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CORRECTED PUBLICATION

(54) **ADJUSTABLE APERTURE AXIS PEEP SIGHT DEVICE**

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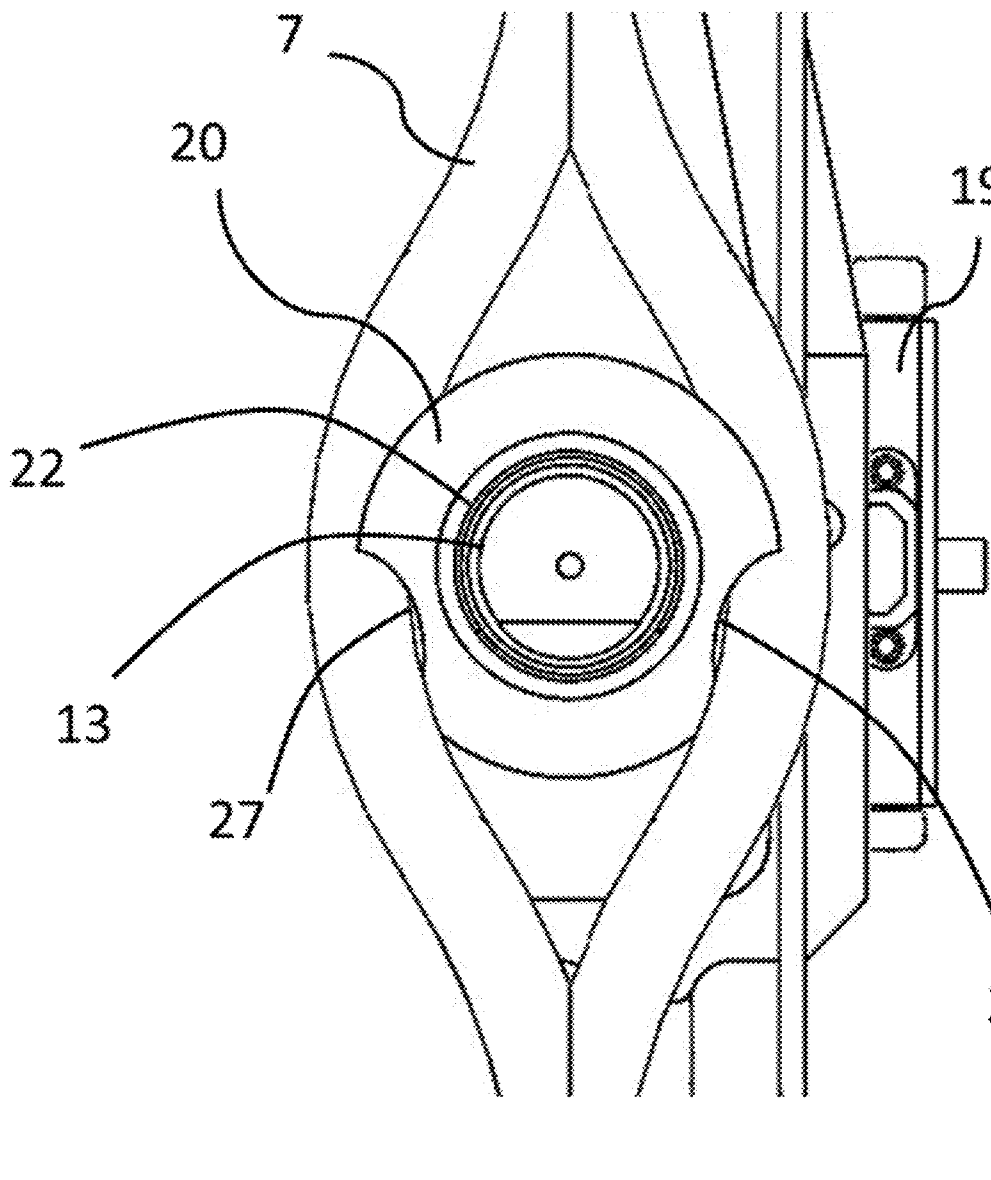
CPC *F41G 1/467* (2013.01)

(57) **ABSTRACT**

An adjustable aperture axis peep sight device is disclosed with an outer ring having a first axis, and an inner body member having a second axis. The first axis of the outer ring forms a sight angle with the second axis of the inner body member. A first partially spherical surface is formed on the outer ring. A second partially spherical surface is formed on the inner body member. The first partially spherical surface movably mates with the second partially spherical surface. The sight angle is adjustable by moving the inner body member relative to the outer ring.



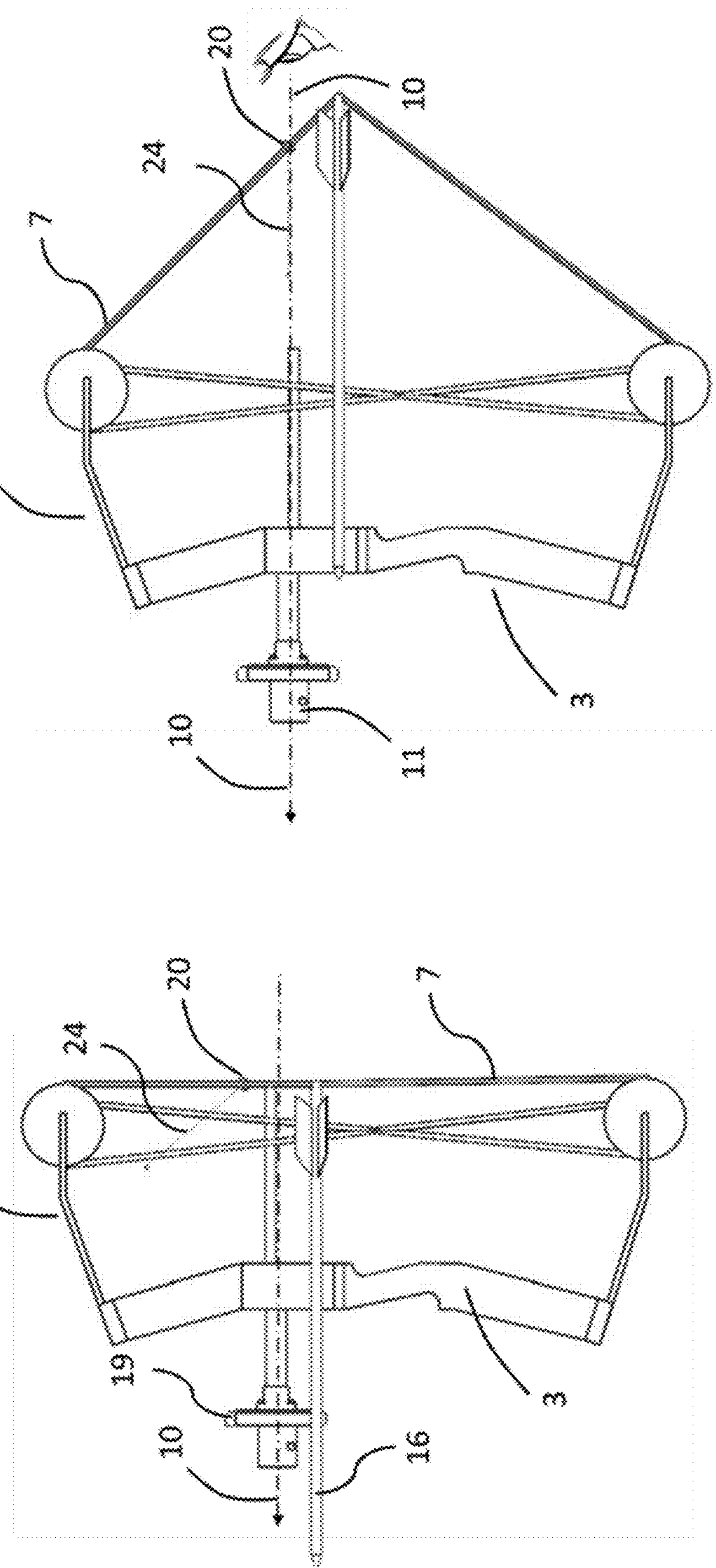
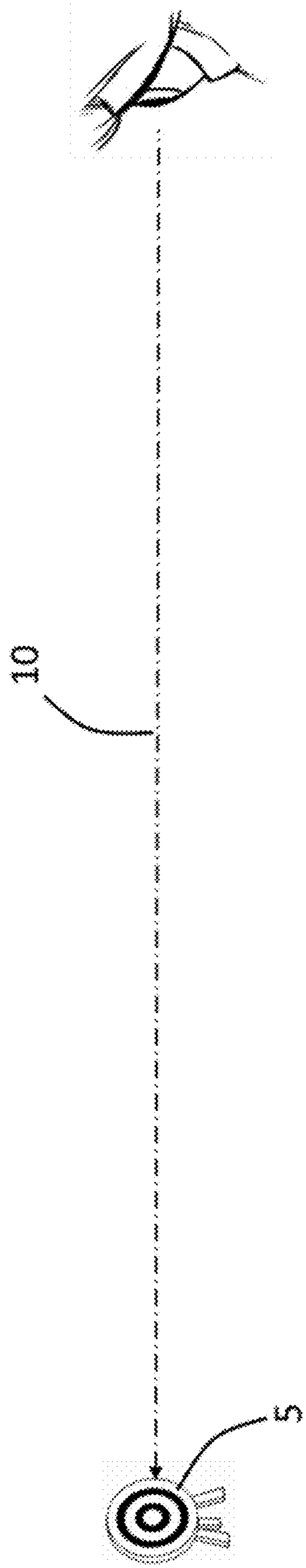


Fig. 1

Fig. 2



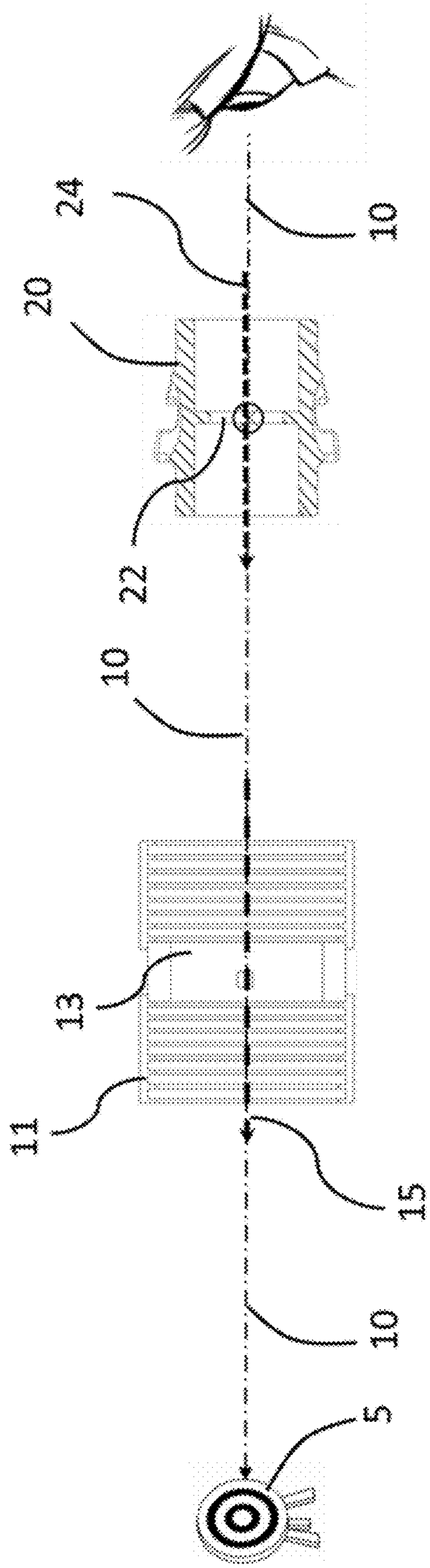


Fig. 3

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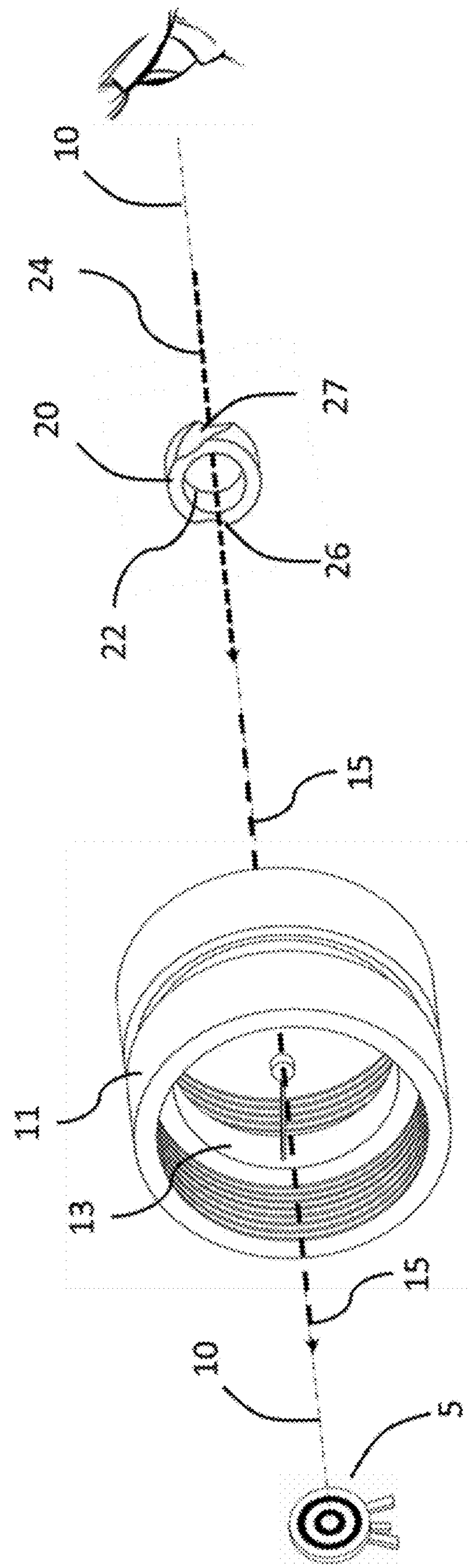

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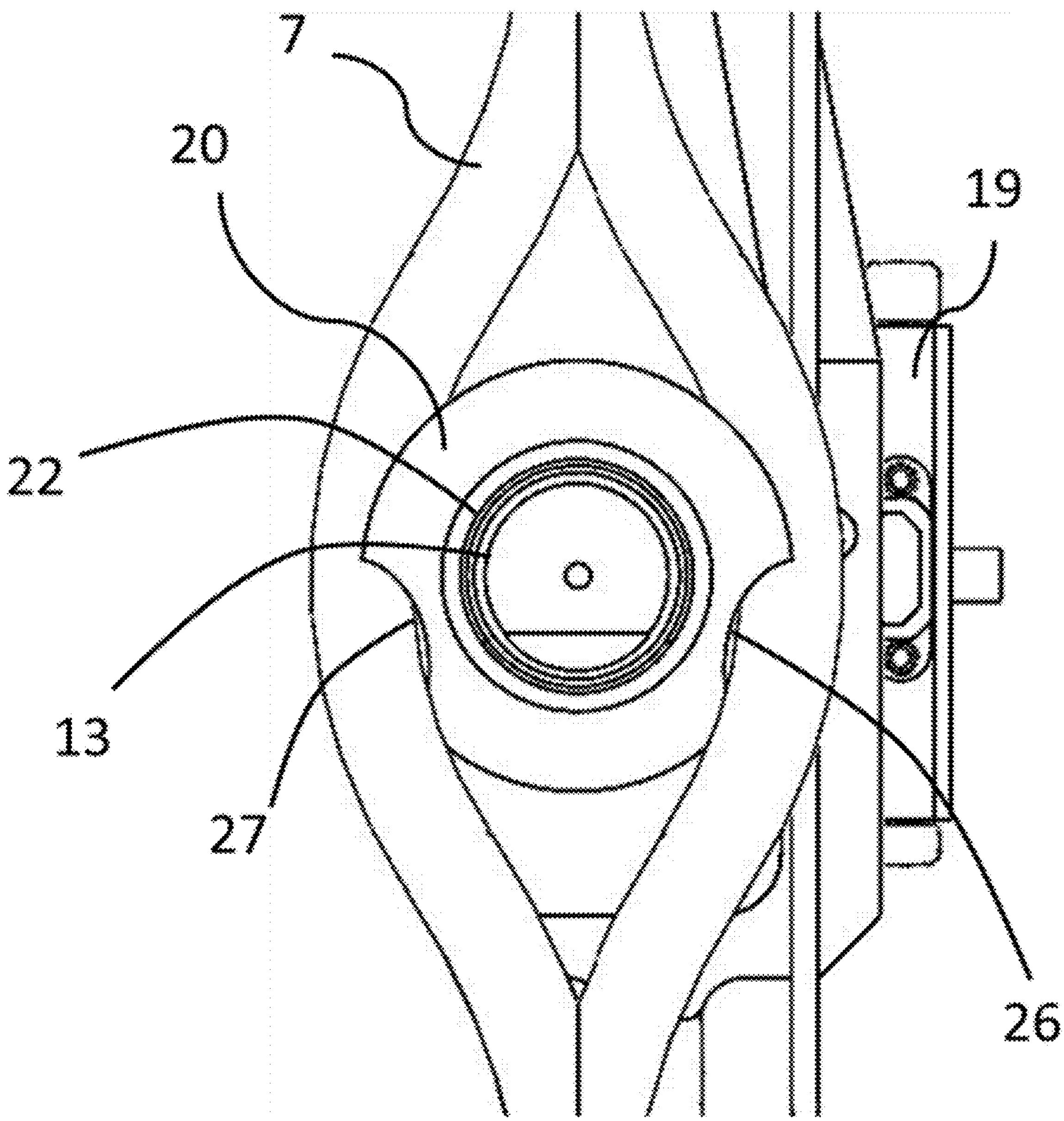

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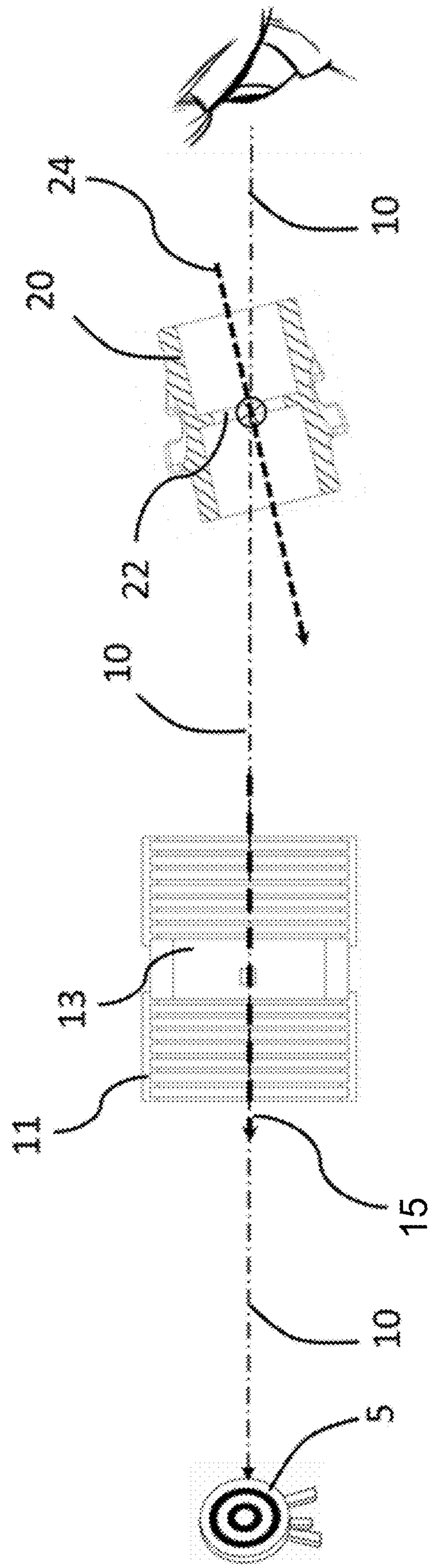

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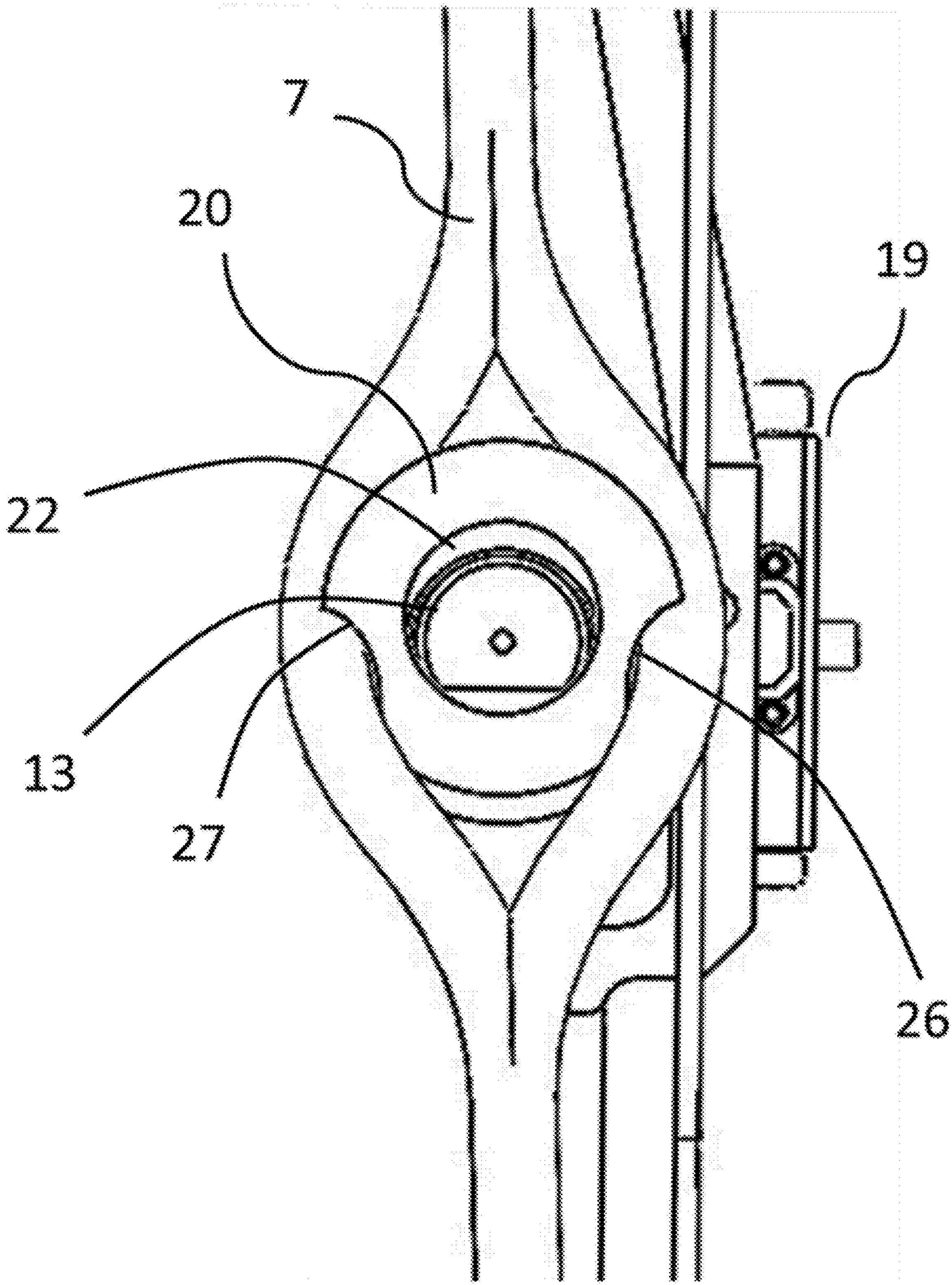

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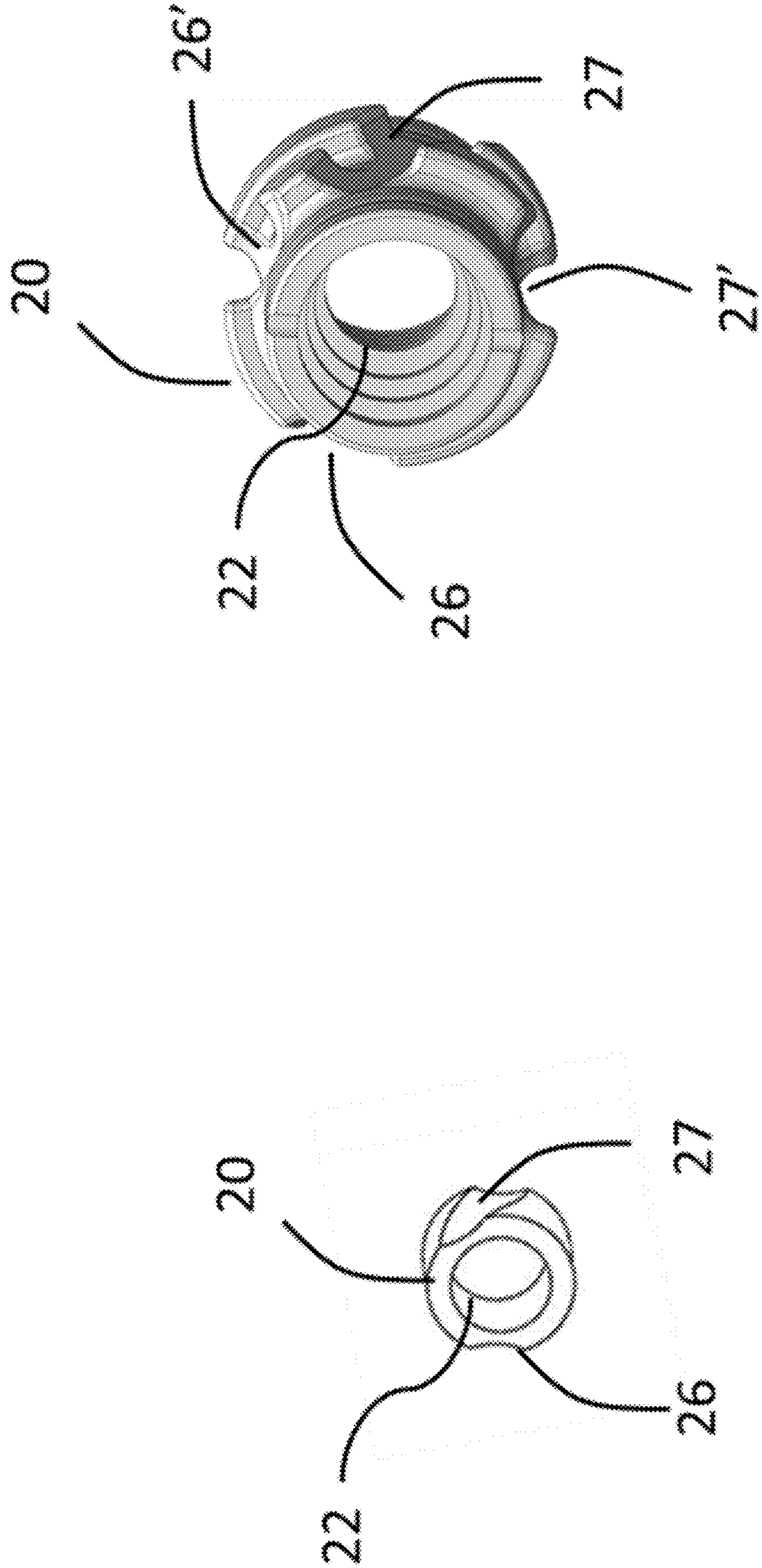

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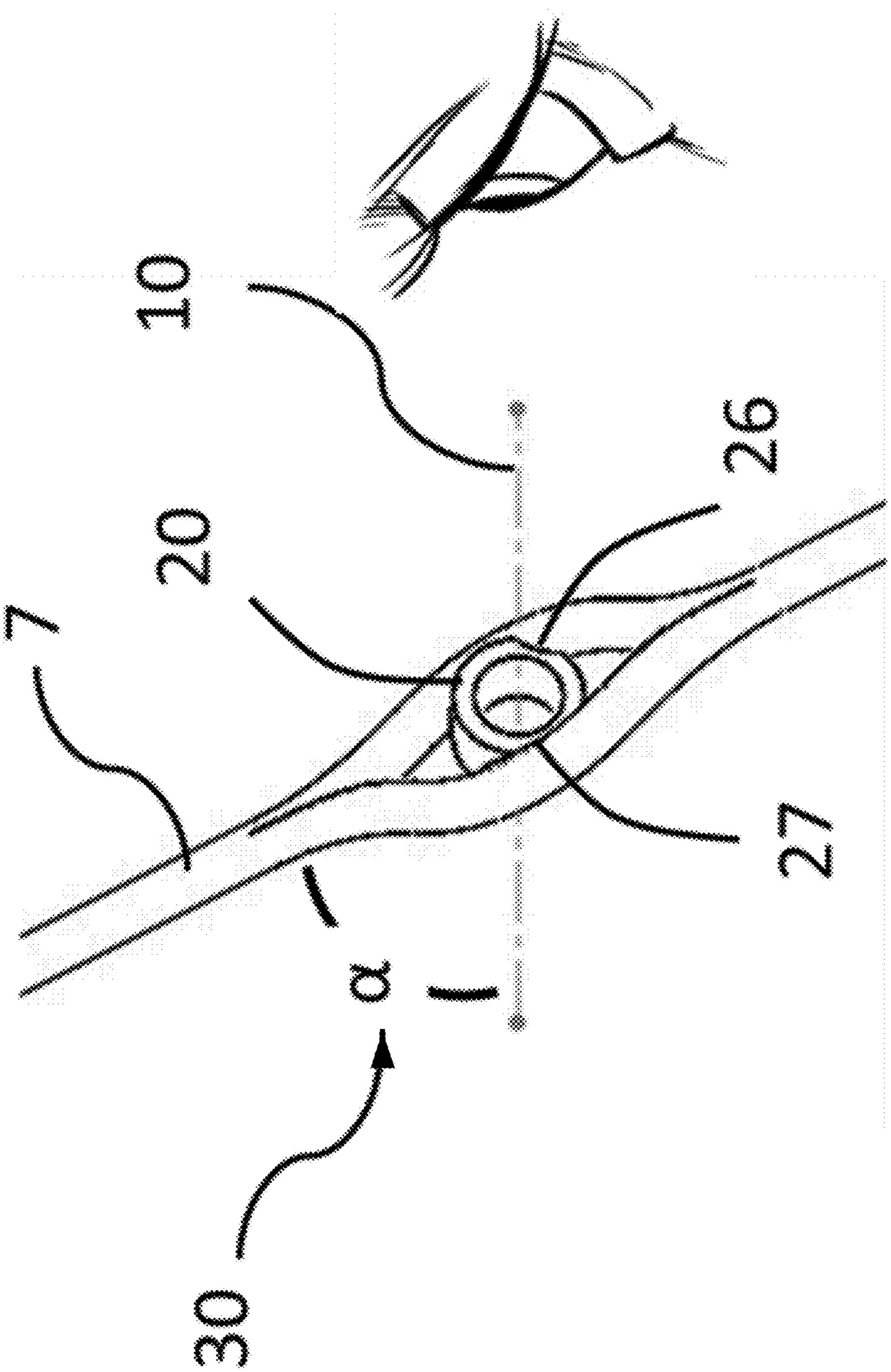


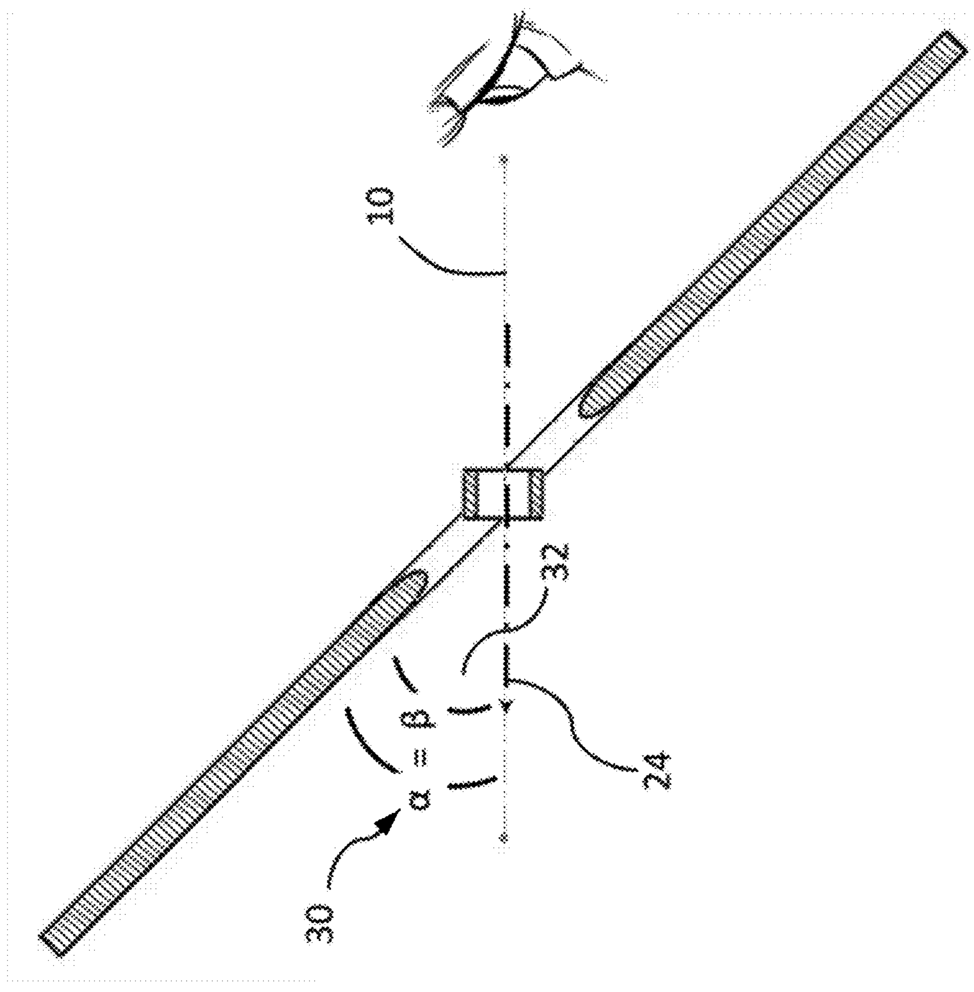
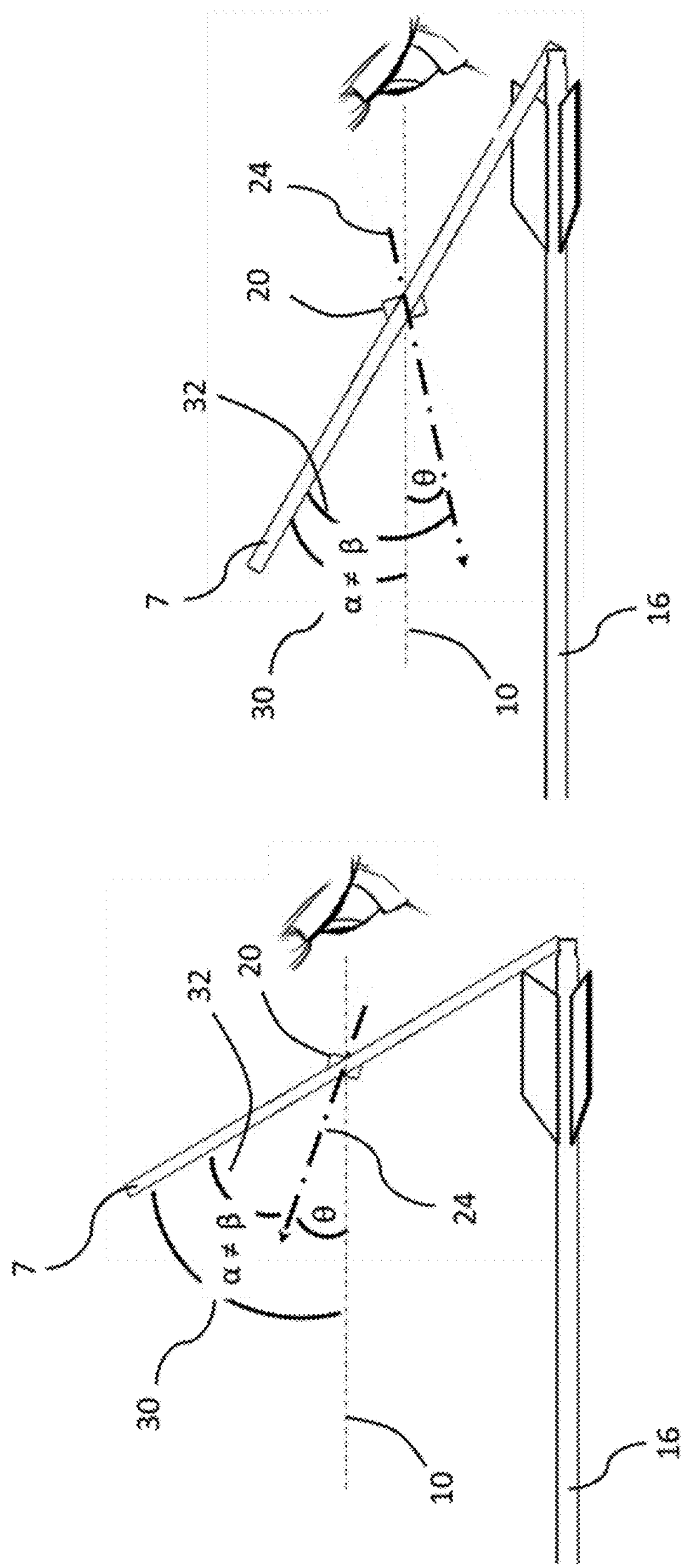
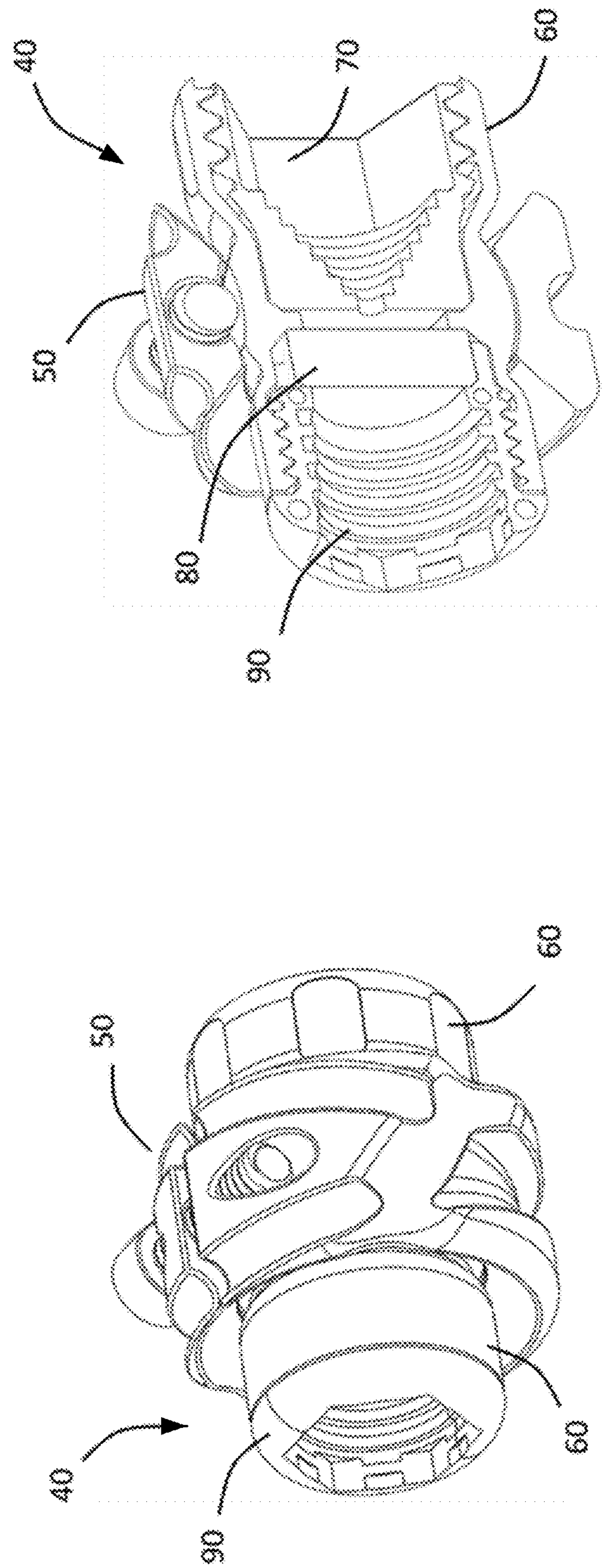


Fig. 10

Fig. 11





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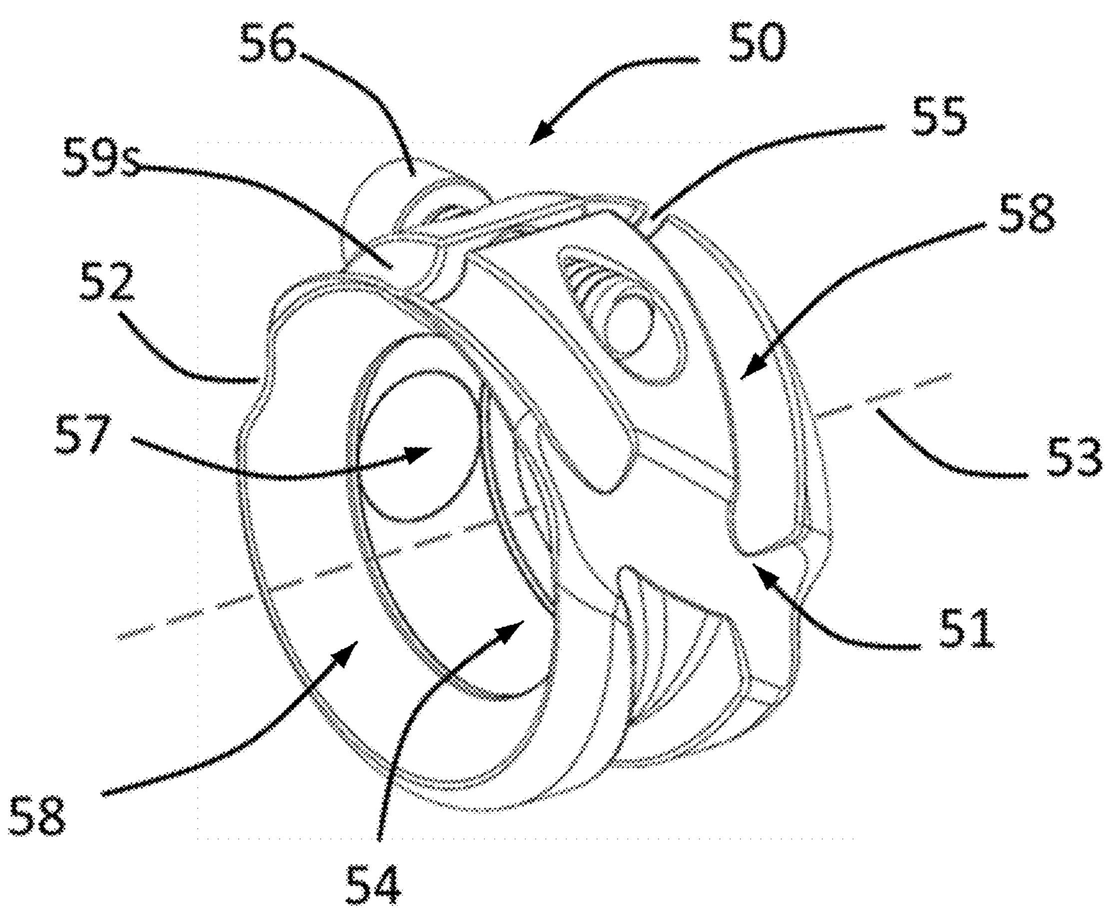

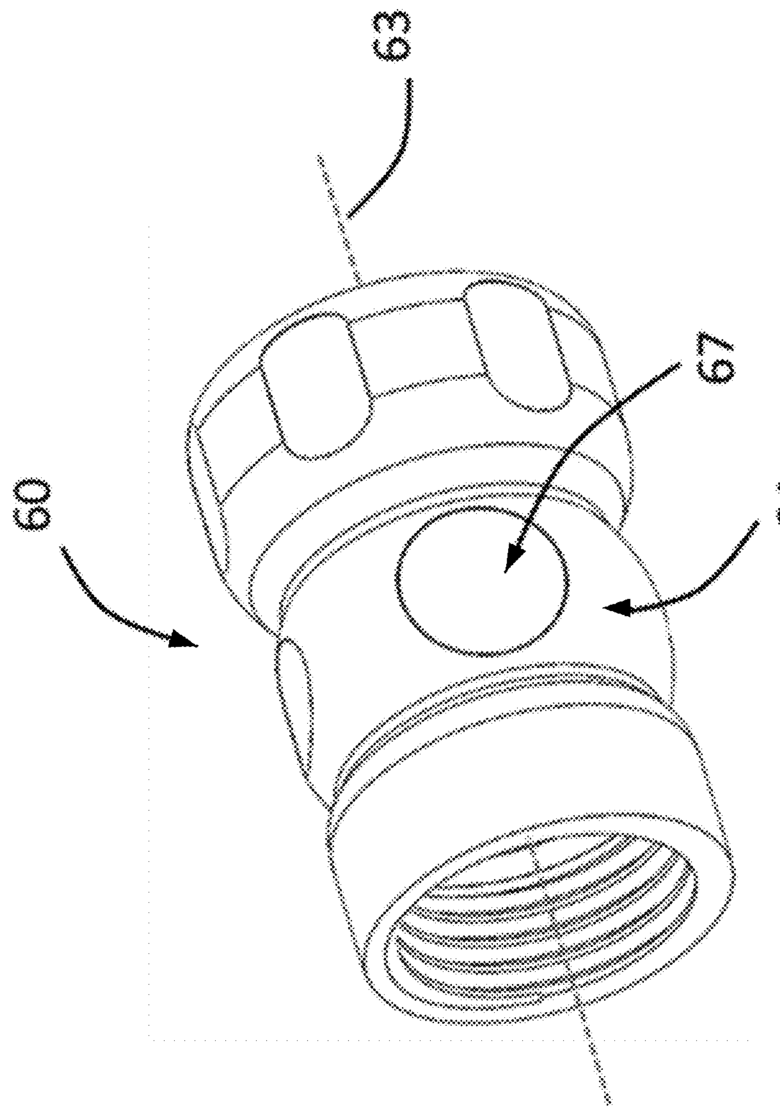

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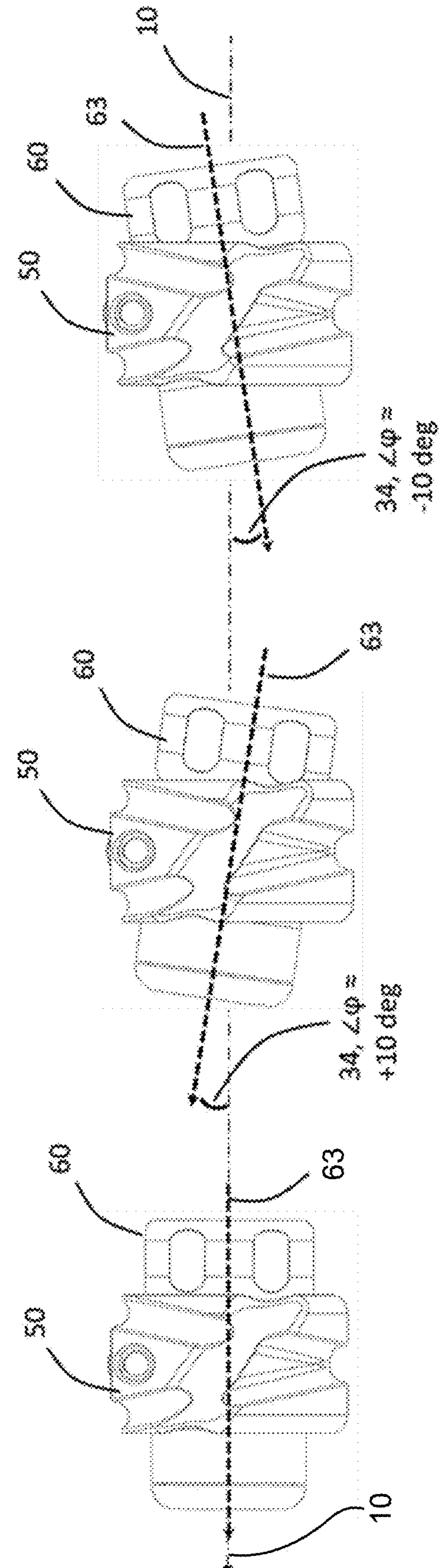

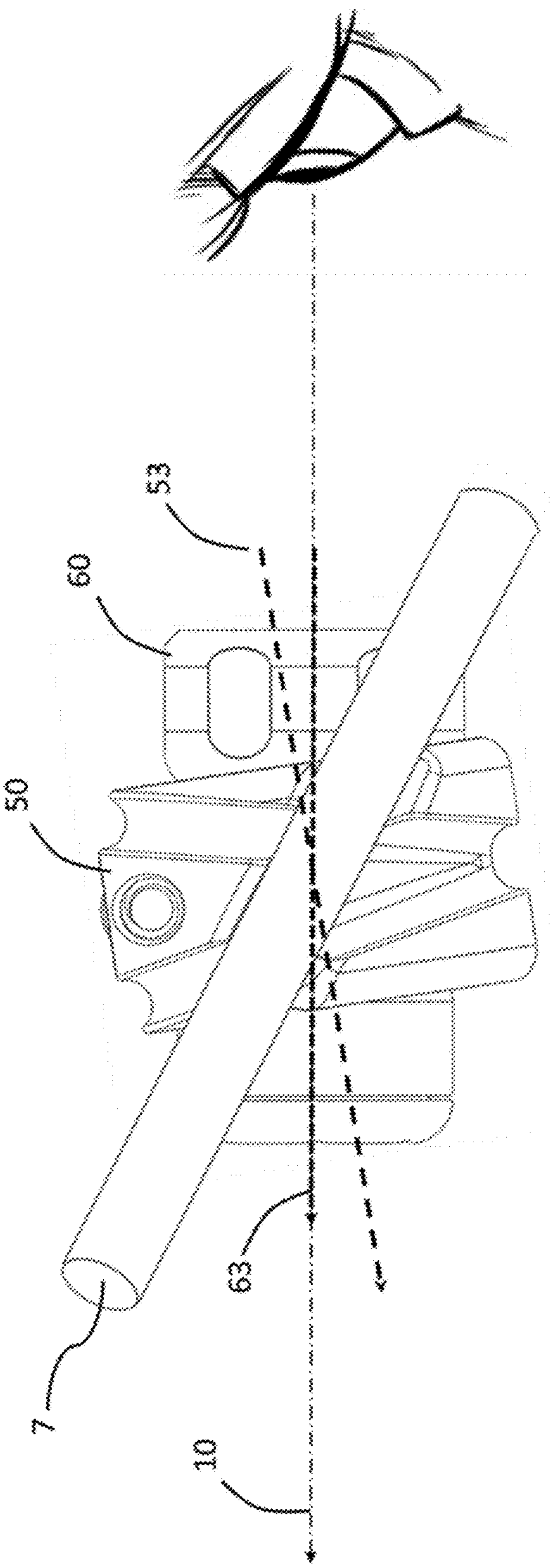

Fig. 16

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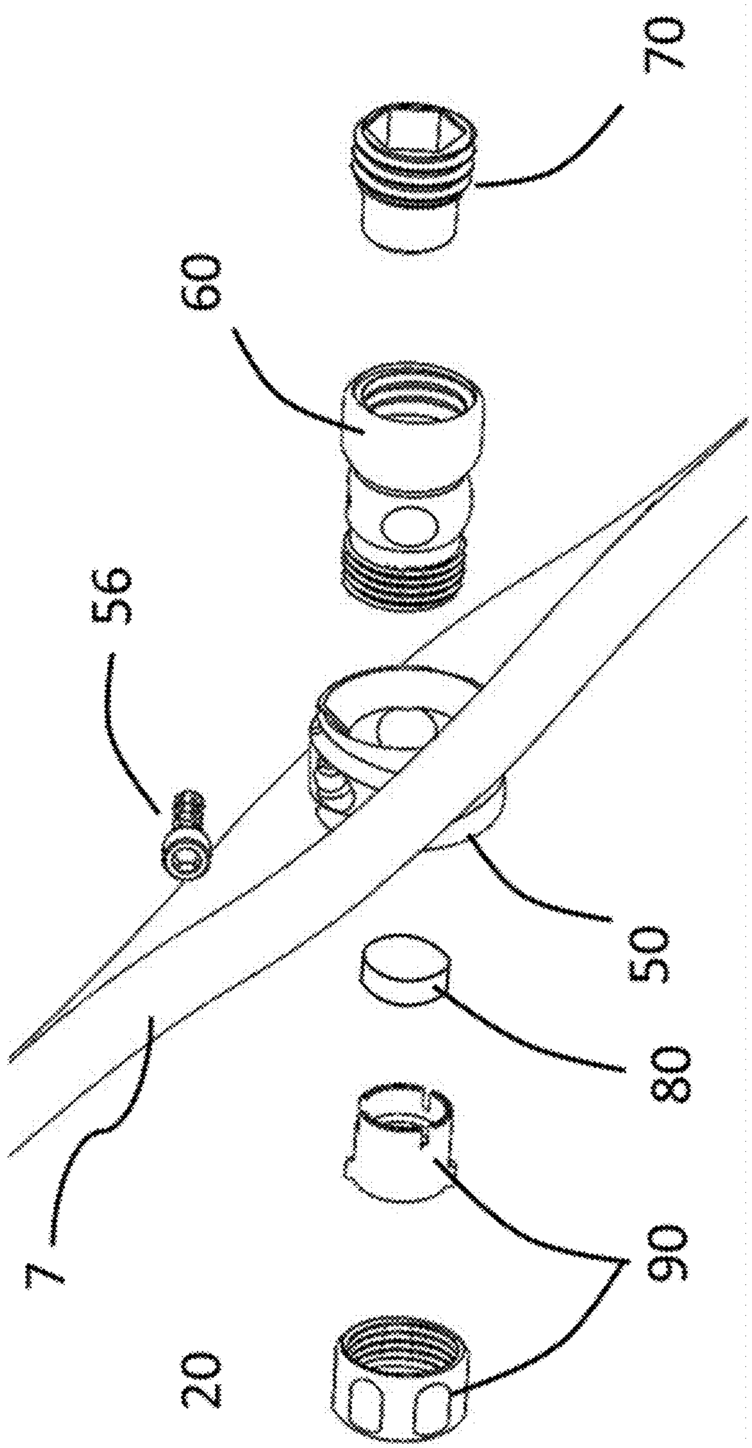

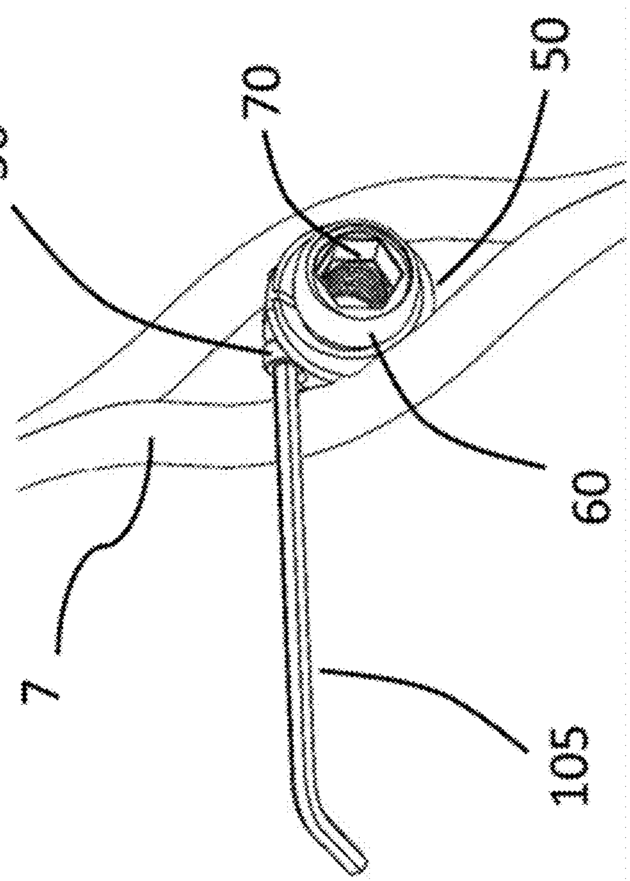

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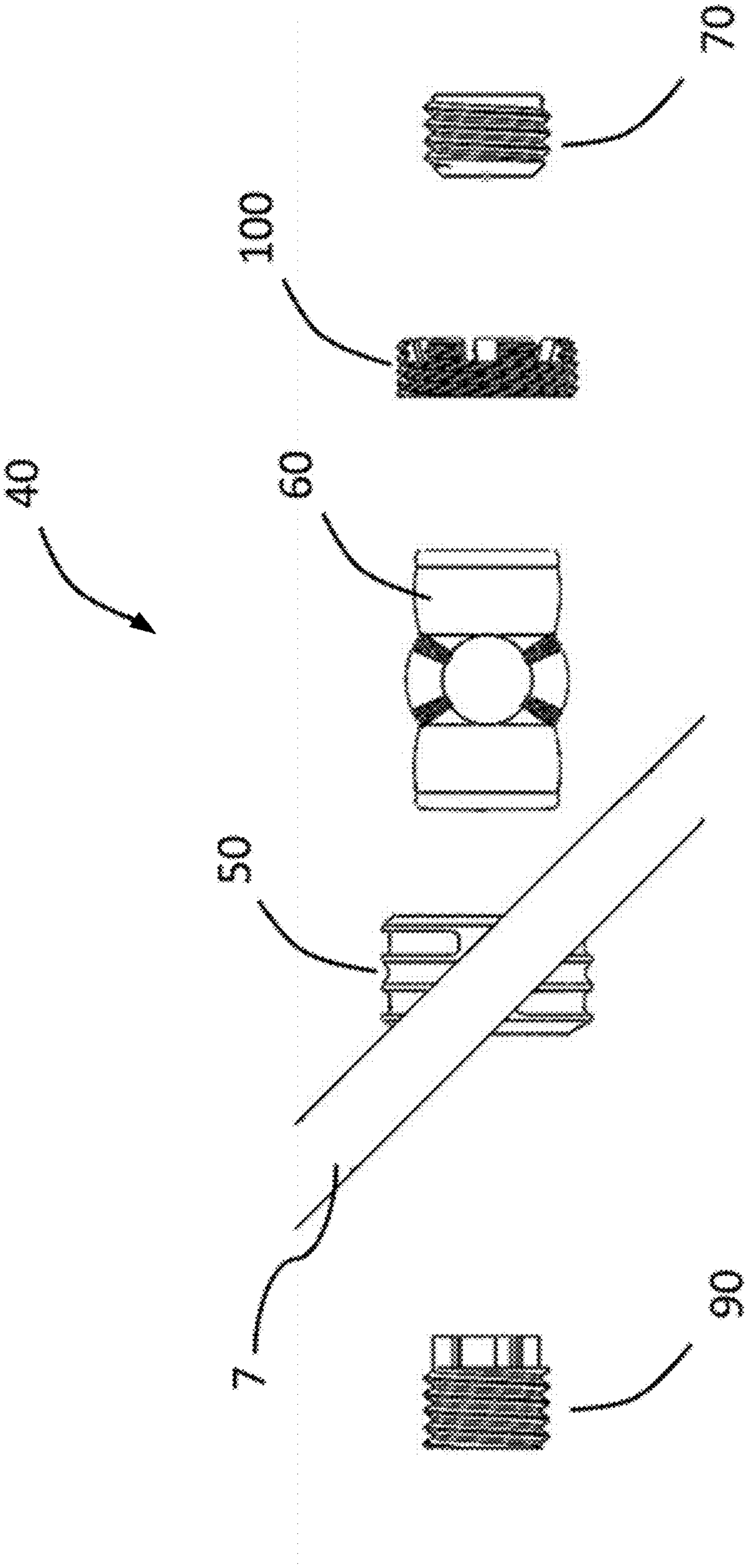

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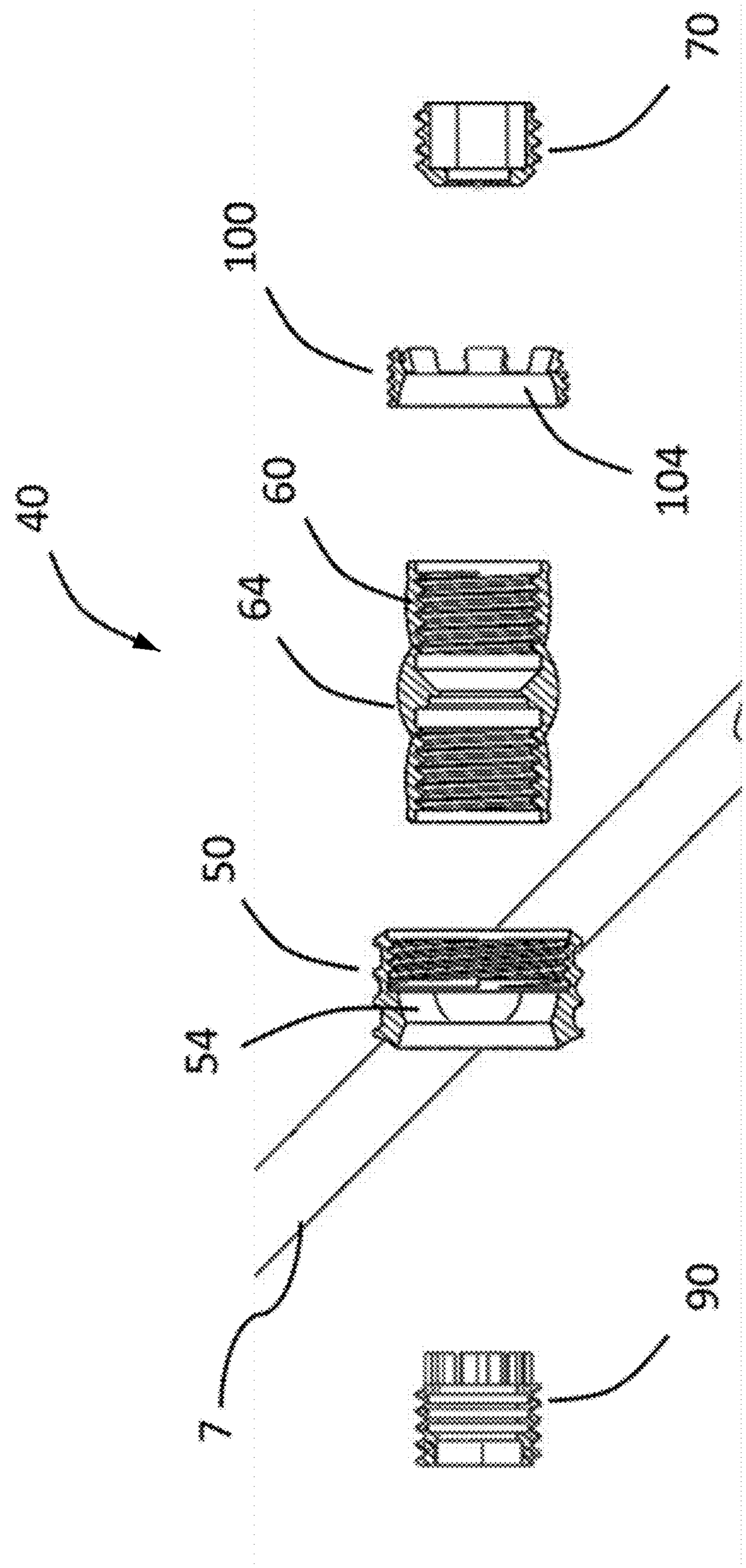

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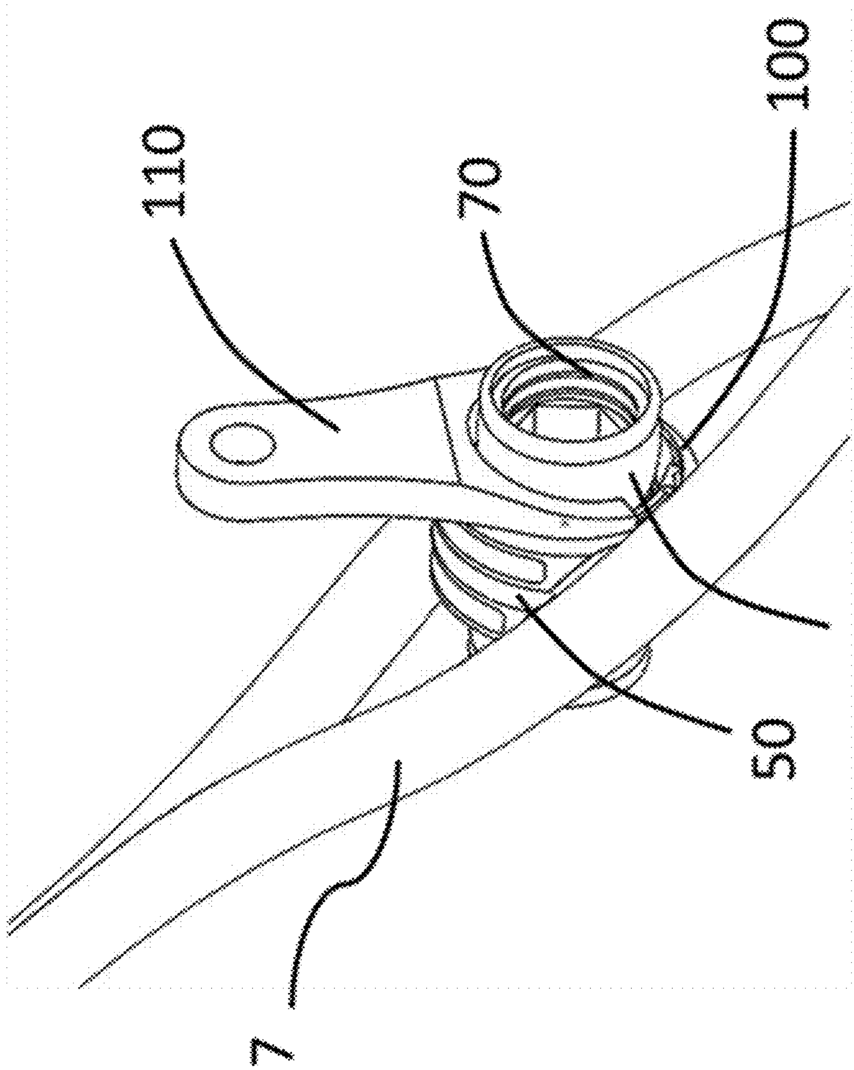

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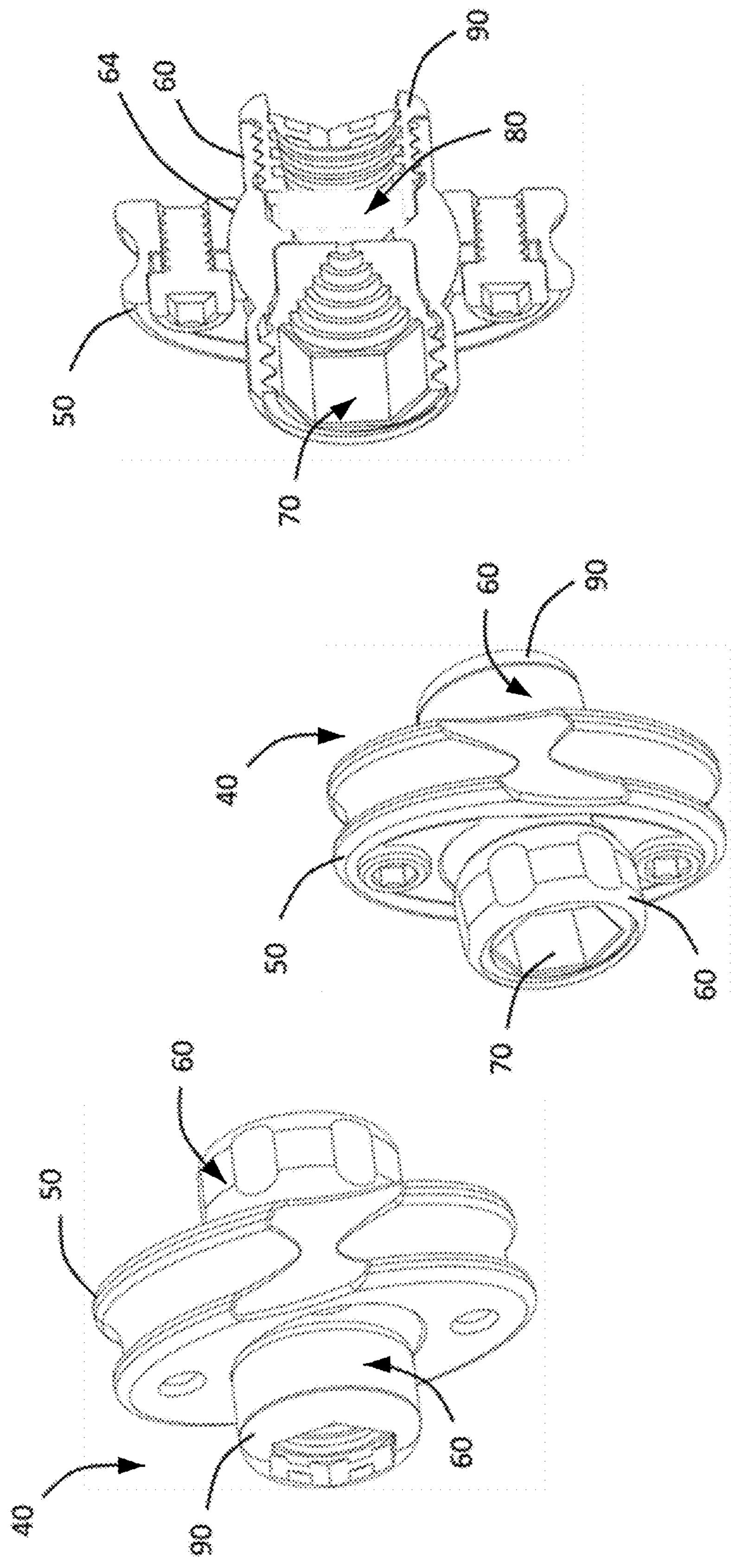

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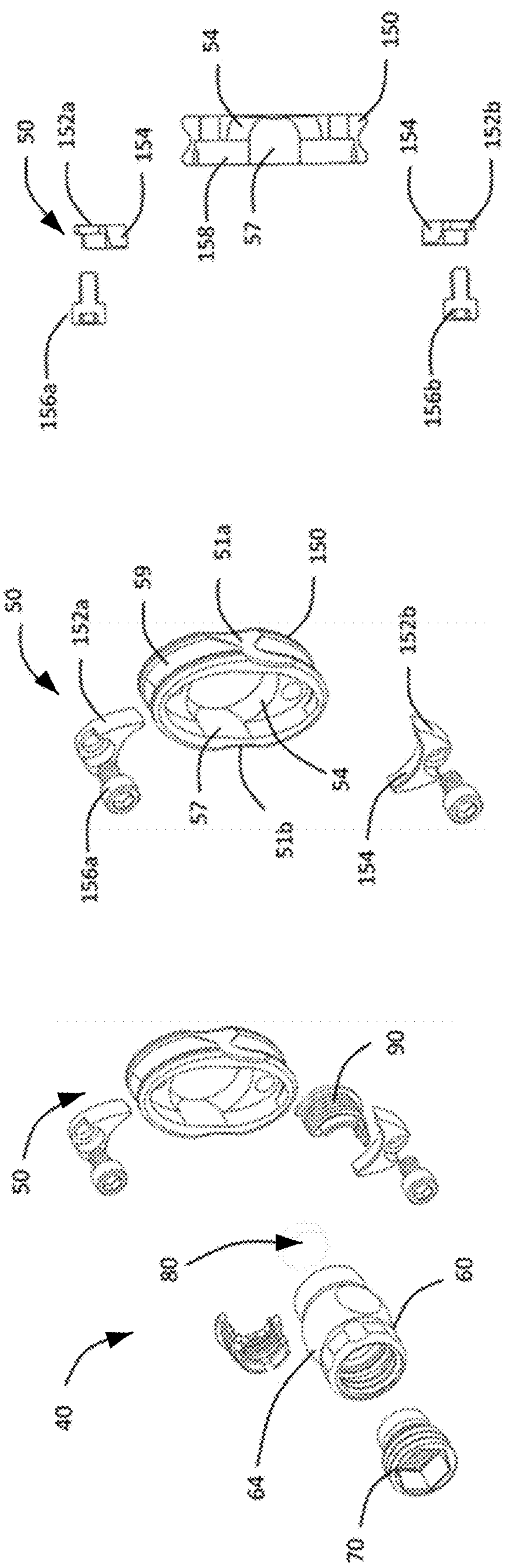
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Fig. 24B

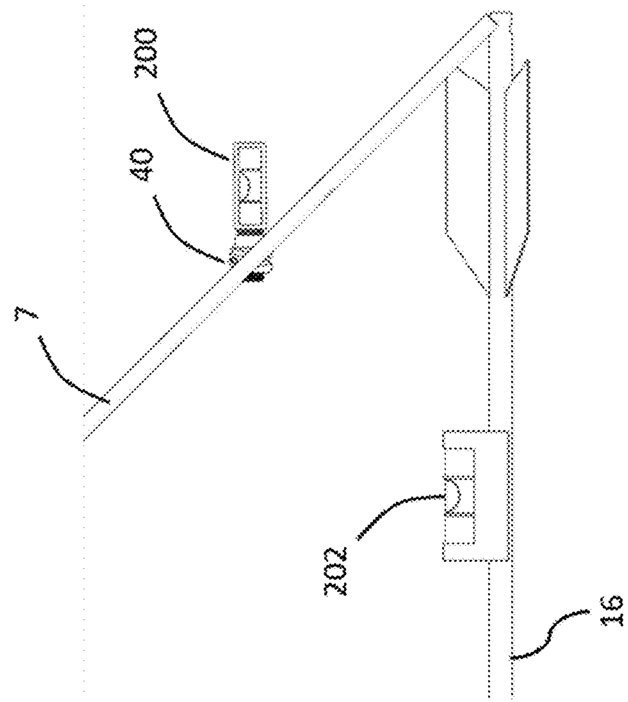
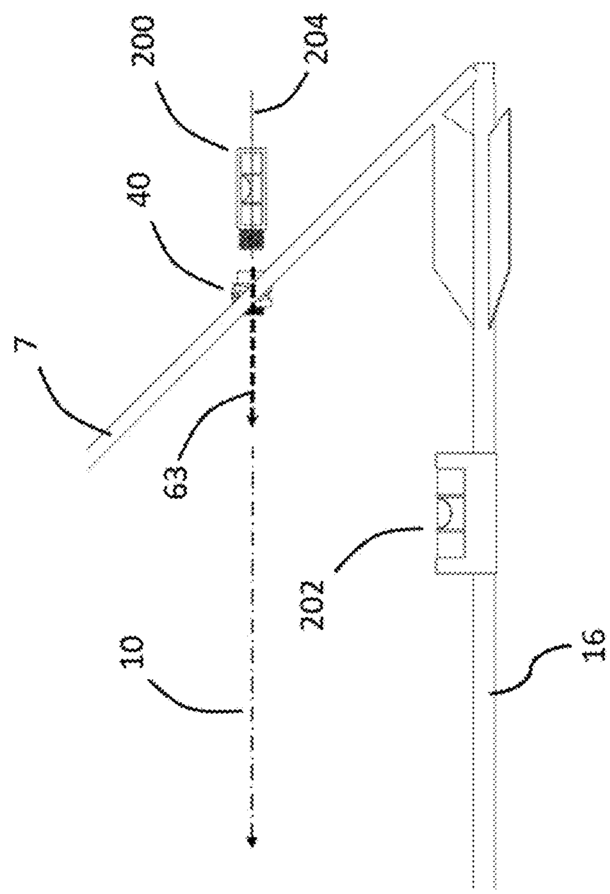


Fig. 24A



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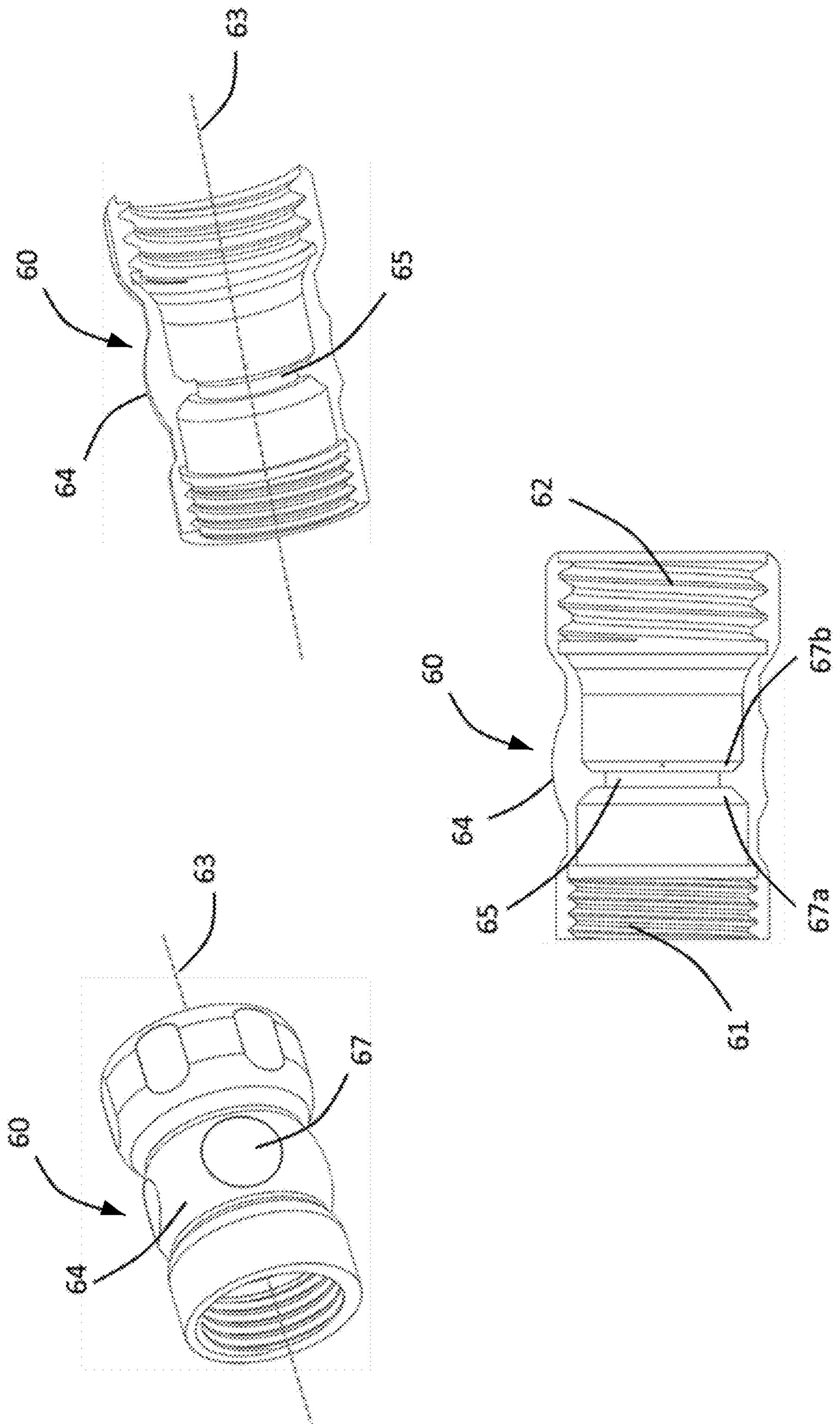

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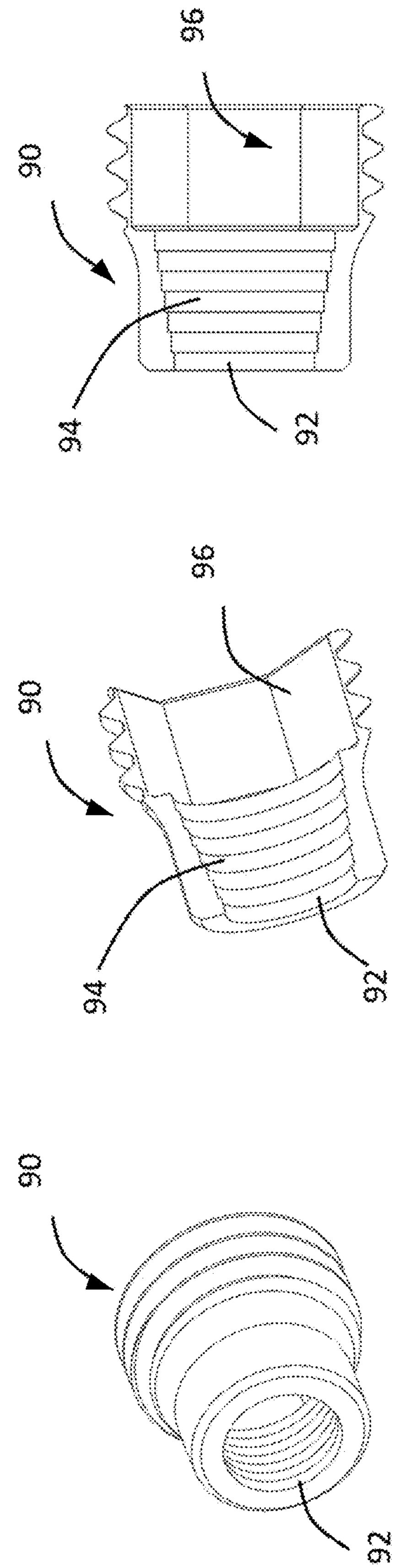

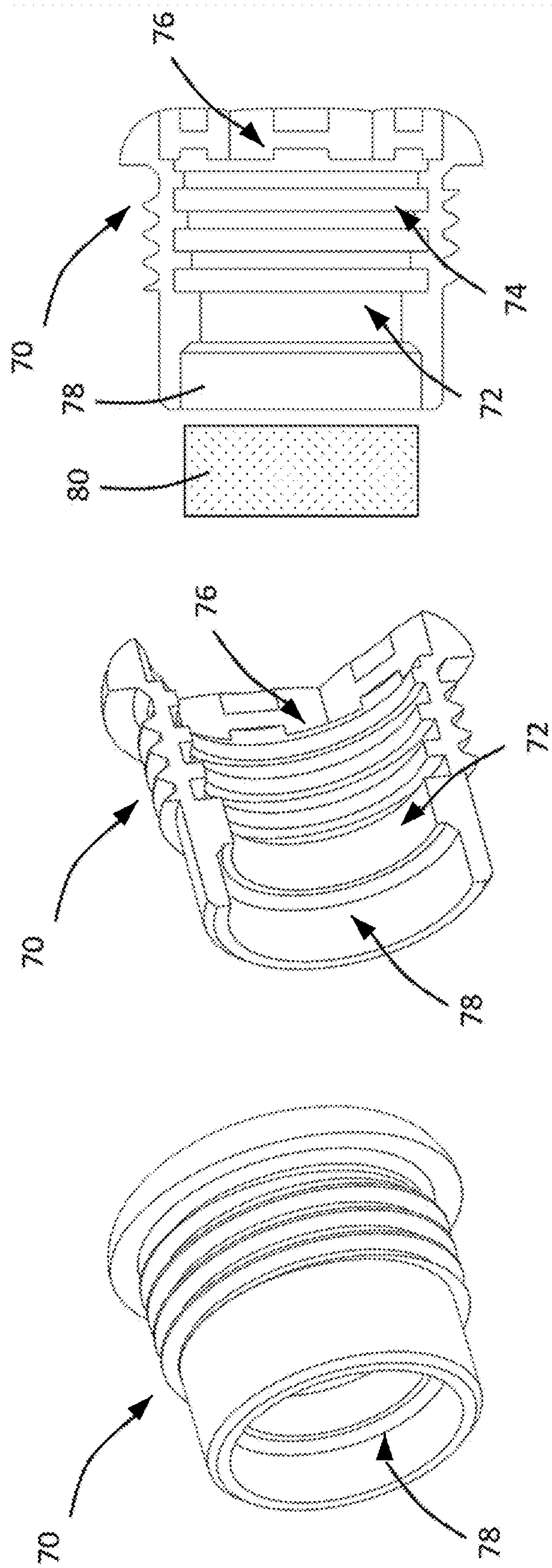

Fig. 27

ADJUSTABLE APERTURE AXIS PEEP SIGHT DEVICE

PRIORITY

[0001] This application claims the priority filing benefit of U.S. Provisional Patent Application No. 63/380,852 filed Oct. 25, 2022 for "Adjustable Aperture Axis Peep Sight Device" of Munsell and Hall, hereby incorporated by reference in its entirety as though fully set forth herein.

BACKGROUND

[0002] In an archery sighting system, the two major components for consistent and repeatable aiming include a front aperture with an aiming reticle, and a rear aperture known as a "peep" sight. Maximum accuracy is achieved when the two are coaxially aligned. However, the aperture axis of the peep sight often is not coaxially aligned with the line-of-sight to the target through the front aperture due to the variability of the bow geometry fitted to the archer and the resultant string angle as the peep is mounted to the string.

[0003] Depending on the length of the bow (from limb-to-limb), and the draw length of the archer, when the bow is at full draw, the string angle can vary from approximately 35 degrees to 55 degrees as measured from the horizontal Line-of-Sight (LOS) to the target. Rear peep sights specifically have fixed mechanical features or grooves on opposite sides of the outer diameter of the housing that mount and align the housing to the bow string. As a result, the peep sight is constrained from being able to accommodate all the string angles that are produced by the combination of the archer's draw length and the bow geometry.

[0004] The string mounting grooves of the peep are fixed in position and set the angular position of the peep housing relative to the bow string and the LOS to the target. Because peep housings are small in outside diameter (less than 0.75") there are a limited number of these alignment grooves that can be incorporated in the housing. Typically, a maximum of two string groove pairs (i.e., a total of 4 grooves) can be accommodated in the peep housing. Angle pairs are generally 52 degrees and 47 degrees, 47 degrees and 42 degrees, or 42 degrees and 37 degrees. If the string angle does not match these predetermined groove angles, then the peep aperture axis will not be co-aligned with the LOS to the target. This results in inaccuracies when co-aligning the front sight aperture with the peep sight's rear aperture with the LOS.

[0005] There remains a need to have the ability to optimize and personalize the angle of the peep aperture axis when the peep is mounted in the bow string in a fixed orientation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a perspective of an example bow system at rest and at full draw.

[0007] FIG. **2** is a perspective view of an example Line-Of-Sight (LOS) to the target.

[0008] FIG. **3** shows an example Line-of-Sight (LOS) to the target with co-aligned front sight and rear peep.

[0009] FIG. **4** is an isometric view of the example Line-of-Sight (LOS) to the target co-aligned with front sight and rear peep.

[0010] FIG. **5** is an example archer's perspective view of the Line-of-Sight (LOS) to the target with co-aligned front sight and rear peep.

[0011] FIG. **6** shows an example Line-of-Sight (LOS) to the target with co-aligned front sight and misaligned rear peep.

[0012] FIG. **7** shows an example archer's perspective view of the Line-of-Sight (LOS) to the target with co-aligned front sight and misaligned rear peep.

[0013] FIG. **8** shows an example of a conventional rear peep with fixed string groove pairs—single pair (L) and two pair (R).

[0014] FIG. **9** shows an example of a conventional rear peep with fixed string groove pairs installed in a bow string with the bow at full draw and Line-of-Sight (LOS) through the rear peep.

[0015] FIG. **10** shows an example of a conventional rear peep with fixed string groove pairs installed in a bow string with the bow at a full draw, with Line-Of-Sight (LOS) angle Alpha and Peep Aperture axis angle Beta equal and co-aligned.

[0016] FIG. **11** shows an example of a conventional rear peep axis not co-aligned with the Line-Of-Sight (LOS) with a difference angle Theta equal to +10 degrees (L) and −10 degrees (R).

[0017] FIG. **12** shows an example peep assembly with an adjustable inner aperture component.

[0018] FIG. **13** shows an example outer component of the peep assembly with fixed string grooves.

[0019] FIG. **14** shows an example inner aperture component of the peep assembly.

[0020] FIG. **15** shows an example peep assembly adjustment, with the inner component co-aligned (L), +10 degrees (C), and −10 degrees (L), with respect to the outer component.

[0021] FIG. **16** shows an example peep assembly adjustment in situ, with the inner component co-aligned with the Line-Of-Sight (LOS), and the outer component m is-aligned with the Line-Of-Sight (LOS) and the inner component axis.

[0022] FIG. **17** shows an exploded view of an example peep assembly with a two piece baffle element.

[0023] FIG. **18** shows an exploded view of an example peep assembly with a lateral locking/clamping mechanism and tool.

[0024] FIG. **19** shows an exploded view of an example peep assembly with an axial locking mechanism.

[0025] FIG. **20** is an exploded view showing an example cross section of a peep assembly with an axial locking mechanism.

[0026] FIG. **21** shows an isometric view of an example peep assembly with an axial locking mechanism and locking tool.

[0027] FIG. **22** are isometric views showing an example peep assembly with two-piece axial locking mechanism.

[0028] FIG. **23** are exploded views showing an example peep assembly with two-piece axial locking mechanism.

[0029] FIGS. **24**A-B show (A) an example peep assembly in situ with an independent alignment tool, and (B) an alignment tool coupled to the peep assembly.

[0030] FIG. **25** are component views showing an example inner body member.

[0031] FIG. **26** are component views showing an example rearward facing aperture insert.

[0032] FIG. **27** shows another example forward facing insert with optional light baffles and lens cavity (lens optional).

DETAILED DESCRIPTION

[0033] A peep sight assembly device is disclosed. An example adjustable aperture axis peep sight device includes an outer ring having a first axis, and an inner body member having a second axis. The first axis of the outer ring forms a sight angle with the second axis of the inner body member. A first partially spherical surface is formed on the outer ring. A second partially spherical surface is formed on the inner body member. The first partially spherical surface movably mates with the second partially spherical surface. The sight angle is adjustable by moving the inner body member relative to the outer ring.

[0034] Another example adjustable aperture axis peep sight device includes an outer ring having a first partially spherical surface, and an inner body member having a second partially spherical surface. The first partially spherical surface mates with the second partially spherical surface. The inner body member moves relative to the outer ring. The example adjustable aperture axis peep sight device may also include a forward facing (toward the target) insert assembly having a lens cavity and rearward facing (toward the archery) inserts to set the peep aperture size. The forward facing insert assembly is insertable into a front portion of the inner body member. A rearward facing aperture is insertable into the rearward portion of the inner body. A leveling device may be provided on or in the inner body member to assess a position of the second axis of the inner body member relative to a line-of-sight axis to a target where the angle between the second axis of the inner body member and the line-of-sight axis to the target is near zero.

[0035] Another example adjustable aperture axis peep sight device includes an outer body member having first mounting means, and an inner body member having a second mounting means. The first mounting means movably mates with the second mounting means. The inner body member moves relative to the outer body member. The outer body member compresses the inner body member through a clamping force applied by a fastener that reduces a diameter of the outer body member, fixing the inner body member relative to the outer ring. In an example, the inner body member is adjusted independent of the outer body member over an angular range phi **34** ($\angle\phi$) of approximately +/−10 degrees when the clamping force is not applied.

[0036] In an example, the outer body member is secured to the bowstring at a fixed angular position, generally at 45 degrees. The inner body member independently pivots relative to the outer body member when the inner and outer body members are coupled. Adjusting the inner body member adapts the angular relation between the aperture axis of the inner body member to the line-of-sight to the target independent of the outer body member being fixed to the string at an angle when at full draw.

[0037] Before continuing, it is noted that as used herein, the terms "includes" and "including" mean, but is not limited to, "includes" or "including" and "includes at least" or "including at least." The term "based on" means "based on" and "based at least in part on."

[0038] It is also noted that the examples described herein are provided for purposes of illustration, and are not intended to be limiting. Other devices and/or device configurations may be utilized to carry out the operations described herein.

[0039] The operations shown and described herein are provided to illustrate example implementations. It is noted that the operations are not limited to the ordering shown. Still other operations may also be implemented.

[0040] FIG. **1** is a perspective of an example bow system **1** at rest and at full draw. FIG. **2** is a perspective view of an example Line-Of-Sight (LOS) **10** to the target **5**. When aiming a modern archery bow system **1**, the front sight aperture **11** and the conventional rear peep sight **20** and aperture **22** are used in conjunction for aligning the bow system **1** to the aiming line-of-sight (LOS) **10** to the target **5**.

[0041] FIG. **3** shows an example Line-of-Sight (LOS) **10** to the target **5** with co-aligned front sight **11** and rear peep **20**. FIG. **4** is an isometric view of the example Line-of-Sight (LOS) **10** to the target **5** co-aligned with front sight and rear peep. FIG. **5** is an example archer's perspective view of the Line-of-Sight (LOS) **10** to the target **5** with co-aligned front sight and rear peep where line-of-sight axis **10** to the target and the peep axis **24** is near zero. FIG. **6** shows an example Line-of-Sight (LOS) **10** to the target **5** with co-aligned with the front sight axis **15** and misaligned rear peep axis **24**.

[0042] FIG. **7** shows an example archer's perspective view of the Line-of-Sight (LOS) **10** to the target **5** with co-aligned front sight **13** and misaligned rear peep **20** and peep inner aperture **22**. The most accurate orientation of these two aiming components are when these are coaxially aligned with the LOS **10** to the target **5** (FIG. **3**). In this orientation, the archer sees concentric circles (FIG. **5**) resulting in the archer effectively looking through one circular aperture. If either of the aiming apertures **13** and **22** are not co-aligned, the archers will instead see an oval shape, indicating a co-alignment error (i.e., non-concentric rings, FIG. **7**).

[0043] The front aiming housing **11** with aperture **13** is attached to a front sight **19** which has multiple adjustments to co-align the front sight aperture axis **15** with the LOS **10** to the target **5** (FIG. **1**). The rear peep sight **20** is mechanically attached to the string **7** of the bow **3** in a fixed orientation. The angle **30** ($\varphi\alpha$) of the bow string **7** (or "string angle") relative to the LOS **10** to the target **5**, varies depending on the vertical length of the bow **3** and how far the archer can draw the bow back (e.g., the draw length at full draw).

[0044] FIG. **8** shows an example of a conventional rear peep with fixed string groove pairs—single pair **26** and **27** (L) and two pair **26'** and **27'** (R). FIG. **9** shows an example of a conventional rear peep with fixed string groove pairs installed in a bow string **7** with the bow at full draw and Line-of-Sight (LOS) **10** through the rear peep where the angle Alpha **30** represents the fixed angle between the two. When the angle Alpha **30** equals the string groove angles pairs **26**, **27** or **26'**, **27'** the error between the peep axis **24** and the line of sight **10** is zero. FIG. **10** shows an example of a conventional rear peep with fixed string groove pairs installed in a bow string with the bow at a full draw, with Line-Of-Sight (LOS) **10** angle Alpha and Peep Aperture axis angle Beta equal and co-aligned. FIG. **11** shows an example of a conventional rear peep axis not co-aligned with the Line-Of-Sight (LOS) **10** with a difference angle Theta equal to +10 degrees (L) and −10 degrees (R).

[0045] Existing rear peep sights **20** have a limited number of orientations as a result of the fixed string grooves **26** and **27** and **26'** and **27'** mounting feature (FIG. **8**). Unless the string angle Phi **30** is equal to the mounting groove angle **32** (∠β), there will always exist a co-alignment angular error ∠θ between the LOS **10** to the target **5** and the rear peep **20** aperture axis **24** when sighting and aiming a bow system **1** (FIGS. **6** and **11**). The co-alignment angle error φθ ranges between about +10 degrees and about −10 degrees (FIG. **11**). The invention disclosed herein provides the capability to adjust the inner body member aperture axis **63** to be collinear with the axis of the LOS **10** to the target **5**, independent of the aperture axis **53** of the outer components, as it is fixed to the string angle (∠α≠∠β where ∠θ≈+/−10 degrees).

[0046] FIG. **12** shows an example peep assembly **40** with an adjustable inner body member aperture component **60**. FIG. **13** shows an example peep assembly **40** with an outer component ring **50** having fixed string grooves **51** and **52**. FIG. **14** shows an example inner aperture component **60** of the peep assembly **40**.

[0047] In an example, the adjustable aperture axis peep sight device **40** includes an outer component (or "outer ring" or "outer sub-assembly") **50** having a first axis **53**, and an inner aperture component (or "inner body member," "inner sub-assembly," or "inner peep component") **60** having a second axis **63**. The first axis of the outer ring **50** forms a sight angle (FIG. **15**) with the second axis of the inner body member **60**. A first partially spherical surface is formed on the outer ring **50**. A second partially spherical surface is formed on the inner body member **60**. The first partially spherical surface movably mates with the second partially spherical surface. The sight angle is adjustable by moving the inner body member **60** relative to the outer ring **50**.

[0048] In an example, the inner body member is substantially cylindrical. In an example, the first partially spherical surface is concave and the second partially spherical surface is convex. In another example, the first partially spherical surface is convex and the second partially spherical surface is concave.

[0049] In an example, the ring is split, and further comprising a connector **56** to join two ends of the outer ring **50** together and compress and lock the inner body member **60** position relative to the outer ring **50**.

[0050] In an example, the outer ring **50** further comprises mounting channels opposite each other that non-negotiably couple the ring to a bow string **7**. For example a circumferential mounting channel is shown formed in the outer ring **50** to receive a separate securing cord looped around a circumference of the outer ring for connecting to a bow string **7**. Two radial grooves **59*a*** and **59*b*** join into one groove at an opposite side of the outer ring **50** and a lateral securement **56** to provide access to a clamping mechanism **56** with a tool **105** (FIG. **18**).

[0051] In an example, a rear opening of the inner body member **60** receives a rear aperture **70**. A forward opening of the inner body member **60** receives a front light baffle. The front light baffle may include an optional user selectable optical lens. Wherein the inner body member is usable without either front or rear inserts.

[0052] In an example, at least one leveling device **200** (FIG. **24**) is attached to the inner body member **60** to assess a position of the second axis of the inner body member **60** relative to an axis of a line-of-sight to the target **5**.

[0053] FIG. **15** shows an example peep assembly adjustment, with the inner component co-aligned (L), +10 degrees (C), and −10 degrees (L), with respect to the outer component **50**. FIG. **16** shows an example peep assembly adjustment in situ, with the inner aperture component **60** co-aligned with the Line-Of-Sight (LOS) **10**, and the outer component **50** mis-aligned with the Line-Of-Sight (LOS) **10** when attached to bow string **7** and the axis of the inner aperture component **60**. FIG. **17** shows an exploded view of the example peep assembly **40** with a two piece baffle element.

[0054] In an example, the inner aperture component **60** is adjusted independent of the outer component **50** across the sight angle having an angular range phi **34** (∠ϕ) of approximately +/−10 degrees. The independent adjustment co-axially aligns the second axis **63** of the inner aperture component **60** to a line-of-sight axis **10** to a target **5** resulting in an angle error theta greater than zero between the first axis **53** and the second axis **63**.

[0055] During operation, the inner aperture component **60** is adjustable relative to the outer component **50**. The outer component **50** is generally a circular shaped aperture device that mounts into the bow string **7** via a pair of complementary grooves **51** and **52** or **51*a*** and **51*b*** integral to the outer surface of the outer component **50** at a fixed orientation relative (approximately 45 degrees) to the aperture axis **53** and string angle alpha when the bow is at full draw. The outer component **50** has a front and aft end. Between the forward end and aft end is a spherical surface **54** that can be either concave or convex. The outer component has a relief slot **55** that allows for the diameter of the outer component **50** to increase when an inner aperture component **60** with a complementary spherical feature **64** is inserted and decreased when the clamping force is applied

[0056] In an example, the outer component **50** has a clamping mechanism (e.g., mechanism **56**) that reduces the diameter through mechanical force, such that its spherical shape **54** interferes with the complementary spherical shape **64** of the inner aperture component **60**, to couple the components **50** and **60** relative to each other as assessed and set by the archer. Furthermore, the outer component **50** may have additional feature(s) **57** that limit the relative movement in the horizontal plane of the inner aperture component **60** when feature **67** and feature **57** are coplanar (FIGS. **13** and **14**). Furthermore the outer component **50** has feature(s) **58** on the front and aft ends to allow for the inner aperture component **60** to pivot without interference between the components **50** and **60**.

[0057] FIG. **18** shows a view of an example peep assembly with a lateral locking/clamping mechanism and tool. A radial two-groove feature **59*a*** and **59*b*** receives a separate securing cord to be looped around the circumference of the outer component **50** to secure the outer component **50** to the string **7**. In one embodiment, the two-grooves join to form a single groove at the opposite side of the outer component **50** at the lateral securing feature **56** to allow access to the clamping mechanism **56** with tool **105** (FIG. **18**). In another embodiment (FIG. **19**), the string grooves **59*a*** and **59*b*** are two separate groves.

[0058] FIG. **19** shows an exploded view of the example peep assembly with an axial locking mechanism. FIG. **20** is an exploded view showing an example cross section of a peep assembly with an axial locking mechanism. FIG. **21**

shows an isometric view of the example peep assembly with an axial locking mechanism and locking tool.

[0059] In another example of a locking mechanism (FIGS. **20** and **21**), the spherical shape **63** of the inner aperture component **60** is compressed with a threaded locking ring **100** that is applied in alignment of the axis **53** of the outer component **50**. The locking mechanism **100** is threaded in and tightened with a tool **110**, thus compressing complementary surfaces **54**, **64** and **104**. The result is the inner body member **60** is fixed relative to the outer ring **50**.

[0060] FIG. **22** are isometric views showing an example peep assembly with two-piece axial locking mechanism. FIG. **23** are exploded views showing an example peep assembly with an example two-piece axial locking mechanism.

[0061] In an example of an axial locking mechanism (FIGS. **22** and **23**), the outer component **50** has a cavity **158** that receives multiple locking elements **152***a* and **152***b* with spherical features **154**. When coupled to body **150** with fasteners **156***a* and **156***b*, the inner aperture component **60** spherical feature **64** camps between surfaces **154** and **54** where these spherical surfaces encompass the spherical feature **64** of inner aperture component **60**. When the clamping force applied by fasteners **156***a* and **156***b* is not applied, the inner aperture component **60** can pivot relative to the outer component **50**. When the axial locking or clamping force is applied by fasteners **156***a* and **156***b* through elements **152***a* and **152***b*, the inner aperture component **60** and outer component **50** are positioned relative to each other to accommodate the angle error theta (LO).

[0062] The inner aperture component **60** of the peep assembly with associated axis **63** can be adjusted independent of the outer component **50** with aperture axis **53** across an angular range phi **34** ($\angle\phi$) of approximately +/−10 degrees (FIG. **15**). This independent degree of adjustment allows the aperture axis **63** of the inner aperture component **60** to be co-axially aligned to the LOS **10** to the target **5** independent of the outer component **50** being non-negotiably coupled to the bow string **7**. This independent adjustment enables the peep assembly **40** to be optimized to compensate for the co-aligned angle error theta ($\angle\theta$), which is dependent on the bow **3** length and the archer's draw length.

[0063] In an example, the inner aperture component **60** has a cylindrical or barrel shape with an outer spherical mating surface **64** (convex or concave). When mated to the inner surface **54** of the outer component **50** with a complementing spherical shape, this shape enables the axis **63** of inner aperture component **60** to pivot in a plane that intersects the surface of the target **5**, and is parallel to the limiting feature **67**. The inner aperture component **60** has an innermost mechanical reference **65** that serves as a dimensional reference for locating additional element(s) of the rear aperture insert **70**, optional optical element **80** and baffle assembly **90** along axis **63** where the mechanical reference has conical or spherical shaped feature(s) **67***a* and **67***b* where the base meets the inner circumference of the inner diameter of the inner aperture component **60**.

[0064] The barrel shape of the inner aperture component **60** has features (e.g., inner and outer threads **61** and **62**) for accommodating additional element(s). Example element(s) include but are not limited to, light baffles **90** of a one-piece or multiple piece design, an optional optic **80** (where the optic can be powered, unpowered, clear or colored, single or multiple), and various sized insertable apertures **70**.

[0065] These elements, when combined, make up the peep assembly **40** that includes outer component **50** and inner aperture component **60**. The outer component is coupled to the bow string **7**, and the inner aperture component **60** pivots relative to the outer component **50**.

[0066] In an example, the inner aperture component **60** co-axial alignment to the LOS **10** is critically set at full draw (FIG. **22**). To set the angular position of the inner aperture component **60**, a bubble vial **200** (single or dual axis) or other level device may be coupled to the inner aperture component **60**, where the axis **204** of the bubble vial **200** is collinear with the axis **63** of inner aperture component **60**. The archer can adjust the inner aperture component **60** such that the bubble vial is level, representing the LOS **10** to the target. The outer component **50** with mechanism **56** can then be coupled to the inner aperture component **60** to set the relative angle phi **34** ($\angle\phi$).

[0067] In an example, the forward facing insert **70** with complementary threaded features may couple to the threaded feature **62** of the inner aperture component **60**. The aperture has light baffles **74** that are larger than the smallest diameter **72** (e.g., the sighting aperture). A tool feature **76** enables a tool (not shown) to be inserted into the aperture to install it into the inner aperture component **60**. Additionally, the insert **70** may also include a cavity **78** with optional threads (not shown) for an optical lens or lenses **80**. The forward facing insert may also have external feature(s) (e.g., knurling, not shown) to allow for threaded insertion by the archer without the aid of an additional tool. The insert **70** can be of one piece or multiple that seats against the innermost mechanical reference **65** of the inner aperture component **60**. The light baffles **74** may be separate from the insert and may not be included as part of the insert **70**.

[0068] In an example, the rearward facing aperture insert **90** has a complementary threaded feature to couple to the threaded feature **61** of the inner aperture component **60**. The light baffles **94** eliminate off-axis stray light. The light baffle can be of one piece or multiple, and includes a final aperture **92** to optimize the sight picture for co-aligning the inner body member axis **63** with the line of sight **10**. Final aperture **92** may include a cavity (not shown) for an optional optic or lens **80** that seats against the innermost mechanical reference **65** of inner aperture component **60**. The rearward facing aperture insert may include feature(s) to receive a tool (not shown) or have a feature that is greater than or equal to the minimum outer diameter of the inner body member (not shown) to aid in the threaded insertion of the insert **90** into the inner body member **60**.

[0069] FIG. **24** show an example peep assembly **200** in situ with an independent alignment tool **202** (L), and the alignment tool **202** coupled to the peep assembly **200** (R). FIG. **25** are component views showing an example inner body member **60**. FIG. **26** are component views showing an example of rearward facing aperture insert **90** where the smallest aperture opening **92** ranges from 0.032" to 0.3125" in diameter and each unique aperture opening is embodied in a separate rearward facing aperture insert **90**. Baffles features **94** are options; being integral (unitary) to the aperture **90** or as a separate component (not shown). Enabling features to aid in the installation of the rearward facing aperture insert **90** into the inner body member **60** include (but not limited to) a geometric shape (e.g. hexagon, star, circle, etc.) **96**. As shown, the geometric shape **96** is internal to the rearward facing aperture **90** where the diameter is less than the minimum diameter of the inner body member, or can be embodied as a diameter feature which is larger than or equal to the minimum diameter of the outer surface of the inner body member **60**.

[0070] FIG. **27** shows an embodiment of the forward facing insert **70**. The insert consists of the smallest diameter **72** defining the optical lens cavity **78** with optional optical element **80**. The optical element interfaces interface member **65** of the inner body member **60**. Baffle elements **74** are forward of the smallest diameter **72** with mounting features (e.g. external threads). Enabling geometric features **76** for installing the insert in the inner body member **60** with mating tool (e.g. hexagon wrench) not shown. It is noted that the examples shown and described are provided for purposes of illustration and are not intended to be limiting. Still other examples are also contemplated.

1. An adjustable aperture axis peep sight device, comprising:
- an outer ring having a first axis;
- an inner body member having a second axis, the first axis of the outer ring forms a offset angle with the second axis of the inner body member;
- a first partially spherical surface formed on the outer ring; and
- a second partially spherical surface formed on the inner body member, the first partially spherical surface movably mating with the second partially spherical surface;
- wherein the offset angle is adjustable by moving the inner body member relative to the outer ring.

2. The adjustable aperture axis peep sight device of claim **1**, wherein the inner body member is adjusted independent of the outer ring across the sight angle having an offset angular range phi ($\angle\phi$) of approximately +/−10 degrees.

3. The adjustable aperture axis peep sight device of claim **2**, wherein the independent adjustment co-axially aligns the second axis of the inner body member to a line-of-sight axis to a target resulting in an offset angle error theta greater than zero between the outer ring axis and the inner body member axis.

4. The adjustable aperture axis peep sight device of claim **1**, wherein the inner body member is substantially cylindrical.

5. The adjustable aperture axis peep sight device of claim **1**, wherein the first partially spherical surface is concave and the second partially spherical surface is convex.

6. The adjustable aperture axis peep sight device of claim **1**, wherein the first partially spherical surface is convex and the second partially spherical surface is concave.

7. The adjustable aperture axis peep sight device of claim **1**, wherein the ring is split, and further comprising a connector to join two ends of the outer ring together and compress and lock the inner body member position relative to the outer ring.

8. The adjustable aperture axis peep sight device of claim **1**, wherein the outer ring further comprises mounting channels opposite each other that non-negotiably couple the ring to a bow string.

9. The adjustable aperture axis peep sight device of claim **1**, further comprising a circumferential mounting channel formed in the outer ring to receive a separate securing cord looped around a circumference of the outer ring for connecting to a bow string.

10. The adjustable aperture axis peep sight device of claim **9**, further comprising two radial grooves that join into one groove at an opposite side of the outer ring and a lateral securement to provide access to a clamping mechanism with a tool.

11. The adjustable aperture axis peep sight device of claim **1**, wherein a rear opening of the inner body member receives a rear aperture.

12. The adjustable aperture axis peep sight device of claim **1**, wherein a forward opening of the inner body member receives a forward facing light baffle.

13. The adjustable aperture axis peep sight device of claim **12**, wherein the front light baffle further comprises a user selectable optical lens.

14. The adjustable aperture axis peep sight device of claim **1**, further comprising at least one leveling device attached to the inner body member to assess a position of the inner body member's axis relative to the line of sight to the target.

15. An adjustable aperture axis peep sight device, comprising:
- an outer ring having a first partially spherical surface; and
- an inner body member having a second partially spherical surface;
- wherein the first partially spherical surface mates with the second partially spherical surface;
- wherein the inner body member moves relative to the outer ring.

16. The adjustable aperture axis peep sight device of claim **15**, further comprising an insert assembly having a lens cavity.

17. The adjustable aperture axis peep sight device of claim **16**, wherein the insert assembly is insertable into a front portion of the inner body member.

18. The adjustable aperture axis peep sight device of claim **16**, further comprising an assessment device of the inner body member to assess a position of the second axis of the inner body member relative to a line-of-sight axis to a target where the angle between the second axis of the inner body member and the line-of-sight axis to the target is near zero.

19. An adjustable aperture axis peep sight device, comprising:
- an outer body member having first mounting means; and
- an inner body member having a second mounting means;
- wherein the first mounting means movably mates with the second mounting means;
- wherein the inner body member moves relative to the outer body member;
- wherein the outer body member compresses the inner body member through a clamping force applied by a fastener that reduces a diameter of the outer body member.

20. The adjustable aperture axis peep sight device of claim **19**, wherein the inner body member is adjusted independent of the outer body member over an angular range phi ($\angle\phi$) of approximately +/−10 degrees.

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