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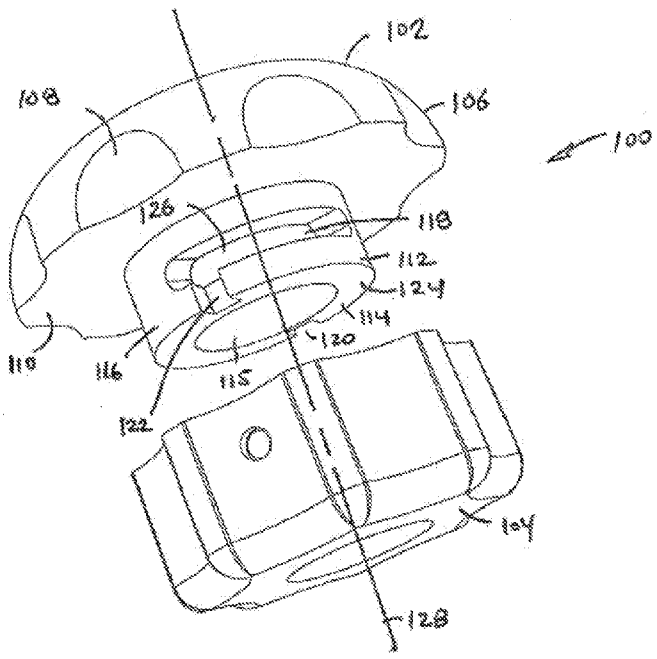

FIG. 2A

(57) Abstract: Disclosed is an infinitely adjustable depth stop for a laparoscopic instrument having a shaft, the depth stop including a first component having a first annular space adapted to allow the shaft to be fitted therethrough. The first annular space has a reducible diameter and an interference surface against which the shaft may be fitted. Upon reduction of the reducible diameter, the interference surface frictionally engages the shaft to arrest relative movement of the depth stop along the shaft. The frictional engagement may be along a curve, a spiral curve, or an area. Means are also provided to reopen the reducible diameter to release the depth stop.

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LAPROSCOPIC INSTRUMENT DEPTH STOP

BACKGROUND OF THE INVENTION

[0001] The present invention relates to laparoscopic instrument depth stops, particularly morcellator depth stops.

[0002] Morcellating devices are conventionally utilized for removing tissue from patients during a laparoscopic procedure. Examples of such tissue may be uterine fibroids or even an entire uterus. In some instances, it is desirable to limit the depth of penetration of the morcellating device beneath the skin of a patient to prevent insertion of the mocellating portion of the device beyond the compromised tissue and into healthy tissue below.

[0003] One known method of limiting the depth of penetration is to provide a sliding collar that may be slid up and down the shaft of a morcellating device and locked into place with a locking set screw. Another method includes spacers placed in series on the shaft of the morcellating device. In these devices, the sliding collar or spacers abuts the exterior skin of a patient and serve to restrict the depth in which the shaft may penetrate the body.

BRIEF SUMMARY OF THE INVENTION

[0004] Although well received, these methods have proven to be insufficient for the delicate equipment and in the modern operating arena. In the sliding collar example, the locking screw has proven to be difficult to secure with a gloved hand. Moreover, torqueing of the screw creates a point load that can easily damage the morcellator shaft. In the stacked spacer example, depth adjustability is naturally limited by the number and dimensions of the spacers available. It is therefore very

difficult to provide a stop at precisely the necessary depth for a particular patient.

[0005] The present invention provides for laparoscopic depth stops that are attachable to a laparoscopic instrument shaft, such as a morcellator shaft, where the depth stops can be adjusted and securely positioned on the shaft to enable infinitely variable positioning with heretofore unknown ease of use. The laparoscopic depth stops described herein also provide the capability of being secured to the morcellator without damaging the morcellator shaft. Principally, the shaft is protected from damage because the forces acted upon it by the inventive devices are non-point load forces, and instead act along a curve, spiral curve, or area.

[0006] In accordance with one embodiment of the invention, there is provided a depth stop for a laparoscopic instrument having a shaft, where the depth stop comprises a first component having a first annular space adapted to allow the shaft to be fitted therethrough, and a second component adapted to be connected to the first component, the second component having a second annular space adapted to allow the shaft to be fitted therethrough. The first annular space and the second annular space form a combined annular space having a first cross sectional area. When the first component is moved relative to the second component the combined annular space reduces to a second cross sectional area less than the first cross sectional area to impart a force on the shaft, the force capable of arresting relative movement of the depth stop along the shaft.

[0007] The movement may be by rotation.

[0008] The reduction in combined annular space may be created by eccentric alignment of the first annular space and second annular space relative to each other. If so provided, the first component may comprise a handle with a cylindrical portion

extending therefrom, the cylindrical portion having an exterior recess. The second component may include a cylindrical well adapted to accept the cylindrical portion of the first component, the cylindrical well having an interior extension adapted to fit within the recess when the first component and the second component are connected.

[0009] The reduction in annular space may be created by tapering of the first annular space. If so provided, the first component may comprise a tapered section and the second component may comprise a collet that conforms to the geometry of the tapered section. The first component and the second component may be threaded together with threads, whereby rotation of the first component and second component relative to each other moves the collet with respect to the tapered section.

[0010] The reduction in annular space may be created by rotation of a stop lever about a point outside the cross sectional area of the shaft. The depth stop may further comprise a spring, the spring imparting a force on the stop lever. The stop lever includes a cylindrical section between a first tab and second tab.

[0011] The second component may be a helical coil. The first component may further comprise a series of recesses, the depth stop further comprising a third component, the third component including a ramp adapted to ratchet with the series of recesses. The depth stop may further comprise a release button adapted to release the ramp from the series of recesses.

[0012] In accordance with a further embodiment, there is provided a depth stop for a laparoscopic instrument having a shaft, where the depth stop comprises a first component having a first annular space with a first cross sectional area adapted to allow the shaft to be fitted therethrough, and a second component adapted to be fitted over portions of the first

component to reduce the first annular space to a second cross sectional area less than the first cross sectional area.

[0013] The second component may be fitted over the first component by moving the second component a direction perpendicular to the longitudinal axis of the shaft.

[0014] The second component may be a clip having first and second legs connected by a connector member.

[0015] In accordance with a further embodiment of the invention, there is provided a depth stop for a laparoscopic instrument having a shaft, where the depth stop comprises a first component having a first annular space adapted to allow the shaft to be fitted therethrough. The first annular space has a reducible diameter and an interference surface against which the shaft may be fitted. Upon reduction of the reducible diameter, the interference surface frictionally engages the shaft to arrest relative movement of the depth stop along the shaft.

[0016] The frictional engagement may be along a curve. The curve may be a spiral curve.

[0017] The frictional engagement may form an area.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, together with features, objects, and advantages thereof, will be or become apparent to one with skill in the art upon reference to the following detailed description when read with the accompanying drawings. It is intended that any additional organizations, methods of operation, features, objects or advantages ascertained by one skilled in the art be included

within this description, be within the scope of the present invention, and be protected by the accompanying claims.

[0019] With respect to the drawings,

[0020] Figure 1A depicts a conventional depth stop in use on a surgical morcellating device;

[0021] Figure 1B depicts an alternate embodiment of a conventional depth stop;

[0022] Figure 2A depicts a perspective view of a depth stop in accordance with a first embodiment of the present invention;

[0023] Figure 2B depicts a second perspective view of the depth stop of Figure 2A;

[0024] Figure 2C depicts a bottom view of the male component forming a portion of the depth stop of Figure 2A;

[0025] Figure 2D depicts a top view of the female component forming a portion of the depth stop of Figure 2A;

[0026] Figure 2E depicts a perspective view of the male component of Figure 2C;

[0027] Figure 2F depicts a perspective view of the female component of Figure 2D;

[0028] Figure 3A depicts a depth stop in accordance with a second embodiment of the present invention;

[0029] Figure 3B depicts a perspective view of the outer component of the depth stop of Figure 3A;

[0030] Figure 3C depicts a perspective view of the inner component of the depth stop of Figure 3A;

[0031] Figure 4A depicts a perspective view of a depth stop in accordance with a third embodiment of the present invention;

[0032] Figure 4B depicts a perspective view of a first section of the depth stop of Figure 4A;

[0033] Figure 4C depicts a perspective view of the second section of the depth stop of Figure 4A;

[0034] Figure 4D depicts a perspective view of select components of the second section of the depth stop of Figure 4A;

[0035] Figure 5A depicts a perspective view of a depth stop in accordance with a fourth embodiment of the present invention;

[0036] Figure 5B depicts a perspective view of the base component of the depth stop of Figure 5A;

[0037] Figure 5C depicts a cross sectional view of the depth stop of Figure 5A;

[0038] Figure 6A depicts a perspective view of a depth stop in accordance with a fifth embodiment of the present invention;

[0039] Figure 6B depicts a perspective view of the inner portion and helical gripper of the depth stop of Figure 6A;

[0040] Figure 6C depicts a second perspective view of the inner portion and helical gripper of the depth stop of Figure 6A;

[0041] Figure 6D depicts a perspective view of the outer portion and helical gripper of the depth stop of Figure 6A; and

[0042] Figure 6E depicts a perspective view of the outer portion of the depth stop of Figure 6A.

DETAILED DESCRIPTION

[0043] In the following are described the preferred embodiments of the laparoscopic instrument depth stop of the present invention. In describing the embodiments illustrated in the drawings, specific terminology will be used for the sake of clarity. However, the invention is not intended to be limited to the specific terms so selected, and it is to be understood that each specific term includes all technical equivalents that operate in a similar manner to accomplish a similar purpose. Where like elements have been depicted in multiple embodiments, identical reference numerals have been used in the multiple embodiments for ease of understanding.

[0044] As discussed above, the invention features laparoscopic depth stops that are attachable to laparoscopic devices. For ease of discussion, a morcellator will be used as a representative device. However, other laparoscopic devices are to be considered within the context of this disclosure.

[0045] The present disclosure therefore provides for depth stops for a morcellator having a shaft, where the depth stops can be adjusted with infinitely variable positioning and then secured to the shaft. The laparoscopic depth stops described herein also provide the capability of being secured to the morcellator without damaging its shaft by applying force to the shaft in a form other than a point load. For example, the forces applied may be along a curve, spiral, or within an area.

[0046] As discussed above, conventional depth stops are known. Figure 1A discloses one such conventional depth stop 600A generally comprising a sliding collar 602 that may slide along the shaft 604 of a morcellator 606, or other laparoscopic device. The sliding collar 602 includes a locking screw 608 that may be tightened to lock the sliding collar against the shaft 604. Thus, when the shaft 604 of the morcellator 606 is inserted through the skin S of a patient, its end 610 may be prevented from extending beyond compromised tissue CT to be removed and into healthy tissue HT.

[0047] In so locking the device of Figure 1A, it will be appreciated that the forces acting on the shaft 604 by virtue of the locking screw 608 are point forces. No matter how much care is taken by the surgeon in securing the sliding collar 602, these point forces may damage the delicate shaft 604 of the surgical tool.

[0048] Figure 1B depicts an alternative conventional system. Here, the depth stop 100B generally comprises a series of spacers 612, 614, 616 that may be stacked to limit the excursion

of the shaft 604 into the skin S. The number of spacers and the size of the spacers may be varied as required. Nevertheless, there are only a reasonable number of different size spacers to choose from, and the depth stop is therefore not infinitely variable.

[0049] Generally speaking, the depth stops of the present invention provide for curve, spiral, or area contact between portions of the depth stop and the morcellator shaft rather than point contact. These configurations help to equalize or counteract forces acting on the morcellator shaft while also minimizing the impact of such forces resulting in both improved functionality and reduced risk of damaging the morcellator shaft. Additionally, the depth stops of the present invention provide infinitely variable depth control by being adjustable in an infinite number of positions.

[0050] In accordance with one embodiment, presented initially in a first perspective view in Figure 2A, a depth stop 100 comprises a male component 102 and a female component 104. As will be discussed, the male component 102 and female component 104 engage each other and may be turned relative to each other to offset eccentric lumens that engage the shaft of a morcellator to lock the depth stop 100 in place.

[0051] The male component 102 comprises a handle 106 which in the embodiment shown is generally formed in the shape of a mushroom. Other configurations that easily fit within the grasp of a gloved surgeon are also contemplated. Moreover, the handle may be knurled or may include depressions 108, as shown, to aid in tactile feel and grip.

[0052] Extending from a central location of the bottom portion 110 of the handle 106 is a male connector 112. The male connector 112 is configured as an open cylindrical structure with an annular wall 114 forming an annular space 115. Formed

in the generally smooth outer portions 116 of the annular wall 114 are a pair of recesses 118, 120. As best shown in Figure 2A with respect to recess 118, the recesses 118, 120 each include a first portion 122 extending through the annular wall 114 to the termination 124 thereof. In turn, the first portion 122 extends in the opposite direction into a second portion 126 generally configured transverse to the first portion and extending partially around the central axis 128 of the male component 102 and particularly the male connector 112.

[0053] Figure 2B depicts the depth stop 100 in a second perspective view highlighting the female component 104. As shown, the female component 104 is generally configured as a circular component forming an annular ring 130. The annular ring 130 forms a well, is generally smooth on its interior portion 132, and may be knurled or otherwise shaped on its outer portion 134 to facilitate handling by a gloved surgeon. As shown in Figure 2B, the outer portion 134 is preferably scalloped. Extending from the interior portion 132 into the annular space 136 provided by the annular ring 130 are a pair of extensions 138, 140. The extensions 138, 140 may be formed as part of the female component 104 or may be formed as separate pins that are fitted in apertures of the female component and affixed therein.

[0054] In the embodiment shown, the extensions 138, 140 are tubular but it will be appreciated that the extensions may be configured as other shapes and configurations provided that such shapes or configurations are adapted to fit within the recess 118 of the male connector 112. It will also be appreciated that the male component 102 and female component 104 may be fitted together by positioning the extensions 138, 140 first into the first portions 122 (and the other corresponding first portion) of the recesses 118, 120 and then into the second portions 126

(and the other corresponding second portion). Upon rotation of the male component 102 relative to the female component, the extensions 138, 140 will travel through the second portions 126 (and the other corresponding second portion) to lock the two components together.

[0055] Figure 2C depicts a bottom view of the male component 102. Highlighted for reference are the bottom portion 110 of the handle 106 and male connector 112. From this view, it will be appreciated that the geometric centerline 142 of the annular wall is offset from the geometric centerline 144 of the outer portion 116 of the male connector 112 by a distance "d." Distance "d" is preferably 0.20" and the exact tolerance would depend on the materials used and the tolerance range of the instrument. This offset creates a first eccentricity.

[0056] A second eccentricity is shown in Figure 2D, a top view of the female component 104. The eccentricity can be seen by examination of the apertures formed by the top portion 146 of the annular ring 120, which is also shown in Figure 2B, versus the bottom wall 148 within the annular space 136. Here, the geometric centerline 150 of the top portion 146 (and the outer portion 134) is offset a distance "d2" from the geometric centerline 152 of the bottom wall 148. Notably, the female component 104 includes a notch 154 on its our wall aligning with the smaller annual diameter of the female component while the male component also includes a similar notch 156 (Figure 2C) aligning with the smaller annual diameter thereof. When the two notches 154, 156 are aligned, so too are the extensions 138, 140 and the recesses 118, 120.

[0057] A morcellator shaft may be positioned through the annular space 115 of the male component and the annular space 136 of the female component 104 with the two components connected and the notches 154, 156 aligned. The depth stop 100

may then be moved up or down the morcellator shaft to a desired position, whereby the surgeon may rotate one or both of the male component 102 and female component 104 to provide for a shift in the two annular spaces 115, 136. This shift reduces the overall cross sectional area of the combined annular space. It will be appreciated that the annular spaces 115, 136 are sized such that this shift and reduction in size locks the depth stop 100 against the morcellator shaft by virtue of friction alone. To unsecure the depth stop 100, the surgeon merely has to rotate the two components in the opposite direction. If it is desired to take the two components apart, the surgeon rotates in the opposite direction the full excursion permitted and pulls the components apart as the extensions 138, 140 are removed from the recesses 118, 120.

[0058] For clarity, Figures 2E and 2F are also provided, with Figure 2E being a further perspective view of the male component 102 and Figure 2F being a further perspective view of the female component 104.

[0059] A second embodiment of the invention is provided in Figure 3A in the form of depth stop 200. Depth stop 200 comprises two major components, an outer component 202 and an inner component 204. As shown in Figure 3A, the inner component and outer component may be fitted together.

[0060] A perspective view of the outer component 102 is shown in Figure 3B. As shown, the outer component comprises a gripping portion 206 and a base portion 208. The base portion 208 is generally round while the gripping portion 206 extends outwardly therefrom with a series of fins 210. The fins 210 are separated by scalloped sections 212 to enable the gloved hand of a surgeon to interact with the outer component 202. Of course, other configurations are possible.

[0061] Extending through a central portion of the outer component 202 is a lumen 214 having an inner wall 216. The inner wall 216 of the lumen includes threads 218. It will be appreciated that the inner wall 216 of the lumen 214 tapers from a first diameter near the base 208 to a smaller second diameter near the upper extent of the fins 210.

[0062] Figure 3C depicts a perspective view of the inner component 204 of the depth stop 200. The inner component 204 comprises a handle section 220 and a collet section 222. The handle section 220 is configured with arrayed fins 224 separated by scalloped sections 226 to aid with a surgeon's grasping of the depth stop 202.

[0063] The collet section 222 extends outwardly from the base 226 of the handle section 220 toward a collet section terminus 228. It will be appreciated that the collet section 222 is sized and configured to fit within the lumen 214 of the outer component 202 and includes threads 230 for mating with the threads 218 of the outer section. When so engaged, the outer component 202 and inner component 204 may be rotated relative to each other to advance the inner component, and specifically the collet section 222, further into the lumen 214 of the outer component.

[0064] The collet section is tubular and includes a lumen 229 therethrough. At the terminus 228 of the collet section 222 are collets 232a, 232b, 232c, 232d. Although four such collets are shown, there may be as few as one or more than four. As the collet section 222 is advanced through the lumen 214 of the outer component 202, the collets 232a, 232b, 232c, 232d are squeezed together into the spaces 234a, 234b, 234c, 234d there between by virtue of the tapered inner wall 216

[0065] It will be appreciated that when the lumen 214 of the outer component 202 and the lumen 229 of the collet section 222

of the inner component 204 are threaded through the shaft of a morcellator, the components are free to slide up and down thereon. The inner and outer components 202, 204 are sized and configured such that when the inner component is threaded into the outer component, and the two components are rotated relative to each other, the collets 232a, 232b, 232c, 232d will squeeze together by virtue of the tapered inner wall 216 of the lumen 214 to squeeze the morcellator shaft and affix the depth stop 200 thereon. Relative rotation in the opposite direction serves to unfix the two depth stop 200 from the shaft by releasing the collets 232a, 232b, 232c, 232d.

[0066] It will be appreciated that the depth stop 200 may be sized and configured such that the collets 232a, 232b, 232c, 232d provide effective force on the morcellator shaft without damaging the shaft. Also, the thread pitch may be engineered to limit the rotation necessary to achieve such effective force, or may be engineered to permit finer control by requiring a greater degree of rotation to achieve the effective force.

[0067] A third embodiment of the invention is first depicted in Figure 4A as depth stop 300. Depth stop 300 comprises a first section 302 and a second section 304. The first section 302 is generally mushroom-shaped and includes a mushroom cap 306 and base section 308. The second section 304 is generally cylindrical and connects with the base section 308 of the first section 302.

[0068] The first section 302 is shown in greater detail in Figure 4B. Here, it can be seen that the base section 308 comprises a plurality of separate sections, including an open cylindrical section 310. The open cylindrical section 310 includes a partial cylinder section 312 with an open section 314. Opposite the open section 314 is a plug 316 extending from the exterior wall 318 of the open cylindrical section 310.

Lastly, the open cylindrical section also includes a plurality of apertures 320.

[0069] Figure 4C depicts a top perspective view of the second section 304. The second section 304 comprises several components, including a stop lever 322, actuator slide 324, spring 326, and a cylindrical body 328. The cylindrical body 328 generally comprises a base 330 and a cylindrical upstanding wall 332 extending therefrom. The cylindrical upstanding wall 332 includes an annular space 334 within its confines. It will also be appreciated that the base 330 includes an aperture 336.

[0070] The upstanding wall 332 includes an open section 338 adjacent to which is the actuator slide 324. The actuator slide 324 includes an opening 340 facing inward relative to the second section 304 and ribs 342 facing outward. The ribs 342 facilitate tactical feel of a gloved surgeon.

[0071] The stop lever 322 extends across the upstanding wall 332 from a portion opposite the open section 338, where it connects to spring 326, to the open section 338. In turn, the spring 326 connects between the stop lever 322 and the base 330 of the cylindrical body 328.

[0072] The configuration of the stop lever 322, spring 326, and slide 324 are shown in Figure 4D. In Figure 4D, it is shown that the stop lever 322 includes a spring tab 342 on a first side for connecting to the spring 326 and a slide tab 344 on a second side for connecting to the slide 324. Between the spring tab 342 and the slide tab 344 is a cylindrical section 346. In the standard configuration, it will be appreciated that the stop lever 322 is parallel to the base 330 of the cylindrical body 328 such that the lumen 348 of the cylindrical section 346 presents its greatest cross sectional area to a morcellator shaft extending through the cylindrical body. The connection between the spring tab 342 and spring 326 may be a pressure fit

within an aperture (not shown) of the 342, or other means. The connection between the slide tab 344 and slide 324 is preferably by way of a pin 325.

[0073] It is also noted that the cylindrical body 332 includes a plurality of apertures 350, generally corresponding to the size and configuration of the apertures 320 of the first section 302. Thus, when the first section 302 and second section 304 of the depth stop 300 are brought together, pins (not shown) may be driven through the aligned apertures 320, 350 to connect the two members. So connected, it will be appreciated that a shaft of a morcellator may be threaded through the aperture of the first member (not shown, but configured at the upper extremity of the mushroom head 306), the stop lever 322, and the aperture 336 of the base 330. In the standard configuration, the depth stop 300 is free to slide up and down the morcellator shaft. However, upon positioning in a location where it is desired that the depth stop 300 be secured, the surgeon merely shifts the slide 324 from a first position, upward within the open section 338 toward the plug 316 which fits within the open section. This action tends to rotate the stop lever 322 about its intersection with the spring 326, outside the cross sectional area of the shaft, and effectively reduces the cross sectional area presented to the shaft by the cylindrical section 346 of the stop lever 322. As such, it will be appreciated that a line force is imposed around a portion of the circumference of the shaft by the stop lever 322, effectively securing the depth stop 300.

[0074] A fourth embodiment of the invention is provided starting with Figure 5A, which depicts depth stop 400. Depth stop 400 comprises two components, a base 402 and clamp 404.

[0075] AS shown in Figure 5B, the base 402 comprises a domed upper portion 406 with a lumen 408 extending through its central

portion. Opposite of the domed upper portion 406 is a circular foot 410. Connecting the domed upper portion 406 and the foot 410 is a split strap 412. It will be appreciated that the lumen 408 extends through the split strap 412 and the foot 410.

[0076] The split strap 412 comprises an anchor 414 which provides the actual connection between the domed upper portion 406 and the foot 410. Extending from the anchor 414 are two arms 416, 418 (418 is most clearly shown in Figure 5C).

[0077] Figure 5C is a cross sectional view of the depth stop 400. As shown in Figure 5C, the arms 416, 418 are created as opposing arches 420, 422 forming a portion of the lumen 408. The arches 420, 422 begin at the anchor 414 and terminate with tabs 424, 426 which are spaced apart to leave a gap 428. As will be discussed later, the arches 420, 422 may flex at the anchor to open or close the gap 428. Approximately midway along their respective lengths, the tabs 424, 426 include bulges 430, 432.

[0078] Also shown in Figure 5C is the clamp 404. Clamp 404 is generally shaped as a horse shoe with a pair of open arms 432, 434 and a connector 436. The open arms 432, 434 and connector 436 form an inner surface 438 with cams 440, 442 at its end opposite the connector 436. At the connector 436, the clamp 404 also comprises an aperture 444.

[0079] It will be appreciated that in operation, the clamp 404 may be grasped by a gloved surgeon at recesses 446, 448 located approximately centrally on its arms 432, 434. The open end (at the arms 432, 434, opposite the connector 436) of the clamp 404 may then be slid against the outer walls 446, 448 of the arches 420, 422 of the split strap 412, simultaneously spreading the arms 432, 434 of the clamp and squeezing the gap 428 of the split strap. To aid in holding the base 402, the anchor includes grasping regions 445, 447. Continuing pressure

on the recesses 446, 448 further cams open the clamp 404 by action of the cams 440, 442 against the outer walls 446, 448 of the arches 420, 422. Upon sufficient excursion of the clamp 404 around the split strap 412, when the cams 440, 442 reach the decreasing radius of the split strap 412, the clamp will "pop" into place forcing the tabs 424, 426 to enter the aperture 444 at the connector 436. The inner walls of the recess 450, 452 cooperate with the bulges 430, 432 to effectively close the gap 428, or at least reduce its size. This decreases the diameter of the lumen 408 in the area of the split strap 412.

[0080] In this regard, the base 402 of the depth stop 400 may be placed on the shaft of a surgical instrument, such as a morcellator, by threading the shaft through the lumen 408. The base 402 may then be moved up or down the shaft to a desired stop location. At that location, a surgeon may connect the clamp 404 to the base 402 as discussed above to reduce the diameter of the lumen 408 at the split strap 412 and effectively lock the split strap against the shaft. When it is desired to move the depth stop 400, the surgeon simply removes the clamp 400 by pulling back on the recesses 446, 448 in a manner opposite to assembly while supporting the base at the grasping regions 445, 447.

[0081] The fifth embodiment of the present invention is shown initially in Figure 6A, a perspective view of the depth stop 500. Depth stop 500 comprises three components, an inner portion 502, outer portion 504, and helical gripper 506 (best shown in Figure 6B).

[0082] The inner portion 502 begins, opposite its connection with the outer portion 504, with a mushroom head 506. Although shown in Figure 6A only at its exit at the outer portion 504, the mushroom head 506 includes a lumen 508 through its central axis 510. The lumen is sized and configured to accept a shaft

of a surgical instrument, such as a morcellator. Tapering down from the base 512 of the mushroom head 506 is a cylindrical portion 514. As shown in Figure 6B, a perspective view of the underside of the inner portion 502, the cylindrical portion 514 ends with a series of sloped recesses 515 around its perimeter. It will be appreciated that these sloped recesses 515 form a portion of a ratchet, as will be discussed.

[0083] Also shown in Figure 6B is the lumen 508 of the inner portion 502. Within the lumen 508 is the helical gripper 506, which includes at one end a first bent tab 516 and at its second end a second bent tab 518. The second bent tab 518 is fitted within a recess 520, best shown in Figure 6C, of the lumen 508 of the inner portion 502.

[0084] Figure 6D depicts a perspective view of the outer portion 504 with helical gripper 506 protruding therefrom. The outer portion 504 is generally cylindrical with a cutout 522 near its upper end 524. At the lower end 526 of the outer portion 504, there is a chamfered edge 528. The lumen 508 passes through the cylindrical outer portion 204 from the lower end 526 to the upper end 524.

[0085] Within the cutout 522 is a cantilevered release button 530. As suggested, the release button 530 is cantilevered from an inner wall 532 of the cutout 522 by a pliable arm 534.

[0086] Figure 6E depicts a top perspective view of the outer portion 504. Here, the release button 530 can be seen from its rear 536. On the rear section 536 is mounted a ramp 538. It will be appreciated that when assembled with the inner portion 502, this ramp 538 fits within the one of the series of recesses 515. By virtue of the ramped shape of the ramp 538, and the slope of the recesses 515, the outer portion 504 may rotate relative to the inner portion 502 in the direction of arrow R

while the cantilevered release button 530 ratchets from one recess 515 to the next.

[0087] Also shown is slot 540. Upon assembly of the depth stop 500, the first bent tab 516 is fitted within the slot 540. Recall that the second bent tab 518 is fitted within recess 520 of the inner portion 502. As the outer portion 504 is rotated relative to the inner portion 502 in the direction of arrow R, the helical gripper 506 is tightened such that its relative cross sectional area is reduced. In the meantime, the outer portion 504 is prevented from rotating in the direction opposite of arrow R by virtue of the ratcheting of the release button 530, and specifically action of the ramp 538 fitting within the one of the series of recesses 515. When it is desired to permit rotation of outer portion 504 in the direction opposite of arrow R, the release button 530 may be lifted to pull the ramp 538 away from, and out of interaction with, the recesses 515. This serves to increase the relative diameter of the helical gripper 506.

[0088] It will therefore be appreciated that in use, the depth stop 500 may be fitted on a shaft of a surgical instrument, such as a morcellator. When the depth stop 500 is in a position where it is desired to be affixed, a surgeon may rotate the outer component 504 relative to the inner component 502 in the direction of arrow R to tighten the helical gripper 506 around the shaft. Ratchet action of the ramp 538 and recesses 515 will prevent loosening until such time that the release button 530 is lifted.

[0089] Each of the components described in the various embodiments may be configured from a variety of materials. Preferably, such materials are suitable for the surgical arena and have engineering properties suitable for their use. For example, the materials should be capable of repeated use and

heat sterilization. Such materials include various metals, polymers, and the like. Items such as spring 326 are preferably metal. Other components, such as the helical gripper 506, may be configured from silicone.

[0090] Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

I CLAIM:

1. A depth stop for a laparoscopic instrument having a shaft, where the depth stop comprises:

a first component having a first annular space adapted to allow the shaft to be fitted therethrough;

a second component adapted to be connected to the first component, the second component having a second annular space adapted to allow the shaft to be fitted therethrough;

the first annular space and the second annular space forming a combined annular space having a first cross sectional area;

wherein when the first component is moved relative to the second component the combined annular space reduces to a second cross sectional area less than the first cross sectional area to impart a force on the shaft, the force capable of arresting relative movement of the depth stop along the shaft.

2. The depth stop of claim 1, wherein said movement is rotation.

3. The depth stop of claim 1, wherein the reduction in combined annular space is created by eccentric alignment of the first annular space and second annular space relative to each other.

4. The depth stop of claim 3, wherein:

the first component comprises a handle with a cylindrical portion extending therefrom, the cylindrical portion having an exterior recess; and

the second component includes a cylindrical well adapted to accept the cylindrical portion of the first component, the cylindrical well having an interior extension adapted to fit

within said recess when said first component and said second component are connected.

5. The depth stop of claim 1, wherein the reduction in annular space is created by tapering of the first annular space.

6. The depth stop of claim 5, wherein the first component comprises a tapered section and the second component comprises a collet that conforms to the geometry of the tapered section.

7. The depth stop of claim 6, wherein the first component and the second component are threaded together with threads, whereby rotation of the first component and second component relative to each other moves the collet with respect to the tapered section.

8. The depth stop of claim 1, wherein the reduction in annular space is created by rotation of a stop lever about a point outside the cross sectional area of the shaft.

9. The depth stop of claim 8, further comprising a spring, said spring imparting a force on said stop lever.

10. The depth stop of claim 9, wherein said stop lever includes a cylindrical section between a first tab and second tab.

11. The depth stop of claim 1, wherein said second component is a helical coil.

12. The depth stop of claim 11, wherein said first component further comprises a series of recesses;

said depth stop further comprising a third component, said third component including a ramp adapted to ratchet with said series of recesses.

13. The depth stop of claim 12, further comprising a release button adapted to release said ramp from said series of recesses.

14. A depth stop for a laparoscopic instrument having a shaft, where the depth stop comprises:

a first component having a first annular space with a first cross sectional area adapted to allow the shaft to be fitted therethrough;

a second component adapted to be fitted over portions of the first component to reduce the first annular space to a second cross sectional area less than the first cross sectional area.

15. The depth stop of claim 14, wherein the second component is fitted over the first component by moving the second component a direction perpendicular to the longitudinal axis of the shaft.

16. The depth stop of claim 14, wherein the second component is a clip having first and second legs connected by a connector member.

17. A depth stop for a laparoscopic instrument having a shaft, where the depth stop comprises:

a first component having a first annular space adapted to allow the shaft to be fitted therethrough;

the first annular space having a reducible diameter and an interference surface against which the shaft may be fitted;

wherein, upon reduction of the reducible diameter, the interference surface frictionally engages the shaft to arrest relative movement of the depth stop along the shaft.

18. The depth stop of claim 17, wherein the frictional engagement is along a curve.

19. The depth stop of claim 18, wherein the curve is a spiral curve.

20. The depth stop of claim 17, wherein the frictional engagement forms an area.

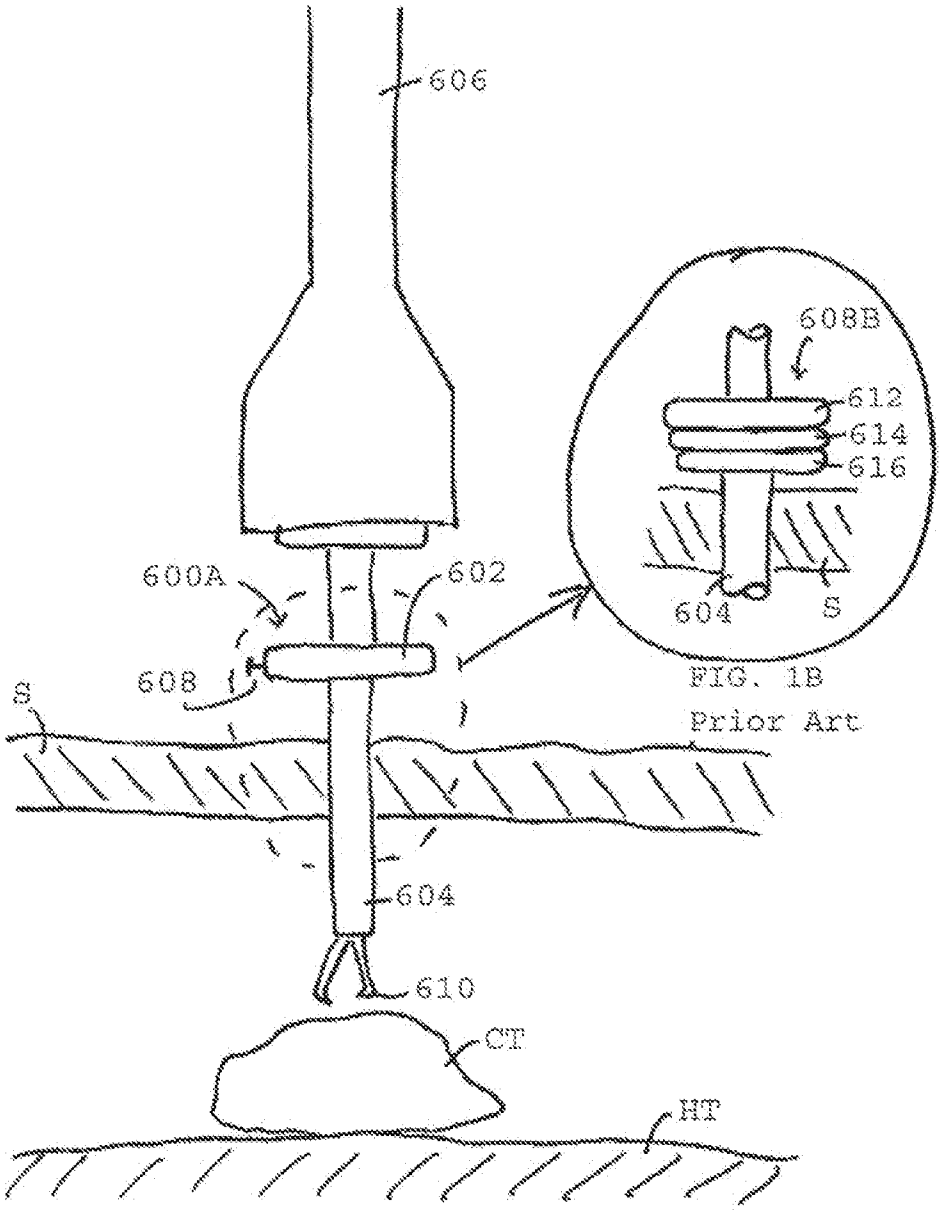

FIG. 1B
Prior Art

FIG. 1A
Prior Art

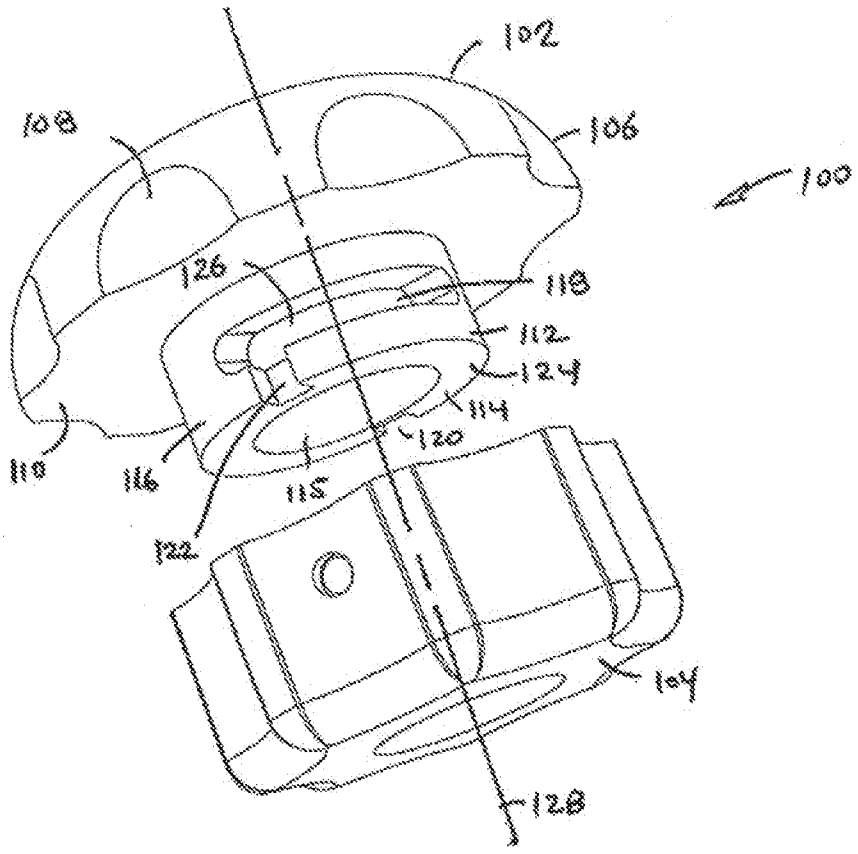

FIG. 2A

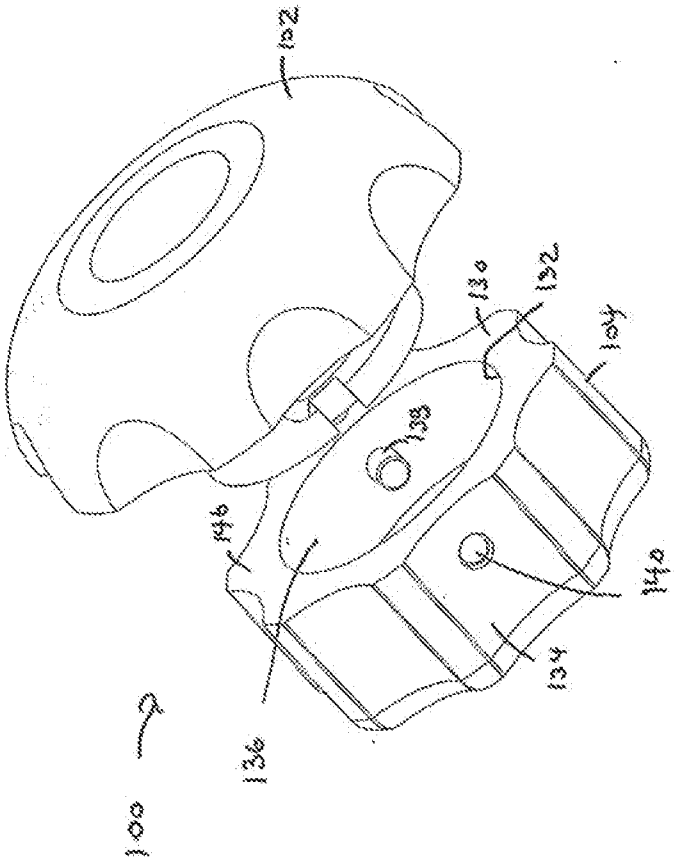

FIG. 2B

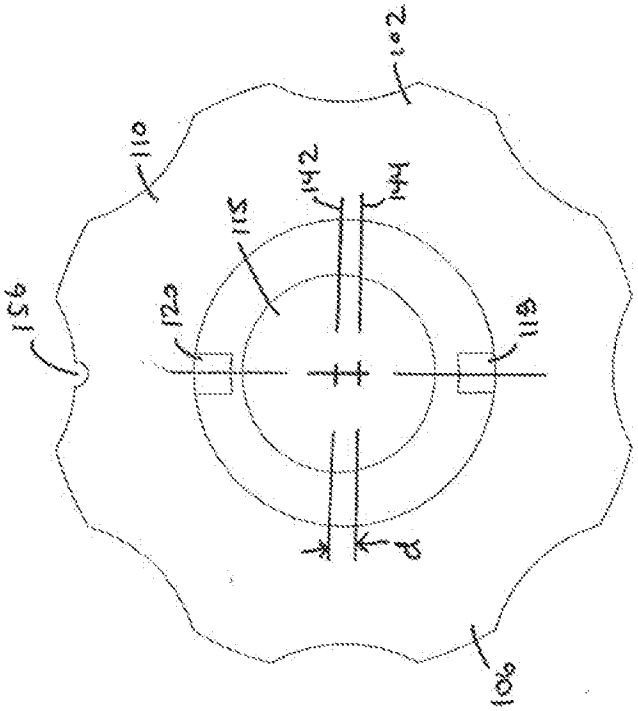

Fig. 2C

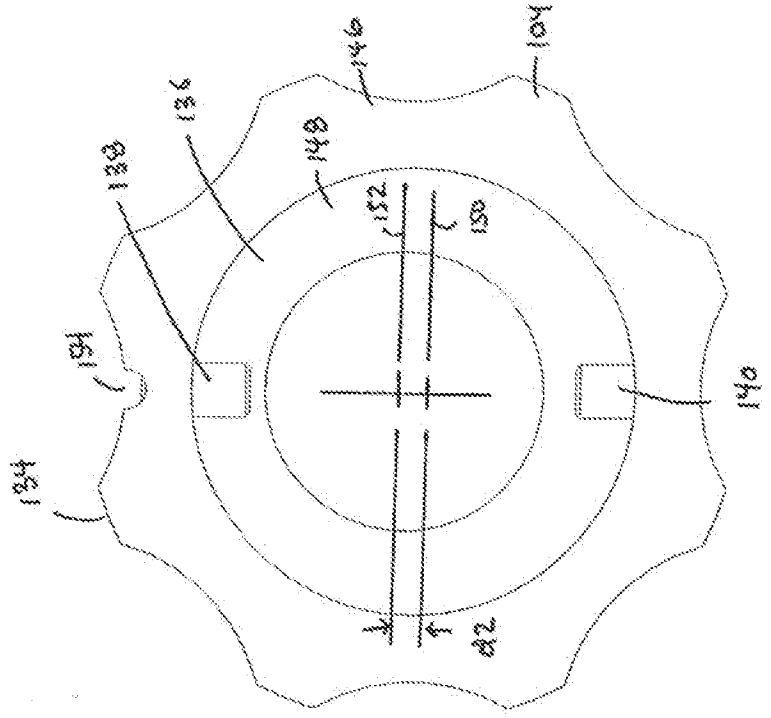

FIG. 2D

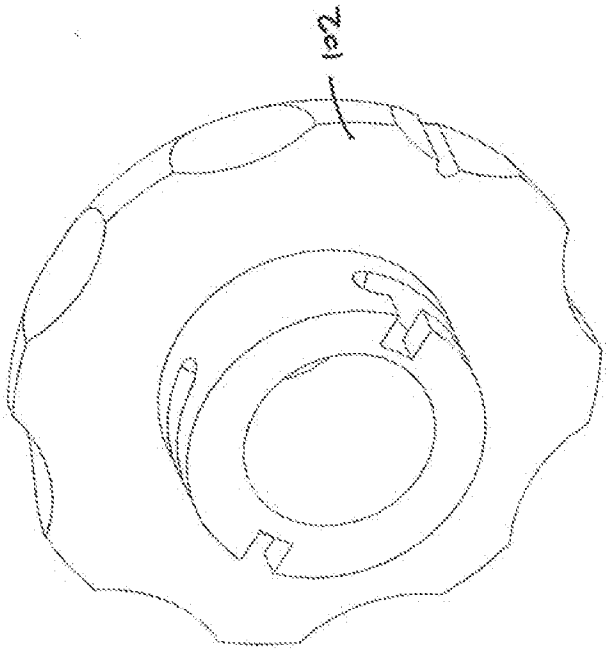

FIG. 2E

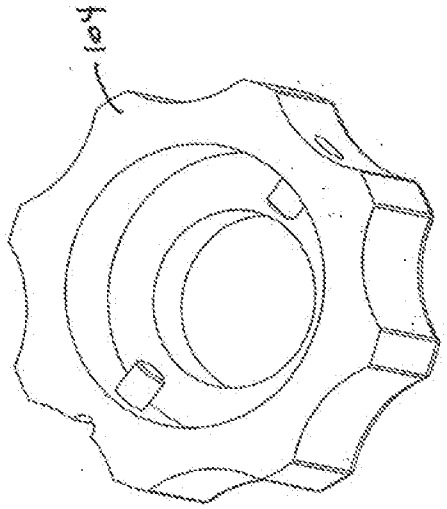

Fig. 2F

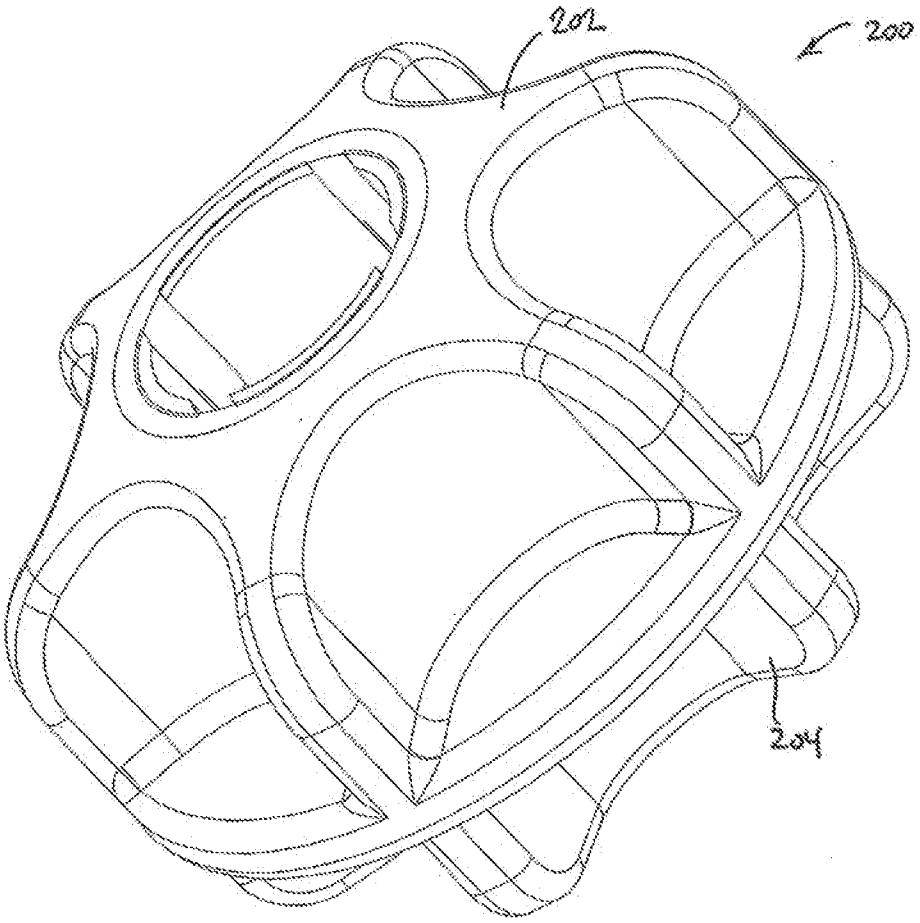

FIG. 3A

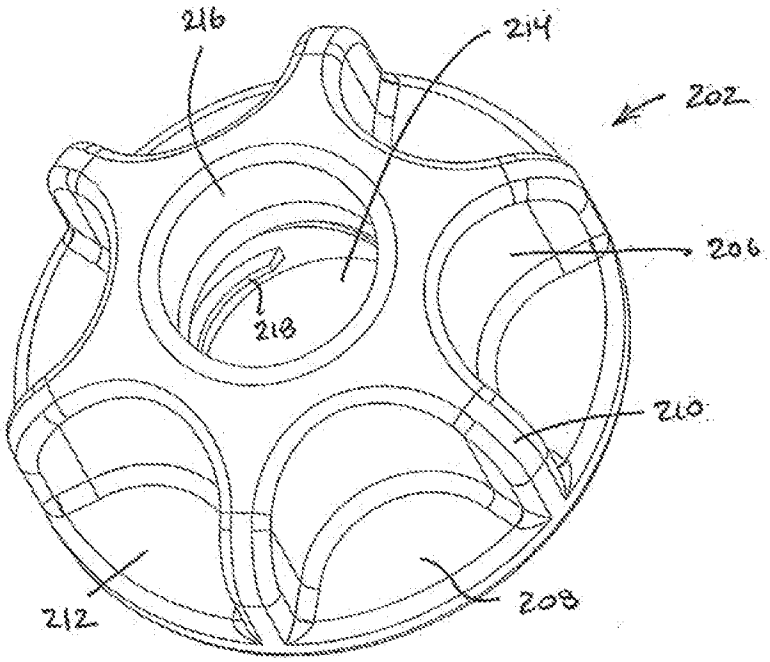

Fig. 3B

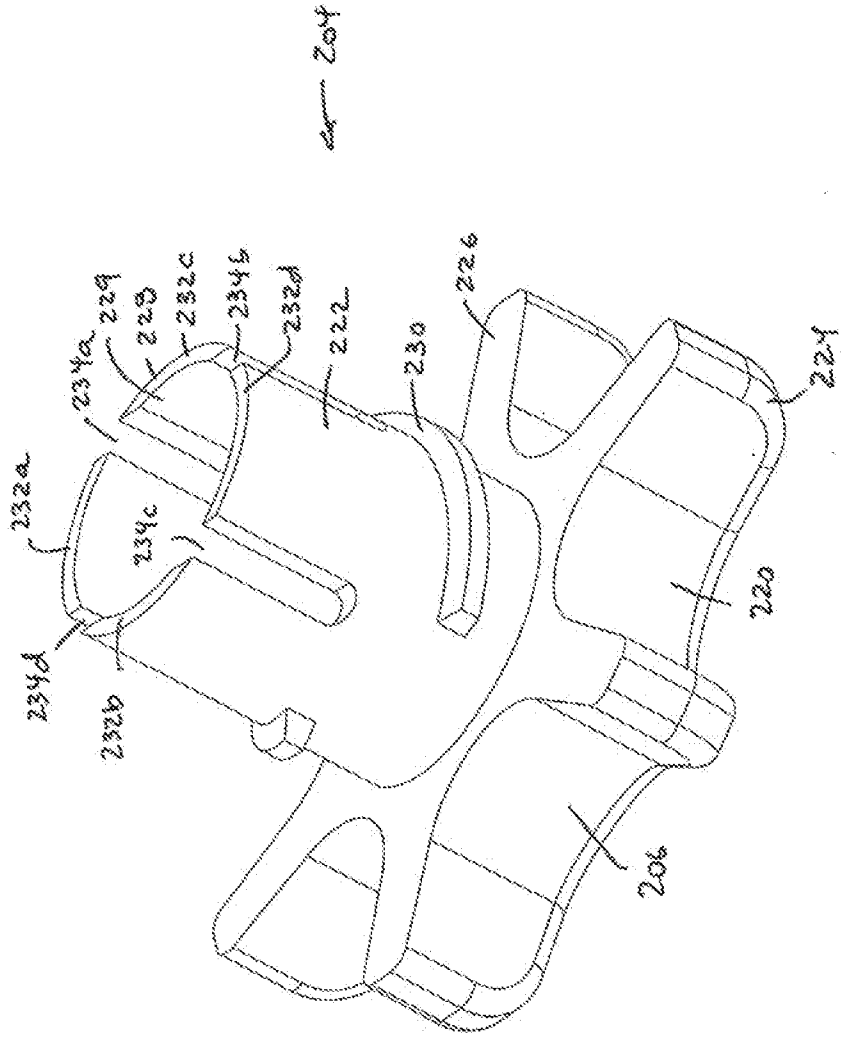
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FIG. 3C

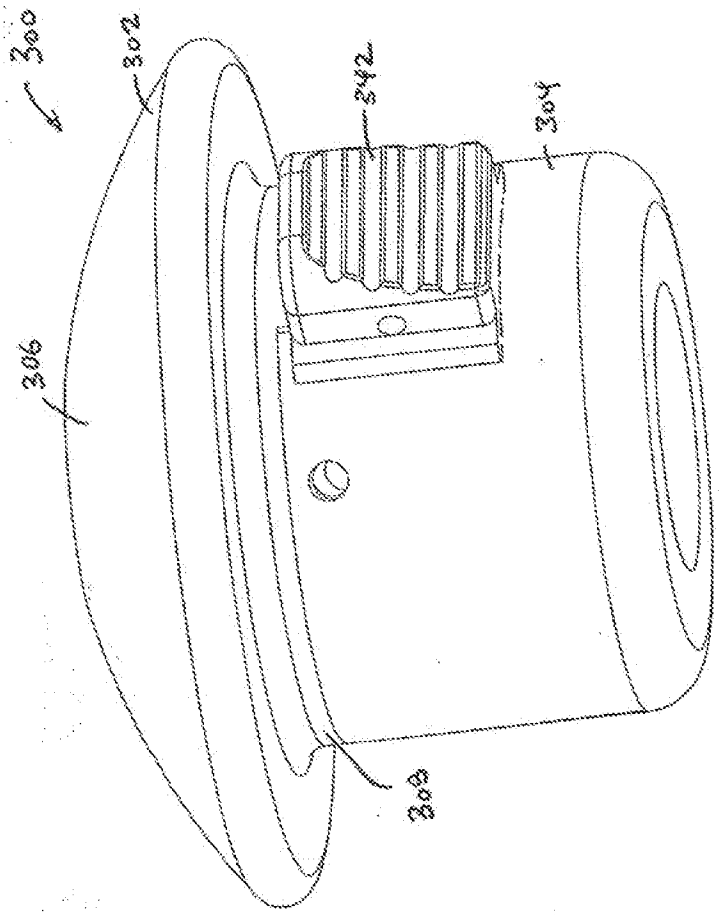

FIG. 4A

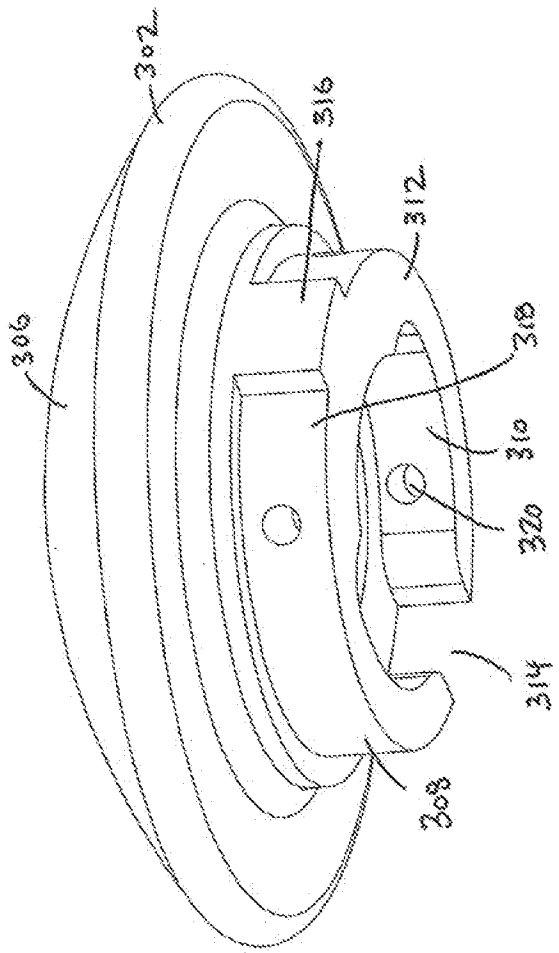

FIG. 4B

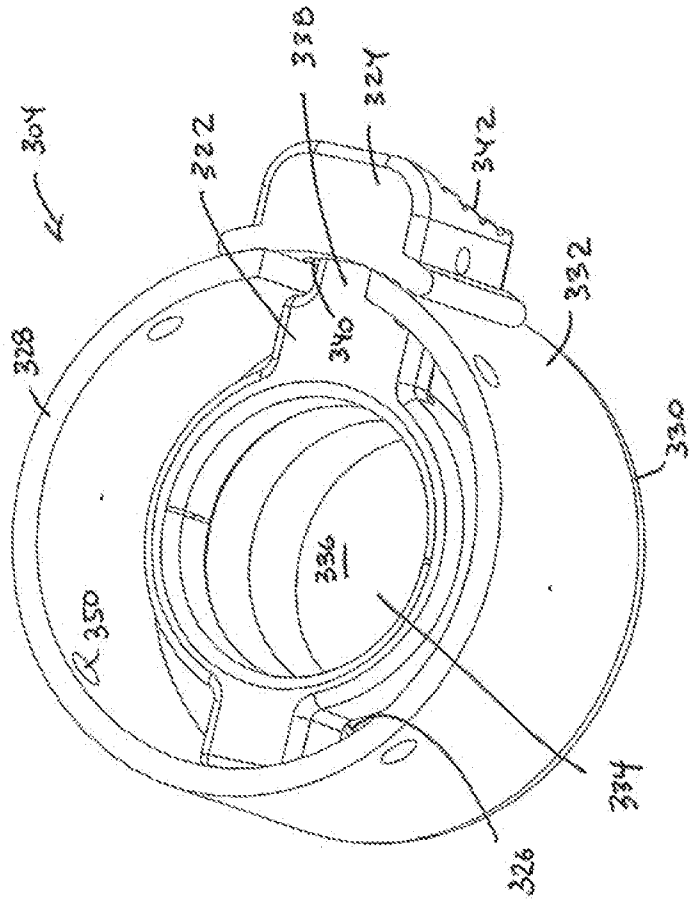

Fig. 4C

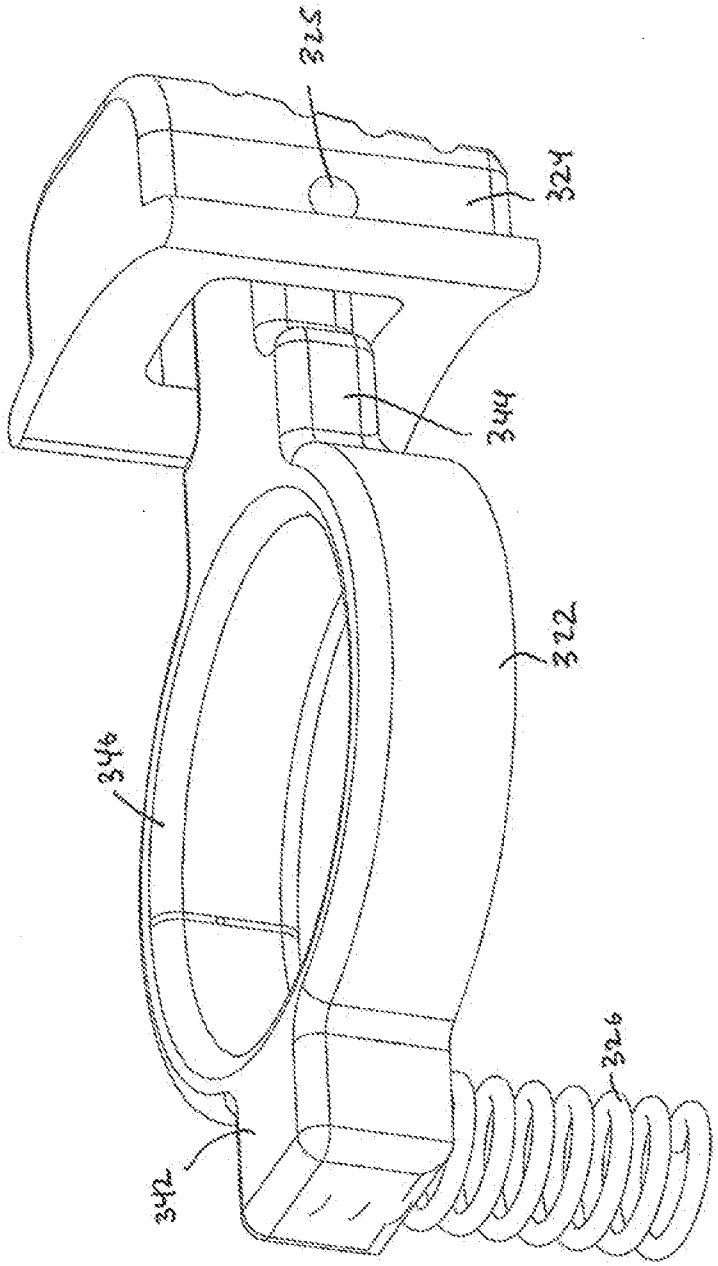

FIG. 4D

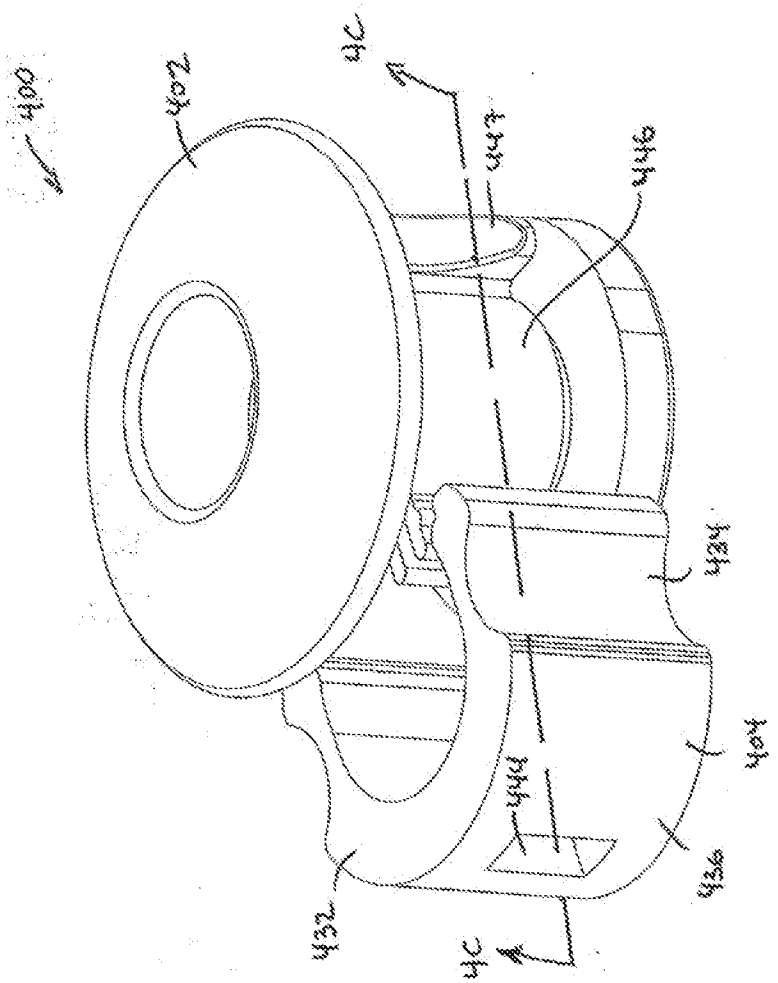

FIG. 5A

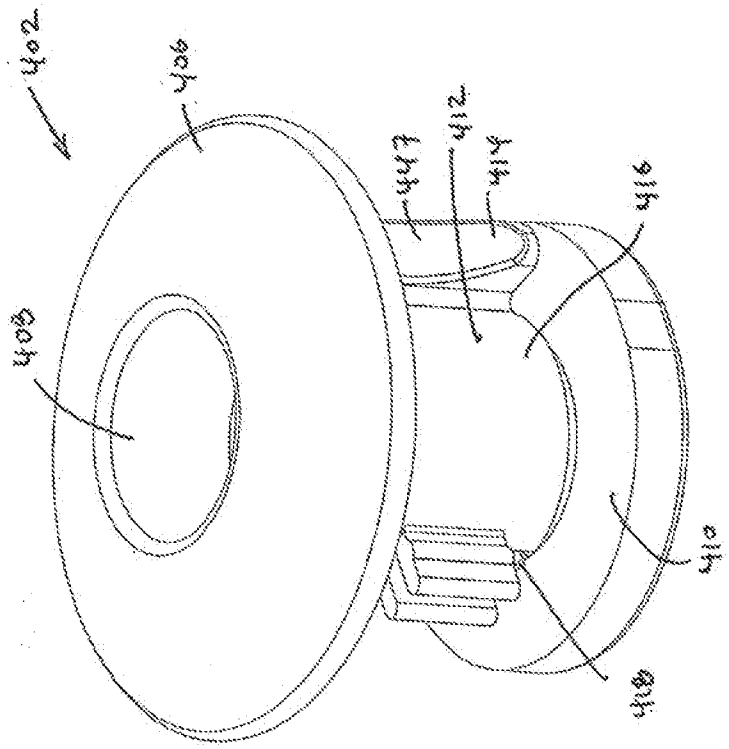

FIG. 5B

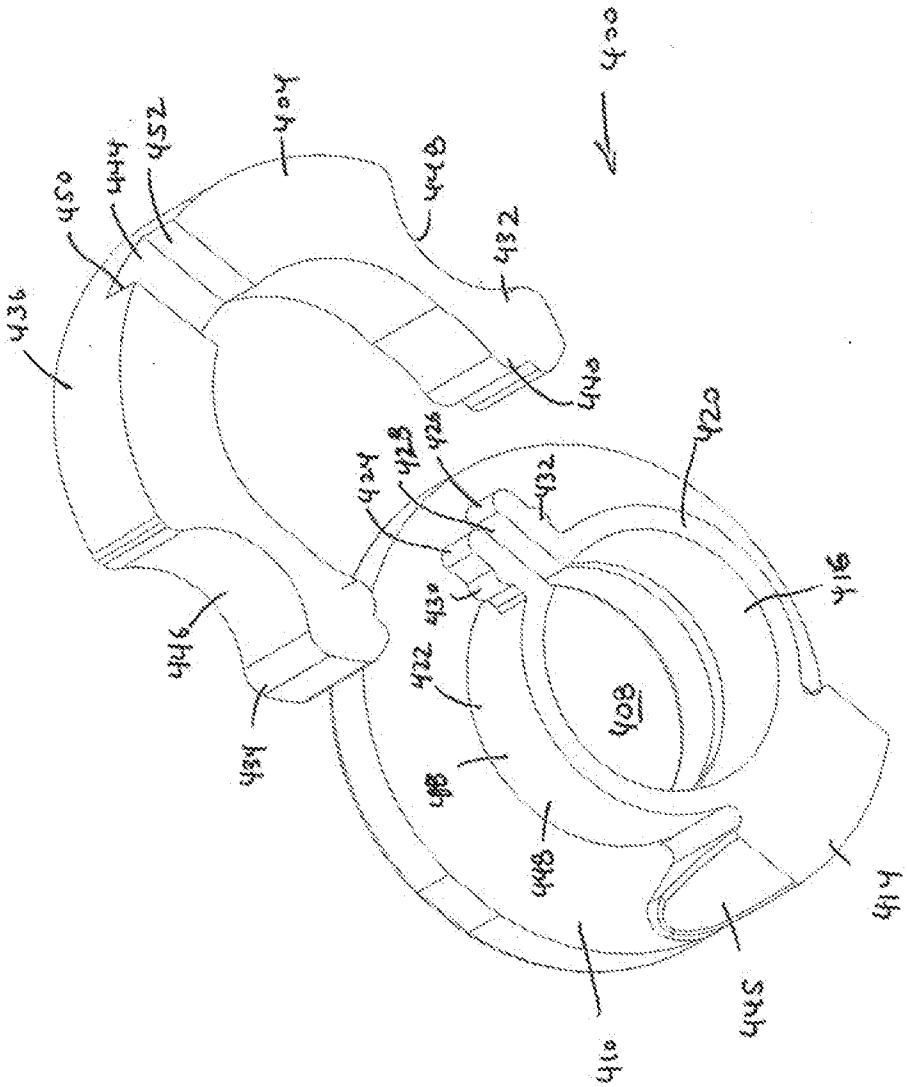
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FIG. 5C

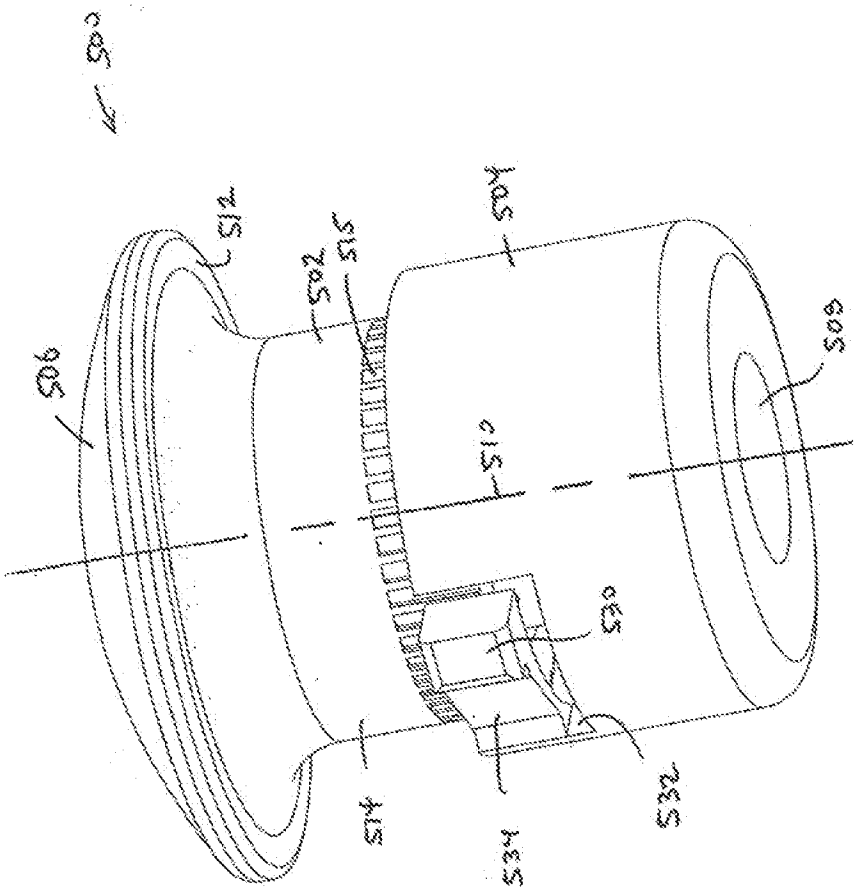

FIG. 6A

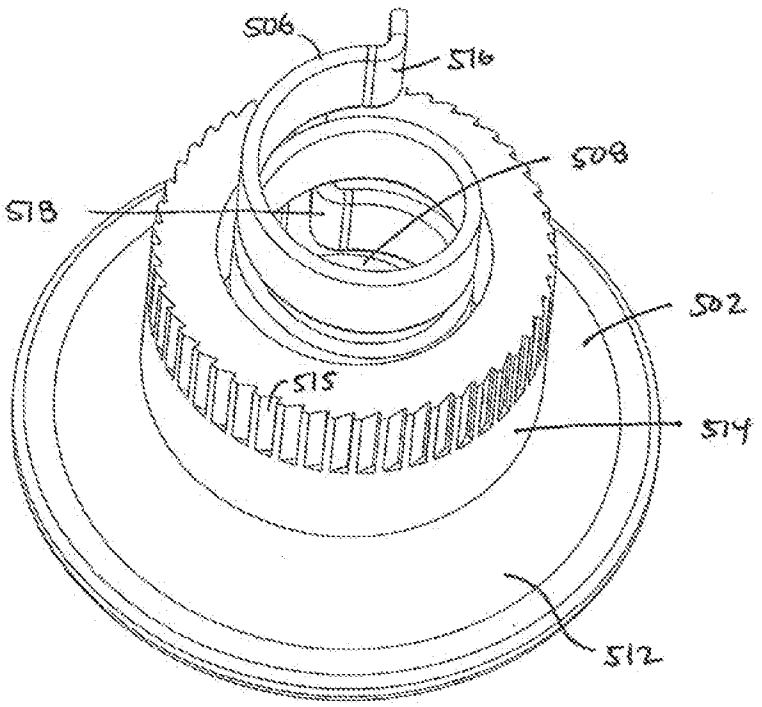

Fig. 6B

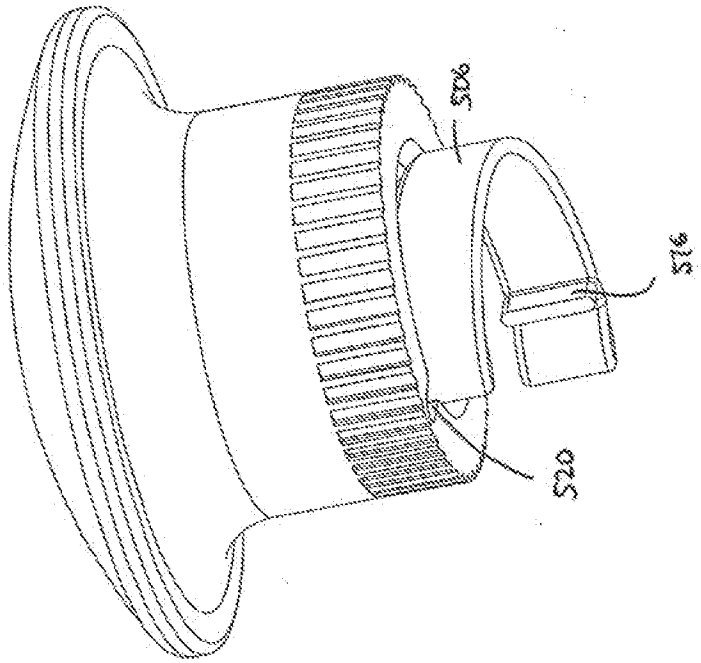

FIG. 6C

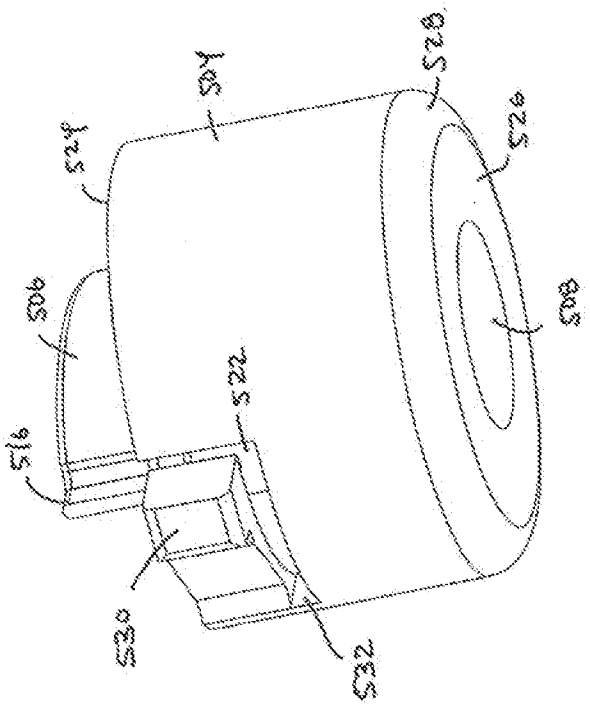

FIG. 9J

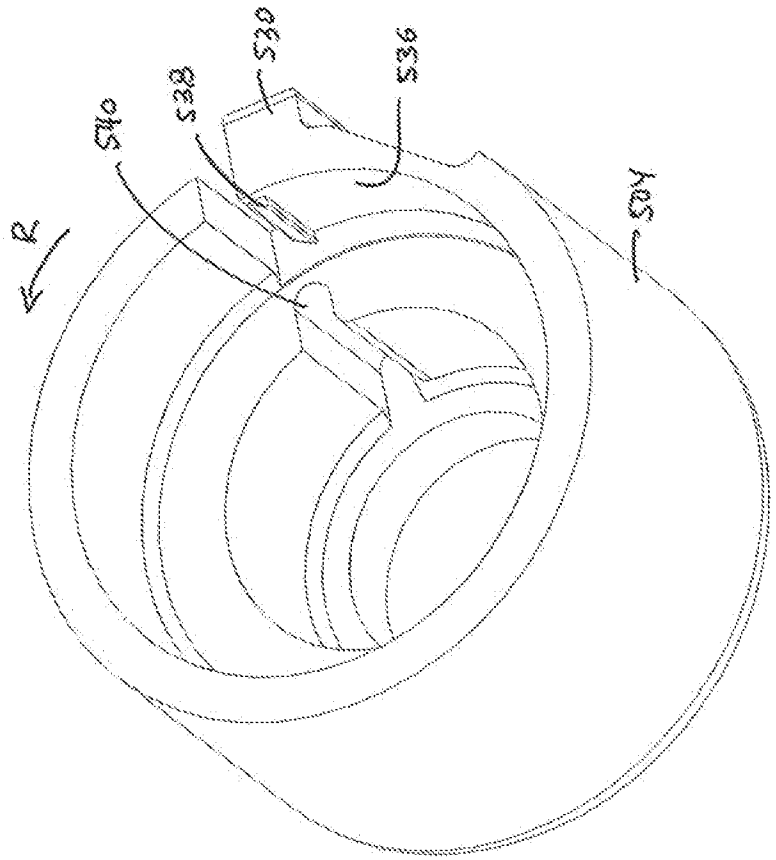

Fig. 6E

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/020551

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/32
ADD. A61B17/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/063529 A1 (BUSER JOHN P [US] ET AL) 11 March 2010 (2010-03-11) figures 6, 9, 10 paragraph [0060] - paragraph [0062] -----	1,2,5-7, 17,18,20
X	US 5 279 575 A (SUGARBAKER DAVID J [US]) 18 January 1994 (1994-01-18) figures 25, 26 column 4, line 31 - line 55 -----	1-4, 17-19
X	US 5 217 441 A (SHICHMAN DANIEL [US]) 8 June 1993 (1993-06-08) figures 2, 3, 4A-B, 5A-C, 6 column 5, line 55 - column 7, line 7 ----- -/--	1,2,5-7, 17,18,20

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 May 2014	15/09/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Emirdag, Eda

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/020551

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 2 147 654 A1 (ELLMAN ALAN G [US]) 27 January 2010 (2010-01-27) figures 5, 12 paragraph [0020] - paragraph [0021]	1,2
A	EP 1 762 193 A1 (STORZ KARL GMBH & CO KG [DE]) 14 March 2007 (2007-03-14) the whole document	1-7, 17-20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/020551

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-7, 17-20

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-7, 17-20

   (a) Locking with an eccentric alignment
   (b) Locking with a collet

   ---

2. claims: 8-10, 14-16

   (a) Locking with a biased lever
   (b) Locking with a clip

   ---

3. claims: 11-13

   Locking with a helical coil

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2014/020551

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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