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(54) **REEL BASED CLOSURE DEVICE**

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A43B 5/04	(2006.01)

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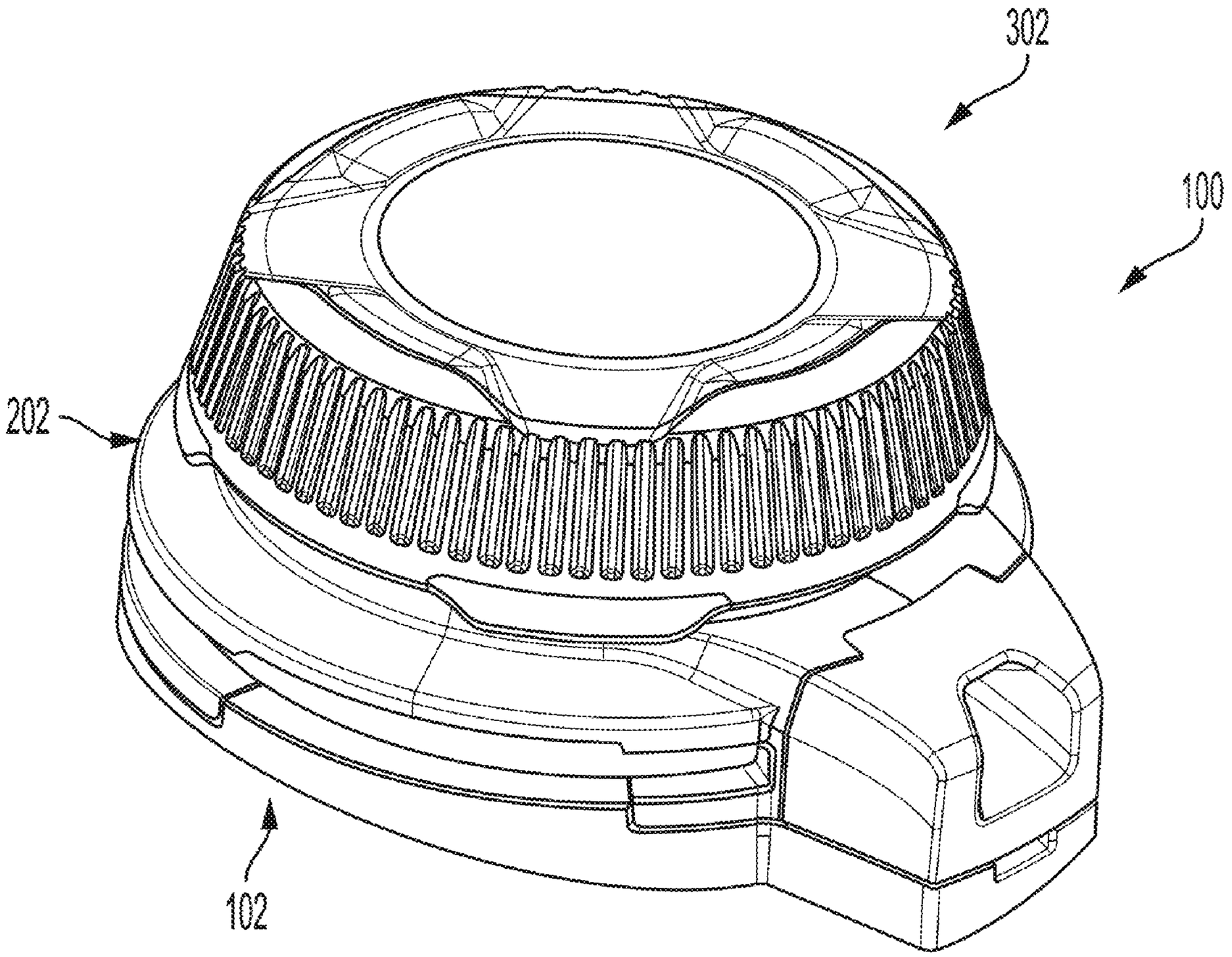
CPC ***A43C 1/06*** (2013.01); ***A43B 5/0415*** (2013.01)

(57) **ABSTRACT**

A boot, such as a ski boot, may include a lower portion or shell that is configured to accommodate a foot and an upper portion or cuff that extends upward from the lower portion and that is configured to accommodate a lower leg of a wearer. The boot may also include a tightening system that is coupled with the lower portion of the boot in order to close and tighten the lower portion about the foot. The tightening system includes a reel based closure device and a tension member that is operably coupled with the reel based closure device so that an operation of the reel based closure device effects tensioning of the tension member. The tightening system also includes a plurality of guide members that route or direct the tension member along a path and a terminal member that is fixedly coupled with the tension member.



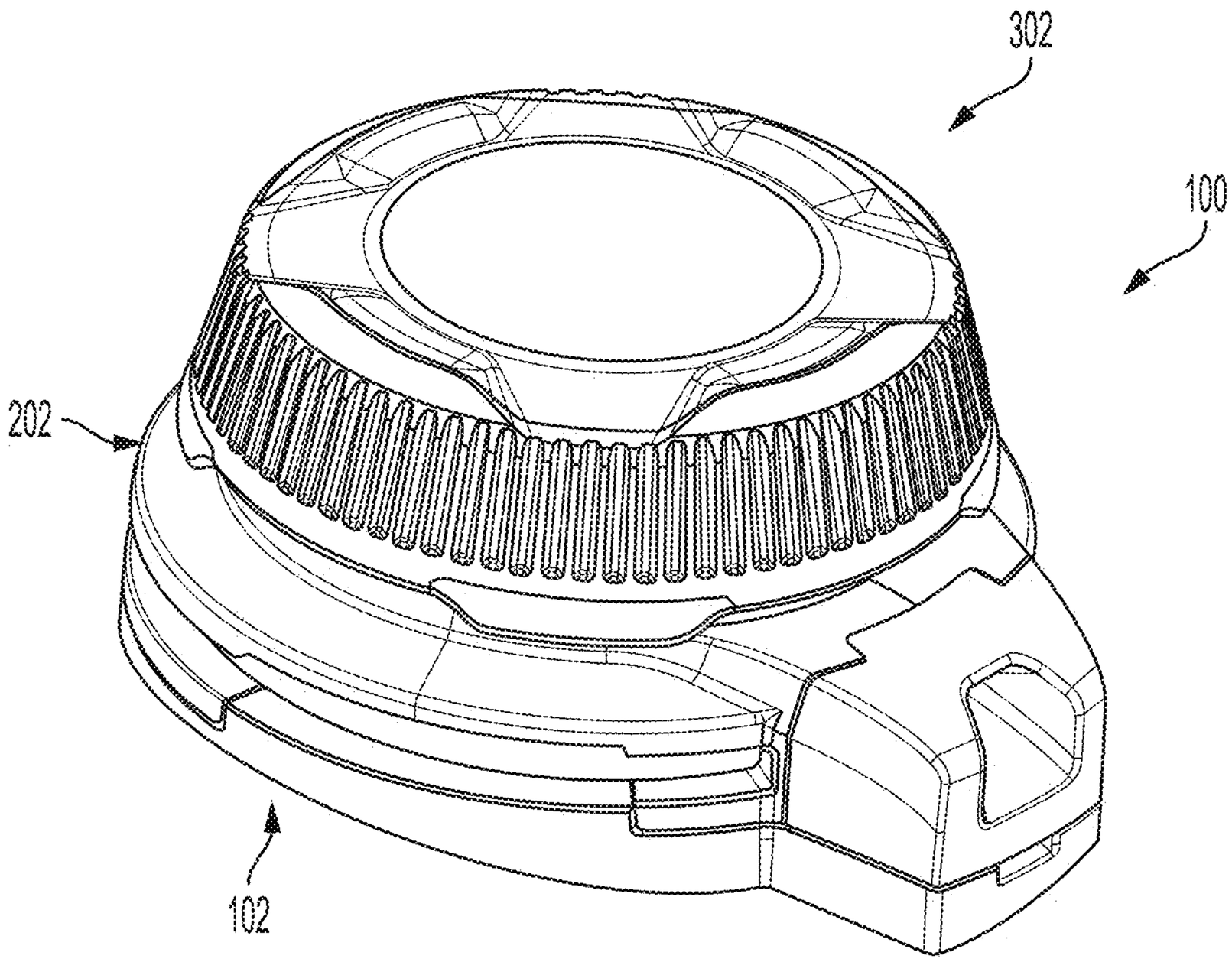


FIG. 1

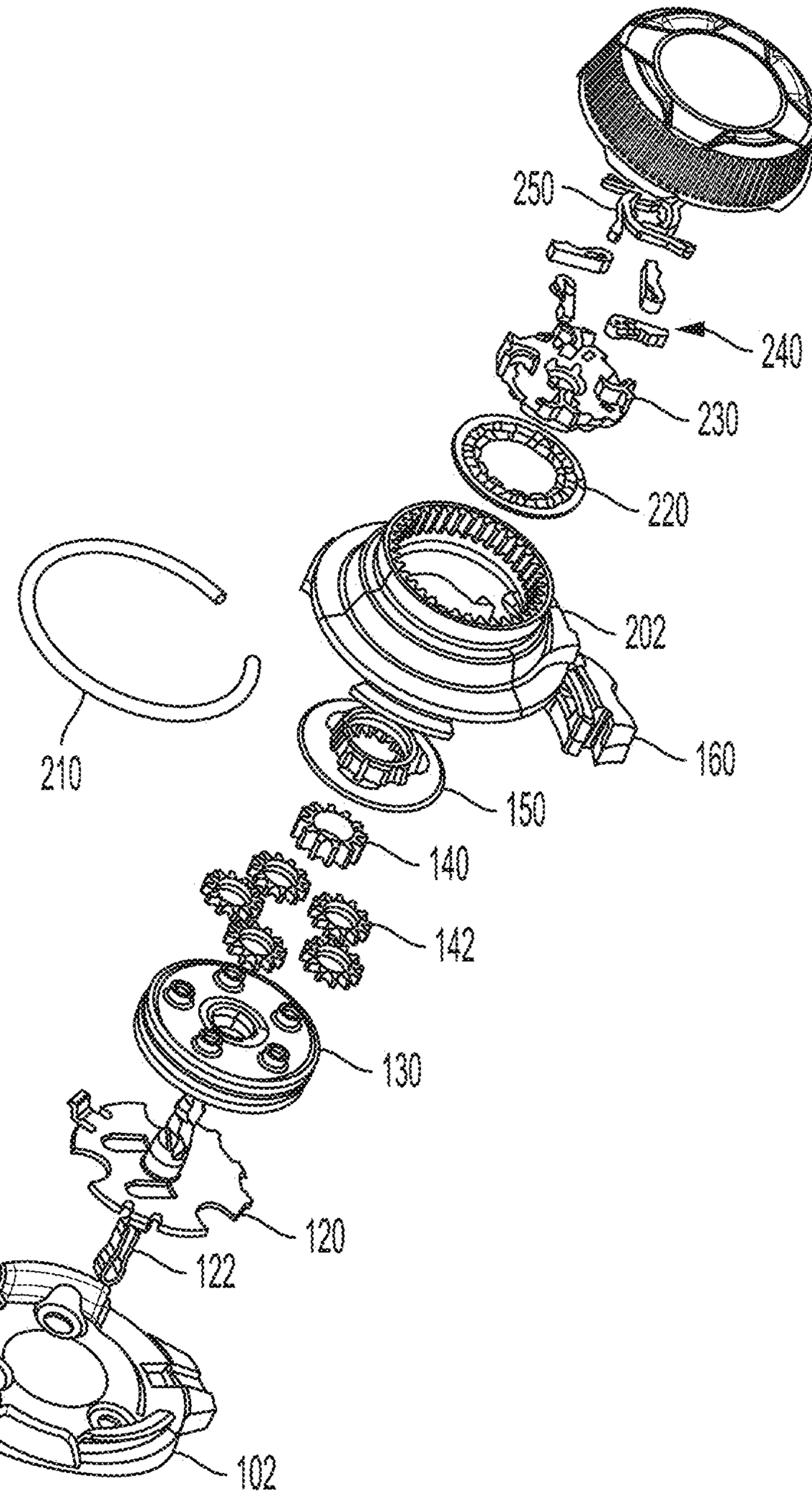
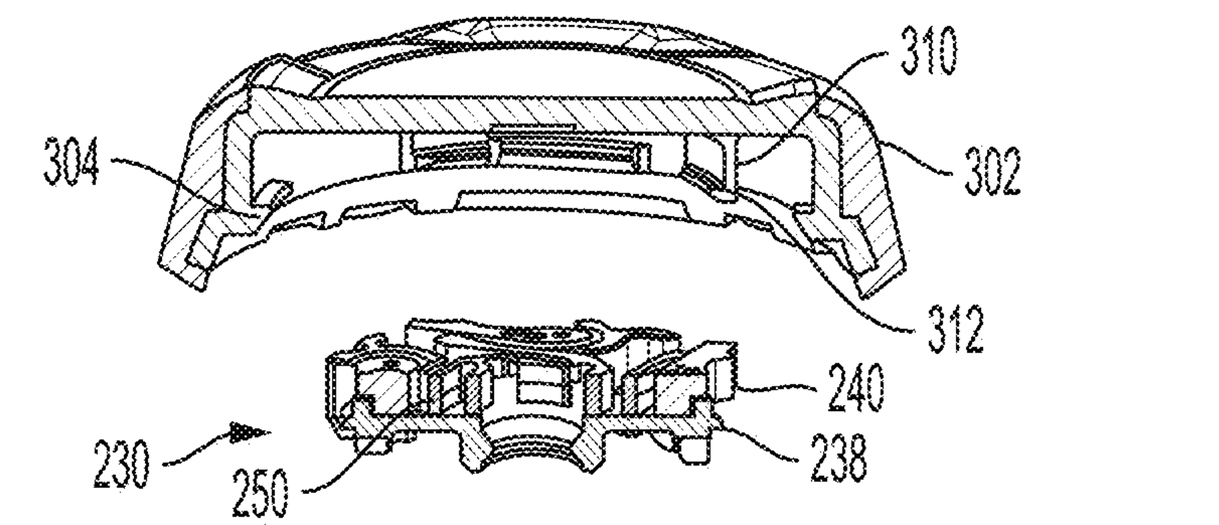


FIG. 2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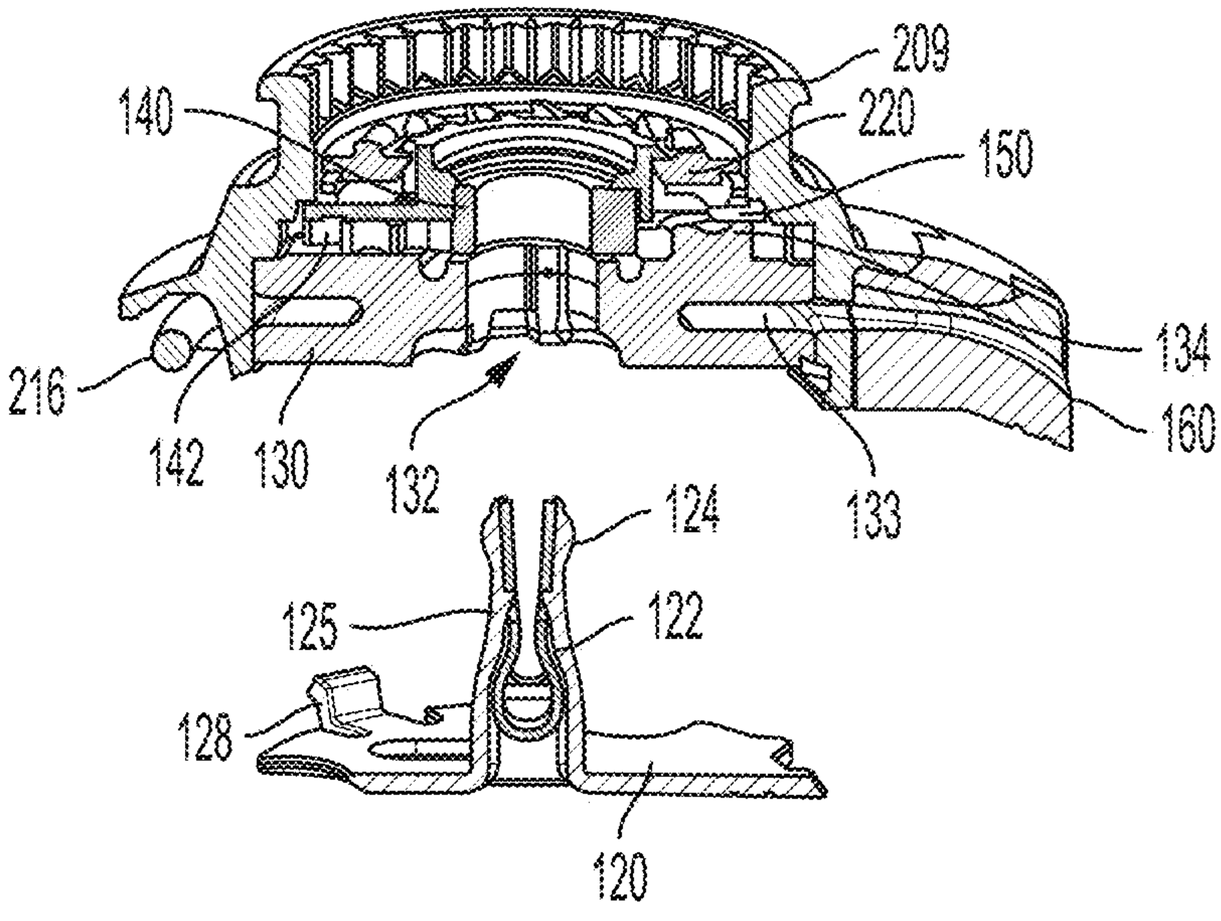
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FIG. 3A

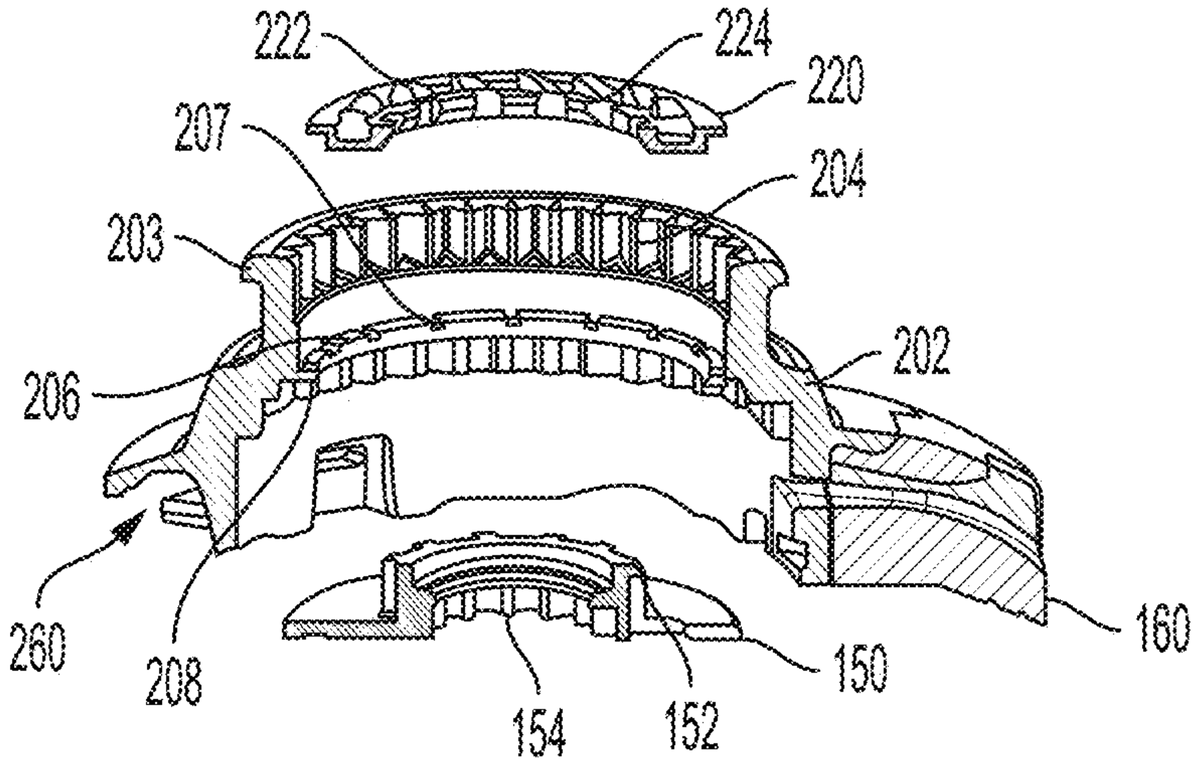
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FIG. 3B

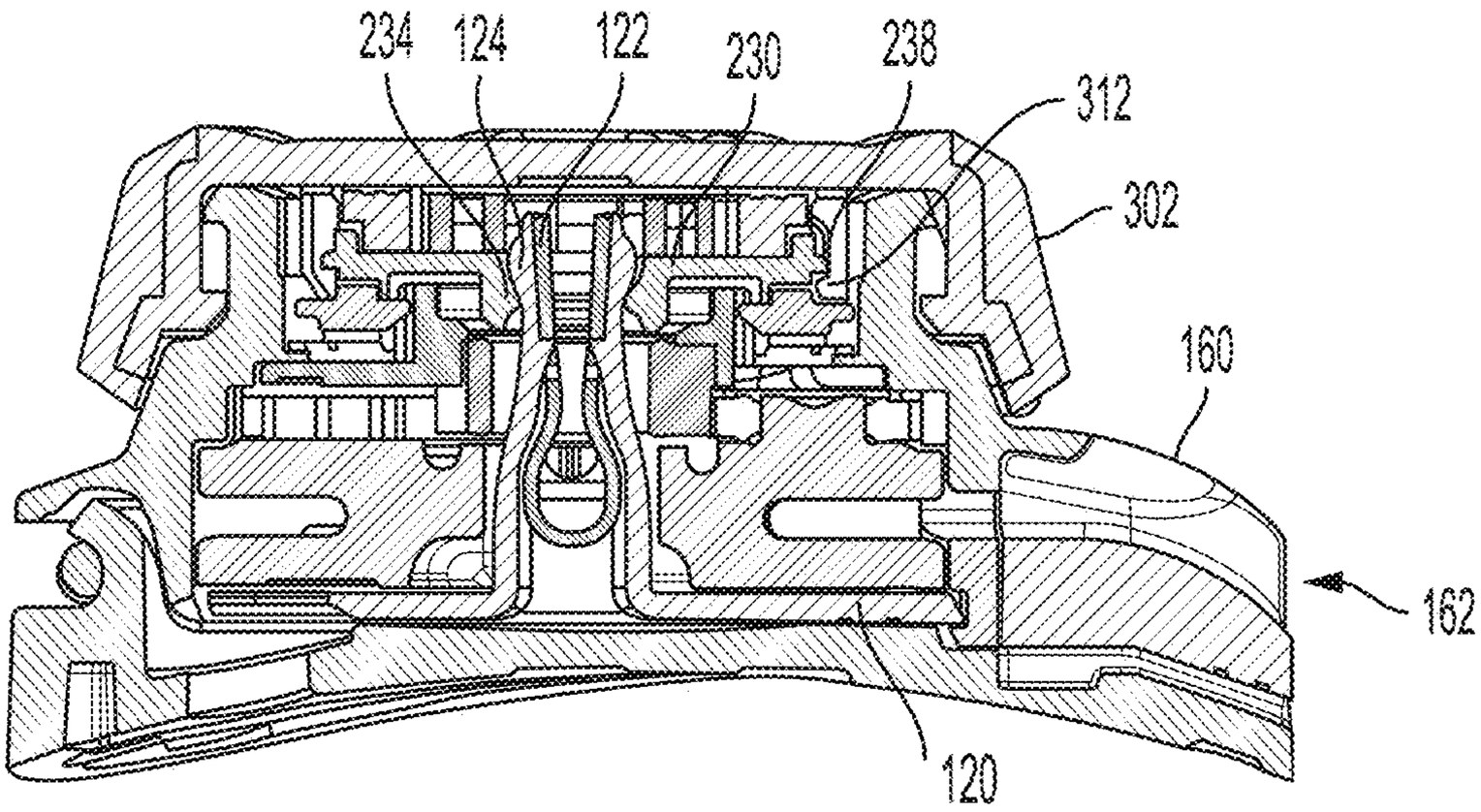

FIG. 4A

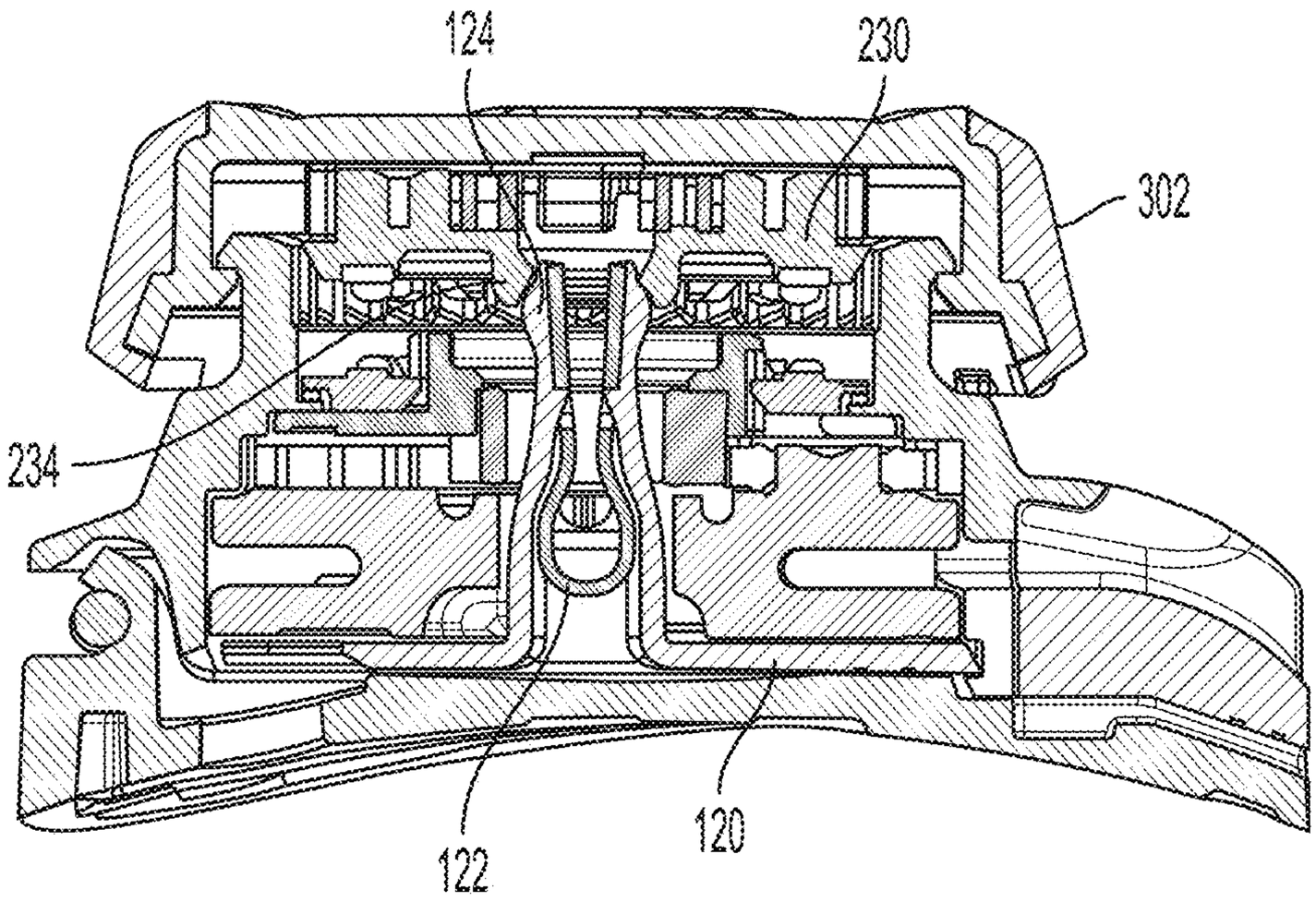

FIG. 4B

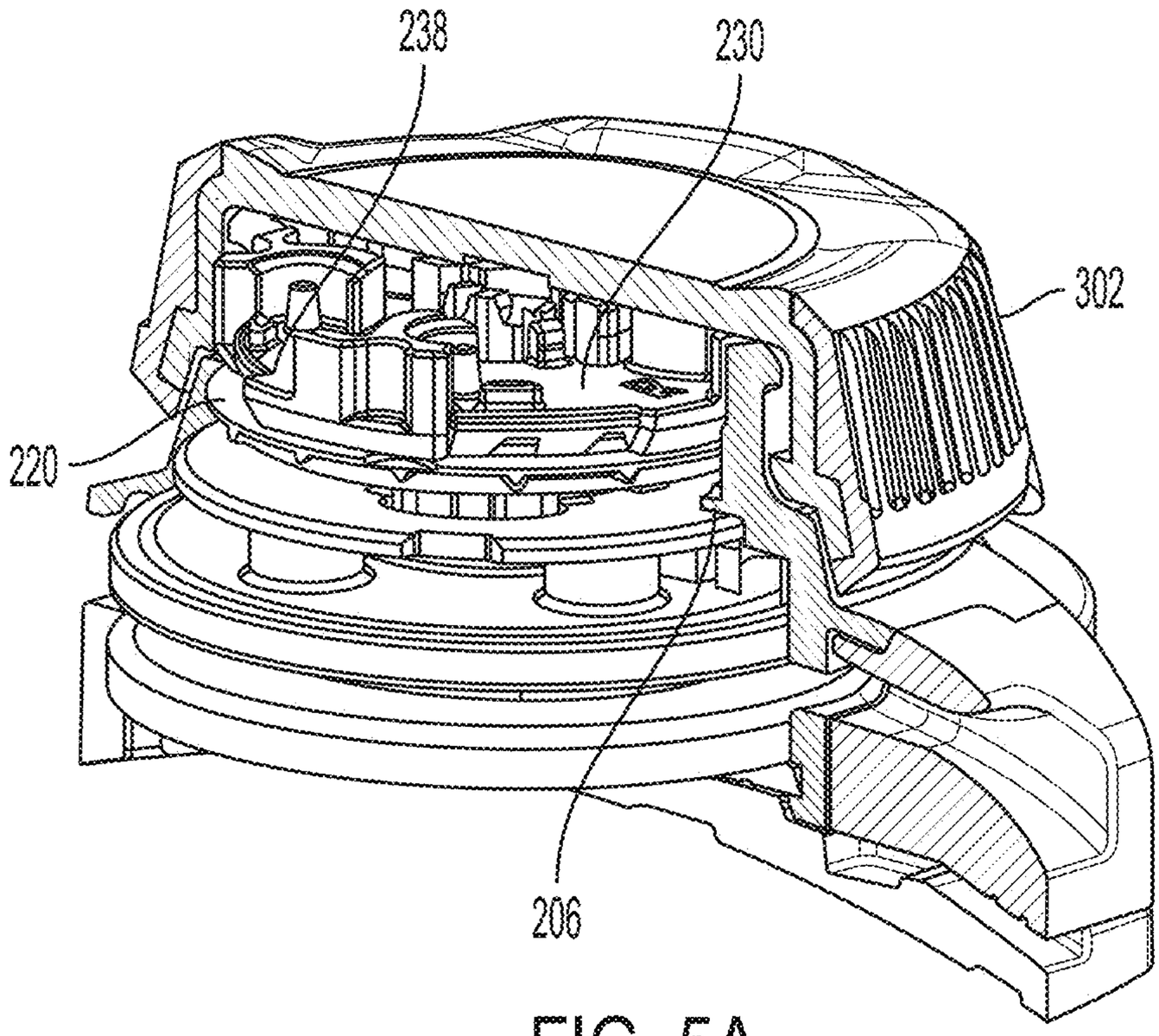

FIG. 5A

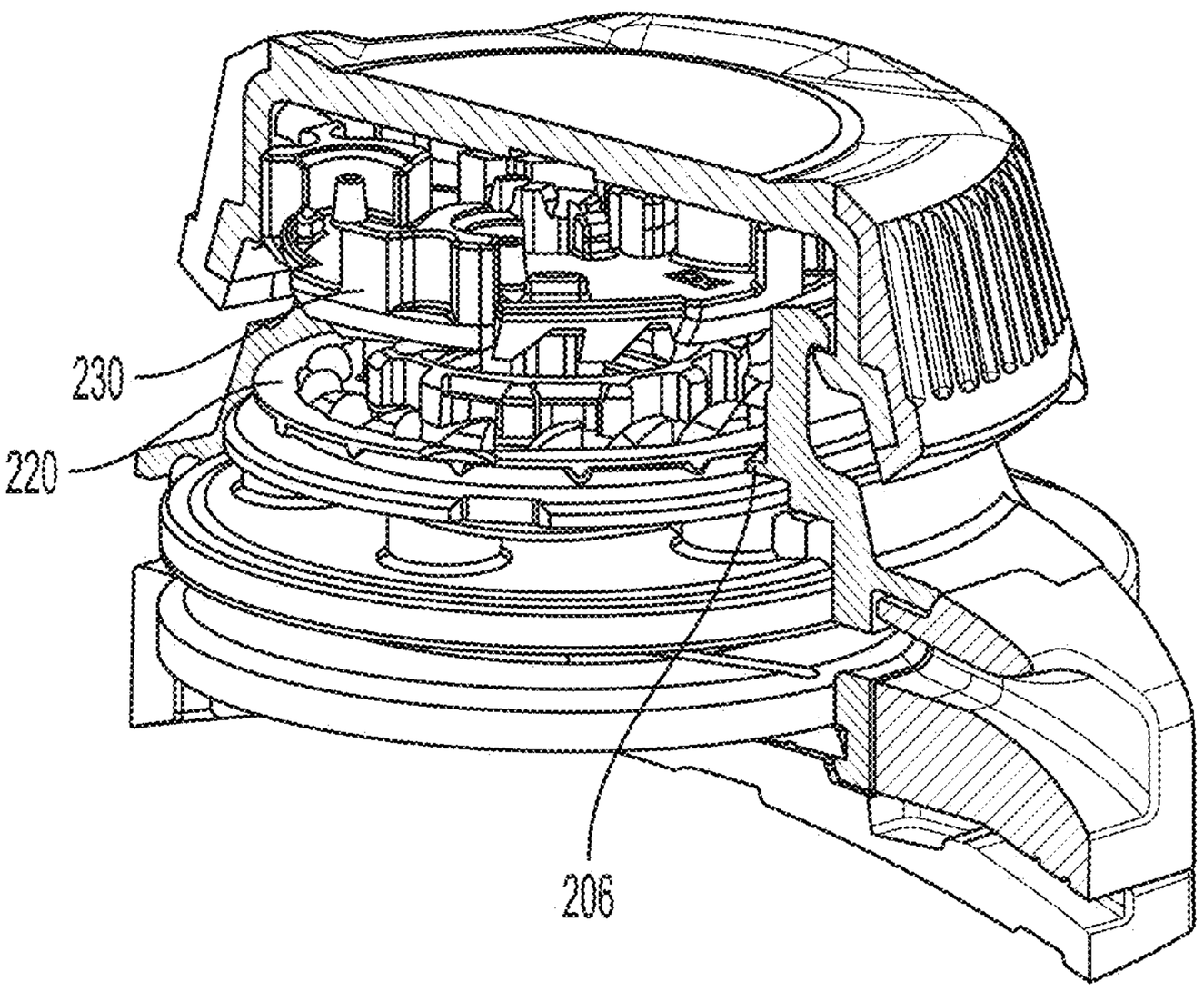

FIG. 5B

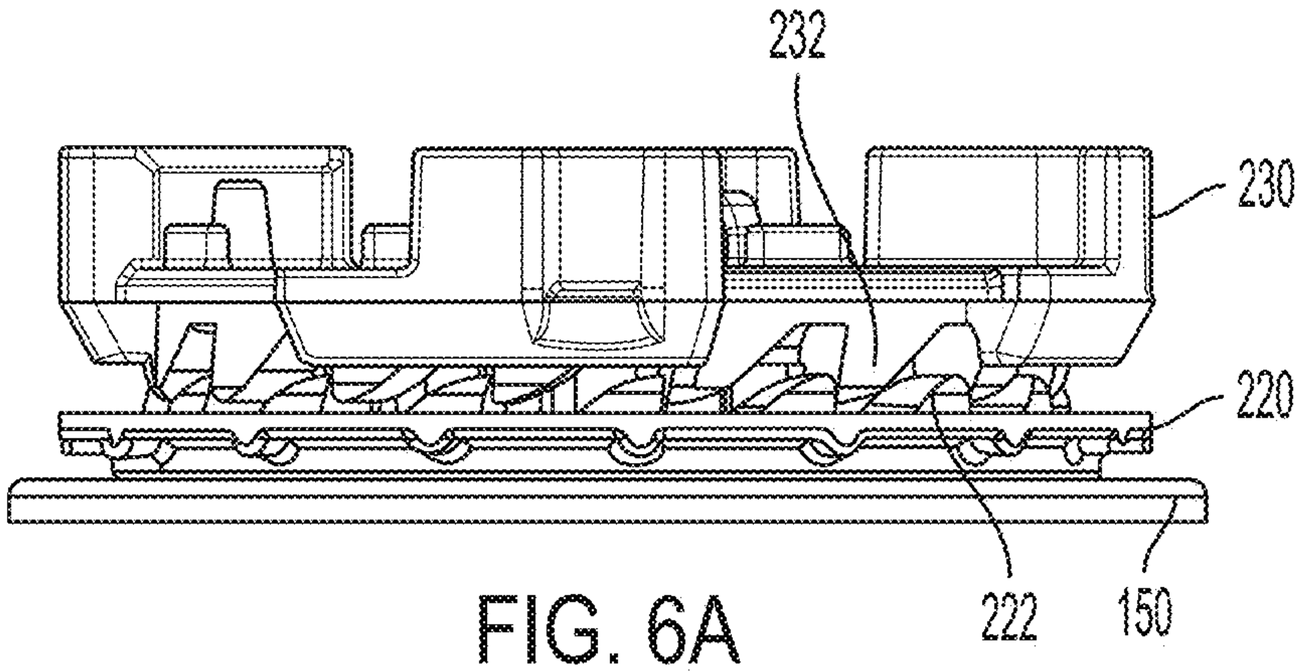

FIG. 6A

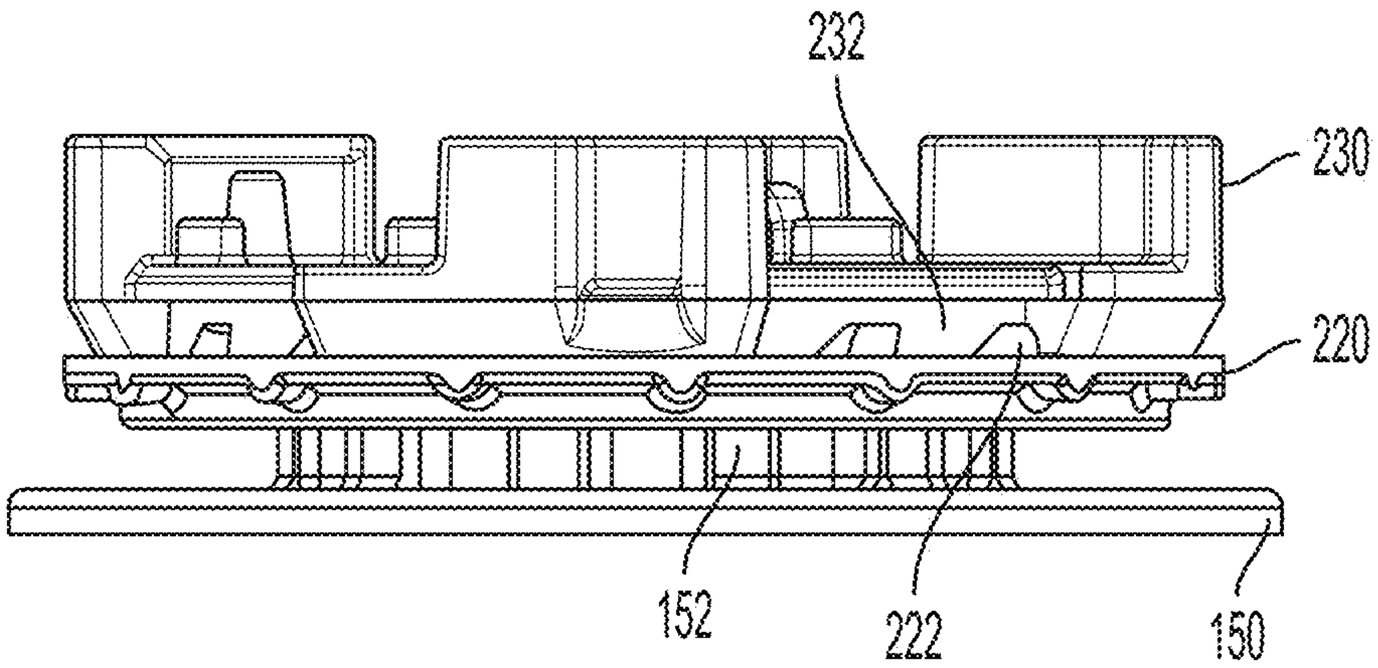

FIG. 6B

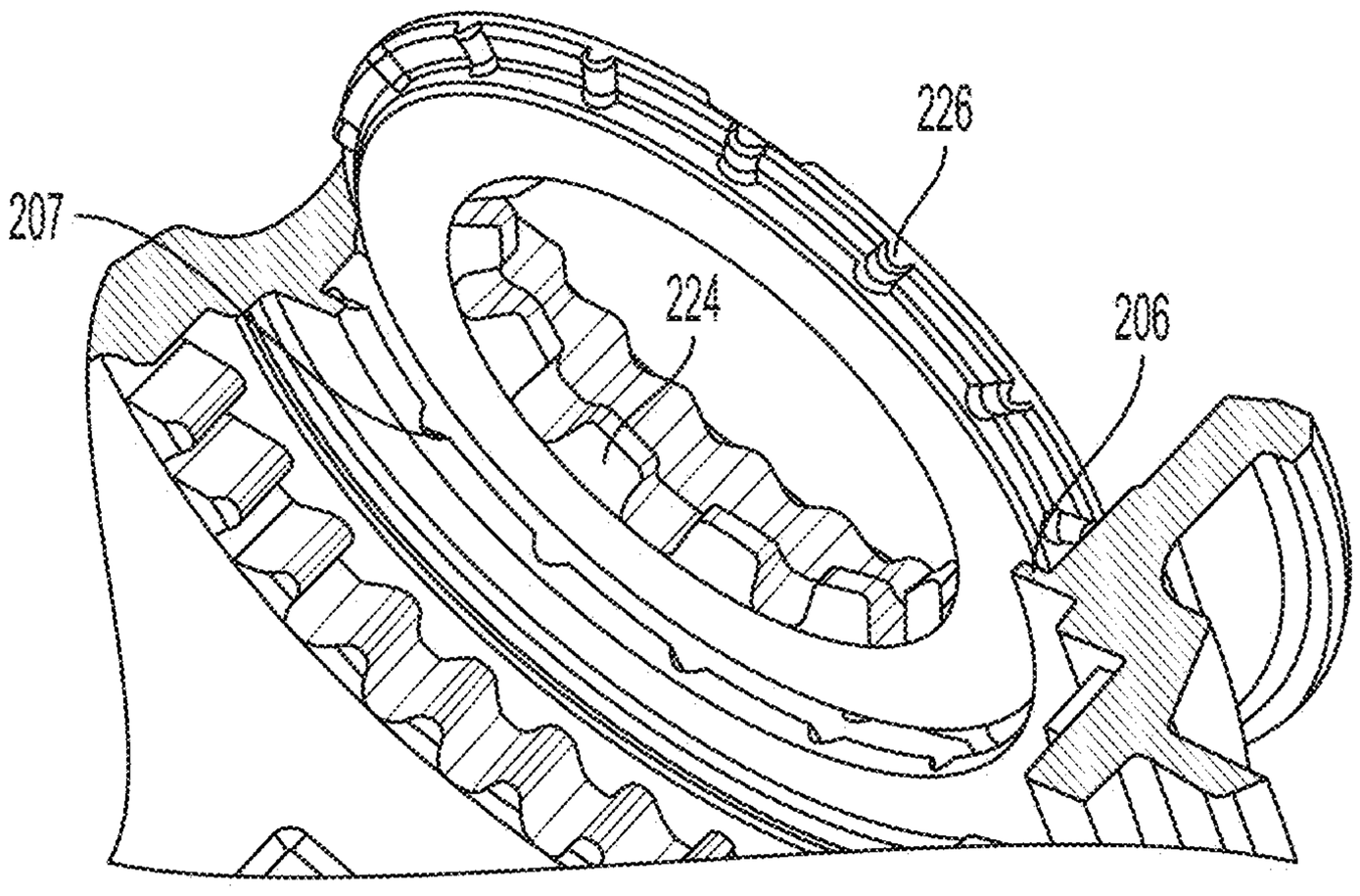

FIG. 6C

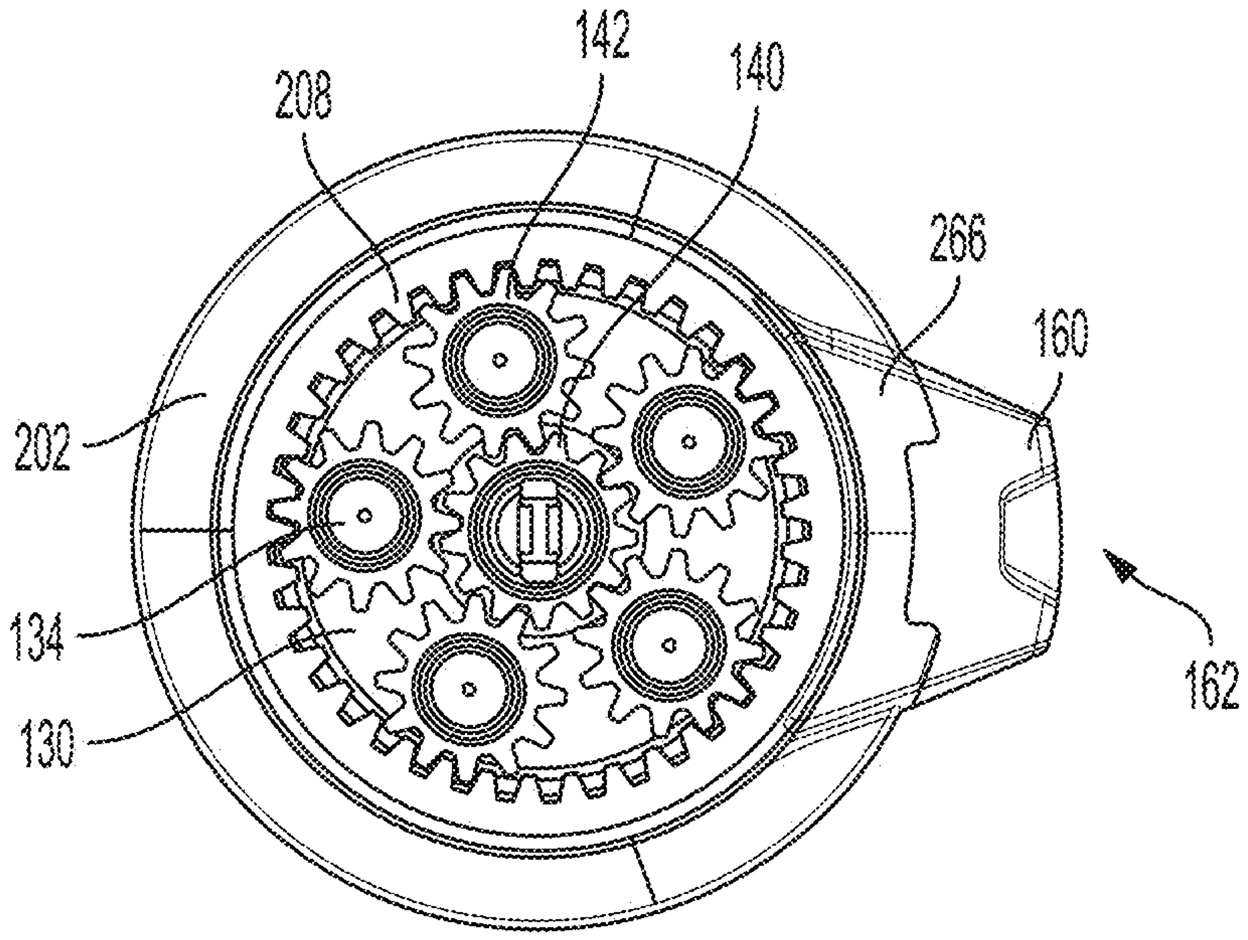
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FIG. 7

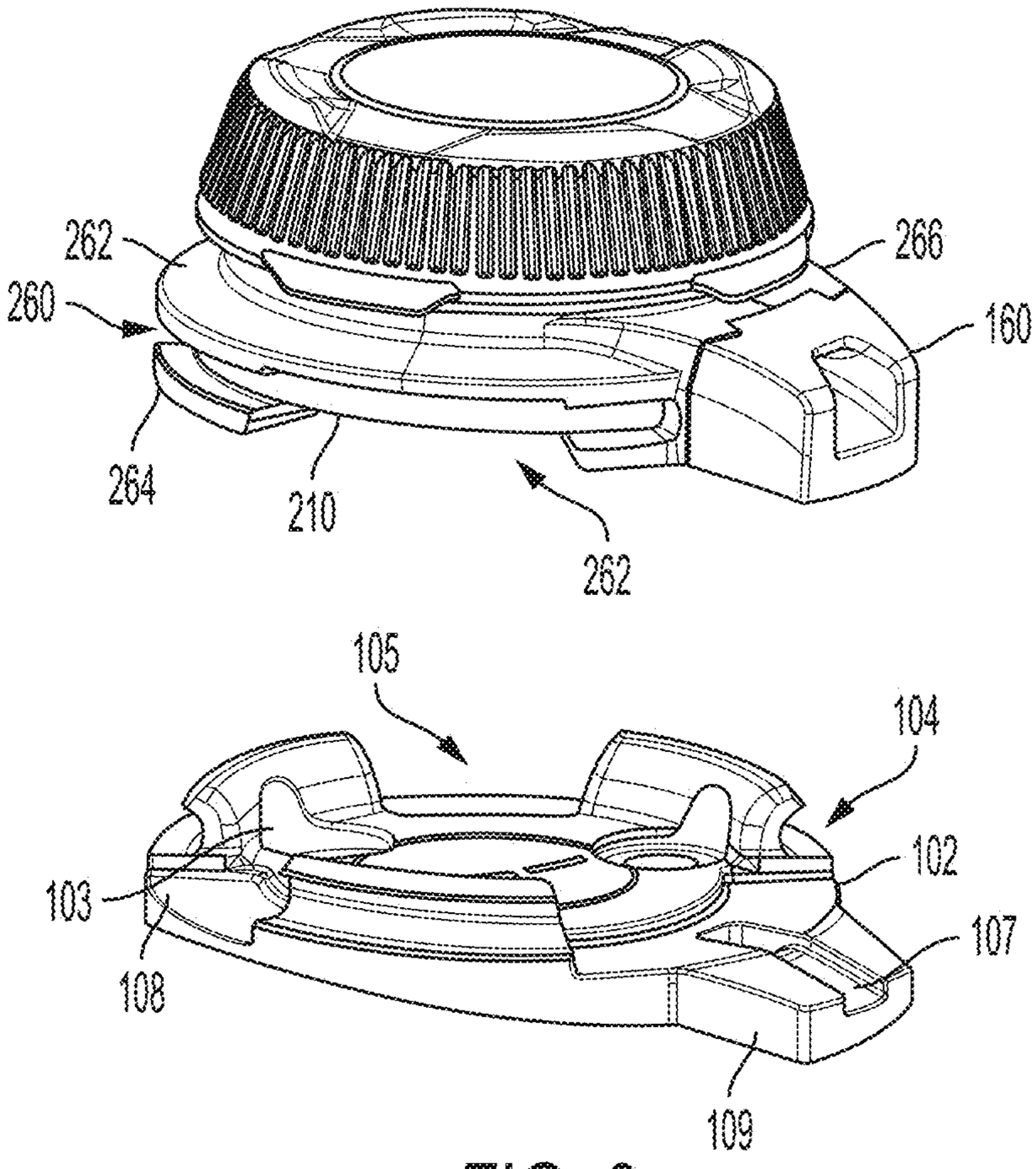
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FIG. 8

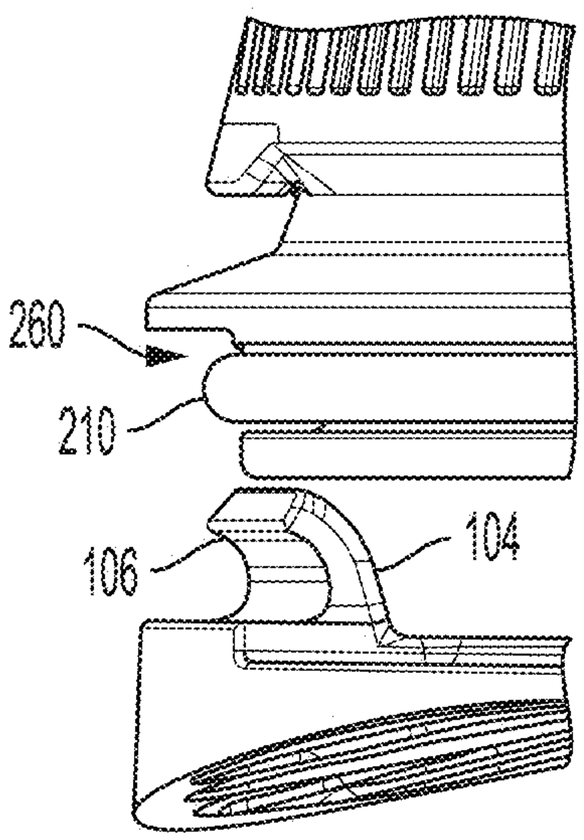

FIG. 9A

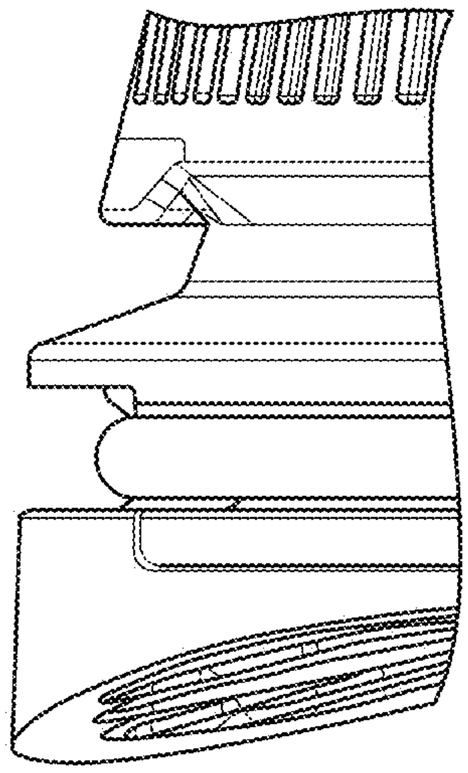

FIG. 9B

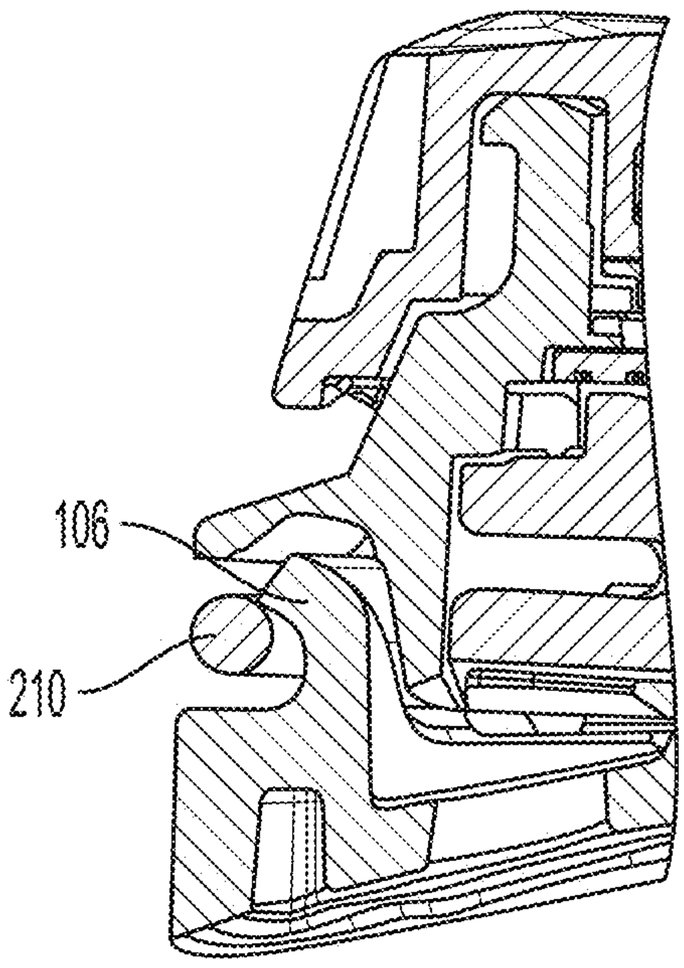

FIG. 9C

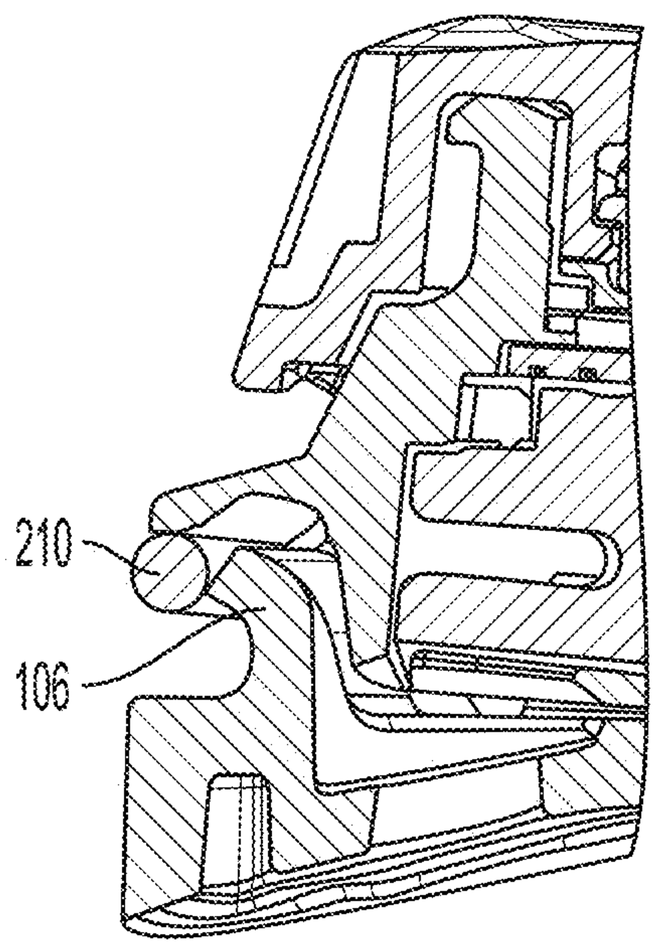

FIG. 9D

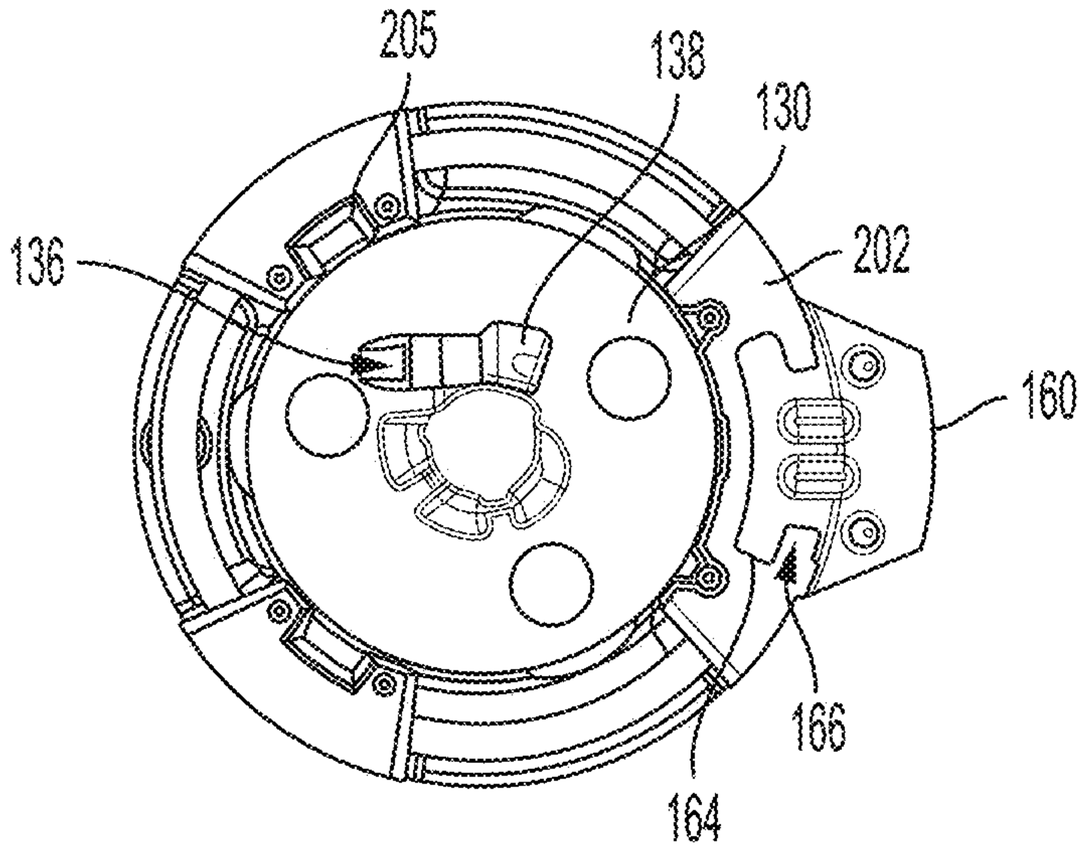

FIG. 10A

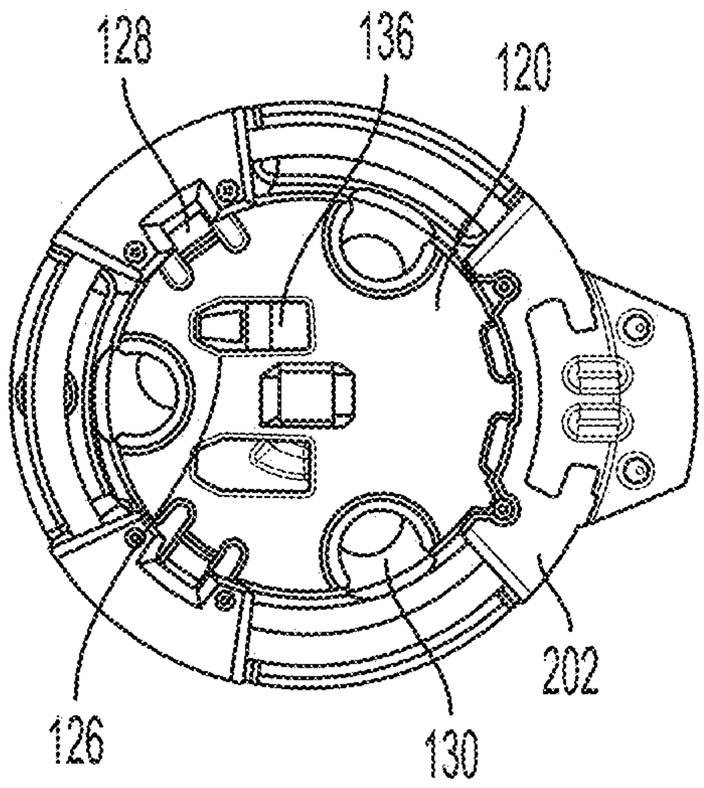

FIG. 10B

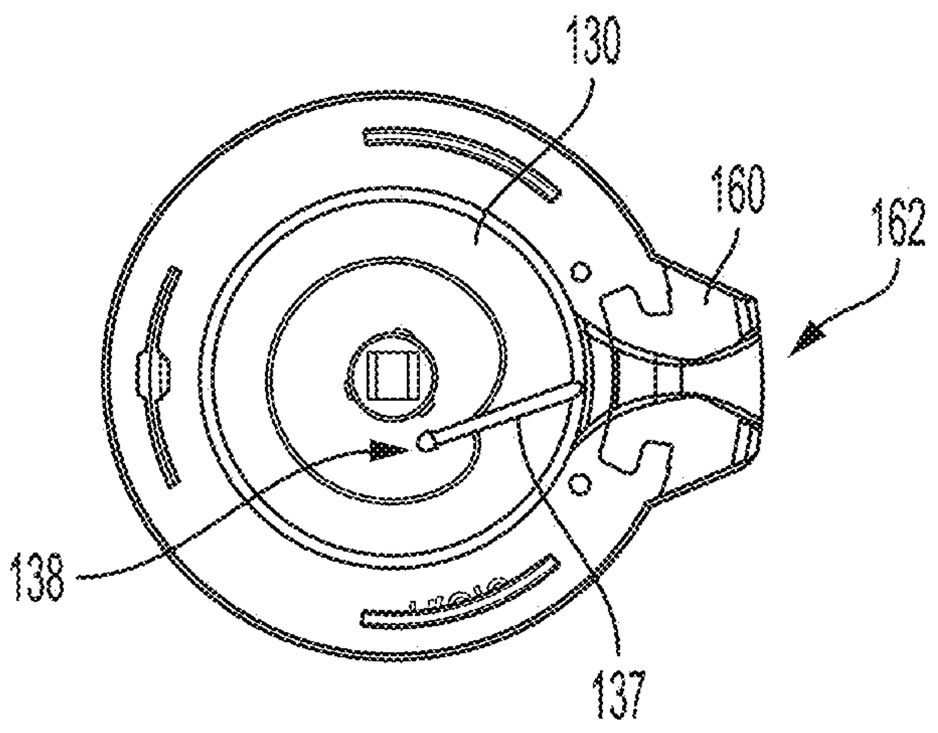

FIG. 10C

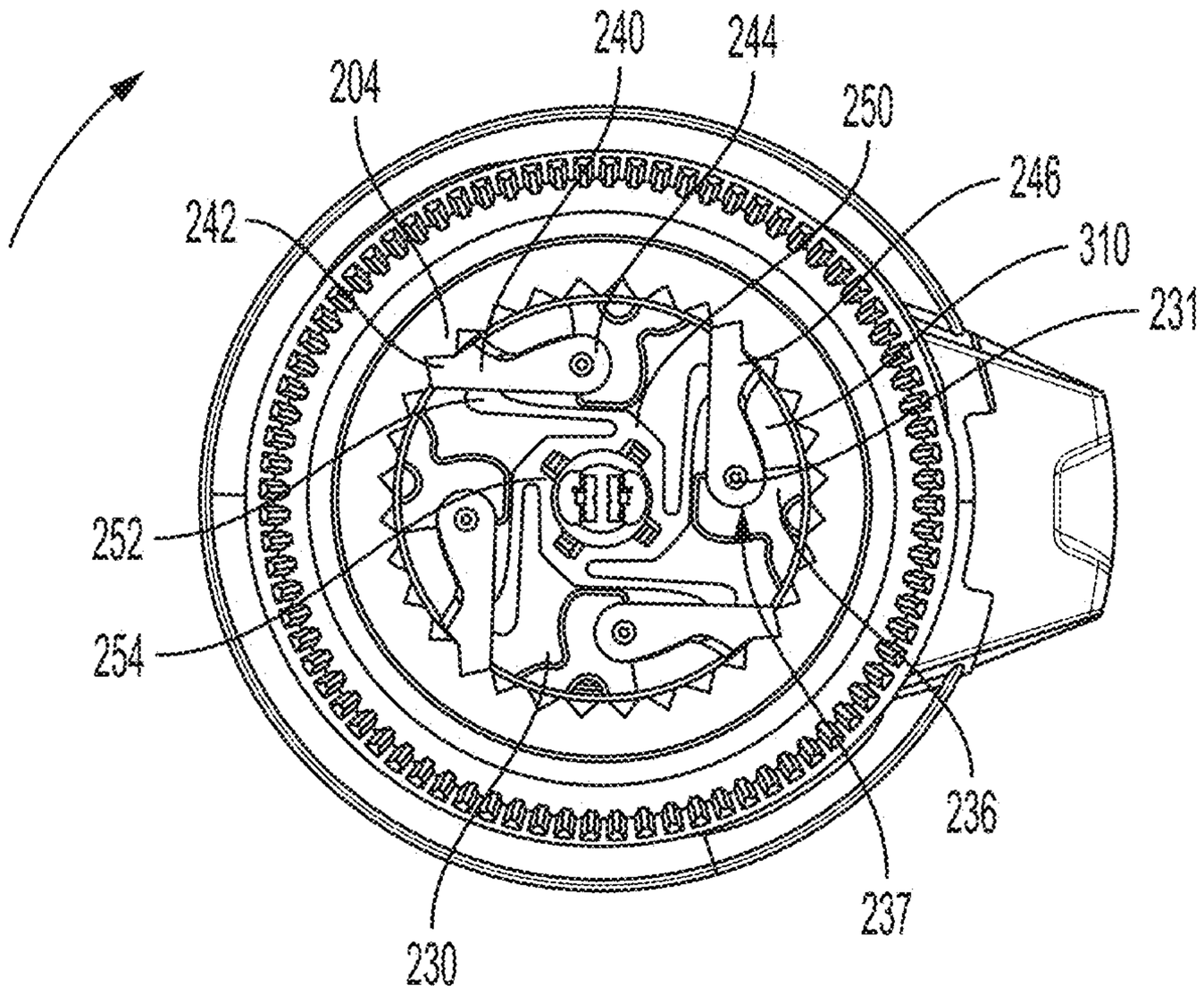

FIG. 11A

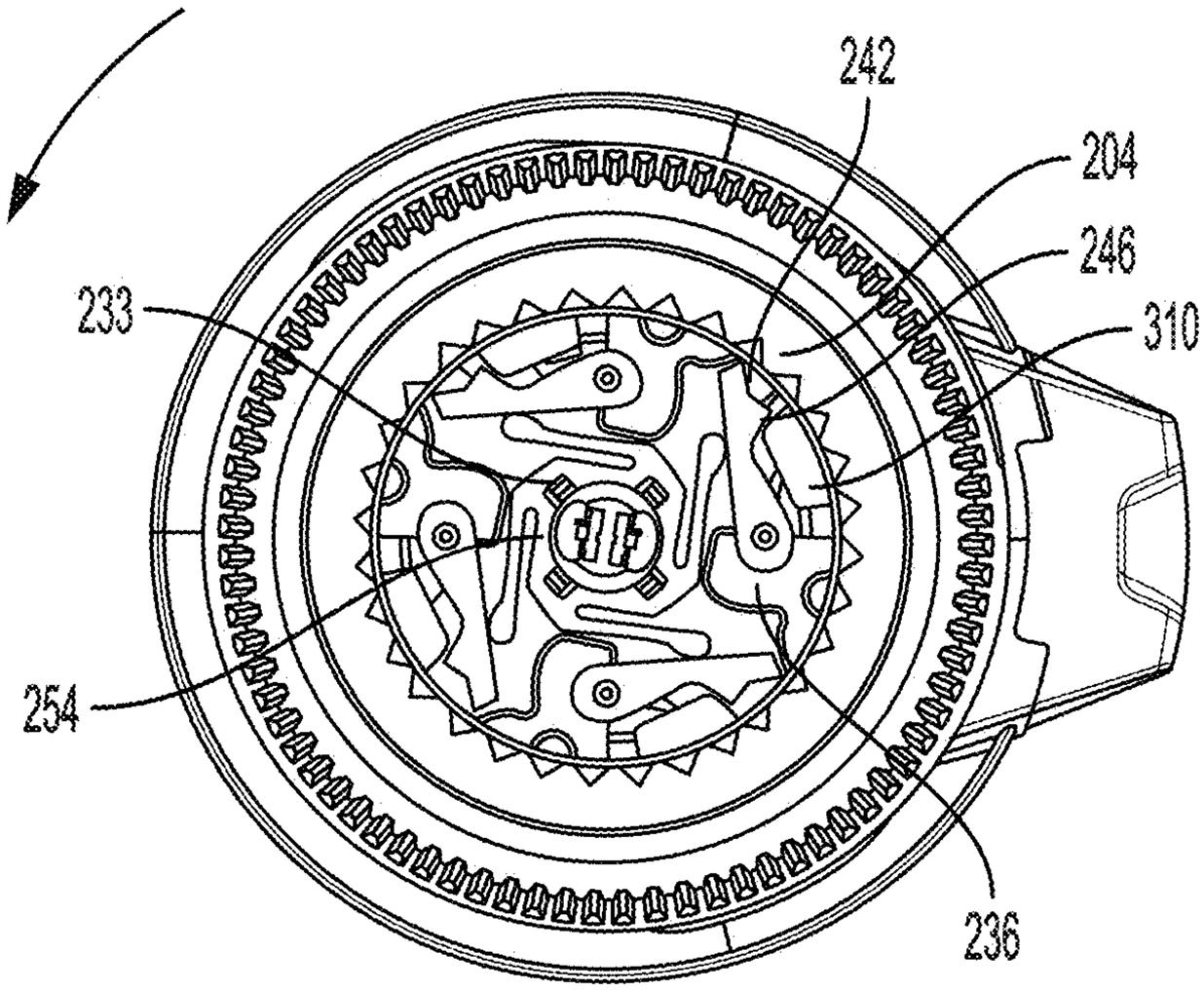

FIG. 11B

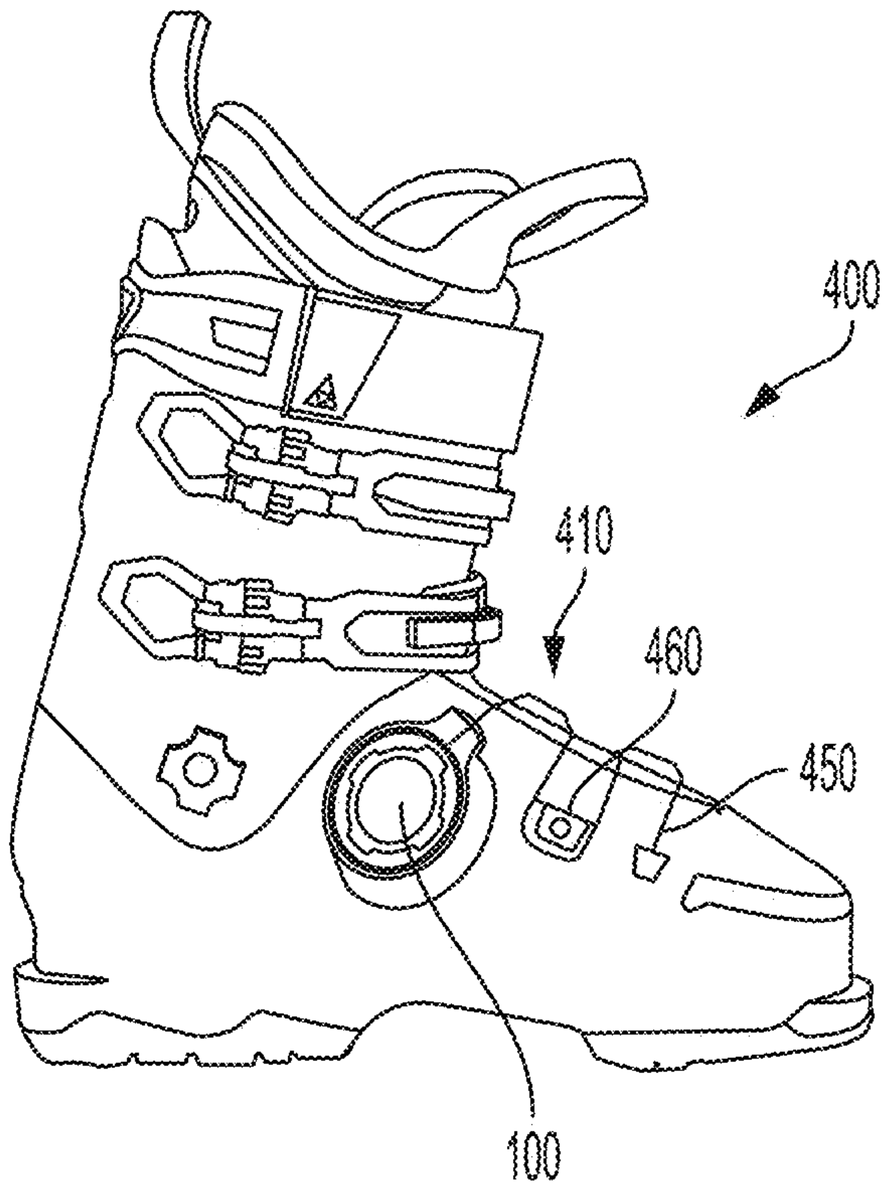

FIG. 12

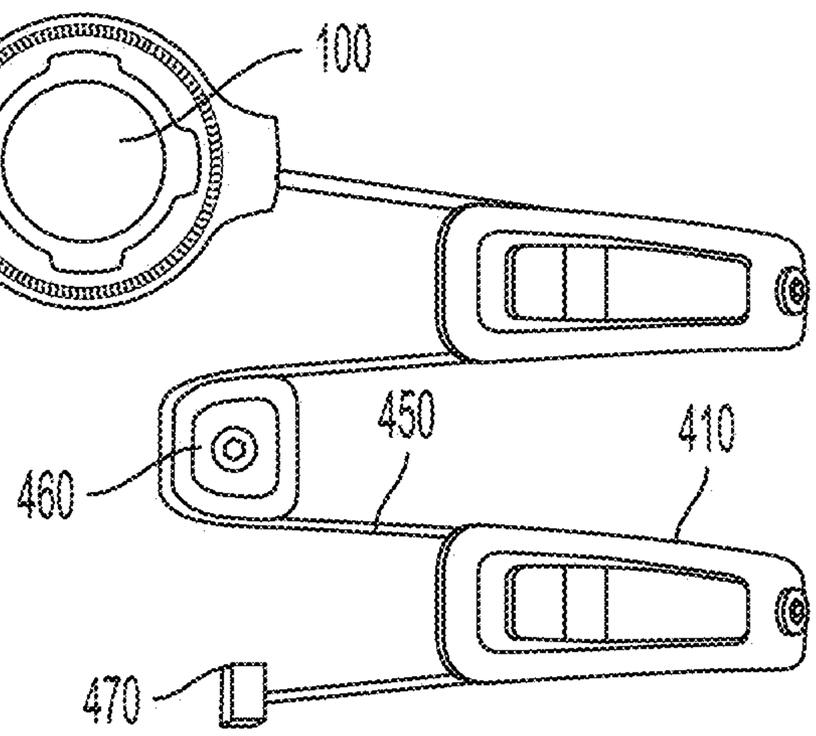

FIG. 13

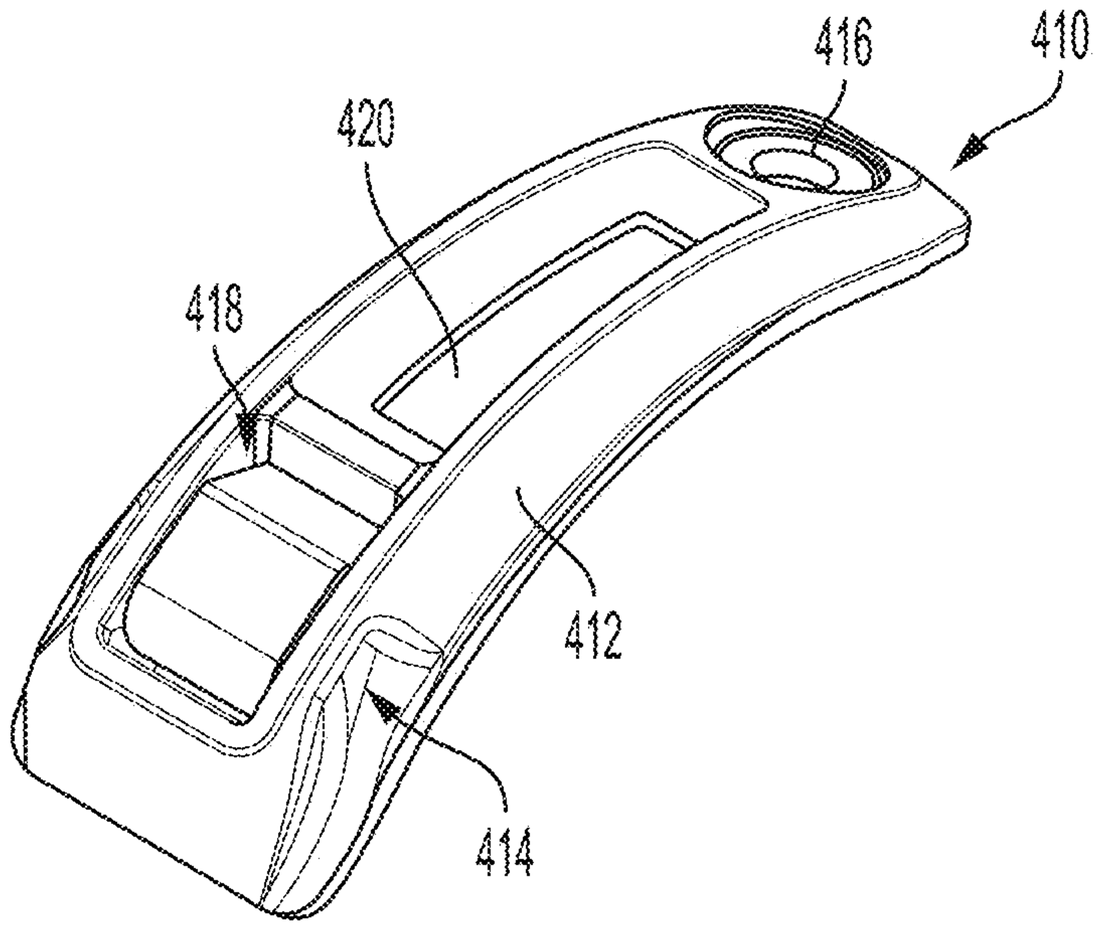

FIG. 14A

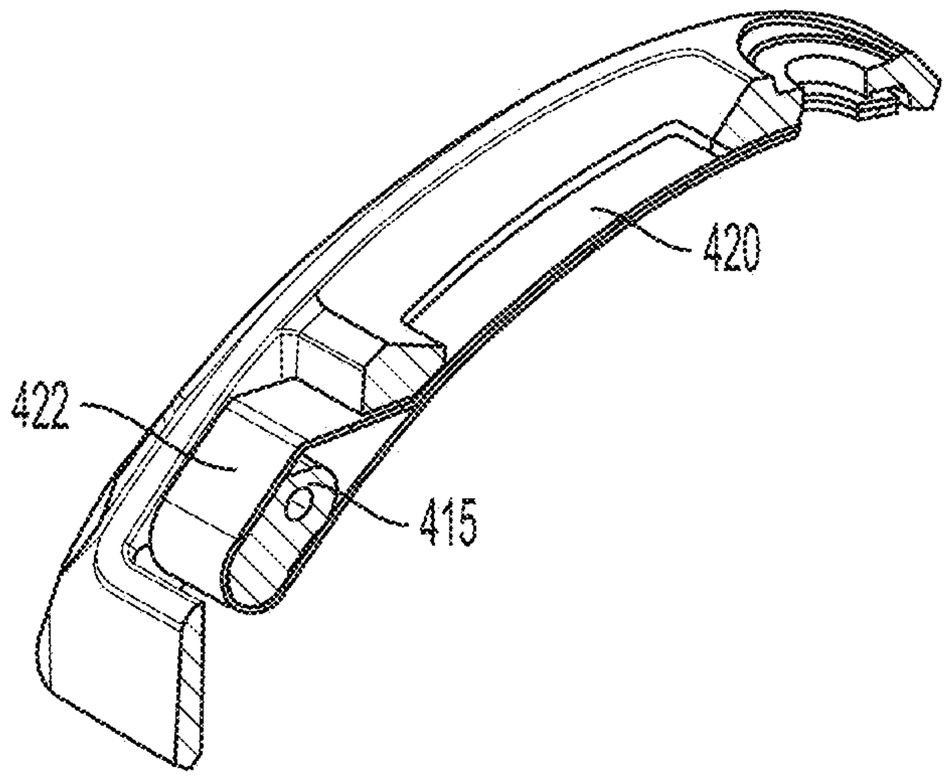

FIG. 14B

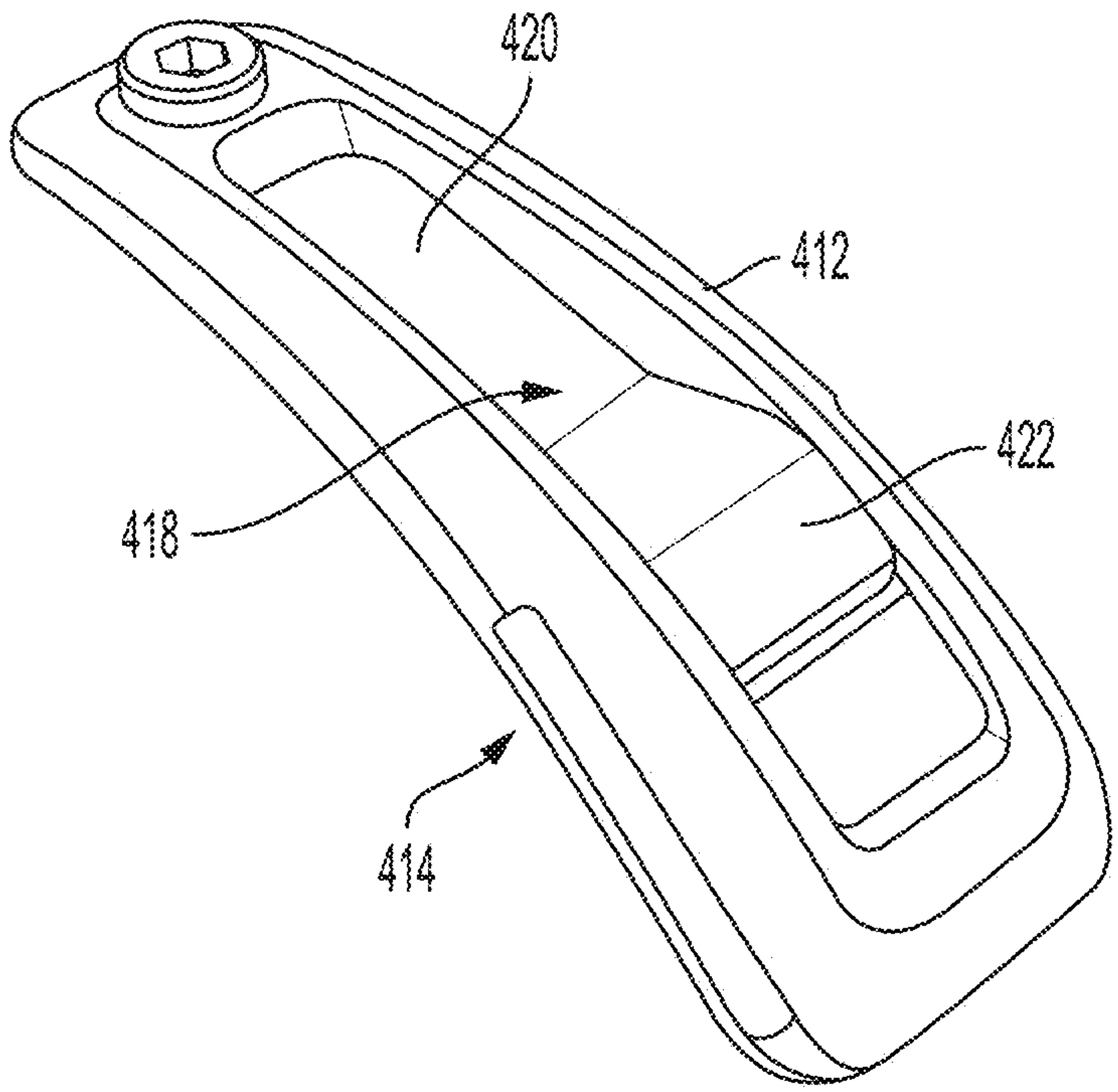

FIG. 14C

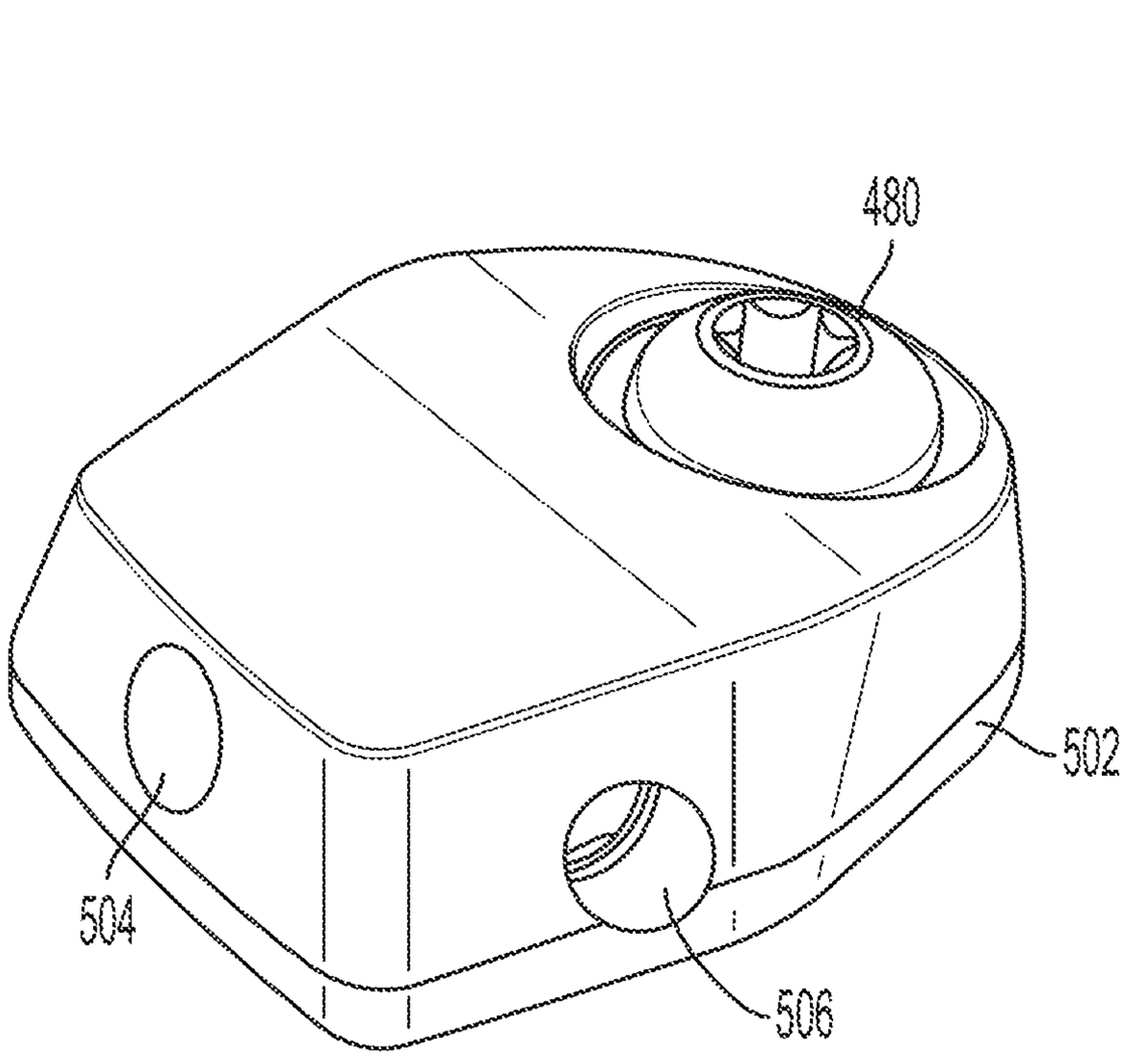

FIG. 15A

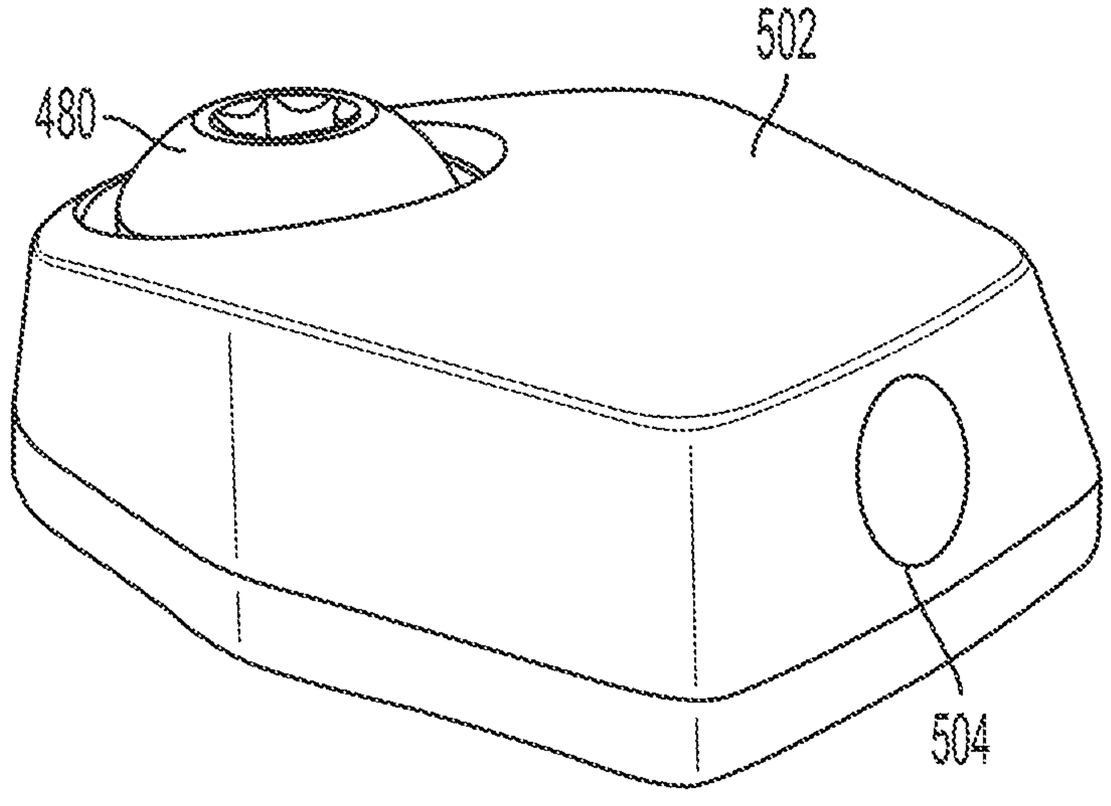

FIG. 15B

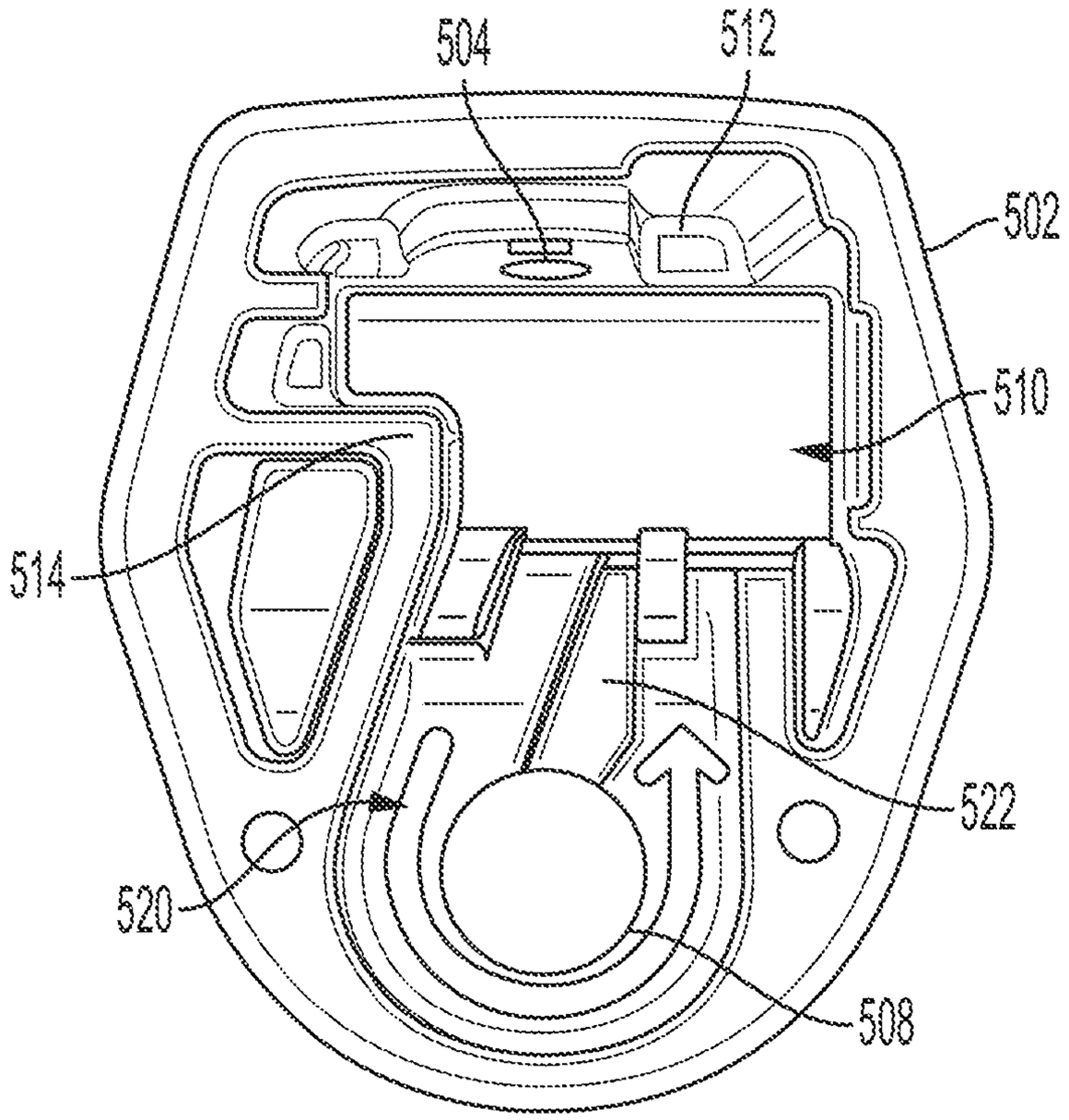

FIG. 15C

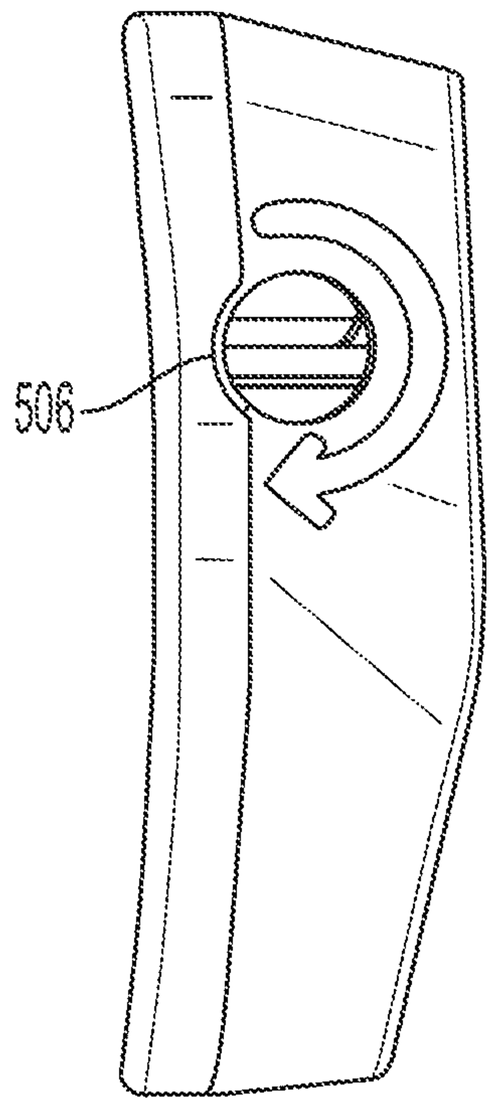

FIG. 15D

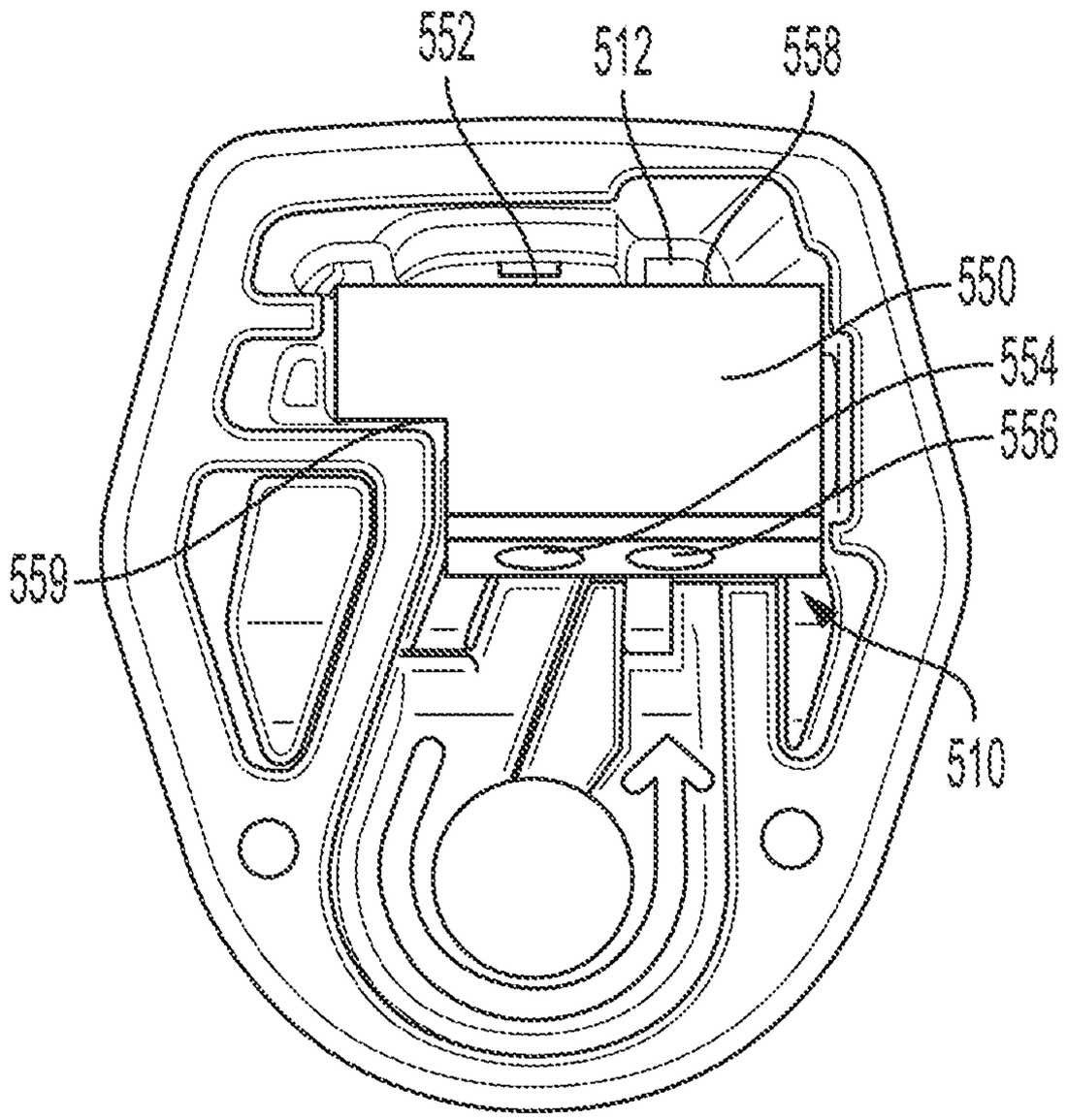

FIG. 15E

REEL BASED CLOSURE DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to Provisional U.S. Patent Application No. 63/121,732, filed Dec. 4, 2020, entitled "Reel Based Closure Device," the entire disclosure of which is hereby incorporated by reference, for all purposes, as if fully set forth herein.

BACKGROUND

[0002] Snow skiing, including alpine skiing, Nordic skiing and telemark skiing, is a popular winter recreational activity or sport around the world. Equipment that is used in skiing includes boots, skis and bindings that attach the boots to the skis. Ski boots, such as alpine ski boots, typically have exterior shells that are made of rigid materials, such as various rigid polymers. The exterior shells are often difficult to close about a user's leg and foot due to the rigid polymer materials that are employed. It is also often difficult to make the ski boot comfortable due to the rigid materials that are employed. A proper balance between comfort and fit is desired in ski boots, but may be difficult to achieve due the use of rigid materials and other design constraints. Conventional closure devices that are employed to close ski boots often tighten the ski boot in relatively large increments or steps, which may add a degree of complexity in achieving a proper balance between fit and comfort. Described herein are components, systems, and devices that enable quick and easy closure of ski boot, other boots, or articles of footwear. The components, systems, and devices balance comfort and fit in tightening articles of footwear about a wearer's foot. The components, systems, and devices may also be used to close and tighten various other non-footwear related articles.

BRIEF DESCRIPTION

[0003] Described herein are components, systems, and devices that enable quick and easy closure of ski boot, other boots, or articles of footwear. The components, systems, and devices balance comfort and fit in tightening articles of footwear about a wearer's foot. The components, systems, and devices may also be used to close and tighten various other non-footwear related articles.

[0004] According to one aspect, a ski boot includes a rigid exterior shell having a lower shell and an upper cuff. The lower shell that is configured to couple with a ski binding and to accommodate a foot of a wearer. The upper cuff is pivotally coupled with the lower shell and is configured to accommodate a lower leg of the wearer. A tightening system is coupled with the lower shell. The tightening system includes a reel based closure device that is coupled with the lower shell adjacent to the upper cuff. The tightening system may be the sole tightening device that is attached to the lower shell. Stated differently, the lower shell may not include any other tightening devices that close and tighten the lower shell about the wearer's foot.

[0005] A tension member is operably coupled with the reel based closure device so that an operation of the reel based closure device effects tightening of the tension member and thereby closes and tightens the lower shell about the wearer's foot. A first guide is positioned on a first side of an opening of the lower shell and a second guide is positioned on a second side of the opening of the lower shell. A terminal member is coupled with the lower shell adjacent to a toe box. The first guide and the second guide route or direct the tension member along a path about the lower shell across the opening and to the terminal member. A distal end of the tension member is fixedly coupled with the terminal member, which secure the tension member to the ski boot.

[0006] The first guide may be a long guide having a longitudinal length that is substantially greater than a lateral width of the guide. A proximal end of the long guide may be attached to the lower shell near a sole of the lower shell while a distal end of the long guide is positioned near the opening. The distal end of the long guide may engage the tension member. The second guide may be a short guide have a longitudinal length that is substantially shorter than the longitudinal length of the long guide. In such arrangements, the tightening system may also include a third guide that is positioned on the first side of an opening of the lower shell. The third guide may also be a long guide and have a configuration similar to the first guide. The first guide, second guide, and third guide may be arranged about the lower shell so that the second guide is positioned between the first guide and the third guide along the path.

[0007] A housing of the reel based closure device may include a single entry port or aperture for the tension member. Stated differently, the may not include any other entry port or aperture for the tension member other than the single entry port/aperture. The housing of the reel based closure device may be detachably coupleable, via a spring member, to a base member that is fixed to the ski boot. The reel based closure device may include a gear mechanism that amplifies an input torque or force. The reel based closure device may also be configured to incrementally loosen the tension member based on a first operation of the reel based closure device and to fully loosen the tension member based on a second operation of the reel based closure device. The second operation of the reel based closure device is typically different than the first operation of the reel based closure device.

[0008] The terminal member includes a lock component that is configured to engage the tension member and disengage the tension member. When the lock component is engaged with the tension member, the lock component fixedly couples the tension member to the terminal member. When the lock component is disengaged from the tension member, the lock component allows the tension member to be removed from the terminal member. The terminal member may be configured so that when the tension member is coupled with the lock component, the tension member is positioned within a channel that wraps around a thru hole of a coupling bolt that secure the terminal member to the ski boot.

[0009] According to another aspect, a long guide for routing or directing a tension member about an article includes a main body having a lateral width, a longitudinal length that is substantially greater than the lateral width, and a channel that is formed in a distal end of the main body. The channel is shaped and sized so that the tension member is insertable through the channel. The long guide also includes a reinforcement member that is coupled with the main body. The reinforcement member supports or reinforces the channel formed in the distal end of the main body. The reinforcement member may extend from a proximal end of the main body to the channel formed in the distal end of the main body. The channel may be formed in a guide segment

that is disposed within a looped end of the reinforcement member. The guide segment may extend between opposing sides of the main body so as to be accessible to the tension member.

[0010] According to another aspect, a reel based closure device for tensioning a tension member includes a housing, a spool rotatably positioned within the housing, and a dial or knob that is operably coupled with the spool so that a rotation of the dial or knob effects a rotation of the spool in a tightening direction to thereby wind the tension member about the spool. The housing may be detachably coupleable, via a spring member, with a base member that is affixable to an article. The reel based closure device may include a gear mechanism that amplifies an input torque or force of the dial or knob, and/or the reel based closure device may be configured to incrementally loosen the tension member based on a first operation of the dial/knob and to fully loosen the tension member based on a second operation of the dial/knob. The housing may only include one lace port or opening for the tension member.

[0011] According to another aspect, a boot includes a lower portion that is configured to accommodate a foot and an upper portion that extends upward from the lower portion and that is configured to accommodate a lower leg, The boot also includes a tightening system that is coupled with the lower portion. The tightening system includes a reel based closure device and a tension member that is operably coupled with the reel based closure device so that an operation of the reel based closure device effects tensioning of the tension member. The tightening system also includes a plurality of guide members that route or direct the tension member along a path and a terminal member that is fixedly coupled with a distal end of the tension member.

[0012] The plurality of guide members may include a first guide and a third guide that are positioned on a first side of the boot and a second guide that is positioned on a second side of the boot opposite the first side. The first guide and the third guide may each have a longitudinal length that is greater than a longitudinal length of the second guide. The first guide, second guide, and third guide may be arranged about the boot so that the second guide is positioned between the first guide and the third guide along the path. The second guide may include an open channel within which the tension member is removably positioned.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present invention is described in conjunction with the appended figures:

[0014] FIG. **1** illustrates an assembled perspective view of a reel based closure device.

[0015] FIG. **2** illustrates an exploded perspective view of the reel based closure device of FIG. **1**.

[0016] FIGS. **3**A-**3**B illustrate cross-sectional exploded views of the reel based closure device of FIG. **1**.

[0017] FIGS. **4**A-**5**B illustrate cross-sectional assembled views of the reel based closure device of FIG. **1**.

[0018] FIGS. **6**A-**6**B illustrate several components of the reel based closure device of FIG. **1** and, more specifically, relative movement between the several components.

[0019] FIG. **6**C illustrates a clutch plate positioned within a housing of the reel based closure device of FIG. **1**.

[0020] FIG. **7** illustrates a gear mechanism of the reel based closure device of FIG. **1**.

[0021] FIG. **8** illustrates a housing and base member of the reel based closure device of FIG. **1**.

[0022] FIGS. **9**A-**9**D illustrate attachment of the housing and base member of FIG. **8**.

[0023] FIGS. **10**A-**10**B illustrate the base member and a coupling component of the reel based closure device of FIG. **1**.

[0024] FIG. **10**C illustrates a top cross-sectional view of the housing and a spool of the reel based closure device of FIG. **1**.

[0025] FIGS. **11**A-**11**B illustrate a function of various components of the reel based closure device of FIG. **1** in controlling a rotation of a spool.

[0026] FIG. **12** illustrates a ski boot having the reel based closure device of FIG. **1**.

[0027] FIG. **13** illustrates a lace path and guide configuration that may be employed on the ski boot of FIG. **12**.

[0028] FIGS. **14**A-**14**C illustrate a long guide that may be employed on the ski boot of FIG. **12**.

[0029] FIGS. **15**A-**15**E illustrate a terminal member that may be employed on the ski boot of FIG. **12**.

[0030] In the appended figures, similar components and/or features may have the same numerical reference label. Further, various components of the same type may be distinguished by following the reference label by a letter that distinguishes among the similar components and/or features. If only the first numerical reference label is used in the specification, the description is applicable to any one of the similar components and/or features having the same first numerical reference label irrespective of the letter suffix.

DETAILED DESCRIPTION

[0031] The ensuing description provides exemplary embodiments only, and is not intended to limit the scope, applicability or configuration of the disclosure. Rather, the ensuing description of the exemplary embodiments will provide those skilled in the art with an enabling description for implementing one or more exemplary embodiments. It being understood that various changes may be made in the function and arrangement of elements without departing from the spirit and scope of the invention as set forth in the appended claims.

[0032] The embodiments herein describe reel based closure devices that are usable to close and tighten an article. The reel based closure devices may be especially useful in closing and tightening articles that require a substantial amount of lace tension. For example, alpine or ski boots (hereinafter ski boots) are typically made of rigid plastic materials that require a substantial amount of closure force to tighten about a user's foot. Conventional reel based closure devices, and other devices, may not be suited to tighten ski boots about a user's foot because the reel based closure device may not be designed to output a needed torque. In addition, the tension member or lace that is used with the ski boot may not be designed to handle the required tension.

[0033] The reel based closure devices described herein are better able to achieve high torque outputs and may be paired with a tension member or lace that is designed to withstand higher tension loads. As such, the reel based closure devices may be well suited to close and tighten articles that require substantial closure forces. In addition to tightening ski boots, the reel based closure devices may also be employed to close and tighten various other articles, such as snowboard boots,

military boots, shoes, packs, bags, and the like. In addition, the reel based closure device may also be used to close and tighten various articles that do not require high levels of closure forces. In such instances, the reel based closure device may be used unmodified, or one or more components of the reel based closure device may be modified or altered to enable use for another application. For ease in describing the embodiments herein, the reel based closure device will be generally described as being used to close and/or tighten ski boots, although it should be realized that this description is equally applicable to various other articles.

[0034] The reel based closure device is typically attached to the exterior of the ski boot, such as the shell, and is used to tighten the exterior of the ski boot about a user's leg and/or foot. The reel based closure device is configured to tension a lace or tension member that is guided about the ski boot via one or more guide members, which may be rigid components that are made of plastic or other materials, such as those described herein. In other embodiments, the one or more guide members may be made of flexible or soft components, such as fabric materials.

[0035] The reel based closure device typically includes a knob or dial that may be grasped and rotated by a user. The knob or dial is commonly coupled with a spool around which the tension member or lace is wound in response to rotation of the knob or dial in a tightening direction. Rotation of the tension member or lace around the spool tensions the tension member or lace, which tightens the ski boot about a user's foot by constricting the shell and any internal components (i.e., a liner, etc.) about the user's foot.

[0036] The reel based closure device may replace traditional buckles and/or other tightening systems that are currently used on ski boots to tighten the ski boot about a user's foot. In some embodiments, the reel based closure device may be used in combination with a traditional buckle or other tightening system. Likewise, the ski boot may include multiple reel based closure devices that are arranged to close and tighten different areas or portions of the ski boot.

[0037] The reel based closure devices are significantly easier to operate than traditional buckles and/or other tightening systems. As such, user's may prefer to use a reel based closure device in tightening a ski boot. In addition, reel based closure devices may offer incremental degrees of tightening and loosening of the ski boot in comparison with traditional buckles and/or other tightening systems. For example, traditional buckles and/or other tightening systems often include a limited number of tightening segments (e.g., teeth, steps, racks, and the like) that are used in tightening the ski boot. For example, traditional buckles often employ 5 to 10 teeth on a rack within which an engagement pin is positioned to tighten the ski boot. The engagement pin is moved proximally or distally about the rack and positioned within a proximal or distal tooth in order to increase or decrease the tightness of the ski boot about the foot. The limited number of tightening segments (e.g., teeth) results in the ski boot being tightened or loosened by greater amounts or degrees and thus, it may be difficult to achieve a desired fit.

[0038] In contrast, the reel based closure device may be capable of tightening and/or loosening the ski boot by significantly smaller incremental amounts or degrees. For example, if a minor increase in tightness is desired, the knob of the reel based closure device may be rotated by a quarter turn, an eighth of a turn, or less to slightly increase the tension in the tension member. The slight increase in the tension member's tension normally results in a slight increase in the tightness or constriction of the ski boot about the user's foot. This incremental adjustment of the ski boot's tightness may allow a desired fit of the ski boot to be easily achieved.

[0039] Referring to FIG. **1**, illustrated is an assembled perspective view of a reel based closure device **100**. FIG. **2** illustrates an exploded perspective view of the reel based closure device **100**. FIGS. **3**A-**11**B illustrate various views of the components of the reel based closure device **100**. Reference will be made throughout this disclosure to the various Figures illustrating the reel based closure device **100**.

[0040] FIG. **1** illustrates a base member or bayonet **102** that is designed to attach to a housing **202** of the reel based closure device **100**. The base member **102** is designed to be attached to a ski boot shell (not shown) via mechanical fastening, adhesive bonding, molding, or using any other fastening technique. In a specific embodiment, the base member **102** may include one or more apertures **103** (see FIG. **8**) that allow a bolt, rivet, screw, or other mechanical fastener to attach the base member **102** to a ski boot shell. The base member **102** is illustrated as including three apertures **103**, although more or fewer apertures **103** may be employed.

[0041] The base member **102** is commonly a rigid material that is designed to withstand impact from external objects without breaking. In a specific embodiment, the base member **102** may be made of glass filled nylon, although various other rigid materials may alternatively be used. The base member **102** is designed to couple with the housing **202** in a manner that allows the housing **202** to be detached or removed from the base member **102**. Various methods of attaching the housing **202** to the base member **102** may be employed, but in the illustrated embodiment, a spring member is used to fasten and couple the housing **202** to the base member **102**. The spring member is designed to flex upon impact of an object with the housing **202** to allow the housing to detach from the base member **102** and thereby prevent breaking of the base member **102** and/or housing **202**.

[0042] In some embodiments, the spring member may be a split ring or c-spring **210**. The base member **102** includes one or more arcuate or curved axial extending members **104** (see FIGS. **9**A-D) that define a recess or groove within which the c-spring **210** is positioned when the housing **202** is attached to the base member **102**. The housing **202** similarly includes a groove **260** (see FIGS. **3**B & **8**) that houses the c-spring **210**. The groove **260** of the housing **202** is shaped and sized so that the c-spring **210** fits securely within the groove **260**. The groove **260** is defined by an upper annular lip or ring **262** and one or more radially protruding members **264**. As illustrated in FIG. **8**, the one or more radially protruding member **264** of the housing **202** are shaped and sized so that they are insertable within openings **105** between opposing pairs of axially extending members **104**. The base member **102** includes recesses **108** on the circumferential edge that correspond to the shape and size of the radially protruding members **264**. When the housing **202** is coupled with the base member **102**, the radially protruding members **264** are positioned within the recesses **108**, which enables the groove of the base member **102** to be aligned

with the groove **260** of the housing **202**. In the illustrated embodiment, the housing **202** includes three radially protruding members **264** and the base member includes three axially extending members **104**, although more or fewer of such features may be employed as desired.

[0043] The radially protruding members **264** and/or annular lip **262** extend radially outward from the housing **202** so that when the housing **202** is coupled with the base member **102**, a distal edge of the radially protruding members **264** and/or annular lip **262** is roughly aligned with a distal end of the base member **102**. In this manner, the housing **202** and base member **102** may visually appear to seamlessly integrate with one another. To further secure the c-spring **210** to the housing, a lace port **266** of the housing **202** may include a pair of circumferentially extending apertures (not shown) that are positioned on opposing ends of the groove **260**. The pair of circumferentially extending apertures are shaped and sized so that the opposing ends of the C-spring may be positioned within the apertures.

[0044] The c-spring **210** is designed to flex radially to enable the housing **202** to be attached and detached from the base member **102**. For example, as illustrated in FIGS. **9**A-B, to attach the housing **202** to the base member **102**, the c-spring **210** is flexed so that the diameter of the c-spring is widened and is able to be fit over the axially extending members **104** and within the groove of the base member **102**. Widening of the c-spring's diameter likewise enables the c-spring **210** to be fit within the groove **260** of the housing **202**.

[0045] In order to allow the housing **202** to be detached from the base member **102**, the axial extending members **104** are designed so that the c-spring **210** may deflect out of the groove. Specifically, the axial extending members **104** are curved near a top end **106** so that the diameter of the top end **106** of the axial extending members **104** is greater than a diameter of the axial extending members' groove. The greater diameter top end **106** of the axially extending member **104** helps secure the c-spring **210** within the groove while the curved or arcuate design enables the c-spring **210** to be easily flexed out of the groove. When an upward force is exerted on the housing **202**, such as upon the housing **202** striking an object or upon application of a housing removal tool, the c-spring **210** is forced upward within the base member's groove. As illustrated in FIGS. **9**C-D, the curved inner surface of the axially extending members **104** functions as a ramp and causes the c-spring **210** to flex radially outward as the c-spring **210** and housing **202** move axially upward relative to the base member **102**. If the force is sufficiently strong, the c-spring **210** will flex sufficiently and will move out of the groove as shown in FIG. **9**D, which detaches the housing **202** from the base member **102** and enables the housing **202** to be moved upward and out of contact with the base member **102**. The force that is required to release or detach the housing **202** from the base member **102** may be varied by altering the angel of the inner surface of the axially extending members **104** and/or the stiffness of the c-spring.

[0046] To detach the housing **202** from the base member **102**, the base member is designed to function with a housing removal tool. Specifically, the housing includes a support **109** for the lace exit component **160**. The support **109** is shaped and sized in accordance with the lace exit component **160** in order to reinforce the lace exit component **160**. A radially extending groove **107** is formed in the support **109**, which enables a housing removal tool (not shown), such as a small flat head screw driver, to be inserted along the groove **107** and under the housing **202**. With the housing removal tool positioned within the groove **107** and under the housing **202**, the housing removal tool may apply an upward force on the housing **202** to detach the housing **202** from the base member **102**.

[0047] As illustrated in FIG. **2**, a coupling component or member **120** is positionable between the base member **102** and the housing **202**. The coupling component **120** is designed to attach to a bottom end of the housing **202** and is shaped and sized so that a bottom end of the coupling component **120** is positionable within an interior region of the base member **102**. As illustrated in FIGS. **10**A-B, the shape and size of the coupling component **120** corresponds with the shape and size of the bottom end of the housing **202**. Specifically, the bottom end of the coupling component **120** is roughly circular in shape and is sized so that the coupling component **120** is insertable within a circular opening of the bottom end of the housing **202**. To attach the coupling component **120** to the housing **202**, the coupling component **120** includes upward extending tabs **128** that snap into corresponding slots **205** that are forward on the bottom end of the housing **202**. The upward extending tabs **128** includes a radially outward extending nub that snaps or clips into a recess within a corresponding slot **205**, which fastens the coupling component **120** to the housing **202**. The coupling component **120** is illustrated as including two tabs **128**, although more or fewer tabs may be employed as desired. A front portion of the coupling component includes radially extending nubs that fit within corresponding features on the housing **202**. The nubs aid in alignment and securement of the coupling component **120** about the housing **202**. The bottom end of the coupling component also includes one or more apertures (not labeled) that correspond in size and orientation to the apertures **103** in the base member **102**. The apertures in the coupling component **120** allow the coupling component to be fit over a mechanical fastener (e.g., a bolt) that is inserted within the apertures **103** of the base member **102**, which reduces an overall height of the reel based closure device **100**. The coupling component **120** also includes one or more lace apertures **126**, which are alignable with lace ports **136** in a spool **130** to enable easy coupling of the tension member with the spool **130** as described herein.

[0048] A boss **125** extends axially upward from the bottom end of the coupling component **120**. When the coupling component is attached to the housing **202**, the boss **125** protrudes axially upward into the interior region of the housing **202**. The boss **125** includes a pair of fingers that are separated by a gap. The boss **125**, and more specifically the pair of fingers, function to enable a dial core **230** to be moved axially upward and downward relative to the housing **202**. A reinforcement spring **122** is positioned in the gap between the pair of fingers and is used to strengthen and reinforce the pair of fingers. The reinforcement spring **122** aids in resiliently deflecting the pair of fingers as a dial core **230** is moved axially upward and downward about the boss **125**. The reinforcement spring **122** may stiffen the pair of fingers and prevent the pair of fingers from plastically deforming due to extended use of the closure device **100**. The reinforcement spring **122** includes an aperture that engages with a small projection on the inner surface of the pair of fingers. Engagement of the aperture and projection

locks or retains the reinforcement spring **122** in position relative to the pair of fingers.

[0049] The spool **130** is positionable within the bottom end of the housing **202**, typically by inserting the spool **130** within the housing's open bottom end. The spool **130** includes a central aperture **132** through which the boss **125** of the coupling component **120** is inserted. The spool **130** is configured to rotate around the boss **125** in both a clockwise and counterclockwise direction with minimal frictional engagement between the two components. A gear mechanism (**140**, **142**), drive component **150**, and dial core **230** are also typically configured to rotate around the boss **125** in a clockwise and counterclockwise direction. The spool **130** includes a channel **133** within which the tension member (not shown) is wound as the spool **130** is rotated in a tightening direction (e.g., clockwise). The tension member is similarly unwound from about the central channel **133** as the spool **130** is rotated in a loosening direction (e.g., counterclockwise). The central channel **133** has a width that is slightly larger than the width of the tension member, which ensures that the tension member is wound about the central channel **133** as a "single stack", meaning that the wound tension member forms a single layer within the channel **133**. The single stack winding of the tension member constrains vertical forces that the tension member might develop if it was coiled onto the spool in an uncontrolled manner and protects the tension member from damaging itself during the winding process. Given the substantial tension forces that the closure device **100** is capable of generating, winding the tension member about the spool **130** in an uncontrolled manner may cause excessive kinking and/or damage of the tension member.

[0050] As briefly mentioned above, the dial core **230** is axially moveable with respect to the housing **202**. Movement of the dial core **230** relative to the housing **202** enables the tension member to be fully loosened, which means that the spool **130** is able to rotate in the loosening direction in a relatively unrestrained manner. The "fully loosening" feature is an optional feature that may be omitted in some embodiments of the closure device **100**. To enable full loosening of the tension member, the closure device **100** is designed to move or transition between an engaged state or position in which the dial core **230** is operationally coupled with the spool **130** and a disengaged state or position in which the dial core **230** is operationally decoupled from the spool **130**. The transition between the two states is achieved via axial movement of the dial core **230** relative to the housing **202**. Axial movement of the dial core **230** relative to the housing **202** is commonly achieved via pulling axially upward on the knob **302**. However, in other embodiments, the dial core **230** may be moved axially upward via a counter rotation of the knob **302** or via operation of a button (not shown), lever mechanism (not shown), clamp (not shown), and the like. In such embodiments, to move the dial core **230** axially upward, the knob **302** and dial core **230** may include cammed, ramped, or sloped surfaces, or another mechanism, that moves the dial core **230** axially upward as the knob **302** is rotated in the loosening direction or as the button, lever mechanism, etc. are operated.

[0051] As illustrated in FIGS. **4**A-B, the boss **125** is designed to cooperate with the dial core **230** to support and maintain the dial core **230** in either the engaged position or the disengaged position. Specifically, the top end of the boss **125** supports and maintains the dial core **230** and/or knob **302** in the engaged and disengaged positions via an annular projection or member **124**. In one embodiment, the engaged position is illustrated in FIG. **4**A while the disengaged position is illustrated in FIG. **4**B. In the engaged position, the dial core **230** is engaged with the clutch plate **220**, which enables forces to be transferred between these two components as described herein. In the disengaged position, the dial core **230** is disengaged from the clutch plate **220**, which allows the spool **130** to "free wheel" or spin freely in the loosening direction within the housing **202**. Similarly, in the disengaged position, one or more pawls **240** may be disengaged from teeth **204** that are formed on, or otherwise coupled with, the housing **202**. In other embodiments, the one or more pawls **240** may remained engaged with the teeth **204** in the disengaged position.

[0052] The annular projection **124** has a diameter that is greater than a diameter of a central opening **234** of the dial core **230**, which causes the annular projection **124** to interfere with and impede upward and downward movement of the dial core **230** about the top end of the boss **125**. While the annular projection **124** impedes axial movement of the dial core **230**, the annular projection **124** does not prevent axial movement of the dial core **230** due to the ability of the boss's fingers to displace or flex radially inward. As the dial core **230** is moved axially about the annular projection **124**, the pair of fingers flex inward toward one another, which allows the central opening **234** of the dial core **230** to be is moved axially upward or downward about and over the annular projection **124**. After the dial core **230** is moved axially upward or downward about the annular projection **124**, the pair of fingers resiliently flex outward to resume an un-deflected configuration. In operation, the central opening **234** of the dial core **230** is positioned above or below the annular projection **124**, which supports and maintains the dial core **230** and/or knob **302** in either the engaged or disengaged position. The reinforcement spring **122** increases the stiffness of the boss **125** and reduces fatigue on the boss **125** due to repeated movement of the dial core **230** about the annular projection **124**.

[0053] The knob **302** is coupled to the housing **202** by axially aligning the knob **302** and the housing **202** and by snapping the knob **302** atop an annular flange or rib **209** of the housing **202**. Specifically, an inner wall or surface of the knob **302** includes one or more projections **304**, or a radial lip, that snaps over the annular rib **209** of the housing **202** as the knob **302** is pressed and moved axially downward relative to the housing. The projections **304** of the knob **302** define an inner diameter that is smaller than an outer diameter of the annular rib **209**. As such, in coupling the knob **302** with the housing **202**, the inner wall of the knob **302** must flex outward to some degree and/or the housing **202** must flex inward to some degree to allow the knob **302** to be moved axially downward about and snap over the housing **202**. After the knob **302** is moved axially downward, the projections **304** are positioned axially below the annular rib **209** of the housing **202**. Due to the interference between the projections **304** and the annular rib **209**, uncoupling of the knob **302** from the housing **202** via axially upward movement of the knob **302** is prevented or significantly impeded. Uncoupling of the knob **302** from the housing **202** may further be impeded by designing the annular rib **209** and/or projections **304** so that they do not naturally deflect outward as the knob **302** is forced upward relative to the housing **202**. Additional details of the cou-

pling of the dial core **230**, knob **302**, and housing **202** are provided in U.S. patent application Ser. No. 14/991,788, filed Jan. 8, 2016, entitled "Integrated Closure Device Components and Methods," the entire disclosure of which is incorporated by reference herein.

[0054] The housing **202** includes an annular ring or lip **206** that is disposed on an inner wall. The annular ring **206** functions as a partition and divides the housing **202** into an upper half and a lower half. The annular ring **206** is configured so that some of the components that are positioned in the lower half of the housing **202** contact and engage a bottom surface of the annular ring **206** and so that some of the components positioned in the upper half contact and engage an upper surface of the annular ring **206**. The components that are positioned in the lower half of the housing **202** include the coupling component **120**, spool **130**, gear mechanism (**140**, **142**), and drive component **150**. The components that are positioned in the upper half of the housing **202** include a clutch plate **220**, dial core **230**, one or more pawls **240**, and pawl disc **250**. The annular ring **206** blocks or impedes these components from moving into the other half of the housing **202**.

[0055] The gear mechanism (**140**, **142**) is operably coupled with the spool **130**. The gear mechanism (**140**, **142**) increases the mechanical advantage of the closure device **100**, which increases the torque output of the closure device **100** and increases the tension forces that the closure device **100** is capable of generating. The gear mechanism includes a sun gear **140**, a plurality of planetary gears **142**, and a ring gear **208**. The ring gear **208** may include teeth that are formed on the inner wall of the housing **202** below the annular ring **206** or the ring gear **208** may be a separate component that is coupled with the lower half of the housing **202** (e.g., press fit, keyed, etc.). As illustrated in FIGS. **3**A and **7**, the sun gear **140** is coaxially aligned with and rests atop the spool **130** while each of the planetary gears **142** is rotatably positioned on a boss **134** that extends axially upward from an upper surface of the spool **130**. The sun gear **140** is axially taller than the planetary gears **142** so that the upper portion of the sun gear **140** matingly engages with spline teeth **154** that are formed on a lower inner cylindrical wall of the drive component **150**. The spline teeth **154** extend axially downward from an annular ring that is formed or positioned within the drive component **150**.

[0056] As the drive component **150** is rotated in the tightening direction due to a rotation of the knob **302**, the drive component **150** transfers rotational forces to the sun gear **140** due to mating engagement of the sun gear **140** and spline teeth **154**, which causes the sun gear **140** to rotate in the tightening direction. Rotation of the sun gear **140** likewise causes the planetary gears **142** to rotate about the spool's bosses **134**, which causes the planetary gears **142** to move in the tightening direction within the housing **202** due to engagement of the planetary gears **142** and the ring gear **208**. Movement of the planetary gears **142** in the tightening direction causes the spool **130** to rotate in the tightening direction due to the engagement of the planetary gears **142** and the spool's bosses **134**.

[0057] In some embodiments, the gear mechanism (**140**, **142**) may be omitted. In such embodiments, the drive component **150** may directly interface with the spool **130** in order to transfer rotational forces to the spool **130**. It may be desirable to omit the gear mechanism when the end application of the closure device **100** does not require substantial tension forces and torque output. Removal of the gear mechanism may enable the closure device **100** to be axially smaller, which may be preferred in some embodiments. The drive component **150** may directly interface with the spool **130** via axially oriented teeth, spline teeth, and the like.

[0058] The drive component **150** functions to transfer forces from the components that are positioned above the annular ring **206** (i.e., the clutch plate **220**, knob **302**, etc.) to the components that are positioned below the annular ring **206** (i.e., the spool **130**, gear mechanism, etc.). To enable transferring of forces, the drive component **150** is operationally coupled with the clutch plate **220**. The drive component **150** includes an outward facing spline **152** that is positioned on an upper surface of the drive component **150**. The spline **152** couples with corresponding teeth **224** on the clutch plate **220**. Engagement of the spline **152** and teeth **224** allows torque to be transmitted through the clutch plate **220** and drive component **150** to the gear mechanism (**140**, **142**) and spool **130**.

[0059] In one embodiment, the drive component **150** and clutch plate **220** are assembled together via a snap fit coupling. Specifically, one or more radially outward extending tabs (not numbered) are positioned between a pair of teeth of the drive component's spline **152**. The one or more radially outward extending tabs are positioned above a corresponding tooth **224** of the clutch plate **220** when the clutch plate **220** is coupled with the drive component **150**. The clutch plate **220** is snap fit coupled with the drive component **150** by coaxially aligning the clutch plate **220** and drive component **150** and by pressing the clutch plate **220** axially downward and onto the drive component **150**. The two components deflect to some degree as the clutch plate **220** is pressed axially downward onto the drive component **150** and as one or more of the clutch component's teeth **224** move past the corresponding outward extending tabs. Once assembled, the one or more radially outward extending tabs contact the corresponding teeth **224** as the clutch plate **220** is moved axially upward relative to the drive component **150**, which prevents uncoupling of the two components.

[0060] As illustrated in FIG. **3**B, the drive component **150** is positioned below the annular ring **206** while the clutch plate **220** is positioned above the annular ring **206**. When these two components are coupled together, the annular ring **206** is sandwiched between the two components, which essentially locks the housing **202**, the clutch plate **220**, and the drive component **150** together. The clutch plate **220** is designed to engage a top surface of the annular ring **206** in order to prevent a rotation of the spool **130** in the loosening direction once a tension in the tension member is decreased to a tension threshold or below the tension threshold. The tension threshold is commonly at or near a point in which minimal tension, or no tension, is present in the tension member. This point typically corresponds to a point in which the tension member has been fully unwound from about the spool **130**. Preventing rotation of the spool **130** in the loosening direction once the tension member is at or near a zero tension threshold prevents back winding of the tension member about the spool **130**, which prevents kinking or entangling of the tension member about the spool **130**.

[0061] As illustrated in FIGS. **3**B and **6**C, the housing's annular ring **206** includes a plurality of depressions or teeth **207** (hereinafter depressions **207**) that are arranged, and evenly spaced, circumferentially around the annular ring

206. The depressions **207** are configured to engage corresponding nubs or teeth **226** (hereinafter nubs **226**) that are positioned circumferentially around, and evenly spaced, on an outer edge or ring of the clutch plate **220**. When the nubs **226** engage the depressions **207** on the annular ring **206**, the clutch plate **220** is prevented from rotating relative to the housing **202** and annular ring **206**. Engagement of the nubs **226** and the depressions **207** locks the clutch plate **220** in position relative to the annular ring **206**. The spool **130** is also prevented from rotating within the housing **202** due to the coupling of the drive component **150** with the spool **130** and the coupling of the clutch plate **220** with the drive component **150** as described herein.

[0062] To engage the annular ring **206**, the clutch plate **220** moves axially downward within the interior of the housing **202**. The clutch plate **220** is designed to move downward within the housing **202** only when the tension in the tension member reaches the tension threshold or decreases beyond the tension threshold. The nubs **226** and the depressions **207** are disengaged when the clutch plate **220** is in an axially raised position, which position is illustrated in FIGS. **4**A, **5**A, and **6**B. As shown in the images, the bottom surface of the clutch plate **220** is positioned above the annular ring **206** and thus, the nubs **226** and the depressions **207** are disengaged, which allows the spool **130** to rotate in both the tightening and loosening directions. After the nubs **226** and the depressions **207** engage, further rotation of the spool **130** in the loosening and tightening directions is prevented.

[0063] As illustrated in FIGS. **5**A and **6**B, the clutch plate **220** is maintained in the axially raised position due to engagement of the clutch plate **220** and the dial core **230**. Specifically, the clutch plate **220** includes upper teeth **222** that engage with axial teeth **232** of the dial core **230**. The clutch plate's upper teeth **222** extend axially upward from an upper surface of the clutch plate **220** while the axial teeth **232** of the dial core **230** extend downward from a lower surface of the dial core **230**. The clutch plate's upper teeth **222** and the dial core's axial teeth **232** may include a slight taper or sloped configuration that biases the clutch plate **220** axially upward when the teeth are engaged. Tension in the tension member facilitates in engagement of the clutch plate's upper teeth **222** and the dial core's axial teeth **232** by biasing the clutch plate **220** toward rotation in the loosening direction via the spool **130** and drive component **150**. The clutch plate's upper teeth **222** and the dial core's axial teeth **232** remain engaged until the tension in the tension member reaches or exceeds the tension threshold, after which point the tension member no longer biases the clutch plate **220** toward rotation in the loosening direction. As the tension in the tension member is reduced to near the tension threshold, the engagement of the clutch plate's upper teeth **222** and the dial core's axial teeth **232** begins to reduce, which allows the clutch plate **220** to begin to slide axially downward relative to the dial core **230** as illustrated in FIG. **6**A.

[0064] At some point near the tension threshold, the clutch plate **220** will slide downward and into engagement with the annular ring **206**, which prevents further rotation of the clutch plate **220**, drive component **150**, and spool **130** as described herein. For simplicity in illustrating the various components, the annular ring **206** is omitted from FIG. **6**A. However, it should be realized that the position of the clutch plate **220**, drive component **150**, and dial core **230** in FIG. **6**A corresponds to a position in which the clutch plate **220** would be engaged with the annular ring **206**. The clutch plate **220** is also able to move axially downward when the dial core **230** is moved axially upward as illustrated in FIGS. **4**B and **5**B. Axially upward movement of the dial core **230** forces the clutch plate's upper teeth **222** and the dial core's axial teeth **232** to disengage. The clutch plate **220** is prevented from moving upward with the dial core **230** due to engagement of the drive component's one or more radially outward extending tabs and corresponding teeth **224** of the clutch plate **220**. Disengagement of the clutch plate **220** and the dial core **230** as illustrated in FIGS. **4**B and **5**B allows the spool **130** to "free wheel" or spin freely in the loosening direction within the housing **202** because the clutch plate **220** and dial core **230** are not rotationally locked or coupled together.

[0065] In some embodiments, the nubs **226** and depressions **207** may be designed so that they do not immediately engage when the clutch plate **220** moves axially downward and into contact with the annular ring **206**. This configuration may allow the spool **130** to spin freely in the loosening direction when the dial core **230** is moved axially upward. For example, when the dial core **230** is moved axially upward as described herein, the clutch plate **220** is no longer engaged with the dial core **230** and thus, the clutch plate **220** is able to move axially downward into contact with the annular ring **206**. In such instances, the clutch plate **220** may contact the annular ring **206** even when tension remains in the tension member. To enable the spool **130** to spin freely in the loosening direction when the clutch plate **220** contacts the annular ring **206**, the nubs **226** and depressions **207** may not engage in the locking manner described above. Rather, the nubs **226** and depressions **207** may be designed so that the nubs **226** ramp or move out of the depressions **207** as the spool **130** rotates in the loosening direction, which prevents the spool **130** from being rotationally locked to the housing **202**. More specifically, the nubs **226** and depressions **207** may have a rounded or angled shape, which allows the nubs **226** to ramp or move out of engagement with the depressions **207**. In such instances, the nubs **226** and depressions **207** are still able to engage when the knob **302** is rotated in a loosening direction and the tension member is near the tension threshold. In such instances, the dial core **230** pushes or forces the clutch plate **220** downwards, which forces the nubs **226** and depressions **207** to remain locked or engaged together and thereby prevents the clutch plate **220** and spool **130** from rotating in the loosening direction.

[0066] To enable axial movement of the clutch plate **220** about the drive component **150**, the drive component's spline **152** and the clutch plate's teeth **224** are configured to allow for such axial movement as illustrated in FIGS. **6**A and **6**B. Specifically, the drive component's spline teeth are axially elongated in comparison with the clutch plate's teeth **224**, which allows the shorter clutch plate's teeth **224** to slide axially within channels or grooves formed between the spline teeth.

[0067] After engagement of the nubs **226** and the depressions **207**, the closure device **100** is configured so that the knob **302** is rotatable in the loosening direction without affecting rotation of the spool **130**. Specifically, as illustrated in FIG. **6**A, a rear surface of the dial core's axial teeth **232** and a rear surface of the clutch plate's upper teeth **222** are oppositely sloped or ramped so that a rotation of the dial core in the loosening direction causes the rear surfaces to engage and causes the dial core **230** to skip over the clutch

plate **220**, which pushes or forces the clutch plate **220** downwards as previously described. As further illustrated in FIG. **6**A, the dial core's axial teeth **232** and the clutch plate's upper teeth **222** slightly overlap when the dial core **230** is in the axially lowered position so that a rotation of the dial core **230** in the tightening direction (via the knob **302**) causes the dial core **230** and clutch plate **220** to reengage, which pulls or biases the clutch plate **220** into the axially raised position illustrated in FIG. **6**B and allows the spool **130** to be rotated in the tightening and loosening directions. The dial core **230** and clutch plate **220** reengage due to the clutch plate **220** resisting rotation in the tightening direction due to tension in the tension member and/or engagement of the clutch plate's nubs **226** with the annular ring's depressions **207**.

[0068] In some embodiments, the clutch plate's nubs **226** and the annular ring's depressions **207** may be replaced by other frictional components, such as a rubber type gasket or material, abrasive materials, tacky materials, and the like. As illustrated in FIG. **6**C, the clutch plate's nubs **226** may be axially recessed from a bottom surface of the clutch plate **220**, which allows the clutch plate **220** to sit lower about the annular ring **206**. For example, the nubs **226** may be formed or positioned on a circumferential ring or edge that is axially recessed from a bottom surface of the clutch plate **220**. In some embodiments, the bottom surface of the clutch plate **220** may be roughly aligned with the bottom surface of the annular ring **206** and/or the bottom surface of the clutch plate **220** may contact the upper surface of the drive component **150** when the clutch plate's nubs **226** engage with the annular ring's depressions **207**.

[0069] The dial core **230** is configured to couple with the knob **302**, typically via a snap fit coupling. In some embodiments, the knob **302** includes axially extending tabs **310** that are configured to couple with corresponding edges or lips **238** of the dial core **230**. The tabs **310** each include a radially inward lip **312** that is shaped and sized to fit under a corresponding edge **238** of the dial core **230** (see FIG. **4**A). The tabs **310** are resilient, which enables the tabs to snap into engagement with the dial core's edges **238**. The tabs **310** are also sufficiently strong so that axially upward forces imparted on the knob **302** (e.g., a user pulling the knob axially upward) are transferred to the dial core **230** and cause the dial core **230** to move axially upward with the knob **302**. As such, the knob **302** and dial core **230** essentially move as a single component.

[0070] The tabs' inward lips **312** couple with the dial core's edges **238** in a manner that allows the knob **302** to rotate about the dial core **230** to some degree, which enables the knob **302** to be rotated in the loosening direction to incrementally loosen tension as described below. To enable the relative movement of the knob **302**, the dial core's edges **238** are sized slightly larger than the tabs' inward lips **312**. As illustrated in FIG. **5**A, the dial core's edges **238** are formed by recessing a peripheral edge of the dial core **230**, which creates a slot within which the tabs **310** are positioned. The tabs **310** have a circumferential width that is less than a circumferential width of the corresponding slot, which allows the tabs **310** to rotate within the slot to some degree. The tabs **310** may have a radial width that corresponds to a width of the recess so that when the tabs **310** are coupled with the dial core's edges **238**, an outer surface of the tabs **310** roughly aligns with the outer surface of the dial core **230**. In one embodiment, the knob **302** includes four tabs **310** and the dial core **230** includes four edges **238**, although more or fewer tabs **310** and edges **238** may be employed as desired. The tabs **310** and edges **238** of the dial core are typically positioned immediately adjacent a corresponding pawl **240**, which enables the tabs **310** to engage the pawls **240**, although the position of the tabs **310** and edges **238** may be varied as desired. With the dial core **230** attached to the knob **302**, the one or more pawls **240**, and pawl disc **250** are sandwiched between the knob **302** and dial core **230**.

[0071] The closure device **100** includes a lace exit component **160** that is separate from the housing **202** and that assembles to the housing **202**. The separation of the lace exit component **160** from the housing **202** allows the lace exit component **160** to be formed of a low friction and abrasion resistant material while a high strength and impact resistant material is used for the housing **202**. For example, the housing **202** may be made of a high impact material that is less abrasion resistant while the lace exit component **160** is made a high abrasion resistant material that is less impact resistant. The abrasion resistant material allows the lace exit component **160** to function with tension members that are designed to withstand higher tensile loads. The lace exit component **160** allows such tension members to repeatedly slide over surfaces of the component without experiencing excessive wearing. As illustrated in FIG. **10**A, the lace exit component **160** includes a key **164** that is designed to fit within a corresponding slot **166** in the housing **202**. The key **164** may be tabs that extend outward from a main body of the lace exit component **160**. The lace exit component **160** may be attached to the housing **202** by positioning the lace exit component **160** below the housing and sliding the key **164** axially upward into the corresponding slot **166** in the housing **202**. The lace exit component **160** includes a lace channel **162** within which the tension member is positioned so that the tension member is able to access the spool **130** within the housing **202**. The lace exit component **160** is shaped and sized to correspond with the support **109** of the base member **102**.

[0072] As illustrated in FIGS. **10**A-B, the coupling component **120** includes one or more lace apertures **126** that are alignable with a lace port **136** in a spool **130**. Alignment of the lace aperture **126** with the spool's lace port **136** enables easy coupling of the tension member with the spool **130**. For example, as illustrated in FIG. **10**C, the spool **130** is alignable within the interior of the housing **202** so that a channel **137** of the spool **130** aligns with the lace channel **162** of the lace exit component **160**. When the spool's channel **137** is aligned with the lace exit component's lace channel **162**, a tension member may be inserted within the lace exit component's lace channel **162** and through the spool's channel **137**. A distal end of the spool's channel **137** forms an opening **138**, which is designed to direct the tension member downward and through the lace port **136**. Insertion of the tension member through the spool's channel **137** and through the lace port **136** causes the tension member to extend outward from the bottom end of the spool **130**. With the tension member extending beyond the bottom end of the spool **130**, a knot may be tied in the tension member, or a separate component may be attached to the tension member, so that retraction of the tension member causes the distal end of the tension member to engage with the spool's opening **138** and prevents retraction of the tension member through the opening **138**. In this manner, the tension member may be easily coupled with the spool **130**.

[0073] Alignment of the coupling component's lace aperture **126** with the spool's lace port **136** allows the tension member to extend through the spool **130** and through the coupling component **120** so the knot may be tied in the tension member, or the separate component may be attached to the tension member, without requiring the coupling component **120** to be detached from the spool **130**. In some embodiments, the spool **130** may include a single lace port **136** while the coupling component **120** includes a pair of lace apertures **126**. This design enables a single coupling component **120** to be used with a spool **130** regardless of if the lace port **136** is positioned on a left or right hand side of the spool **130**, which configuration may be employed dependent on if the spool **130** is designed to rotate in a clockwise or counterclockwise tightening direction. FIG. **10**C illustrates a top cross-sectional view of the spool **130** and thus, the channel **137** is illustrated as being on an opposite side of the spool **130** from the lace port **136**. The lace port **136** may be formed in the spool's channel **133** by forming a semi-circular groove in a top flange or bottom flange of the spool **130**, or in both flanges of the spool **130**. The semi-circular groove may guide or direct the tension member toward the opening **138** as the tension member is inserted through the lace exit component's lace channel **162**.

[0074] Referring now to FIGS. **11**A-B, the coupling of the one or more pawls **240**, the pawl disc **250**, and the dial core **230** is illustrated. The function of the one or more pawls **240**, pawl disc **250**, and knob **302** in controlling the rotation of the spool **130** is also illustrated. To facilitate in coupling the one or more pawls **240** with the dial core **230**, the dial core **230** includes one or more drive bosses **236** that extend axially upward from a top surface of the dial core **230**. Each drive boss **236** includes a recess **237** that is shaped and sized to accommodate a proximal end **244** of the one or more pawls **240**. The recess **237** is designed so that each pawl **240** is able to rotate in a clockwise and counterclockwise direction atop the dial core **230**. In a specific embodiment, the recess **237** and the proximal end **244** of the pawl **240** are each semi-circular in shape. The proximal end **244** of the pawl **240** may engage or contact a wall of the recess **237** so that forces or loads exerted on the pawl **240** are transferred to the drive boss **236**. In this manner, each drive boss **236** supports and reinforces a corresponding pawl **240**.

[0075] The dial core **230** also includes one or more pivot bosses **231** that extend axially upward from the top surface of the dial core **230**. Each pivot boss **231** couples with a corresponding pawl **240** by inserting the pivot boss **231** within an aperture positioned on the proximal end of the corresponding pawl **240**. Coupling of a pawl **240** with a pivot boss **231** enable the pawl **240** to pivot or rotate about the pivot boss **231**. In some embodiments, the one or more pawls **240** may be integrated with the dial core **230**. In such embodiments, the one or more pawls **240** are typically configured so that they are moveable or rotatable about the dial core **230**. For instance, the one or more pawls **240** may be compliant mechanisms and/or may be coupled with one or more compliant members or mechanisms.

[0076] The pawl disc **250** is coupled with the dial core **230** by aligning recesses **254** of the pawl disc **250** with corresponding keyed protrusions **233** of the dial core **230**. The pawl disc **250** may then be pressed downward atop the dial core **230** so that the keyed protrusions **233** snap into the corresponding recesses **254**. In some embodiments, the pawl disc **250** may be integrated with the dial core **230** and/or one or more pawls **240**. In such embodiments, the pawl disc **250** should be configured to bias the one or more pawls **240** outward as described herein. Separation of the one or more pawls **240**, pawl disc **250**, and/or dial core **230** allows each component to be made of a different material, which may enable the components to be optimized for a particular purpose. For example, the one or more pawls **240** may be made of a high stiffness material that is able withstand higher forces while a soft spring like material is used for the pawl disc **250** to actuate or bias the one or more pawls **240**. The dial core **230** may be made of a material that is suited for supporting and reinforcing the pawl disc **250** and one or more pawls **240**.

[0077] The pawl disc **250** includes one or more arms **252** that extends outward from a main body of the pawl disc **250**. The one or more arms **252** are flexible and are positioned atop the dial core **230** so that a distal end of each arm **252** is positioned against a rear surface of a corresponding pawl **240**. The arms **252** are configured to provide a biasing force that presses or biases the pawls **240** toward engagement with the teeth **204** that are formed on, or otherwise coupled with, the housing **202**. More specifically, the arms **252** bias the pawls **240** so that the pawls rotate about the pivot bosses **231** into engagement with the teeth **204**. In this manner, the pawl disc **250** functions as a spring that presses or biases the pawls **240** toward engagement with the teeth **204**.

[0078] Each pawl **240** includes one or more teeth **242** that are positioned on a distal end of the pawl **240**. The one or more teeth **242** are shaped and sized so that they are engageable with the teeth **204** of the closure device **100**. More specifically, the one or more teeth **242** are shaped and sized so that they are able to fit within a tooth, or within teeth, of the closure device **100**. Engagement of the one or more pawls' teeth **242** and the closure device's teeth **204** prevents rotation of the dial core **230** in the loosening direction (e.g., counterclockwise in FIG. **11**A). Specifically, when the pawls **240** are engaged with the teeth **204** and a force is applied to the dial core **230** in the loosening direction (via the tension member and spool **130**), the one or more pawls **240** are oriented and coupled with the dial core **230** in a manner that does not allow the one or more pawls **240** to rotate. As such, the one or more pawls **240** remain engaged with the teeth **204**, which prevents rotation of the dial core **230** in the tightening direction.

[0079] The spool **130** is prevented from rotating in the loosening direction due to the engagement of the dial core **230** with the clutch plate **220**, drive component **150**, and spool **130** as described herein. Due to the biasing force of the pawl disc **250**, the pawls **240** remain engaged with the teeth **204** until the pawls **240** are moved out of engagement with the teeth **204** due to upward movement of the dial core **230** or rotation of the knob **302** in the loosening direction. In addition, the biasing force of the pawl disc **250** causes the one or more pawls **240** to automatically reengage the teeth **204** when the dial core **230** is moved axially downward or when rotation of the knob **302** in the loosening direction is ceased.

[0080] To rotate the spool **130** in the tightening direction, the tabs **310** are configured to engage the drive boss **236** of the dial core. Specifically, the tabs **310** extend axially downward from the knob **302** and are positioned so that when the knob **302** is coupled with the housing **202** in the engaged position, each tab **310** is adjacent a drive boss **236** and is between a pawl **240** and the teeth **204**. As illustrated

in FIG. **11**A, when the knob **302** is rotated in the tightening direction (e.g., clockwise in FIG. **11**A), a proximal end of each tab **310** contacts a distal surface of a drive boss **236**. Engagement of the tabs **310** and drive bosses **236** causes rotational forces to be transferred from the knob **302** to the dial core **230** as the knob **302** is rotated in the tightening direction, which causes the dial core **230** to rotate in the tightening direction. Rotation of the dial core **230** in the tightening direction causes the spool **130** to also rotate in the tightening direction due to engagement of the dial core **230** clutch plate **220**, drive component **150**, and spool **130** as described herein. The orientation of the one or more pawls **240** atop the dial core **230** causes the one or more pawls **240** to deflect inward and skip over the teeth **204** as the dial core **230** is rotated in the tightening direction. The pawl disc **250** causes the one or more pawls **240** to spring outward as the one or more pawls **240** skip over the teeth **204**.

[0081] The tabs **310** are further configured to allow the dial core **230** to be incrementally rotated in the loosening direction. Specifically, as the knob **302** is rotated in the loosening direction (e.g., counterclockwise in FIG. **11**B), each tab **310** rotates within the interior of the housing **202** so that a distal surface of each tab **310** contacts and engages the distal end of a corresponding pawl **240**. Further rotation of the knob **302** in the loosening direction causes the tab **310** to push, pivot, or rotate the corresponding pawl **240** out of engagement with the teeth **204**. Disengagement of the one or more pawls **240** and the teeth **204** momentarily unlocks the dial core **230** from the housing **202**, which allows the dial core **230** to momentarily or incrementally rotate in the loosening direction responsive to a force in the loosening direction from the spool **130** and tension member. More specifically, tension loads or forces in the tension member are imparted on the spool **130**, which are transferred to the clutch plate **220** and dial core **230** due to the engagement of those components with the spool **130**. The tension loads cause the dial core **230** to rotate in the loosening direction when the dial core **230** is unlocked from the housing **202**.

[0082] As the dial core **230** rotates in the loosening direction, each tab **310** disengages a corresponding pawl **240** and pivots or rotates back into engagement with the teeth **204** due to the biasing force from the pawl disc **250**. The one or more pawls **240** remain engaged with the teeth **204** until further rotation of the knob **302** in the loosening direction causes the tabs **310** to push, pivot, or rotate the pawls **240** out of engagement with the teeth **204** again. In this manner, the dial core **230** and spool **130** may be incrementally rotated in loosening direction to loosen or lessen the tension in the tension member.

[0083] The incremental engagement and disengagement of the pawls **240** and tabs **310** to enable rotation of the spool **130** and dial core **230** in the loosening direction may be referred to as "sweeping" the pawls **240** out of engagement with the teeth **204**. To facilitate in "sweeping" the pawls **240** out of engagement with the teeth **204**, each pawl **240** may include an nub or tab **246** that extends slightly outward from a surface of the pawl **240**. The distal end of each tab **310** may also include an angled or ramped surface. The angled or ramped surface of each tab **310** engages with the nub or tab **246** of each pawl **240** and applies a gradually increasing force to the pawl **240**, which reduces stress and wear on the two components. In some embodiments, the angled or ramped surface may only be formed on an upper portion of each tab **310**. In such embodiments, the lower portion of each tab **310** may include the radially inward lip **312** that is shaped and sized to fit under a corresponding edge **238** of the dial core **230**.

[0084] The degree or amount of each loosening step may be equivalent to a distance between each tooth **204** or a distance between multiple teeth as desired. As described herein, when the tension in the tension member is near the tension threshold, the clutch plate **220** will slide downward and into engagement with the annular ring **206**, which prevents further rotation of the clutch plate **220**, drive component **150**, and spool **130**. When the clutch plate **220** engages with the annular ring **206**, further rotation of the dial core **230** and knob **302** in the loosening direction is possible due to the configuration of the dial core **230** and clutch plate **220**.

[0085] In the illustrated embodiment, the closure device **100** may include four pawls **240**, four tabs **310**, and four arms **252**. This configuration may be ideal for generating high torque and accommodating high tension loads. In other embodiments, more or fewer components may be employed based on a particular application or need, or based on a desired torque output.

[0086] Referring now to FIG. **12**, illustrated is a ski boot **400** that includes the closure device **100** described above. The closure device **100** may be ideal for tensioning the ski boot **400** since it is able to output high torque and generate high tension loads, which are typically required to close and tighten a ski boot about a user's foot. The ski boot **400** includes a unique long guide **410** that is designed to accommodate high tension loads and facilitate in closing and tightening of the ski boot's shell. The long guide **410** is illustrated in greater detail in FIGS. **14**A-C. FIG. **13** illustrates a lace path and guide configuration that may be employed on the ski boot **400** of FIG. **12**. Specifically, the guide configuration includes a plurality of long guides **410** and one or more shorter guides **460** that are positioned between a pair of long guides **410**. The closure device **100** is positioned at a top of the lace path and a tension member **450** is routed from the closure device **100** along the lace path via the plurality of long guides **410** and the one or more shorter guides **460**. The tension member **450** terminates at a distal end of the lace path via a terminal member or terminating end component **470**. The termination of the distal end of the tension member **450** enables the closure device **100** to generate greater tension forces in the tension member **450**.

[0087] The lace path may extend across an opening between two shells of the ski boot **400**. In some embodiments, the plurality of long guides **410** may be positioned on one shell while the one or more shorter guides **460** are positioned on an opposite shell. The one or more shorter guides **460** may be riveted or mechanically fastened to the ski boot **400** while a distal end of the longer guides **410** is attached to the ski boot. The one or more shorter guides **460** may have an open channel or end within which the tension member **450** is positioned while the longer guides **410** include a closed channel through with the tension member **450** is positioned. The tension member may be removed or withdrawn from the open channel of the one or more shorter guides **460** to allow the ski boot **400** to be more easily removed from about the foot.

[0088] Referring to FIGS. **14**A-C, the longer guide **410** is made of multiple components. Specifically, the longer guide **410** includes an exterior shell or body **412** and a reinforce-

ment component **420**. The exterior shell **412** houses the reinforcement component **420**. The longer guide **410** enables the guide to be attached on a side of the ski boot **400**, typically near a sole of the ski boot, while the distal end that engages the tension member **450** is positioned closure to an opening of the ski boot **400**. This configuration helps the guide **410** wrap over the shell and facilitates in properly closing the shell about the foot.

[0089] The reinforcement component **420** enables the guide **410** to withstand high tension loads without breaking or cracking. The reinforcement component **420** also enables the exterior shell **412** to be made of a low friction material, which may not be able to withstand the tension forces that are imparted on the tension member **450**. The exterior shell **412** and reinforcement component **420** each extend from a proximal end of the guide **410** to a distal end of the guide **410**. A proximal end of the exterior shell **412** and reinforcement component **420** include an aperture **416** that allows a rivet or other mechanical fastener to attach the guide **410** to the ski boot **400**. The reinforcement component **420** is formed of a material strip that extends from the proximal end to the distal end of the guide **410**. The material strip may be made of a metal material, such as aluminum, or another material that is able to withstand high tensile loads, such as a fabric material, carbon fiber material, rigid polymer material, and the like.

[0090] The material strip is folded to form a looped end **422**. The folded material strip results in the reinforcement component **420** having an upper and lower segment that each extend from the looped end **422** to the proximal end of the guide. The upper and lower segments may each include the aperture **416** and may each be coupled with the ski boot shell. The upper and lower segments are typically positioned in contact with one another from the proximal end to the looped end **422** of the reinforcement component **420**, although in some embodiments, the upper and lower segments may be separated by the exterior shell **412** or another material.

[0091] The exterior shell **412** includes a guide segment **415** that is disposed within the looped end **422** of the reinforcement component **420**. The guide segment **415** extends between opposing sides of the exterior shell **412**. The distal end of the exterior shell and the guide segment **415** include a channel **414** through which the tension member **450** is positioned. The guide segment **415** is made of a lower friction material than the reinforcement component **420**, which minimizes frictional engagement of the guide **410** and tension member. When the guide **410** is tensioned by the tension member **450**, the guide segment **415** presses against the looped end **422** of the reinforcement component **420**. In this manner, some or all of the tension load in the guide segment **415** is transferred from the exterior shell **412** to the reinforcement component **420**, which is better able to handle the high tension loads that are generated from the closure device **100**. The tension in the looped end **422** is transferred to the proximal end of the guide **410** via the upper and lower segments of the reinforcement component's material strip and is ultimately transferred to the shell of the ski boot **400** due to the mechanical fastener anchoring the long guide **410** to the shell. The tension forces pull the opposing shells together and pull the ski boot closed over the user's foot. The long guide **410** is also pressed downward atop the shell, which further closes and tightens the shell about the user's foot.

[0092] The exterior shell **412** commonly surrounds the reinforcement component **420**. For example, the exterior shell **412** may cover the opposing sides of the reinforcement component **420**, although in other embodiments one or both sides of the reinforcement component **420** may be exposed. The exterior shell **412** may also include a distal most end that is positioned distally of the looped end **422**. The distal most end of the exterior shell **412** may allow the tension member **450** to transition into and out of the channel **414** in a minimal frictional manner. For example, opposing sides of the exterior shell's distal most end may be arcuate or curved and provide a smooth transition radius that eliminates sharp corners that may damage the tension member **450** or cause undue pressure on the guide segment **415** and/or looped end **422**. In some embodiments, the opposing sides of the exterior shell's distal most end may have a radius of between 40 and 50 mm to provide a smooth transition for the tension member **450**. The distal most end may also cover the looped end **422** and prevent the looped end from contacting surrounding objects.

[0093] In some embodiments, the exterior shell **412** may include one or more openings **418** through which the reinforcement component **420** is visible. For example, in the illustrated embodiment, the exterior shell **412** includes two open section through which the looped end **422** and upper segment are visible. The distal most open section may enable the reinforcement component **420** to be easily coupled with the exterior shell **412** by allowing the upper and lower segments to be separated and placed around the guide segment **415**. The upper and lower segments may then be moved proximally until the looped end **422** is positioned around the guide segment **415**. In other embodiments, the looped end **422** and/or upper and lower segments may be covered by the exterior shell **412** so that the reinforcement component **420** is not visible. The upper and lower segments may also be positioned on a bottom end or surface of the exterior shell **412** so that the lower segment contacts the shell of the ski boot **400**. In other embodiments, the upper and lower segments may be disposed or enclosed within the exterior shell **412** as desired.

[0094] The exterior shell **412** may include a pair of openings **418** that are separated by a material bridge as illustrated in FIGS. **14**A-B, or the exterior shell **412** may include a single opening **418** as illustrated in FIG. **14**C. The material bridge that separates the pair or openings may function to keep the upper and lower segments of the reinforcement component **420** in contact. In some embodiments, the long guide **410** may have a length of between 40 and 80 mm and more commonly a length of between 50 and 70 mm. The long guide may likewise have a width of between 15 and 35 mm and more commonly a width of between 20 and 30 mm. In a specific embodiment, the long guide may have a length of approximately 60 mm and a width of approximately 25 mm. The long guide **410** may be curved about its longitudinal length to help the long guide engage and contact an upper surface of the ski boot's shell. The shorter guide **460** may have a width that corresponds to the width of the long guide and a length that is shorter than the width of the shorter guide **460**. The shorter guide **460** may not require a reinforcement component since the mechanical fastener is positioned distally of the tension member **450**.

[0095] Referring to FIGS. **15**A-E, illustrated is an embodiment of a terminal member or terminating end component

470 (hereinafter terminal member **470**) that is designed to attach to the distal end of the tension member **450** and to attach to the ski boot **400**, or any other article, in order to fixedly couple or attach the tension member **450** to the ski boot **400** or article. For ease in describing the terminal member **470**, reference will be made to the terminal member **470** attaching to a ski boot **400**, although it should be recognized that the terminal member **470** may be coupled with any desired article.

[0096] The terminal member **470** is able to attach and detach from the ski boot **400**, which enables the terminal member **470** to be quickly and easily replaced if the tension member **450** fails, or for any other reason. The terminal member **470** includes a main body **502** having an inner cavity **510** and thru hole **508**. The thru hole **508** is positioned on a proximal end of the main body **502** and is shaped and sized so that a bolt **480** or other mechanical fastening device may be inserted through the thru hole **508** and attached to the ski boot **400**. An upper portion of the thru hole **508** may be recessed from an upper surface of the main body **502**. The recessed portion of the thru hole **508** may have a wider diameter than the remainder of the thru hole **508** to allow the bolt **480** to be recessed relative to the upper surface of the main body **502** and thereby reduce a profile of the terminal member **470** when attached to the ski boot **400**.

[0097] The main body **502** also includes a lace port or aperture **504** through which the tension member **450** is inserted as described herein below. The lace aperture **504** is positioned on a distal end of the main body **502** opposite the thru hole **508**. When the terminal member **470** is attached to the ski boot **400**, the lace aperture **504** is positioned so that an opening of the lace aperture **504** faces the lace path of the tension member **450**. The main body **502** further includes an aperture **506** that enables a tool (not shown) to access a lock component **550** that is positioned within the cavity **510** of the main body **502**. The tool, which may be a screw driver or other device, is insertable within the aperture **506** to engage the lock component **550** and induce a locking force on the tension member **450** or release the locking force that is induced on the tension member **450**. The locking force that is imparted or exerted on the tension member **450**, via the lock component **550**, is sufficient to lock, or fixedly attach, the tension member **450** to the terminal member **470**. The aperture **506** is typically positioned on a sides of the main body **502** roughly perpendicular to the lace aperture **504**; however, the aperture **506** may be positioned elsewhere about the main body **502** as desired. Positioning of the aperture **506** on the side of the main body **502** roughly perpendicular to the lace aperture **504** may be preferred because it allows the user to easily access the aperture **506** when the terminal member **470** is fixedly secured to the ski boot **400**, via bolt **480**, without interference by the tension member **450** or other components of the ski boot **400**.

[0098] FIG. **15**C illustrates a bottom view of the terminal member **470**. The cavity **510** formed in the main body **502** is evident in FIG. **15**C. In some embodiments, the cavity **510** has an L-shaped configuration to prevent the lock component **550** from being inserted within the cavity **510** in an incorrect orientation. Specifically, the main body **502** includes an elbow **514** that protrudes into a corner or portion of the cavity **510** so that the cavity **510** has an L-shaped profile when viewed from a bottom end, as in FIG. **15**C. A secondary cavity **512** is also defined in the bottom portion of the main body **502** near the lace aperture **504**. The secondary cavity **512** extends from the cavity **510** and forms a small pocket or recess in the distal end of the main body **502**. As described herein below, the distal end of the tension member **450** is positioned within the secondary cavity **512** when the tension member is coupled with the terminal member **470** and lock component **550**.

[0099] A channel **520** is formed in the proximal end of the main body **502**. The channel **520** extends from the cavity **510** and around the thru hole **508**. The channel **520** is shaped and sized to correspond with a diameter of the tension member **450**. More specifically, the channel **520** has a width and depth that is greater than the diameter of the tension member **450**, which allows the tension member **450** to be fully positioned within the channel **520** and wrapped around the bolt **480** that is positioned through the thru hole **508**. In some embodiments, a wall **522** extends from the cavity **510** to the thru hole **508**, or adjacent to the thru hole **508**, in order to divide a distal portion of the channel **520** between the cavity **510** and thru hole **508** into first and second sections (shown in FIG. **15**E as separate channels positioned laterally adjacent one another). The wall **522** may function to route or guide the tension member **450** as it is inserted through the channel **520** and lock component **550**. In some embodiments, an arrow or other symbol may be formed on a surface of the channel **520**. In the illustrated embodiments, the arrow is formed in the channel **520** around the thru hole **508**. The arrow may visibly indicate a direction that the tension member **450** is to be routed through the lock component **550** and channel **520**.

[0100] FIG. **15**C illustrates the lock component **550** positioned within the cavity **510** of the terminal member **470**. The lock component **550** may include an L-shaped profile that mirrors the L-shaped profile of the cavity **510**. Specifically, an elbow **559** may be formed in the lock component **550** that matches the elbow **514** of the cavity **510** to enable the lock component **550** to be inserted within the L-shaped cavity **510**. The L-shaped cavity **510** and lock component **550** ensures that the lock component **550** is always properly or correctly inserted within the cavity **510** by preventing the lock component **550** from being inserted within the cavity **510** unless it is properly oriented and aligned with the cavity **510**. Proper and correct insertion of the lock component **550** may be important to ensure that the tension member **450** is insertable through the lock component **550** in a manner that does not kink or damage the tension member **450**. For example, the lock component **550** includes a lace entry aperture **552** that coaxially aligns with the lace aperture **504** of the main body **502** when the lock component **550** is inserted within the cavity **510**. If the lock component **550** is not properly inserted within the cavity **510**, the lace entry aperture **552** may be misaligned with the lace aperture **504** of the main body **502**, which may kink or damage the tension member **450** upon tensioning of the tension member **450** or assembly of the terminal member **470** about the ski boot **400**.

[0101] The lace entry aperture **552** is formed on a distal side of the lock component **550**. A lace exit aperture **554** is formed on a proximal side of the lock component **550** opposite the lace entry aperture **552**. A channel or lumen extends between the lace entry aperture **552** and the lace exit aperture **554**, which enables the tension member to be inserted fully through the lock component **550** between the lace entry aperture **552** and the lace exit aperture **554**. When

the lock component **550** is positioned within the cavity **510**, the lace exit aperture **554** aligns with a first section of the channel **520**.

[0102] A second lace entry aperture **556** is formed on the proximal side of the lock component **550** while a second lace exit aperture **558** is formed on the distal side of the lock component **550** opposite the second lace entry aperture **556**. When the lock component **550** is positioned within the cavity **510**, the second lace entry aperture **556** is aligned with a second section of the channel **520** while the second lace exit aperture **558** is aligned with the secondary cavity **512**. A channel or lumen extends between the second lace entry aperture **556** and the second lace exit aperture **558**, which enables the tension member to be inserted fully through the lock component **550** between the second section of the channel **520** and the secondary cavity **512**.

[0103] FIG. **15**D illustrates a side view of the main body **502** and, more specifically, illustrates the tool access aperture **506**. The aperture **506** is formed in the main body **502** so that it extends from the cavity **510** to an exterior surface of the main body **502**. As briefly described above, a tool may be inserted through the aperture **506** to engage the lock component **550** positioned within the cavity **510** of the main body. The tool may be used to lock or unlock the tension member **450** from engagement with the lock component **550**, which fixedly couples the tension member **450** to the terminal member **470** or releases the tension member **450** therefrom. In a specific embodiment, the tool may access a set screw (not shown) that is threaded into a main body of lock component **550**. The tool may rotate the set screw into increased or decreased frictional engagement with the tension member **450**. The set screw may exert a clamping or compressional force on the tension member **450** to lock the tension member **450** within the main body of the lock component **550** and thereby fixedly attach the tension member **450** to the terminal member **470**. More specifically, rotation of the set screw may move the set screw toward or away from the channel or lumen between the second lace entry aperture **556** and the second lace exit aperture **558**, which may compress the tension member **450** within this channel or lumen. In some embodiments, a component or material, such as a nylon patch, may be positioned between the tension member **450** and the distal end of the set screw in order to minimize or eliminate unwanted damage to the tension member **450** from the set screw.

[0104] To fixedly couple or secure the tension member **450** with the lock component **550**, the tension member **450** is inserted through the lace aperture **504** of the main body **502** and through the lace entry aperture **552** of the lock component **550**. The tension member **450** is then inserted through the channel between the lace entry aperture **552** and lace exit aperture **554** until the tension member **450** extends from the lace exit aperture **554**. The tension member **450** is then curved around the thru hole **508** within the channel **520** following the arrow formed or defined on the surface of the channel **520**. In some embodiments, the wall **522** may be angled to help guide or deflect the tension member **450** toward the channel **520** upon exiting the lace exit aperture **554**. The tension member **450** is then inserted through the second lace entry aperture **556** and through the respective channel until the tension member **450** extends from the second lace exit aperture **558**. Upon exiting the second lace exit aperture **558**, the distal end of the tension member **450** is positioned within the secondary cavity **512**. The set screw may then be engaged, via the tool inserted through the tool access aperture **506**, to lock the tension member **450** within the lock component **550**. Detachment of the tension member **450** from the lock component **550** may be achieved by accessing the set screw, via the tool inserted through the tool access aperture **506**, and rotating the set screw toward an unlocked position. The tension member **450** may then be removed from the lock component **550** and terminal member **470**. All of the above processes may be performed while the terminal member **470** is attached to a ski boot **400**.

[0105] While several embodiments and arrangements of various components are described herein, it should be understood that the various components and/or combination of components described in the various embodiments may be modified, rearranged, changed, adjusted, and the like. For example, the arrangement of components in any of the described embodiments may be adjusted or rearranged and/or the various described components may be employed in any of the embodiments in which they are not currently described or employed. As such, it should be realized that the various embodiments are not limited to the specific arrangement and/or component structures described herein.

[0106] In addition, it is to be understood that any workable combination of the features and elements disclosed herein is also considered to be disclosed. Additionally, any time a feature is not discussed with regard in an embodiment in this disclosure, a person of skill in the art is hereby put on notice that some embodiments of the invention may implicitly and specifically exclude such features, thereby providing support for negative claim limitations.

[0107] Having described several embodiments, it will be recognized by those of skill in the art that various modifications, alternative constructions, and equivalents may be used without departing from the spirit of the invention. Additionally, a number of well-known processes and elements have not been described in order to avoid unnecessarily obscuring the present invention. Accordingly, the above description should not be taken as limiting the scope of the invention.

[0108] Where a range of values is provided, it is understood that each intervening value, to the tenth of the unit of the lower limit unless the context clearly dictates otherwise, between the upper and lower limits of that range is also specifically disclosed. Each smaller range between any stated value or intervening value in a stated range and any other stated or intervening value in that stated range is encompassed. The upper and lower limits of these smaller ranges may independently be included or excluded in the range, and each range where either, neither or both limits are included in the smaller ranges is also encompassed within the invention, subject to any specifically excluded limit in the stated range. Where the stated range includes one or both of the limits, ranges excluding either or both of those included limits are also included.

[0109] As used herein and in the appended claims, the singular forms "a", "an", and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to "a process" includes a plurality of such processes and reference to "the device" includes reference to one or more devices and equivalents thereof known to those skilled in the art, and so forth.

[0110] Also, the words "comprise," "comprising," "include," "including," and "includes" when used in this specification and in the following claims are intended to

specify the presence of stated features, integers, components, or steps, but they do not preclude the presence or addition of one or more other features, integers, components, steps, acts, or groups.

1. A ski boot comprising:

a rigid exterior shell comprising:

a lower shell that is configured to couple with a ski binding, the lower shell being configured to accommodate a foot;

an upper cuff that is pivotally coupled with the lower shell, the upper cuff being configured to accommodate a lower leg;

a tightening system coupled with the lower shell, the tightening system including:

a single reel based closure device that is coupled with the lower shell adjacent to the upper cuff;

a tension member operably coupled with the reel based closure device so that an operation of the reel based closure device effects tightening of the tension member;

a first guide that is positioned on a first side of an opening of the lower shell;

a second guide that is positioned on a second side of the opening of the lower shell; and

a terminal member that is coupled with the lower shell adjacent to a toe box;

wherein the first guide and the second guide route or direct the tension member along a path about the lower shell across the opening and to the terminal member; and

wherein a distal end of the tension member is fixedly coupled with the terminal member.

2. The ski boot of claim **1**, wherein the first guide is a long guide having a longitudinal length that is substantially greater than a lateral width, and wherein the long guide has a proximal end that is attached to the lower shell near a sole of the lower shell and a distal end that is positioned near the opening and that engages the tension member.

3. The ski boot of claim **2**, wherein the second guide is a short guide have a longitudinal length that is substantially shorter than the longitudinal length of the long guide.

4. The ski boot of claim **3**, wherein the tightening system further comprises a third guide that is positioned on the first side of an opening of the lower shell, the third guide being a long guide have a configuration similar to the first guide, wherein the first guide, second guide, and third guide are arranged about the lower shell so that the second guide is positioned between the first guide and the third guide along the path.

5. The ski boot of claim **1**, wherein a housing of the reel based closure device includes a single entry port or aperture for the tension member.

6. The ski boot of claim **1**, wherein the reel based closure device includes a housing that is detachably coupleable, via a spring member, with a base member that is fixed to the ski boot.

7. The ski boot of claim **1**, wherein the reel based closure device includes a gear mechanism that amplifies an input torque or force, and wherein the reel based closure device is configured to incrementally loosen the tension member based on a first operation and to fully loosen the tension member based on a second operation.

8. The ski boot of claim **1**, wherein the terminal member comprises a lock component that is configured to engage the tension member and disengage the tension member, wherein when engaged with the tension member, the lock component fixedly couples the tension member to the terminal member, and wherein when disengaged from the tension member, the lock component allows the tension member to be removed from the terminal member.

9. The ski boot of claim **8**, wherein the terminal member is configured so that when the tension member is coupled with the lock component, the tension member is positioned within a channel that wraps around a thru hole of a coupling bolt.

10.-**20**. (canceled)

21. A ski boot comprising:

a rigid exterior shell including a lower shell and an upper cuff coupled with the lower shell;

a tightening system coupled with the lower shell, the tightening system including:

a reel based closure device;

a tension member operably coupled with the reel based closure device;

at least one guide that is coupled with the lower shell; and

a terminal member that is coupled with the lower shell adjacent to a toe box;

wherein the at least one guide routes or directs the tension member along a path about the lower shell to the terminal member; and

wherein a distal end of the tension member is fixedly coupled with the terminal member.

22. The ski boot of claim **21**, wherein the at least one guide is a long guide having a longitudinal length that is substantially greater than a lateral width, the long guide having a proximal end that is attached to the lower shell and a distal end that engages the tension member.

23. The ski boot of claim **22**, further comprising a short guide have a longitudinal length that is substantially shorter than the longitudinal length of the long guide.

24. The ski boot of claim **23**, wherein the tightening system further comprises a second long guide, wherein the short guide is positioned between the at least one guide and the second long guide along the path.

25. The ski boot of claim **21**, wherein a housing of the reel based closure device includes a single entry port or aperture for the tension member.

26. The ski boot of claim **21**, wherein the reel based closure device includes a housing that is detachably coupleable, via a spring member, with a base member that is fixed to the lower shell.

27. The ski boot of claim **21**, wherein the reel based closure device includes a gear mechanism that amplifies an input torque or force, and wherein the reel based closure device is configured to incrementally loosen the tension member based on a first operation and to fully loosen the tension member based on a second operation.

28. The ski boot of claim **21**, wherein the terminal member comprises a lock component that is configured to engage the tension member and disengage the tension member, wherein when engaged with the tension member, the lock component fixedly couples the tension member to the terminal member, and wherein when disengaged from the tension member, the lock component allows the tension member to be removed from the terminal member.

29. The ski boot of claim **28**, wherein the terminal member is configured so that when the tension member is

coupled with the lock component, the tension member is positioned within a channel that wraps around a thru hole of a coupling bolt.

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