(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 December 2012 (13.12.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/170425 A1

(51) International Patent Classification:
A61B 17/17 (2006.01)

(21) International Application Number:
PCT/US2012/040913

(22) International Filing Date:
5 June 2012 (05.06.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/493,649 6 June 2011 (06.06.2011) US
13/289,659 4 November 2011 (04.11.2011) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

— *with international search report (Art. 21(3))*

WO 2012/170425 A1

(54) **Title**: DRILL GUIDE FOR SHOULDER

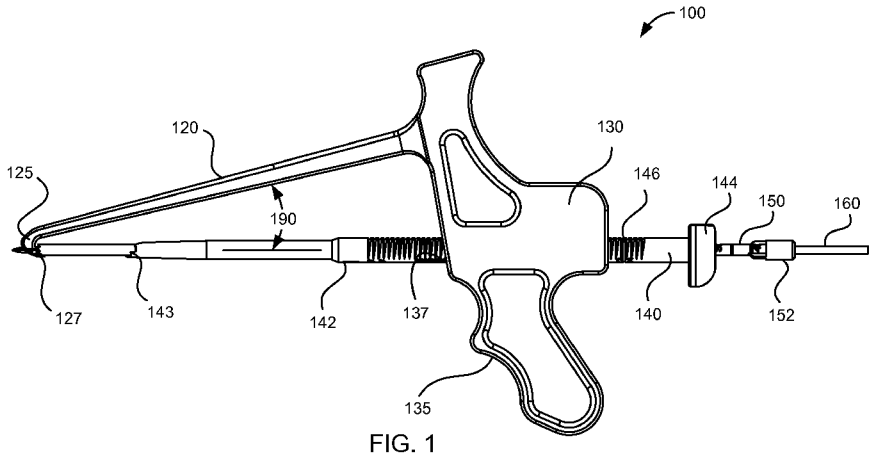


FIG. 1

(57) **Abstract**: In an embodiment, drill guide for drilling bony matter may include a handle assembly and an aimer arm. The handle assembly may include one or more sleeve channels to accommodate one or more drill sleeves for one or more drills that may be used to drill the bony matter. The aimer arm may be used to position the drill guide on the bony matter. The aimer arm may contain a hook for hooking the drill guide on and/or into the bony matter. The aimer arm may be positioned on the handle assembly at an angle between, for example, five and sixteen degrees relative to a position of a drill sleeve inserted in the sleeve channel.

APPARATUS FOR DRILLING BONE

RELATED APPLICATIONS

[0001] This patent application claims the benefit of U.S. Provisional Patent Application No. 61/493,649, titled "Guide To Allow Drilling Across The Glenoid", which was filed on June 6, 2011. This patent application is also a continuation-in-part of U.S. Patent Application No. 13/289,659, titled "Drill Guide With Depth Stop", which was filed on November 4, 2011. The contents of above-identified applications are incorporated by reference as though fully set forth herein.

BACKGROUND

[0002] Shoulder instability may be caused from congenital deformity, recurrent overuse activity, and/or traumatic dislocation. Surgical stabilization of a glenohumeral joint in the shoulder may be necessary after conservative treatment fails and recurrent instability/subluxation continues. For example, a recurrent instability/subluxation may be caused in part by significant bony deficiency of a surface area of a glenoid (e.g., greater than 20% of the glenoid's surface area is missing), which may be part of the glenohumeral joint.

[0003] When bony lesions reach critical dimensions, reconstruction of this deficit using autograft bone may be performed. The Bristow-Latarjet (hereinafter "Latarjet") procedure is a popular procedure used to reconstruct bony deficits of the glenoid. The procedure typically involves transferring a distal coracoid into the bony defect.

[0004] Specifically, a deltopectoral approach may be used to expose the coracoid process. The corcoacromial ligament and the pectoralis minor attachment may be divided,

whereas coracobrachialis and the short head of the biceps origins may remain intact. The coracoid may be osteotomized at its' "knee" yielding bony graft approximately 1.5 centimeters (cm) in length.

[0005] With the arm in external rotation, the subscapularis muscle may be either split along its length or detached from the lesser tuberosity and the joint is exposed. The graft may be shaped and contoured to fill the defect and may be secured with screw fixation placed at the antero-inferior glenoid. With the corachobracialis and biceps still attached to the coracoid, they may now serve as a dynamic sling further stabilizing the glenohumeral joint. The subscapularis split is then repaired.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate one or more embodiments described herein and, together with the description, explain these embodiments. In the drawings:

[0007] FIG. 1 illustrates a side view of an example embodiment of a single-sleeved drill guide;

[0008] FIG. 2 illustrates a front view of the drill guide illustrated in FIG. 1;

[0009] FIG. 3 illustrates a cut-away side view of the drill guide illustrated in FIG. 1;

[0010] FIG. 4 illustrates a top view of the drill guide illustrated in FIG. 1;

[0011] FIG. 5 illustrates an example use of the drill guide illustrated in FIG. 1;

[0012] FIG. 6 illustrates a cut-away side view of an example embodiment of a multi-sleeved drill guide; and

[0013] FIG. 7 illustrates a top view of the drill guide illustrated in FIG. 6.

DETAILED DESCRIPTION

[0014] The Latarjet procedure may be performed open or arthroscopically. The glenoid bone graft may be fixed with one or two fasteners (e.g., screws, double-buttons). The fasteners may be a source of complications, thus, great care may need to be taken to ensure an orientation and length of the fasteners does not result in anterior or posterior soft-tissue impingement and/or penetration of the glenoid articular surface (e.g., impingement between the humeral head and the fasteners).

[0015] Moreover, the Latarjet procedure is an anterior procedure in that access is gained to the glenoid from the front side of the patient. Because it is anterior, in order to gain access to the glenoid, the subscapularis may need to be split. Thus, the procedure may be somewhat invasive and may carry with it certain risks, such as nerve damage.

[0016] Securing a graft to the glenoid may involve drilling a hole in the glenoid. A drill guide and wire may be used to determine an offset for the hole, however, an angle of the drill relative to the glenoid may have to be estimated by a surgeon performing the drilling. Also, in some instances two holes may be required to secure the graft, thus, a second guide and wire and/or further estimation by the surgeon may be necessary.

[0017] One or more embodiments described herein provide for an apparatus (e.g., an instrument) that may be used to drill one or more holes in bony matter (e.g., a glenoid). The bony matter may be drilled, for example, from a posterior end of the bony matter.

[0018] The apparatus may include a handle assembly and an aimer arm. The handle assembly may include a sleeve channel to accommodate a drill sleeve for a drill that is used to drill the bony matter. The aimer arm may contain a hook for hooking the apparatus on the bony

matter. The aimer arm may be positioned on the handle assembly at an angle relative to a position (e.g., axis) of a drill sleeve inserted in the sleeve channel. The angle may be, for example, between five and sixteen degrees. The angle may be fixed in the apparatus or the apparatus may contain provisions for adjusting the angle.

[0019] The aimer arm may be placed across the bony matter and used to position one or more drills to drill the bony matter at a predetermined angle. Moreover, the apparatus may include one or more drill sleeves and one or more drill guides that may be used to guide the one or more drills to the bony matter. Each drill sleeve may be, for example, adjusted to drill the bony matter at a predetermined depth using a drill. Advantageously, the apparatus may be used to drill one or more holes in bony matter at a known angle and distance thereby obviating reliance on estimation and/or guesswork.

[0020] The apparatus may allow an all-arthroscopic (mini-invasive) technique, which may preserve the posterior deltoid and rotator cuff muscles. In addition, the apparatus may provide accuracy in appropriate graft positioning (e.g., positioning the graft to be flush to the glenoid surface and below the equator). Further, the apparatus may allow a length of a fastener (e.g., a screw), that may be used to secure the graft, to be chosen accurately. This may obviate anterior or posterior soft-tissue impingement and/or penetration of the glenoid articular surface (e.g., impingement between the humeral head and the fastener's head).

[0021] The apparatus may further allow a direction of multiple fasteners, used to fasten the graft, to be oriented in a strictly parallel fashion. This may provide for consistent bone graft fixation and healing.

[0022] The apparatus may be anatomical and accommodate restoring glenoid bone stock without violation of articular cartilage by drills or fasteners. The humeral head may also be protected, as there the apparatus may obviate impingement by the fastener. Moreover, since the apparatus may be used to place the graft extra-articulary, the humeral head may be protected from a creation of uneven surfaces which may articulate with the humeral head.

[0023] In addition, the apparatus may be used in a posterior procedure. Thus, the apparatus may obviate risk of injury to, for example, vital anterior structures (brachial plexus) or the supra scapular nerve in the back of the scapula. The apparatus may be versatile in that it may be used with various fixation techniques, such as, for example, screw fixation or double-button fixation. Moreover, the apparatus may be used to drill a single hole or multiple holes for fixation.

[0024] FIG. 1 illustrates a side view of an example embodiment of a single-sleeved drill guide 100. Referring to FIG. 1, drill guide 100 may include an aimer arm 120 and a handle assembly 130.

[0025] The aimer arm 120 may include a proximal arm portion and distal arm portion. The proximal arm portion may extend distally from the handle assembly 130. The distal arm portion of the aimer arm 120 may include a distal tip 125 with a spiked hook 127. The distal tip 125 may make contact with bony matter (e.g., the glenoid) and the spiked hook 127 may hook on and/or into the bony matter. Note that in other embodiments the distal tip 125 may be pointed and/or may include a blunted end (e.g., the tip 125 may be spherical).

[0026] The handle assembly 130 may include a handle grip 135 (e.g., a pistol grip) and a sleeve channel 137. The sleeve channel 137 may be cylindrical and may receive a drill sleeve

140. The sleeve channel 137 and the drill sleeve 140 may be oriented horizontally relative to the handle assembly 130. The handle grip 135 may be positioned on the handle assembly 130 to enable the handle assembly 130 to be easily grasped (e.g., gripped) and accommodate manipulation of the drill guide 100, for example, during surgery.

[0027] The drill sleeve 140 may be sized for insertion through the sleeve channel 137. The drill sleeve 140 may include a body142, a distal tip 143, and a handle 144. The body 142 may include a rack 146 in the form of, for example, a series of ratchet teeth and/or radial grooves. The ratchet teeth and/or radial grooves may be along one side of the body 142.

[0028] The drill sleeve 140 may be bored to provide a passageway through the drill sleeve 140 for a drill (e.g., drill 160), a depth guide (e.g., depth guide 150) and/or a wire. The bore may be circular although other shapes, such as, for example, polygonal shapes (e.g., triangular, squared, rectangular, pentagonal, hexagonal, octagonal) may be used. The depth guide 150 may be used to guide a drill 160. The depth guide 150 may include a depth stop 152 that may be used to control a depth of drilling using the drill 160. The drill 160 may be used to drill into bony matter. Depth markings may be provided on an outer sleeve of the depth guide 150. It should be noted, however, depth markings may be provided elsewhere. For example, depth markings may be provided on a barrel of the drill sleeve 140. It should also be noted that the depth guide 150 and drill 160 may be a single unit.

[0029] The aimer arm 120 may be positioned at an angle 190 relative to, for example, the drill sleeve 140 and/or the drill 160 (e.g., relative to an axis of the drill sleeve 140 and/or the drill 160). An extent of the angle 190 may depend on the surface of the bony matter to be drilled. Generally, the angle 190 may fall between, for example, five and sixteen degrees.

[0030] The aimer arm 120 may be rigidly attached to the handle assembly 130 and the sleeve channel 137 may be a fixed bore through the handle assembly 130. Here, the angle 190 may be fixed (e.g., fixed at 12 degrees) and may not be adjustable. Alternatively, the handle assembly 130 may contain provisions to adjust the angle 190 such that the angle 190 falls somewhere within a predetermined range of degrees. Here, the handle assembly 130 may contain provisions to adjust, for example, the angle of the drill sleeve 140 in the sleeve channel 137 and/or the aimer arm 120 such that the angle 190 may fall within the predetermined range.

[0031] FIG. 2 illustrates a front view of the drill guide 100 showing the position of the aimer arm 120, the distal tip 125 of the aimer arm, drill sleeve handle 144, and handle grip 135 when the drill guide 100 is viewed head-on. Note that the aimer arm 120 may be slightly tapered with respect to the width of the handle assembly 130. Further, the handle grip 135 may be substantially the same width as the handle assembly 130.

[0032] The aimer arm 120 may be sized to fit an anatomy of a patient. For example, in the case of the Latarjet procedure the aimer arm 120 may be sized to pass between a humeral head and the glenoid of the patient. During the procedure, the patient may be in, for example, a "beach chair" position. The aimer arm 120 may pass between the patient's glenoid and humerous with the hook 127 inferior to the patient's arm (i.e., with a plane of the handle 144 running superior – inferior). This may be done to avoid damaging, for example, articular surfaces with the hook 127. The handle 144 may be rotated, for example, 90 degrees to a medial position allowing the hook 127 to engage the glenoid rim.

[0033] FIG. 3 illustrates a cut-away side view of the drill guide 100. Referring to FIG. 3, the handle assembly 130 may include a locking mechanism that may be used to hold the drill

sleeve 140 in place in the sleeve channel 137. The locking mechanism may include a cover 380, a spring 382, and a pawl 384. The pawl 384 may engage a rack 146 on the drill sleeve 140 to hold the drill sleeve 140 in place and to restrict linear motion of the drill sleeve 140. The spring 382 may provide a force on the pawl 384 to engage the pawl 384 with the rack 146 and hold the pawl 384 in the rack 146. Together, the rack 146 and pawl 384 may act as a ratchet mechanism that may provide for a one-way linear motion of the drill sleeve 140. The cover 380 may provide a cover for the spring 382 and pawl 384 assembly. The cover 380 may be threaded and screwed into handle assembly 130. Other embodiments of cover 380 may include, for example, snap fit covers.

[0034] It should be noted that the locking mechanism illustrated in FIG. 3 is an example of a locking mechanism that may be used with drill guide 100. Other locking mechanisms that may be used with drill guide 100 may include, for example, detent pins, ball locks, and/or other locking mechanisms.

[0035] FIG. 3 also illustrates a positioning of the drill sleeve 140 in the sleeve channel 137. As noted above, the sleeve channel 137 may include a bore through the handle assembly 130 that enables the drill sleeve 140 to pass freely though the handle assembly 130. Also shown in FIG. 3, is a position of the depth guide 150 in the drill sleeve 140 and the drill 160 in the depth guide 150. As illustrated, the drill sleeve 140 may contain a bore that may enable the depth guide 150 to freely pass through the drill sleeve 140. Moreover, the depth guide 150 may contain a bore that may enable the drill 160 to pass freely through the depth guide 150. The bore through the depth guide 150 may be circular to accommodate, for example, a rotary motion of the drill 160.

[0036] FIG. 4 illustrates a top view of the drill guide 100. FIG. 4 shows an example tapering of the aimer arm 120 with respect to the handle assembly 130. In addition, FIG. 4 shows an example positioning of the cover 380 and a top view positioning of the drill sleeve 140, the depth guide 150, and the drill 160.

[0037] FIG. 5 illustrates an example use of drill guide 100. Referring to FIG. 5, the drill guide 100 may be attached to a posterior aspect (edge) of a glenoid 530 which is part of a scapula 520. Specifically, the distal end of the aimer arm 120 may be positioned to hook the spiked hook 127 on the anterior aspect of the glenoid 530. The distal end of the aimer arm 120 may be positioned to rest on the glenoid 530. The distal end of the drill sleeve 140 may be slid through the sleeve channel 137 and positioned at the posterior aspect of the glenoid 530 below the aimer arm 120. The distal end of the drill sleeve 140 may contain teeth that may make contact with the glenoid 530. Moreover, the drill sleeve 140 may include a rack 146 and the handle assembly 130 may include a pawl 384 which may engage the rack 146 and limit horizontal movement of the drill sleeve 140 in the sleeve channel 137 after, for example, the distal end of the drill sleeve 140 is positioned at the posterior aspect of the glenoid 530. After the drill sleeve 140 is positioned, the depth guide 150 may be inserted through the drill sleeve 140. The drill 160 may be inserted in the depth guide 150. The drill 160 may then be used to drill the glenoid 530. Note that the drill 160 may drill the glenoid 530 at angle 190, which may represent an angle from the center of the drill to the aimer arm 120. Also note that the angle 190 may be predetermined (e.g., fixed), such as described above.

[0038] A drill guide may include multiple sleeves. The multiple sleeves may accommodate multiple drills that may be used to drill multiple holes in bony matter (e.g., the

glenoid). FIG. 6 illustrates an example of a multi-sleeved drill guide 600 that may include multiple drill sleeves 640 for drilling multiple holes in bony matter at a predetermined angle and distance from each other.

[0039] Referring to FIG. 6, the drill guide 600 may include an aimer arm 620 and a handle assembly 630. The aimer arm 620 may be rigidly attached to the handle assembly 630. The aimer arm 620 may include a proximal arm portion and distal arm portion. The proximal arm portion may extend distally from the handle assembly 630. The distal arm portion of the aimer arm 620 may include a distal tip 625 with a spiked hook 627. The distal tip 625 may make contact with bony matter 670 and the spiked hook 627 may hook on and/or into the bony matter 670. Note that in other embodiments the distal tip 625 may be pointed and/or may include a blunted end (e.g., the tip may be spherical).

[0040] The handle assembly 630 may include a handle grip 635 (e.g., a pistol grip) and multiple sleeve channels 637. A sleeve channel 637 may be a cylindrical bore through the handle assembly 630 and may receive a drill sleeve 640. The sleeve channels 637 and their respective drill sleeves 640 may be oriented horizontally relative to the handle assembly 630. Note that in other embodiments, the sleeve channels 637 may be oriented relative to the handle assembly 630 differently. For example, the sleeve channels 637 are oriented vertically relative to the handle assembly 630. The handle grip 635 may be positioned on the handle assembly 630 to enable the handle assembly 630 to be easily grasped and accommodate manipulation of the multiple drill sleeves 640, for example, during surgery.

[0041] A drill sleeve 640 may be sized for insertion through a sleeve channel 637. A drill sleeve 640 may include a body 642, a distal tip 643, and a handle 644. The body 642 may

include a rack 646 in the form of, for example, a series of ratchet teeth and/or radial grooves. The ratchet teeth and/or radial grooves may be along one side of the body 642.

[0042] A drill sleeve 640 may be bored to provide a passageway through the drill sleeve 640. The passageway may be used to accommodate, for example, a drill (e.g., drill 660), a depth guide (e.g., depth guide 650) and/or a wire. The bore may be circular although other shapes, such as, various polygonal shapes (e.g., square, rectangle, triangle), may be used. The depth guide 650 may be used to guide a drill 660. The depth guide 650 may include a depth stop that may be used to control a depth of drilling using the drill 660. The drill 660 may be used to drill into bony matter 670, such as, for example a glenoid.

[0043] The aimer arm 620 may be positioned at an angle 690 relative to, for example, a drill sleeve 640 and/or a drill 660 (e.g., relative to an axis of the drill sleeve 640 and/or the drill 660). An extent of the angle 690 may depend on the surface of the bony matter 670. Generally, the angle 690 may fall between, for example, five and sixteen degrees.

[0044] The angle 690 may be fixed (e.g., fixed at 12 degrees) and may not be adjustable. Alternatively, the handle assembly 630 may contain provisions to adjust the angle 690 such that the angle 690 falls somewhere within a range of degrees (e.g., between 5 and 16 degrees). For example, the handle assembly 630 may contain provisions to adjust the angle of the drill sleeve 640 in channel 637 and/or the aimer arm 620 such that angle 690 may fall within the range.

[0045] The handle assembly 630 may include one or more locking mechanisms that may be used to lock one or more drill sleeves 640 in place in their respective sleeve channels 637. A locking mechanism may include a cover 680, a spring 682, and a pawl 684. The pawl 684 may engage a rack 642 on a drill sleeve 640 to hold the drill sleeve 640 in place. Spring 682 may

provide a force to engage the pawl 684 with the rack and hold the pawl 684 in the rack 642. Cover 680 may provide a cover for the spring 682 and pawl 684 assembly. Note that separate covers 680, springs 682, and/or pawls 684 may be provided, for example, for each drill sleeve 640.

[0046] It should be noted that the locking mechanism illustrated in FIG. 6 is an example of a locking mechanism that may be used with the drill guide 600. Other locking mechanisms that may be used with the drill guide 600 may include, for example, detent pins, ball locks, and/or other locking mechanisms.

[0047] FIG. 7 illustrates a top view of the drill guide 600. Referring to FIG. 7, the drill guide 600 may include drill sleeves 640a-b. The drill sleeves 640a-b may pass through channels 637 (FIG. 6) in the handle assembly 630.

[0048] Hook 627 (FIG. 6) at the distal end of the aimer arm 620 may be hooked on to or in the bony matter 670. For example, the bony matter 670 may be a glenoid and the hook 627 may be hooked on to or in the anterior aspect of the glenoid. The aimer arm 620 may be positioned to rest across the bony matter 670. The distal ends of the drill sleeves 640a-b may be slid through channels 637 in the handle assembly 630. Separate channels 637 may be provided, for example, for each drill sleeve 640. The distal ends of the drill sleeves 640a-b may be positioned at an end of the bony matter 670 opposite the hook 627. For example, the bony matter 670 may be a glenoid, the hook 627 may be hooked to the anterior aspect of the glenoid, and the distal ends of the drill sleeves 640a-b may be positioned at the posterior aspect of the glenoid.

[0049] The distal ends of the drill sleeves 640a-b may contain teeth that may make contact with the bony matter 670. Moreover, the drill sleeve 640a-b may include racks 646a-b, respectively, and the handle assembly 630 may include pawls 684 (FIG. 6) which may engage the racks 646a-b and limit movement (e.g., linear movement) of the drill sleeves 640a-b in the channels 637. For example, the racks 646a-b and pawls 684 may act as ratchet mechanisms that may provide for a one-way linear motion of the drill sleeves 640a-b.

[0050] After the drill sleeves 640a-b are positioned, depth guides 650a-b may be inserted through drill sleeves 640a-b, respectively. The drills 660a-b may be inserted through depth guides 650a-b, respectively, and used to drill the bony matter 670. Note that, in this example, the drills 6560a-b may be used to drill two holes in the bony matter 670 at a predetermined angle and at a predetermined distance 692 between centers of the holes. It should be noted that distance 692 may be fixed in the drill guide 600 or the drill guide 600 may contain provisions for adjusting distance 692.

[0051] The foregoing description of embodiments is intended to provide illustration and description, but is not intended to be exhaustive or to limit the invention to the precise form disclosed. Modifications and variations are possible in light of the above teachings or may be acquired from practice of the invention.

[0052] No element, act, or instruction used herein should be construed as critical or essential to the invention unless explicitly described as such. Also, as used herein, the article "a" is intended to include one or more items. Where only one item is intended, the term "one" or similar language is used. Further, the phrase "based on" is intended to mean "based, at least in part, on" unless explicitly stated otherwise.

[0053] It is intended that the invention not be limited to the particular embodiments disclosed above, but that the invention will include any and all particular embodiments and equivalents falling within the scope of the following appended claims.

CLAIMS

What is claimed is:

1. An apparatus comprising:

a handle assembly, the handle assembly including a sleeve channel to accommodate a drill sleeve for a drill that is used to drill bony matter; and

an aimer arm for positioning the apparatus on the bony matter, the aimer arm containing a hook for hooking the apparatus on the bony matter, the aimer arm positioned on the handle assembly at an angle between five and sixteen degrees relative to a position of a drill sleeve inserted in the sleeve channel.

2. The apparatus of claim 1, further comprising:

a grip attached to the handle assembly, the grip allowing the apparatus to be gripped.

3. The apparatus of claim 1, further comprising:

a drill sleeve inserted in the sleeve channel, the drill sleeve including a bore for accommodating a drill, a depth guide, or a wire.

4. The apparatus of claim 3, further comprising:

a drill guide inserted in the drill sleeve, the depth guide including a bore for accommodating a drill for use in drilling the bony matter.

5. The apparatus of claim 4, further comprising:

a drill inserted in the depth guide, the drill for use in drilling a hole in the bony matter.

6. The apparatus of claim 3, further comprising:

a locking mechanism for locking the drill sleeve in place in the sleeve channel.

7. The apparatus of claim 6, wherein the drill sleeve includes a rack, and wherein the locking mechanism comprises:

a pawl that engages the rack.

8. The apparatus of claim 7, wherein the locking mechanism further comprises:

a spring that provides a force on the pawl to cause the pawl to engage the rack and hold the pawl in the rack.

9. An apparatus comprising:

a plurality of drill sleeves, a drill sleeve containing a bore for accommodating a drill for drilling bony matter;

a handle assembly, the handle assembly including a plurality of sleeve channels to accommodate the plurality of drill sleeves; and

an aimer arm for positioning the apparatus on the bony matter, the aimer arm containing a hook for hooking the apparatus on the bony matter, the aimer arm positioned on the handle assembly at an angle between five and sixteen degrees relative to a position of a drill sleeve inserted in a sleeve channel.

10. The apparatus of claim 9, wherein the apparatus contains provisions for adjusting the angle.

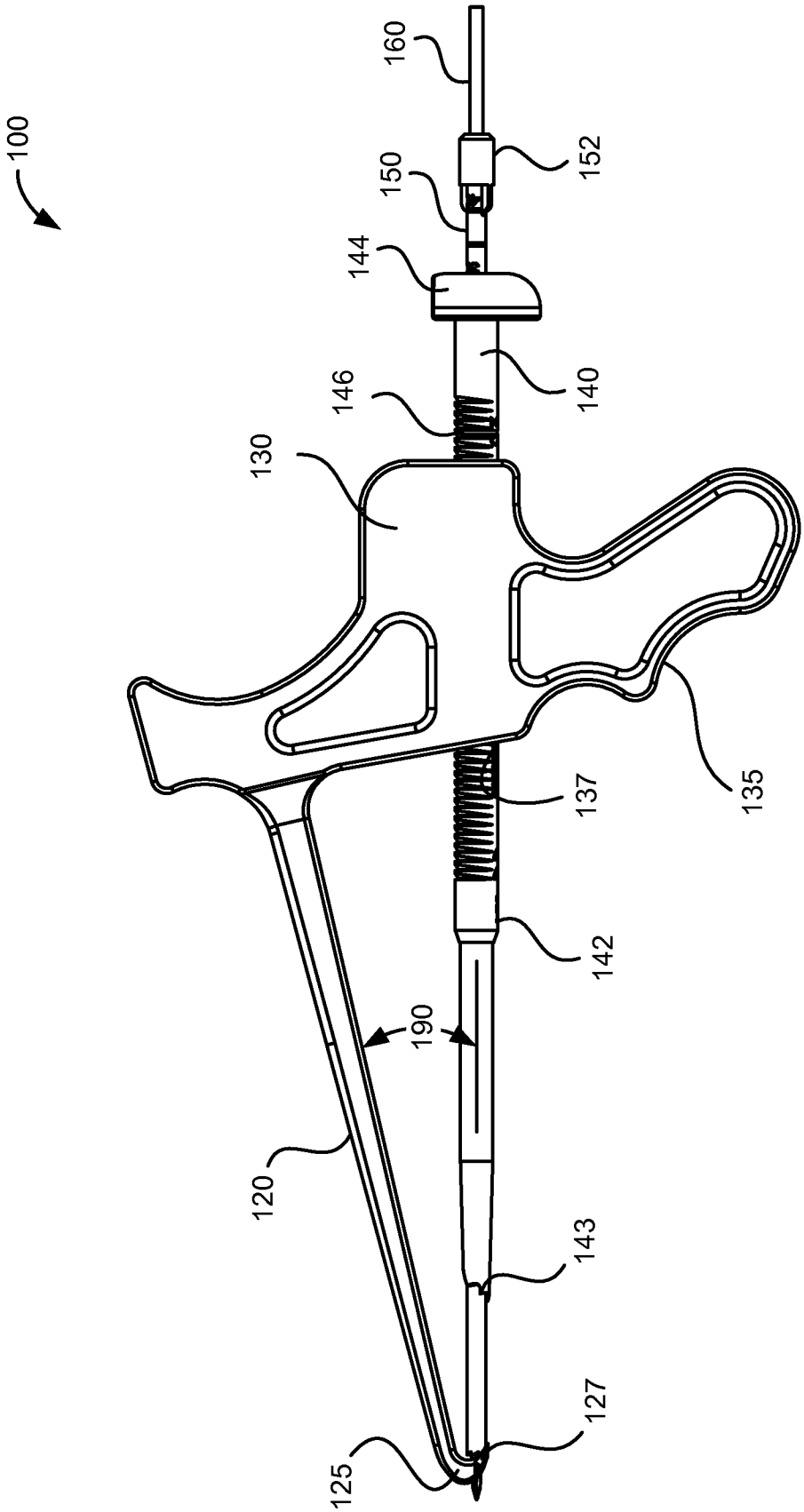


FIG. 1

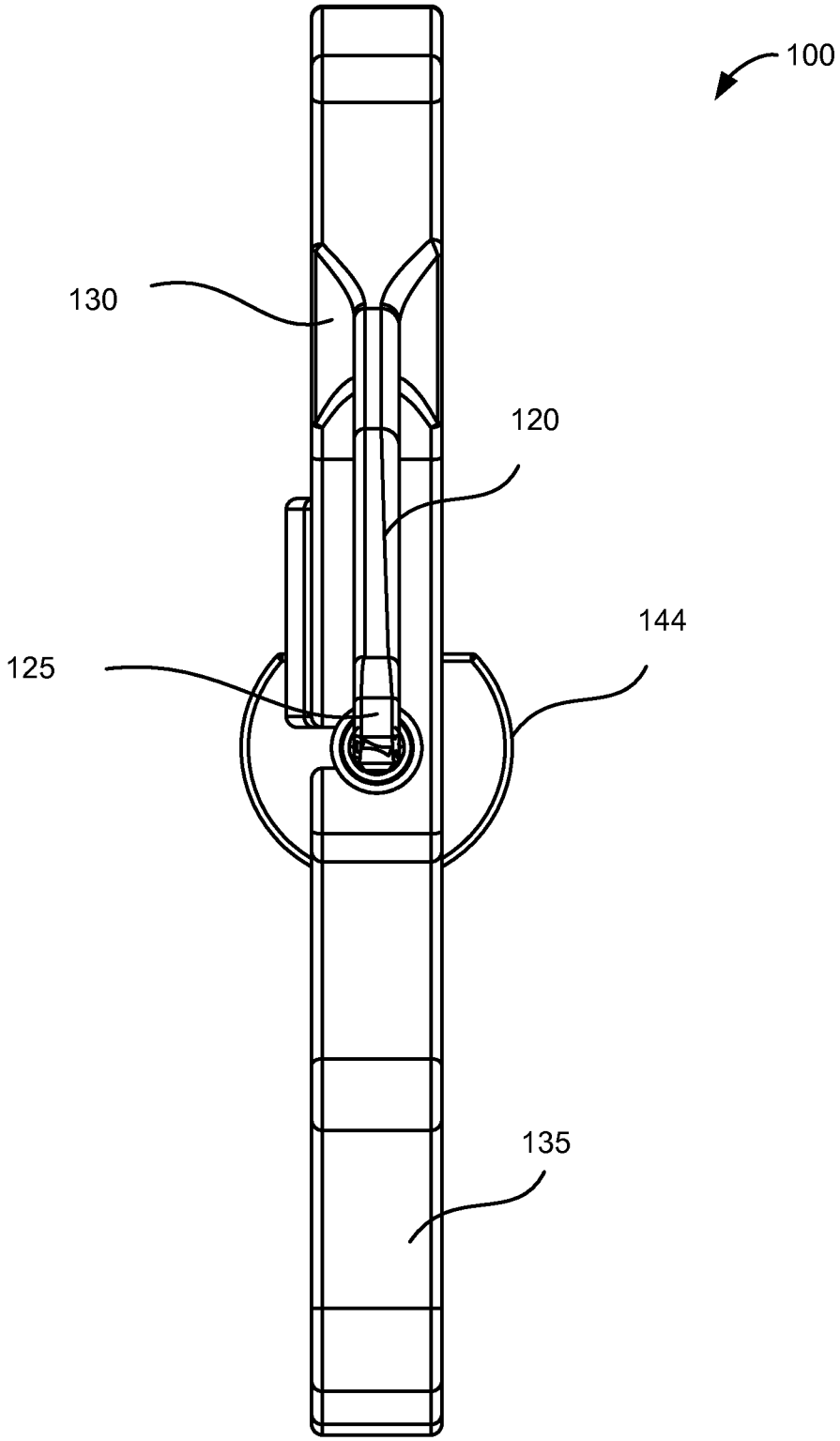


FIG. 2

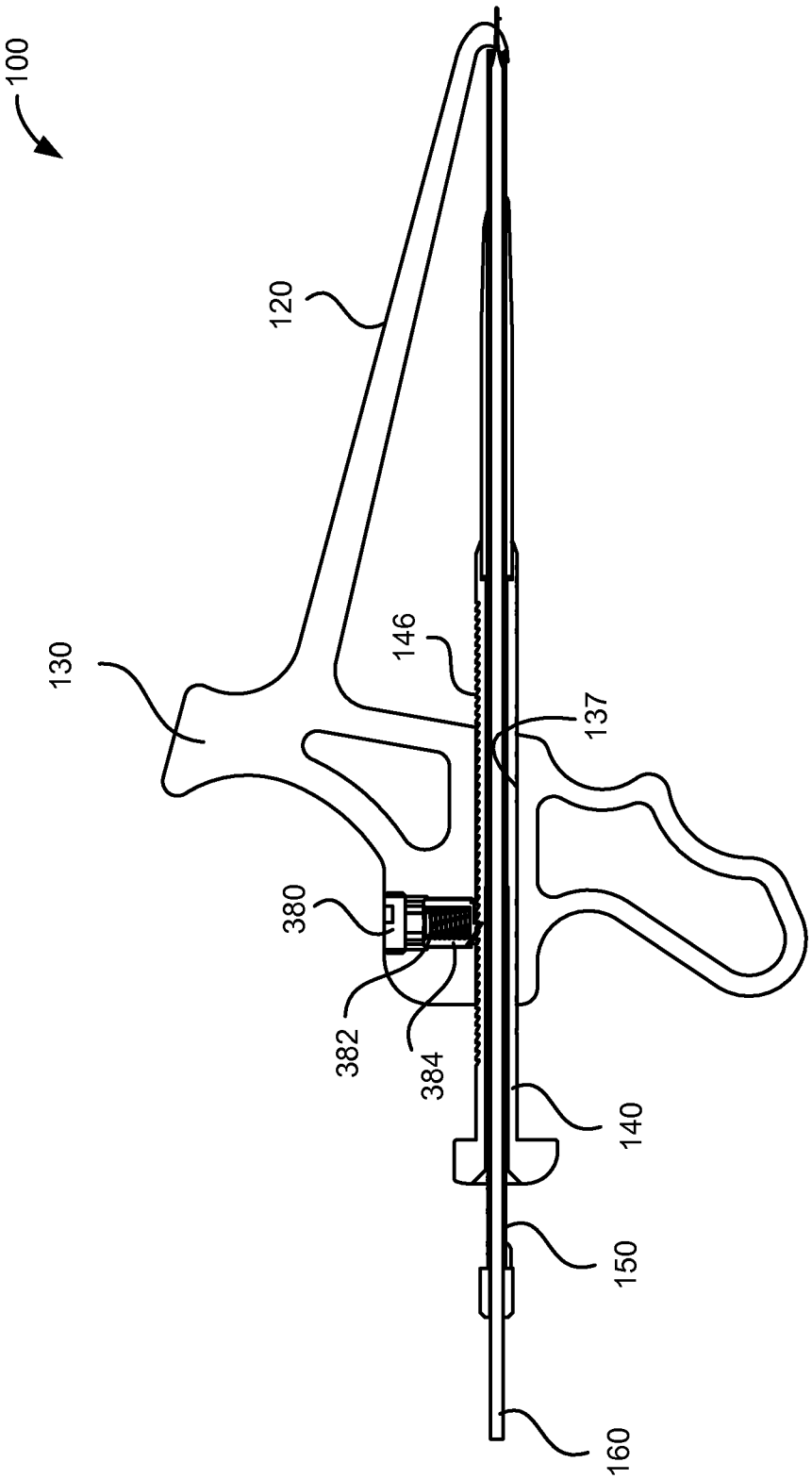


FIG. 3

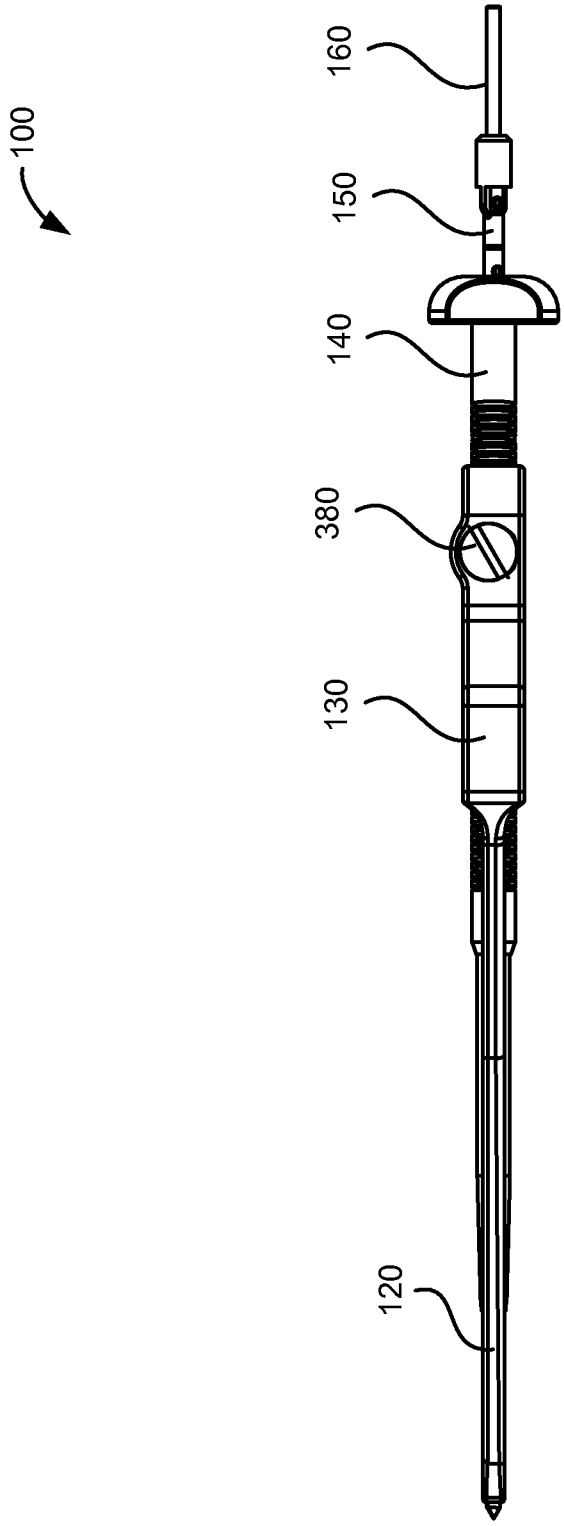


FIG. 4

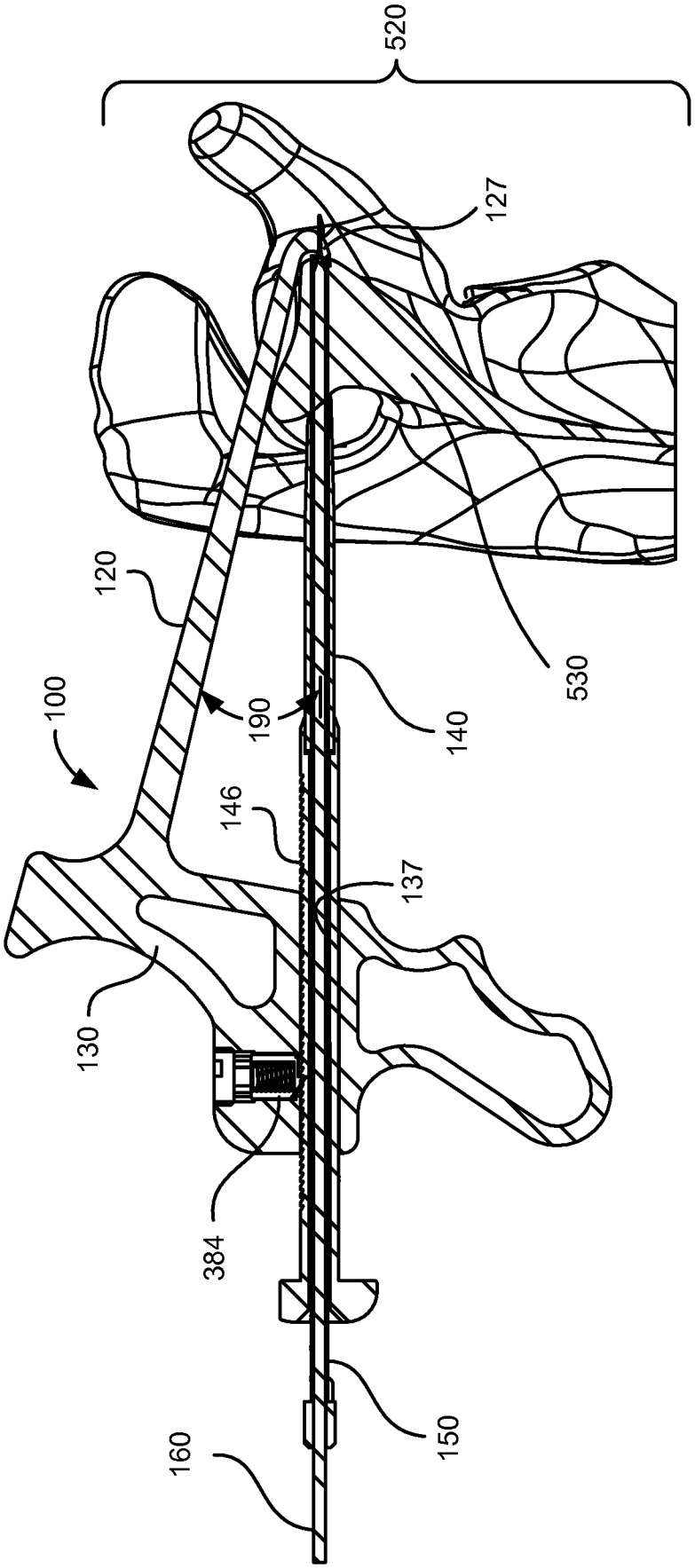


FIG. 5

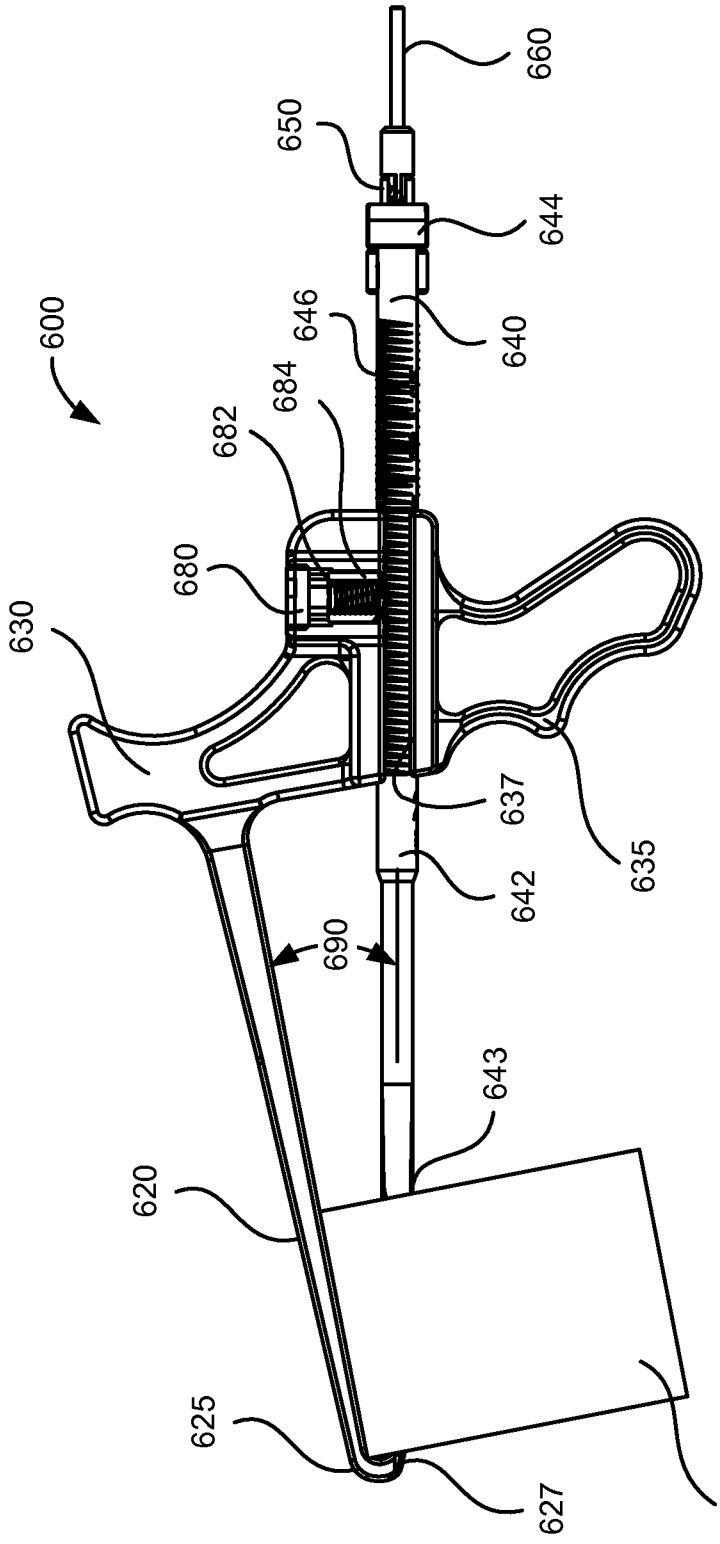

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690

FIG. 6

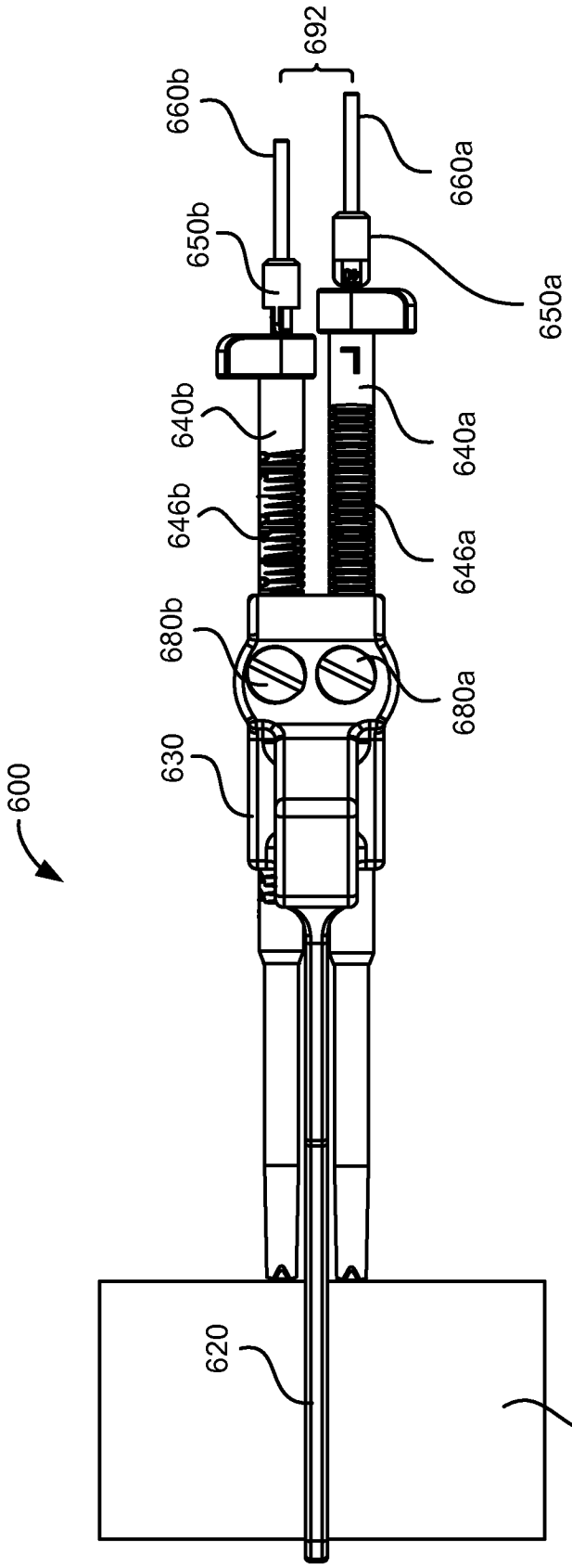

692
660b
660a
650b
650a
640b
640a
646b
646a
680b
680a
630
600
620
670

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/040913

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/17
ADD.

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2003/216742 A1 (WETZLER MERRICK [US] ET AL) 20 November 2003 (2003-11-20) paragraph [0028]	1-10
X	US 2010/121324 A1 (TYBER JEFF [US] ET AL) 13 May 2010 (2010-05-13) paragraph [0039]	1-8
X,P	WO 2012/061733 A1 (SMITH & NEPHEW INC [US]; SMITH GRAHAM [US]) 10 May 2012 (2012-05-10) the whole document	1-8

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 August 2012	04/09/2012

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	Hamann, Joachim

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2012/040913

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003216742 A1	20-11-2003	DE 602004000771 T2	10-05-2007
		EP 1449484 A1	25-08-2004
		US 2003216742 A1	20-11-2003
		US 2005177171 A1	11-08-2005
US 2010121324 A1	13-05-2010	NONE	
WO 2012061733 A1	10-05-2012	US 2012123417 A1	17-05-2012
		WO 2012061733 A1	10-05-2012