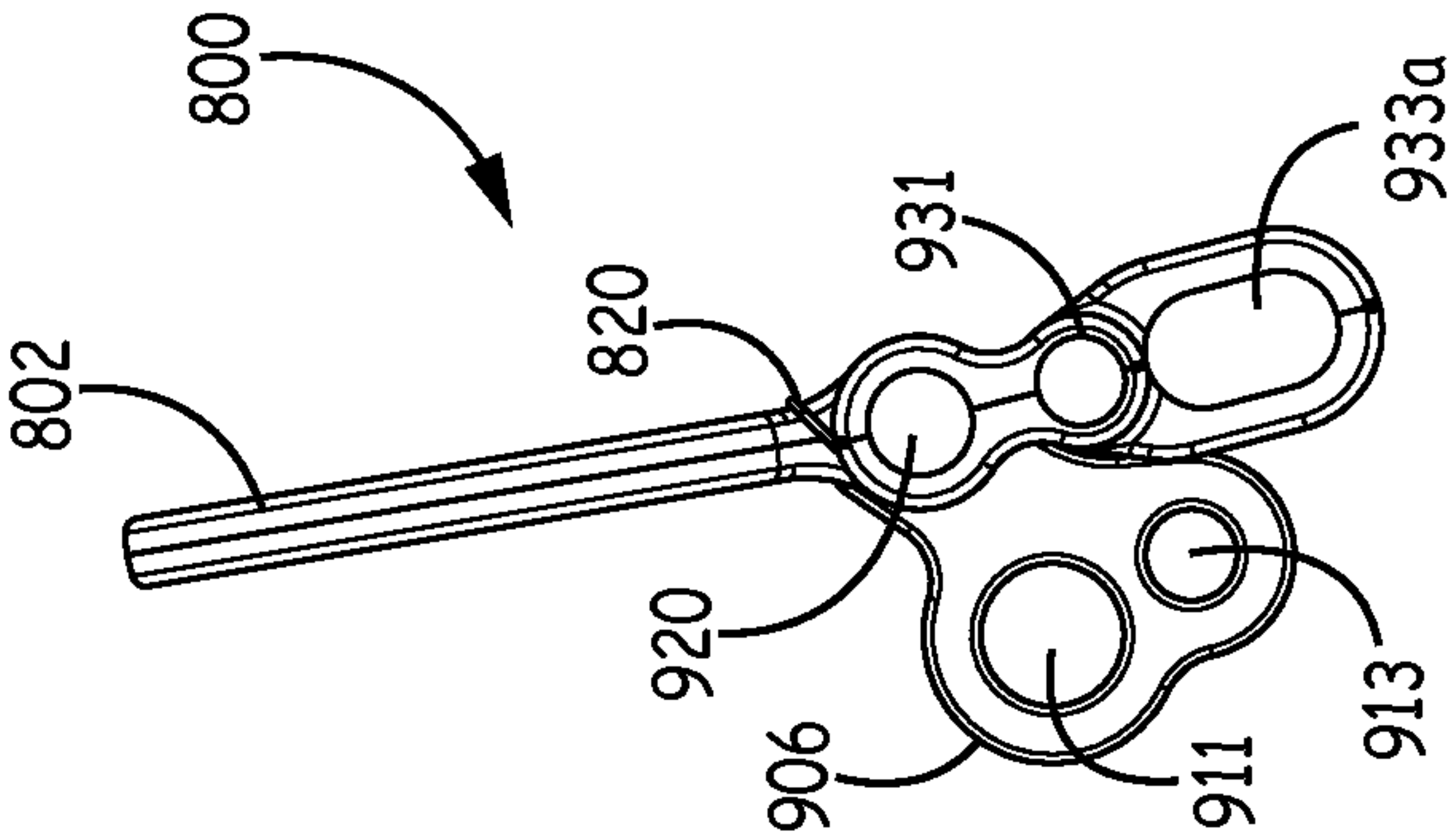


FIG. 12B

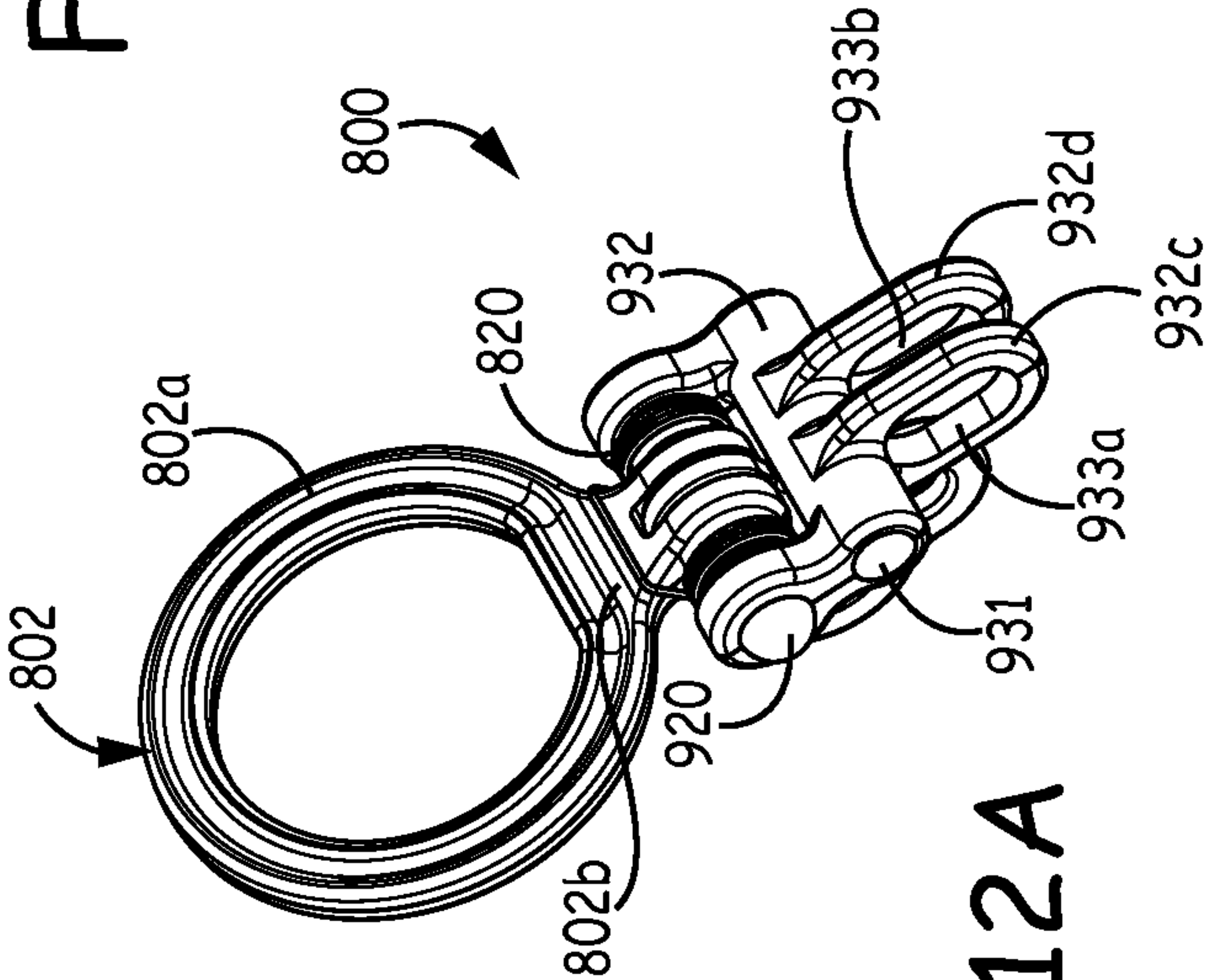


FIG. 12A

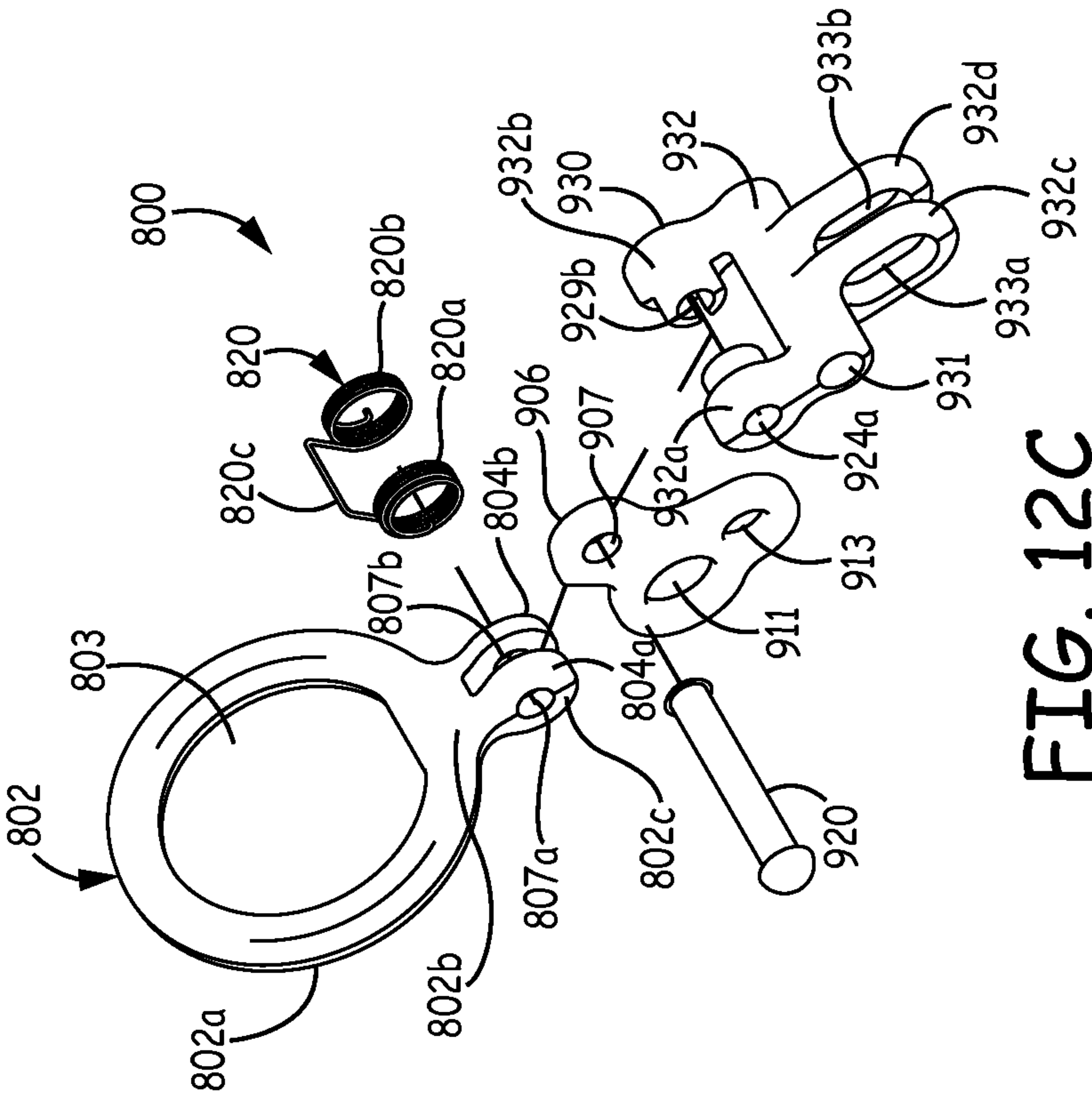


FIG. 12C

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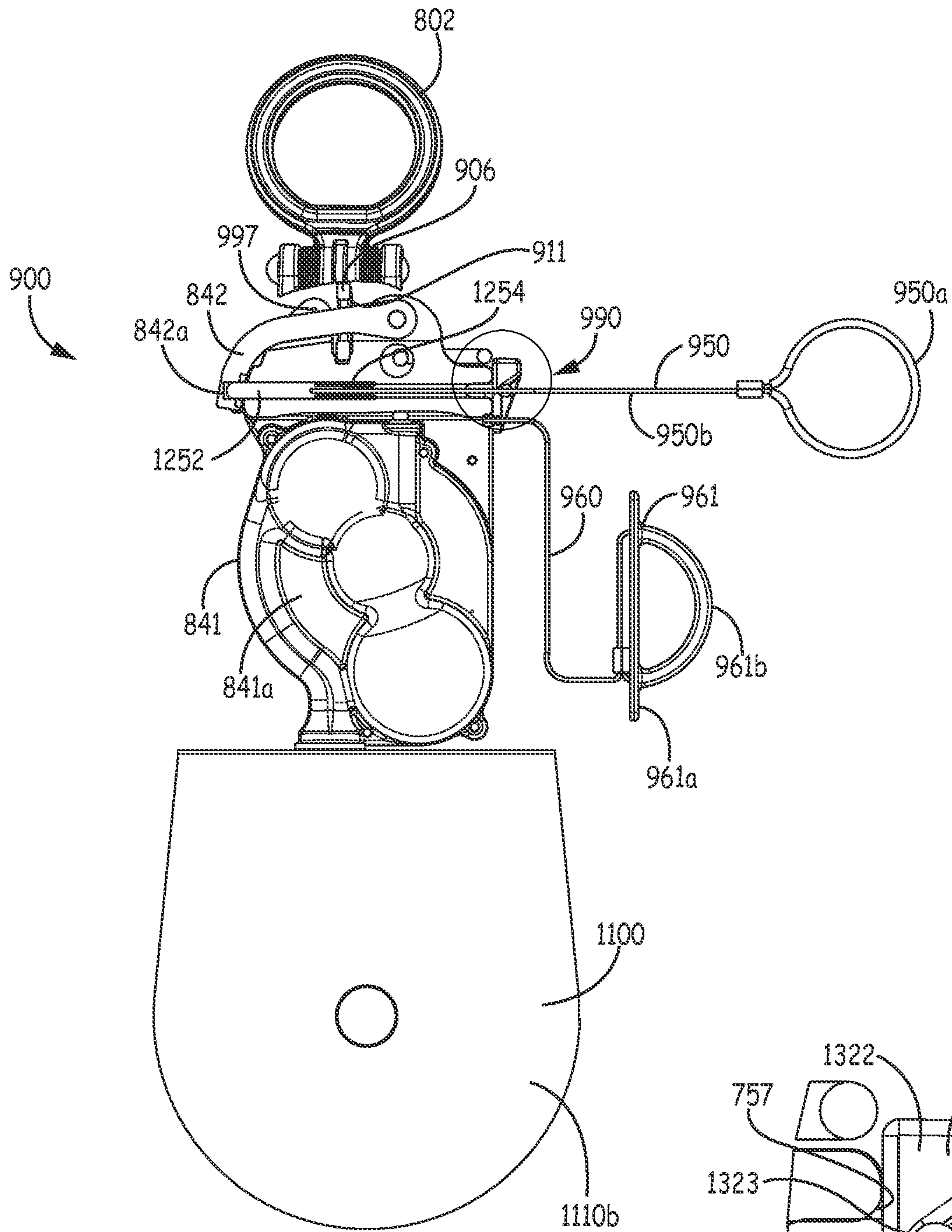


FIG. 13A

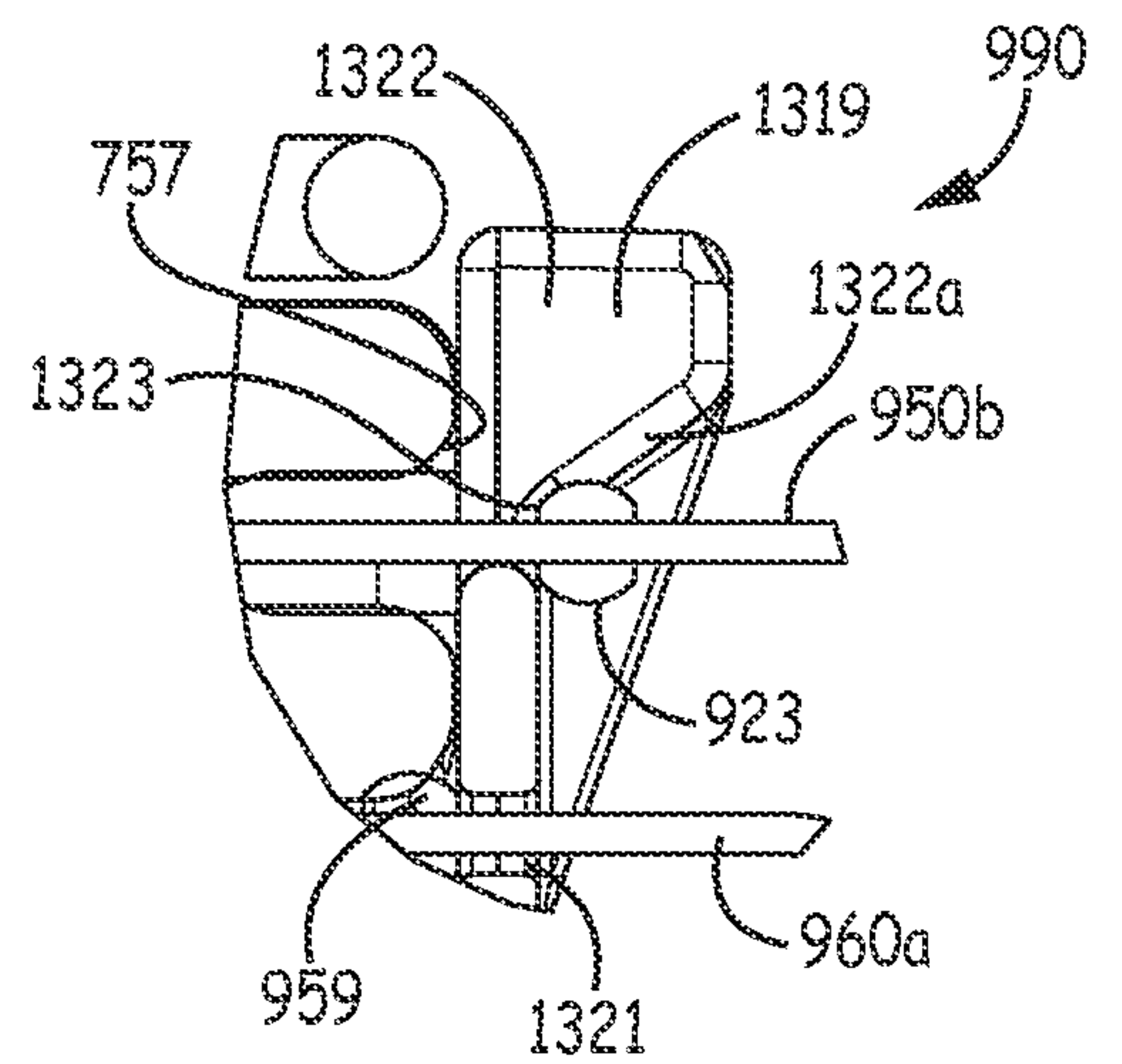


FIG. 13B

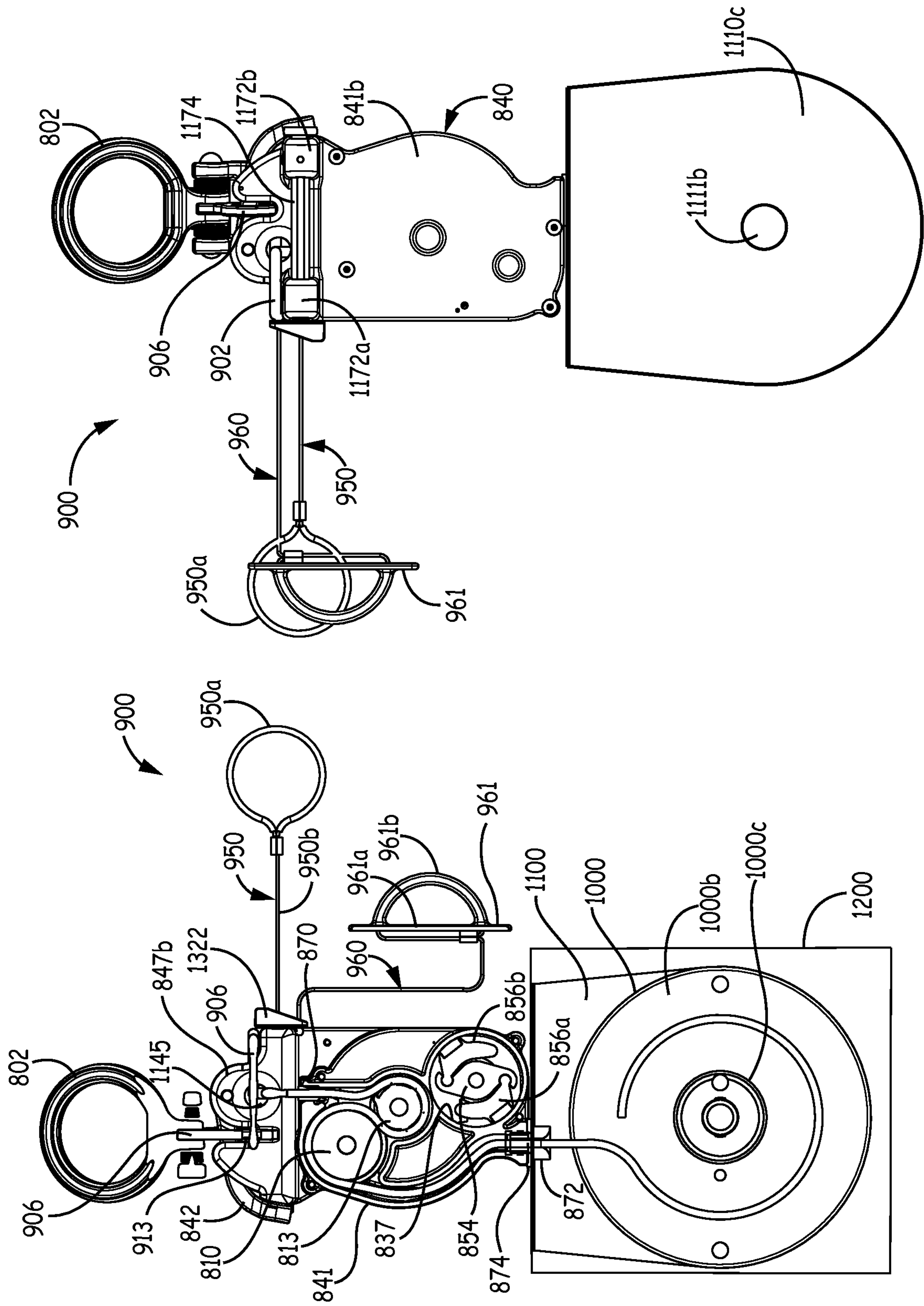
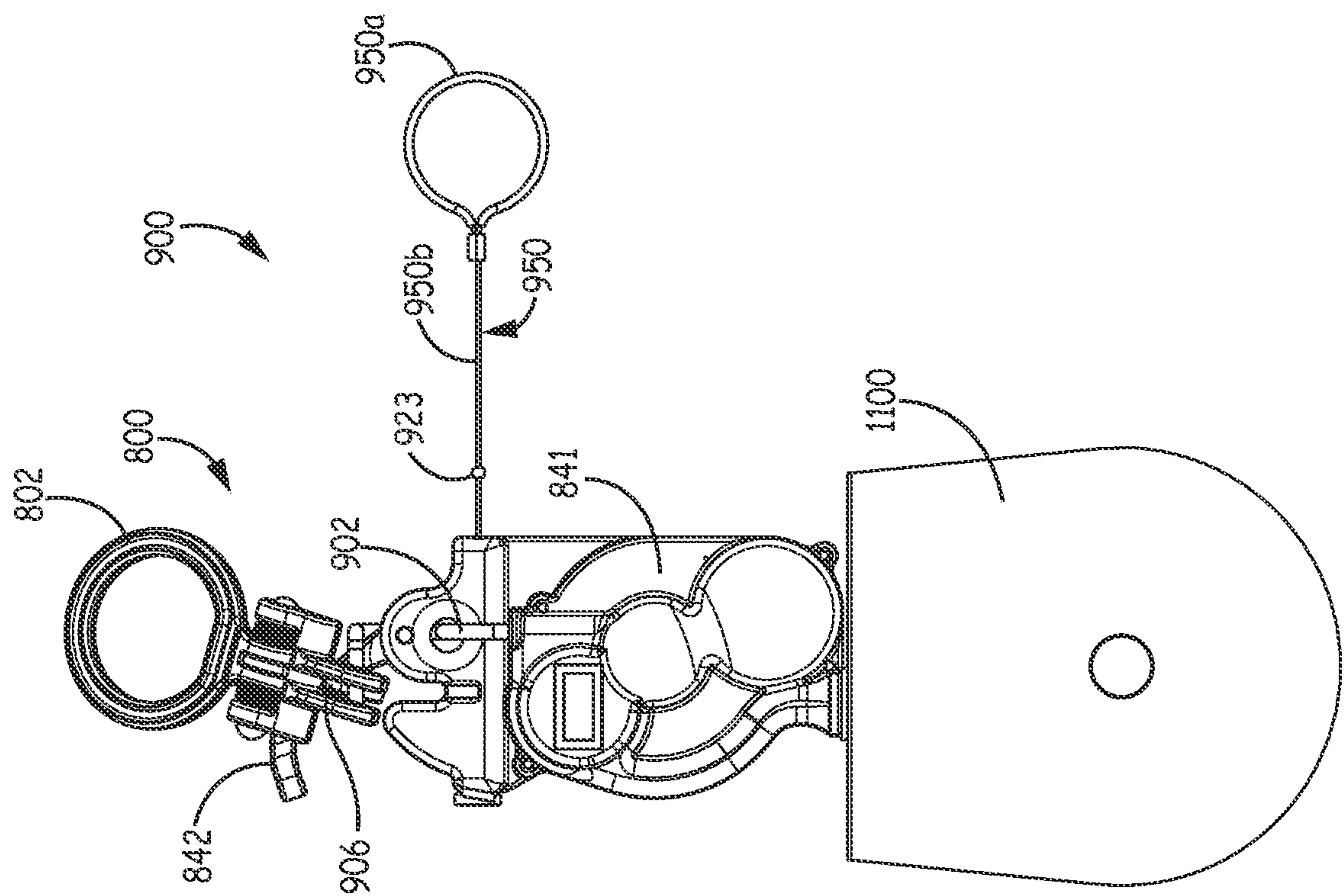
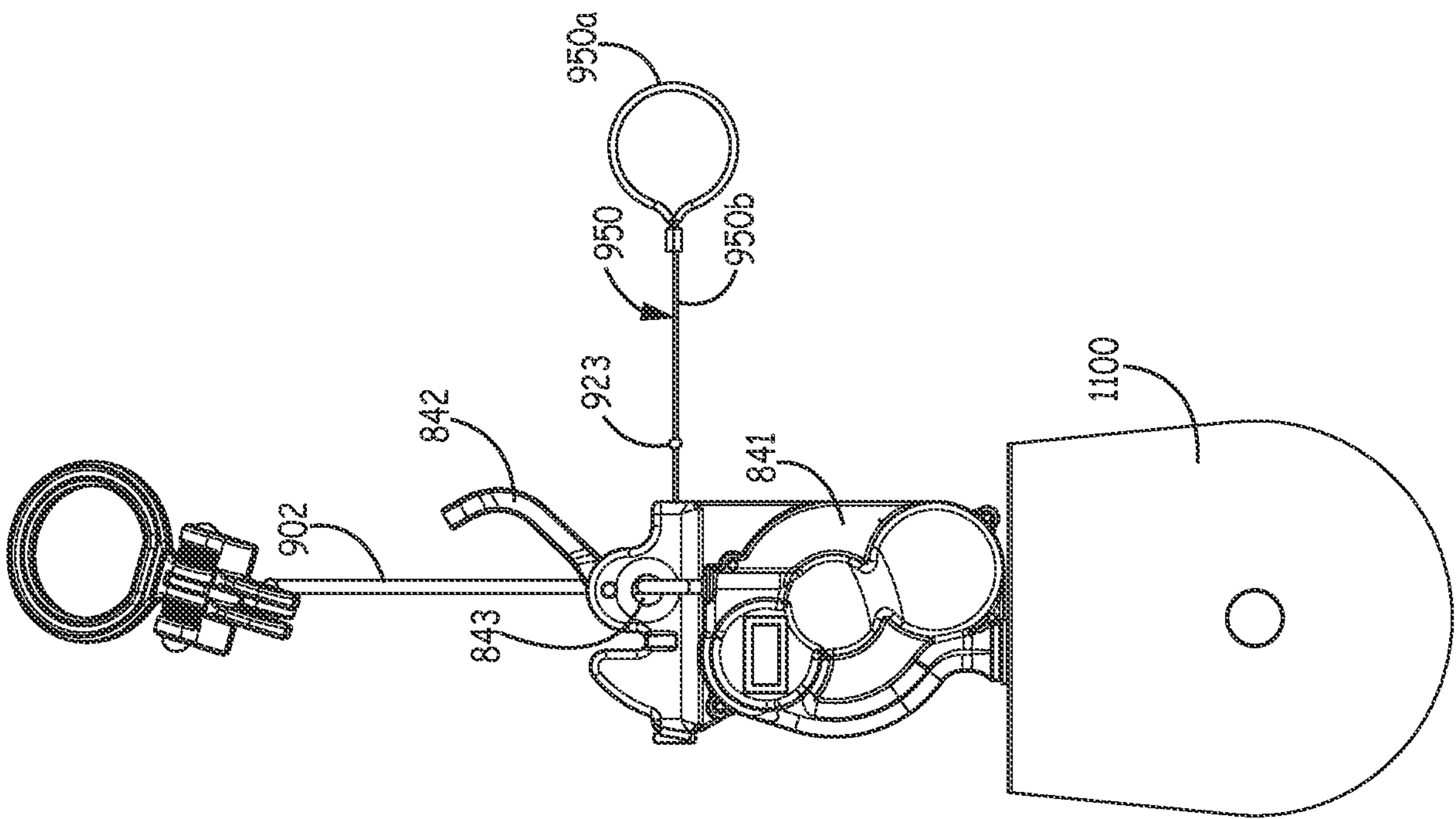


FIG. 15

FIG. 14



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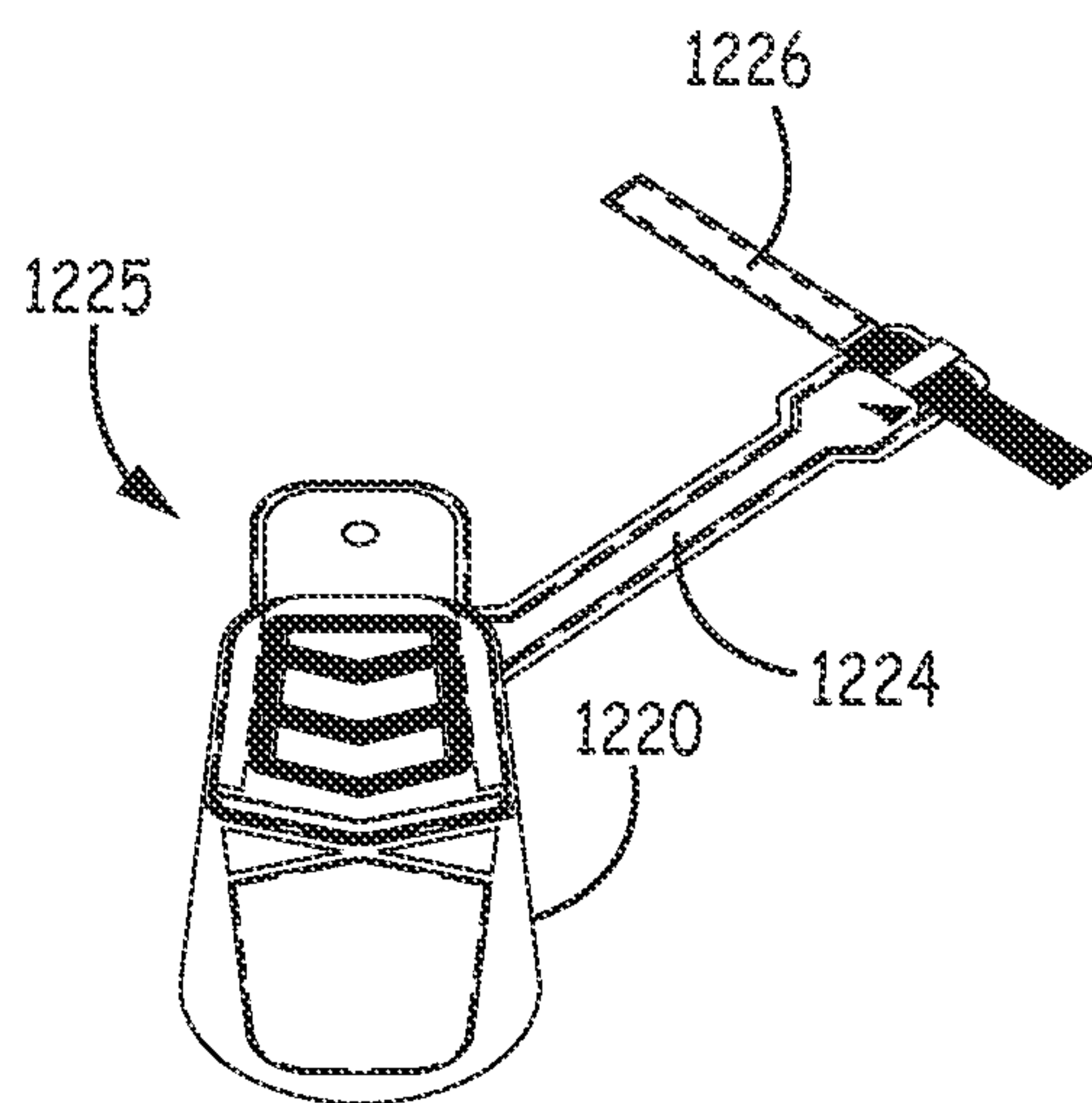


FIG. 17

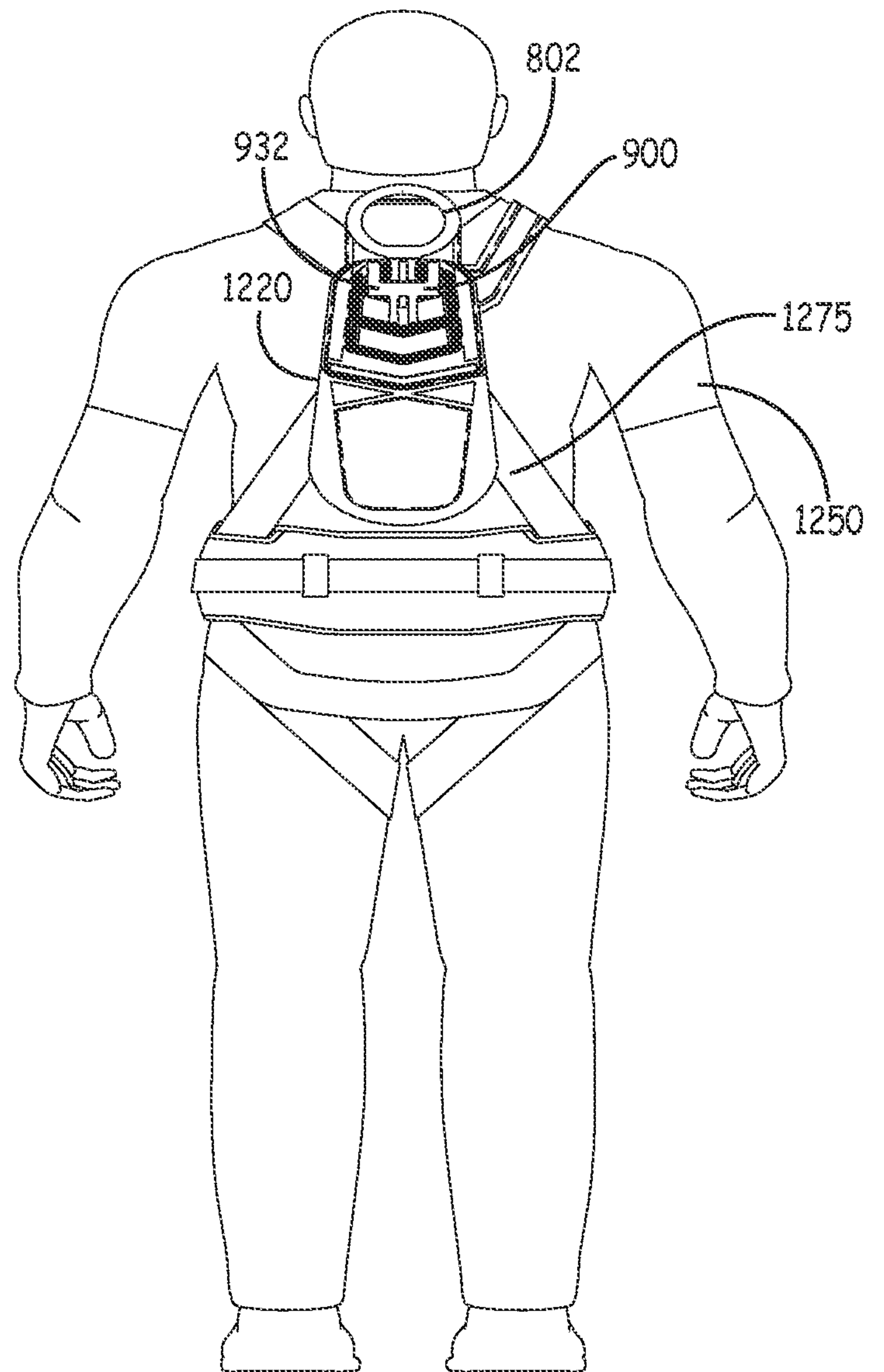


FIG. 18

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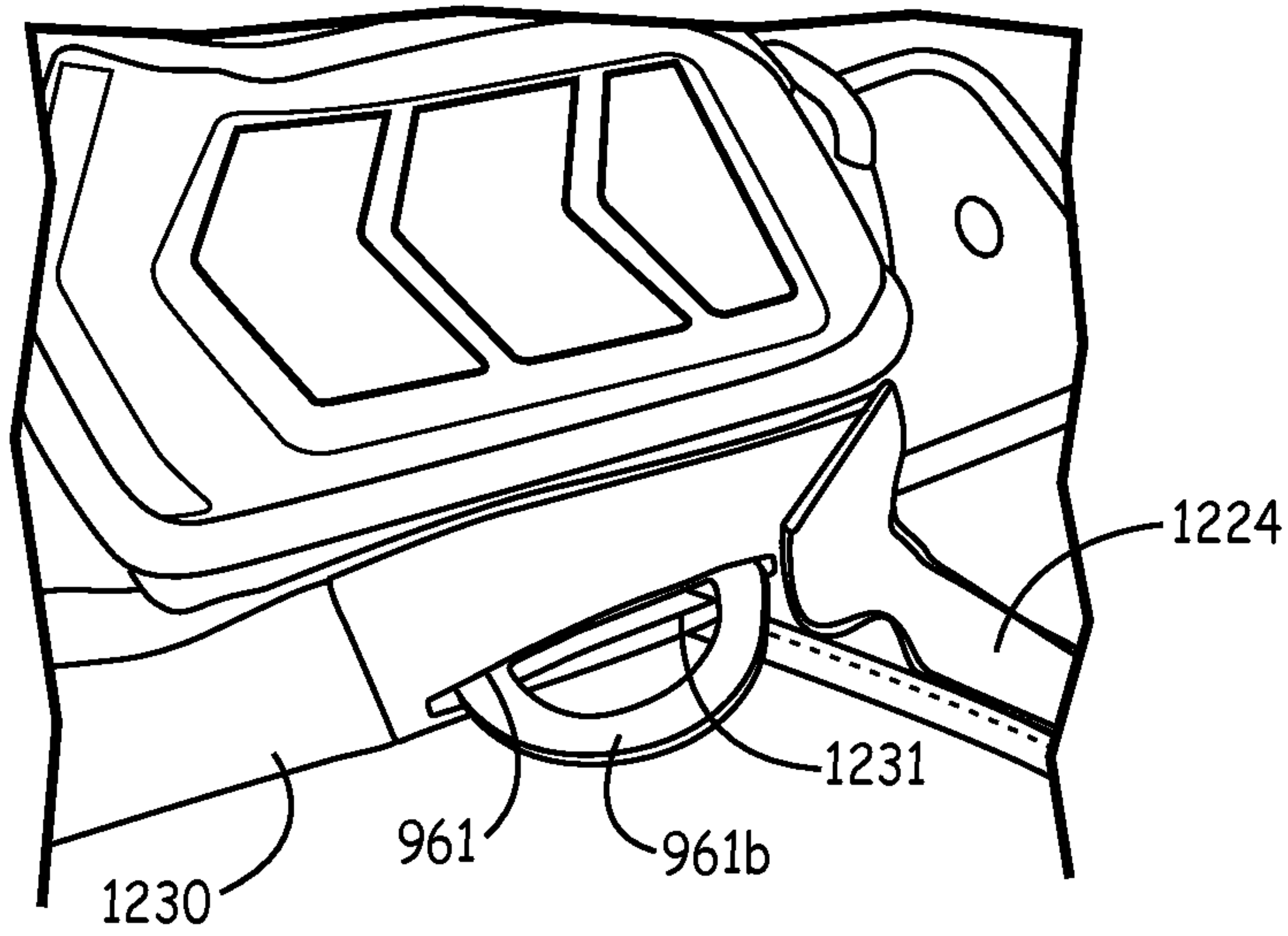


FIG. 19

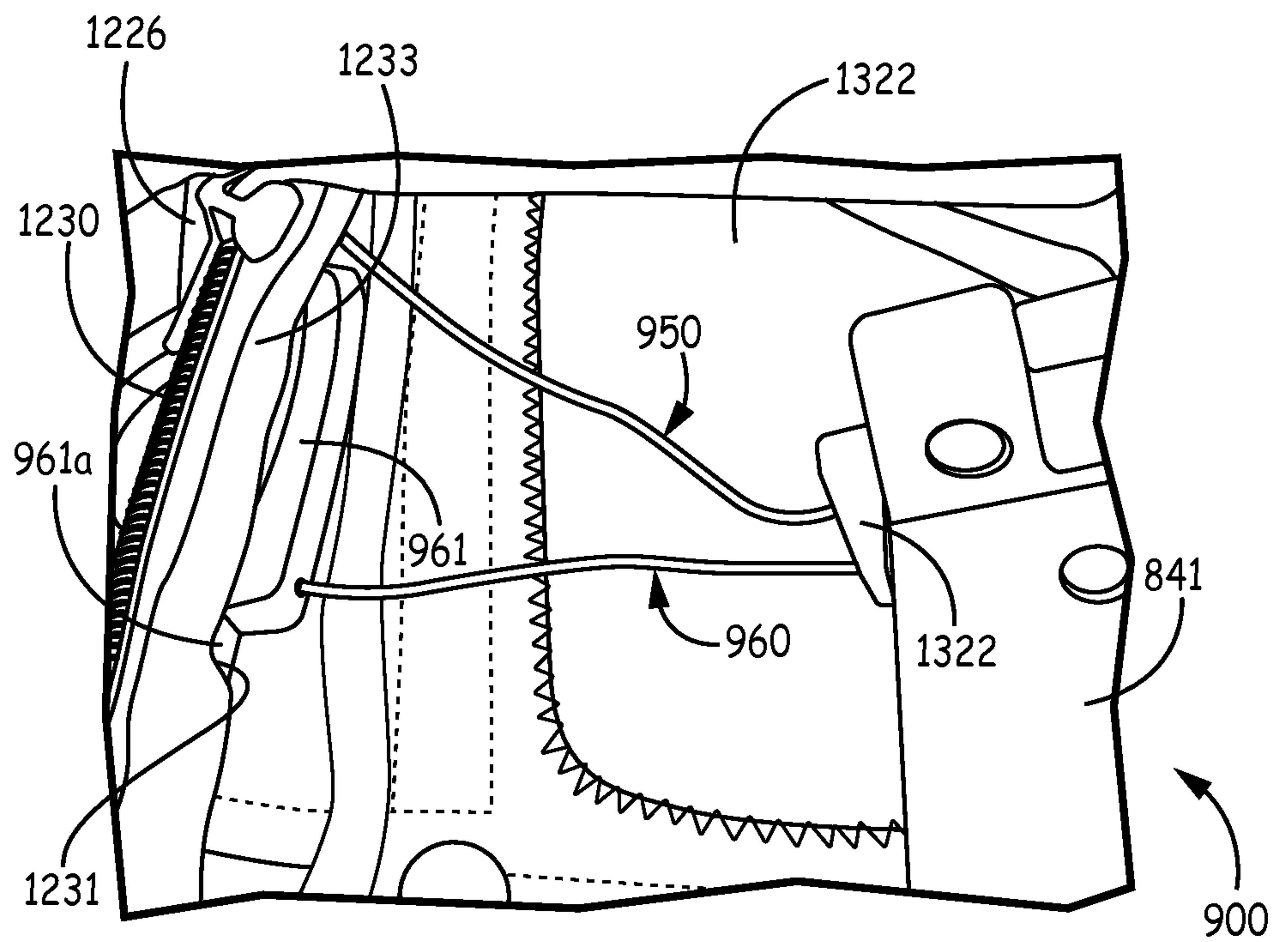


FIG. 20

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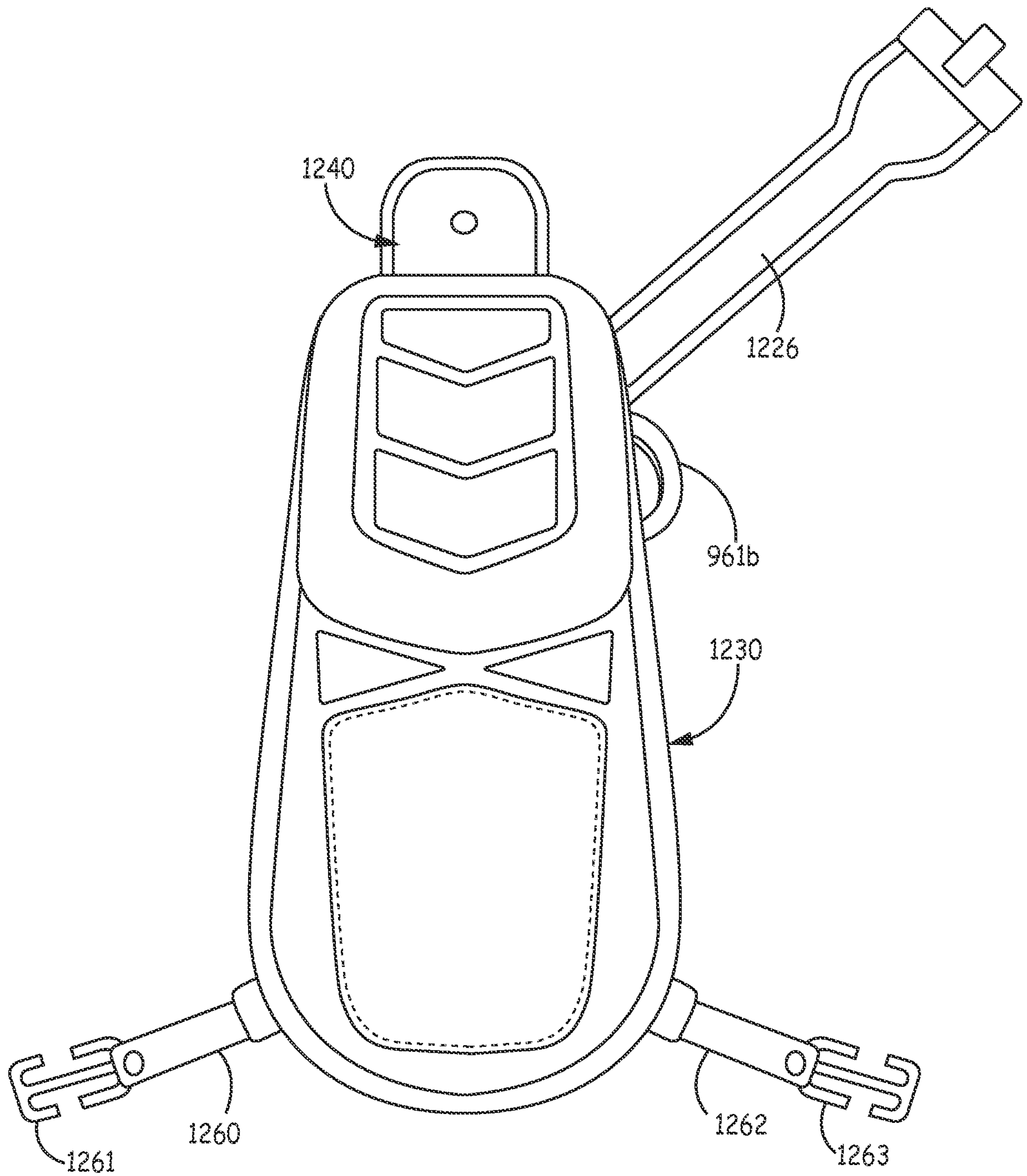


FIG. 21

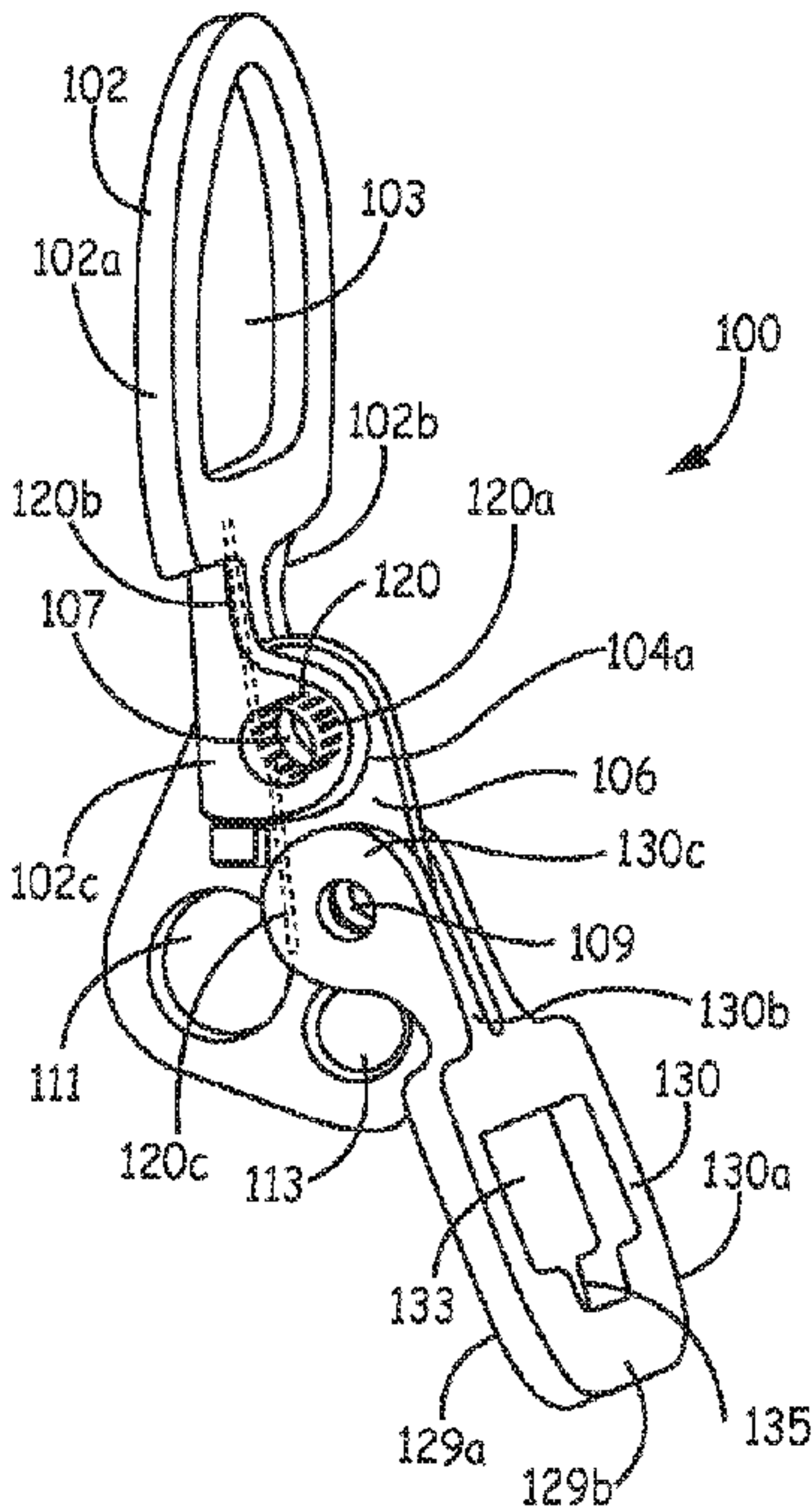


FIG. 1