

7. An implant assembly according to claim 3, wherein the axial bore of the spacer sleeve tapers towards its closed end and the implant pin tapers towards its free end, the exterior surface of the spacer sleeve generally forming a cylinder.

8. An implant assembly according to claim 3, wherein the spacer sleeve is formed from a plastics material and the implant is formed substantially from a metallic material

9.. An implant assembly according to claim 4, wherein the collar is less than 5mm thick in a direction parallel to the axis of the implant.

10. An implant assembly according to claim 1, wherein the roughened surface comprises a porous structure adapted to encourage bone ingrowth.

11.. An implant assembly according to claim 10, wherein the porous structure comprises a porous coating applied to at least a portion of the interior surface of the cavity.

12. An implant assembly according to claim 1, wherein the implant comprises a femoral resurfacing implant and the joint prosthesis comprises a hip joint prosthesis.

13. A method of implanting an implant forming one component of a joint prosthesis, the implant comprising an articulating surface and an axial cavity, the axial cavity being generally circular in cross section in a plane normal to the axis of the implant, at least a portion of the interior surface of the cavity being roughened, the implant being detachably coupled to a spacing element, the method comprising:

receiving the end of a bone in the cavity, the spacer sleeve preventing the implant from fully seating on the end of the bone such that the implant and the end of the bone are in a predetermined spaced apart arrangement;

rotating the implant assembly while applying axial pressure to the implant in the direction of the bone such that bone is abraded by the roughened surface;

removing the implant from the end of the bone;

removing the spacing element from the implant;

positioning the implant over the end of the bone such that the end of the bone is inserted into the cavity; and

applying an axial impaction force to the implant until the implant is fully seated upon the end of the bone.

- 5      14.      A method according to claim 13, further comprising:  
             drilling the bore into the end of the bone and forming the end of the bone to the approximate shape of the cavity prior to positioning the implant assembly over the end of the bone.

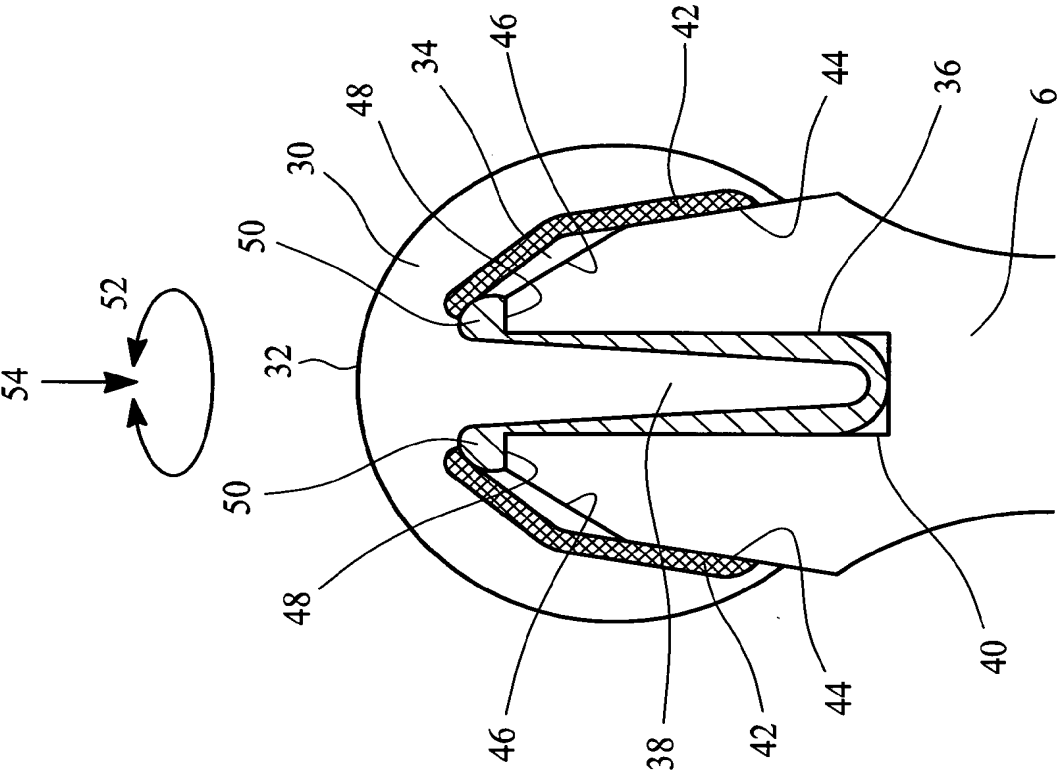


FIG. 1

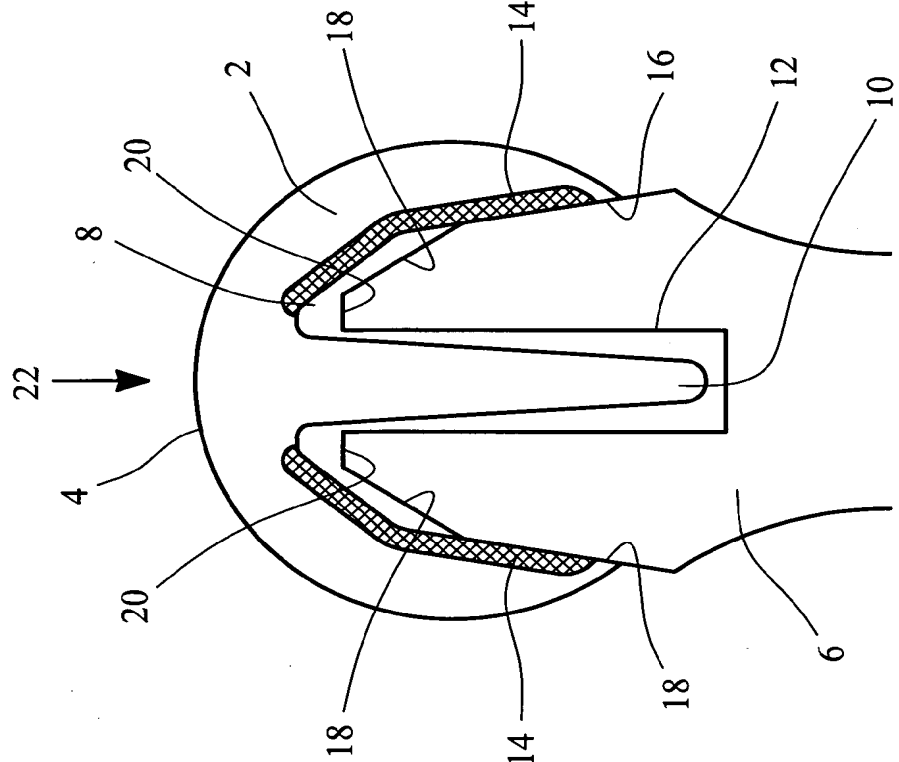


FIG. 2

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/GB2008/051138

A. CLASSIFICATION OF SUBJECT MATTER  
INV. A61F2/36 A61F2/40

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)

A61F 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 practical, search terms used)

EP0-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                         | Relevant to claim No. |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | EP 1 470 802 A (DEPUY PRODUCTS INC [US])<br>27 October 2004 (2004-10-27)<br>paragraphs [0024], [0051], [0055],<br>[0061], [0066]           | 1, 2, 10,<br>11       |
| A         | GB 764 600 A (PRYOR & HOWARD LTD; FRANK<br>LEONARD JAMES PRYOR)<br>28 December 1956 (1956-12-28)<br>page 2, line 23 - line 36              | 1                     |
| A         | US 2005/245934 A1 (TUKE MICHAEL A [GB] ET<br>AL) 3 November 2005 (2005-11-03)<br>figure 37                                                 | 1                     |
| A         | WO 2004/032767 A (DEPUY INT LTD [GB];<br>FENTON GARY [GB])<br>22 April 2004 (2004-04-22)<br>cited in the application<br>the whole document | 1                     |

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

☒ 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
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- \*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.
- \*Z\* document member of the same patent family

Date of the actual completion of the international search

18 March 2009

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB2008/051138

## 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.: 13, 14  
because they relate to subject matter not required to be searched by this Authority, namely:  
**Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery**
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:

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

### 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.

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/GB2008/051138

| Patent document<br>cited in search report |    | Publication<br>date | Patent family<br>member(s)                                                                 | Publication<br>date                                                |
|-------------------------------------------|----|---------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| EP 1470802                                | A  | 27-10-2004          | AU 2004201199 A1<br>JP 2004298638 A<br>US 2004193278 A1                                    | 21-10-2004<br>28-10-2004<br>30-09-2004                             |
| GB 764600                                 | A  | 28-12-1956          | NONE                                                                                       |                                                                    |
| US 2005245934                             | A1 | 03-11-2005          | EP 1588668 A1                                                                              | 26-10-2005                                                         |
| WO 2004032767                             | A  | 22-04-2004          | AU 2003269236 A1<br>DE 60311289 T2<br>EP 1549230 A1<br>JP 2006501917 T<br>US 2006015111 A1 | 04-05-2004<br>21-06-2007<br>06-07-2005<br>19-01-2006<br>19-01-2006 |



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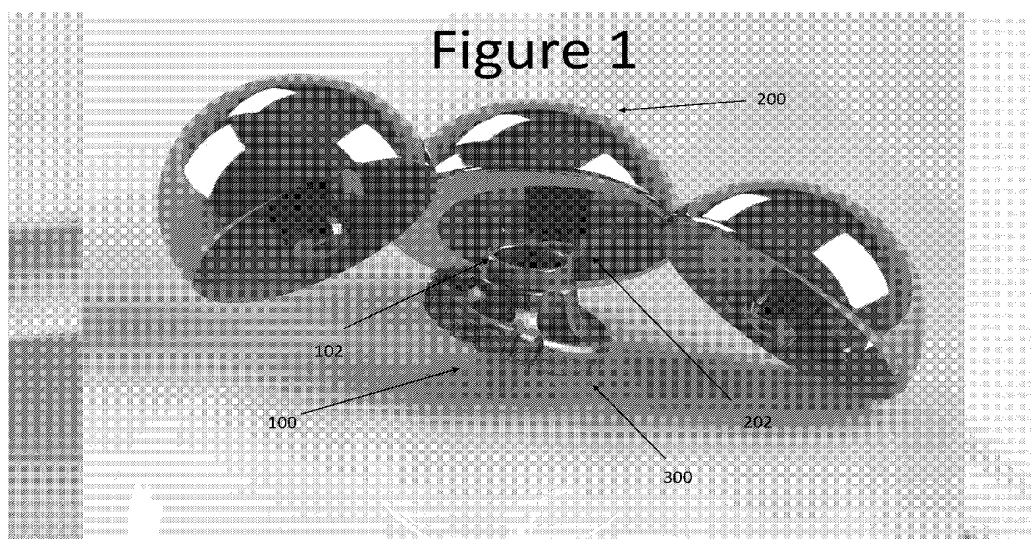
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(54) **Title:** TOTAL REVERSE SHOULDER SYSTEMS AND METHODS



(57) **Abstract:** A reverse shoulder system can include, for example, a glenoid baseplate comprising a longitudinal axis, the glenoid baseplate further including a stem and a central channel within a sidewall of the stem. The stem can include a longitudinal axis. The longitudinal axis of the glenoid baseplate can be angled with respect to the longitudinal axis of the stem, wherein the longitudinal axis of the glenoid baseplate is not perpendicular with respect to the longitudinal axis of the stem. Other components including a glenosphere, tools, and methods of use are also disclosed.

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

## TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

### BACKGROUND

**[0001]** This application claims the benefit under 35 U.S.C. § 119(e) as a nonprovisional application of U.S. Prov. App. No. 62/816,708, which is hereby incorporated by reference in its entirety.

**[0002]** Shoulder replacement is a commonly performed medical procedure for treatment of osteoarthritis, rheumatoid arthritis, as well as for treatment of certain deformities related to oncological indications as well as trauma. There are two primary types of articulations available to surgeons for treatment: anatomic and reverse. With anatomic, the surgeon replaces the articular surfaces with industrial materials such that the articulating surfaces are substantially the same shape as the natural anatomy. A stem can be commonly fixed inside the canal of the humerus, a metallic articular head can be rigidly fixed to the proximal aspect of the same, the articular head having a convex articular surface adapted to articulate with the glenoid implant. The glenoid implant can include on its back side (medial side) certain pegs or posts or fins adapted to be rigidly fixed within the glenoid fossa of the scapula and on its front side a concave or flat articular surface adapted to articulate with the humeral head of the humeral implant.

**[0003]** When a reverse prosthesis is used, the articular surface is reversed in that the metallic ball is rigidly fixed to the glenoid fossa of the scapula, and the concave articular surface is rigidly fixed to the humeral bone, thereby reversing the fashion of articulation of the prosthesis.

**[0004]** The surgeon chooses between the two types of prostheses by assessing a number of conditions of the patient including level of pain, patient activity level, deformity or severity of the boney degradation, the strength of surrounding soft tissues, and present or absence of prior surgery, and particularly the health and strength of the rotator cuff muscle and tendon. Disease of the rotator cuff is common among patients with arthritis of the shoulder. In this circumstance, it is commonly observed that the absence or insufficiency of the rotator cuff leads to a condition where the anatomic shoulder replacement prosthesis is

not sufficiently stabilized by surrounding soft tissue. In this case, a reverse shoulder replacement prosthesis can be preferred in some cases due to the higher inherent stability of the articulation. In addition, the reverse prosthesis can advantageously utilize the remaining muscles in a way they can be more effective in the absence of the other soft tissue structures by adjusting the position of the articular surfaces within the joint.

## SUMMARY

**[0005]** In some embodiments, disclosed herein is a reverse shoulder system, comprising any number of a glenoid baseplate comprising a longitudinal axis, the glenoid baseplate further comprising a stem and a central channel within a sidewall of the stem, the stem comprising a longitudinal axis. The longitudinal axis of the glenoid baseplate can be angled with respect to the longitudinal axis of the stem, wherein the longitudinal axis of the glenoid baseplate is not perpendicular with respect to the longitudinal axis of the stem.

**[0006]** In some configurations, the glenoid baseplate comprises a generally disc-shaped portion extending radially outward from the central channel.

**[0007]** In some configurations, the stem comprises a sidewall that extends superiorly with respect to the disc portion.

**[0008]** In some configurations, the glenoid baseplate comprises a peripheral edge.

**[0009]** In some configurations, the peripheral edge comprises spaced-apart anti-rotation features.

**[0010]** In some configurations, the anti-rotation features comprise slots.

**[0011]** In some configurations, an inferior portion of the peripheral edge comprises a porous coating.

**[0012]** In some configurations, an inferior surface of the generally disc-shaped portion comprises a porous coating, but a superior surface does not comprise a porous coating.

**[0013]** In some configurations, the peripheral edge and/or an inferior surface of the baseplate comprises a conical geometry.

**[0014]** In some configurations, an inferior surface of the baseplate is concave.

[0015] In some configurations, the stem comprises a Morse taper lock superior to a superior-most portion of the generally disc-shaped portion of the glenoid baseplate.

[0016] In some configurations, the system further comprises a glenosphere.

[0017] In some configurations, the glenosphere comprises a superior dome-shaped surface comprising a rotational control feature configured such that an inserter tool can lock the glenosphere and the baseplate to allow for rotation of the glenosphere and the baseplate together.

[0018] In some configurations, the rotational control feature comprises a spline.

[0019] In some configurations, the system further comprises a central set screw and locking nut.

[0020] In some configurations, the system further comprises a central compression screw non-integral with the baseplate and configured for placement adjacent and distal to the central set screw.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0021] These drawings are illustrative embodiments and do not present all possible embodiments of this invention.

[0022] FIG. 1 illustrates an embodiment of components of a total reverse shoulder system.

[0023] FIG. 2 illustrates various embodiments of humeral trays that can be utilized with total reverse shoulder systems, according to some embodiments.

[0024] FIG. 3 illustrates a variety of humeral bearing components that can be utilized with total reverse shoulder systems, according to some embodiments.

[0025] FIG. 4 illustrates schematically an embodiment of a glenoid baseplate configured to be inset into the glenoid.

[0026] FIG. 5 illustrates schematically an embodiment of a glenoid baseplate 500 configured to be inset into the glenoid.

[0027] FIG. 6 illustrates a threaded locking insert for a central channel of a stem/post, according to some embodiments.

[0028] FIG. 7 illustrates various views of glenospheres, according to some embodiments.

[0029] FIG. 8 illustrates a schematic cross-section of a fully assembled glenosphere with a locking bolt, according to some embodiments.

[0030] FIGS. 8A-8U illustrate a glenoid surgical technique, according to some embodiments.

[0031] FIG. 9 illustrates an embodiment of a sizer/angle guide.

[0032] FIG. 10 illustrates an embodiment of a stem drill guide.

[0033] FIG. 11 schematically illustrates a stem angle change with a rotational adjustment.

[0034] FIG. 12 schematically illustrates views of a glenoid baseplate inserter (alone on the left and together with a baseplate on the right), according to some embodiments. .

[0035] FIG. 13 schematically illustrates views of a calibrated central drill, according to some embodiments. .

[0036] FIG. 14 schematically illustrates views of fixed angle peripheral drill guides, according to some embodiments. .

[0037] FIG. 15 schematically illustrates views of variable angle peripheral drill guides, according to some embodiments.

[0038] FIG. 16 schematically illustrates side and top views of central screws, according to some embodiments.

[0039] FIG. 17 schematically illustrates side and top views of fixed angle peripheral compression screws, according to some embodiments.

[0040] FIG. 18 schematically illustrates side and top views of variable angle peripheral screws, according to some embodiments.

[0041] FIG. 19 schematically illustrates views of a glenosphere inserter, according to some embodiments.



## DETAILED DESCRIPTION

[0042] In some embodiments, disclosed herein are various embodiments of a total reverse shoulder system, including a variety of humeral trays, humeral bearings, inset glenoid baseplates, threaded locking inserts, and glenospheres. Glenoid surgical techniques are also described, which can utilize various tools including but not limited to sizer/angle guides, stem drill guides, glenoid baseplate inserters, calibrated central drills, peripheral drill guides with fixed or variable angles, central screws, fixed angle peripheral compression screws, variable angle peripheral screws, and glenosphere inserters. Dimensions listed on the accompanying Figures are non-limiting examples only.

[0043] FIG. 1 illustrates an embodiment of components of a total reverse shoulder system, including a glenosphere 200 and a glenoid baseplate 102 which can be partially or completely inset in some embodiments. The glenoid baseplate 102 can be a generally disc-shaped structure and include a central aperture defining a surface of (e.g., integral with an elongate stem), or configured to fit an elongate stem or post therethrough. The glenoid baseplate 102 can include a longitudinal axis that is at an angle to a longitudinal axis of the elongate stem 100. The longitudinal axis of the glenoid baseplate 102 can be at an angle, such as generally oblique with respect to the longitudinal axis of the elongate stem 100. In some embodiments, the angle is an acute angle, and not a right angle. The angle between the two intersecting longitudinal axes of the respective baseplate 102 and the stem 100 could be, for example, about, at least about, or no more than about 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, or more or less degrees, or ranges including any two of the foregoing values.

[0044] FIG. 2 illustrates various embodiments of humeral trays that can be utilized with total reverse shoulder systems, according to some embodiments. The humeral trays can include various inner diameters IDs and outer diameters ODs, including 30mm, 32mm, 34mm, 36mm, 38mm, 40mm, 42mm, or more or less IDs and/or ODs, and ranges including any two of the foregoing values. The trays can include one or more pegs, such as a central peg extending from a medial surface. The trays can be neutral, or include extensions (e.g., in thickness) that can be, for example, +2, 4, 6, 8, 10, 12mm, or ranges including any two of the foregoing values. The trays can include various cross-sections, including oval or

round cross-sections. The trays can be compatible with the same poly bearing surfaces in some cases. In some embodiments, a kit can include at least four different sizes of trays (34mm oval neutral; 34mm oval +6mm extension; 38mm round neutral; 38mm round +6mm extension).

**[0045]** FIG. 3 illustrates a variety of humeral bearing components that can be utilized with total reverse shoulder systems, according to some embodiments, including humeral trays as illustrated and described in connection with FIG. 2. The bearing components can include, for example, a peripheral ring 302 and a central recessed portion that can be outlined radially outwardly by an inner edge of the peripheral ring, and an inner bowl-shaped portion 304. The peripheral ring can include indicia, such as a slot or other marking 399 illustrating the highest point of the bearing component. Also illustrated is the recessed poly dome 395, and a partial or full annular barb 397 around the outer circumference of the bearing component. The bearing component can include a variety of geometries include neutral, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 degree angles to horizontal, or ranges including any two of the foregoing values. In some embodiments, the bearing component does not change the joint center. In some embodiments, the bearing component can include 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45mm, or more or less spherical diameters, or ranges including any two of the foregoing values. In some embodiments, systems and methods can include an offset of 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10mm, or ranges including any two of the foregoing values.

**[0046]** FIG. 4 illustrates schematically an embodiment of a glenoid baseplate configured to be inset into the glenoid G as illustrated. The longitudinal axis of the baseplate can be angled with respect to the longitudinal axis of the stem/post as described, for example, with respect to FIG. 1, and can include a version change 499 to compensate for posterior bony defects. In some embodiments, the glenoid baseplate includes a central channel therethrough defining a surface of (e.g., integral with an elongate stem), or configured to fit configured to house a stem/post as shown. The glenoid baseplate can include a generally conical shape with a concave undersurface configured to rest within a reamed surface of glenoid bone, which advantageously allows for a single rotary reamer to be utilized, in contrast to conventional glenoid baseplates with flat undersurfaces that require a two-step

reaming process. The post 493 can have a length of about, at least about, or no more than about 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, 10, 10.5, 11, 11.5, 12, 12.5, 13, 13.5, 14, 14.5, 15mm or more or less, or ranges including any two of the foregoing values. In some embodiments, the central channel and/or stem can include a female Morse taper 497 of about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or more or less degrees, including ranges incorporating any two of the foregoing values. As shown in the right illustration of FIG. 4, the baseplate can be configured to pivot around the stem/taper at arrow 495 for version correction and to allow for a direct bone-implant interface without requiring augmentation. In some embodiments, the system can be configured to provide version angle corrections of, for example, about 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20 degrees or more or less, or ranges including any two of the foregoing values. In some embodiments, the baseplate could have a diameter of about, at least about, or no more than about 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40mm, or more or less, or ranges including any two of the foregoing values. The baseplate can advantageously pivot around the central stem with a Morse taper for version correction and allows for a direct bone-implant interface.

**[0047]** FIG. 5 illustrates schematically an embodiment of a glenoid baseplate 500 configured to be inset into the glenoid (not shown in FIG. 5). The longitudinal axis of the baseplate 500 can be angled with respect to the longitudinal axis of the stem/post 510 as described, for example, with respect to FIGS. 1 and 4 above. The baseplate 500 could have a generally arcuate peripheral edge. The peripheral edge could include spaced-apart anti-rotational slots 521 directed generally transverse to a longitudinal plane of the baseplate 500. In some embodiments, the peripheral edge of the baseplate 500 can taper (e.g., decrease) in diameter from a superior to inferior dimension. A central channel can extend through the baseplate 500, as well as include a superiorly-extending sidewall or lip 511 somewhat similar to the side slopes of a volcano. The central channel can defining a surface of (e.g., integral with an elongate stem), or configured to fit be configured to house the stem/post 510 therethrough. The baseplate 500 can also include a plurality of regularly or irregularly spaced-apart secondary (peripheral) channels 555 spaced radially outward from the central channel of the baseplate and configured to house fixed and variable angle screws therethrough. The secondary channels 555 can be asymmetric and include superiorly-

extending portions 556 that can extend into and interrupt the superiorly-extending sidewall or lip 511 of the central channel of the baseplate 500. The baseplate 500 can include a porous coating 585 on the entire, or only a part of the peripheral edge and/or an inferior surface (e.g., undersurface) of the baseplate 500 to promote bone ingrowth, for example.

**[0048]** Still referring to FIG. 5, the stem/post 510 could have an internal taper, such as a Morse taper, of about, at least about, or no more than about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 degrees, or more or less, or ranges including any two of the foregoing values. The stem/post 510 can also include a rotational control feature 545 along an outer diameter of the stem/post 510, and in some embodiments superiorly with respect to the uppermost surface of the sidewall 511 of the central channel of the glenoid baseplate 500 as shown. The rotational control feature 545 could be non-circular or non-arcuate, such as a hexagonal shape as shown for example. The stem/post 510 can also include a central channel and include a Morse taper lock 535 configured to mate with a glenosphere (not shown). The Morse taper lock can extend superiorly with respect to the uppermost surface of the sidewall 511 of the central channel of the glenoid baseplate 500. The central channel of the stem/post 510 can be configured to house a primary screw (not shown) therethrough, which can be a variable angle primary screw, and optionally locking.

**[0049]** FIG. 6 illustrates a threaded locking insert 600 for a central channel of a stem/post, according to some embodiments. The insert 600 can include an outer male thread 602 and configured to go into the central channel of a baseplate. The outer diameter of the insert can also include a hexagonal geometry portion 604 at the superior end, of about, at least about, or no more than about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10mm or more or less, or ranges including any two of the foregoing values. The hexagonal geometry portion 604 can be configured to serve as a rotational control feature in some embodiments. The insert 600 can also include a female thread 608 configured to receive a supplemental glenosphere locking screw (not shown), and a spherical surface 612, for example, at its inferior end to lock a variable angle screw.

**[0050]** FIG. 7 illustrates various views of glenospheres, according to some embodiments. The left image illustrates a glenosphere with a rotational control feature 702, which can include a spline, such as an asymmetric spline, and configured to advantageously

allow for rotational control about the spline and allow an inserter tool to lock and rotate the glenosphere together with another component, such as a baseplate. The glenosphere can also include one or more indicia, such as an eccentric rotational mark 704. The glenosphere can include a generally dome-shaped surface 714, a cavity 706 with an inferior-facing opening 708, and a hollow post including a morse taper lock 711 into the baseplate. The glenosphere could be a full hemisphere, or short of a full hemisphere by a distance 720 of about, at least about, or no more than about 0.5mm, 0.75mm, 1mm, 1.25mm, 1.5mm, 1.75mm, 2mm, 2.25mm, 2.5mm, 2.75mm, 3mm, or more or less, or ranges including any two of the foregoing values.

**[0051]** Still referring to FIG. 7, in some embodiments, the glenosphere can include an articulating diameter of about, at least about, or no more than about 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50mm, or more or less, or ranges including any two of the foregoing values. In some embodiments, systems and methods can include an offset and/or eccentric dimension of 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10mm, or ranges including any two of the foregoing values. In some embodiments, the glenosphere has a neutral geometry. In some embodiments, a glenosphere 724 is offset by about +3mm or about 6mm, for example. In some embodiments, a glenosphere 722 has an eccentric dimension of between about 2mm and about 4mm. In some embodiments, a secondary locking screw can be utilized together with the glenosphere.

**[0052]** FIG. 8 illustrates a schematic cross-section of a fully assembled glenosphere with a locking bolt, according to some embodiments, along with the baseplate. The glenosphere can include a central channel therethrough including a rotational control feature 702 at, for example, a superior-most portion that can be as described elsewhere herein. The central channel can also include a threaded surface 808 for an inserter/head extractor, such as inferior to the rotational control feature 702, and optionally be configured to accommodate a secondary locking screw at 810, to push and/or rotate with the post of the baseplate. A post of the glenosphere can be placed at least partially within a central channel of the baseplate as illustrated. A central set screw/locking nut 814 can be connected to, and in some cases removably attachable to a central channel, e.g., of the glenoid baseplate, and have an end adjacent or directly touching an end of a central compression screw 816, which can

include a diameter of, for example, of about, at least about, or no more than about 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, 10mm, or more or less, or ranges including any two of the foregoing values. The central compression screw can be configured to angulate with respect to the baseplate, and advantageously allow for the use of a locking screw.

**[0053]** Figures 8A-8U illustrate a glenoid surgical technique, according to some embodiments, which can include any number of the following actions. FIG. 8A illustrates a glenoid surface with an A3-E3 defect. A sizer/angle guide can be placed as in FIG. 8B. A wire guide/wire can be placed in FIG. 8C. The wire guide and sizer/angle guide can be removed, as in FIG. 8D. The glenoid surface can then be reamed for the baseplate, as in FIGS. 8E and 8F. The stem drill guide can then be placed and adjusted in FIG. 8G. A hole for a stem can then be drilled in FIGS. 8H and 8I. The baseplate can then be inserted, as shown in FIG. 8J, and the threaded rod removed, as shown in FIG. 8K. A central cavity can be drilled, and the length of a central screw to be placed determined, in FIG. 8L. The drill can be removed in FIG. 8M, and the screw and screw driver placed through the shaft, and the screw tightened in FIG. 8N. The baseplate inserter handle can be removed in FIG. 8O, and holes can be drilled for the peripheral locking screws in FIG. 8P. Holes can be drilled for variable angle screws, as shown in FIG. 8Q. The peripheral screws can be inserted and tightened in FIG. 8R. The central set screws and secondary locking nuts can be inserted and tightened in FIG. 8S. The glenosphere can be inserted in FIG. 8T, and the locking bolt inserted and tightened in FIG. 8U.

**[0054]** FIG. 9 illustrates an embodiment of a sizer/angle guide including an inferior tilt mechanism 902. The mechanism could be fixed to a set angle (e.g., about 0, 5, 10, 15, 20, 25 degrees, or ranges including any two of the foregoing values), or adjustable in some embodiments. The mechanism could be round or oval shaped in some embodiments, and include a slot (e.g., posterior or posterior inferior) to allow for removal. The inferior tilt mechanism 902 could include a set screw with a calibrated window, or individual depth screws in some cases.

**[0055]** FIG. 10 illustrates an embodiment of a stem drill guide, that can include a diameter of about, at least about, or no more than about 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40mm or more or less, or ranges including any

two of the foregoing values. The drill guide could include a version angle of, for example, about 0, 5, 10, 15, 20, 25 degrees or more or less, or ranges including any two of the foregoing values. In some embodiments, the larger the version angle, the more stem tilt is generated as rotation occurs.

**[0056]** FIG. 11 schematically illustrates a stem angle change with a rotational adjustment (e.g., about 30 degrees), and an angled version plate (e.g., about 15 degrees) as a non-limiting example. Anterior-posterior and inferior-superior views are illustrated.

**[0057]** FIG. 12 schematically illustrates views of a glenoid baseplate inserter (alone on the left and together with a baseplate on the right), according to some embodiments. The baseplate inserter can be configured for any number of: positive rotational control; slim design to allow visualization through screw holes to know when seated; and/or a multi-function handle allows for drilling central screw hole, and inserting a central screw.

**[0058]** FIG. 13 schematically illustrates views of a calibrated central drill, according to some embodiments. Calibrated marks/indicia 902 at spaced-apart desired increments (e.g., 5mm increments in some embodiments) near the proximal end of the instrument can help to determine the length of a central screw that may be needed. The calibration length can start at, for example, about, at least about, or no more than about 15mm, 20mm, 25mm, 30mm, 35mm, 40mm, or more or less, including any two of the foregoing values and may advantageously allow for a surgical step to be cut out.

**[0059]** FIG. 14 schematically illustrates views of fixed angle peripheral drill guides, according to some embodiments. The drill guides can be configured to fit over a geometry, such as a polygonal shaped portion (e.g., octagon) on the top of the baseplate, and the operator can then determine which fixed angle screws to drill.

**[0060]** FIG. 15 schematically illustrates views of variable angle peripheral drill guides, according to some embodiments.

**[0061]** FIG. 16 schematically illustrates side and top views of central screws, according to some embodiments, including a head 1601, threaded shaft 1602, and distal tapered portion. In one embodiment, the screw can have a 6.5mm head, and 6mm threaded shaft, although various size ranges and increments are possible, including about, at least about, or no more than about 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, 10mm, or more

or less head and/or threaded shaft diameters, or ranges including any two of the foregoing values. In some embodiments, a central screw can include a total or working length of about, at least about, or no more than about 10, 11, 12, 13, 14, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70mm, or more or less, or ranges including any two of the foregoing values. In some embodiments, anodization of the screw can optionally be present to help differentiate the screws. The screw head could have various internal feature geometries 1603, including a T20 hexalobe configuration in some embodiments.

**[0062]** FIG. 17 schematically illustrates side and top views of fixed angle peripheral compression screws, according to some embodiments, including a head 1701, double-lead thread 1703 proximal to a threaded shaft 1702, and distal tapered portion. The screws can be various size ranges and increments, and include T20 hexalobe or other internal head feature geometries 1704 as described elsewhere herein. In one embodiment, the head could be about 5.7mm in diameter, with a 4.5mm threaded shaft diameter, or dimensions listed elsewhere herein, such as in connection with FIG. 16 for example.

**[0063]** FIG. 18 schematically illustrates side and top views of variable angle peripheral screws, according to some embodiments, including a head 1801, threaded shaft 1802, and distal tapered portion. The screws can be various size ranges and increments, and include T20 hexalobe or other internal head feature geometries 1803 as described elsewhere herein. In one embodiment, the head could be about 5.7mm in diameter, with a 4.5mm threaded shaft diameter, or dimensions listed elsewhere herein, such as in connection with FIGS. 16 or 17 for example.

**[0064]** FIG. 19 schematically illustrates views of a glenosphere inserter, according to some embodiments, which can include a distal end with a feature complementary to a spline on the glenosphere, such as described in connection with FIG. 7, for example. The glenosphere inserter can be configured to, for example, advantageously provide positive attachment to the glenosphere; allow for solid rotational control while inserting; and/or may involve a secondary impaction step after removal.

**[0065]** In some embodiments, embodiments of the invention can be used or modified with use with particular advantages of using inset glenoid fixation technology in anatomic shoulder arthroplasty, such as described, for example, in U.S. Pat. Nos. 8,007,538



and/or 8,778,028 to Gunther, which are hereby incorporated by reference in their entireties. Furthermore, embodiments of the invention can be used or modified with use with systems and methods as disclosed, for example, in U.S. Pub. No. 2018/0368982 to Ball, which is hereby incorporated by reference in its entirety.

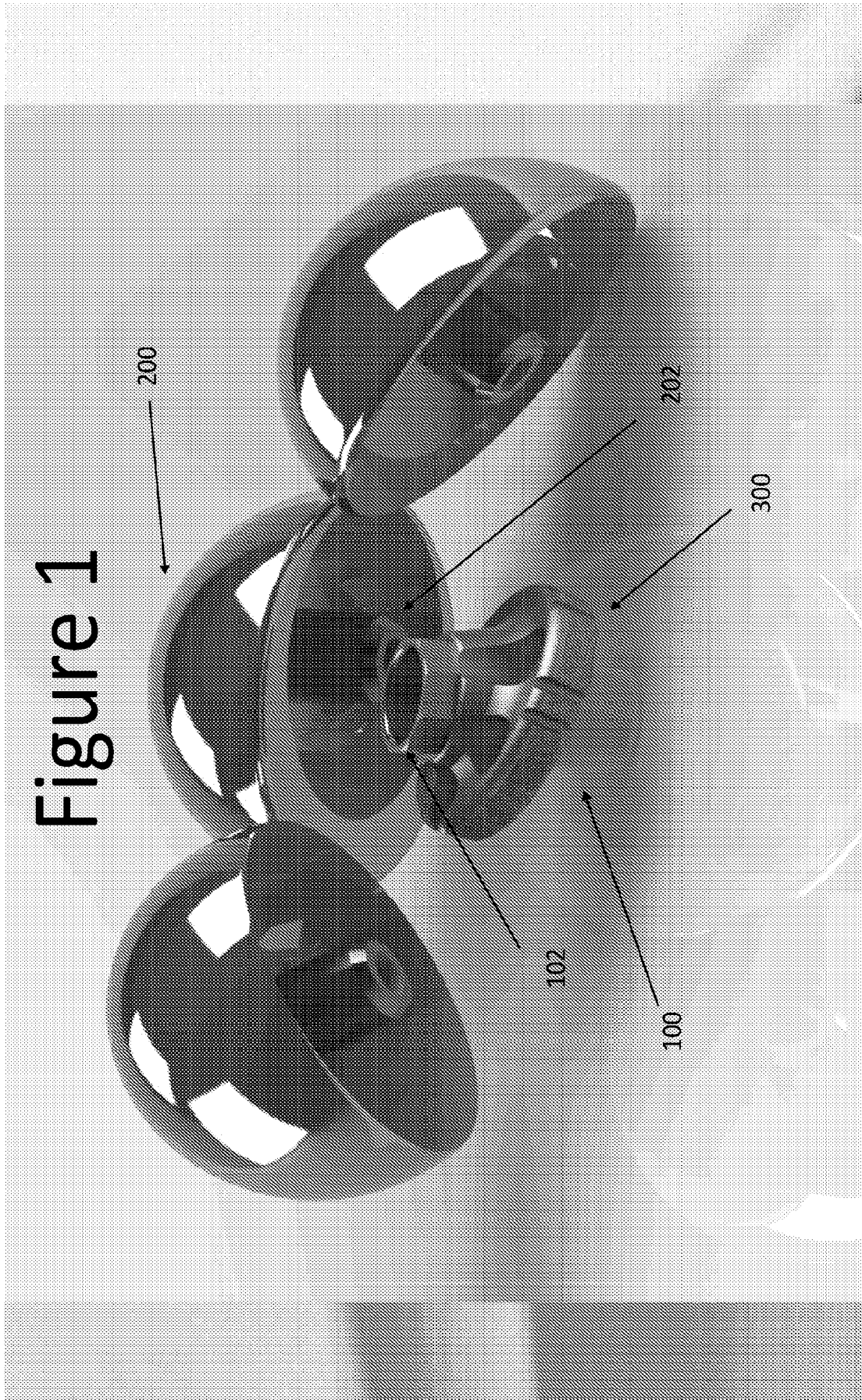
**[0066]** Various other modifications, adaptations, and alternative designs are of course possible in light of the above teachings. Therefore, it should be understood at this time that within the scope of the appended claims the invention may be practiced otherwise than as specifically described herein. It is contemplated that various combinations or subcombinations of the specific features and aspects of the embodiments disclosed above may be made and still fall within one or more of the inventions. Further, the disclosure herein of any particular feature, aspect, method, property, characteristic, quality, attribute, element, or the like in connection with an embodiment can be used in all other embodiments set forth herein. Accordingly, it should be understood that various features and aspects of the disclosed embodiments can be combined with or substituted for one another in order to form varying modes of the disclosed inventions. Thus, it is intended that the scope of the present inventions herein disclosed should not be limited by the particular disclosed embodiments described above. Moreover, while the invention is susceptible to various modifications, and alternative forms, specific examples thereof have been shown in the drawings and are herein described in detail. It should be understood, however, that the invention is not to be limited to the particular forms or methods disclosed, but to the contrary, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the various embodiments described and the appended claims. Any methods disclosed herein need not be performed in the order recited. The methods disclosed herein include certain actions taken by a practitioner; however, they can also include any third-party instruction of those actions, either expressly or by implication. For example, actions such as “insetting an implant into a glenoid cavity” includes “instructing the inseting of an implant into the glenoid cavity.” The ranges disclosed herein also encompass any and all overlap, sub-ranges, and combinations thereof. Language such as “up to,” “at least,” “greater than,” “less than,” “between,” and the like includes the number recited. Numbers preceded by a term such as “approximately”, “about”, and “substantially” as used herein include the recited numbers (e.g., about 10% =

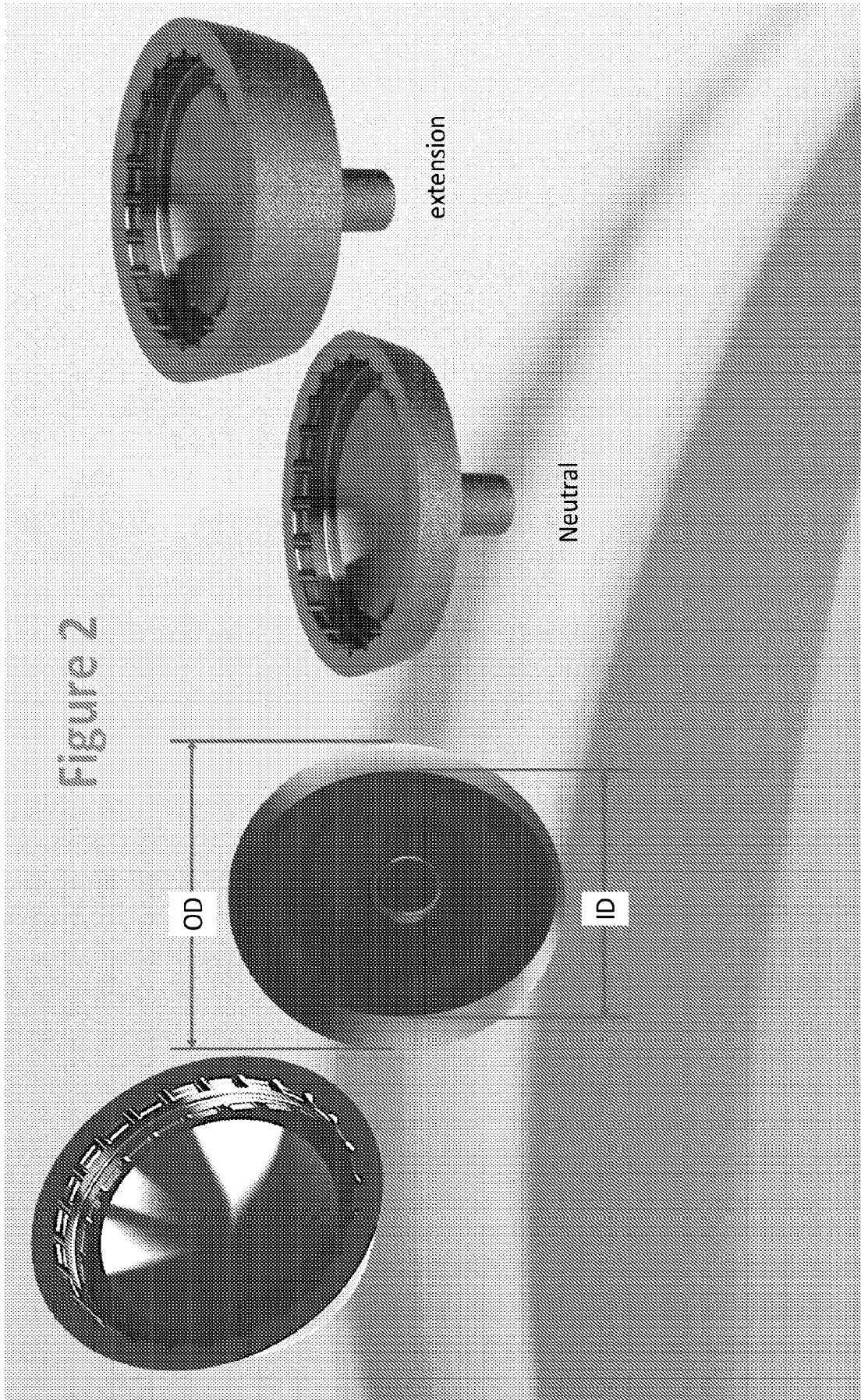
10%), and also represent an amount close to the stated amount that still performs a desired function or achieves a desired result. For example, the terms “approximately”, “about”, and “substantially” may refer to an amount that is within less than 10% of, within less than 5% of, within less than 1% of, within less than 0.1% of, and within less than 0.01% of the stated amount.

WHAT IS CLAIMED IS:

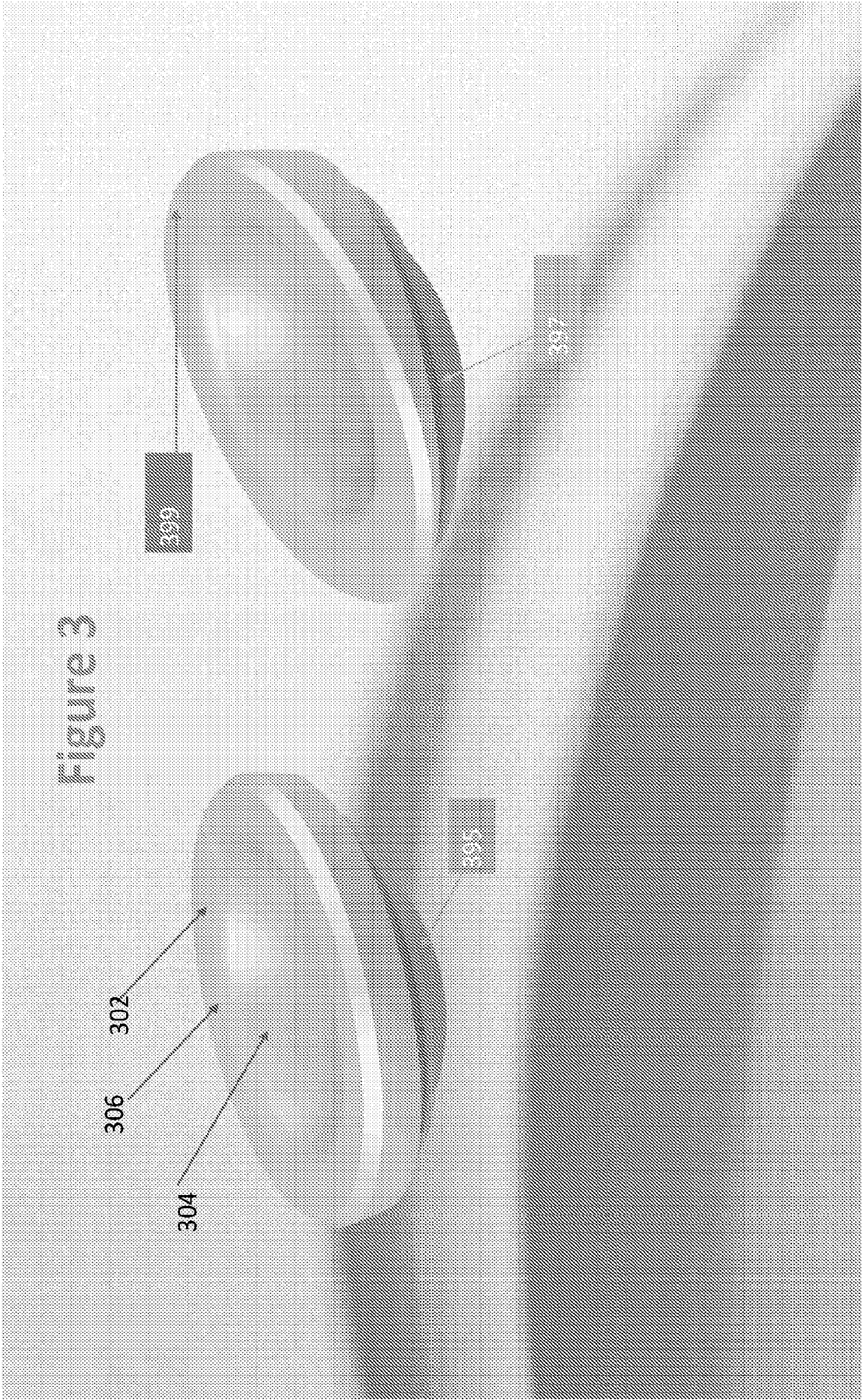
1. A reverse shoulder system, comprising:
  - a glenoid baseplate comprising a longitudinal axis,
  - the glenoid baseplate further comprising a stem and a central channel within a sidewall of the stem, the stem comprising a longitudinal axis,
  - wherein the longitudinal axis of the glenoid baseplate is angled with respect to the longitudinal axis of the stem, wherein the longitudinal axis of the glenoid baseplate is not perpendicular with respect to the longitudinal axis of the stem.
2. The system of Claim 1, wherein the glenoid baseplate comprises a generally disc-shaped portion extending radially outward from the central channel.
3. The system of Claim 2, wherein the stem comprises a sidewall that extends superiorly with respect to the disc portion.
4. The system of Claim 1, wherein the glenoid baseplate comprises a peripheral edge.
5. The system of Claim 4, wherein the peripheral edge comprises spaced-apart anti-rotation features.
6. The system of Claim 5, wherein the anti-rotation features comprise slots.
7. The system of Claim 4, wherein an inferior portion of the peripheral edge comprises a porous coating.
8. The system of Claim 1, wherein an inferior surface of the generally disc-shaped portion comprises a porous coating, but a superior surface does not comprise a porous coating.

9. The system of Claim 4, wherein the peripheral edge and/or an inferior surface of the baseplate comprises a conical geometry.
10. The system of Claim 1, wherein an inferior surface of the baseplate is concave.
11. The system of Claim 1, wherein the stem comprises a Morse taper lock superior to a superior-most portion of the generally disc-shaped portion of the glenoid baseplate.
12. The system of Claim 1, further comprising a glenosphere.
13. The system of Claim 12, wherein the glenosphere comprises a superior dome-shaped surface comprising a rotational control feature configured such that an inserter tool can lock the glenosphere and the baseplate to allow for rotation of the glenosphere and the baseplate together.
14. The system of Claim 13, wherein the rotational control feature comprises a spline.
15. The system of Claim 12, further comprising a central set screw and locking nut.
16. The system of Claim 15, further comprising a central compression screw non-integral with the baseplate and configured for placement adjacent and distal to the central set screw.









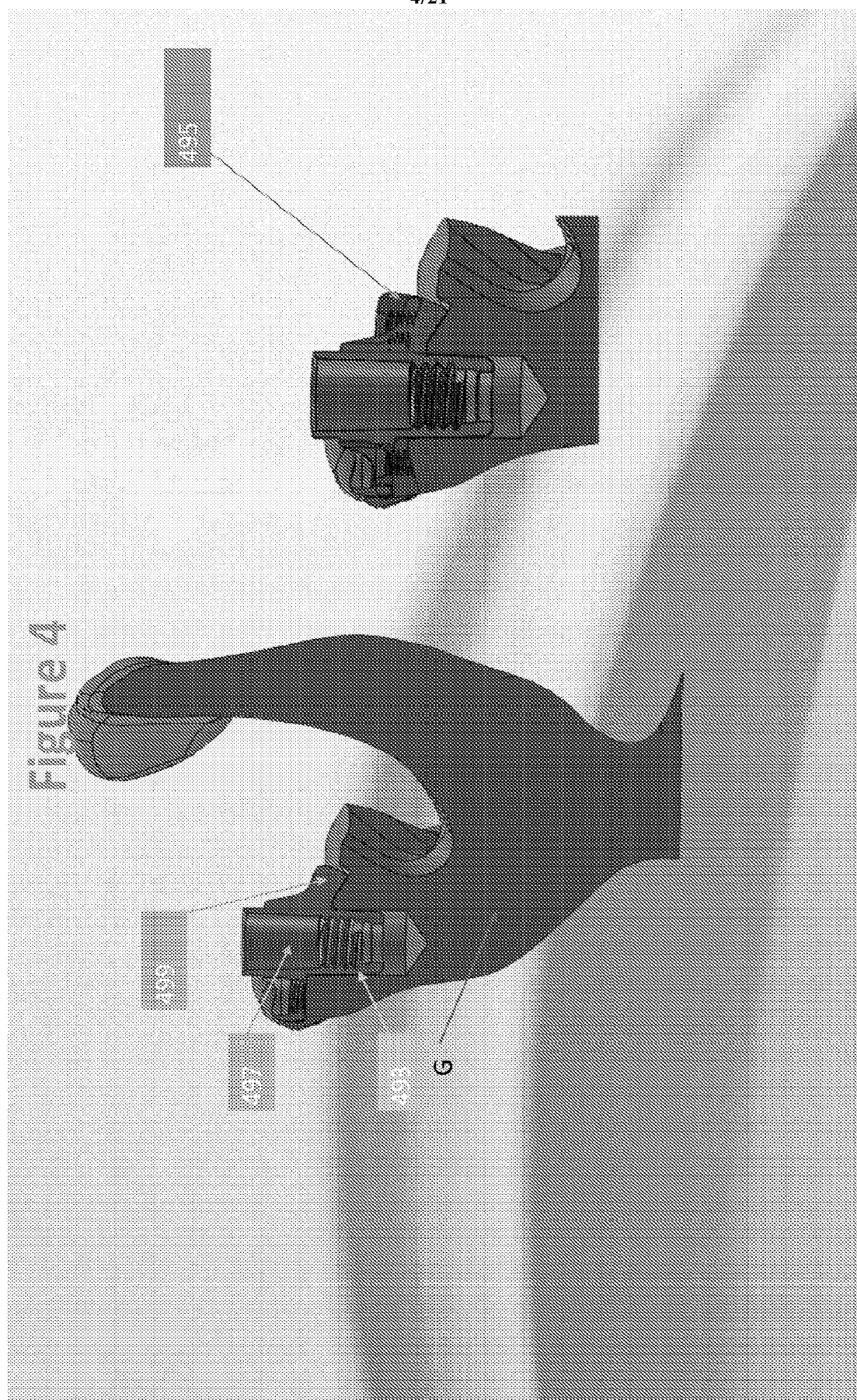




Figure 5

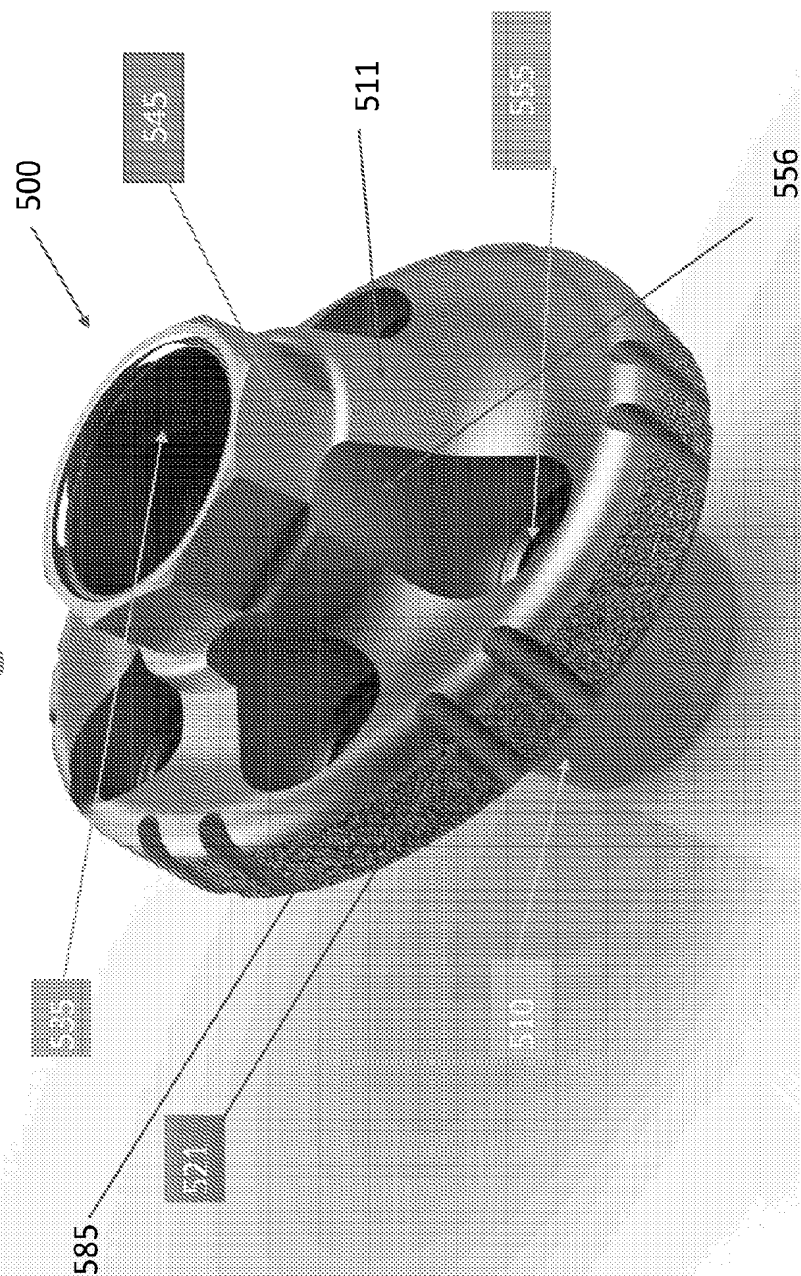
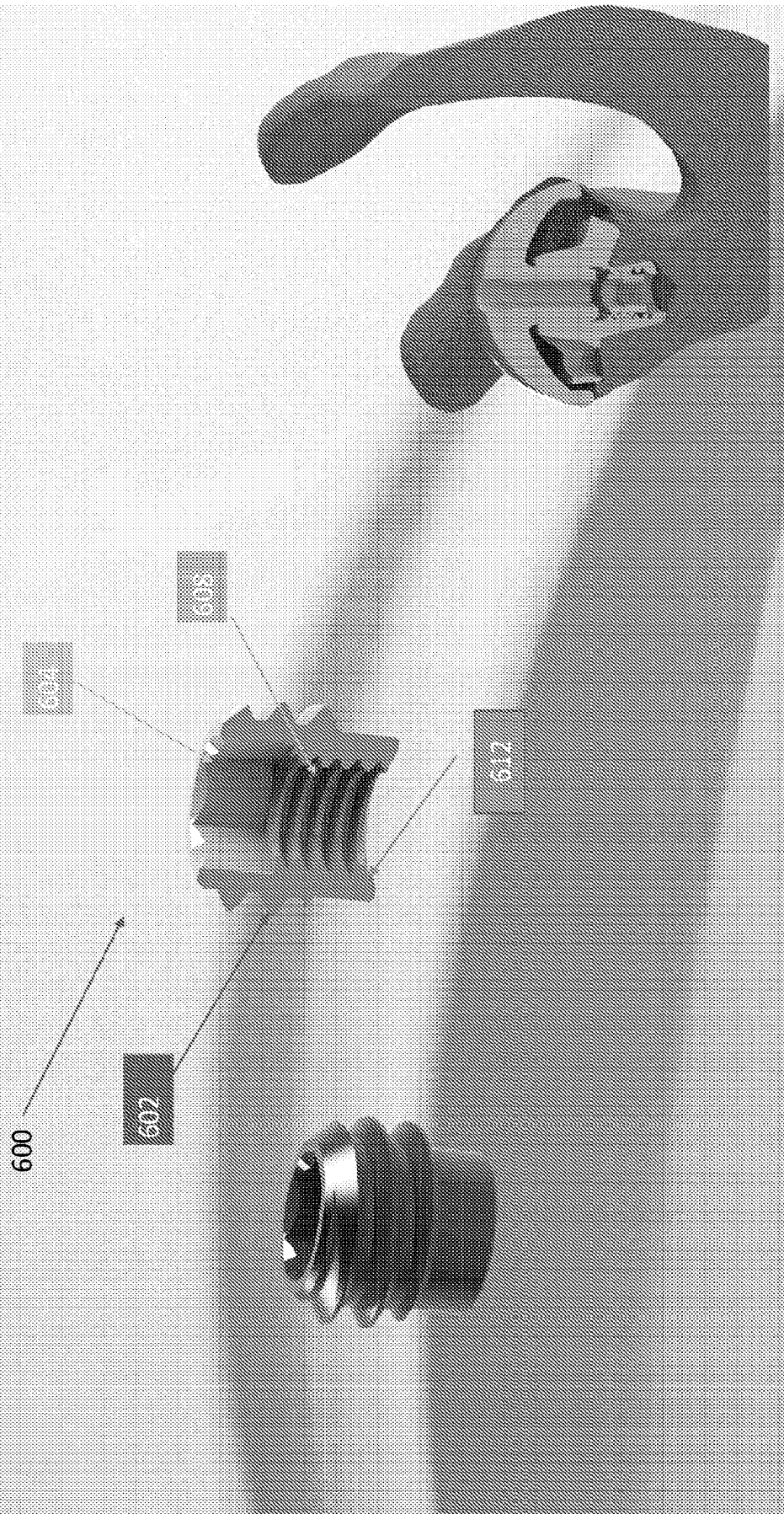


Figure 6



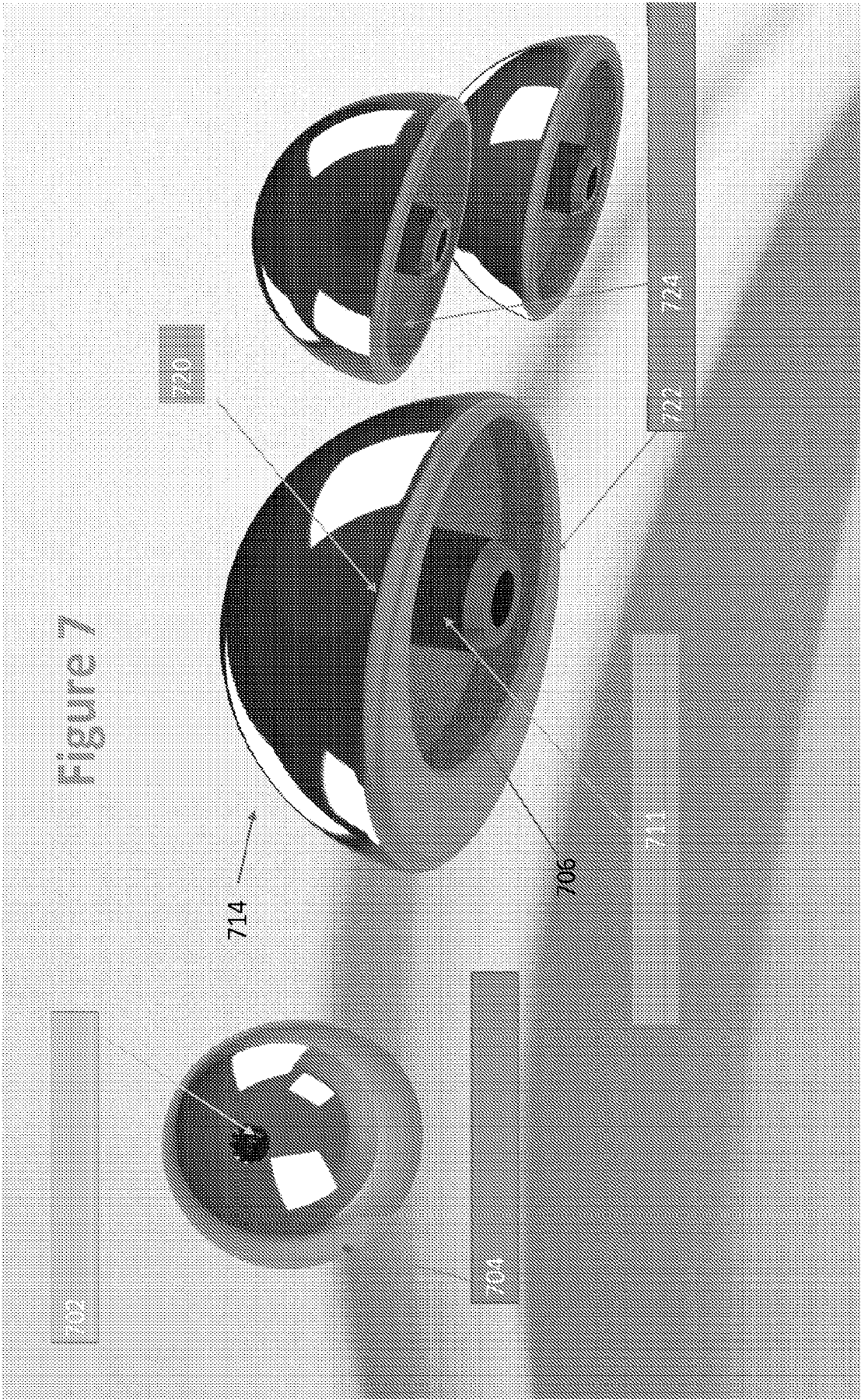
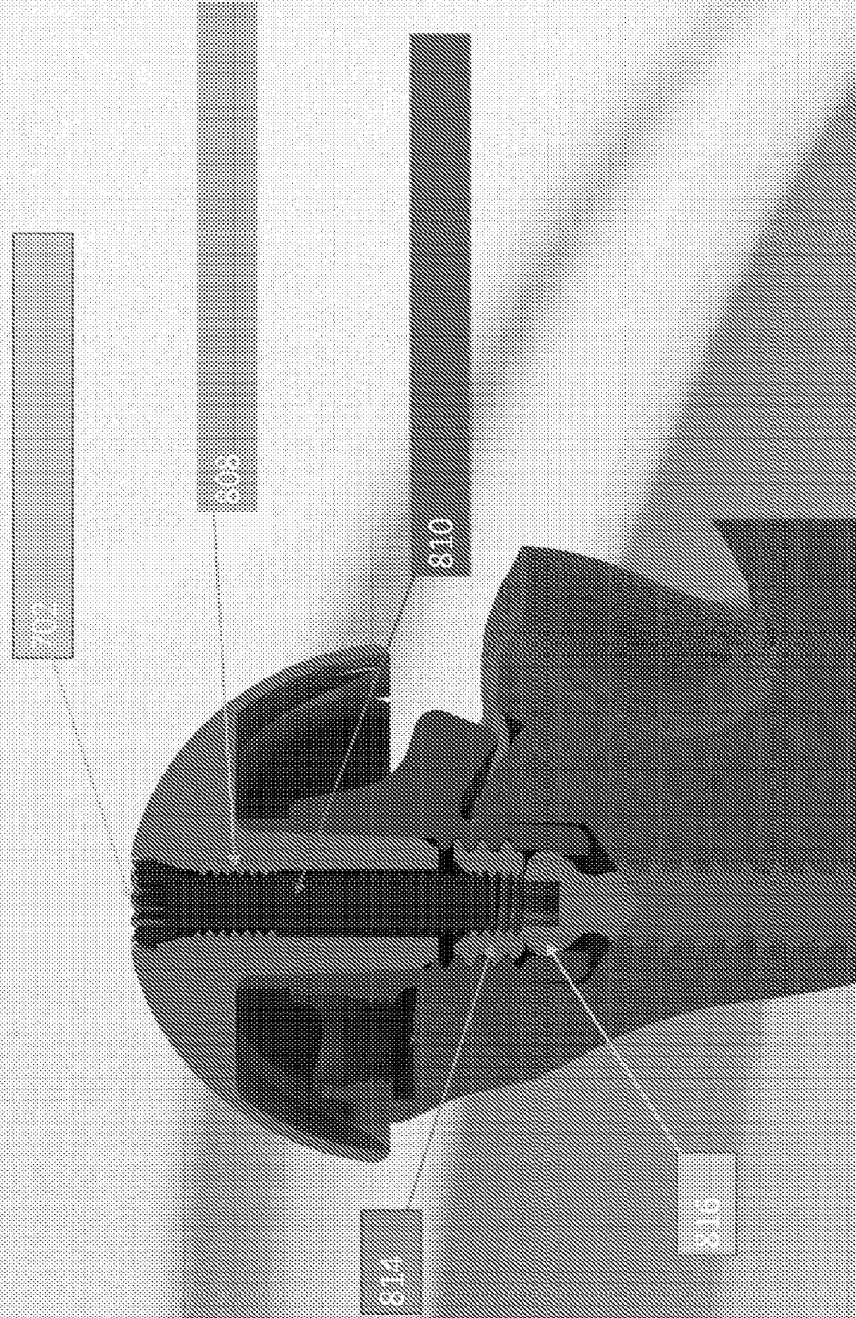
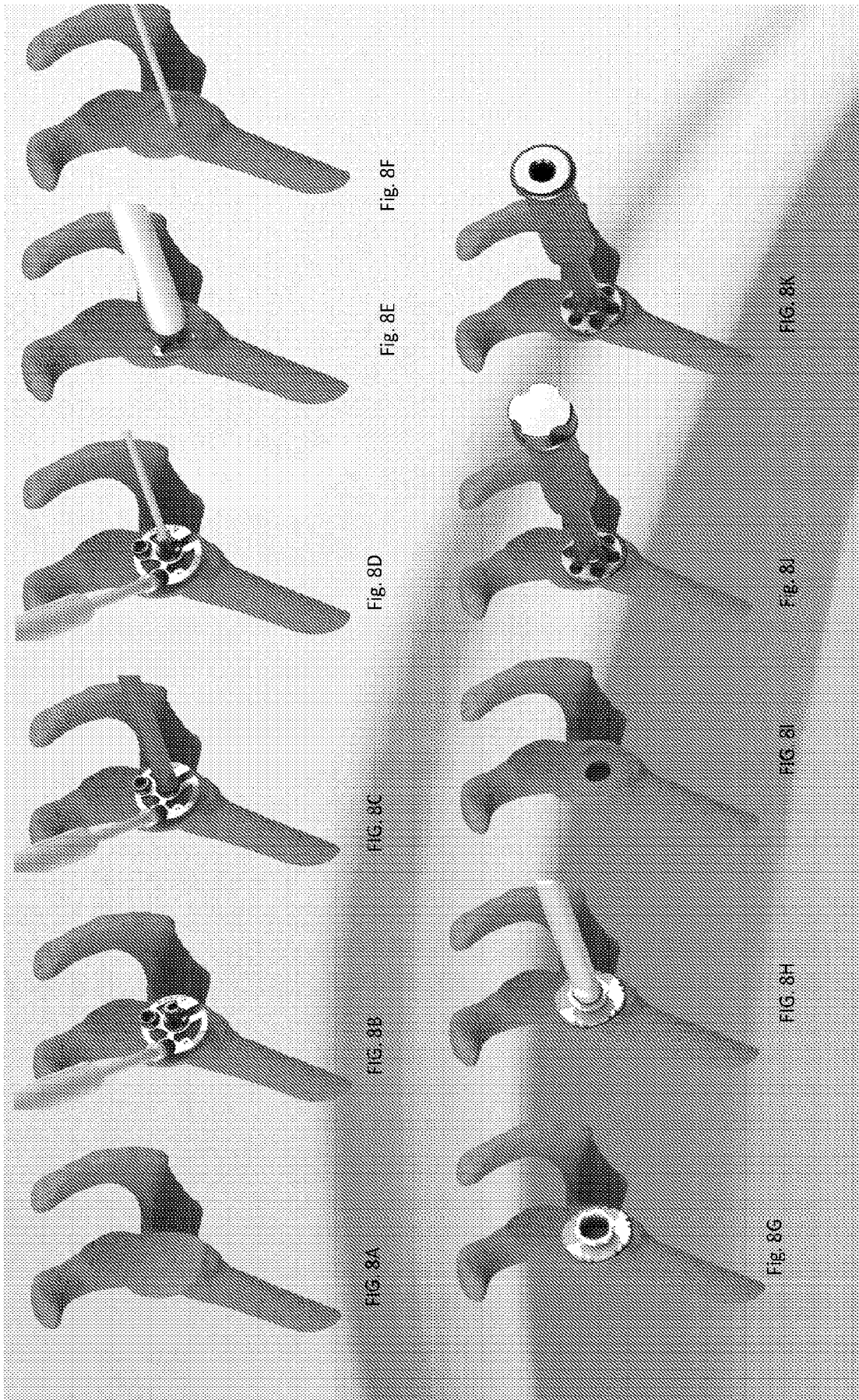




Figure 8





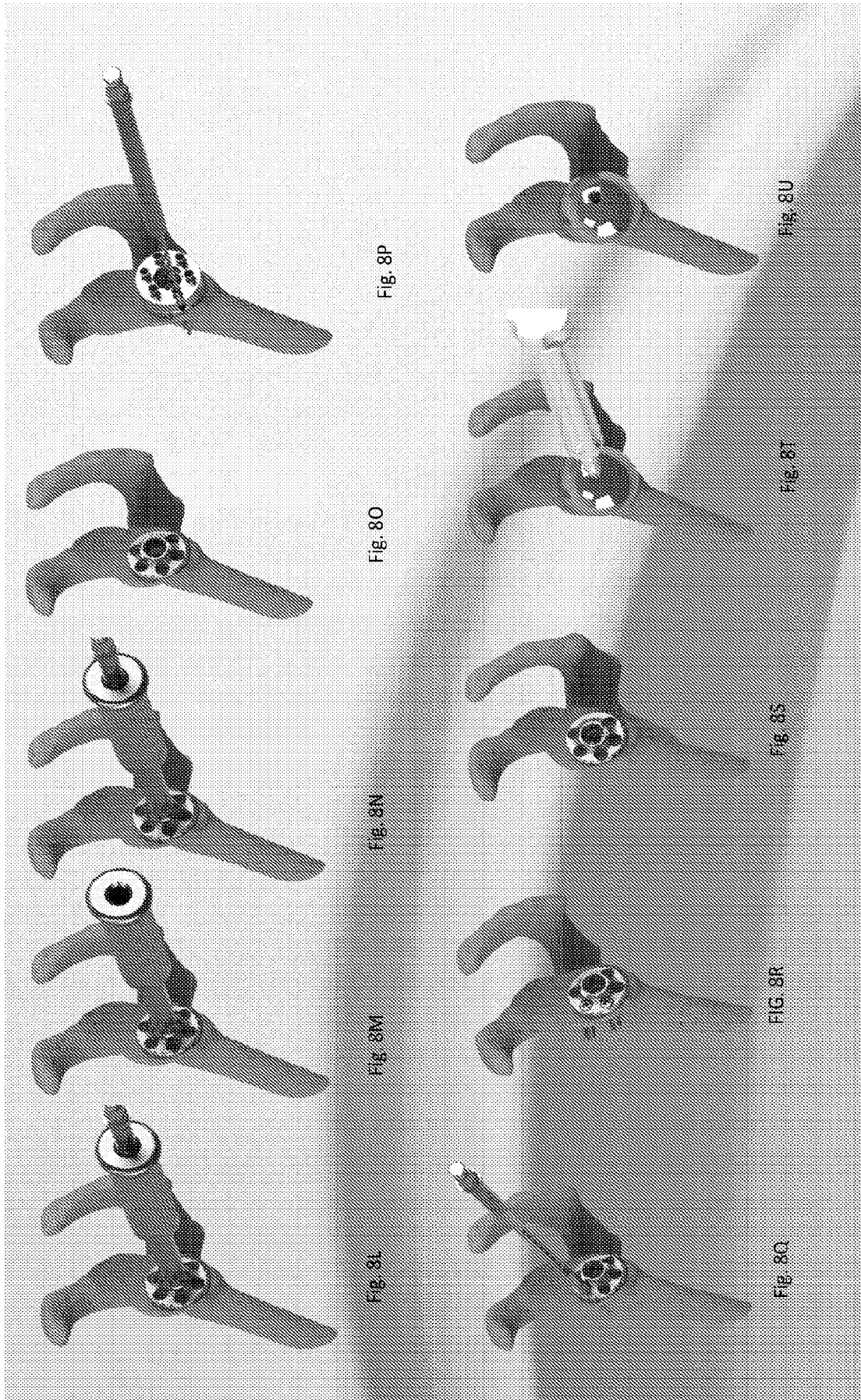




Figure 9

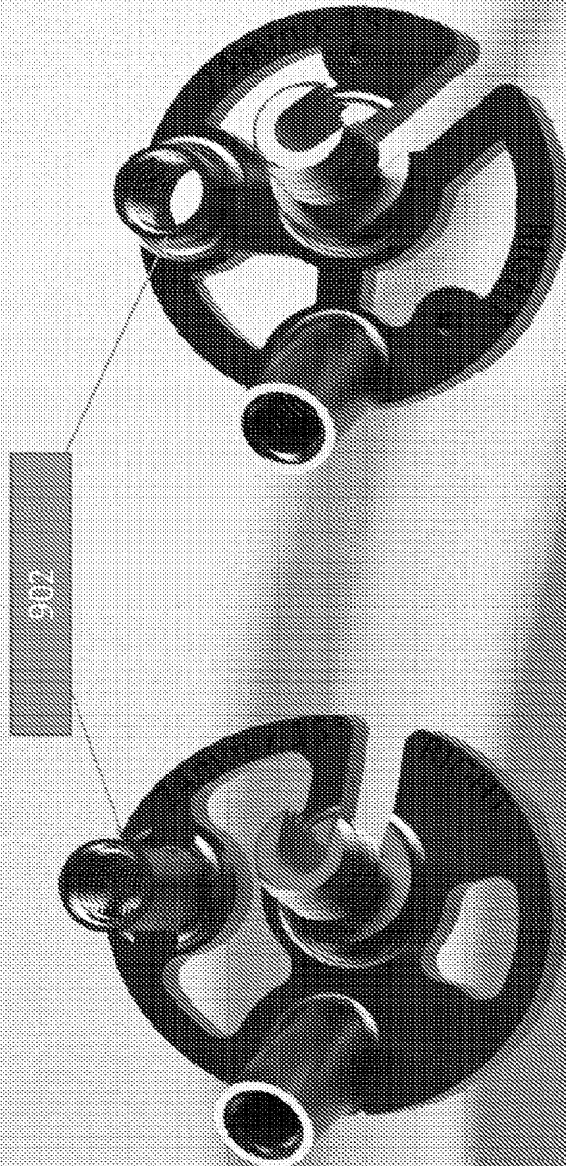


Figure 10

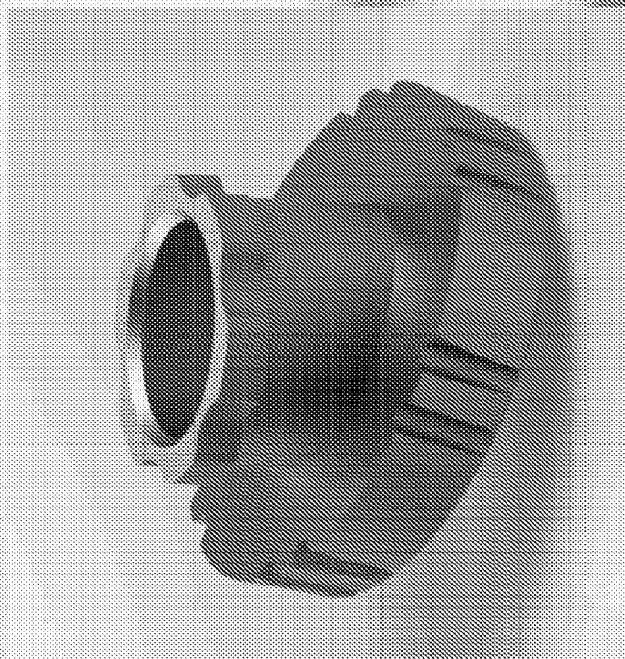




Figure 11

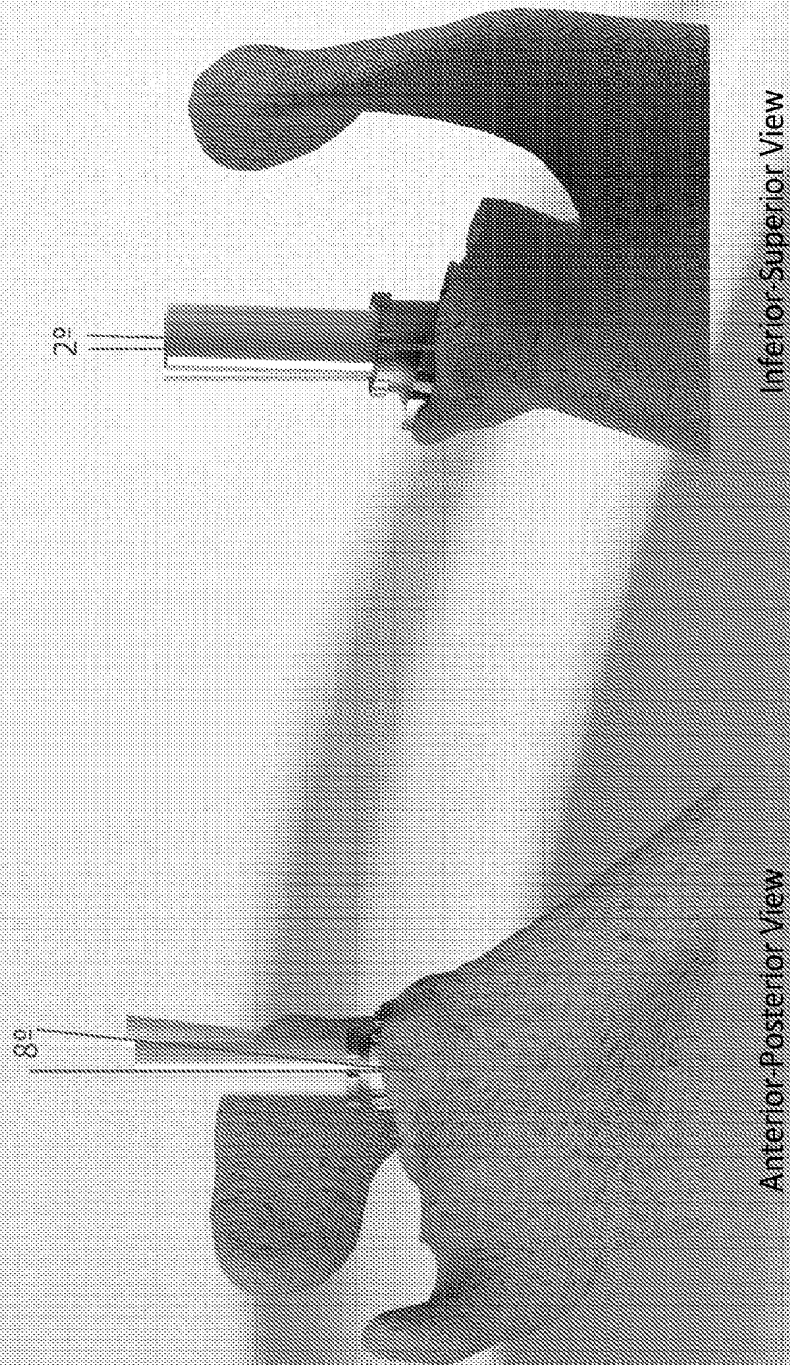


Figure 12

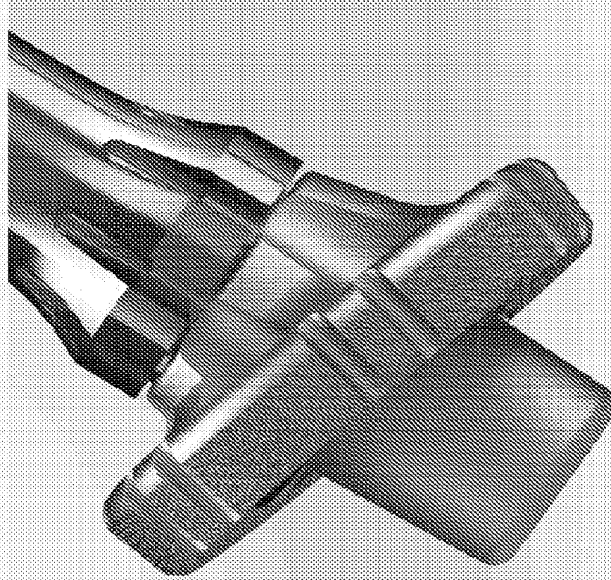


Figure 13





Figure 14

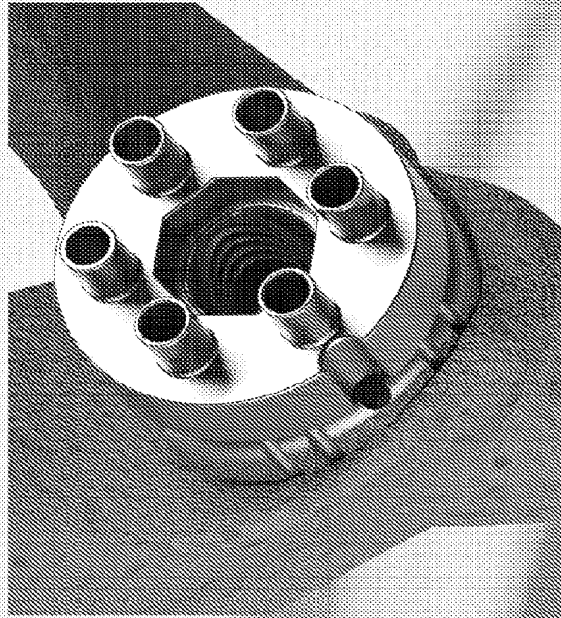
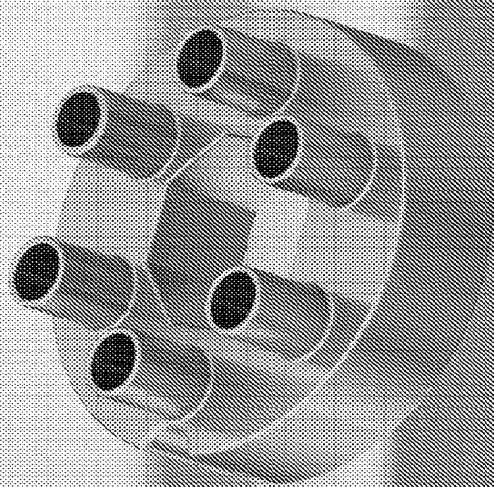


Figure 15

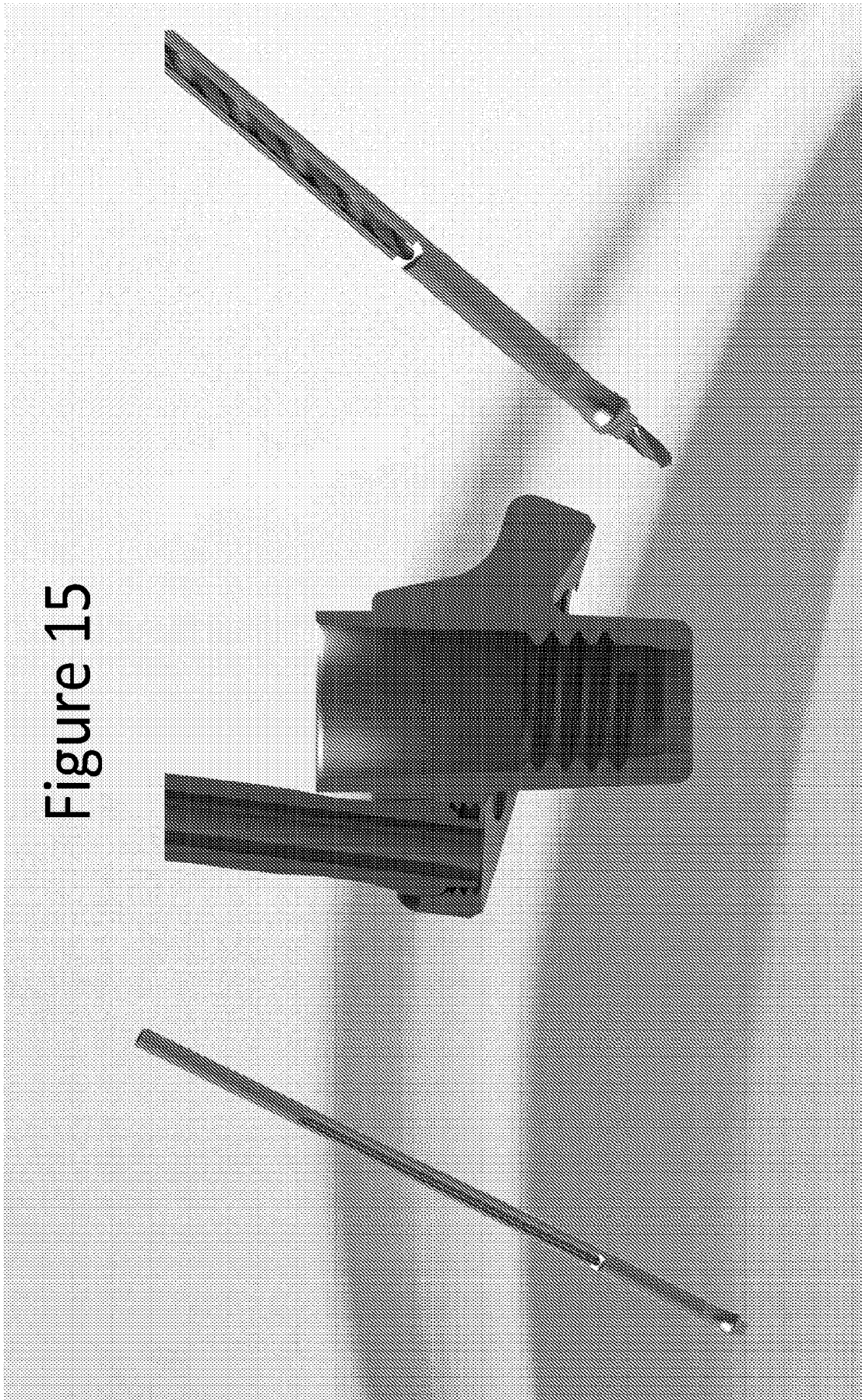


Figure 16

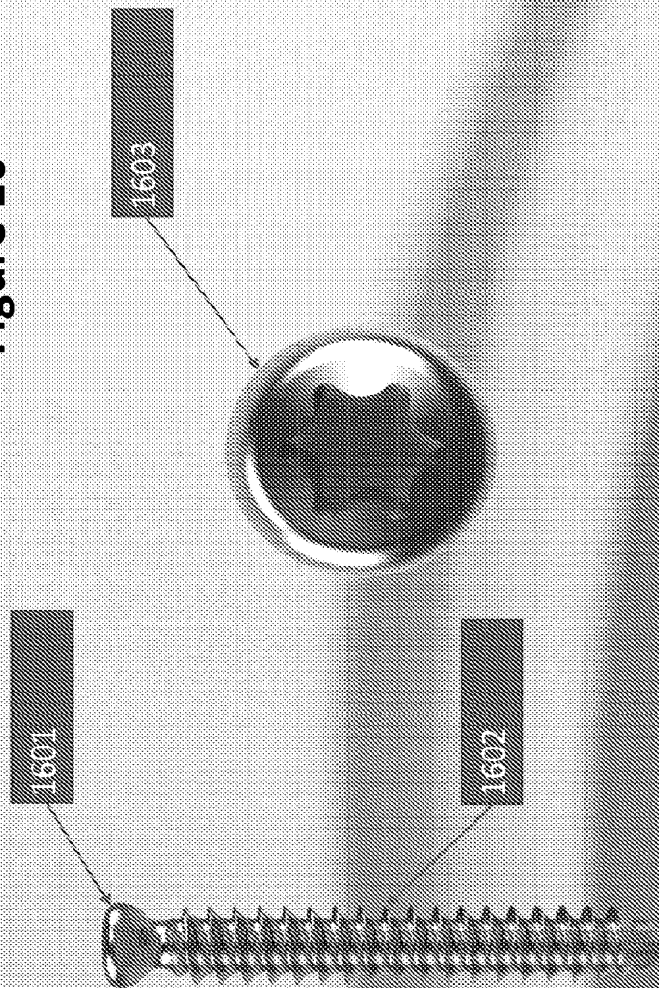




Figure 17





Figure 18

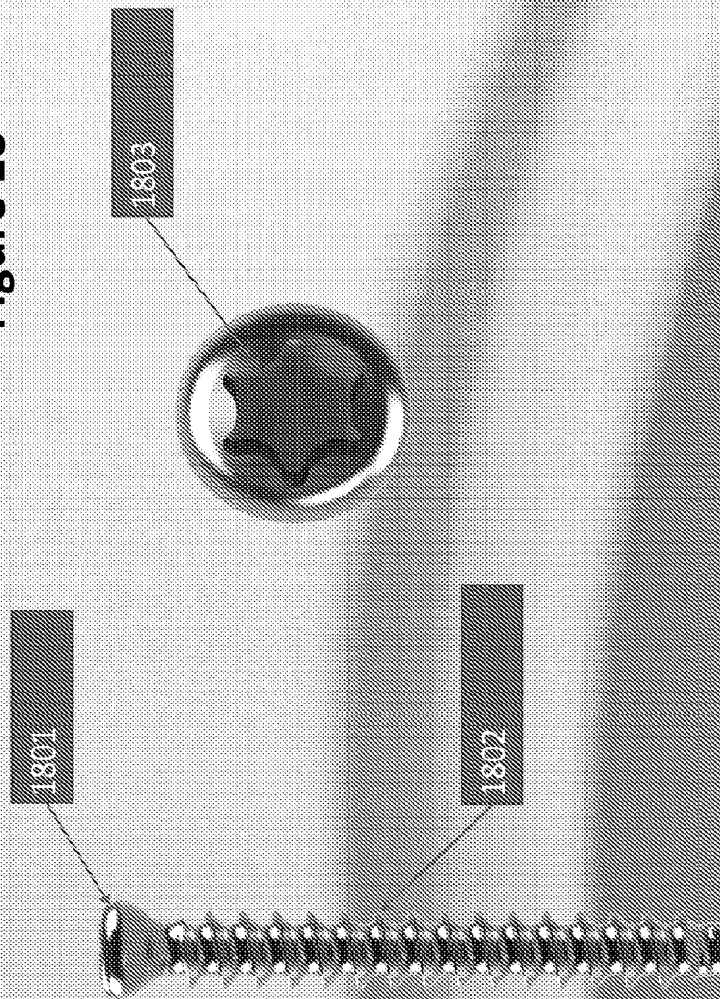
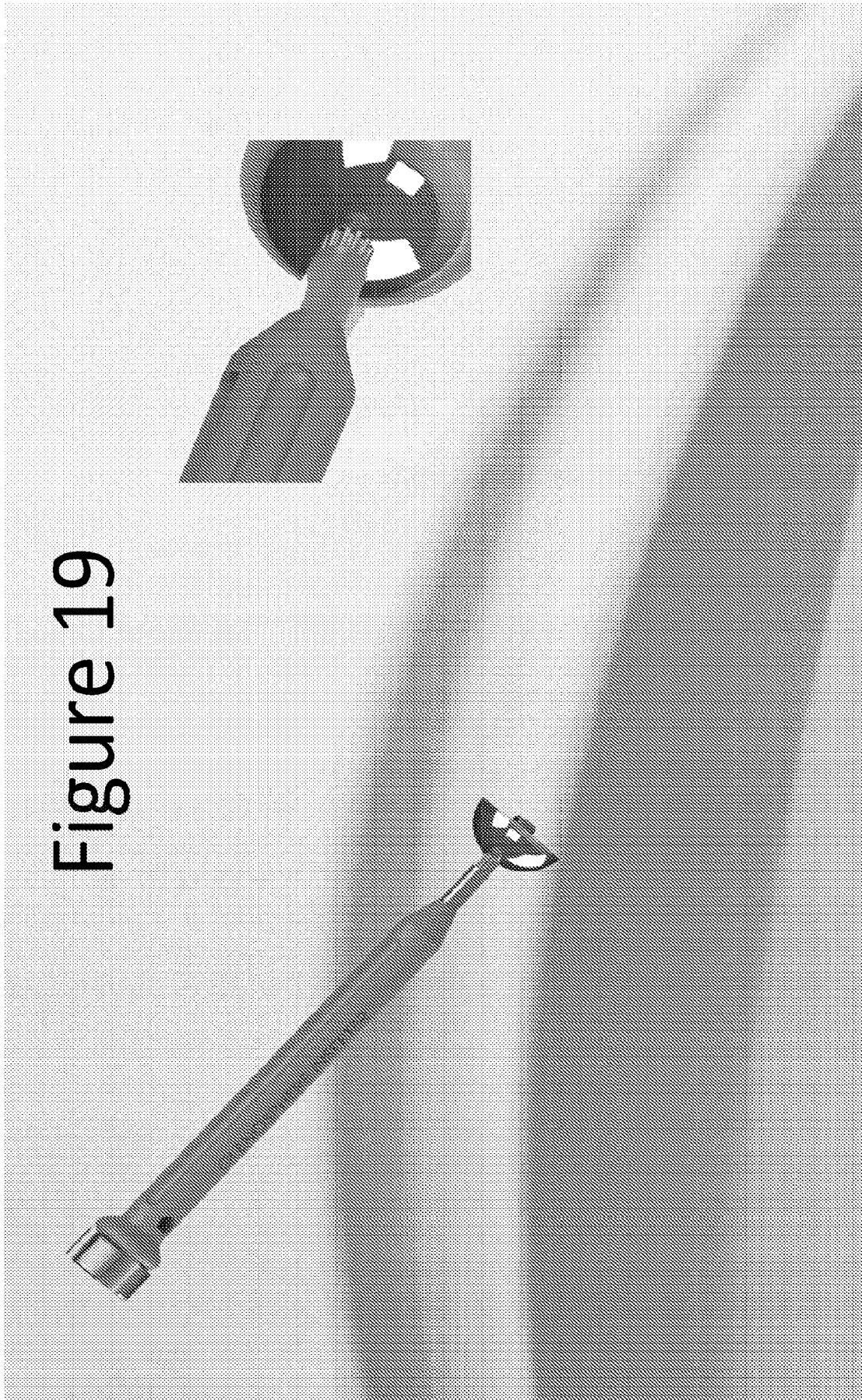


Figure 19



# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 20/22094

## A. CLASSIFICATION OF SUBJECT MATTER

IPC - A61F 2/40, A61F 2/30 (2020.01)

CPC - A61F 2/4081, A61F 2002/30405, A61F 2002/4085, A61F 2002/30367, A61F 2002/30011, A61B 17/8033, A61F 2/40, A61F 2/4014, A61F 2/4003, A61F 2002/4022

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)

See Search History document

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

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category*     | Citation of document, with indication, where appropriate, of the relevant passages                                     | Relevant to claim No.                         |
|---------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| X<br>---<br>Y | US 2018/0078377 A1 (Tornier, Inc.) 22 March 2018 (22.03.2018) entire document, especially title, abstract.             | 1-2, 4-9, 12-14<br>-----<br>1-3, 10-11, 15-16 |
| Y             | WO 2018/022227 A1 (Tornier, Inc.) 01 February 2018 (01.02.2018) entire document, especially title, abstract.           | 1-3, 11                                       |
| Y             | US 2018/0071104 A1 (Biomet Manufacturing, LLC) 15 March 2018 (15.03.2018) entire document, especially title, abstract. | 10                                            |
| Y             | US 2008/0177327 A1 (Malandain et al.) 24 July 2008 (24.07.2008) entire document, especially title, abstract.           | 15-16                                         |
| A             | US 2018/0161169 A1 (Tornier) 14 June 2018 (14.06.2018) entire document, especially title, abstract.                    | 1-16                                          |
| A             | US 9,283,083 B2 (Winslow et al.) 15 March 2016 (15.03.2016) entire document, especially title, abstract.               | 1-16                                          |
| A             | US 9,545,312 B2 (Tornier SAS) 17 January 2017 (17.01.2017) entire document, especially title, abstract.                | 1-16                                          |

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

|                                                                                                                                                                         |                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| * Special categories of cited documents:                                                                                                                                | "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                                              |
| "A" document defining the general state of the art which is not considered to be of particular relevance                                                                | "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                                                                     |
| "D" document cited by the applicant in the international application                                                                                                    | "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 |
| "E" earlier application or patent but published on or after the international filing date                                                                               | "&" document member of the same patent family                                                                                                                                                                                                    |
| "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                                                                  |                                                                                                                                                                                                                                                  |

Date of the actual completion of the international search

20 May 2020

Date of mailing of the international search report

12 JUN 2020

Name and mailing address of the ISA/US

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Facsimile No. 571-273-8300

Authorized officer

Lee Young

Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

CATALYST, EX-1005

PAGE 46

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 20/22094

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                               | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | US 2017/0273806 A1 (Tornier) 28 September 2017 (28.09.2017) entire document, especially title, abstract.         | 1-16                  |
| A         | US 2018/0200067 A1 (Encore Medical, L.P.) 19 July 2018 (19.07.2018) entire document, especially title, abstract. | 1-16                  |
| A         | US 2012/0209392 A1 (Angibaud et al.) 16 August 2012 (16.08.2012) entire document, especially title, abstract.    | 1-16                  |

Form PCT/ISA/210 (continuation of second sheet) (July 2019)

**SPRUSON&FERGUSON****AUSTRALIA***Patents Act 1990***Statement of Grounds & Particulars of Opposition**

We, Ascension Orthopedics, Inc. an American company, of 8700 Cameron Road, Austin, Texas 78754, U.S.A., (hereinafter referred to as “the Opponent”) provide the following information in support of the Notice of Opposition filed 05 July 2012 in relation to Australian Accepted Patent Application No. 2006218936 (hereinafter referred to as “the Opposed Application”) for an alleged invention in the name of Shoulder Innovations, LLC (hereinafter referred to as “the Applicant”).

The grounds of opposition relied on by the opponent are as follows:-

**A. Grounds of Opposition****I. Ground 1: Section 59(b)**

The alleged invention is not a patentable invention because it does not comply with paragraphs 18(1) (a) or (b).

1. The alleged invention, so far as claimed in any claim, was made publicly available in Australia before the priority date of that claim;
2. The alleged invention, so far as claimed in any claim, was obvious and did not involve an inventive step, having regard to what was known or used in Australia on or before the priority date of that claim;
3. The alleged invention, so far as claimed in any claim was, before the priority date of that claim, otherwise not novel in Australia; and
4. The alleged invention, so far as claimed in any claim, is not a manner of new manufacture within the meaning of Section 6 of the Statute of Monopolies.

**II. Ground 2: Section 59(c)**

The specification filed in respect of the opposed application does not comply with Sub-Sections 40(2) or (3).

The Opponent reserves the right to contest the claim to the priority date of 25 February 2005, the entitlement of the claims as accepted to the priority date of the opposed application as filed.

## **B. The Particulars of the Opposition**

### **I. Particulars for Ground 1**

- A. The following documents were available to the public before the priority date of the claims or has an Australian priority date earlier than that of the Opposed Application:
1. US 2004/0220674 which was published on 4 Nov, 2004
  2. Extract from Lima-Lto Medical Systems product catalogue, which was published in February 2001
  3. PowerPoint document entitled 'Shoulder Prosthesis Design Evolution' which is dated 4 August 2000 and which was published via presentation by Mr Paolo Dalla Pria at the Naples International Shoulder Congress, Naples, Italy, 2000
  4. Pre-operative letter from Dr Mark Ross to Dr Lawrence Malisano dated 26<sup>th</sup> October 2000
  5. Post-operative notes written by Dr Phillip Duke documenting an operation performed on a patient by Dr Mark Ross on 5 February 2001
  6. Post-operative letter from Dr Mark Ross to Dr Lawrence Malisano dated 5<sup>th</sup> February 2001
  7. Product stickers from the back of the post-operative notes written by Dr Phillip Duke on 5 Feb 2001, of item 5 above.
  8. Post-operative X-ray of a glenoid implanted in the glenoid surface of the patient dated 15 January 2002
  9. Extract of Figure 16-27 from 'The Shoulder', Charles A. Rockwood and Frederick A. Matsen, 2<sup>nd</sup> Edition, 1998
  10. Abstract from 2006 SESA Conference Handbook, included as evidence of details of operations performed by Dr Mark Ross since 2001
  11. PowerPoint document entitled 'SMR Shoulder Operative/Video Presentations' which was presented by Dr Mark Ross at an international conference in Rome, Italy, 2003



- B. The alleged invention as claimed is not patentable as it is not novel when compared with the prior art base as it existed in Australia before the priority date of the claims.

The independent claim of the application defines a method for repairing a shoulder joint of a patient, the method comprising the following steps:

- 1(a) (a) identifying a patient having a glenoid surface;
- 1(b) (b) reaming a cavity into the glenoid surface; and
- 1(c) (c) implanting a glenoid implant having a body and a peg,
- 1(d) the body having a bearing surface on a peripheral edge thereof into the cavity,
- 1(e) such that at least a portion of the peripheral edge of the body resides below the adjacent glenoid surface and is circumferentially surrounded by cortical bone of the glenoid.

The relevant prior art base includes a number of shoulder operations performed by Dr Mark Ross, an orthopaedic surgeon, at the Brisbane Hand and Upper Limb Clinic, QLD, Australia between February 2001 and February 2005.

The operations performed by Dr Ross include a shoulder arthroplasty operation performed on a male patient at The Brisbane Hand and Upper Limb Clinic, QLD, Australia on 5 February 2001 in the presence of several persons. These persons include Dr Ross' fellow surgeon, Dr Phillip Duke, as supported by item 5 above.

The operation involved the implantation of a polymeric glenoid having a circular body and a central peg into the glenoid surface of the patient such that it was recessed within the glenoid surface. The particulars of the operation are discussed in items 4 and 5 above.

In particular, the operation performed on 5 February 2001 involved a method for repairing a shoulder joint of a patient, (shoulder arthroplasty or 'total shoulder replacement') as supported by items 4 and 5 listed above.

The operation included the step of identifying a patient having a glenoid surface. This step involved carrying out an ultrasound and a CT scan on the shoulder of the patient prior to the operation taking place, as supported by item 4 above. The patient was subsequently admitted for surgery, as supported by the post-operational note and letter of items 5 and 6 above. The glenoid surface was accessed through an anterior delto-pectoral approach as supported by item 6 listed above. The operation therefore included feature 1(a) above.

The operation included the step of reaming a cavity into the glenoid surface (feature 1(b)), as supported by item 6 above.

Dr Ross then implanted a glenoid implant into the cavity (feature 1(c)). The glenoid used was a product named 'miniglenoid' that was produced by an Italian company, Lima-Lto s.p.a. The miniglenoid had a product number of 7560.50.030 as supported by item 7 above. The product Lot no.00489 is shown in item 7 above to have a date of manufacture of 1999. The miniglenoid was made available to the public in the product catalogue of Lima-Lto, an example of which from February 2001 is shown in item 2 above.

The miniglenoid used in the operation comprised a body and a peg (feature 1(c)), as shown in the photograph of the miniglenoid in slide 53 of the 2000 presentation given by Lima-Lto engineer Paolo Dalla Pria, seen in item 3 above. The body of the glenoid is shown in the photograph to have a bearing surface on a peripheral edge thereof (feature 1(d)). Dr Ross described the glenoid used in the operation in item 10 above as being a poly 20mm diameter circular glenoid with a single 8mm x 10mm central peg. The post-operative X-ray of the patient seen in item 8 listed above also shows that the glenoid used by Dr Ross on 5 February 2001 has each of the features 1(c) and 1(d) of claim 1.

The miniglenoid was implanted by Dr Ross into the glenoid cavity such that at least a portion of the peripheral edge of the body resided below the adjacent glenoid surface and is circumferentially surrounded by cortical bone of the glenoid (feature 1(e) above). This is supported by item 8 listed above.

As such, Dr Ross performed each of the steps of at least claim 1 of the alleged invention in respect of a single operation before the priority date of the claims.

- C. The invention as claimed in claims 1 to 22 does not involve an inventive step when compared with documents 1 to 11 listed at A above and in light of the common general knowledge as it existed in the patent area before the priority date of the claims.

In particular, the alleged invention as claimed in at least claim 1 lacks an inventive step over the common general knowledge of the person skilled in the art in Australia in light of either the prior art item 3 listed above or the prior art item 11 listed above or the patent publication of item 1 listed above.

The independent claim of the application defines a method for repairing a shoulder joint of a patient, the method comprising the following steps:

- 1(a) (a) identifying a patient having a glenoid surface;
- 1(b) (b) reaming a cavity into the glenoid surface; and

1(c) (c) implanting a glenoid implant having a body and a peg,

1(d) the body having a bearing surface on a peripheral edge thereof into the cavity,

1(e) such that at least a portion of the peripheral edge of the body resides below the adjacent glenoid surface and is circumferentially surrounded by cortical bone of the glenoid.

The relevant prior art base includes the common general knowledge of a person of ordinary skill in the art and includes, but is not limited to the following:

A method for repairing a shoulder joint of a patient, said method comprising:

1(a) (a) identifying a patient having a glenoid surface;

1(b) (b) reaming a cavity into the glenoid surface; and

1(c) (c) implanting a glenoid implant having a body and a peg,

1(d) the body having a bearing surface on a peripheral edge thereof into the cavity,

1(e) such that at least a portion of the peripheral edge of the body resides below the adjacent glenoid surface and is circumferentially surrounded by cortical bone of the glenoid.

The person skilled in the art in Australia is considered to be a doctor specialising in the field of shoulder surgery, including the repair of shoulder joints. It is well within the common general knowledge of such a person skilled in the art to identify a patient having a glenoid surface (feature 1(a)), as this is a routine and essential step of the task of repairing a patient's shoulder joint.

It is also within the common general knowledge of the person skilled in the art in Australia to ream a cavity into the glenoid surface (feature 1(b)), prior to implanting a glenoid, as evidenced by item 9 above, which is an extract from a well-known textbook in the field of shoulder repair that was published before the priority date of the claims. Figure 16-27 illustrates and describes the act of reaming the glenoid surface in preparation of the implantation of a glenoid into the glenoid surface (feature 1(b)). This figure also shows a glenoid having a body and a peg, the body having a bearing surface on a peripheral edge thereof, and a cavity in the glenoid surface for receiving the peg of the implanted glenoid (features 1(c) and 1(d)).

Furthermore, a glenoid having the features 1(c) and 1(d) had already been disclosed to the public before the priority date of the claims. For example, a glenoid having a body and a peg, the body having a bearing surface on a peripheral edge thereof was disclosed at a public conference in Naples, 2000 by Mr Paolo Dalla Pria of Lima-Lto, see slide 53 of item 3 listed above. The 2000 presentation of Mr Dalla Pria furthermore clearly shows in slide 53 that the glenoid is implanted into a cavity in the glenoid surface such that at least a portion of the peripheral edge of the body resides below the adjacent glenoid surface and is circumferentially surrounded by cortical bone of the glenoid (feature 1(e)).

Furthermore, the glenoid was again disclosed at a public conference in Rome, 2003 by Dr Mark Ross, see slide 24 of item 11 listed above. The 2003 presentation of Dr Ross furthermore clearly shows in slides 25 and 29 that the glenoid is implanted into a cavity in the glenoid surface such that at least a portion of the peripheral edge of the body resides below the adjacent glenoid surface and is circumferentially surrounded by cortical bone of the glenoid (feature 1(e)). Slides 26 to 28 of the presentation of item 11 discuss the benefits of recessing the implant in the glenoid surface. These benefits include load sharing and the minimisation of eccentric loading, and therefore address the stated objective of the alleged invention of reducing shear stresses from the body out to the circumferential cortical support, improving fixing strength.

A further presentation that included the material of item 11 above was given by Dr Ross at a meeting of the Queensland Shoulder Society in Brisbane, 2004. The presentation was given to many Australian delegates and its subject matter is considered to be within the common general knowledge of the person skilled in the art.

Furthermore, Figure 1 of US 2004/0220674 (item 1 listed above) clearly shows a glenoid implanted in a cavity in a glenoid surface, such that at least a portion of the peripheral edge of the body resides below the adjacent glenoid surface. The Figure shows that the portion of the peripheral edge seen in the sectional view is surrounded by cortical bone of the glenoid.

The person skilled in the art in Australia would have readily ascertained, understood and regarded as relevant each of the prior art items 1, 3 and 11 before the priority date of the claims of the alleged invention as follows.

Items 3 and 11 were presented at international conferences in the field of shoulder repair that were attended by a number of Australian delegates. The presentations are directly relevant to the field of the alleged invention and would have been readily understood by those delegates.

Item 1 is a US patent publication that is directly in the field of the alleged invention and the inventor, Mr Paolo Dalla Pria, is known in the field and has presented his work at at least one international conference, see item 3 listed above. The publication is readily available on the Espacenet database and the skilled person in Australia would have readily ascertained the document from the database, understood its content and regarded it as relevant to the technical field.

- D. The alleged invention as claimed is not a manner of new manufacture as required by paragraph 18(1) (a) of the Patents Act 1990 for the following reasons:

The alleged invention as claimed is nothing more than a mere working direction. The glenoid implant described in the above features 1(c) to 1(d) was in the public domain at the time of the priority date. The invention as claimed does nothing more than provide mere working directions for using the implant.

The alleged invention as claimed is also generally inconvenient. The claimed method, if it is patented, will prevent surgeons specializing in shoulder surgery in Australia from carrying out the task that they are ordinarily entitled to do, that is, the utilization of a product that is not subject to patent protection per se in Australia as it is intended to be used on a patient.

## **II. Particulars for Ground II**

The specification does not comply with sub-section 40(3) for the following reasons:

The claims are not clear or succinct. For example:

- (a) Claim 7 is unclear as it is not described as to with which component or feature the glenoid implant is secured using one or more screws.
- (b) Claim 8 is unclear as it is not described as to with which component or feature the humeral implant is secured.
- (c) Claim 22 is unclear as to the scope of the claimed thickness of the peripheral edge as the claimed range is considered to be vague.

### **The Opponent seeks the following relief:**

- (i) The refusal to grant a patent on this application
- (ii) The costs of these proceedings.

A copy of this Statement was served on the Applicant at its address for service by facsimile on 5 October 2012.

Our address for service is:-

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DATED this Fifth Day of October, 2012

**Ascension Orthopedics, Inc.**

Registered Patent Attorney



①⑨ RÉPUBLIQUE FRANÇAISE  
INSTITUT NATIONAL  
DE LA PROPRIÉTÉ INDUSTRIELLE  
PARIS

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**2 567 019**

②① N° d'enregistrement national : **84 10742**

⑤① Int Cl<sup>4</sup> : A 61 F 2/30.

①② **DEMANDE DE BREVET D'INVENTION**

**A1**

②② Date de dépôt : 6 juillet 1984.

③⑦ Priorité :

④③ Date de la mise à disposition du public de la  
demande : BOPI « Brevets » n° 2 du 10 janvier 1986.

⑥⑦ Références à d'autres documents nationaux appa-  
rentés :

⑦① Demandeur(s) : *FOURNIER Gilles.* — FR.

⑦② Inventeur(s) : Odile Doursounian.

⑦③ Titulaire(s) :

⑦④ Mandataire(s) :

⑤④ Mode de contention des pièces d'une endoprothèse articulaire.

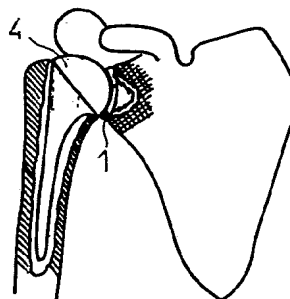
⑤⑦ La présente invention concerne un mode original de  
contention des pièces constituant une endoprothèse articulaire  
caractérisée par l'utilisation de matériaux aimantés de pôles  
opposés au niveau de la jonction des pièces de l'article.

Cette invention permet aux surfaces articulaires d'être en  
contact en permanence sans s'opposer à la liberté des mouve-  
ments et diminue les contraintes sur les ancrages osseux.

Les phénomènes de luxation des pièces articulaires sont  
ainsi évités par recentrage en permanence de la pièce mobile  
4 dans la pièce fixe 1 grâce à l'effet magnétique.

Cette invention peut être appliquée à toutes les articulations  
du corps humain ou des mammifères.

Les aimants utilisés peuvent également être de même pôle  
pour maintenir à distance les pièces de l'article et éviter les  
frottements.



**FR 2 567 019 - A1**

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Vente des fascicules à l'IMPRIMERIE NATIONALE, 27, rue de la Convention — 75732 PARIS CEDEX 15

**CATALYST, EX-1005**

**PAGE 56**

1.

La présente invention concerne un mode original de contention des constituants d'une endoprothèse articulaire destinés à être implantés chez les mammifères et en particulier, chez l'homme.

Le modèle proposé selon la présente invention est caractérisé par l'utilisation de matériaux aimantés au niveau de la jonction des pièces de l'article ; cette utilisation de matériaux aimantés permet le maintien d'un contact entre les pièces prothétiques sans s'opposer à leur mobilité.

Actuellement, les destructions des articulations squelettiques chez l'homme sont dans certains cas traitées par remplacement des surfaces articulaires.

Le remplacement des surfaces articulaires par endoprothèse pose de nombreux problèmes concernant :

- . la bio-compatibilité des matériaux.
- . les moyens d'union entre la prothèse et l'os.
- . le maintien d'un contact entre les pièces articulaires.

C'est sur ce dernier point que porte la présente invention.

Le maintien d'un contact entre les pièces articulaires est généralement obtenu de deux façons :

- 1) soit en utilisant des prothèses dont les constituants s'emboîtent de manière plus ou moins rétentive (par exemple, articulation de type rotule).
- 2) soit en comptant sur les parties molles environnantes (en particulier muscles) pour assurer la cohésion du système.

Ces deux systèmes présentent divers inconvénients :

- pour les endoprothèses rétentives, le problème essentiel est l'ancrage sur l'os ; car, alors, toutes les contraintes subies par l'articulation sont répercutées au niveau de l'interface entre l'os et la prothèse.
- pour les endoprothèses non rétentives, le problème essentiel est la stabilité de l'articulation elle-même. L'indépendance des pièces prothétiques l'une par rapport à l'autre, peut entraîner des défauts de centrage de l'articulation ou des luxations des pièces l'une par rapport à l'autre.

Le principe que nous avons mis au point selon l'invention offre une alternative nouvelle à l'union des pièces prothétiques entre elles.

Il consiste à réaliser les pièces articulaires prothétiques avec des matériaux aimantés qui permettront aux deux surfaces articulaires d'être en contact l'une avec l'autre sans que ce mode de contention ne s'oppose à la liberté des mouvements et sans que les contraintes sur l'ancrage osseux ne soient excessives.

Ce principe de contention selon l'invention permet d'éviter les phénomènes de luxation des pièces constituant l'articulation puisque l'effet magnétique recentre en permanence les pièces articulaires.

Ce principe peut s'appliquer à toutes les articulations du corps humain ou des mammifères et il trouve tout son intérêt dans les articulations anatomiquement peu emboîtées.

La description du principe selon l'invention est représentée sur la figure 5 ci-jointe, à titre d'exemple, dans une articulation scapulo-humérale schématisée, et sans échelle déterminée.

La figure 1 détaille la pièce glénoïdienne destinée à être implantée dans une omoplate, dans l'exemple considéré d'une articulation scapulo-humérale.

L'implantation dans l'os se fait par l'intermédiaire du téton d'ancrage (2).  
10 La partie aimantée pourra être soit la totalité de la surface glénoïdienne prothétique (1), soit une fraction de celle-ci, par exemple située au centre de celle-ci, de façon à recentrer en permanence les pièces articulaires.

La figure 2 détaille la pièce humérale dans l'exemple pris d'une articulation scapulo-humérale. L'ancrage dans l'humérus se fait à l'aide de la queue  
15 d'ancrage (3).

La tête humérale (4) prothétique sera donc aimantée en totalité ou en partie à l'aide d'un aimant de pôle opposé à celui se trouvant situé dans la cavité glénoïde (1).

La figure 3 montre la position des pièces articulaires une fois implantées  
20 dans l'humérus (5) et l'omoplate (6).

Le glissement des pièces articulaires peut éventuellement être facilité par recouvrement de la tête humérale (4) ou de la cavité glénoïdienne (1) à l'aide d'une matière facilitant le glissement et qui ne neutralise pas l'effet magnétique.

25 Enfin, notons que deux aimants de même pôle pourraient être utilisés dans certaines articulations pour maintenir à distance au contraire deux pièces articulaires et faciliter leur glissement l'une par rapport à l'autre en diminuant les forces de frottement.

Ceci pourrait être utilisé dans le cas des prothèses rétentives.

REVENDICATIONS

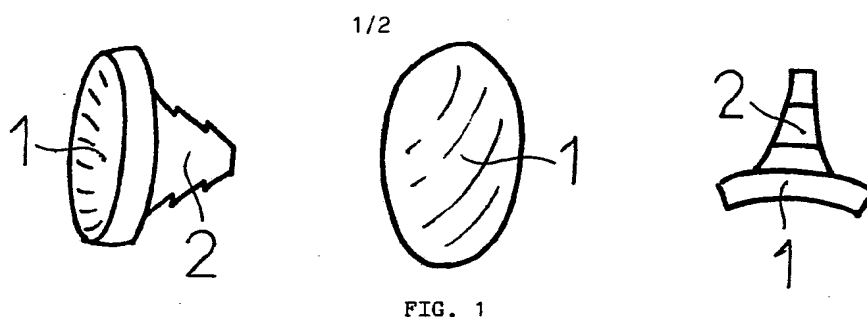
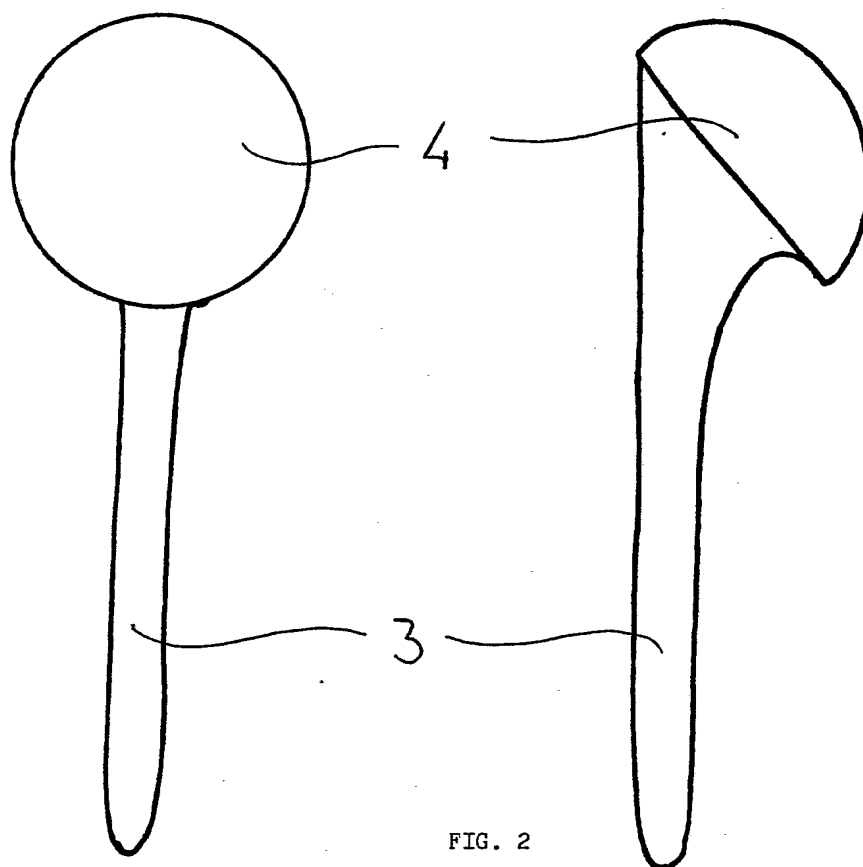
1. Endoprothèse articulaire, caractérisée en ce qu'elle comprend des matériaux aimantés, intégrés dans les pièces articulaires formant l'endoprothèse.

2. Endoprothèse aimantée selon la revendication 1 caractérisée en ce que la totalité ou une partie seulement des pièces articulaires peut être aimantée.

3. Endoprothèse aimantée selon la revendication 2 caractérisée en ce que les aimants utilisés peuvent être de pôle opposé ou semblable afin de maintenir les pièces de l'article l'une contre l'autre ou au contraire de les maintenir à distance selon le type d'articulation utilisé.

4. Application de l'endoprothèse selon l'une quelconque des revendications 1 à 3 pour une implantation à l'intérieur d'un organisme vivant humain ou animal.

5. Application de l'endoprothèse selon l'une quelconque des revendications 1 à 3 pour une implantation applicable à toutes les articulations du squelette humain ou animal.



2/2

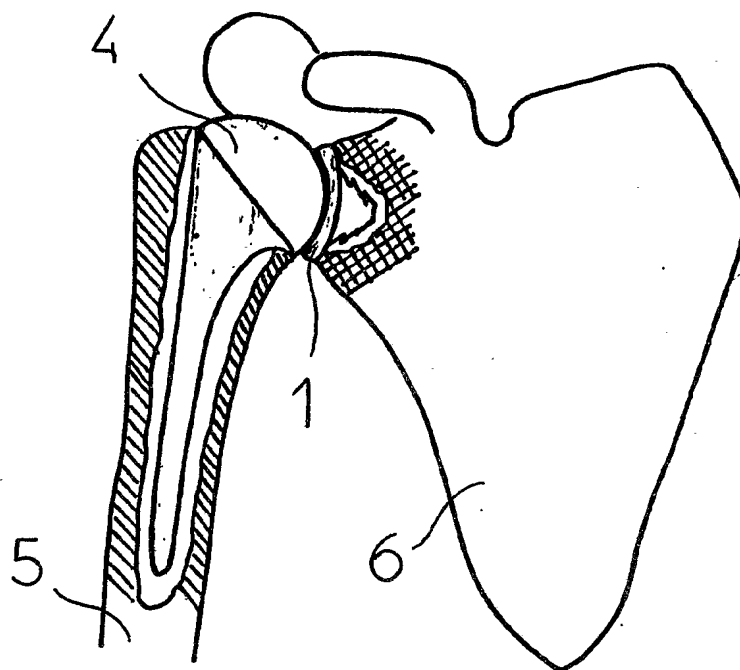


FIG. 3





⑮ **BUNDESREPUBLIK  
DEUTSCHLAND**



**DEUTSCHES  
PATENT- UND  
MARKENAMT**

⑫ **Offenlegungsschrift**  
⑩ **DE 101 64 328 A 1**

⑤① Int. Cl. 7:  
**A 61 F 2/40**

②① Aktenzeichen: 101 64 328.4  
②② Anmeldetag: 28. 12. 2001  
④③ Offenlegungstag: 17. 7. 2003

**DE 101 64 328 A 1**

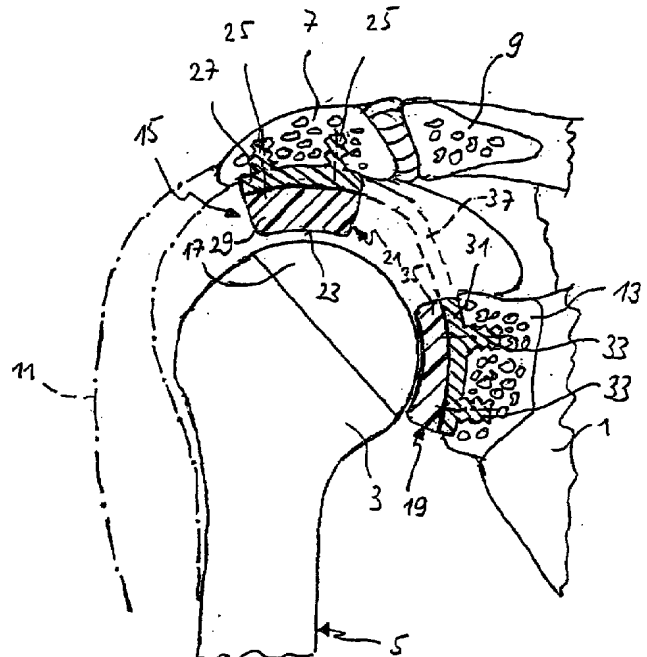
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**Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen**

⑤④ Subacromiale Prothese

⑤⑦ Bei fehlender Supraspinatussehne führt die beginnende Kontraktion des Deltamuskels (11) zu einer Dezentrierung des Humeruskopfs (3) und dementsprechend zu schmerzhaften Einklemmeffekten im subacromialen Raum (15). Um dies zu verhindern, wird vorgeschlagen, dass die Schultergelenkprothese ein im subacromialen Raum (15) unter Abstützung am Acromion (7) anzuordnendes Stützelement (21) umfasst, welches mit einer im Wesentlichen oberhalb des Humeruskopfs (3) gelegenen Auflagefläche (23) den Humeruskopf (3) bei der beginnenden Kontraktion des Deltamuskels (11) abstützt. Das Stützelement (21) ist zweckmäßigerweise über einen Fortsatz (37) mit einem die glenoidale Gelenkfläche bildenden Gelenkpfannenelement (19) zu einer Baueinheit verbunden, wodurch die Verankerung des Gelenkpfannenelements (19) im Knochenstock des Schulterblatthalses (13) verbessert wird.



**DE 101 64 328 A 1**

[0001] Die Erfindung betrifft eine Schultergelenkprothese.

[0002] In intaktem Zustand sorgt die Rotatorenmanschette des Schultergelenks für eine hinreichende Drehfixierung des Humeruskopfs in der Gelenkpfanne am Hals des Schulterblatts (Scapula). Das Schulterblatt übergreift mit einem seinerseits gelenkig mit dem Schlüsselbein (Clavicula) verbundenen Fortsatz (Acromion) den Humeruskopf dorsal von oben. An dem Acromion setzt der in erster Linie für die laterale Hubbewegung des Oberarmbeins verantwortliche Deltamuskel an, der sich der Gelenkpfanne (Glenoid) abgewandt längs des Oberarmbeins erstreckt. Der subacromiale Raum zwischen dem Acromion und dem Humeruskopf ist bei intaktem Schultergelenk durch die Sehne des Supraspinatusmuskels und einem Schleimbeutel (Bursa subdeltoidea) ausgefüllt. Aufgrund seiner der Gelenkpfanne entfernten Lage übt der Deltamuskel bei Kontraktion Schwenkkkräfte auf den Humeruskopf aus, die ihn exzentrisch gegen die Gelenkpfanne zu verkippen trachten und ihn gegen das Acromion ziehen. Ebenso gibt es ventral und dorsal kräftige Muskeln, die ebenfalls eine dezentralisierende Wirkung auf den Humeruskopf ausüben. Bei intakter Rotatorenmanschette wirkt diese den Aushebelbewegungen entgegen, indem sie den Humeruskopf drehpunktfixierend in die Gelenkpfanne hineinzieht. Bei der Implantation einer Humeruskopfprothese und ggf. einer Gelenkpfannenprothese fällt die Supraspinatussehne und ggf. der darüber liegende Schleimbeutel als drehpunktfixierendes Element des Schultergelenks vielfach weg mit der Folge von subacromialen Einklemm- und Schmerzphänomenen beim Anheben des Arms.

[0003] Unter einem ersten Aspekt ist es Aufgabe der Erfindung, eine die Drehpunktfixierung verbessernde Schultergelenkprothese anzugeben.

[0004] Kennzeichnend für eine erfindungsgemäße Schultergelenkprothese, die dieser Aufgabe gerecht wird, ist ein im subacromialen Raum unter Abstützung am Acromion anzuordnendes Stützelement mit einer im Wesentlichen oberhalb des Humeruskopfs gelegenen Auflagefläche zur Abstützung des Humeruskopfs. Das Stützelement (Subacromialprothese) übernimmt bei defekter oder fehlender Supraspinatussehne die anfängliche Drehpunktfixierung des Humeruskopfs relativ zur Gelenkpfanne und verhindert, dass der Deltamuskel den Humeruskopf bei beginnender Kontraktion unerwünscht weit zum Acromion hinzieht und Bereiche der Rotatorenmanschette eingeklemmt werden. Das Stützelement kann hierbei so bemessen sein, dass seine Auflagefläche auch in der Ruhelage des herabhängenden Arms am Humeruskopf anliegt. Im Prinzip genügt es jedoch, wenn die Auflagefläche in der herabhängenden Ruhestellung des Arms in geringem Abstand, beispielsweise einem oder mehreren Millimetern, vom Humeruskopf entfernt verläuft und erst bei beginnender Kontraktion des Deltamuskels am Humeruskopf drehpunktfixierend zur Anlage kommt.

[0005] Das erfindungsgemäße Stützelement wird zweckmäßigerweise in Situationen eingesetzt, bei welchen der Humeruskopf und ggf. auch die Gelenkpfanne durch eine Prothese ersetzt ist. Die Implantation des erfindungsgemäßen Stützelements kann aber auch ohne Prothetik des eigentlichen Schultergelenks eingesetzt werden, da die beginnende Deformation der Gelenkflächen des Humeruskopfs und der Gelenkpfanne vielfach bereits frühzeitig zu Schäden an der Supraspinatussehne und dem darüber liegenden Schleimbeutel führen. In beiden Fällen verbessert das Stützelement die Drehpunktfixierung des Humeruskopfs. Wird die Auflagefläche des Stützelements als Gleitfläche für den

Humeruskopf ausgebildet, so werden die zur Stabilisierung verfügbaren Gelenkflächen vergrößert, und dementsprechend wird die primäre Gelenkstabilität erhöht. Dies gilt insbesondere bei konkav geformter Auflagefläche des Stützelements.

[0006] Das Stützelement umfasst zweckmäßigerweise Mittel zur Befestigung am Acromion, insbesondere wenigstens ein zum Acromion hin vorstehendes Verankerungselement, z. B. in Form eines oder mehrerer Stege oder Zapfen, die in den Knochenstock des Acromions implantierbar sind. Unter einer Implantation soll jedoch hier und im Folgenden auch eine Verankerung durch Einzementieren, Kleben, Verwendung von Klammern oder dergleichen verstanden werden.

[0007] Die Fixierung des Gelenkpfannenelements (Glenoidprothese) einer Schultergelenkprothese am Hals des Schulterblatts ist infolge des geringen für die Befestigung zur Verfügung stehenden Knochenstockes schwierig und vielfach nicht hinreichend stabil. Die Stabilität der Fixierung des Gelenkpfannenelements einer Schultergelenkprothese kann beträchtlich verbessert werden, wenn das Stützelement und das Gelenkpfannenelement zu einer Baueinheit verbunden oder im Zuge der Implantation und unabhängig vom Knochenstock zu einer solchen Baueinheit verbindbar sind. Beispielsweise kann ein insbesondere aus Metall oder/und Kunststoff bestehendes Verbindungsglied das Stützelement und das Gelenkpfannenelement vorzugsweise biegesteif miteinander verbinden. Das am Acromion abgestützte Stützelement trägt zur besseren Fixierung des Gelenkpfannenelements am Schulterblatthals bei und verhindert zur Lockerung führende Verkippen des Gelenkpfannenelements.

[0008] Die verbesserte Fixierung des Gelenkpfannenelements im schulterblattseitigen Knochenstock erlaubt es, die dem Humeruskopf zugeordnete Gleitfläche des Gelenkpfannenelements verglichen mit herkömmlichen Glenoidprothesen zu vergrößern, und zwar in einem Ausmaß, dass die Umfangsbegrenzung der Gleitfläche zumindest bereichsweise über den schulterblattseitigen, zur Abstützung des Gelenkpfannenelements bestimmten Knochenstock seitlich übersteht. Insbesondere im Bereich des Verbindungsglieds kann auf diese Weise die Gleitfläche beträchtlich vergrößert werden.

[0009] Das Stützelement und das Gelenkpfannenelement können integral aus einheitlichem Material bestehen. Zweckmäßigerweise handelt es sich jedoch um eine Baueinheit in Verbundbauweise, bei welchem das Verbindungselement aus einem abstoßungsreaktionsfrei in den Knochenstock implantierbaren Material, z. B. Titan oder dgl., hergestellt ist, während die zur Abstützung am Humeruskopf bestimmten Bereiche des Stützelements bzw. des Gelenkpfannenelements aus geeigneten Gleitpaarungen wie z. B. Metall-Metall, Keramik-Keramik, Metall-Keramik, Polyethylen-Keramik, Polyethylen-Metall o. ä. bestehen.

[0010] Bevorzugt ist das Verbindungselement so ausgestaltet, dass es im Zuge der Implantation angepasst werden kann. Die Anpassung kann über justierbare Fügeelemente, Kupplungen oder dgl. erfolgen. Es kann aber auch vorgesehen sein, dass das Verbindungselement für Implantier-Anpasszwecke z. B. durch Verbiegen bleibend deformierbar ist. So kann z. B. das Verbindungselement aus thermoplastischem Kunststoffmaterial bestehen, das zur Anpassung auf seine Erweichungstemperatur erwärmt wird.

[0011] Vorangegangen wurden die auf Grund der subacromialen Abstützung und Fixierung des Gelenkpfannenelements sich ergebenden Vorteile einer verbesserten Fixierung des Gelenkpfannenelements im Knochenstock und der Möglichkeit, die Gelenkfläche zur Erhöhung der primären

Gelenkstabilität zu vergrößern, unter dem ersten Aspekt der Erfindung in Verbindung mit einem dem Humeruskopf zugeordneten Stützelement erläutert. Die sich aus der verbesserten Fixierung des Gelenkpfannenelements (Glenoidprothese) ergebenden Vorteile lassen sich unter einem zweiten Aspekt der Erfindung, der vom ersten Aspekt unabhängige erfinderische Bedeutung hat, auch dann erreichen, wenn die Schultergelenkprothese kein Stützelement hat, das Gelenkpfannenelement jedoch einen bis in den acromialen Raum reichenden, am Acromium abstützbaren Fortsatz aufweist. Der Fortsatz entspricht in seinem Aufbau und seiner Wirkungsweise dem vorstehend erläuterten Verbindungselement und wird seinerseits am Acromium fixiert, wie dies vorangegangen für das Stützelement erläutert wurde. Insbesondere kann der Fortsatz Mittel zur Befestigung am Acromium umfassen, beispielsweise wiederum wenigstens ein zum Acromium vorstehendes, in diesem befestigbaren Verankerungselement, beispielsweise in Form einer Schraube, einer Klammer oder eines Klemnteils ähnlich einem "Press-Fit"). Es versteht sich, dass der Fortsatz ähnlich dem Stützelement ggf. auch einzementiert oder angeklebt werden kann. Die vorangegangen für das Verbindungselement erläuterten Ausgestaltungen lassen sich auch bei dem Fortsatz einsetzen.

[0012] Im Folgenden werden Ausführungsbeispiele der Erfindung anhand einer Zeichnung näher erläutert. Hierbei zeigt

[0013] **Fig. 1** eine schematische Schnittansicht einer Schultergelenkprothese gemäß einem ersten Aspekt der Erfindung im implantierten Zustand und

[0014] **Fig. 2** eine schematische Schnittansicht einer Schultergelenkprothese gemäß einem zweiten Aspekt der Erfindung, gleichfalls im implantierten Zustand.

[0015] **Fig. 1** zeigt schematisch das Schulterblatt **1** (Scapula), das im Humeruskopf **3** endende Oberarmbein **5**, das vom Schulterblatt **1** ausgehende und den Humeruskopf **3** dorsal und von oben her im Abstand übergreifende Acromion **7** und das gelenkig mit dem Acromion **7** verbundene Schlüsselbein **9** (Clavicula). Bei **11** ist der am Acromion **7** ansetzende, das Oberarmbein **5** hebende Deltamuskel angedeutet.

[0016] Bei intaktem Schultergelenk gleitet der Humeruskopf **3** mit einer kugeligen Gelenkfläche in der konkaven Gelenkfläche einer an einem Hals **13** des Schulterblatts **1** ausgebildeten Gelenkpfanne. Für die Drehpunktfixierung des Humeruskopfs **3** in dieser Gelenkpfanne sorgt neben anderen Bändern der Rotatorenmanschette der Supraspinatusmuskel, dessen humeruskopfseitige Sehne sich von der Seite des Schulterblatts **1** her durch den zwischen dem Acromion **7** und dem Humeruskopf **3** gebildeten subacromialen Raum **15** hindurch erstreckt und der Gelenkpfanne gegenüberliegend auf der Aussenseite des Humeruskopfs **3** angreift. Ein Schleimbeutel (Bursa subdeltoidea) überdeckt die Sehne des Subraspinatusmuskels zum Acromion **7** und zum Deltamuskel **11** hin.

[0017] Bei Implantation einer Schulterprothese, bei welcher ein oder beide Gelenkteile ersetzt werden, sind in aller Regel die Supraspinatussehne oder andere Teile der Rotatorenmanschette nicht mehr vorhanden. Wie in **Fig. 1** als Beispiel schematisch dargestellt, kann die Gelenkfläche des Humeruskopfs **3** durch eine z. B. als Kugelkalotte ausgebildete Kopfprothese **17** ersetzt sein, und anstelle der gelenkidalen Gelenkfläche des Schulterblatts **1** kann ein hohlkugelig gekrümmtes Gelenkpfannenelement **19** (Glenoidprothese) in den Hals **13** des Schulterblatts **1** implantiert sein. Mit beginnender Kontraktion des Deltamuskels **11** reichen die Haltekräfte der verbliebenen Rotatorenmanschette vielfach nicht aus, um den Humeruskopf **3** in dem Gelenkpfannenelement

**19** zu halten. Der Humeruskopf **3** weicht damit nach oben zum Acromion **7** hin aus, was zu schmerzhaften Einklemmeffekten sowie durch exzentrischen Druck auf die implantierte Glenoidprothese zu deren Lockerung führen kann.

[0018] Defekte der vorstehend erläuterten Art werden vermieden, wenn gemäß der Erfindung im subacromialen Raum **15** ein Stützelement **21** implantiert wird, welches sich einerseits am Acromion **7** abstützt und andererseits dem Humeruskopf **3**, insbesondere der Gelenkfläche seiner Kopfprothese **17** mit einer Stützfläche **23** in geringem Abstand von einem oder einigen wenigen Millimetern gegenüberliegt oder aber ständig an der Kopfprothese **17** anliegt. Bei beginnender Kontraktion des Deltamuskels **11** hält das Stützelement **21** den Humeruskopf **3** im Wesentlichen drehpunktfixiert fest. Einklemmeffekte der vorstehend erwähnten Art oder auch Kippdeformationen an dem Gelenkpfannenelement **19** werden auf diese Weise vermieden.

[0019] Das Stützelement **21** verbessert damit die Drehpunktfixierung des Humeruskopfs **3**. Seine Stützfläche **23** ist zweckmäßigerweise konkav gewölbt und bildet eine zusätzliche, den Humeruskopf **3** gleitfähig stützende Gelenkfläche.

[0020] Ähnlich Gelenkpfannenelementen herkömmlicher Schulterendoprothesen, wie sie beispielsweise in DE 39 17 285 A1 oder EP 0 328 854 A1 beschrieben sind, kann das Stützelement **21** einteilig oder als Verbundelement z. B. welches aus einem der Verankerung dienenden Basisteil **27** und einem die Stützfläche **23** bildenden Auflageteil **29** besteht, ausgebildet sein. Es wird durch eine geeignete Befestigung z. B. Verankerungsvorsprüngen **25** oder Schrauben, Klammern oder aber durch Zementierung oder Klebung aber auch Klemmung im Sinne eines Press-Fits oder ähnlich an der Acromionunterseite befestigt und bildet zum Humeruskopf bzw. zu dessen endoprothetischem Ersatz eine geeignete Gelenkfläche aus. Die Gelenkfläche kann Teil einer z. B. aus Metall-Metall, Keramik-Keramik, Metall-Keramik, Polyethylen-Keramik, Polyethylen-Metall-Gleitpaarungen sein. Im Ausführungsbeispiel der **Fig. 1** wird die konkave Gelenkfläche durch eine Auflage **35** aus dem Material der Gleitpaarungskomponente gebildet.

[0021] Das Stützelement **21** wurde vorangegangen im Zusammenhang mit einer Schulterendoprothese erläutert. Soweit lediglich die Supraspinatussehne oder die Rotatorenmanschette geschädigt ist, kann das Stützelement **21** auch bei ansonsten hinreichend intaktem Schultergelenk implantiert werden.

[0022] Bei dem in **Fig. 1** dargestellten Ausführungsbeispiel ist das Gelenkpfannenelement **19** als vom Stützelement **21** gesondertes Bauteil ausgebildet und ist auch gesondert von dem Stützelement **21** am Hals **13** des Schulterblatts **1** fixiert. Das Gelenkpfannenelement **19** umfasst ähnlich dem Stützelement **21** ein Basisteil **31**, welches mit Verankerungsfortsätzen **33**, beispielsweise in Form von Zapfen oder Rippen oder dgl., im Knochenstock des Schulterblatthalses **13** oder durch Schrauben, Klammern oder Zementierung, Klebung aber auch Klemmung im Sinne eines Press-Fits oder dergleichen verankert ist.

[0023] Der zur Verankerung des Gelenkpfannenelements **19** zur Verfügung stehende Knochenstock ist vergleichsweise gering. Bei Drehpunktabweichungen übt der Humeruskopf **3** Kippkräfte auf das Gelenkpfannenelement **19** aus, die bereits nach vergleichsweise kurzer Zeit zu einer Lockerung der Gelenkpfannenverankerung führen können. Die Verankerung des Gelenkpfannenelements **19** kann wesentlich verbessert werden, wenn es mit dem Stützelement **21** zu einer in sich selbst tragenden Baueinheit verbunden wird. Hierzu kann das im Knochenstock des Schulterblatthalses **13** zu verankernde Basiselement **31** mit einem in den sub-

acromialen Raum **15** hineinreichenden und dort das Stützelement **21** bildenden Fortsatz versehen sein, wie er in **Fig. 1** bei **37** gestrichelt angedeutet ist. Der Fortsatz **37** kann integral in das Basisteil **27** des Stützelements übergehen. Um die Implantation der Baueinheit zu erleichtern, kann die Verbindung im Bereich des Stützelements **21** oder/und des Gelenkpfannenelements **19**, ggf. auch dazwischen, lösbar sein, so dass die Elemente erst im Zuge der Implantation zu einer festen Baueinheit verbunden werden. Der Fortsatz **37** verbindet das Stützelement **21** und das Gelenkpfannenelement **19** hinreichend biegesteif miteinander, so dass die Verankerungsvorsprünge **25** des Stützelements **21** die Belastbarkeit des Gelenkpfannenelements **19** erhöhen. Darüber hinaus kann der Fortsatz **37** so gestaltet sein, dass er im Zuge der Implantation der Schulterprothese zur Anpassung an die Gestalt des Knochengerüsts bleibend deformierbar ist. Der Fortsatz **37** kann aus Metall, beispielsweise Titan, bestehen oder Metall in einem Verbund mit anderen Materialien enthalten und zur Anpassung an das Knochengerüst bleibend gebogen werden. Auch kann der Fortsatz **37** aus einem im Zuge der Implantation zur Anpassung erweichbaren thermoplastischen Kunststoffmaterial oder aber einem nach der Anpassung härtbaren Kunststoffmaterial bestehen.

[0024] Der am Acromion **7** fixierte Fortsatz **37** verbessert die Fixierung des Gelenkpfannenelements **19** im Knochenstock beträchtlich. Verglichen mit herkömmlichen Glenoidprothesen kann auf diese Weise die zur Stützung des Humeruskopfs **3** verfügbare Gelenkfläche beträchtlich vergrößert werden, was die primäre Gelenkstabilität der Schultergelenkprothese erhöht.

[0025] Die verbesserte Knochenfixierung einer Glenoidprothese durch zusätzliche Fixierung am Acromion lässt sich aber auch unabhängig von den mittels einer Subacromialprothese, d. h. des Stützelements, erreichbaren Vorteilen erzielen. **Fig. 2** zeigt eine Schultergelenkprothese gemäß einem zweiten Aspekt der Erfindung, bei welcher lediglich eine Glenoidprothese und ggf. eine Kopfprothese des Humeruskopfs vorgesehen ist, jedoch keine Subacromialprothese im Sinne des vorstehend erläuterten Stützelements. In den Figuren dargestellte funktionsgleiche Komponenten sind mit gleichen Bezugszahlen bezeichnet, in **Fig. 2** jedoch zur Unterscheidung mit dem Buchstaben a versehen. Zur Erläuterung des Aufbaus und der Wirkungsweise wird auf die Beschreibung der Komponenten **1–19**, **25** und **31–37** der **Fig. 1** Bezug genommen. Die Komponenten **21**, **23**, **27** und **29** fehlen.

[0026] **Fig. 2** zeigt eine Schultergelenkprothese mit einem Gelenkpfannenelement **19a** (Glenoidprothese), die wiederum am Hals **13a** des Schulterblatts **1a** in der vorstehend erläuterten Weise fixiert ist. Das Gelenkpfannenelement **19** weist einen Fortsatz **37a** auf, der bis in den subacromialen Raum **15a** hineinreicht und dort am Acromion **7a** seinerseits fixiert ist. Im Bereich des Gelenkpfannenelements **19a** sind zur Fixierung Fortsätze **33a** vorgesehen, während der Fortsatz **37a** mit Verankerungsvorsprüngen **25a** versehen ist. Die im Zusammenhang mit **Fig. 1** erläuterten Varianten der Verankerung bzw. Fixierung sind auch bei der Variante der **Fig. 2** einsetzbar.

[0027] Die zusätzliche Fixierung des Gelenkpfannenelements **19a** mittels des Fortsatzes **37a** am Acromion **7a** erlaubt es, die den Humeruskopf **3a** stützende Gelenkfläche **41** des Gelenkpfannenelements **19a** verglichen mit herkömmlichen Glenoidprothesen zu vergrößern. Insbesondere kann die Gelenkfläche **41** nunmehr auch über die Umfangsberandung des das Gelenkpfannenelement **19a** tragenden Knochenstocks, hier des Schulterblatthalses **13a**, vorstehen, ohne dass befürchtet werden muss, dass Gelenkkräfte das Gelenkpfannenelement **19a** aus seiner Verankerung aushe-

beln. Wie **Fig. 2** zeigt kann sich das Gelenkpfannenelement **19a** insbesondere längs des Fortsatzes **37a** weit über den Hals **13a** hinaus erstrecken und bis nahe an den subacromialen Raum **15a** heranreichen. Die Vergrößerung der konkaven Gelenkfläche **41** erhöht die primäre Gelenkstabilität des Schultergelenks.

[0028] Das in **Fig. 2** dargestellte Gelenkpfannenelement **19a** ist wiederum als Verbundelement ausgebildet, wobei auf dem als Basisteil dienenden Fortsatz **37a** ein die Gleitflächenpaarung der Gelenkfläche **41** bestimmendes Auflageteil **35a** angeordnet ist. Es versteht sich, dass die Komponenten **35a** und **37a** auch integral aus einheitlichem Material bestehen können.

[0029] Um den Fortsatz **37a** den räumlichen Verhältnissen des Knochengerüsts anpassen zu können, kann dieser mehrteilig justierbar gestaltet sein. Der Fortsatz **37a** kann aber auch so ausgebildet sein, dass er bleibend deformierbar ist. Bei Fortsätzen auf Metallbasis können diese so gestaltet sein, dass sie zu Anpassungszwecken bleibend verbogen werden können. Fortsätze aus thermoplastischem Material können durch Erwärmen auf Erweichungstemperatur bleibend verformt werden. Geeignet sind aber auch vorgeformte, jedoch deformierbare Fortsätze aus einem nachträglich, beispielsweise durch UV-Bestrahlung oder Wärmezufuhr oder Elektronenbestrahlung härtbaren Material.

#### Patentansprüche

1. Schultergelenkprothese, **gekennzeichnet durch** ein im subacromialen Raum (**1**) unter Abstützung am Acromion (**7**) anzuordnendes Stützelement (**21**) mit einer im Wesentlichen oberhalb des Humeruskopfs (**3**) gelegenen Auflagefläche (**23**) zur Abstützung des Humeruskopfs (**3**).
2. Schultergelenkprothese nach Anspruch 1, dadurch gekennzeichnet, dass das Stützelement (**21**) Mittel (**25**) zur Befestigung am Acromion (**7**) umfasst, insbesondere wenigstens ein zum Acromion (**3**) vorstehendes, in diesem befestigbares Verankerungselement aufweist.
3. Schultergelenkprothese nach Anspruch 1 oder 2, dadurch gekennzeichnet, dass sie zusätzlich ein dem Humeruskopf (**3**) zugeordnetes schulterblattseitig anzuordnendes Gelenkpfannenelement (**19**) umfasst.
4. Schultergelenkprothese nach Anspruch 3, dadurch gekennzeichnet, dass das Stützelement (**21**) und das Gelenkpfannenelement (**19**) zu einer Baueinheit verbunden oder verbindbar sind.
5. Schultergelenkprothese nach Anspruch 4, dadurch gekennzeichnet, dass das Stützelement (**21**) und das Gelenkpfannenelement (**19**) über ein Verbindungsglied (**37**) verbunden oder verbindbar sind und das Gelenkpfannenelement (**19**) vom Stützelement (**21**) gesondert Mittel (**33**) zur schulterblattseitigen Befestigung aufweist.
6. Schultergelenkprothese nach Anspruch 5, dadurch gekennzeichnet, dass das Verbindungsglied (**37**) aus Metall oder/und Kunststoff besteht.
7. Schultergelenkprothese nach Anspruch 5 oder 6, dadurch gekennzeichnet, dass das Verbindungsglied (**37**) für Implantier-Anpasszwecke bleibend deformierbar ist.
8. Schultergelenkprothese nach einem der Ansprüche 4 bis 7, dadurch gekennzeichnet, dass das Stützelement (**21**) und das Gelenkpfannenelement (**19**) im Wesentlichen biegesteif miteinander verbunden sind.
9. Schultergelenkprothese nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, dass die Auflageflä-

che (23) des Stützelements (21) als Gleitfläche für den Humeruskopf (3) ausgebildet ist.

10. Schultergelenkprothese nach einem der Ansprüche 1 bis 9, dadurch gekennzeichnet, dass die Auflagefläche (23) des Stützelements (21) konkav ist. 5

11. Schultergelenkprothese mit einem eine Gelenkfläche (41) zur Abstützung des Humeruskopfs (3a) definierenden, schulterblattseitig zu fixierenden Gelenkpfannenelement (19a), dadurch gekennzeichnet, dass das Gelenkpfannenelement (19a) einen bis in den acromialen Raum (15a) reichenden, am Acromion (7a) abstützbaren Fortsatz (37a) aufweist. 10

12. Schultergelenkprothese nach Anspruch 11, dadurch gekennzeichnet, dass der Fortsatz (37a) Mittel (25a) zur Befestigung am Acromion (7a) umfasst, insbesondere wenigstens ein zum Acromion (7a) vorstehendes, an diesem befestigbares Verankerungselement aufweist. 15

13. Schultergelenkprothese nach Anspruch 11 oder 12, dadurch gekennzeichnet, dass der Fortsatz (37a) aus Metall oder/und Kunststoff besteht. 20

14. Schultergelenkprothese nach einem der Ansprüche 11 bis 13, dadurch gekennzeichnet, dass der Fortsatz (37a) für Implantier-Anpasszwecke bleibend deformierbar ist. 25

15. Schultergelenkprothese nach einem der Ansprüche 3 bis 14, dadurch gekennzeichnet, dass das Gelenkpfannenelement (19; 19a) eine dem Humeruskopf (3; 3a) zugeordnete Gleitfläche (41) hat, deren Umfangsbegrenzung zumindest bereichsweise über den schulterblattseitigen, zur Abstützung des Gelenkpfannenelements (19; 19a) bestimmten Knochenstock (13; 13a) hinausragt. 30

16. Schultergelenkprothese nach Anspruch 15, dadurch gekennzeichnet, dass die Gleitfläche (41) zumindest im Bereich des Verbindungsglieds (37) bzw. des Fortsatzes (37a) über den Knochenstock (13; 13a) hinausragt. 35

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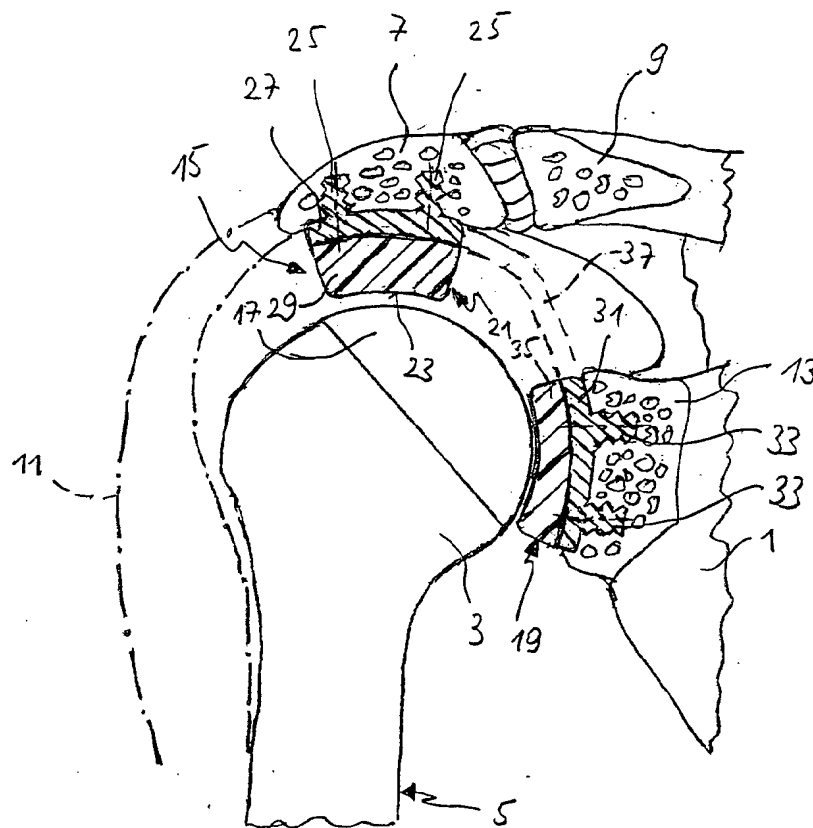


Fig. 1



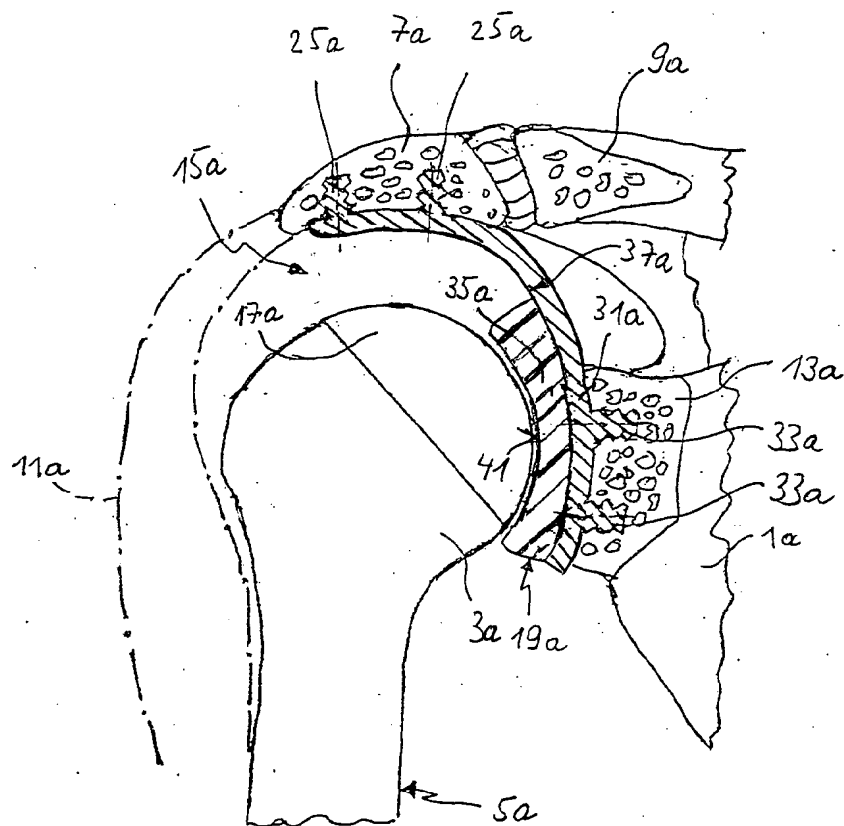


*Fig. 2*

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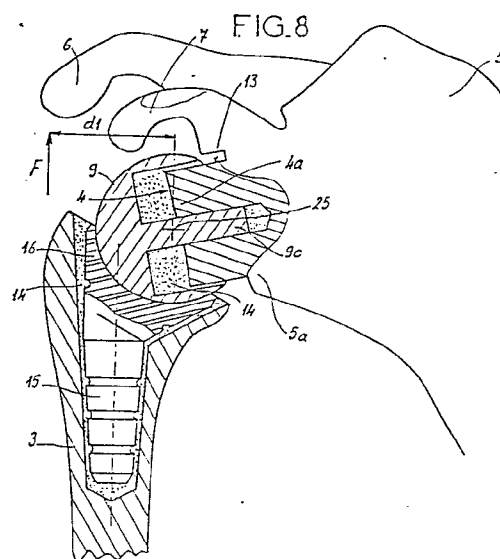
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**(54) Prothèse totale de l'épaule.**

(57) Cette prothèse est du type comportant un élément glénoïdien (9) constitué par une pièce mâle sphérique et destiné à être fixé à la glène (4) de l'omoplate et un élément huméral (15) constitué par une cupule sphérique (16), de même rayon que la pièce mâle sphérique constituant l'élément glénoïdien et solidaire, par sa face externe, d'une tige (17) destinée à être engagée et fixée dans la diaphyse humérale, après résection de l'extrémité supérieure de l'humérus (3).

La pièce mâle sphérique constituant l'élément glénoïdien (9) est évidée et présente une ouverture (9a) s'étendant sur environ deux tiers de sphère et destinée à être engagée et fixée sur la glène (4), tandis que la cupule sphérique (16) de l'élément huméral (15) s'étend sur environ un tiers de sphère



## Description

## "Prothèse totale de l'épaule"

La présente invention concerne une prothèse totale de l'épaule.

Hormis les tumeurs et les nécroses du sujet moyen, la grande majorité des épaules détruites et nécessitant la pose d'une prothèse le sont soit par des fractures comminutives de la tête chez le sujet âgé, dont la coiffe est souvent atteinte, soit par des omarthroses évoluées en luxations supérieures qui sont l'apanage des destructions totales de la coiffe. Or, aucune des prothèses de l'épaule actuellement connues ne donne satisfaction lorsque la coiffe de rotateurs est détruite ou endommagée car elles se contentent de reproduire les surfaces anatomiques de l'articulation, sans pallier l'absence de la coiffe.

Toutes ces prothèses comportent au moins un élément huméral constitué par une tête sphérique destinée à remplacer la tête de l'humérus, tête sphérique solidaire d'une tige destinée à être engagée et fixée dans le canal médullaire de l'humérus, après résection de son extrémité inférieure.

Lorsque la glène, en bon état, n'a pas nécessité la mise en place d'un élément glénoïdien en forme de cupule, la tête sphérique de l'élément huméral prend directement appui contre la glène.

On conçoit aisément que, dans ces conditions, en l'absence de coiffe fonctionnelle et compte tenu de la forte composante ascendante développée par le deltoïde en début d'abduction, l'élément huméral ne peut pas rester fixe et se subluxer vers le haut. Cette subluxation s'accompagne généralement d'une usure de la partie supérieure de la glène, engendrant une glénoïdite douloureuse et invalidante qui impose rapidement la pose d'un élément glénoïdien.

Cependant, si cet élément glénoïdien n'est pas fortement rétentif, les risques de subluxation vers le haut demeurent et si, par contre, il est fortement rétentif à l'égard d'une subluxation vers le haut, les efforts importants auxquels il est soumis risquent d'entraîner son descellement.

Il peut paraître surprenant, à première vue, que l'on ne puisse pas appliquer à l'articulation de l'épaule des prothèses procédant du même principe que celles utilisées avec succès pour restaurer des articulations de hanches.

Or, la différence provient, semble-t-il, du fait que chez l'homme, qui n'est pas un quadrupède, le fémur est porteur tandis que l'humérus ne l'est pas. Il en résulte, en effet, chez l'homme, que lorsque son bras est au repos le long de son corps, le plan tangent à la tête humérale et passant par le point de contact de cette dernière avec la glène est presque vertical de sorte qu'en début d'abduction, la force de traction que le deltoïde doit transmettre à l'humérus, surtout si le bras est chargé, est très élevée. Ce phénomène est d'ailleurs amplifié par le fait que le centre de rotation du bras, confondu avec le centre de la tête humérale, est éloigné de la glène et proche de l'axe de la diaphyse humérale.

C'est probablement à partir de ces observations qu'ont été conçues des prothèses telles que celles

connues par les brevets US 3 978 528 et DE 2 344 569 comportant un élément glénoïdien constitué par une pièce mâle sphérique et destiné à être fixé à la glène de l'omoplate et un élément huméral constitué par une cupule sphérique, de même rayon que la pièce mâle sphérique constituant l'élément glénoïdien et solidaire, par sa face externe, d'une tige destinée à être engagée et fixée dans la diaphyse humérale, après résection de l'extrémité supérieure de l'humérus. Cependant, dans ces prothèses connues, pour sa fixation à la glène de l'omoplate, la pièce sphérique de l'élément glénoïdien porte latéralement des piliers d'ancrage qui éloignent considérablement son centre de la glène, ce qui rend plus pénibles les mouvements d'abduction du bras en diminuant la longueur du bras de levier avec lequel le deltoïde agit sur l'humérus. En outre, rien n'est prévu pour permettre un choix de latéralisation de l'articulation en fonction de l'état des muscles et des tendons de cette articulation, ni pour lui procurer une rétentio suffisante pour au moins diminuer les risques de luxation.

La présente invention vise à remédier à tous ces inconvénients. A cet effet, dans la prothèse qu'elle concerne et qui est du type précité, la pièce mâle sphérique constituant l'élément glénoïdien est évidée et présente une ouverture s'étendant sur environ deux tiers de sphère et destinée à être engagée et fixée sur la glène, tandis que la cupule sphérique de l'élément huméral s'étend sur environ un tiers de sphère.

Ainsi, le centre d'articulation du bras se trouve fortement déporté en direction de la glène, ce qui favorise considérablement l'abduction du bras en augmentant la longueur du bras de levier avec lequel le deltoïde agit sur l'humérus.

La pièce sphérique évidée de l'élément glénoïdien peut être constituée par une simple calotte sphérique d'épaisseur de deux à cinq millimètres mais l'évidement de cette pièce sphérique peut aussi présenter la forme d'un cylindre dont le fond est destiné à prendre appui, directement ou non, contre la glène après que celle-ci ait été préparée par réalisation d'un cylindre d'encastrement centré sur elle, de même rayon que le logement cylindrique de la pièce sphérique et formé, surtout, en haut, dans le pied de l'apophyse coracoïde et, en bas, dans le pilier de l'omoplate.

La pièce sphérique de l'élément glénoïdien peut être en acier inoxydable, en céramique ou en alliage à base de titane ou de cobalt ou en tout autre produit biocompatible ou en un complexe résultant d'une combinaison de ces différents matériaux.

La pièce sphérique de l'élément glénoïdien et la cupule de l'élément huméral ont avantageusement un diamètre de quarante-deux millimètres.

De préférence, le plan de l'ouverture de la cupule de l'élément huméral fait, avec celui de l'axe de sa tige d'ancrage, un angle compris entre 55° et 70°, angle duquel doit être approchant celui que forme le plan de résection de l'humérus avec l'axe de sa

diaphyse.

La fixation à la glène de la sphère de l'élément glénoïdien ainsi que celle de l'élément huméral dans la diaphyse de l'humérus peuvent être améliorées par l'utilisation d'un ciment à os en petite quantité.

L'implantation de l'élément huméral est normalement précédée non seulement de la résection de la tête humérale suivant un plan formant, avec l'axe de sa diaphyse, un angle compris entre 55° et 70°, mais aussi d'une préparation du logement de la tige de cet élément au moyen de deux fraises coniques dont la dimension correspond à la taille de la tige de l'élément huméral considéré.

Au moins la face concave de la cupule de l'élément huméral est en un matériau présentant un faible coefficient de frottement par rapport au matériau constitutif de la face convexe de la pièce sphérique de l'élément glénoïdien.

Suivant une première forme d'exécution simple de l'invention, cet élément huméral est réalisé en polyéthylène de haute densité qui possède l'avantage de présenter un très faible coefficient de frottement à l'égard de la pièce sphérique de l'élément glénoïdien, quel qu'en soit le matériau constitutif.

Suivant une variante d'exécution de l'invention, l'élément huméral est constitué par deux pièces assemblées l'une à l'autre, à savoir un corps en matériau biocompatible comprenant une embase destinée à recevoir la cupule sphérique et solidaire de la tige d'ancrage dans la diaphyse humérale et une cupule présentant une cavité en forme de calotte sphérique, en matériau à faible coefficient de frottement par rapport à celui de la pièce sphérique de l'élément glénoïdien, les faces d'assemblage de la cupule et de l'embase du corps destinée à la recevoir étant agencées pour assurer à la fois leur centrage et leur fixation mutuelle.

De préférence, cet agencement est réalisé de manière à permettre leur fixation mutuelle de manière amovible.

Cet agencement a l'avantage de permettre de prévoir un jeu de cupules différentes présentant des cavités en forme de calotte sphérique d'ampleurs différentes et d'épaisseurs totales différentes.

Le praticien peut ainsi choisir, parmi les cupules de ce jeu, celle correspondant le mieux à la rétention et à la latéralisation désirée en fonction de l'état des muscles et des tendons du patient.

Par exemple, les faces d'assemblage de la cupule et de son embase aménagée sur le corps de l'élément huméral présentent des profils tronconiques complémentaires, respectivement mâle et femelle.

Les profils tronconiques complémentaires des faces d'assemblage de la cupule et de son embase sont avantageusement prolongées, du côté de leur grande base, par une portée cylindrique permettant d'améliorer la fixation de la cupule dans son embase, sans en altérer le caractère amovible.

La cupule est avantageusement en polyéthylène de haute densité et le corps est en acier inox, en titane ou en chrome-cobalt.

De toute façon, l'invention sera bien comprise à l'aide de la description qui suit, en référence au

dessin schématique annexé représentant, à titre d'exemple non limitatif, une forme d'exécution de cette prothèse totale de l'épaule :

Figure 1 est une vue de côté en élévation montrant l'articulation d'une épaule droite, avant restauration par cette prothèse :

Figure 2 est une vue de côté en élévation montrant l'élément glénoïdien seul ;

Figure 3 est une vue en coupe axiale d'une forme d'exécution particulière de l'élément glénoïdien ;

Figure 4 est une vue de côté en élévation de l'élément huméral ;

Figure 5 est une vue de côté en élévation, avec coupe partielle, montrant le mode de préparation de la zone glénoïdienne de l'omoplate, en vue de la mise en place de l'élément glénoïdien ;

Figures 6 et 7 sont des vues en coupe axiale de l'extrémité supérieure de l'humérus, après résection, illustrant les deux phases successives de sa préparation, en vue de la mise en place de l'élément huméral ;

Figure 8 est une vue de côté en élévation, avec coupe partielle, montrant l'articulation de figure 1 après mise en place de cette prothèse ;

Figure 9 est une vue en coupe axiale d'une variante d'exécution de l'élément huméral, dans le cas où il comporte une cupule amovible ;

Figure 10 est une vue similaire à figure 9 illustrant les effets du choix d'une cupule destinée à augmenter la latéralisation de l'articulation.

Figure 1 montre une articulation d'épaule droite, vue de face, avec la tête sphérique 2 d'un humérus 3 en appui contre la glène 4 d'une omoplate 5 dont on voit également l'acromion 6 et l'apophyse coracoïde 7.

Comme on peut le voir en examinant cette figure 1, la force F que doit exercer le deltoïde sur l'humérus en début d'abduction, c'est-à-dire en début de mouvement de rotation vers le haut en partant depuis la position normale de repos, le bras pendant à la verticale vers le bas, est très élevée car la distance d séparant la zone d'action du deltoïde sur l'humérus 3 et le centre 8 de la tête sphérique 2 de l'humérus 3 est très petite.

On conçoit aisément que lorsque la coiffe de cette épaule est détruite ou fortement endommagée au point de ne plus assurer la stabilité verticale de la tête 2 de l'humérus 3, la force F tend à provoquer une subluxation vers le haut de cette articulation.

L'objet de la présente invention est donc essentiellement d'allonger la longueur du bras de levier avec lequel le deltoïde agit sur l'humérus 3 ; elle vise par conséquent à augmenter la distance d.

La prothèse totale qu'elle concerne se compose d'un élément glénoïdien constitué essentiellement par une pièce sphérique 9 s'étendant sur environ deux tiers de sphère, représentée sur les figures 2 et 3 et qui est destinée à être fixée sur la glène 4 de l'omoplate 5 en étant fortement engagée sur le col 4a de la glène 4. Pour ce faire, d'une part, la pièce sphérique 9 présente une ouverture 9a, de préférence circulaire et, d'autre part, l'omoplate 5 est

préparée en réalisant, comme montré sur la figure 5, à l'aide d'une scie-cloche 11 coaxiale à une mèche de centrage 12, un cylindre d'encastrement 13 entourant la glène 4 et son col 4a. Comme le montre notamment cette figure 5, ce cylindre d'encastrement 13 pénètre fortement, en partie haute, dans le pied de l'apophyse coracoïde 7 et, en partie basse, dans le pilier externe 5a de l'omoplate 5. Ce cylindre d'encastrement 13 permet ensuite l'engagement de l'élément glénoïdien 9 et sa fixation en utilisant, éventuellement, une petite quantité de ciment à os 14.

L'élément glénoïdien 9 peut être réalisé tout simplement à la forme d'une pièce sphérique d'une épaisseur de l'ordre de 2 mm à 5 mm.

Dans une variante d'exécution de cet élément glénoïdien, telle que représentée sur la figure 3, la pièce sphérique 9 présente un évidement cylindrique 9b coaxial à l'ouverture 9a et d'un diamètre lui permettant d'être engagée sur le cylindre d'encastrement 13 préparé à l'aide de la scie-cloche 11. Dans ce cas, il est possible de mettre à profit le perçage 12a réalisé dans le centre de la glène 4 par la mèche de centrage 12 de la scie-cloche 11 pour améliorer la fixation de l'élément glénoïdien 9 à l'omoplate. Il suffit, pour cela, que la pièce sphérique 9 présente une tige d'ancrage 9c coaxiale à l'évidement cylindrique 9b et apte à être engagée dans le perçage 12a, avec ou sans ciment à os.

Cette pièce sphérique 9 constituant l'élément glénoïdien peut être en acier inoxydable, en céramique, en alliage de titane ou de cobalt ou en tout autre matériau biocompatible approprié.

Elle peut aussi être réalisée en un complexe résultant d'une combinaison de ces différents matériaux.

La figure 4 montre l'élément huméral 15 qui comprend, essentiellement, une cupule 16 solidaire, par sa face externe, d'une tige d'ancrage 17. Cette cupule 16 présente un évidement 16a en forme de calotte sphérique s'étendant sur environ un tiers de sphère et de même diamètre que la calotte sphérique 9 de l'élément glénoïdien.

Pour permettre la mise en place de l'élément huméral 15, l'humérus 3 doit être préparé, en premier lieu, par une résection de son extrémité supérieure suivant un plan 18 qui forme, avec l'axe 3a de la diaphyse de l'humérus 3, un angle A compris entre 55° et 70°. Dans l'exemple illustré sur le dessin, cet angle est de 60° car la normale 21 au plan 16b de l'ouverture de l'évidement sphérique 16a de la cupule 16 fait, avec l'axe 17a de sa tige d'ancrage 17, un angle B de 30°.

Le logement de la tige d'ancrage 17 de l'élément huméral 15 est ensuite creusé, comme illustré sur les figures 6 et 7, à l'aide de deux fraises coniques, respectivement 23 et 24. L'élément huméral 15 est alors mis en place et sa fixation peut être améliorée en utilisant une petite quantité de ciment à os 14.

L'élément huméral 15 est avantageusement en un matériau présentant une faible coefficient de frottement par rapport à celui dont est constitué l'élément glénoïdien 9. Lorsque ce dernier est en céramique d'alumine ou en acier inoxydable, l'élément huméral 15 est avantageusement en polyéthylène haute

densité.

La figure 8 montre l'épaule de figure 1 après mise en place de la prothèse totale de l'invention et l'examen comparatif des figures 1 à 8 permet de constater que la distance d1 séparant, sur la figure 8, le centre 25 de l'élément glénoïdien 9 de la ligne d'action du deltoïde sur l'humérus 3, c'est-à-dire de la force F, est bien supérieure à la valeur d illustrée sur la figure 1 car la constitution et le mode de montage de cette prothèse permettent de déplacer considérablement le centre de l'articulation (centre 25) en direction de la glène 4 de l'omoplate 5 et, ce de fait, d'augmenter de façon importante la longueur du bras de levier avec lequel le deltoïde agit sur l'humérus 3.

Les figures 9 et 10 illustrent une variante d'exécution de l'élément huméral 15 permettant d'adapter cette prothèse à l'état de l'articulation du patient, notamment en fonction de ses distensions éventuelles de muscles et de ligaments.

Dans cet exemple, l'élément huméral 15 est réalisé en deux parties assemblées l'une à l'autre, à savoir un corps 26 et une cupule 29. Le corps 26, qui est réalisé en un matériau biocompatible tel qu'en acier inox, titane ou chrome-cobalt, comporte une tige 27 d'ancrage dans la diaphyse humérale surmontée d'une embase 28 destinée à recevoir et maintenir une cupule 29 présentant une cavité 31 en forme de calotte sphérique et dont le matériau constitutif est choisi de manière à présenter un faible coefficient de frottement par rapport à la face externe sphérique de l'élément glénoïdien 9. Un matériau convenant parfaitement à la réalisation de cette cupule 29 est le polyéthylène haute densité.

Pour que l'assemblage de la cupule 29 à son embase 28 soit réalisé de manière à permettre son centrage et sa fixation correcte, leurs faces d'assemblage sont avantageusement conformées en tronc de cône, respectivement mâle et femelle, emboîtables l'un dans l'autre, l'embase 28 servant alors de berceau à la cupule 29.

Les parties tronconiques complémentaires de la cupule 29 et de son embase 28 sont avantageusement prolongées, du côté de leur grande base, par une portée cylindrique améliorant, par coïncement, la tenue de la cupule 29 dans son embase 28, sans en altérer le caractère amovible.

Cet agencement confère à cet assemblage l'amovibilité propre à permettre le choix et la mise en place d'une cupule 29 au dernier moment par le praticien, un jeu de cupules 29, 29a ou 29b différentes pouvant être alors mises à la disposition de ce dernier.

La figure 9 montre, en traits pleins, l'utilisation d'une cupule 29 à faible valeur rétentive, utilisable lorsque les muscles et les tendons du patient ne présentent pratiquement aucune distension. En effet, dans ce cas, il n'est pas nécessaire d'augmenter la distance L séparant l'axe 27a de la tige d'ancrage 27 du centre de la calotte sphérique 31 de la cupule 29, ni d'augmenter l'ampleur de la calotte sphérique que constitue la cavité 31 en rapprochant le plan de son ouverture du plan équatorial contenant son centre 32.

Sur la figure 9, on a montré, en traits mixtes, une

cupule 29a dont le centre 32 est confondu avec celui de la cupule 29 mais dont le plan d'ouverture de la cavité 31a est très proche du plan équatorial contenant le centre 32 de cette cavité.

Dans l'exemple illustré sur la figure 10, la cupule 29b assemblée au corps 26 présente la même rétentio n que la cupule 29a de l'exemple illustré en traits mixtes sur la figure 9. Par contre, la distance L1 séparant l'axe 27a de la tige d'ancrage 27 et le centre 32 de la cavité en forme de calotte sphérique 31 de la cupule 29b est nettement supérieure à la distance correspondante L de l'exemple précédent. Cette différence est due à une augmentation de l'épaisseur totale de la cupule 29, qui a eu pour effet d'augmenter la distance séparant le fond 33 de la cavité 31 et la petite base du berceau tronconique de l'embase 28.

Comme le montrent les exemples qui viennent d'être décrits, cet assemblage amovible de la cupule 29 au corps 26 et la présence d'un jeu de cupules différentes 29a à 29b permettent au praticien d'adapter au dernier moment la géométrie de cette prothèse à l'état de l'articulation du patient qui la reçoit.

## Revendications

1.- Prothèse totale de l'épaule, du type comportant un élément glénoïdien (9) constitué par une pièce mâle sphérique et destiné à être fixé à la glène (4) de l'omoplate et un élément huméral (15) constitué par une cupule sphérique (16), de même rayon que la pièce mâle sphérique constituant l'élément glénoïdien (9) et solidaire, par sa face externe, d'une tige (17) destinée à être engagée et fixée dans la diaphyse humérale, après résection de l'extrémité supérieure de l'humérus (3), caractérisée en ce que la pièce mâle sphérique constituant l'élément glénoïdien (9) est évidée et présente une ouverture (9a) s'étendant sur environ deux tiers de sphère et destinée à être engagée et fixée sur la glène (4), tandis que la cupule sphérique (16) de l'élément huméral (15) s'étend sur environ un tiers de sphère.

2.- Prothèse selon la revendication 1, caractérisée en ce que l'élément glénoïdien (9) est constitué par une ample calotte sphérique et présente une épaisseur de deux millimètres.

3.- Prothèse selon la revendication 1, caractérisée en ce que l'élément glénoïdien (9) présente un évidement cylindrique (9b) coaxial à l'ouverture (9a) et dont le fond est destiné à prendre appui contre la glène (4) après que celle-ci ait été préparée par réalisation d'un cylindre d'encastrement (13) centré sur elle, de même rayon que le logement cylindrique (9b) de la calotte sphérique (9) et formé, surtout, en haut, dans le pied de l'apophyse coracoïde (7) et, en bas, dans le pilier (5a) de l'omoplate (5).

4.- Prothèse selon l'une quelconque des revendications précédentes, caractérisée en ce

que l'élément glénoïdien (9) est en acier inoxydable, en céramique, en alliage à base de titane ou de cobalt ou en tout autre matériau biocompatible ou en un complexe résultant d'une combinaison de ces différents matériaux.

5.- Prothèse selon l'une quelconque des revendications précédentes, caractérisée en ce qu'au moins la face concave de la cavité (16a) de la cupule (16) de l'élément huméral (15) est en un matériau présentant un faible coefficient de frottement par rapport au matériau constitutif de la face convexe de la pièce sphérique (9) de l'élément glénoïdien.

6.- Prothèse selon la revendication 5, caractérisée en ce que cet élément huméral (15) est réalisé entièrement en polyéthylène de haute densité.

7.- Prothèse selon la revendication 5, caractérisée en ce que l'élément huméral (15) est constitué par deux pièces assemblées l'une à l'autre, à savoir un corps (26) en matériau biocompatible comprenant une embase (28) destinée à recevoir la cupule sphérique (29) et solidaire de la tige (27) d'ancrage dans la diaphyse humérale et une cupule (29, 29a, 29b) présentant une cavité (31) en forme de calotte sphérique, en matériau à faible coefficient de frottement par rapport à celui de la pièce sphérique (9) de l'élément glénoïdien, les faces d'assemblage de la cupule (29, 29a, 29b) et de l'embase (28) du corps (26) destinée à la recevoir étant agencées pour assurer à la fois leur centrage et leur fixation mutuelle.

8.- Prothèse selon la revendication 7, caractérisée en ce que l'assemblage entre la cupule (29, 29a, 29b) et son embase (28) est amovible.

9.- Prothèse selon la revendication 8, caractérisée en ce qu'il est prévu un jeu de cupules différentes (29, 29a, 29b) présentant des cavités (31) en forme de calotte sphérique d'amp leurs différentes et d'épaisseurs totales différentes.

10.- Prothèse selon l'une quelconque des revendications 7 à 9, caractérisée en ce que les faces d'assemblage de la cupule (29, 29a, 29b) et de son embase (28) aménagée sur le corps (26) de l'élément huméral (15) présentent des profils tronconiques complémentaires, respectivement mâle et femelle.

11.- Prothèse selon la revendication 10, caractérisée en ce que les profils complémentaires des faces d'assemblage de la cupule (29, 29a, 29b) et de son embase (28) sont prolongées, du côté de leur grande base, par une portée cylindrique permettant d'améliorer la fixation de la cupule (29, 29a, 29b) dans son embase (28), sans en altérer le caractère amovible.

12.- Prothèse selon l'une quelconque des revendications 7 à 11, caractérisée en ce que la cupule (29, 29a, 29b) est en polyéthylène de haute densité et le corps (26) est en acier inox, titane ou chrome-cobalt.

13.- Prothèse selon l'une quelconque des revendications précédentes, caractérisée en ce

que le diamètre de la calotte sphérique de l'élément glénoïdien (9) et celui de l'évidement (16a) de la cupule (16) de l'élément huméral est de l'ordre de quarante-deux millimètres.

**14.-** Prothèse selon l'une quelconque des revendications précédentes, caractérisée en ce que le plan de l'ouverture (16b) de la cupule (16) de l'élément huméral (15) fait, avec l'axe (17a) de sa tige d'ancrage (17), un angle (A) compris entre 55° et 70°, angle duquel doit être approchant celui que forme le plan de résection (18) de l'humérus (3) avec l'axe (3a) de sa diaphyse.

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FIG.1

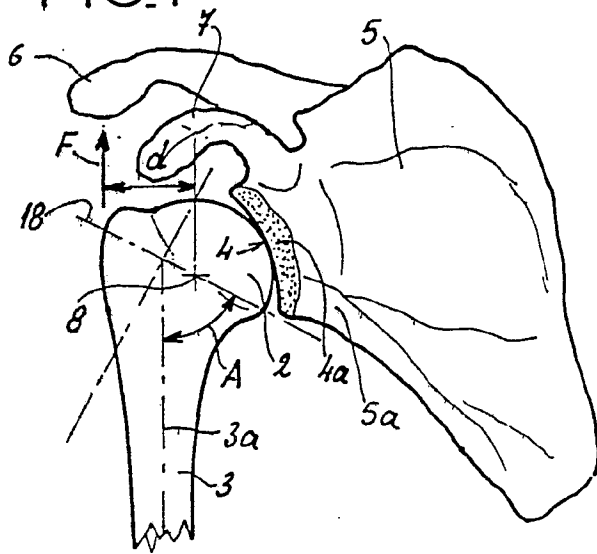


FIG.2

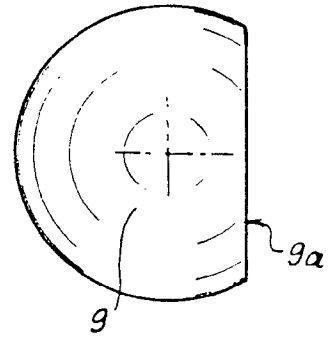


FIG.3

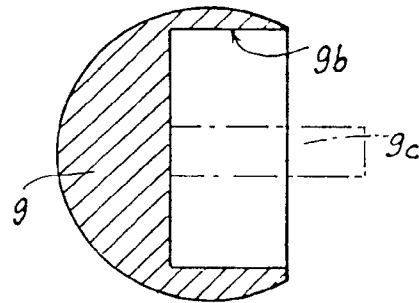


FIG.4

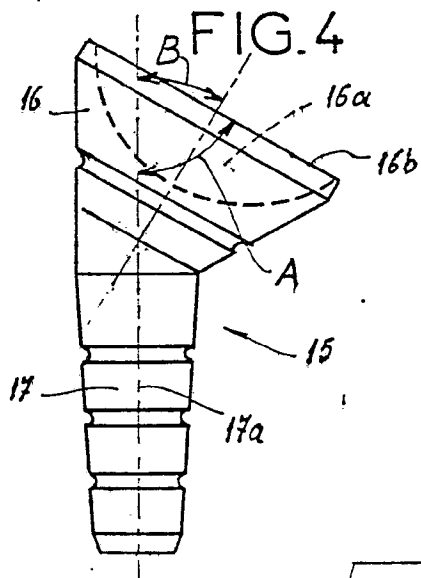
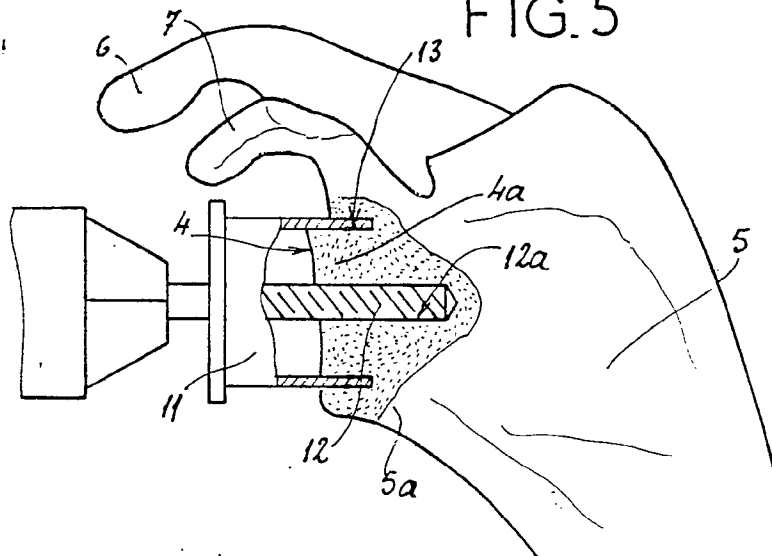
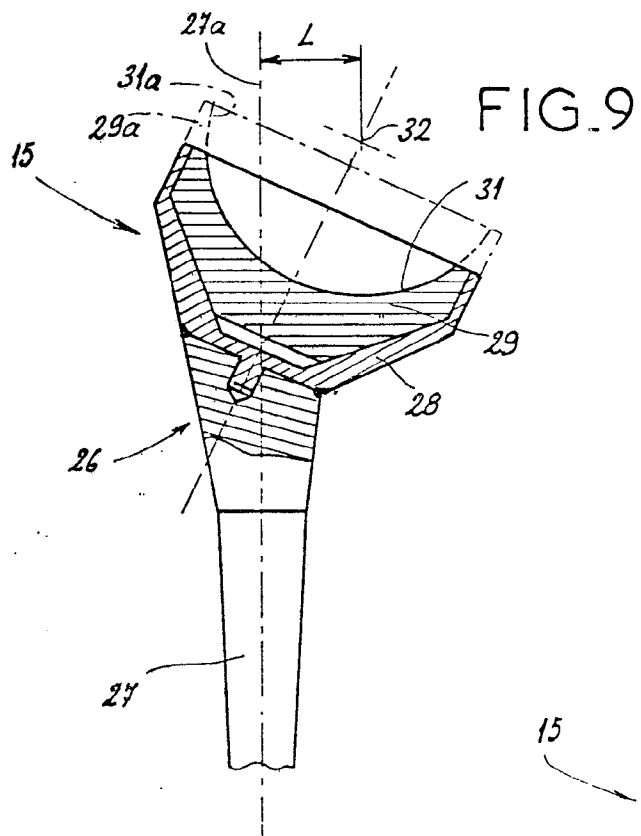
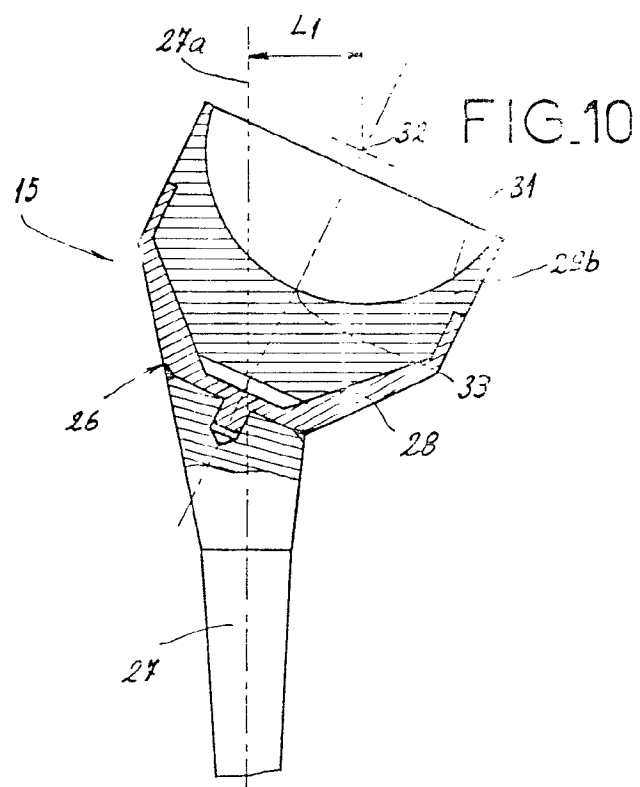


FIG.5







**Espacenet****Description: JP2014515651 (A) — 2014-07-03**

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**Shoulder prosthesis****Description not available for JP2014515651 (A)****Description of corresponding document: EP2502605 (A1)****A high quality text as facsimile in your desired language may be available amongst the following family members:**

CA2830197 (A1) CN103491906 (A) EP2502605 (A1) ES2494192 (T3) US2012265315 (A1)  
WO2012130524 (A1) EP2502606 (A1) EP2663263 (B1) US2012296435 (A1)  
US2014107792 (A1)

The EPO does not accept any responsibility for the accuracy of data and information originating from other authorities than the EPO; in particular, the EPO does not guarantee that they are complete, up-to-date or fit for specific purposes.

[0001] The present disclosure relates to a stemless shoulder prosthesis.

[0002] Generally, a stemless shoulder prosthesis comprises a metaphysical fixation device for fixing the prosthesis to a resected humerus bone. The fixation device comprises a base portion and anchoring means, with a humeral head being fixed to the base portion, for example through a taper or screw connection.

[0003] Unlike shoulder prostheses having a stem, also referred to as stemmed shoulder prostheses, stemless shoulder prostheses do not make use of the humeral canal in the diaphysis of the humerus. In other words, stemless shoulder prostheses do not rely on their fixation in said canal and an anchoring means extending deep into said canal is therefore not provided. This bears the advantage that it is in general not necessary to prepare the humeral canal for the insertion of the prosthesis and consequently bone is preserved.

[0004] In EP 1 467 681 a shoulder joint endoprosthesis is disclosed which, while fixation is largely limited to the epiphyseal region of the humerus, relies on a short central stem for fixation within the bone. Any ribs or fins solely are described as a torsional safeguard while fixation is achieved through a short tapered stem.

[0005] The present disclosure relates to a stemless shoulder prosthesis having a specifically designed fixation device. In particular, combinations of specific base portion designs and anchoring means are described.

[0006] According to the present disclosure, the base portion has a distal side adapted to contact a resection plane of the bone and a proximal side for carrying a humeral head. The anchoring means are connected to the distal side of the base portion and adapted to fix the prosthesis to the bone. The anchoring means define a central axis perpendicular to the distal side of the base portion and a free central space around the central axis. The anchoring means comprise wall sections projecting from the base portion substantially perpendicular to the distal side of the base portion, wherein each wall section extends between an inner edge and an outer edge. The wall sections have a height measured from the distal side of the base portion, the height of each wall section decreasing from its outer edge towards the inner edge, each wall section having a maximum height at its outer edge and a minimum height at its inner edge.

[0007] In other words, said free central space is not provided with protrusions or stem-like anchoring means. In an implanted state of the prosthesis, bony material of the humerus bone can penetrate the free central space and contribute to the anchoring of the prosthesis in the bone.

[0008] The wall sections stabilize and fix the prosthesis to the bone in an implanted state of the prosthesis. The design of the wall sections - which may be essentially planar or comprise curved segments - having decreasing heights towards the central axis result - in a side view of the prosthesis - in a shape resembling in essence an inverted arrow. Said design yields a reliable fixation of the prosthesis to the bone and minimizes the impact on the radially inner bone material.

[0009] In this context, the terms "inner edge" and "outer edge" are to be understood such that the "inner edge" has a smaller distance from the central axis than the corresponding "outer edge". The wall sections may extend not exclusively in a radial direction but may have an extension component in a circumferential direction, may be curved or may extend in a linear, non-radial direction.

[0010] In an embodiment of the prosthesis according to the present disclosure, the wall sections may be arranged around the free central space and are in particular evenly distributed.

[0011] In a further embodiment of the prosthesis according to the present disclosure, the wall sections form a wall extending around the free central space. In particular, the wall extends around the free central space in a closed loop. Thereby, a closed wall without circumferential free ends enclosing the free central space may be formed. The wall may define alternating radially outer convex wall portions and radially inner concave wall portions as the wall extends around the free central space.

[0012] In principle, the geometry defined by the wall sections may be chosen in accordance with the individual needs of the specific patient. Exemplarily, the wall has a star-shape when viewed along the central axis towards the base portion.

[0013] In an embodiment of the prosthesis according to the present disclosure, the outer edge of each wall section is rounded.

[0014] In a further embodiment of the prosthesis according to the present disclosure, each wall section is formed by two wall portions merging into one another at the outer edge of the wall section and each wall portion of a wall section merging into a wall

portion of a neighboring wall section at a common transition zone. The wall portions of each wall section may extend at least partially parallel to each other. In other words, the wall portions at least in part do not diverge or converge in a projection on a plane defined by the base portion. Additionally or alternatively, each transition zone - where neighboring wall sections merge - may be rounded.

[0015] In a further embodiment of the prosthesis according to the present disclosure, each wall section may have its minimum height at the common transition zone.

[0016] To facilitate the insertion of the prosthesis into the humerus bone, each wall section may comprise a distal edge which is formed at least partly as a cutting edge.

[0017] To improve the osseointegration of the prosthesis and blood supply of the bone, at least one of the wall sections may comprise at least one opening.

[0018] In an embodiment of the prosthesis according to the present disclosure, the base portion comprises a plate which may optionally be provided with openings and/or recesses.

[0019] The outer contour of the base portion may have a circular shape. Alternatively, the base portion may be given an anatomical design which is different from a circular shape. Specifically, the base portion may be given a substantially egg-shaped or pear-shaped design.

[0020] Regarding the circumferential direction around the central axis, the wall sections are in specific embodiments arranged at regular intervals. For example, in a design relying on four wall sections, the wall sections may be arranged at 90° between every two neighboring wall sections. Generally, a symmetrical design, in particular if combined with a circular base portion, may be found advantageous.

[0021] Alternatively, the wall section may be arranged asymmetrically in the circumferential direction. Such an anatomical design, in particular if combined with a non-circular design of the base portion, may make use of specific anatomical provisions given at the resected humerus bone.

[0022] Specifically, it may be taken into account that the bone material below the resection plane does not exhibit a constant bone depth or bone density. Moreover, such an anatomical design may account for the fact that the cross-sections of the resection plane have no symmetry planes.

[0023] The number and/or the positioning of the wall sections in such an anatomical design may be chosen in consideration of the mentioned anatomical circumstances in order to obtain reliable support and stability for the prosthesis. The design may or may not be chosen such that the prosthesis is supported predominantly by the cortical bone. Moreover, an anatomical design makes it possible to maximize the cortical coverage for the prosthesis.

[0024] Generally, the stemless shoulder prosthesis as disclosed herein may be used in total shoulder arthroplasty as well as in hemi shoulder arthroplasty. Moreover, the disclosed shoulder prosthesis may be used for patients with a so-called dysfunctional rotor cuff.

[0025] In addition, the stemless shoulder prosthesis as disclosed herein provides for the general advantages over stemmed prostheses, namely to preserve more bone, to reserve the humeral canal for future arthroplasty and to reduce time and cost of surgery.

[0026] In the following, further aspects of the stemless shoulder prosthesis as disclosed herein are described.

[0027] The prosthesis may be provided in different sizes to take the anatomical variety of the patients into account. The size of the wall sections may increase with increasing size of the prosthesis. However, according to one aspect the size of the base portion may remain constant, i.e. prostheses of different sizes are provided with a uni-sized base portion. This may apply for a symmetrical design having a circular base portion as well as for an anatomical design with a non-circular base portion, in particular having an egg-shaped or pear-shaped design.

[0028] Further embodiments of the disclosure are also recited in the dependent claims, the description and the drawings.

[0029] The different embodiments of the stemless shoulder prosthesis described above in accordance with the scope of the independent claim(s) and the features realized there and/or recited in the dependent claims of the disclosure may be combined.

[0030] Further areas of applicability of the present disclosure will become apparent from the detailed description provided hereinafter. It should be understood, that the detailed description and specific examples are intended for the purpose of illustration only and are not intended to limit the scope of the invention in any way. The figures are simplified and schematic. Details not necessary for the understanding of the invention are omitted.

[0031] The present disclosure will be explained in more detail and becomes fully understood from the detailed description and the accompanying drawings, wherein Figs. 1 to 5 : show an exemplary embodiment of a stemless shoulder prosthesis according to the present disclosure from various perspectives.

[0032] Fig. 1 shows a stemless shoulder prosthesis 10 according to the present disclosure having a symmetrical design. Prosthesis 10 comprises a circular base plate 11 provided with recesses 11' at its radially outer rim. Prosthesis 10 is connected to prosthetic humeral head 15.

[0033] The distal side of base plate 11 is provided with anchoring means 12 that serve to reliably anchor prosthesis 10 in the humerus bone of a patient. Anchoring means 12 comprise five wall sections 13 regularly disposed around a central axis C of prosthesis 10. Each wall section 13 comprises wall portions 13a, 13b which are at least partly arranged parallel to each other and which extend perpendicularly from base plate 11. Wall portions 13a, 13b are in essence planar. Wall portions 13a, 13b of each wall section 13 merge at a radially outer edge O of wall sections 13. At radially inner edges I of wall sections 13, wall portions 13b merge into wall portion 13a of neighboring wall sections 13 at transition zones T. Like the radially outer edges O, transition zones T have a rounded geometry.

[0034] The term "radially" is in this context to be understood to be related to a distance

from central axis C. In other words, radially inner edge I is located closer to central axis C than radially outer edge O.

[0035] Transition zones T define in this exemplary embodiment the radially innermost points of anchoring means 12 thereby defining a free central space F around central axis C which is devoid of protrusions or wall elements. Therefore, in an implanted state of prosthesis 10, material of the humerus bone extends into space F promoting osseointegration. To foster this process, wall portions 13a, 13b of wall sections 13 are provided with openings 25 which - inter alia - improve the blood circulation in regions adjacent to prosthesis 10. In particular, openings 25 improve the blood circulation - and thus osseointegration - in a circumferential direction with respect to central axis C. Moreover, providing openings 25 and free central space F minimizes the size of prosthesis 10 within the bone thereby minimizing the surgical impact of the implant while at the same time promoting its osseointegration properties. It should be noted, however, that openings 25 are generally not mandatory.

[0036] To facilitate the insertion of prosthesis 10 into the bone of the patient, wall portions 13a, 13b and transition zones T are provided with a cutting edge 29 at their distal edges. Since wall portions 13a, 13b and transition zones T form together a star-like closed loop around central axis C, cutting edge 29 is also continuous.

[0037] The geometry of wall sections 13 is such that their distal edges essentially recede towards the radially inner end I of respective wall section 13. In the shown exemplarily embodiment, the distal edges of wall sections 13 are curved reaching their minimum at transition zones T adjacent radially inner edges I. However, a linear slope of said distal edges is also conceivable. As regards distal height, the minimum of anchoring means 12 is defined by transition zones T.

[0038] Fig. 2 shows a view of prosthesis 10 along central axis C from distal. This perspective reveals the geometry of anchoring means 12 defined by wall sections 13 resembling - figuratively speaking - a star with five arms having rounded transitional segments between the arms and rounded outer arm ends. It can further be seen that wall portions 13a, 13b of wall sections 13 extend at least in part parallel to each other. However, in specific embodiments, it may be advantageous to arrange wall portions 13a, 13b inclined relative to each other and/or the number of wall sections 13 differs from this specific embodiment.

[0039] Further, it can be taken from Fig. 2, that base plate 11 is not only provided with recesses 11' but also comprises openings 25' which may e.g. serve to fix prosthesis 10 even more reliably to the humerus bone, e.g. by using a screw.

[0040] Figs. 3 and 4 show different side views of prosthesis 10. Humeral head 15 is not attached to prosthesis 10. Therefore, a view on connection portion 17 is unobstructed. Connection portion 17 is slightly tapered towards proximal. Instead of a taper connection other types of connection means to reliably fix humeral head 15 to prosthesis 10 may be provided.

[0041] Fig. 5 shows prosthesis 10 again in a perspective view similar to that of Fig. 1 albeit without humeral head 15.

[0042] Unlike in the embodiment shown in the figures, the radially outwardly facing sides of wall sections 13 may be provided with protrusions such as small ribs or webs



extending in a plane perpendicular to the central axis C.

[0043] All anatomical terms relating to directions and locations, such as anterior, posterior, medial, lateral, proximal, distal and sagittal, refer to an intended implanted state of the components and implants described above.

[0044] The description is merely of exemplary nature and, thus, variations that do not depart from the gist of the disclosed teachings are intended to be within the scope of the disclosure.

List of reference numbers

[0045]

10 : prosthesis

11 : base plate

11' : recess

12 : anchoring means

13 : wall section

13a, 13b : wall portion

15 : humeral head

17 : connection portion

25, 25' : opening

29 : cutting edge

C : central axis

F : free central space

I : radially inner edge

O : radially outer edge

T : transition zone



**Espacenet**

**Claims: JP2014515651 (A) — 2014-07-03**

## Shoulder prosthesis

**Claims not available for JP2014515651 (A)**

**Claims of corresponding document: EP2502605 (A1)**

**A high quality text as facsimile in your desired language may be available amongst the following family members:**

CA2830197 (A1) CN103491906 (A) EP2502605 (A1) ES2494192 (T3) US8992623 (B2)  
WO2012130524 (A1) EP2502606 (B1) EP2663263 (B1)

- [Original claims](#)
- [Claims tree](#)

The EPO does not accept any responsibility for the accuracy of data and information originating from other authorities than the EPO; in particular, the EPO does not guarantee that they are complete, up-to-date or fit for specific purposes.

1. Stemless shoulder prosthesis comprising a fixation device for fixing the prosthesis to a resected humerus bone,  
 the fixation device comprising a base portion (11) and anchoring means (12), the base portion (11) having a distal side adapted to contact a resection plane of the bone and a proximal side for carrying a humeral head (15), and the anchoring means (12) being connected to the distal side of the base portion (11) and adapted to fix the prosthesis to the bone,

wherein the anchoring means (12) define a central axis (C) perpendicular to the distal side of the base portion (11) and a free central space (F) around the central axis (C),  
 wherein the anchoring means (12) comprise wall sections (13) projecting from the base portion (11) substantially perpendicular to the distal side of the base portion (11),  
 wherein each wall section (13) extends between an inner edge (I) and an outer edge (O), and

wherein the wall sections (13) have a height measured from the distal side of the base portion (11), the height of each wall section (13) decreasing from its outer edge (O) towards the inner edge (I), each wall section (13) having a maximum height at its outer edge (O) and a minimum height at its inner edge (I).

2. Stemless shoulder prosthesis according to claim 1,  
 wherein the wall sections (13) are arranged around the free central space (F) and are in particular evenly distributed.

3. Stemless shoulder prosthesis according to claim 1 or 2,  
 wherein the wall sections (13) form a wall extending around the free central space (F).

4. Stemless shoulder prosthesis according to claim 3, wherein the wall extends around the free central space (F) in a closed loop.
5. Stemless shoulder prosthesis according to claim 3 or 4, wherein the wall defines alternating radially outer convex wall portions and radially inner concave wall portions as the wall extends around the free central space (F).
6. Stemless shoulder prosthesis according to any of claims 1 to 5, wherein the outer edge (O) of each wall section (13) is rounded.
7. Stemless shoulder prosthesis according to any of claims 1 to 6, wherein each wall section (13) is formed by two wall portions (13a, 13b) merging into one another at the outer edge (O) of the wall section (13) and each wall portion (13a, 13b) of a wall section (13) merging into a wall portion (13a, 13b) of a neighboring wall section (13) at a common transition zone (T) .
8. Stemless shoulder prosthesis according to claim 7, wherein the wall portions (13a, 13b) of each wall section (13) extend at least partially parallel to each other.
9. Stemless shoulder prosthesis according to claim 7 or 8, wherein each transition zone (T) is rounded.
10. Stemless shoulder prosthesis according to any of claims 7 to 9, wherein each wall section (13) has a minimum height at the common transition zone (T) .
11. Stemless shoulder prosthesis according to any of claims 1 to 10, wherein each wall section (13) comprises a distal edge which is formed at least partly as a cutting edge (29).
12. Stemless shoulder prosthesis according to any of claims 1 to 10, wherein at least one of the wall sections (13) and/or the base portion (11) comprises at least one opening (25).
13. Stemless shoulder prosthesis according to any of claims 1 to 12, wherein the base portion comprises a plate (11).

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(54) 【発明の名称】 肩関節プロテーゼ

## (57) 【要約】

本開示は、切除された上腕骨へプロテーゼを固定するための固定装置を備えるステム無し肩関節プロテーゼに関する。固定装置は、ベース部11、31、32と定着手段12、12'とを備え、ベース部11、31、32は、上腕骨の切除平面に当接するようになっている遠位面と上腕骨頭を保持するための近位面とを有する。定着手段は12、12'は、ベース部11、31、32の遠位面に接続され、プロテーゼを上腕骨へ固定するようになっている。定着手段12、12'は、中心軸Cを形成し、定着手段12、12'はベース部11、31、32から突出する複数の突起物13、13'、13a、13b、13cを備え、各突起物13、13'、13a、13b、13cは、内側端Iと外側端Oとの間に延びる。突起物13、13'、13a、13b、13cは、中心軸Cの周りに自由中央空間Fを形成する。

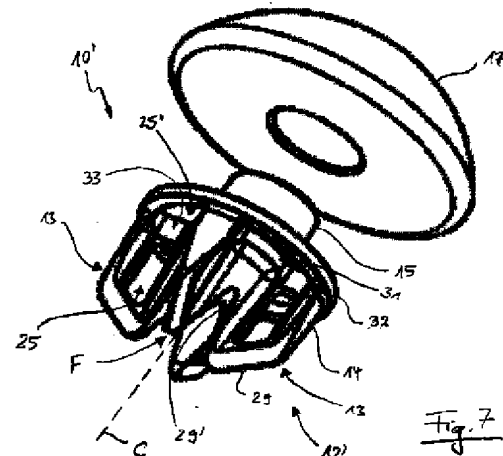


Fig. 7

## 【特許請求の範囲】

## 【請求項 1】

切除された上腕骨へプロテーゼを固定するための固定装置を備えるステム無し肩関節プロテーゼであって、

前記固定装置が、ベース部（11、31、32）と定着手段（12、12'）とを備え、前記ベース部（11、31、32）が前記上腕骨の切除平面に当接するようになっている遠位面と上腕骨頭（17）を保持するための近位面とを有し、前記定着手段（12、12'）が、前記ベース部（11、31、32）の前記遠位面に接続され、かつ前記プロテーゼを前記上腕骨へ固定するようになっており、

前記定着手段（12、12'）が中心軸（C）を形成し、

前記定着手段（12、12'）が前記ベース部（11、31、32）から突出する複数の突起物（13、13'、13a、13b、13c）を備え、各突起物（13、13'、13a、13b、13c）が内側端（I）と外側端（E）との間に延び、前記突起物（13、13'）が前記中心軸Cの周りに自由中央空間（F）を形成する、ステム無し肩関節プロテーゼ。

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## 【請求項 2】

前記突起物の前記内側端（I）が前記自由中央空間（F）を形成する、請求項 1 に記載のステム無し肩関節プロテーゼ。

## 【請求項 3】

前記自由中央空間（F）が前記ベース部（11、31、32）の前記遠位面から広がる円錐形を有し、かつ／または前記突起物（13、13'）の前記内側端（I）が相互に分散する、請求項 1 または 2 に記載のステム無し肩関節プロテーゼ。

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## 【請求項 4】

前記突起物（13、13'、13a、13b、13c）がリブ、刃またはフィンとして形成される、請求項 1 または 3 のいずれか 1 項に記載のステム無し肩関節プロテーゼ。

## 【請求項 5】

各突起物（13、13'）が前記ベース部（11、31、32）の前記近位面から測定して所定の高さを有し、前記突起物（13、13'）の前記高さが、前記外側端（O）から前記自由中央空間（F）へ向かって増大するかまたは一定であり、特に、各突起物（13）がその外側端（O）において最小高さを有する、請求項 1 ～ 4 のいずれか 1 項に記載のステム無し肩関節プロテーゼ。

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## 【請求項 6】

少なくとも 1 つの突起物（13、13'）が少なくとも 1 つの開口部（25）を備える、請求項 1 ～ 5 のいずれか 1 項に記載のステム無し肩関節プロテーゼ。

## 【請求項 7】

各突起物（13、13'）が少なくとも部分的に切刃（29）として形成される遠位縁を備える、請求項 1 ～ 6 のいずれか 1 項に記載のステム無し肩関節プロテーゼ。

## 【請求項 8】

少なくとも 1 対の隣り合う突起物（13、13'）がウェブ（27、27'）によって接続され、該ウェブ（27、27'）が前記突起物（13、13'）の内側端（I）の間に延びる、請求項 1 ～ 7 のいずれか 1 項に記載のステム無し肩関節プロテーゼ。

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## 【請求項 9】

前記突起物（13、13'）及び前記ウェブ（27、27'）が前記ベース部（11、31、32）の前記遠位面から測定して所定の高さを有し、前記ウェブ（27、27'）の前記高さが前記突起物（13、13'）の前記高さより小さい、請求項 8 に記載のステム無し肩関節プロテーゼ。

## 【請求項 10】

前記ウェブ（27、27'）が切刃（29'）を備え、かつ前記ウェブ（27、27'）の前記切刃（29'）が前記隣り合う突起物（13、13'）の切刃（29）に合体する、請求項 8 または 9 に記載のステム無し肩関節プロテーゼ。

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**【請求項 1 1】**

前記ウェブ（27、27'）が少なくとも1つの開口部（25'）を備える、請求項8～10のいずれか1項に記載のステム無し肩関節プロテーゼ。

**【請求項 1 2】**

前記突起物（13、13'）がその外側端（O）にウィング（14）を備える、請求項1～11のいずれか1項に記載のステム無し肩関節プロテーゼ。

**【請求項 1 3】**

前記ベース部（31、32）が開口部（25''）を有し、前記開口部（25''）が前記突起物（13'）の間に配設される、請求項1～12のいずれか1項に記載のステム無し肩関節プロテーゼ。

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**【請求項 1 4】**

前記ベース部（11）がプレートを備える、請求項1～13のいずれか1項に記載のステム無し肩関節プロテーゼ。

**【請求項 1 5】**

前記ベース部が半径方向外側のリング（32）と、半径方向内側部（31）と、前記外側のリング（32）と前記内側部（31）との間に延びる放射状スポークとを備える、請求項1～14のいずれか1項に記載のステム無し肩関節プロテーゼ。

**【発明の詳細な説明】****【技術分野】****【0001】**

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本開示は、ステム無し肩関節プロテーゼに関する。

**【背景技術】****【0002】**

概して、ステム無し肩関節プロテーゼ（stemless shoulder prosthesis）は、切除された上腕骨へプロテーゼを固定するための骨幹端固定装置（metaphysial fixation device）を備える。固定装置は、ベース部と定着手段とを備え、上腕骨頭は、例えばテーパーまたはスクリュー接続によってベース部へ固定される。

**【0003】**

ステム付き肩関節プロテーゼ（stemmed shoulder prosthesis）とも呼ばれるステムを有する肩関節プロテーゼとは異なり、ステム無し肩関節プロテーゼは、上腕骨幹部の上腕骨の管（canal）を使用しない。言い換えると、ステム無し肩関節プロテーゼは、上腕骨の管における固定に依存せず、従って、上腕骨の管の中へ深く延びる定着手段は設置されない。これは、プロテーゼを挿入するために上腕骨の管を準備する必要がなく、従って骨が保存されると言う利点を生む。

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**【0004】**

欧州特許第1467681号には、固定をほとんど上腕骨端部に限定しつつ、骨内部に固定するための短い中央ステムに依存する肩関節内プロテーゼが開示される。リブまたはフィン、専らねじり保護として説明されており、固定は短いテーパー状のステムによって得られる。

**【発明の概要】**

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**【0005】**

本開示は、具体的に設計された固定装置を有するステム無し肩関節プロテーゼに関する。特に、具体的なベース部設計及び定着手段の組合せ体について説明する。

**【0006】**

本開示によれば、ベース部は、上腕骨の切除平面に当接するための遠位面と、上腕骨頭を支えるための近位面とを有する。定着手段は、ベース部の遠位面に接続され、プロテーゼを骨へ固定するようになっている。定着手段は、中心軸を形成し、ベース部から突出する複数の突起物を備え、各突起物は、内側端と外側端との間に延びる。突起物は、中心軸の周りに自由中央空間を形成する。

**【0007】**

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言い換えると、突起物は、自由中央空間の周りに配設され、自由中央空間は、突起物またはステム形の定着手段を備えない。プロテーゼが埋植された状態のとき、上腕骨の骨物質は、自由中央空間へ浸透して、骨におけるプロテーゼの定着に寄与する。

【0008】

本文脈において、「内側端」及び「外側端」という用語は、「内側端」が対応する「外側端」より中心軸から小さい距離を持つものとして解釈されるものとする。突起物は、半径方向に限らず延びることができ、周方向の延在要素を持つこと、湾曲すること、または線形に非半径方向へ延びることができる。

【0009】

本開示に係るプロテーゼの実施形態において、突起物の内側端は自由中央空間を形成する。内側端は、例えば、突起物の半径方向内側終点または縁である。または、突起物の半径方向内側区分を上記の意味の内側端と解釈できる。特に、中心軸の最も近くに配置される突起物の部分は自由中央空間を形成する。

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【0010】

本開示に係るプロテーゼの実施形態において、定着手段は、複数の突起物のみを備えることができる。ただし、必要であれば、プロテーゼを定着するための付加的手段を設置することができる。

【0011】

特に、中心軸及び／または突起物は、ベース部の遠位面に概ね直角に延びるかまたは突出する。これに加えて、またはその代わりに、突起物は、中心軸に概ね平行に延びるかまたは突出する。

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【0012】

本開示に係るプロテーゼの実施形態において、自由中央空間は、ベース部の遠位面から遠位方向へ広がる円錐形を有する。また、中心軸に沿ってベース部の遠位面から遠位方向へ見るとき、突起物の内側端が相互から分散するように、自由中央空間を設計することも可能である。テーパ状の自由中央空間は、上腕骨へのプロテーゼの固定を容易にする。

【0013】

特に、突起物は、リブ、刃またはフィンとして形成される。

【0014】

前記突起物は、基本的に平面状または湾曲的にすることができる。要求特性を持つ突起物の形状を得るために、平面部と湾曲部を組み合わせることも可能である。概して、本開示に係るプロテーゼの実施形態の突起物の曲率は一定であるか、または突起物の延在に沿って変動できる。

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【0015】

プロテーゼの特定の実施形態において、中心軸の周りの自由中央空間に定着手段の突起物がない限り、有利であると見なされる場合には、突起物が交差することが考えられる。

【0016】

プロテーゼの突起物は、全て同様な形状を有することができる。ただし、異なる形状を有する突起物を持つプロテーゼを提供することが好ましい場合がある。

【0017】

各突起物が中心軸を含む平面を形成することが考えられる。言い換えると、突起物によって形成された平面は交差し、前記平面の交差点が中心軸を形成する。または、その内側端が中心軸に向かって収束しないように突起物または少なくとも1つの突起物を設計することを想定できる。このような設計においては、突起物またはその補外の内側部は、形象的に言うと、中心軸に沿って見るとき、上記の自由中心空間に対して接線方向に延びる。

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【0018】

本開示に係るプロテーゼの実施形態において、各突起物はベース部の遠位面から測定して所定の高さを有し、突起物の高さは、外側端から自由中央空間へ向かって増大するかまたは一定値を維持する。特に、各突起物は、その外側端において最小高さを有する。

【0019】

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プロテーゼに隣接する上腕骨の領域における血液循環を改善するため及び骨結合を促進するために、少なくとも1つの突起は少なくとも1つの開口部を備えることができる。

【0020】

本開示に係るプロテーゼを上腕骨へ固定するプロセスは、各突起物が少なくとも部分的に切刃として形成された遠位縁を備える場合、容易になる。

【0021】

本開示に係るプロテーゼの別の実施形態において、少なくとも1対の隣り合う突起物は、ウェブによって接続され、ウェブは、特に突起物の内側端の間に延びる。前記ウェブは、プロテーゼの安定性を増大し、上腕骨へのプロテーゼの効果的固定に寄与する。

【0022】

上述のように少なくとも1つのウェブを備えるプロテーゼの実施形態において、突起物及びウェブは、ベース部の遠位面から測定して所定の高さを持つことができ、ウェブの高さは突起物の高さより小さい。

【0023】

少なくとも1つのウェブを備えるプロテーゼの実施形態において、ウェブは、特にウェブの遠位縁に設置される切刃を備える。特に、ウェブの切刃は、隣接する突起物の切刃に合体する。

【0024】

本開示に係るプロテーゼの実施形態において、ウェブは、例えばプロテーゼに隣接する領域における血液循環を強化して骨結合を促進するために、少なくとも1つの開口部を備える。

【0025】

本開示に係るプロテーゼの別の実施形態において、突起物の少なくとも1つまたは全ては、その外側端にウィングを備える。特に、ウィングは、中心軸と反対向きの外側面においてベース部と実質的に同一平面に配置される。ウィングは、中心軸に沿って見たときプロテーゼの外輪郭に対して実質的に接線方向へ延びて、ベース部によって形成される平面に平行の断面において突起物にT字形を与えることができる。突起物の半径方向外側端のこのT字形ウィングの設計は、ウィング部が切除境界部（比較的高い骨密度が期待される部分）の比較的近くに位置するので、優れた安定性及び支持を与えることができる。さらにまたはその代わりに、突起物の少なくとも1つまたは全ての内側端は、突起物の外側端に関連して上に述べたようなウィングを備えることができる。ベース部に平行の断面において、このような突起物はドッグボーン状の形状を持つことができる。

【0026】

本開示に係るプロテーゼの実施形態において、ベース部は開口部を備え、開口部は、突起物の間に配設される。

【0027】

本開示に係るプロテーゼの実施形態において、ベース部はプレートを備え、プレートは、必要であれば開口部を備えることができる。

【0028】

本開示に係るプロテーゼの別の実施形態において、ベース部は、半径方向外側リングと、半径方向内側部と、外側リングと内側部との間に延びる放射状スポークとを備える。ベース部のこのような設計は、骨結合を促進すると同時に優れた安定性を与える。突起物は、放射状スポークから突出できる。半径方向内側部は、環状形状を持つことができる。代表的なものとして、ベース部は車輪状の形状を持つことができる。

【0029】

ベースの外輪郭は、円形形状を持つことができる。または、ベース部に円形形状とは異なる解剖学的形状を与えることができる。具体的には、実質的に卵形または洋ナシ形の設計をベース部に与えることができる。

【0030】

特定の実施形態において、中心軸の周りの周方向において、突起物は規則的間隔で配設



される。例えば、4つの刃を持つ設計において、刃は、2つの隣り合う刃の間をそれぞれ90°で配設できる。概して、特に円形ベース部と組み合わせる場合、対称的設計が有利であろう。

#### 【0031】

或いは、複数の突起物は、周方向に非対照的に配設できる。特に非円形設計のベース部と組み合わせるとき、このような解剖学的設計は切除された上腕骨に与えられた解剖学的処置を使用できる。具体的には、切除平面の下方の骨物質が一定の骨深さまたは骨密度を示さないことを考慮に入れることができる。さらに、このような解剖学的設計は、切除平面の断面が対称形平面を持たないことを考慮に入れることができる。

#### 【0032】

プロテーゼのための信頼できる支持及び安定性を得るために、このような解剖学的設計における突起物の数及び位置は、上記の解剖学的状況を考慮して選択できる。プロテーゼが主に骨皮質によって支持されるように設計を選択することもしないこともできる。さらに、解剖学的設計は、プロテーゼのための皮質被覆を最大限に大きくできる。

#### 【0033】

概して、本出願において開示するステム無し肩関節プロテーゼは、全肩関節形成術においても半肩関節形成術においても使用できる。さらに、開示する肩関節プロテーゼは、いわゆる回旋腱板機能不全の患者に使用できる。

#### 【0034】

さらに、本出願において開示するステム無し肩関節プロテーゼは、ステム付きプロテーゼに比べて全体的利点を与える。すなわち、より多くの骨を保存し、将来の形成術のために上腕骨の管を確保し、かつ手術の時間とコストを減少する。

#### 【0035】

以下に、本出願において開示するステム無し肩関節プロテーゼのさらなる形態について説明する。

#### 【0036】

突起物のサイズは、プロテーゼのサイズの増大に伴って増大できる。ただし、1つの形態によれば、ベース部のサイズは一定である。すなわち、異なるサイズのプロテーゼが単一サイズのベース部を備える。これは、円形ベース部を有する対称形設計にも、非円形ベース部を持つ特に卵形または洋ナシ形ベース部設計を持つ解剖学的設計にも応用される。

#### 【0037】

上述のように、突起物の内側端のいくつかまたは全ては、接続壁を形成するウェブと接続できる。これによって、円周の自由端をもたない自由中央空間を囲繞する閉鎖壁を形成できる。或いは、自由中央空間へ向かって空隙を与えるように、壁を中断できる。具体的には、ウェブを、いくつかの対の隣り合う突起物の間にのみ、特に明白な突起物のグループ内にのみ設置して、別のグループの突起物の間には設置しない。

#### 【0038】

概して、前記ウェブは、突起物配設体の従ってプロテーゼの定着手段の安定性または剛性を増大できる。

#### 【0039】

突起物の形状は、例えば、ベース部に平行に延びる底部または近位側と中心軸に対して所定の角度で内側位置から外側位置へ向かって延びる頂部または遠位側を持つ非四辺形または非長方形四辺形である。従って、複数の突起物は、一緒に、矢状の設計を形成し、矢の先端はプロテーゼの中心軸上に在る。突起物の遠位縁がベース部へ向かって外から内へ後退する逆の設計も想定できる。

#### 【0040】

本開示の別の実施形態についても、従属クレーム、明細書及び図面において記載する。

#### 【0041】

本開示の独立クレームの範囲に従って上に説明するステム無し肩関節プロテーゼの様々な実施形態及び実施形態において実現される及び／または本開示の従属クレームにおいて

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記載される特徴は、組み合わせることができる。

【0042】

本開示のさらなる適用可能な領域は、以下の詳細な説明から明らかになる。詳細な説明及び具体的実施例は例示のためのものであり、決して本発明の範囲を限定するものではないと解釈すべきである。図面は単純化され、概略的である。本発明の理解に必要な細部は省略する。

【0043】

以下、本開示についてさらに詳細に説明する。詳細な説明及び添付図面から本開示は完全に理解できる。

【図面の簡単な説明】

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【0044】

【図1】本開示に係るステム無し肩関節プロテーゼの第1実施形態を示す。

【図2】本開示に係るステム無し肩関節プロテーゼの第1実施形態を示す。

【図3】本開示に係るステム無し肩関節プロテーゼの第1実施形態を示す。

【図4】本開示に係るステム無し肩関節プロテーゼの第1実施形態を示す。

【図5】本開示に係るステム無し肩関節プロテーゼの第1実施形態を示す。

【図6】本開示に係るステム無し肩関節プロテーゼの第1実施形態を示す。

【図7】本開示に係るステム無し肩関節プロテーゼの第2実施形態を示す。

【図8】本開示に係るステム無し肩関節プロテーゼの第2実施形態を示す。

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【図9】本開示に係るステム無し肩関節プロテーゼの第2実施形態を示す。

【図10】本開示に係るステム無し肩関節プロテーゼの別の実施形態の概略図である。

【図11】本開示に係るステム無し肩関節プロテーゼの別の実施形態の概略図である。

【図12】本開示に係るステム無し肩関節プロテーゼの別の実施形態の概略図である。

【発明を実施するための形態】

【0045】

図1及び2は、異なる視点から見た対称形設計を持つ本開示に係るステム無し肩関節プロテーゼ10を示す。

【0046】

プロテーゼ10は、接続部15を備える円形台板11を備え、接続部15は人工上腕骨頭（図示せず）をプロテーゼ10に取り付けられるようにする。僅かにテーパー状の接続部15の代わりに、上腕骨頭をプロテーゼ10に確実に接続するために、他の適切な接続手段を使用できる。

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【0047】

台板11の遠位面は、患者の上腕骨の中にプロテーゼ10を確実に定着するための定着手段12を備える。定着手段12は、台板11から直角に延びる4つのリブまたは刃13を備える。刃13は、基本的に平面的であり、中心軸Cの周りで周方向に均等に配分される。すなわち、隣り合う刃13の間の角度は90°である。ただし、これより多いまたは少ない刃13が設けられてもよい。さらに、刃13の均等な配分は強制的ではない。刃13は、基本的に半径方向へ延びる。すなわち、各刃13は、台板11に直角に延びかつ中心軸Cを含む平面を形成する。

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【0048】

隣り合う刃13の半径方向内側端Iは、刃13に比べて遠位方向に著しく短く延びるウェブ27によって接続される。ウェブ27は、突起物のない中心軸Cの周りの自由中央空間Fの台板11に隣接する領域を囲繞する。従って、プロテーゼ10が埋植された状態のとき、上腕骨の物質が空間Fの中へ延びて、骨結合を促進する。このプロセスを促進するために、ウェブ27は、開口部25'を備え、開口部25'は、特に、プロテーゼ10に隣接する領域における血液循環を改善する。特に、開口部25'は、自由中央空間Fに配置された骨物質への及び骨物質からの半径方向の血液循環を可能にする。

【0049】

同様の理由で、刃13は、開口部25を備える。開口部は、周方向において血液循環を

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改善し、よって骨結合を改善する。さらに、開口部 25、25' 及び空間 F を設置することによって、プロテゼ 10 のサイズを最小限に抑え、それによって、インプラントの外科的影響を最小限に抑えると同時に、プロテゼの骨結合特性を促進する。

【0050】

刃 13 の半径方向外側端 O には、基本的に周方向へ延びるウィング 14 が設けられる。ウィング 14 は、基本的に台板 11 の外輪郭と同一平面に配置される。ウィング 14 は、刃 13 の定着特性を改善し、ウェブ 27 と同様、プロテゼ 10 の安定性及び剛性に寄与する。

【0051】

ウィング 14 及び刃 13 の遠位縁は、プロテゼ 10 の埋植を容易にする切刃 29 を形成する。これに対して、ウェブ 27 の遠位縁は、この代表的実施形態においては切刃を備えない。

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【0052】

刃 13 は、プロテゼ 10 が側面視において矢じりの形状に類似するような形状を持つ。すなわち、刃 13 の遠位縁は、基本的に刃 13 の半径方向外側端 O へ向かって半径方向において後退する。刃 13 の半径方向内側端 I の縁は、中心軸 C に対して傾斜する。言い換えると、刃 13 の半径方向内側縁は、台板 11 の遠位面から中心軸 C に沿って見たときすなわち近位から遠位へ向かって見たとき、広がる。従って、自由中央空間 F は、台板 11 へ向かって細くなる円錐形を有する。

【0053】

図 3 は、遠位から中心軸 C に沿って見たプロテゼの図である。ウィング 14 が刃 14 の半径方向外側端に T 字形を与えることが分かる。図 3 は、図 4 に示される断面 A-A の位置も示す。

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【0054】

図 4 の断面図は、定着手段 12 の定着特性に寄与する突起物が存在しない自由中央空間 F の円錐形を示す。さらに、接続部 15 への上腕骨頭の確実な接続を容易にするために、接続部 15 が孔 28 を備えることが分かる。

【0055】

図 5 及び 6 は、プロテゼ 10 の機能要素の相対比率を視覚化したプロテゼ 10 の別の側面図である。当然、これらの比率を変化させて、異なるサイズのプロテゼのセットを提供しかつ／または患者固有の必要に合せて最適化されたプロテゼを提供することができる。さらに、ウェブ 27 の U または V 字形遠位縁が刃 13 の半径方向内側縁とどのように合体するかが分かる。

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【0056】

図 7 は、多くの点においてプロテゼ 10 と同様のステム無し肩関節プロテゼ 10' 及び接続部 15 を介してプロテゼ 10' に取り付けられる上腕骨頭 17 の斜視図である。ただし、プロテゼ 10 と 10' にはいくつかの相違がある。

【0057】

例えば、プロテゼ 10' の定着手段 12' の刃 13' を接続するウェブ 27' は、開口部（プロテゼ 10 のウェブ 27 の開口部 25' と比較されたい）を備えず、ウェブ 27' は、隣接する刃 13' の切刃 29 と合体する切刃 29' を備える。さらに、刃 13' の開口部 25 は、刃 13 の開口部 25 より多少大きい。さらに、定着手段 12' も矢じりの形状に類似するが、刃 13' の遠位縁の傾斜は比較的緩やかであり、遠位縁と刃 13' の半径方向外側端 O の縁との間の移行部及び遠位縁と刃 13' の半径方向内側端 I の縁との間の移行部は、より円滑である。

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【0058】

別の相違点は、プロテゼ 10' のベース部の設計に関する。ベース部は、プレート形設計ではなく、内側部 31 と外側リング 32 とによって形成される。内側部 31 とリング 32 は、放射状スポーク 33 によって接続されて、開口部 25' を形成する。刃 13' は、スポーク 33 から突出する。

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## 【0059】

この設計は、十分な剛性及び安定性を持つと同時に、骨結合を促進し、プロテゼ10と比較して重量が減少する。上記の形態は、それぞれプロテゼ10'を中心軸Cに沿って近位から及び遠位から見た図である図8及び図9の中心図からも明らかである。

## 【0060】

プロテゼ10'の側面図を示す図9のその他の図は、プロテゼ10'が中心軸Cに対して回転対称形であることを強調する。

## 【0061】

図10～12は、本開示に係るステム無し肩関節プロテゼの別の実施形態10a、10b、10cを概略的に示す。前記の図は、中心軸Cに沿って遠位から見た図である。

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## 【0062】

図10は、平面的突起物13aを持つプロテゼ10aを示す。外挿しても、突起物13aは、自由中央空間Fの中へ延びない。突起物13aによって形成された平面は、中心軸Cにおいて交差しない。従って、突起物13aの半径方向外側端O及び半径方向内側端Iは、それぞれ上に説明したプロテゼ10、10'の突起物13、13'の設計と異なり、放射状線上に乗らない。ただし、実施形態10、10'及び10aにおいて、及び下に説明する実施形態において、内側端Iは外側端Oより中心軸C近くに配置される。形象的に言えば、突起物13aは中央空間Fを接線方向へ通過する。

## 【0063】

図11は、湾曲突起物13bを持つプロテゼ10bを示す。ただし、この湾曲によっては、突起物13bの延長の外挿E（突起物13bの1つの半径方向内側延長の外挿を点線によって示す）は中央空間Fの中へ収束しない。突起物13bは、自由中央空間Fを接線方向へ通過する。または形象的に言えば、相互に交差することなく自由中央空間Fの周りに巻きつく。

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## 【0064】

図12は、同様に湾曲突起物13cを備えるプロテゼ10cを示す。この場合、突起物13cは、その外挿（図示せず）が中心軸Cにおいて交差することなく自由中央空間Fの中へ収束するような曲率及び位置を持つ。ただし、中心軸Cにおいて突起物の外挿が交差するような曲率及び／または位置を持つように突起物13cを作ることが想定できる。

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## 【0065】

前、後、内側、外側、近位、遠位及び矢状方向など方向及び位置に関する解剖学用語は、全て、上述の構成要素及びインプラントの予定埋植状態に関する。

## 【0066】

説明は単に代表的性質に関するものであり、従って、開示される教示の要旨から逸脱しない変更は、本開示の範囲内にある。

## 【符号の説明】

## 【0067】

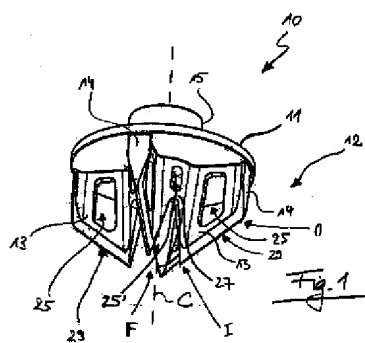
- 10、10'、10a、10b、10c      プロテゼ
- 11      台板
- 12、12'      定着手段
- 13、13'、13a、13b、13c      リブ、刃
- 14      ウィング
- 15      接続部
- 17      上腕骨頭
- 25、25'、25''      開口部
- 27、27'      ウェブ
- 28      孔
- 29、29'      切刃
- 31、32      リング
- 33      スポーク

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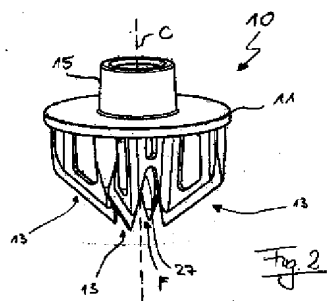
50

C 中心軸  
 F 自由中央空間  
 I 内側端  
 O 外側端  
 E 外挿

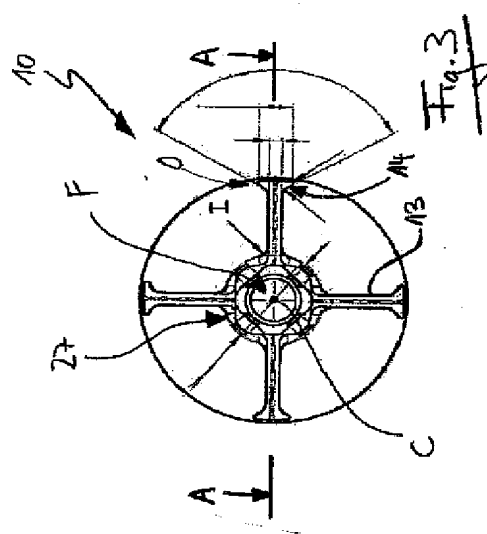
【図 1】



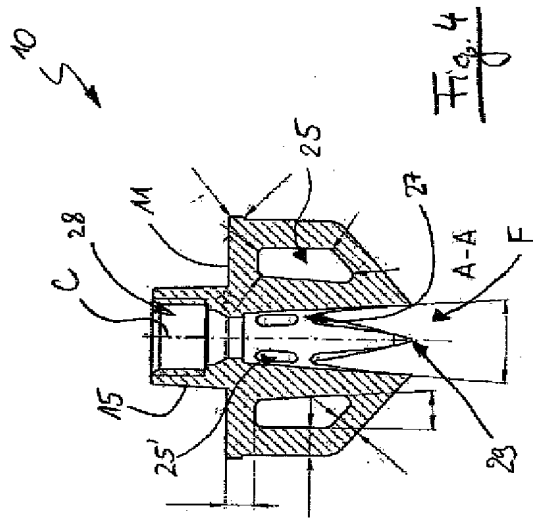
【図 2】



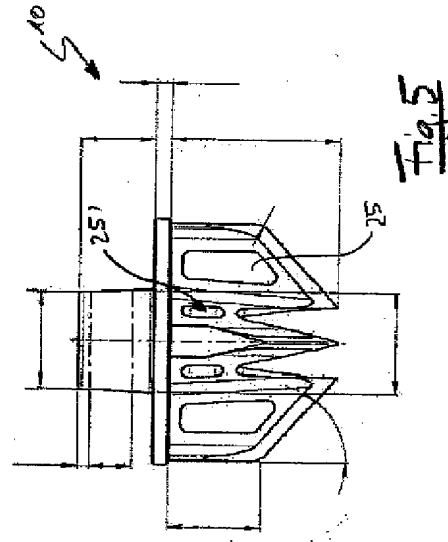
【図 3】



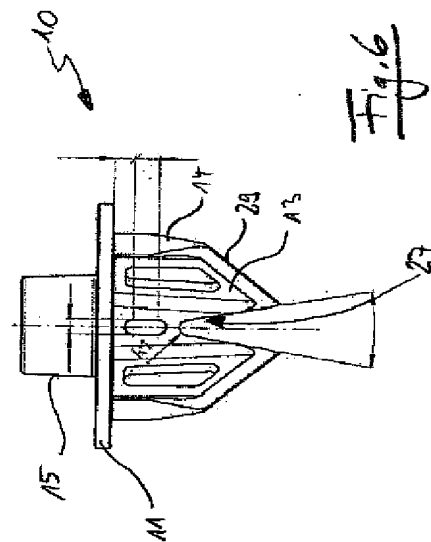
【図 4】



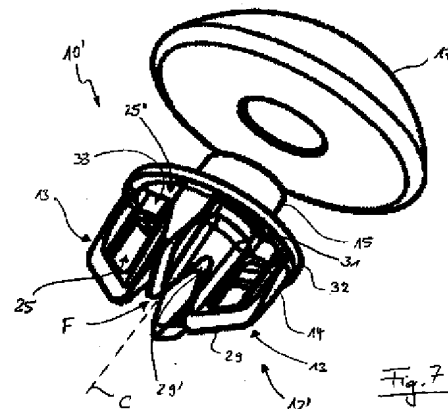
【図 5】



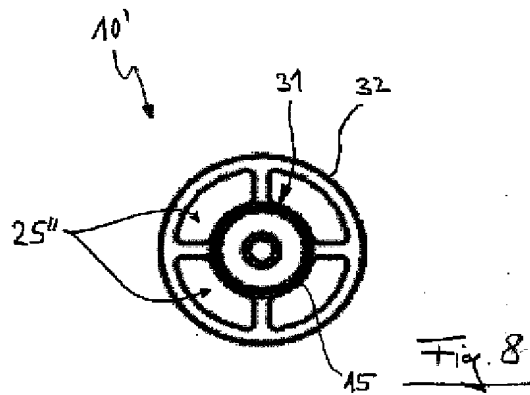
【図 6】



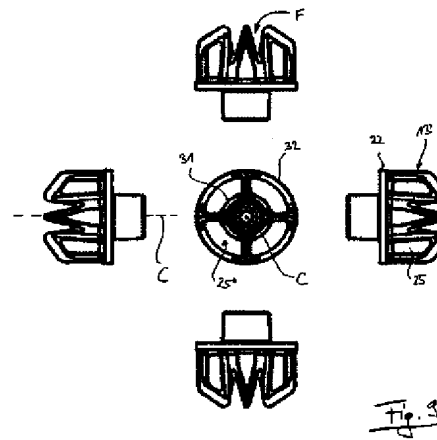
【図 7】



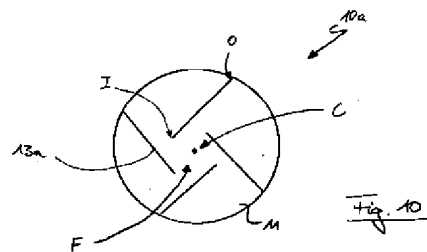
【図 8】



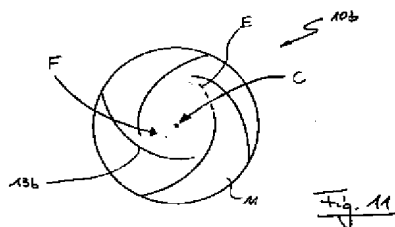
【図 9】



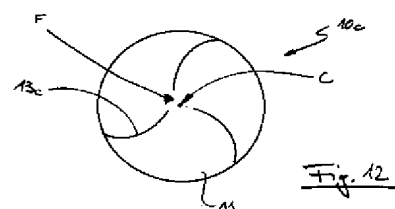
【図 10】



【図 11】



【図 12】



## 【手続補正書】

【提出日】平成25年2月26日(2013.2.26)

## 【手続補正1】

【補正対象書類名】特許請求の範囲

【補正対象項目名】全文

【補正方法】変更

【補正の内容】

【特許請求の範囲】

【請求項1】

切除された上腕骨へプロテーゼを固定するための固定装置を備えるステム無し肩関節プロテーゼであって、

前記固定装置が、ベース部(11、31、32)と定着手段(12、12')とを備え、前記ベース部(11、31、32)が前記上腕骨の切除平面に当接するようになっている遠位面と上腕骨頭(17)を保持するための近位面とを有し、前記定着手段(12、12')が、前記ベース部(11、31、32)の前記遠位面に接続され、かつ前記プロテーゼを前記上腕骨へ固定するようになっており、

前記定着手段(12、12')が中心軸(C)を形成し、

前記定着手段(12、12')が前記ベース部(11、31、32)から突出する複数の突起物(13、13'、13a、13b、13c)を備え、各突起物(13、13'、13a、13b、13c)が内側端(I)と外側端(O)との間に延び、前記内側端(I)は前記外側端(O)よりも前記中心軸(C)に近接しており、前記突起物(13、13')が前記中心軸Cの周りに自由中央空間(F)を形成する、ステム無し肩関節プロテーゼ。

【請求項2】

前記突起物の前記内側端(I)が前記自由中央空間(F)を形成する、請求項1に記載のステム無し肩関節プロテーゼ。

【請求項3】

前記自由中央空間(F)が前記ベース部(11、31、32)の前記遠位面から広がる円錐形を有し、かつ／または前記突起物(13、13')の前記内側端(I)が相互に分散する、請求項1または2に記載のステム無し肩関節プロテーゼ。

【請求項4】

前記突起物(13、13'、13a、13b、13c)がリブ、刃またはフィンとして形成される、請求項1または3のいずれか1項に記載のステム無し肩関節プロテーゼ。

【請求項5】

各突起物(13、13')が前記ベース部(11、31、32)の前記近位面から測定して所定の高さを有し、前記突起物(13、13')の前記高さが、前記外側端(O)から前記自由中央空間(F)へ向かって増大するかまたは一定であり、特に、各突起物(13)がその外側端(O)において最小高さを有する、請求項1～4のいずれか1項に記載のステム無し肩関節プロテーゼ。

【請求項6】

少なくとも1つの突起物(13、13')が少なくとも1つの開口部(25)を備える、請求項1～5のいずれか1項に記載のステム無し肩関節プロテーゼ。

【請求項7】

各突起物(13、13')が少なくとも部分的に切刃(29)として形成される遠位縁を備える、請求項1～6のいずれか1項に記載のステム無し肩関節プロテーゼ。

【請求項8】

少なくとも1対の隣り合う突起物(13、13')がウェブ(27、27')によって接続され、該ウェブ(27、27')が前記突起物(13、13')の内側端(I)の間に延びる、請求項1～7のいずれか1項に記載のステム無し肩関節プロテーゼ。

【請求項9】



前記突起物（１３、１３'）及び前記ウェブ（２７、２７'）が前記ベース部（１１、３１、３２）の前記遠位面から測定して所定の高さを有し、前記ウェブ（２７、２７'）の前記高さが前記突起物（１３、１３'）の前記高さより小さい、請求項８に記載のステム無し肩関節プロテーゼ。

【請求項１０】

前記ウェブ（２７、２７'）が切刃（２９'）を備え、かつ前記ウェブ（２７、２７'）の前記切刃（２９'）が前記隣り合う突起物（１３、１３'）の切刃（２９）に合体する、請求項８または９に記載のステム無し肩関節プロテーゼ。

【請求項１１】

前記ウェブ（２７、２７'）が少なくとも１つの開口部（２５'）を備える、請求項８～１０のいずれか１項に記載のステム無し肩関節プロテーゼ。

【請求項１２】

前記突起物（１３、１３'）がその外側端（Ｏ）にウィング（１４）を備える、請求項１～１１のいずれか１項に記載のステム無し肩関節プロテーゼ。

【請求項１３】

前記ベース部（３１、３２）が開口部（２５''）を有し、前記開口部（２５''）が前記突起物（１３'）の間に配設される、請求項１～１２のいずれか１項に記載のステム無し肩関節プロテーゼ。

【請求項１４】

前記ベース部（１１）がプレートを備える、請求項１～１３のいずれか１項に記載のステム無し肩関節プロテーゼ。

【請求項１５】

前記ベース部が半径方向外側のリング（３２）と、半径方向内側部（３１）と、前記外側のリング（３２）と前記内側部（３１）との間に延びる放射状スポークとを備える、請求項１～１４のいずれか１項に記載のステム無し肩関節プロテーゼ。

【請求項１６】

各突起物（１３、１３'）は基本的に前記外側端（Ｏ）から前記内側端（Ｉ）まで半径方向に延びる、請求項１～１５のいずれか１項に記載のステム無し肩関節プロテーゼ。

## 【国際調査報告】

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2012/052627

## A. CLASSIFICATION OF SUBJECT MATTER

INV. A61F2/40  
ADD. A61F2/30

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)

A61F

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 practical, search terms used)

EP0-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         | WO 02/17822 A1 (WOLF EUGENE M [US])<br>7 March 2002 (2002-03-07)<br>page 21, paragraph 2; figures 5c, 8d<br>-----                                              | 1,2                   |
| X         | WO 2007/054553 A1 (ZIMMER GMBH [CH];<br>SEEBECK JOERN [CH]; SIGGELKOW EIK [CH])<br>18 May 2007 (2007-05-18)<br>figures 9a,9b,12,15<br>-----                    | 1,2,7                 |
| X         | EP 0 485 326 A1 (SULZER AG [CH]; PROTEK AG<br>[CH] SULZER MEDIZINALTECHNIK AG [CH];<br>PROTEK) 13 May 1992 (1992-05-13)<br>the whole document<br>-----<br>-/-- | 1                     |

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

☒ See patent family annex.

## \* Special categories of cited documents :

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\*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  
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\*Z\* document member of the same patent family

Date of the actual completion of the international search

25 April 2012

Date of mailing of the international search report

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page 1 of 2

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2012/052627

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 1 467 681 B1 (MATHYS ORTHOPAEDIE GMBH<br>[DE] MATHYS AG [CH])<br>20 February 2008 (2008-02-20)<br>cited in the application<br>figure 18<br>----- | 1-15                  |
| A         | FR 2 304 324 A1 (WAGNER HEINZ [DE])<br>15 October 1976 (1976-10-15)<br>the whole document<br>-----                                                  | 1-15                  |

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No

PCT/EP2012/052627

| Patent document<br>cited in search report |    | Publication<br>date | Patent family<br>member(s)                                                                                                  | Publication<br>date                                                                            |
|-------------------------------------------|----|---------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| WO 0217822                                | A1 | 07-03-2002          | AU 8696801 A<br>EP 1337205 A1<br>WO 0217822 A1                                                                              | 13-03-2002<br>27-08-2003<br>07-03-2002                                                         |
| WO 2007054553                             | A1 | 18-05-2007          | AU 2006313698 A1<br>CA 2640759 A1<br>EP 1973498 A1<br>US 2009105772 A1<br>WO 2007054553 A1                                  | 18-05-2007<br>18-05-2007<br>01-10-2008<br>23-04-2009<br>18-05-2007                             |
| EP 0485326                                | A1 | 13-05-1992          | AT 117528 T<br>DE 59104399 D1<br>EP 0485326 A1<br>ES 2067202 T3<br>US 5133769 A                                             | 15-02-1995<br>09-03-1995<br>13-05-1992<br>16-03-1995<br>28-07-1992                             |
| EP 1467681                                | B1 | 20-02-2008          | AT 386480 T<br>AU 2002358134 A1<br>DE 20120241 U1<br>EP 1467681 A1<br>JP 2005511243 A<br>US 2004225367 A1<br>WO 03051238 A1 | 15-03-2008<br>30-06-2003<br>24-04-2003<br>20-10-2004<br>28-04-2005<br>11-11-2004<br>26-06-2003 |
| FR 2304324                                | A1 | 15-10-1976          | CH 588859 A5<br>DE 2512407 A1<br>FR 2304324 A1<br>GB 1506306 A<br>US 4035848 A                                              | 15-06-1977<br>23-09-1976<br>15-10-1976<br>05-04-1978<br>19-07-1977                             |

Form PCT/ISA/210 (patent family annex) (April 2005)

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 フロントページの続き

(81)指定国 AP(BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), EA(AM, AZ, BY, KG, KZ, MD, RU, T J, TM), EP(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, R O, RS, SE, SI, SK, SM, TR), OA(BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG), 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, H U, 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

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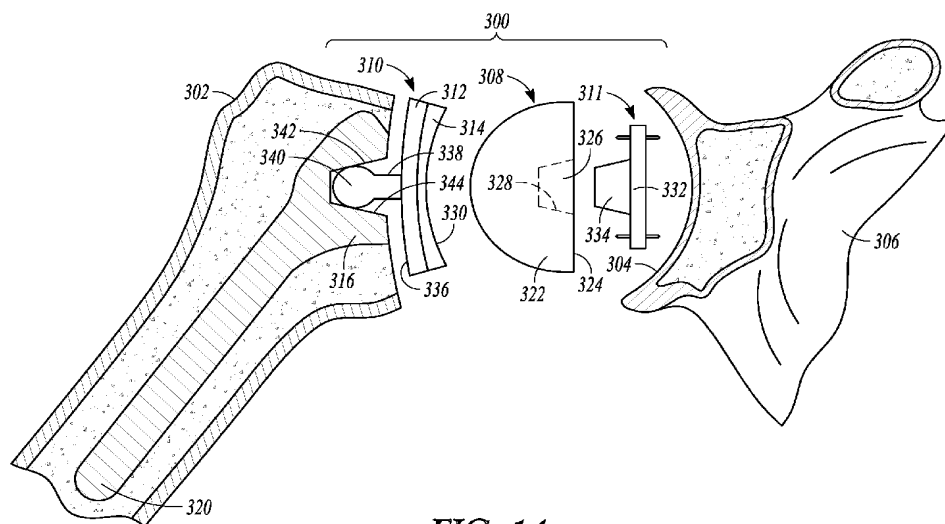


FIG. 14

(57) Abstract: The disclosure includes methods and systems for making orthopedic connections where there is unique adjustability to the connection. Illustratively, one embodiment provides a connecting assembly for connecting a plurality of orthopedic components. Such connecting assemblies can include a first orthopedic component that provides a female bore (342). Additionally, the assembly can include a second orthopedic component that can be or include a male-type connecting member (340) that is positionable in the bore of the first orthopedic component. The male-type connecting member is in the form of a quasi-spherical member (340). The quasi-spherical member can include a textured outer surface, e.g., for contacting one or more walls or surfaces in the bore in a fashion that removably locks or helps to removably lock or fix the quasi-spherical member in the bore.

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## ADJUSTABLE ORTHOPEDIC CONNECTIONS

### CLAIM OF PRIORITY

5    **[0001]**       This patent application claims the benefit of priority, under 35 U.S.C. Section 119(e), to NATHAN WINSLOW et al., U.S. Patent Application Serial Number 62/444,142, entitled “ADJUSTABLE ORTHOPEDIC CONNECTIONS,” filed on January 9, 2017 (Attorney Docket No. 4394.K80PRV), which is hereby incorporated by reference herein in its entirety.

10

### TECHNICAL FIELD

**[0002]**       The present disclosure relates generally to medical technology and in certain aspects to methods and systems for adjustably connecting orthopedic components, e.g., an articulating member to a stem or base.

15

### BACKGROUND

**[0003]**       As further background, the head or other portions of a proximal humerus can be replaced with prosthetic devices, e.g., to treat advanced degeneration of the proximal humerus. Due to the variability of the anatomy, e.g., head height, diameter, inclination and offset to the humeral canal, effective anatomical reconstruction can often necessitate a modular system offering a variety of implant configurations.

20

### OVERVIEW

25   **[0004]**       The present disclosure provides, in certain aspects, unique methods and systems for integrating or connecting orthopedic components. Illustratively, one aspect of the present disclosure provides a connecting assembly for connecting a plurality of orthopedic components. This particular connecting assembly includes a first orthopedic component that provides a bore.

30   The assembly also includes a second orthopedic component that can be or include a quasi-spherical member that is positionable in the bore of the first orthopedic component for removably locking the quasi-spherical member to the first orthopedic component. The quasi-spherical member includes a textured outer surface such as any of those disclosed herein. The textured outer surface



can contact walls of the bore in a manner that removably locks or helps to removably lock the quasi-spherical member to the first orthopedic component. While not necessary, any suitable combination of the following features can be incorporated into or associated with the connecting assembly. The quasi-spherical member can be part of a bone screw or fastener. Such a bone screw can include a shaft (e.g., a fully or partially threaded shaft with or without one or more tapered and/or one or more non-tapered longitudinal sections) that extends away from the quasi-spherical member, for example, where the quasi-spherical member forms all or part of a head of the screw. The orthopedic component can be an implant. The orthopedic component can be a bone plate. With a bone plate, the bore can extend partially or entirely through a wall of the plate. In some forms, a bore will extend entirely through a wall of the plate and a leading tip of the screw will be passed through the bore in advance of the quasi-spherical member. The first orthopedic component can be an articulating ball or head member such as a humeral head. The quasi-spherical member can be a modular component that is connectable to a separate humeral stem component. The textured outer surface can cover a significant portion of the quasi-spherical member such as more than 25% or more than 50%. The textured outer surface can include a plurality of planar surface elements, e.g., with polygonal perimeters.

[0005] In one aspect, the present disclosure provides a ball-side prosthesis for articulating with a socket in a ball and socket joint in a patient. This particular prosthesis comprises an articulating ball member that includes a top side and a bottom side. The top side provides a convex articulating surface for articulating with surfaces in the socket. The bottom side includes an opening into a bore that extends into the articulating ball member from the bottom side toward the top side. The prosthesis further comprises a fixation member that is anchorable to a bone of the patient remaining on the ball side of the ball and socket joint. The prosthesis further comprises a quasi-spherical member that is disposed at a proximal end of the fixation member. The quasi-spherical member is positionable in the bore of the articulating ball member for removably locking the quasi-spherical member to the articulating ball member. The quasi-spherical member includes a textured outer surface such as any of those disclosed herein

for contacting walls of the bore. While not necessary, any suitable combination of the following features can be incorporated into or associated with the prosthesis. The fixation member can include an elongate stem that is receivable in an intramedullary canal on the ball side of the ball and socket joint. The articulating ball member can be a humeral head. The bore can include a tapered segment. The fixation member and the quasi-spherical member can be modular components that are connectable to one another, e.g., using a Morse-type taper connection. The textured outer surface can cover any suitable percentage of the quasi-spherical member, e.g., between about 10% and 100%, or between about 40% and about 99%, or between about 50% and about 90%. The textured outer surface can include a plurality of generally planar faces, e.g., including generally planar faces spaced from one another on the quasi-spherical member and/or including generally planar faces contiguous with one another on the quasi-spherical member. The textured outer surface can include a plurality of surface elements with polygonal perimeters, e.g., including surface elements with planar surfaces within the polygonal perimeters and/or including surface elements with convex and/or concave surfaces within the polygonal perimeters. The textured outer surface can include a three-dimensional tessellation incorporating polygonal surfaces. The quasi-spherical member can approximate a honeycomb of polyhedral cells.

[0006] In one aspect, the present disclosure provides a quasi-spherical member that is positionable in the bore of an orthopedic component for removably locking the quasi-spherical member to the orthopedic component. The quasi-spherical member comprises a textured outer surface that includes a plurality of outermost extensions that are spaced from one another on the textured outer surface and which define a first radius of the quasi-spherical member and a plurality of innermost depressions that are spaced from one another on the textured outer surface and which define a second radius of the quasi-spherical member. The textured outer surface can contact walls of the bore in a manner that removably locks or helps to removably lock the quasi-spherical member to the orthopedic component. While not necessary, any suitable combination of the following features can be incorporated into or associated with the quasi-spherical member or orthopedic component. The bore can include

a tapered segment with a first diameter that is twice the first radius and a second diameter that is twice the second radius. The plurality of innermost depressions can occur on planar and/or non-planar (e.g., concave) surfaces on the quasi-spherical member. The plurality of outermost extensions can be symmetrical peaks on the quasi-spherical member.

[0007] In one aspect, the present disclosure provides a humeral prosthesis for articulating with a glenoid cavity in a patient. This particular humeral prosthesis comprises a humeral head member that includes a top side and a bottom side. The top side provides a convex articulating surface for articulating with surfaces in the glenoid cavity, e.g., a native glenoid cavity. The bottom side includes an opening into a bore that extends into the humeral head member from the bottom side toward the top side. The prosthesis further includes a fixation member that is anchorable to a humerus of the patient. The prosthesis further includes a quasi-spherical member that is disposed at a proximal end of the fixation member, e.g., where the quasi-spherical member is an integral part of the fixation member. The quasi-spherical member is positionable in the bore of the humeral head member for removably locking the quasi-spherical member to the humeral head member. The quasi-spherical member includes a textured outer surface such as any of those disclosed herein for contacting walls of the bore. In one embodiment, the textured outer surface includes a plurality of outermost extensions that are spaced from one another on the textured outer surface and which define a first radius of the quasi-spherical member and a plurality of innermost depressions that are spaced from one another on the textured outer surface and which define a second radius of the quasi-spherical member. While not necessary, the fixation member can include an elongate stem that is receivable in an intramedullary canal on the ball side of the ball and socket joint and/or the textured outer surface can include a three-dimensional tessellation of triangular surfaces whose vertices provide the plurality of outermost extensions.

[0008] In some aspects, the present disclosure provides systems and methods that can be used in a humeral reconstruction surgery in which the head or proximal end of the humerus bone is replaced or repaired, e.g., providing surgeons with modular humeral head systems offering rapid and accurate

adjustability. In some forms, modular humeral heads will have eccentric centers and/or be used with stemmed or stemless humeral fixation members.

5 [0009] Some aspects of the present disclosure involve connections between a female-type bore in a first orthopedic member such as an orthopedic plate (e.g., a bone plate) and a quasi-spherical member or another male-type connector of a second orthopedic member. This second member can be any orthopedic element or device to be connected to the plate. In certain embodiments, this second member will be something to be driven into or otherwise received in bone, for example, to attach the plate to a bone. This 10 second member can be a screw, fastener, pin, spike, or nail. For example, the second member can be a screw with a tapered shaft, or having a significant longitudinal section of the shaft being tapered with or without threading. In some embodiments, the first orthopedic member will be a non-plate orthopedic device. In some embodiments, the first orthopedic member will be an orthopedic implant 15 (e.g., a knee, hip, shoulder, ankle, or another joint implant).

[0010] Some aspects of the present disclosure involve devices/systems/methods relating to a reverse shoulder arthroplasty. A traditional shoulder joint implantation may require that the rotator cuff muscles be present and function normally. When this is not the case, a reverse shoulder 20 prosthesis may be preferable. In the reverse shoulder prosthesis, a humeral implant prosthesis can include a fixation member, a humeral tray connected to the fixation member, and an articulating liner retained in the humeral tray. A glenoid component can support a head member which can articulate with the articulating liner when the humerus bone moves.

25 [0011] The humeral tray can include a top surface for receiving the articulating liner. The humeral tray can include a bottom surface that can include a tray stem having a quasi-spherical member located adjacent the end of the tray stem. The quasi-spherical member can include a textured surface as described above. The quasi-spherical member can be located in a bore at the proximal end 30 of the fixation member. A surgeon can modify an orientation of the humeral tray by the variable positioning of the quasi-spherical member in the bore. Once the desired orientation is located, the quasi-spherical member can be locked into

place. This can allow the surgeon to provide a more accurate fit of the humeral prosthesis to an individual's anatomy.

[0012] Various types of implant components have been used in devices/systems/methods relating to shoulder implant assemblies, including reverse and traditional shoulder arthroplasty. Examples of these devices/systems/methods are illustrated and described in U.S. Pat. Nos. 6,942,699; 7,175,663; 7,241,314; 7,753,959; 7,918,895; 8,246,687; and 8,317,871. Each of these patents is incorporated by reference as if fully set forth herein.

10 [0013] Each of these non-limiting examples can stand on its own or can be combined in various permutations or combinations with one or more of the other examples.

#### BRIEF DESCRIPTION OF THE DRAWINGS

15 [0014] Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate exemplary embodiments of the invention, and such exemplifications are not to be construed as limiting the scope of the invention in any manner. In the drawings, which are not necessarily drawn to scale, like numerals may describe similar components in different views. Like numerals having different letter suffixes may represent different instances of similar components. The drawings illustrate generally, by way of example, but not by way of limitation, various embodiments discussed in the present document.

25 [0015] FIG. 1A shows a humeral prosthesis according to one embodiment of the present disclosure.

[0016] FIG. 1B shows an alternative orientation of the humeral prosthesis of FIG. 1A.

[0017] FIG. 1C shows a radiographic image of an illustrative humeral prosthesis.

30 [0018] FIG. 2 shows a humeral head member according to one embodiment of the present disclosure.

[0019] FIG. 3A shows a side, cross-sectional view of a humeral head member according to one embodiment of the present disclosure.

[0020] FIG. 3B illustrates a radius of a perfect sphere.

[0021] FIG. 3C shows a quasi-spherical member with a textured outer surface according to one embodiment of the present disclosure.

5 [0022] FIGS. 4A-4D show quasi-spherical members with textured outer surfaces of different densities according to additional embodiments of the present disclosure.

[0023] FIG. 5A shows a quasi-spherical member with a textured outer surface according to one embodiment of the present disclosure.

10 [0024] FIG. 5B shows a quasi-ellipsoid member with a textured outer surface according to one embodiment of the present disclosure.

[0025] FIG. 6A shows a quasi-spherical member with a textured outer surface according to one embodiment of the present disclosure.

[0026] FIG. 6B shows a quasi-spherical member with a textured outer surface according to one embodiment of the present disclosure.

15 [0027] FIG. 7A shows a humeral member according to one embodiment of the present disclosure.

[0028] FIG. 7B shows a humeral member according to another embodiment of the present disclosure.

20 [0029] FIG. 8 shows a humeral member according to one embodiment of the present disclosure.

[0030] FIG. 9 shows a humeral member according to another embodiment of the present disclosure.

[0031] FIG. 10 shows a front view of a bone screw according to one embodiment of the present disclosure.

25 [0032] FIG. 11 shows a front view of an orthopedic assembly according to one embodiment of the present disclosure.

[0033] FIG. 12 shows a front view of an orthopedic assembly according to another embodiment of the present disclosure.

30 [0034] FIG. 13A shows a top view of an orthopedic plate according to one embodiment of the present disclosure.

[0035] FIG. 13B is a cross-sectional view taken along view line 13B-13B from FIG. 13A.

[0036] FIG. 13C shows part of an orthopedic plate according to another embodiment of the present disclosure.

[0037] FIG. 14 shows an implant assembly for a total shoulder joint replacement, according to at least one embodiment of the present disclosure.

5 [0038] FIG. 15 shows a perspective view of a humeral tray assembly, according to at least one embodiment of the present disclosure.

[0039] FIG. 16 shows a cross-section of a humeral tray assembly, according to at least one embodiment of the present disclosure.

[0040] FIG. 17 shows a cross-section of a tray engaged with a fixture  
10 member, according to at least one embodiment of the present disclosure.

[0041] FIG. 18 shows a cross-section of a tray engaged with a fixture member, according to at least one embodiment of the present disclosure.

[0042] FIG. 19 shows a cross-section of a tray engaged with a fixture member, according to at least one embodiment of the present disclosure.

15 [0043] FIG. 20 shows a cross-section of a tray engaged with a fixture member, according to at least one embodiment of the present disclosure.

[0044] FIG. 21 shows a humeral tray assembly having an internal bore, according to at least one embodiment of the present disclosure.

[0045] FIG. 22 illustrates an implant assembly for a total shoulder joint  
20 replacement, according to at least one embodiment of the present disclosure.

[0046] FIG. 23 illustrates an implant assembly for a total shoulder joint replacement having a secondary locking system, according to at least one embodiment of the present disclosure.

[0047] FIG. 24 illustrates an implant assembly for a total shoulder joint  
25 replacement having a secondary locking system, according to at least one embodiment of the present disclosure.

[0048] FIG. 25 illustrates an implant assembly for a total shoulder joint replacement having a secondary locking system, according to at least one embodiment of the present disclosure.

30 [0049] FIG. 26 illustrates an implant assembly for a total shoulder joint replacement having a secondary locking system, according to at least one embodiment of the present disclosure.

## DETAILED DESCRIPTION

[0050] As disclosed above, the present disclosure provides, in certain aspects, unique methods and systems for making orthopedic connections. Illustratively, some embodiments of the present disclosure provide a connecting assembly for connecting a plurality of orthopedic components, e.g., where the connecting assembly itself provides a unique way to spatially adjust a first component relative to a second component. Such connecting assemblies can include a first orthopedic component that provides a female bore. Additionally, the assembly can include a second orthopedic component that can be or include a male-type connecting member that is positionable in the bore of the first orthopedic component. In one preferred form, the male-type connecting member will include a quasi-spherical member. The quasi-spherical member includes a textured outer surface, e.g., for contacting one or more walls or surfaces in the bore in a fashion that removably locks or helps to removably lock or fix the quasi-spherical member in the bore. Other suitable male-type connecting members incorporating textured outer surfaces in accordance with the present disclosure can approximate other shapes (e.g., non-spherical shapes such as a quasi-ellipsoid shape) as discussed elsewhere herein. In some preferred embodiments, the geometry of the textured outer surface will allow the quasi-spherical member to be positioned and locked in the bore in a rather large number of orientations or angular positions, for example, to account for variability in the patient's anatomy. In some instances, such a connecting assembly will be part of a ball-side prosthesis for articulating with a socket in a ball and socket joint in a patient. For example, the first orthopedic component can be an articulating ball member such as a humeral head member that includes a top side and a bottom side. The top side can provide a convex articulating surface for articulating with surfaces in the socket. The bottom side can include an opening into the bore, e.g., extending into the articulating ball member from the bottom side toward the top side. The quasi-spherical member can be disposed at the proximal end of a fixation member that is anchorable to a bone of the patient remaining on the ball side of the ball and socket joint. In the context of a humeral prosthesis, for example, the orientation or angular position of the quasi-spherical member in the bore can be adjusted to account for variability in



things like head height, diameter, inclination and offset to the humeral canal. In some embodiments, the first orthopedic component is a bone plate, and the second orthopedic component is a bone screw such as where a leading tip of a shaft of the screw is passed through the plate through the female bore and into bone in advance of a quasi-spherical member that forms part of the screw, e.g., forming all or part of a head of the screw. Thereafter, the quasi-spherical member can be received and locked in the bore in a rather large number of orientations or angular positions for attaching the plate to bone, for example, by advancing the screw to a desired final location in the bone. Such connections can be effective to resist back-out of the screw. In some instances, a shaft or a leading tip of a shaft never passes through a female bore in a plate. In some embodiments, a leading tip of the shaft enters bone before the screw contacts or is associated with the plate. In some forms, a screw is advanced to a desired final location in the bone before the quasi-spherical member is locked in the female bore, for example, where a plate is impacted down onto a pre-positioned screw so that the quasi-spherical member is forcefully received and locked in the female bore.

[0051] In some embodiments, the first component can be a fixation member that can be inserted into a humerus bone of a patient. The fixation member can define a bore near its proximal end. In some embodiments, the second component can be a humeral tray member. The humeral tray member can include a tray stem extending from the back surface of the tray. The distal end of the stem can include a quasi-spherical member. A surgeon can adjust the position of the tray relative to the fixation member and lock the quasi-spherical member into the bore when the desired orientation is achieved.

[0052] FIGS. 1A-1B show an illustrative humeral prosthesis 10. This particular humeral prosthesis 10 can include a humeral head member 40 and an assembly 9. The assembly 9 can include a quasi-spherical member 20, and a humeral fixation member 60. The humeral head member 40 includes a top side 41 and a bottom side 42. The humeral head member 40 can be hemispherical or partially-spherical in shape and, in this particular instance, the top side 41 provides a convex articulating surface 47 for articulating with glenoid surfaces, e.g., natural or synthetic mating glenoid surfaces of a human or animal shoulder.

The humeral head member 40 can be formed with any suitable material including metals, ceramics, polymers or combinations of these materials. The humeral fixation member 60 is anchorable to a humerus. The humeral fixation member 60 includes a stem 70 which is sized and shaped to be inserted into a canal 73 of the humerus 74 (See FIG. 1C). The stem 70 can be anchored in any suitable manner such as being cemented, non-cemented, pinned, or screwed to the surrounding bone material and can be configured to promote bone ingrowth. The stem 70 can be formed with any suitable material including metals, ceramics, polymers or combinations of these materials. FIG. 1C is a radiographic image of a humeral prosthesis implanted after an illustrative shoulder replacement surgery. The stem 70 of the fixation member 60 can be installed in the canal 73 of a humerus bone 74. The humeral head member (head) 40 can be located at the proximal end 59 of the humerus 74 and can articulate with natural or synthetic mating glenoid surfaces 58 of the shoulder 75.

15 [0053] Referring to FIGS. 1A-1B, during a shoulder replacement in which a humeral prosthesis 10 is required and perhaps owing to variations in anatomy, a surgeon may elect to adjust the orientation or angular position of a humeral head 40 (shown in cross-section) relative to a remaining anatomical structure or another implant component such as humeral fixation member 60.

20 The humeral head member 40 includes a bottom side 42 that provides a bore 43 with one or more walls 44. The bore extends into the humeral head member from the bottom side toward the top side. The bore 43 can be tapered with the opening wider at the bottom side 42 and narrowing towards a base 48 forming a bottom of the bore 43. A suitable female bore can be tapered or non-tapered. A

25 suitable female-type bore can be or incorporate any suitable three-dimensional shape, e.g., incorporating rectilinear and/or curvilinear features. A suitable female-type bore can have a frustoconical shape. Suitable shapes of a female-type bore can be or include full and partial forms of wedges, tapered bodies, toroids, conoids, catenoids, cubes, parallelepipeds, prisms, and combinations of

30 the same. Suitable shapes include but are not limited to full or partial cylinders, cuboids, cones, pyramids, and tetrahedrons, and combinations of the same, and in this regard, it will be understood that male-type connectors incorporating textured outer surfaces in accordance with certain aspects of the present

disclosure can approximate any suitable shape as well. Thus, in addition to spheres, such male-type connecting members can approximate non-spherical shapes, e.g., incorporating any suitable three-dimensional rectilinear and/or curvilinear shape. Illustratively, in some preferred forms, a male-type connector  
5 incorporating a textured outer surface in accordance with the present disclosure will approximate all or part of a shape like a sphere (e.g., a partial sphere such as a hemisphere), ellipsoid, oblate spheroid, prolate spheroid, catenoid, conoid, or paraboloid of revolution.

[0054] Continuing with FIGS. 1A-B, contact between the quasi-spherical  
10 member 20 and walls 44 of the bore at one or more interfaces 22 can allow a surgeon to orient the humeral head 40 in a wide range of positions, two of which can be seen in the different angles of the humeral head 40 illustrated in FIGS. 1A and 1B. FIG. 1A shows the relationship between the fixation member 60 and the humeral head 40 at a first angle 17 and FIG. 1B shows the relationship between  
15 the fixation member 60 and the humeral head 40 at a second angle 18. The geometry of the quasi-spherical member 20 can allow these angular adjustments to be made in three dimensions. During an evaluation of the orientation or angular position of the humeral head 40, the quasi-spherical member 20 may be only partially inserted into the bore 43. Even then, there may be sufficient grip to  
20 hold the components together to allow the surgeon to judge the suitability of the positioning. Once the humeral head 40 is deemed by a surgeon to be suitably oriented, the quasi-spherical member 20 can then be more fully inserted into the bore 43, e.g., by impaction loading accomplished by pressure, impact force or otherwise. In some instances, forcible contact between a male-type member such  
25 as quasi-spherical member 20 and walls of the bore will be sufficient to crush or to otherwise deform surface features of the male-type member and/or surfaces or walls within the female bore. The shape of the bore 43 including its walls 44 and the shape and surface features of the quasi-spherical member 20 can be such that the quasi-spherical member can be positionable in the bore of the humeral head  
30 member for removably locking the quasi-spherical member to the humeral head member, e.g., providing a fixed immovable connection between the quasi-spherical member 20 and the humeral head 40.

[0055] The quasi-spherical member 20 is disposed at a proximal end of the fixation member 60. In this particular embodiment, the humeral prosthesis 10 can include a narrowing and connecting member 37 which can form a transition between the quasi-spherical member 20 and the fixation member 60. This  
5 connecting member 37 can be sized and shaped to provide clearance for adjustment of the humeral head 40 on the quasi-spherical member 20. The humeral head 40 can include a cannulation 55 providing an opening extending from the base 48 of the bore 43 to the convex articulating surface 47. The cannulation 55 can be used for insertion of a pin-like tool (not pictured) to  
10 separate the humeral head 40 from the quasi-spherical member 20 after the two members have been fixedly attached by impact loading. In another example, the cannulation 55 can be threaded to use in conjunction with a bolt (not pictured) to separate the humeral head member 40 from the quasi-spherical member 20. Although the bore 43 is illustrated as positioned on a center axis 39 of the  
15 humeral head 40, the placement of the bore 43 can be offset from the center axis 39 to provide a surgeon with additional configurations for the humeral prosthesis 10.

[0056] FIG. 2 shows a perspective view of another example of a humeral head member 40. The bottom side 42 can include a recessed area 49 which can  
20 provide a humeral head member 40 with a lighter weight and/or greater orientation adjustment.

[0057] FIG. 3A shows a cross-section of a humeral head 40. The bore 43 can be tapered to include a first radius 45 positioned near the bottom side 42 and a second radius 46 positioned near the base 48. While not necessary, the first  
25 radius 45 and the second radius 46 can be related to measurements on the quasi-spherical member 20 (See FIG. 3C). FIG. 3B illustrates a perfect sphere 21 having a radius 23. FIG. 3C illustrates a quasi-spherical member 20 that includes an illustrative textured outer surface 11 covering essentially the entirety of the quasi-spherical member 20. In accordance with certain aspects of the present  
30 disclosure, quasi-spherical members or other male-type connectors in accordance with the present disclosure will incorporate a textured outer surface covering more than 50%, or more than 65%, or more than 75%, or more than 85% of the quasi-spherical member or another connector. In some instances, the

textured outer surface will cover between about 25% and about 50% of the quasi-spherical member or another connector, or between about 35% and about 75%, or between about 50% and about 90%, or between about 60% and about 100%.

5 [0058] Continuing with FIG. 3C, this particular textured outer surface 11 incorporates a tessellation pattern 80 that can be three-dimensional. A suitable tessellation can incorporate a plurality of polygonal elements such as polygonal elements 78. In this particular instance, the polygonal elements are triangular elements or faces 81. Textured outer surfaces according to additional aspects of  
10 the present disclosure can incorporate other suitable three-dimensional tessellations. In certain embodiments, quasi-spherical members or other male-type connectors in accordance with the present disclosure will mimic or approximate a plurality of stacked polyhedra such as but not limited to stacked cubes, rhombic dodecahedrons, truncated octahedrons, hexagonal prisms, or  
15 triangular prisms. In some forms, quasi-spherical members or other male-type connectors in accordance with the present disclosure will mimic or approximate a honeycomb of polyhedral cells including uniform and non-uniform honeycombs.

[0059] Continuing with FIG. 3C, the textured outer surface 11 includes a  
20 plurality of outermost extensions 12 which in this illustrative embodiment occur at vertices of the triangular faces as discussed hereinbelow. A distance from the center of the quasi-spherical member 20 to an outermost extension 12 can be equal to the first radius 45. While not necessary, an arc connecting at least two of the outermost extension 12 can generally have the same curvature as the arc  
25 of the perfect sphere 21. The textured outer surface 11 includes a plurality of innermost depressions 13 which in this illustrative embodiment occur at the centers of the triangular faces as discussed hereinbelow. A distance from the center of the quasi-spherical member 20 to an innermost depression 13 can be equal to the second radius 46. While not necessary, an arc connecting at least  
30 two of the innermost depressions can generally have the same curvature as the arc of the perfect sphere 21. A secure grip between the textured outer surface 11 and inner walls 44 of the bore can occur at one or more interfaces 22. While not necessary, the relationship between the first radius 45 and the second radius 46

can be as follows: where  $R$  = a radius 23 of a perfect sphere 21, the first radius 45 =  $R+t$  and the second radius 46 =  $R-t$  where “ $t$ ” is a variable that can be changed to create a broad range of textured outer surfaces 11.

[0060] FIGS. 4A-D illustrate a spectrum of densities of tessellation patterns 80. FIG. 4A provides a quasi-spherical member 20 with a low density 28 of polygonal elements 78. FIG. 4D provides a quasi-spherical member 20 with a high density 27 of polygonal elements 78. FIGS. 4B-4C illustrate quasi-spherical members 20 with lower and higher intermediate densities 29 of polygonal elements 78. A quasi-spherical member 20 with a higher density will allow a higher quality of spherical mapping. As the quasi-spherical member 20 is being adjusted in the walls 44 of the bore 43 (see FIGS. 1A-B), the higher quality mapping can allow a greater spectrum of possible orientations or angular positions of the humeral head member 40 in relation to the quasi-spherical member 20.

[0061] FIG. 4A shows features of the polygonal elements 78. An individual polygon 86 can have an exterior face 87 that forms an outer surface on the quasi-spherical member 20. The exterior face 87 can include a chord 89 as an edge of the exterior face 87. Each chord 89 can be contiguous with a chord 89 of a neighboring polygon 79. The chord 89 can terminate at each end in a vertex 88. Each vertex 88 of a polygon 86 can be contiguous with a vertex 88 of a neighboring polygon 79. Any number of these exterior surface features (e.g., edges, chords, planar or non-planar faces, vertices, etc.) and/or any of the other exterior surface features disclosed herein that can be incorporated into a textured outer surface of a male-type connecting members can forcibly contact walls or surfaces in a female-type bore to some degree, and in some instances, can be formed with materials that cause such surface features to be crushed or to otherwise deform upon such forcible contact, to removeably lock or help to removeably lock the male-type connecting member in the bore. Just to give one illustrative example, a plurality of planar or nearly planar faces on a textured outer surface of a male-type connecting member (e.g., a quasi-spherical member) can each partially contact a curved wall of a female bore (e.g., cylindrical or conical).

[0062] In accordance with certain aspects of the present disclosure, quasi-spherical members or other male-type connectors in accordance with the present disclosure will incorporate a textured outer surface that includes a plurality of generally planar surfaces, for example, where the combined area of the generally planar surfaces cover more than 50%, or more than 65%, or more than 75%, or more than 85% of the quasi-spherical member or another male-type connecting member. In some instances, the combined area of the generally planar surfaces will cover between about 25% and about 50% of the quasi-spherical member or other male-type connecting member, or between about 35% and about 75%, or between about 50% and about 90%, or between about 60% and about 100%.

[0063] Referring now to FIG. 5A, shown is a quasi-spherical member 20 according to another embodiment of the present disclosure that could be incorporated into any suitable orthopedic system or implant. On what would otherwise be a perfect sphere, a textured outer surface 11 in this instance includes a plurality of planar, circular faces 82 which are spaced from one another on the quasi-spherical member. These types of planar faces can have any suitable perimeter shape, e.g., incorporating rectilinear and/or curvilinear features. Illustratively, in additional embodiments, a textured outer surface will include a plurality of planar surfaces that are non-circular, e.g., polygonal. One example of this is the tessellated surface pattern shown in FIG. 3C. Additionally, it will be understood that when a textured outer surface in accordance with the present disclosure incorporates circular and/or non-circular exterior faces, such faces need not be planar. Illustratively, in additional embodiments, a textured outer surface will include a plurality of non-planar surface elements that are spaced from one another on the quasi-spherical member or another male-type connecting member. Such surface elements can be convex or concave or can incorporate other three-dimensionally curved surfaces. For example, one or more of the planar, circular faces 82 shown in FIG. 5A could instead be slightly convex or slightly concave. Additionally, it will be understood that any two such circular or non-circular surface elements need not be spaced from one another on a textured outer surface of a male-type connecting member. Select surface elements can be contiguous with one another or otherwise contact one another

on the textured outer surface. FIG. 5B shows a quasi-ellipsoid member 85 according to one embodiment of the present disclosure that could be incorporated into any suitable orthopedic system or implant. A textured outer surface 11 in this instance includes a plurality of surface elements "X" which can be any of those disclosed herein, e.g., planar and/or non-planar surface elements. For example, any one surface element "X" can be a bump, bulge, lump, knob, protuberance, dimple, depression, dent, or another type of projection or indentation. Such features can be arranged in regular or irregular patterns. These and other surface textures disclosed herein can be formed in any suitable manner including by cutting away, grinding away or otherwise removing material from an initial workpiece to provide one or more surface features or elements, or by welding, adhering or otherwise adding material to an existing piece to provide one or more surface features or elements, or by casting or otherwise initially forming a component (e.g., using an additive manufacturing process) to have one or more surface features or elements.

[0064] FIGS. 6A-B illustrate variations between the flatness of the surface of each exterior face 87 of each polygonal element 78. FIG. 6A shows a quasi-spherical member 20 having polygons 86 that have planar faces 93. FIG. 6B shows a quasi-spherical member 20 having polygons 86 that have arcuate faces 92. The arcuate face 92 can be formed with curves having a very slight radius or formed with curves having a more pronounced radius as discussed elsewhere herein.

[0065] FIGS. 7A-B represent two configurations of an assembly 9 that includes a fixation member 60 and a quasi-spherical member 20. In FIG. 7A the assembly 9 includes at least two separate pieces. The quasi-spherical member 20 can include a connecting member 37 that is unitarily formed with the quasi-spherical member, or alternatively, the connecting member can be a separately-formed piece that is subsequently connected to the quasi-spherical member using any suitable type of connection such as a tapered fit or threaded connection. For example, the quasi-spherical member can include a female-type bore into which a male-type element of the connecting member is received to make a connection. Also, the fixation member 60 can include a stem cavity 76 which can receive a distal end 61 of the connecting member 37 for making a connection between the



two in any suitable fashion. For example, the connection between the connecting member 37 and the fixation member 60 can be in any of the forms disclosed herein including in the form of a locking taper connection, a screw connection, a bolt connection, or a connection employing additional fasteners to facilitate making the connection. For example, the connecting member can have threads to mate with threads in the stem cavity 76. A configuration such as illustrated in FIG. 7A can allow the mixing and matching of various forms of quasi-spherical member/connecting member assemblies with various forms of connecting members and/or fixation members 60 so that a particular patient's morphology can be matched completely.

[0066] FIG. 7B illustrates an example of a monoblock assembly 69 in which the connecting member 37 is not removable from the fixation member. These examples should not be construed as limiting. For example, the connecting member 37 of FIG. 7A could be integrally formed with the fixation member 60 instead of integrally formed with the quasi-spherical member 20. In such a case, the quasi-spherical member 20 would have a cavity to receive a proximal end of the connecting member 37. It is also possible that the fixation member 60 and the quasi-spherical member 20 and any potential intermediate member be formed as a monoblock or otherwise formed together as a single unit.

[0067] FIG. 8 illustrates an example of a humeral member or assembly 9 that includes a stemless member 62. The stemless member 62 could include what is considered a short stem but in any event is not inserted deep into the canal 73 of the humerus 74 and instead is anchored to more proximal portions of a humerus 74 (see FIG. 1C). While not necessary, the stemless member 62 can be connected to a distal end of a connecting member 37, which in turn can be connected at its opposite end to a quasi-spherical member 20.

[0068] As discussed elsewhere herein, in some preferred forms, a textured outer surface of a male-type connector will exhibit or occupy only a portion of a particular shape such as a part of a sphere, part of an ellipsoid, etc. FIG. 9 shows a humeral member or assembly 9 according to one embodiment of the present disclosure. Assembly 9 can include a fixation member 60 and a male-type connector 100. A portion of the connector is shown in phantom as indicated by dashed line 101, and in this regard, it will be understood that connector 100

can have spherical or partial-spherical qualities. For example, in some forms, connector 100 will be a truncated sphere where an illustrative segment 102 of the sphere is removed or never exists as part of the connector. While the degree or amount of truncation shown in FIG. 9 may be useful in certain embodiments, it is merely illustrative of those contemplated. In this truncated version of the connector, segment 102 is defined along a single plane to create a proximal planar surface 103. When present, such a proximal surface can be planar or non-planar. Also, any suitable portion or percentage of such a truncated or another partial shape can be covered by a textured outer surface.

10 [0069] As also discussed elsewhere herein, quasi-spherical members or other male-type connectors in accordance with certain aspects of the present disclosure can incorporate a textured outer surface covering only a certain portion or percentage (e.g., between about 50% and about 90%) of the quasi-spherical member or another connector. Continuing with FIG. 9, in some other forms, one or more connector segments or other connector portions such as segment 102 will be part of the connector but will be void of a textured outer surface such as surface 99 or will have a lesser-textured, differently-textured, etc. outer surface. For example, the illustrative segment 102, when present, can have a generally smooth outer surface. In this regard, while the amount or percentage of coverage by the textured outer surface 99 shown in FIG. 9 may be useful in certain embodiments, it is merely illustrative of those contemplated. Any suitable degree or percentage of coverage by a particular textured outer surface is contemplated, e.g., more than 50%, or more than 65%, or more than 75%, or more than 85%, or between about 25% and about 50%, or between about 35% and about 75%, or between about 50% and about 90%, or between about 60% and about 100% of the quasi-spherical member or other connector.

25 [0070] In some embodiments, a quasi-spherical member or another male-type connector in accordance with the present disclosure is incorporated into an orthopedic product that is to be driven into or otherwise received in bone, for example, as a product for attaching or securing another orthopedic device such as a bone plate or implant to bone. In some of these embodiments, the orthopedic product is a bone screw, for example, where a quasi-spherical member or other male-type connector is disposed at a location along the length of the screw such

as at a location between the ends of the screw or at or near the end of a screw to form all or part of a screw head. Such products can be formed with any suitable material(s), and in some instances, will include an exterior surface that encourages bone ongrowth or ingrowth, for example, including a blasted surface to encourage bone ongrowth.

5 [0071] With reference now to Figure 10, shown is a bone screw 120 that includes a quasi-spherical member 121 disposed at a proximal end 122 of the screw to provide a screw head 123. In this particular embodiment, a female bore 125 with a hexagonal cross-section extends into the head from a proximal surface 126 of the head. Bone screw 120 also includes a shaft 128. While this sort of a quasi-spherical bone screw head can be paired with a bone screw shaft of any suitable size, shape or configuration, in this particular instance, the shaft extends distally from the proximal end 122 (e.g., head of the screw) to a leading, distal tip 130 of the screw. A central cannula 131 continues on from female bore 15 125 and traverses the entire length of the screw which can be useful, for example, for placing the screw over a positioned K-wire. Bone screws and fasteners in accordance with the present disclosure can be fully or partially cannulated or non-cannulated. Cannulated regions can have any suitable wall thickness.

20 [0072] Continuing with Figure 10, shaft 128 includes a proximal section 133 having a first diameter and a distal section 134 having a second diameter that is smaller than the first diameter. Bone screw and fastener shafts in accordance with the present disclosure can have constant diameters or cross-sections along their lengths, or a shaft diameter or cross-section can vary along 25 its length. For example, any section of a shaft can be tapered or non-tapered. Thus, proximal section 133 and/or distal section 134 can be fully or partially tapered along its length. While not necessary to broader aspects of the disclosure, a dual- or other multi-diameter or cross-section shaft can be useful in a variety of instances, for example, where shaft sections with different diameters or cross sections are intended to reside in different types or areas of bone. For 30 example, when bone screw 120 is placed in a glenoid, this sort of dual-diameter arrangement can account for the smaller volume of bone or a minimum cross-section of the bone anatomy (e.g. blade of scapula) located away from the point

of entry of the screw as well as the comparatively larger volume of available bone located closer to the entry point (e.g. glenoid vault). In this regard, proximal section 133 can be considered a glenoid vault zone, and distal section 134 can be considered a glenoid blade zone of screw 120 if the screw happens to be placed in this particular anatomy.

[0073] Continuing with Figure 10, threading 135 (not shown for clarity reasons) which can have a consistent screw pitch extends along both the proximal and distal sections of the shaft. Bone screws and fastener shafts in accordance with the present disclosure can be fully or partially threaded or non-threaded. Any suitable threading can be employed, and a screw or fastener can have different types of threading at different locations along a shaft. Above are just a few non-limiting examples of how a quasi-spherical member or another male-type connector in accordance with the present disclosure can be paired with a shaft of any suitable size, shape or configuration including self-drilling or self-tapping shafts.

[0074] A quasi-spherical member or another male-type connecting member of a bone screw or other fastening-type device in accordance with the present disclosure can be used with (e.g., received and locked in a bore present in) any number of implants or other orthopedic devices disclosed elsewhere herein. These include plates (e.g., bone plates) and other non-plate orthopedic devices. One or more bone screws or other fastening-type devices in accordance with the present disclosure can be utilized in any one device. Figure 11 is illustrative of one such device and shows, for example, how different angular positions X and Y can be achieved and maintained using connections according to aspects of the present disclosure. In particular, Figure 11 depicts an orthopedic assembly 140 that includes an orthopedic device 141 (e.g., a bone plate or implant) that provides a first tapered female bore 142 and a second, identical tapered female bore 143 with walls 144. These particular bores have a shape of a frustum of a right circular cone. Although not necessary to broader aspects of the disclosure, the bores each extend entirely through a wall or section 145 of the device. Either bore could have any suitable size and shape. As disclosed elsewhere herein, a suitable female bore can be tapered or non-tapered and can otherwise be or incorporate any suitable three-dimensional shape, e.g.,

incorporating rectilinear and/or curvilinear features. Continuing with Figure 11, assembly 140 also includes a first bone screw 146 and an identical second bone screw 147. Each screw includes a quasi-spherical head 148 and a shaft 149 extending from the head. These heads and shafts could be any combination of heads and shafts disclosed herein. In use, the leading ends of the shafts can be passed into and through the bores. In the Figure 11 illustration, this passing occurs in a downward direction, i.e., the leading ends enter the frustoconical bores through the larger top ends of the bores and exit the smaller bottom ends. Thereafter, the screws can be advanced (e.g., into bone) until the quasi-spherical heads are received down into the respective female bores and locked therein to generate the different angular positions X and Y. Based on the Figure 11 orientation, seating can also be fully or partially accomplished by moving the bores in an upward direction relative to the heads. Although not necessary to broader aspects of the disclosure, the walls of the bores extend fully around the seated heads, e.g., with no breaks or openings in the walls that form the frustoconical bore shapes.

[0075] Figure 12 shows a front view of an orthopedic assembly according to another embodiment of the present disclosure, and shows, for example, how different angular positions X and Y can be achieved and maintained using connections according to aspects of the present disclosure. In particular, Figure 12 depicts an orthopedic assembly 140 that includes an orthopedic device 141 (e.g., a bone plate or implant) that provides a first tapered female bore 142' and a second, identical tapered female bore 143' with walls 144'. These particular bores have a shape of a frustum of a right circular cone. Although not necessary to broader aspects of the disclosure, the bores each extend entirely through a wall or section 145 of the device. Either bore could have any suitable size and shape. As disclosed elsewhere herein, a suitable female bore can be tapered or non-tapered and can otherwise be or incorporate any suitable three-dimensional shape, e.g., incorporating rectilinear and/or curvilinear features. Such bores could extend only partially through the wall or section, for example, as shown with the elongated bore or opening in Figure 13C. Continuing with Figure 12, assembly 140 also includes a first bone screw 146 and an identical second bone screw 147. Each screw includes a quasi-

spherical head 148 and a shaft 149 extending from the head. These heads and shafts could be any combination of those disclosed herein. In use, the quasi-spherical heads can be received and locked in the respective female bores to generate the different angular positions X and Y. Based on the Figure 12 illustration, such connections can be achieved by moving wall or section 145 in a downward direction onto the screws (e.g., by impacting the device 141) so that the heads enter the frustoconical bores through the larger bottom ends of the bores and move a distance in the bores toward the smaller top ends until suitably locked in place. Based on the Figure 12 orientation, seating can also be fully or partially accomplished by moving quasi-spherical heads 148 in an upward direction relative to the bores. In this regard, depending on the sizes and shapes of the various components, it is possible to make the connections with no portions of the shafts ever entering the bores. Although not necessary to broader aspects of the disclosure, the walls of the bores extend fully around the seated heads, e.g., with no breaks or openings in the walls that form the frustoconical bore shapes. In some forms, a screw will be advanced to a desired final location in a bone before a quasi-spherical screw head is locked in a female bore of a device, for example, where a plate is impacted down onto a pre-positioned screw so that the quasi-spherical member is forcefully received and locked in the female bore.

[0076] Turning now to Figure 13A, shown is a top view of an orthopedic plate 200 according to one embodiment of the present disclosure. From this view, plate 200 is shown to include a generally rectangular bore or opening 201. Although not necessary to broader aspects of the disclosure, the rectangular opening extends entirely through the plate, i.e., in a direction into the page based on the Figure 13A illustration. Such an opening can be an elongated or slot-type opening of any suitable size and rectangular or non-rectangular shape. A plate or other device can incorporate any number of such openings. Illustratively, such an opening can have one dimension (e.g., rectangular slot length when viewed from the top as in Figure 13A) that is significantly larger than another dimension (e.g., rectangular slot width) including but not limited to a first dimension that is 2 to 40, or 4 to 20, or 8 to 15 times larger than a second dimension. An elongated or slot-type opening can have a curvature along its length, for example, even

providing in some embodiments an annular or ring-shaped slot with no ends. Also, although the width of the opening 201 in Figure 13A is constant along its length, it need not be. Such a slot can be a series of discernable openings or bores like those shown in Figures 11 and 12 which are interconnected across a plate or other device, for example, interconnected by slots or passages of a smaller width or dimension that allow interbore movement of another assembly component such as horizontal movement of a screw or fastener shaft from one bore to another along a plate or other device before the screw or fastener is ultimately locked in place in a particular bore. Any such elongated or slot-type opening can be part of any plate or non-plate orthopedic device in accordance with the present disclosure.

[0077] Figure 13B shows a cross-sectional view taken along view line 13B-13B from FIG. 13A, and it can be seen that walls 202 of the opening are angled or tapered. Based on the Figure 13B orientation, the walls diverge moving from top to bottom so that the top end of the opening 201 is smaller than the bottom end of the opening. Based on the Figure 13B illustration, a connection with a quasi-spherical member or another male-type connector in accordance with the present disclosure can be achieved by moving plate 200 in a downward direction onto the quasi-spherical member (e.g., which forms all or part of a screw head) so that the quasi-spherical member enters the opening through the larger bottom end of the opening and moves a distance in the opening toward the smaller top end until suitably locked in place. Alternatively, the plate could be flipped over from what is shown in Figure 13B, and a leading tip of a screw could be passed into and through the opening, and the screw could be advanced until a quasi-spherical head of the screw is locked into the opening.

[0078] That such openings can have an elongated or slot-type shape allows a quasi-spherical member such as that of the screw shown in Figure 10, prior to being locked in place, to be moved to different relative positions along the length of a slot or other opening. For example, when viewing the Figure 13A illustration, such a quasi-spherical member could be received and locked in place in the opening at or near one end of the opening, at or near the far opposite end of the opening, or anywhere in between. Although not necessary to broader aspects of the disclosure, at opposite ends of the rectangular opening, the

opening 201 is tapered on three sides. Alternatively, the illustration of Figure 13B can represent one end of plate 200 such that it is not a cross-sectional view of plate 200 but rather an end view. In this regard, a quasi-spherical member could be partially and loosely received in the opening, and the plate could be slid  
5 over a quasi-spherical member (e.g., from the side) before a connection is made. Such a configuration could be particularly useful, for example, where space is limited anatomically such as where it is not easy or possible to introduce a plate or device other than from the side. Such side openings could be located anywhere on a plate or other device.

10 [0079] Figure 13C shows part of an orthopedic plate 210 according to another embodiment of the present disclosure. Plate 210 includes a top surface 211 and bottom surface 212. This plate is similar to that shown in Figure 13B except that it includes an opening 213 which extends only partially through the plate, and in this regard, Figure 13C represents a cross-sectional view of the  
15 plate taken from a similar vantage point as the cross-sectional view in Figure 13B. In particular, opening 213 extends into the plate from bottom surface 212, and walls 214 of the opening converge moving toward the top surface 211 of the plate. Alternatively, the illustration of Figure 13C can represent one or both  
20 ends of plate 210 such that it is not a cross-sectional view of plate 210 but rather an end view. In this regard, a quasi-spherical member could be partially and loosely received in the opening, and the plate could be slid over a quasi-spherical member (e.g., from the side) before a connection is made. Such a configuration could be particularly useful, for example, where space is limited anatomically  
25 such as where it is not easy or possible to introduce a plate or device other than from the side. Such side openings could be located anywhere on a plate or other device.

[0080] FIG. 14 illustrates an embodiment of an implant assembly 300 for a total shoulder joint replacement. While the implant assembly 300 is illustrated in the drawings as a reverse shoulder prosthesis, other shoulder prostheses are  
30 contemplated. The implant assembly 300 is configured to be implanted between a resected humerus 302 and a glenoid cavity ("glenoid") 304 of a scapula 306 in a reverse arthroplasty. The implant assembly 300 can include a head member 308 (henceforth: "head"), a humeral tray assembly 310, and an adapter 311. The



humeral tray assembly 310 can include a humeral tray member 312 (henceforth: “tray”) and an articulating liner member 314 (henceforth: “liner”). The implant assembly 300 may also include a fixation member 316 that has a proximal end 318 and a distal end 320.

5 [0081] In the embodiment shown in FIG. 14, the head 308 can be bounded by a convex surface 322, which may be, for example, a hemispherical surface, and a base 324, which may be a substantially planar surface. In one embodiment, the base 324 may be modularly connected to the head 308. A female taper 326 with tapered inner walls 328 can extend from the base 324 into  
10 the head 308. The convex surface 322 of the head 308 can be shaped to articulate with a concave surface 330 of the liner 314 to allow for shoulder joint movement. Such articulation may be centered or eccentric.

[0082] In one embodiment, the adapter 311 may include an adapter tray 332 and an extension or male taper 334 that can be press-fitted into the female  
15 taper 326 of the head 308. For the procedure of reverse arthroplasty, the adapter tray 332 can be attached to the glenoid 304.

[0083] Referring to FIG. 14, the tray 312 can include a bottom side 336 that can include a tray stem 338. The tray stem 338 can be any structure that extends from the bottom side 336 and can be configured in a variety of lengths  
20 and shapes to provide for patient anatomies of different sizes and shapes. The tray stem 338 can include any feature or any combination of features such as described for the connecting member 37 in FIGS. 1, 7, and 8. A quasi-spherical member 340 such as a quasi-spherical member having any feature or any combination of features of the quasi-spherical members described in FIGS. 1-13  
25 can be coupled adjacent the distal end 339 (see FIG. 15) of the tray stem 338 and can be configured to be selectively coupled to the fixation member 316 in a reverse shoulder arthroplasty, or other joint replacement procedure. The fixation member 316 can extend from a distal end 320 to a proximal end 318. A bore 342 can be defined in the proximal end 318. The bore 342 can be tapered and can  
30 include all the features relating to any or any combination of the features of bores 43 or 143 described above. In addition, the bore 342 can include any or any combination of the features of bores 43 or 143 described above as they relate to the quasi-spherical member 340.

[0084] The quasi-spherical member 340 can be located in the bore 342. An angle of the tray 312 relative to the fixation member 316 can be adjusted in three dimensions. Once the tray 312 is deemed by a surgeon to be suitably oriented, the quasi-spherical member 340 can then be more fully inserted into the bore 342, e.g., by impaction loading accomplished by pressure, impact force or otherwise. In some instances, forcible contact between a male-type member such as the quasi-spherical member 340 and walls of the bore 342 will be sufficient to crush or to otherwise deform surface features of the male-type member and/or surfaces or walls within the bore 342. The shape of the bore 342 including its walls 344 and the shape and surface features of the quasi-spherical member 340 can be such that the quasi-spherical member 340 can be positionable in the bore 342 of the fixation member 316 for removably locking the quasi-spherical member 340 to the fixation member 316, e.g., providing a fixed immovable connection between the quasi-spherical member 340 and the fixation member 316.

[0085] In an example, surfaces of the proximal end 318 of the fixation member 316 and/or the proximal end of the resected humerus 302 can be modified or adjusted to enable additional angular adjustment of the tray 312 relative to the fixation member 316.

[0086] FIG. 15 shows a perspective view of a humeral tray assembly 310, according to at least one embodiment of the present disclosure. The humeral tray assembly 310 can generally include a tray 312, a liner 314, and a retaining ring 346. As will become appreciated, the retaining ring 346 can be adapted to retain the liner 314 relative to the tray 312 in a locked position.

[0087] The tray 312 can include a top side 313 that can generally define a tray member cavity 348 that can form a recess configured to receive the liner 314. Note: although the terms top side 313 and bottom side 336 have been used in this description, this is for explanation purposes only and the orientation of the tray 312 can be any three-dimensional orientation, limited only in that “top side 313” and “bottom side 336” are two generally opposing surfaces. The tray 312 can generally include a platform portion 350 and a tray stem 338. The platform portion 350 can have an upper rim 352. The tray 312 can have a liner engaging surface 354. The tray 312 may comprise a biocompatible metal, such as stainless

steel, titanium, titanium alloys, and cobalt-chromium alloys. In an alternative, the tray 312 can comprise any biocompatible material. The upper rim 352 can have a first interlocking portion 356. In the example shown, the first interlocking portion 356 is in the form of tabs 358 radially positioned around the upper rim 352. The tabs 358 can generally be raised relative to the upper rim 352. The platform portion 350 can further define an inboard annular groove 360 formed around the liner engaging surface 354. The upper rim 352 can further include a first slot 362. In one example, the first slot 362 can include a generally planar surface or ledge 364 that is transverse to a long axis of the tray stem 338. Fingers 366 of the retaining ring 346 can engage the first slot 362. Portions of the tray 312 can include bone engaging surfaces having a porous coating.

**[0088]** The liner 314 will now be described in greater detail. The liner 314 may be formed of polyethylene or other suitable bearing material. The liner 314 can generally include an outer tray engaging surface 368 and an inner head engaging surface 370. An outboard annular groove 369 can be formed around the outer tray engaging surface 368. The outer tray engaging surface 368 can have a generally planar surface, while the inner head engaging surface 370 can be generally concave. A second interlocking portion 372 can be formed around a rim portion 371 of the liner 314. In the example shown, the second interlocking portion 372 is in the form of complementary notches 374 defined around the rim portion 371. The first and second interlocking portions 356 and 372 can cooperatively mate in an assembled position (FIG. 16), such that the tabs 358 nest with the notches 374 and, therefore, inhibit rotational motion of the liner 314 within the tray 312. In the particular example shown, the amount of notches 374 equals the amount of tabs 358. It is appreciated however, that in other examples, the notches 374 may outnumber the tabs 358.

**[0089]** The retaining ring 346 can be adapted to locate within the inboard annular groove 360 of the tray 312. In a locked position, the inboard annular groove 360 of the tray 312 is operable to snappingly receive the retaining ring 346 to secure the liner 314 to the tray 312. Explained further, the retaining ring 346 can be adapted to partially nest within the inboard annular groove 360 of the tray 312 and, concurrently, partially nest within the outboard annular groove 369 of the liner 314 in the locked position (FIG. 16). An annular protrusion 376 of

the retaining ring 346 can nest within a second slot 378. In this way, the retaining ring 346 may be discouraged from rotating around the platform portion 350 of the tray 312.

5 [0090] The quasi-spherical member 340 can be coupled to or integral formed with a distal end 339 of the tray stem 338 (see FIG. 16).

[0091] FIG. 16 shows a cross section of a humeral tray assembly 310, according to at least one embodiment of the present disclosure. The quasi-spherical member 340 can include any of the shapes, surfaces, materials, forms, qualities, and/or functions described above in FIGS. 1-13. The tray 312 can  
10 define one or more recesses 380A, 380B in the bottom side 336 that can be configured to allow greater angular movement of the tray 312 relative to the fixation member 316 (see FIG. 14) when the desired orientation of the tray 312 is being set by a surgeon. FIG. 16 shows the liner 314 installed in the tray 312 and held in place by the retaining ring 346 in the outboard annular groove 369  
15 and the inboard annular groove 360. The ledge 364 is shown.

[0092] The tray stem 338 can be configured in a variety of lengths to adapt the humeral tray assembly 310 for different amounts of angular adjustment, and/or different patient anatomies.

[0093] Although the humeral tray assembly 310 has been described in  
20 detail above, the present inventor has contemplated other forms that may include different contours, subassemblies, and/or additions (e.g., spacers), forms (e.g., one piece tray and liner assembly) without changing the intent of this disclosure.

[0094] FIG. 17 shows a tray 312 engaged with a fixation member 316, according to at least one embodiment of the present disclosure. The fixation  
25 member 316 can include a threaded bore 382. The tray stem 338 can include a stem bore 384. Portions of the stem bore 384 can be threaded, or the stem bore 384 can be unthreaded. The stem bore 384 can extend from the liner engaging surface 354 (see FIG. 15) to the tip 386 of the quasi-spherical member 340. If no angular adjustment of the tray 312 is required, a fastener (not shown) can extend  
30 through the stem bore 384 into the threaded bore 382 and can attach the tray 312 to the fixation member 316. Although the quasi-spherical member 340 is shown located near the bore base 390 of the bore 342, the quasi-spherical member 340 can be configured to fit at other locations of the walls 344 of the bore 342 (e.g.,

by altering the diameter of the quasi-spherical member 340 and/or the bore 342). The walls 344 can be tapered, shaped, or formed in manners described above in relation to bore 43 and/or bore 143.

[0095] FIG. 18 shows a tray 312 engaged with a fixation member 316, according to at least one embodiment of the present disclosure. FIG. 18 shows the relationship between the fixation member 316 and the tray 312 at a first angle 392 and FIG. 19 shows the relationship between the fixation member 316 and the tray 312 at a second angle 394. FIG. 18 shows a top edge 396 that is generally in the same plane along both sides of the bore 342. In FIG. 19, the top edge 396 can be configured to be recessed, angled, or cut away, for example at portion 398 so that the second angle 394 can be increased without interfering with the bottom side 336 of the tray 312. The tray stem 338 in FIG. 19 is shorter than the tray stem 338 of FIG. 18 and the tray 312 can be provided with tray stems 338 of various lengths to accommodate different anatomies, surgical procedures, and/or angular adjustments.

[0096] FIG. 20 shows a tray 312 engaged with a fixation member 316, according to at least one embodiment of the present disclosure. In an embodiment, one or both of the tray stem 338 and the quasi-spherical member 340 do not include a stem bore 384 (see FIG. 17) and can be solid material.

[0097] FIG. 21 shows a humeral tray assembly 400 having an internal bore 402, according to at least one embodiment of the present disclosure. The humeral tray assembly 400 can include a tray 412 and a liner 414. The tray 412 can include an internal bore 402, having tapered walls 404 and configured to operate as the bore 43 described in FIGS 1-9. The internal bore 402 can engage a quasi-spherical member 20 located on a fixation member 60 as described in FIGS. 1-9. The humeral tray assembly 400 can be angularly adjusted in the same manner as the humeral head member 40 described above in FIGS. 1-9.

[0098] FIG. 22 shows an implant assembly for a total shoulder joint replacement, according to at least one embodiment of the present disclosure.

[0099] While the implant assembly 500 is illustrated in the drawings as a reverse shoulder prosthesis, other shoulder prostheses are contemplated. The implant assembly 500 is configured to be implanted between a resected humerus 502 and a glenoid cavity ("glenoid") 504 of a scapula 506 in a reverse

arthroplasty. The implant assembly 500 can include a head member 508 (henceforth: “head”), a humeral tray assembly 510, and an adapter 511. The humeral tray assembly 510 can include a humeral tray member 512 (henceforth: “tray”) and a liner member 514 (henceforth: “liner”). The implant assembly 500  
5 may also include a fixation member 516 that has a proximal end 518 and a distal end 520. The fixation member 516 can extend from a distal end 520 to a proximal end 518. A bore 542 can be defined in the proximal end 518.

[00100] In the embodiment shown in FIG. 22, the head 508 can be bounded by a convex surface 522, which may be, for example, a hemispherical surface, and a base 524, which may be a substantially planar surface. In one  
10 embodiment, the base 524 may be modularly connected to the head 508. A female taper 526 with tapered inner walls 528 can extend from the base 524 into the head 508. The female taper 526 can include all the features relating to any or any combination of the features of bores 43 or 143 described above. The convex  
15 surface 522 of the head 508 can be shaped to articulate with a concave surface 530 of the liner 514 to allow for shoulder joint movement. Such articulation may be centered or eccentric.

[00101] In one embodiment, the humeral tray assembly 510 can be fixed to the resected humerus 502, by means of fasteners, adhesives, or press fit. The  
20 tray 512 can include a bottom side 536 that can include a tray stem 538. The tray stem 538 can be any structure that extends from the bottom side 536 and can be configured in a variety of lengths and shapes to provide for patient anatomies of different sizes and shapes. The tray stem 538 can include any feature or any combination of features such as described for the connecting member 37 in  
25 FIGS. 1, 7, and 8. The tray stem 538 can be bonded, press fit, or fastened into a bore 542 that can be defined in the proximal end 518. The bore 542 can be tapered and can include all the features relating to any or any combination of the features of bores 43 or 143 described above.

[00102] In one embodiment, the adapter 511 may include an adapter tray  
30 532. The adapter tray 532 can include an adapter stem 535. The adapter stem 535 can be configured as any structure that extends from the adapter tray 532 and can be configured in a variety of lengths and shapes to provide for patient

anatomies of different sizes and shapes. For the procedure of reverse arthroplasty, the adapter tray 532 can be attached to the glenoid 504.

5 [00103] A quasi-spherical member 540 such as a quasi-spherical member having any feature or any combination of features of the quasi-spherical members described in FIGS. 1-13 can be coupled adjacent a distal end of the adapter stem 535 and can be configured to be selectively coupled to the head 508 in a reverse shoulder arthroplasty, or other joint replacement procedure.

10 [00104] The quasi-spherical member 540 can be located in the female taper 526. An angle of the head 508 relative to the adapter 511 can be adjusted in three dimensions. Once the head 508 is deemed by a surgeon to be suitably oriented, the quasi-spherical member 540 can then be more fully inserted into the female taper 526, e.g., by impaction loading accomplished by pressure, impact force or otherwise. In some instances, forcible contact between a male-type member such as the quasi-spherical member 540 and walls of the female taper 526 will be sufficient to crush or to otherwise deform surface features of the male-type member and/or surfaces or walls within the female taper 526. The shape of the female taper 526 including its tapered inner walls 528 and the shape and surface features of the quasi-spherical member 540 can be such that the quasi-spherical member 540 can be positionable in the female taper 526 of the head 508 for removably locking the quasi-spherical member 540 to the head 508, e.g., providing a fixed, immovable connection between the quasi-spherical member 540 and the fixation head 508.

25 [00105] In an example, surfaces of the glenoid cavity 504 can be modified or adjusted to enable additional angular adjustment of the adapter 511 relative to the head 508.

30 [00106] FIGS. 23-26 illustrate examples of an implant assembly 600 for a total shoulder joint replacement, according to at least one embodiment of the present disclosure. While the implant assembly 600 is illustrated in FIGS. 23-26 as a reverse shoulder prosthesis, other shoulder prostheses are contemplated, and the devices/methods illustrated that include more than one quasi-spherical member can be used in other joint replacement applications and other angularly adjustable fastening applications.

[00107] The implant assembly 600 shown in FIGS. 23-26 can be similar to the implant assembly 500 described above in conjunction with FIG. 22. FIG. 23 illustrates the implant assembly 600 that can include a head 608, an adapter, 611, an adapter tray 632, an adapter stem 635 and a quasi-spherical member 640.

5 The head 608 can define a female taper 626 that can include tapered inner walls 628. The quasi-spherical member 640 can include any or any combination of the features of quasi-spherical members described above. In addition, the quasi-spherical member 640 can define a tip taper 641 which can extend from an outer surface of the quasi-spherical member 640 towards the adapter stem 635.

10 [00108] The implant assembly 600 can include a secondary locking system 699 that can allow a secondary securement of the head 608 to the quasi-spherical member 640. The secondary locking system 699 can include a head 608 having a pin bore 650 that extends from a convex surface 622 to the female taper 626. The pin bore 650 can include a lip 651 that can narrow a portion of  
15 the pin bore 650. The secondary locking system 699 can include a locking pin 652. The locking pin 652 can include a pin base 653. A pin stem 654 can extend from the pin base 653 and can include a pin quasi-spherical member 655 opposite the pin base 653. The pin quasi-spherical member 655 can include any or any combination of the features of quasi-spherical members described above.

20 [00109] The locking pin 652 can be configured to pass at least partially through the pin bore 650. The lip 651 can form a shoulder to prevent the pin base 653 from passing through the pin bore 650 and the pin base 653 can rest against the lip 651 as shown in FIG. 25.

[00110] As shown in FIG. 24, the head 608 can be located on the quasi-spherical member 640. As described above, the head 608 can be angularly  
25 adjusted, and when an angle is accomplished the head 608 can be impacted so that the female taper 626 and the quasi-spherical member 640 are joined in a manner that keeps the head securely at the desired placement angle. As shown in FIG. 24, the pin bore 650 can generally align with the tip taper 641. At least  
30 portions of the diameter of the pin bore 650 can be greater than the diameter of the tip taper 641. Having a greater diameter of the pin bore 650 can allow the pin quasi-spherical head 655 to be located within the tip taper 641 when the head 608 has been adjusted to the desired placement angle.



[00111] FIG. 25 illustrates the locking pin 652 installed in the pin bore 650. The pin quasi-spherical member 655 can be located in the tip taper 641. The connection between the pin quasi-spherical member 655 and the tip taper 641 can include any of the features of the connections described above with tapered  
5 bores and quasi-spherical members. In an example, the locking pin 652 can be installed into the tip taper 641 before the head 608 has been impacted and locked onto the quasi-spherical member 640. In an example, the locking pin 652 can be installed into the tip taper 641 after the head 608 has been impacted and locked onto the quasi-spherical member 640.

10 [00112] FIG. 26 illustrates an implant assembly 600 in which the head 608 has been adjusted so that a base 624 can form an angle 656 with the adapter tray 632. When a desired angle 656 or location of the head 608 relative to the adapter tray 632 has been found, the pin quasi-spherical member 655 can be locked into the tip taper 641 by impaction loading accomplished by pressure,  
15 impact force or otherwise as described above. The pin quasi-spherical member 655 of the locking pin 652 can provide a holding force that can complement or take the place of the holding force provided by the quasi-spherical member 640.

[00113] The above-detailed description includes references to the accompanying drawings, which form a part of the detailed description. The  
20 drawings show, by way of illustration, specific embodiments in which the invention can be practiced. These embodiments are also referred to herein as “examples.” Such examples can include elements in addition to those shown or described. However, the present inventors also contemplate examples in which only those elements shown or described are provided. Moreover, the present  
25 inventors also contemplate examples using any combination or permutation of those elements shown or described (or one or more aspects thereof), either with respect to a particular example (or one or more aspects thereof), or with respect to other examples (or one or more aspects thereof) shown or described herein.

[00114] In the event of inconsistent usages between this document and  
30 any documents so incorporated by reference, the usage in this document controls.

[00115] In this document, the terms “a” or “an” are used, as is common in patent documents, to include one or more than one, independent of any other

instances or usages of “at least one” or “one or more.” In this document, the term “or” is used to refer to a non-exclusive or, such that “A or B” includes “A but not B,” “B but not A,” and “A and B,” unless otherwise indicated. In this document, the terms “including” and “in which” are used as the plain-English equivalents of the respective terms “comprising” and “wherein.” Also, in the following claims, the terms “including” and “comprising” are open-ended, that is, a system, device, article, composition, formulation, or process that includes elements in addition to those listed after such a term in a claim are still deemed to fall within the scope of that claim. Moreover, in the following claims, the terms “first,” “second,” and “third,” etc. are used merely as labels, and are not intended to impose numerical requirements on their objects.

[00116] The above description is intended to be illustrative, and not restrictive. For example, the above-described examples (or one or more aspects thereof) may be used in combination with each other. Other embodiments can be used, such as by one of ordinary skill in the art upon reviewing the above description. The Abstract is provided to comply with 37 C.F.R. §1.72(b), to allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. Also, in the above Detailed Description, various features may be grouped together to streamline the disclosure. This should not be interpreted as intending that an unclaimed disclosed feature is essential to any claim. Rather, inventive subject matter may lie in less than all features of a particular disclosed embodiment. Thus, the following claims are hereby incorporated into the Detailed Description as examples or embodiments, with each claim standing on its own as a separate embodiment, and it is contemplated that such embodiments can be combined with each other in various combinations or permutations. The scope of the invention should be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

30

WHAT IS CLAIMED IS:

1. An implant assembly for use in a reverse total shoulder arthroplasty, comprising:

5 a tray member that includes a top side and a bottom side, the top side defining a tray member cavity, the bottom side including a tray stem;

a fixation member anchorable to a humerus bone of a patient, the fixation member having a distal end and a proximal end, the fixation member including an opening into a bore that extends into the fixation member from said proximal  
10 end toward said distal end; and

a quasi-spherical member disposed adjacent a distal end of the tray stem, the quasi-spherical member positionable in the bore of the fixation member for removably locking the quasi-spherical member to the fixation member, wherein the quasi-spherical member includes a textured outer surface for contacting walls  
15 of the bore.

2. The implant assembly of claim 1, further comprising an articulating liner, the articulating liner including a first end that is receivable in said tray member cavity for axially securing said articulating liner to said tray member, wherein  
20 the articulating liner is configured for articulating with surfaces of a ball member.

3. The implant assembly of claim 1, wherein the bore includes a tapered segment.  
25

4. The implant assembly of claim 1, wherein the textured outer surface covers more than 50% of the quasi-spherical member.

5. The implant assembly of claim 1, wherein the textured outer surface  
30 includes a plurality of generally planar faces.

6. The implant assembly of claim 5, wherein the plurality of generally planar faces are spaced from one another on the quasi-spherical member.

7. The implant assembly of claim 5, wherein the plurality of generally planar faces are contiguous with one another on the quasi-spherical member.
- 5 8. The implant assembly of claim 5, wherein the plurality of generally planar faces have curvilinear perimeters.
9. The implant assembly of claim 8, wherein the plurality of generally planar faces have circular perimeters.
- 10 10. The implant assembly of claim 5, wherein the plurality of generally planar faces have rectilinear perimeters.
11. The implant assembly of claim 10, wherein the plurality of generally  
15 planar faces have polygonal perimeters.
- 12 The implant assembly of claim 11, wherein the plurality of generally planar faces have triangular perimeters.
- 20 13. The implant assembly of claim 1, wherein the textured outer surface includes a plurality of surface elements with polygonal perimeters.
14. The implant assembly of claim 13, wherein the plurality of surface elements are planar within the polygonal perimeters.
- 25 15. The implant assembly of claim 13, wherein the plurality of surface elements are convex or concave within the polygonal perimeters.
16. The implant assembly of claim 1, wherein the textured outer surface  
30 includes a three-dimensional tessellation incorporating polygonal surfaces.
17. The implant assembly of claim 1, wherein the quasi-spherical member approximates a honeycomb of polyhedral cells.

18. The implant assembly of claim 1, wherein the textured outer surface includes a plurality of outermost extensions spaced from one another on the textured outer surface and defining a first radius of the quasi-spherical member  
5 and a plurality of innermost depressions spaced from one another on the textured outer surface and defining a second radius of the quasi-spherical member.
19. The implant assembly of claim 18, wherein the bore includes a tapered segment with a first diameter that is twice the first radius and a second diameter  
10 that is twice the second radius.
20. The implant assembly of claim 18, wherein said plurality of innermost depressions occur on planar surfaces on the quasi-spherical member.
- 15 21. The implant assembly of claim 18, wherein said plurality of innermost depressions occur on concave surfaces on the quasi-spherical member.
22. The implant assembly of claim 18, wherein said plurality of outermost extensions are symmetrical peaks on the quasi-spherical member.

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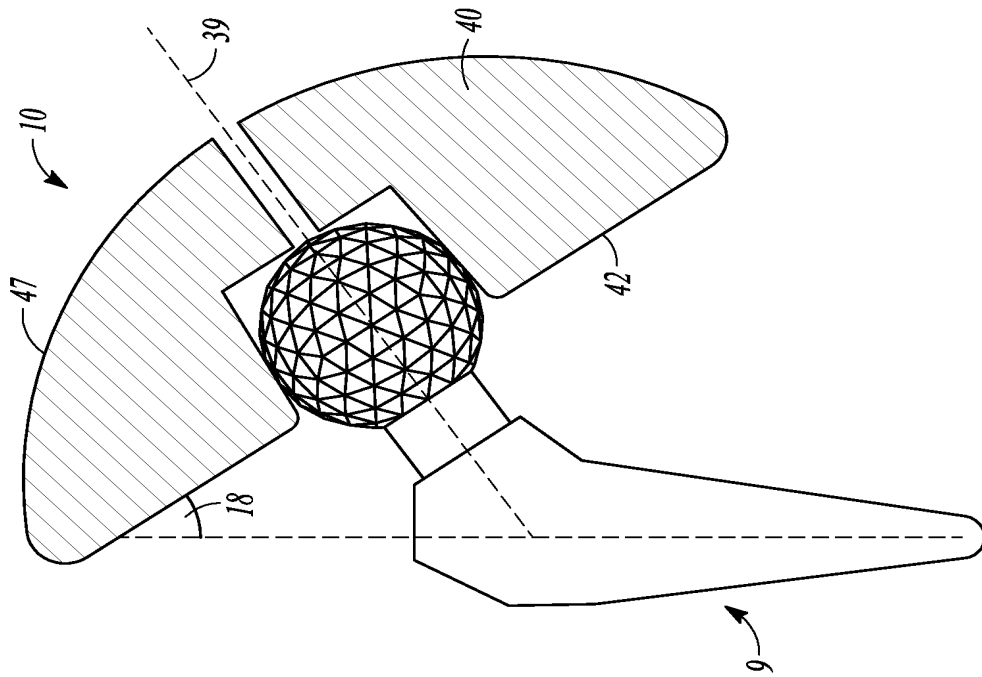


FIG. 1B

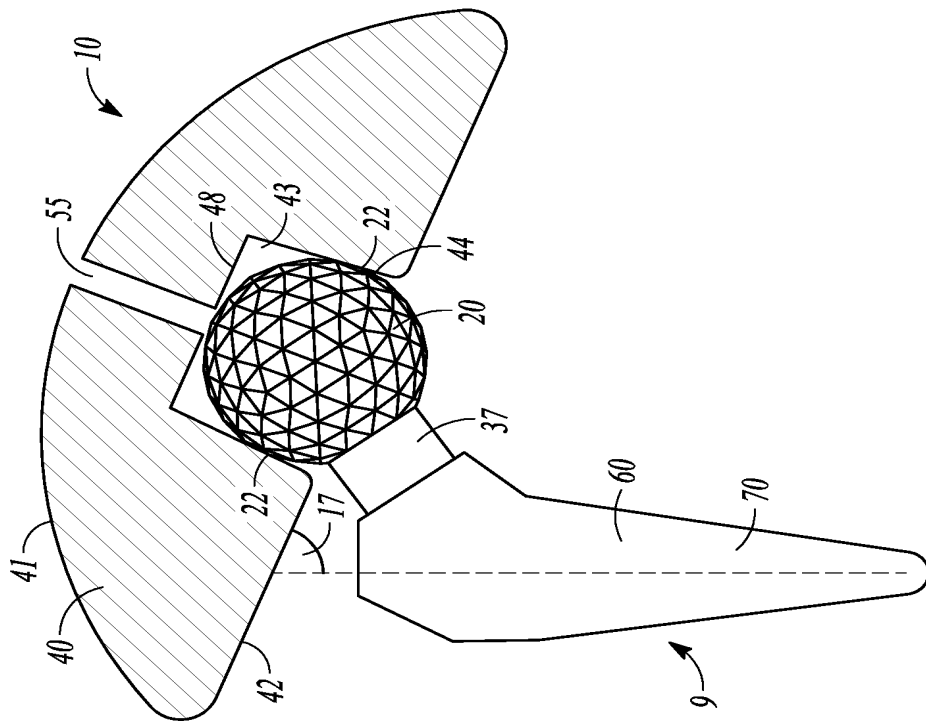
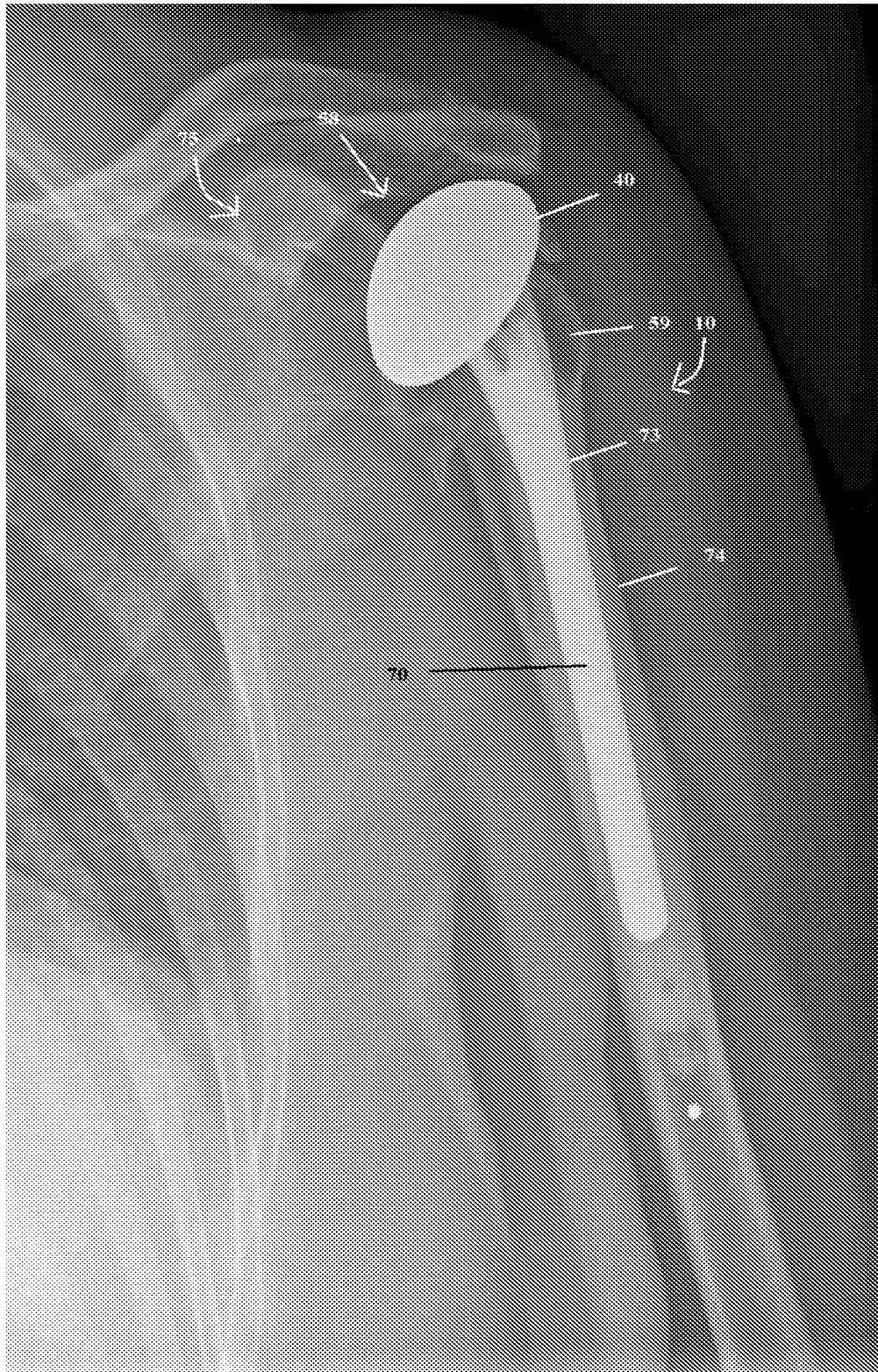


FIG. 1A

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*FIG. 1C*

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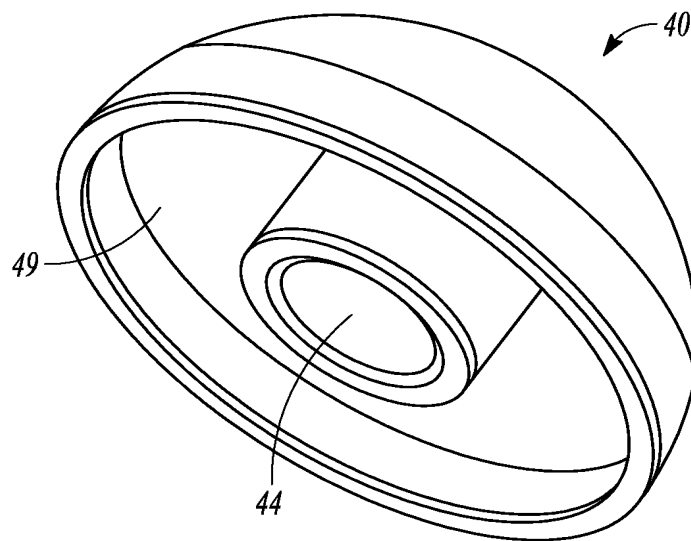
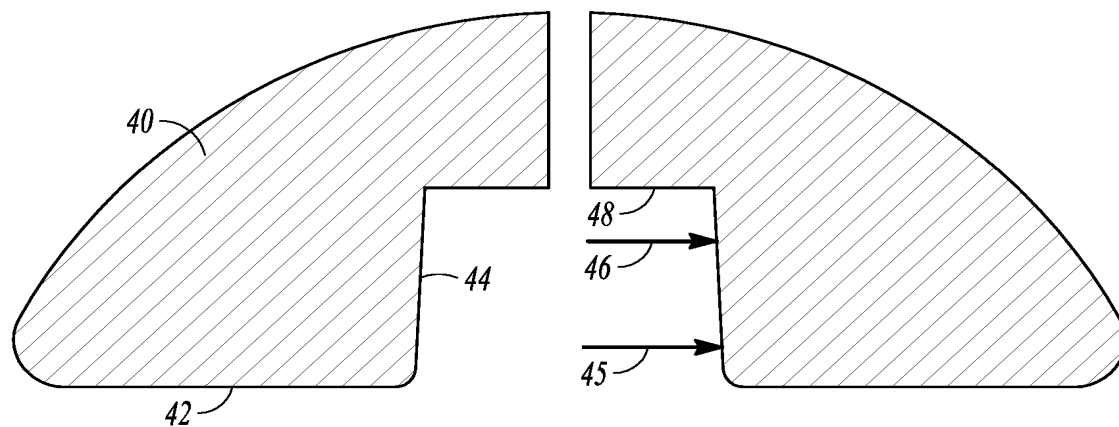
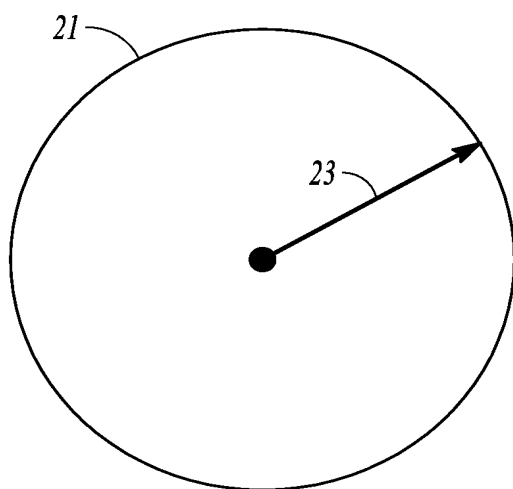
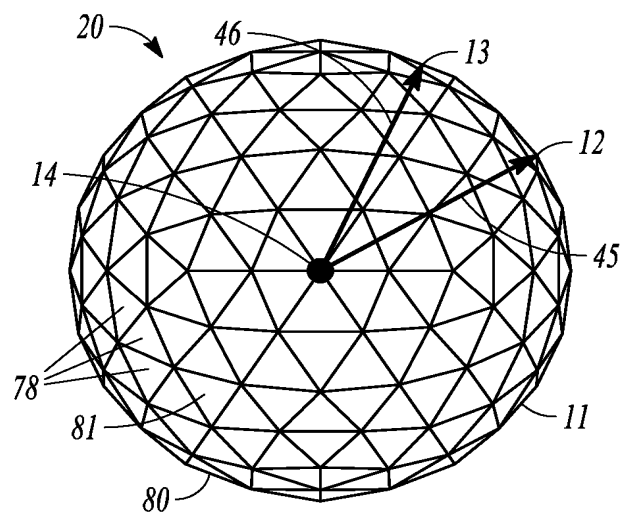


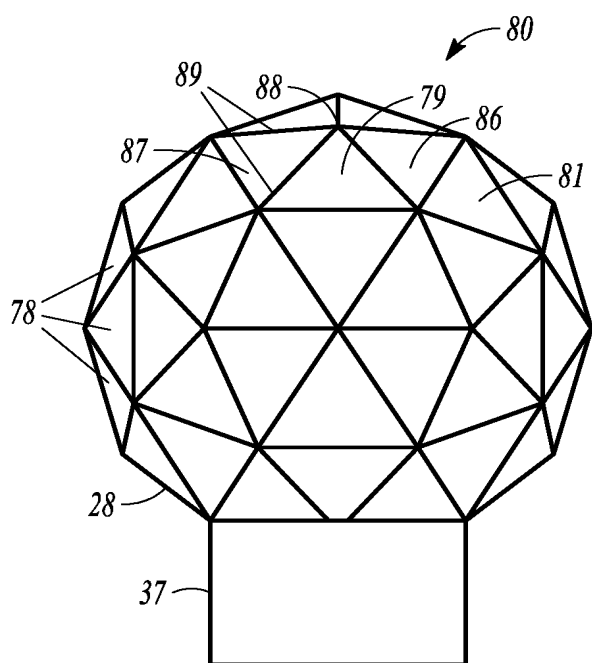
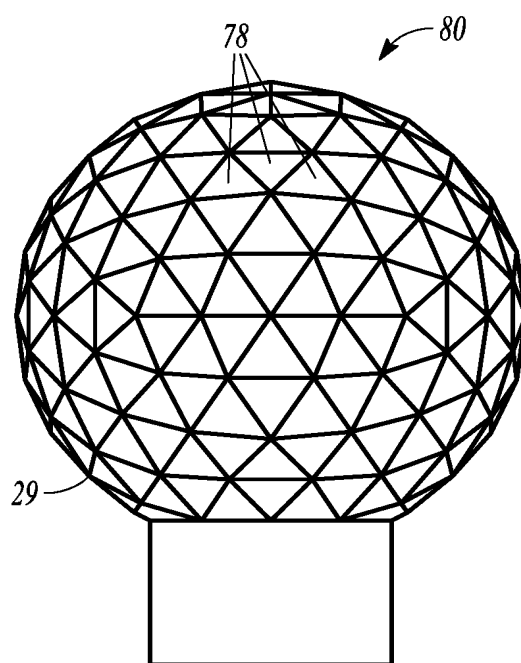
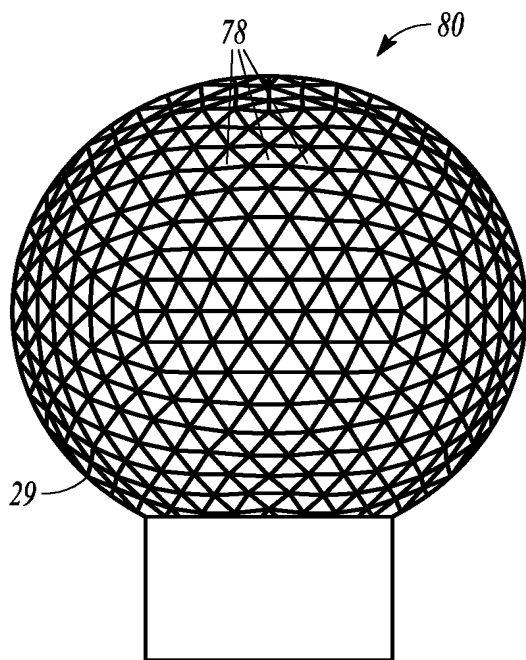
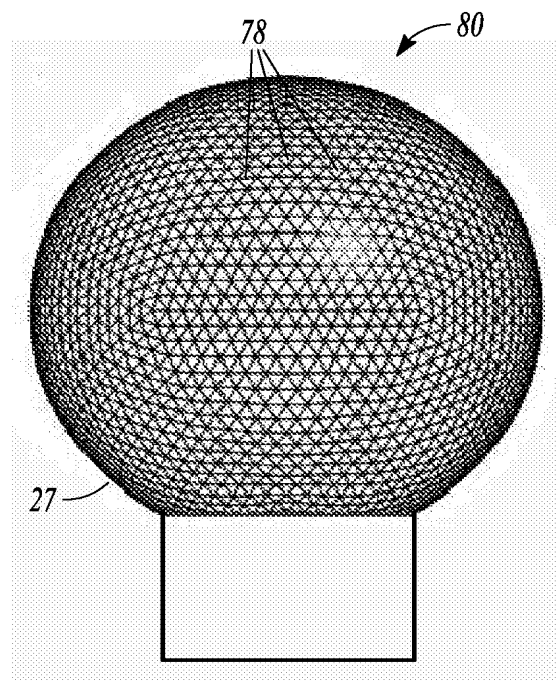
**FIG. 2**



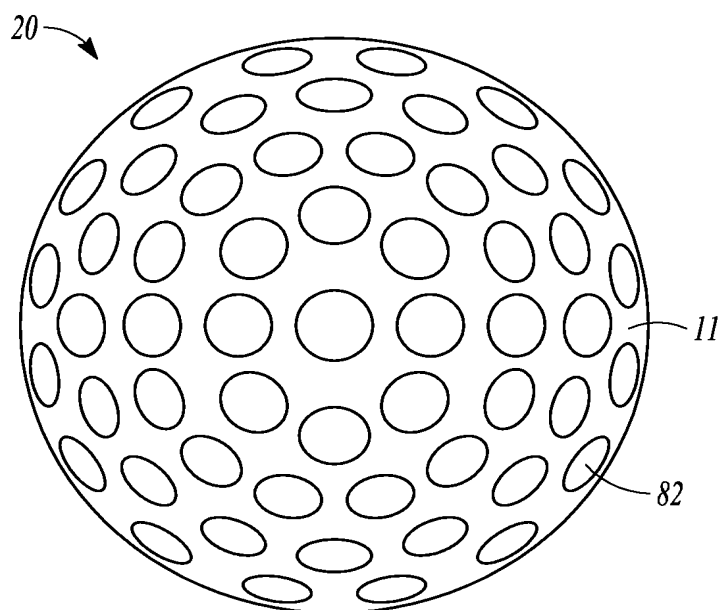
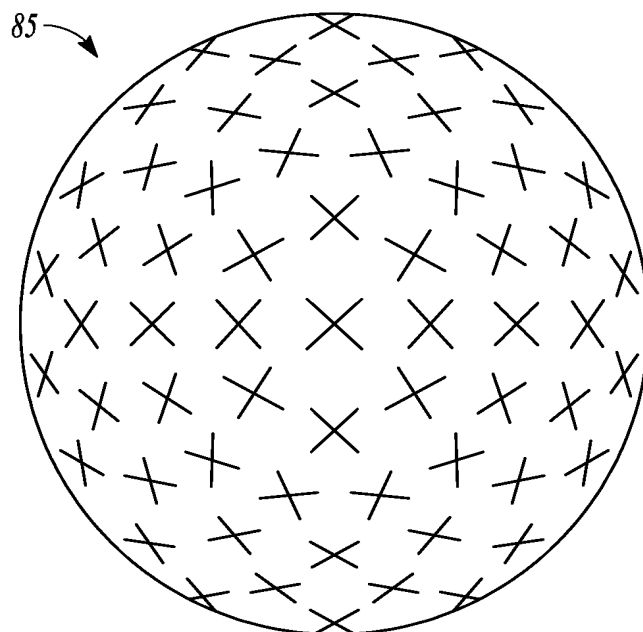
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**FIG. 3A****FIG. 3B****FIG. 3C**

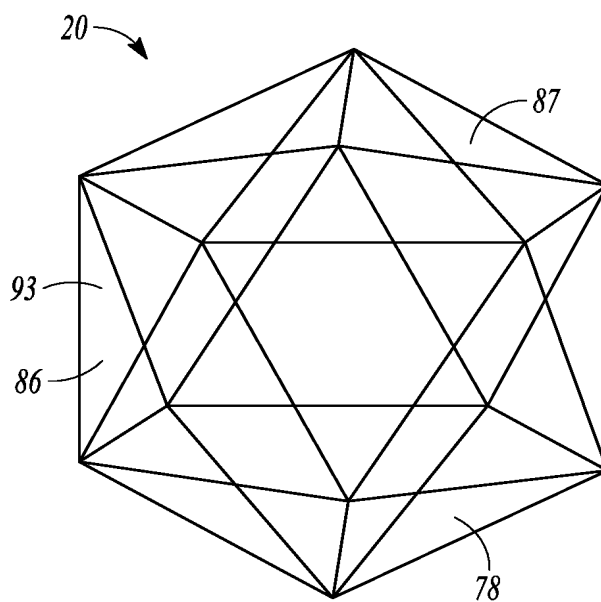
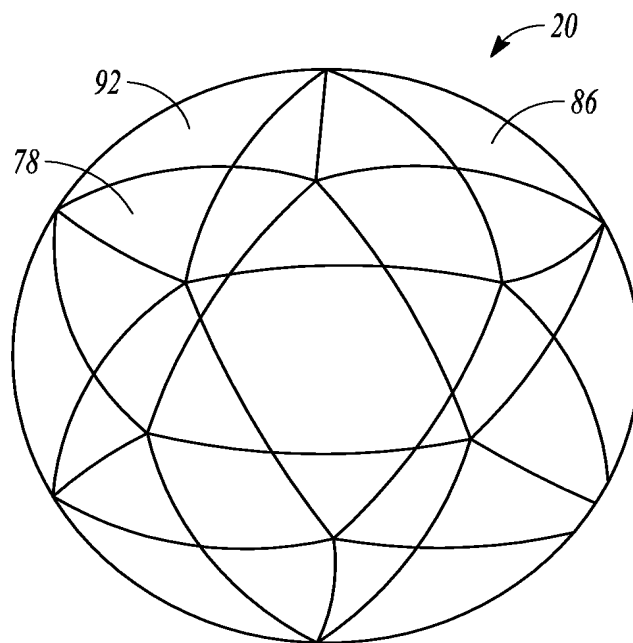
5/25

**FIG. 4A****FIG. 4B****FIG. 4C****FIG. 4D**

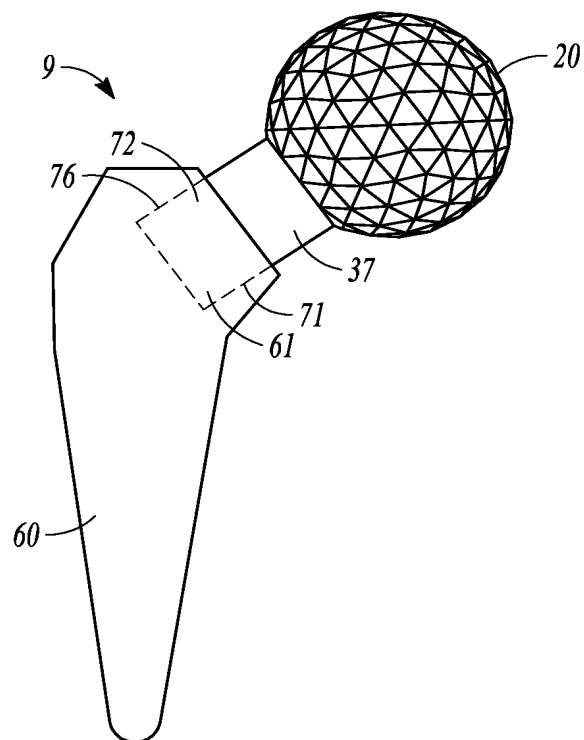
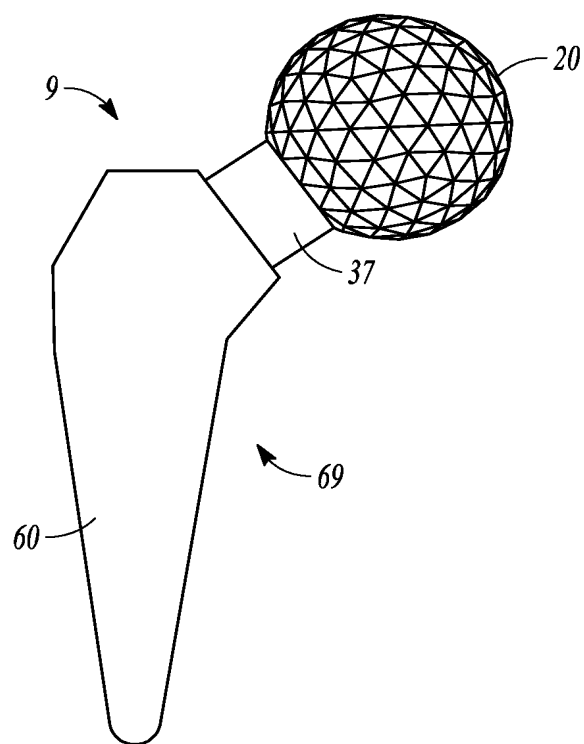
6/25

**FIG. 5A****FIG. 5B**

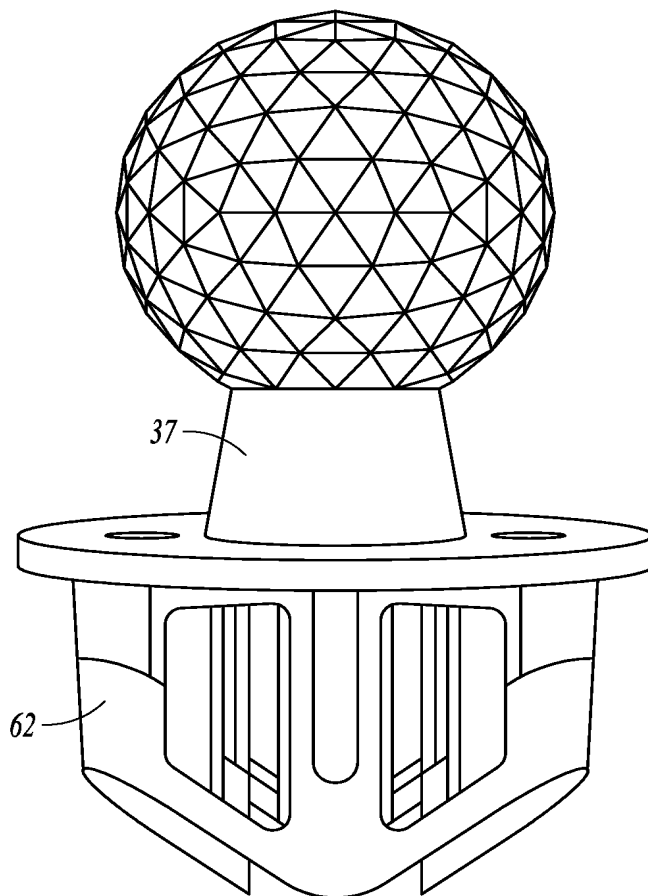
7/25

**FIG. 6A****FIG. 6B**

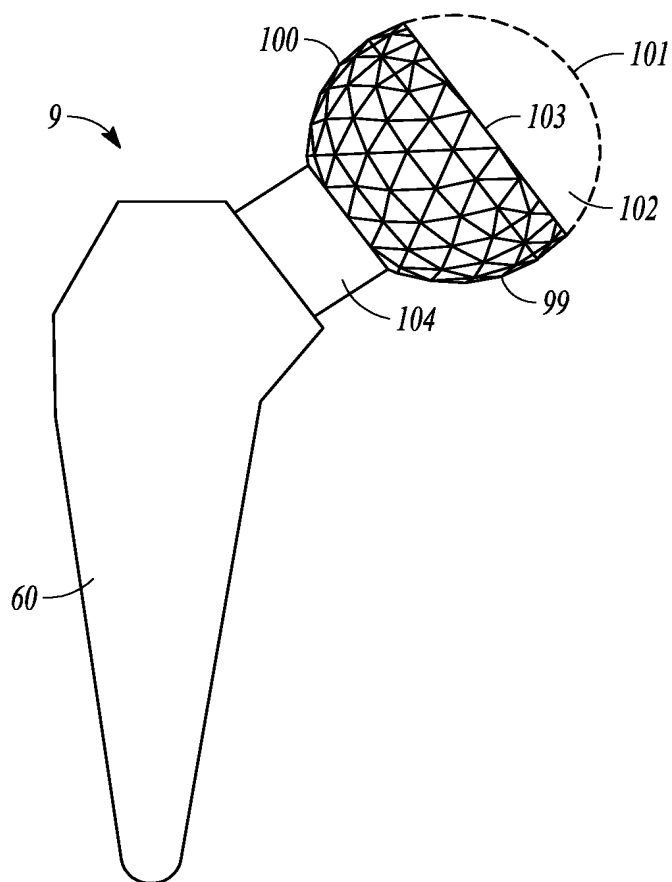
8/25

**FIG. 7A****FIG. 7B**

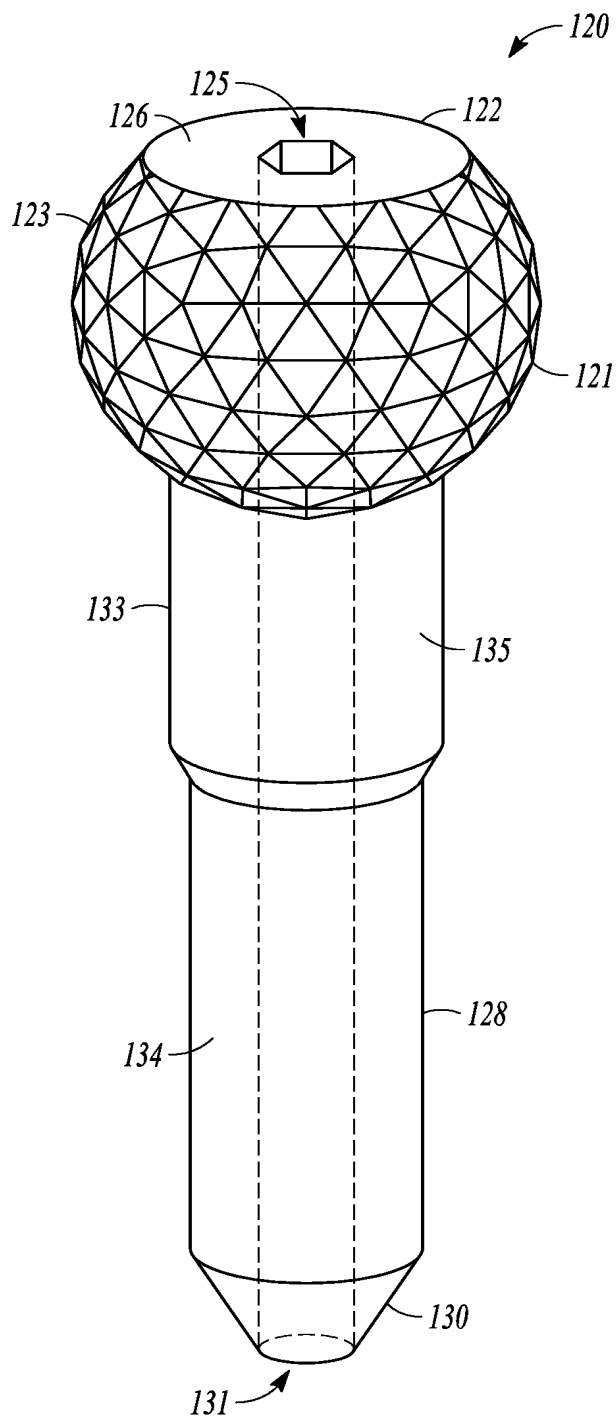
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**FIG. 8**

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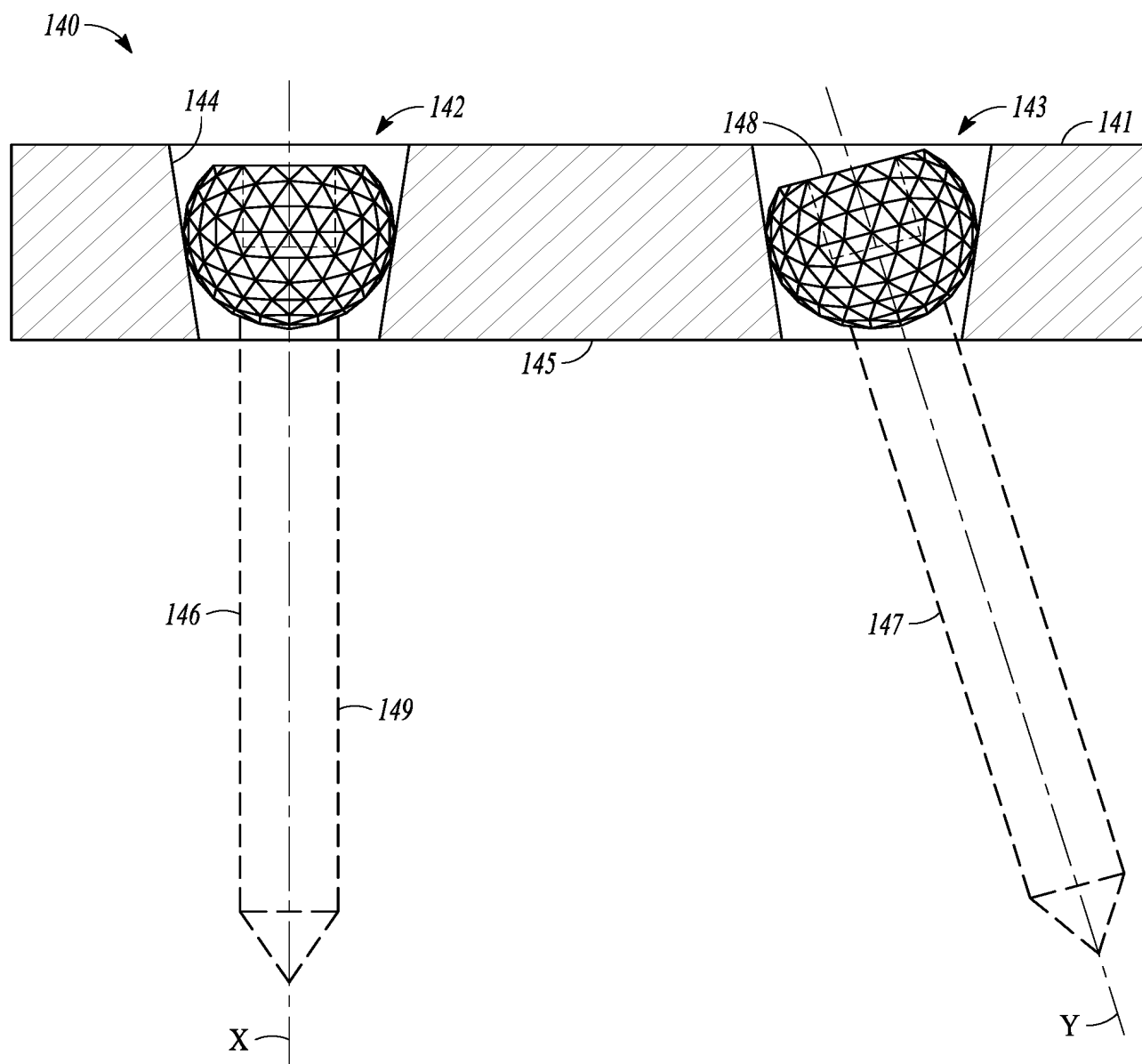
**FIG. 9**

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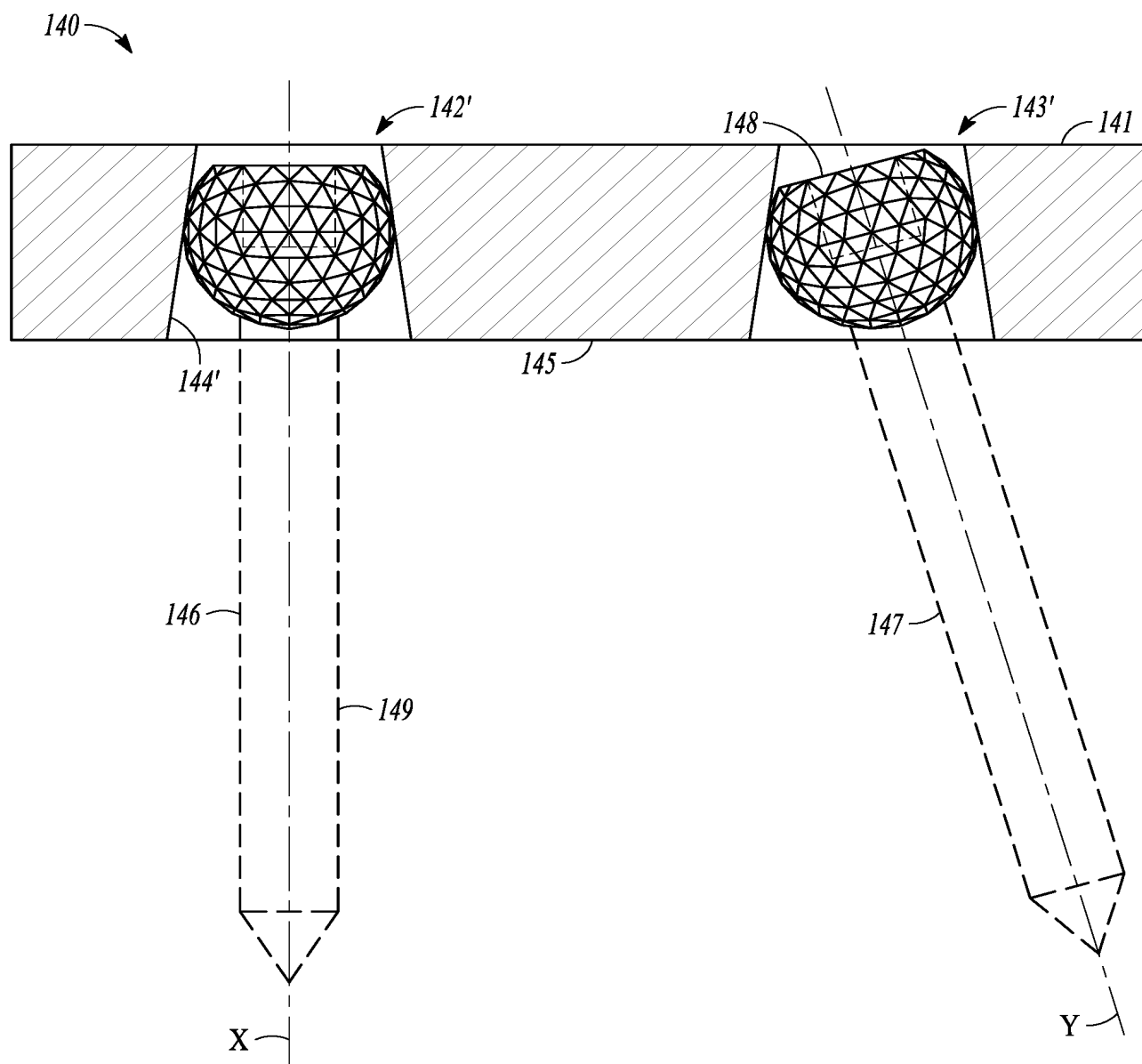
**FIG. 10**



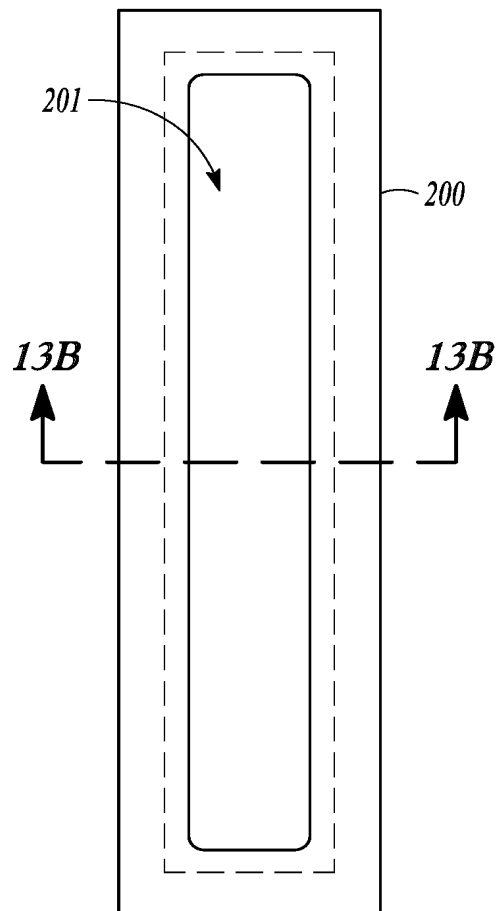
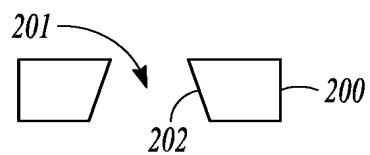
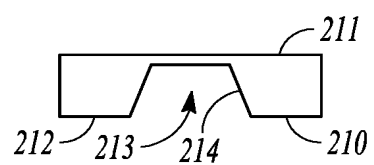
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**FIG. 11**

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**FIG. 12**

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**FIG. 13A****FIG. 13B****FIG. 13C**

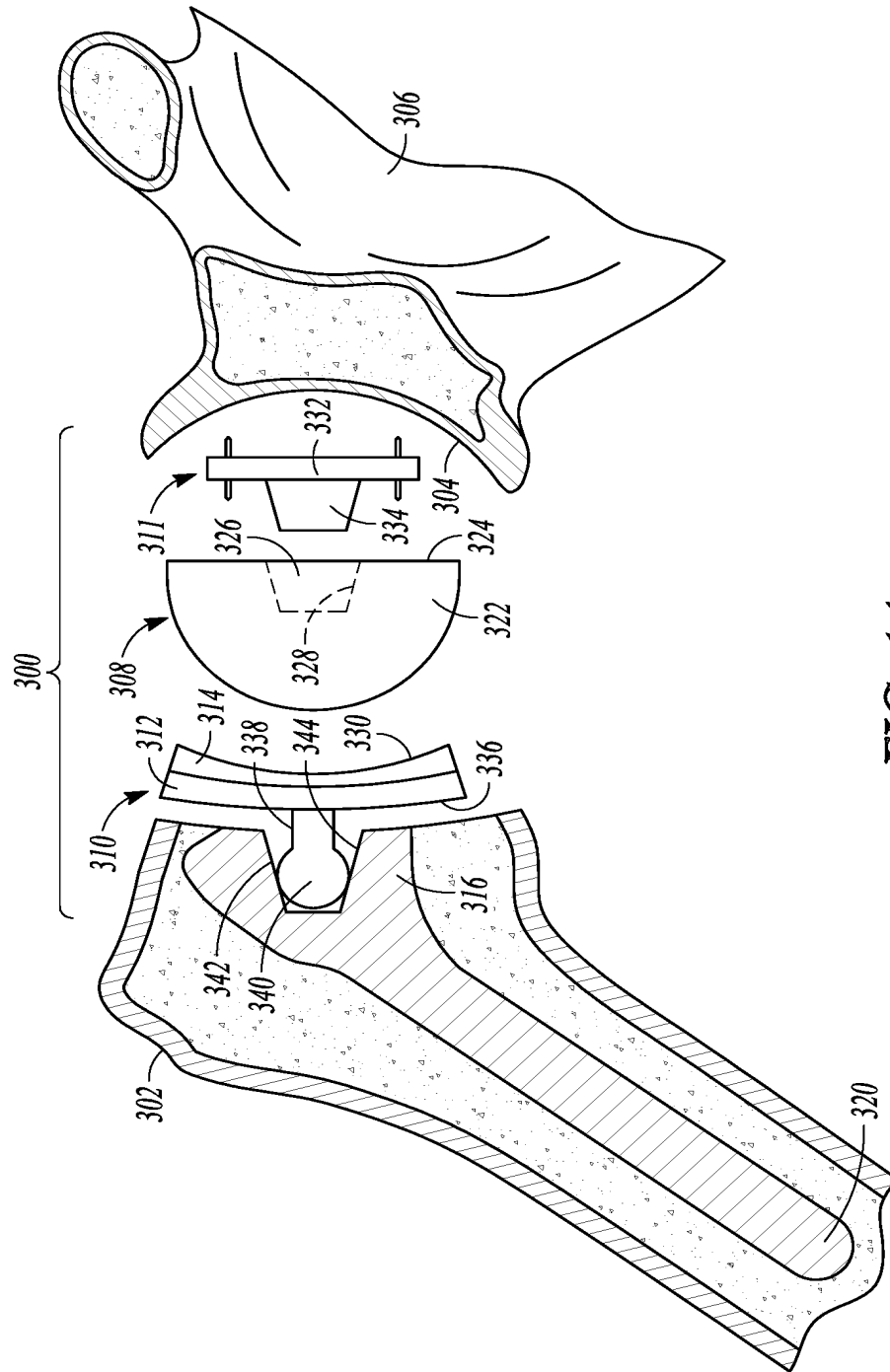


FIG. 14

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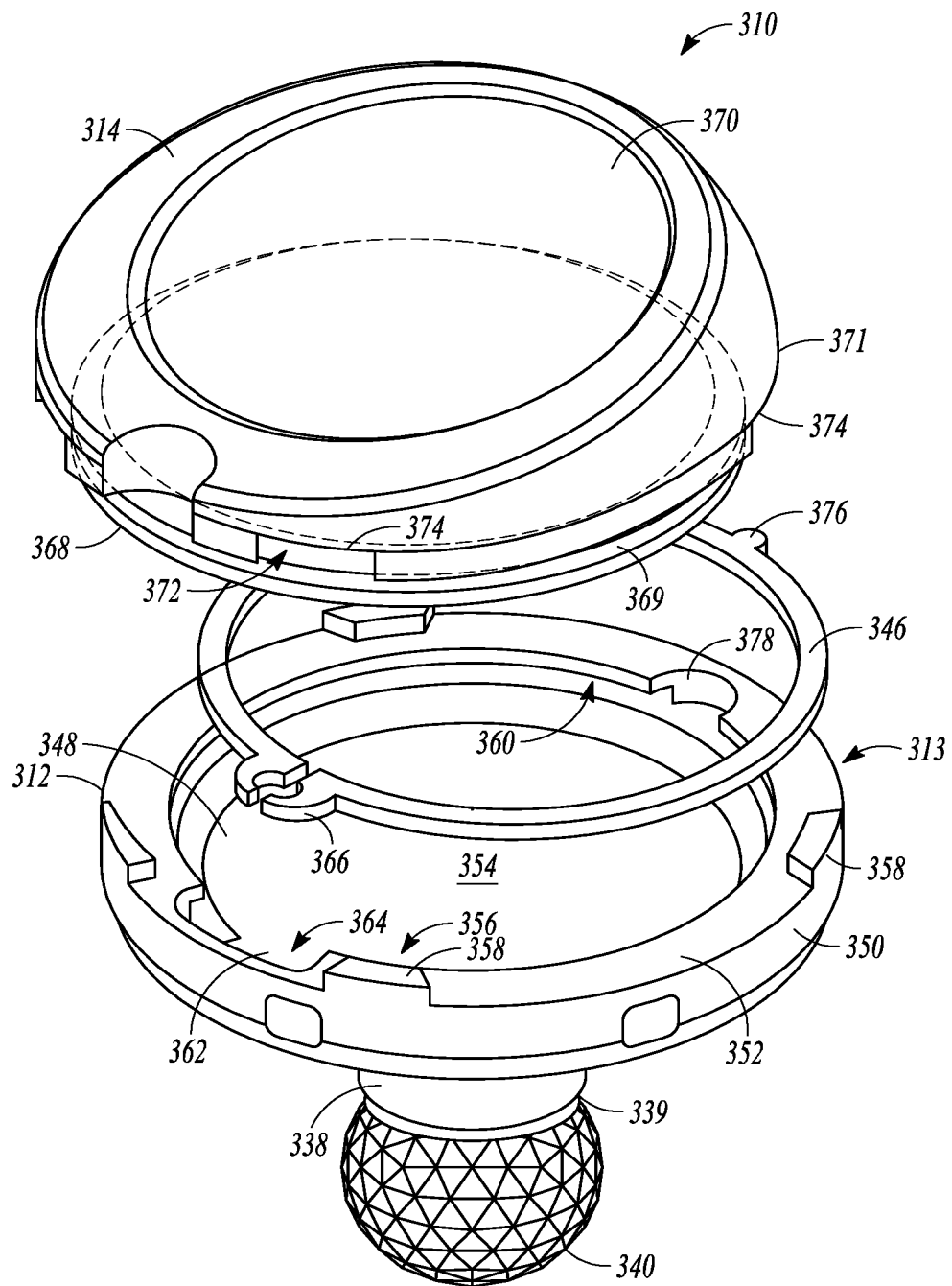
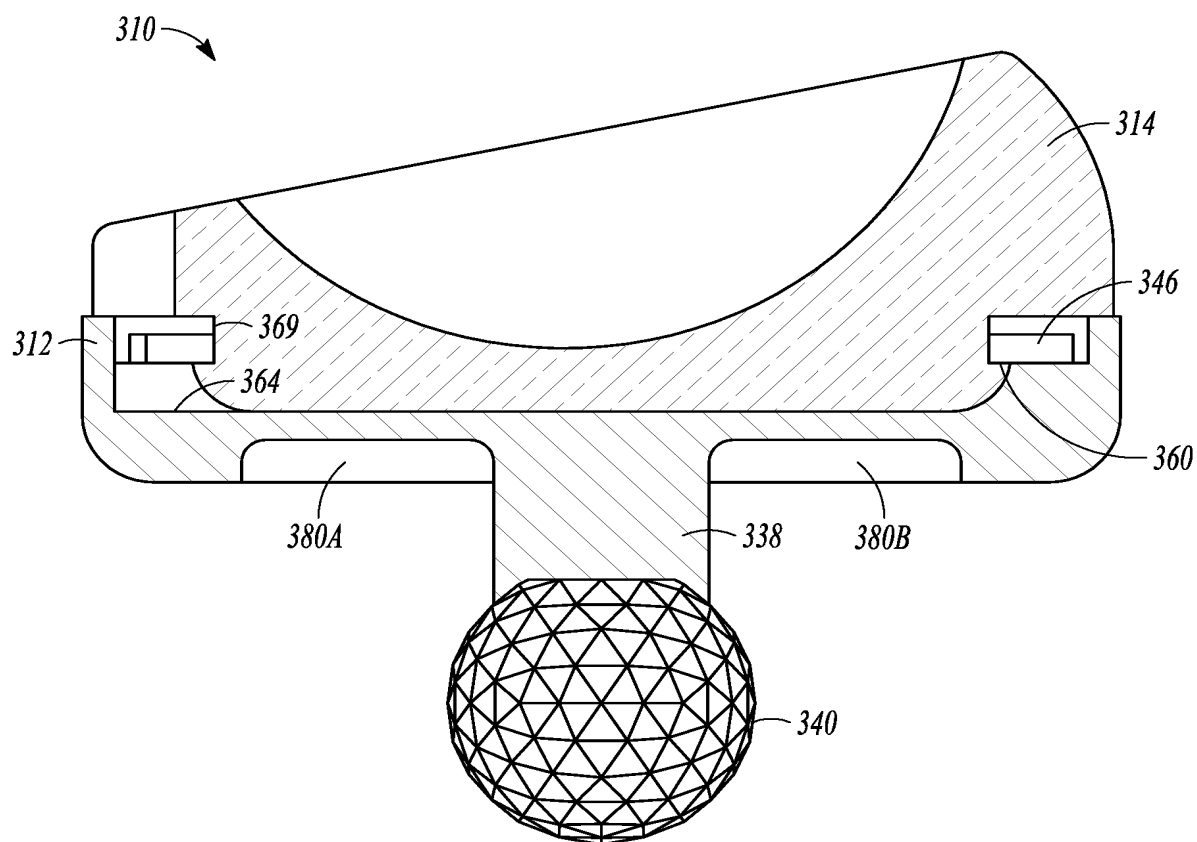
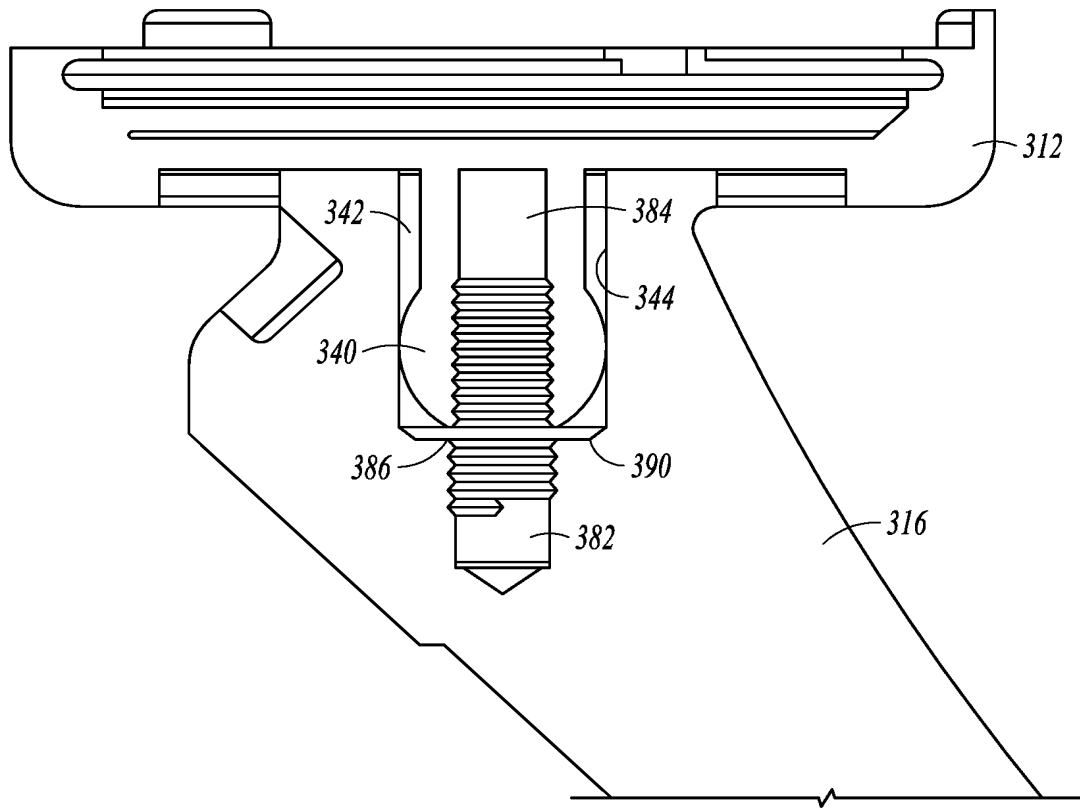


FIG. 15

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**FIG. 16**

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**FIG. 17**

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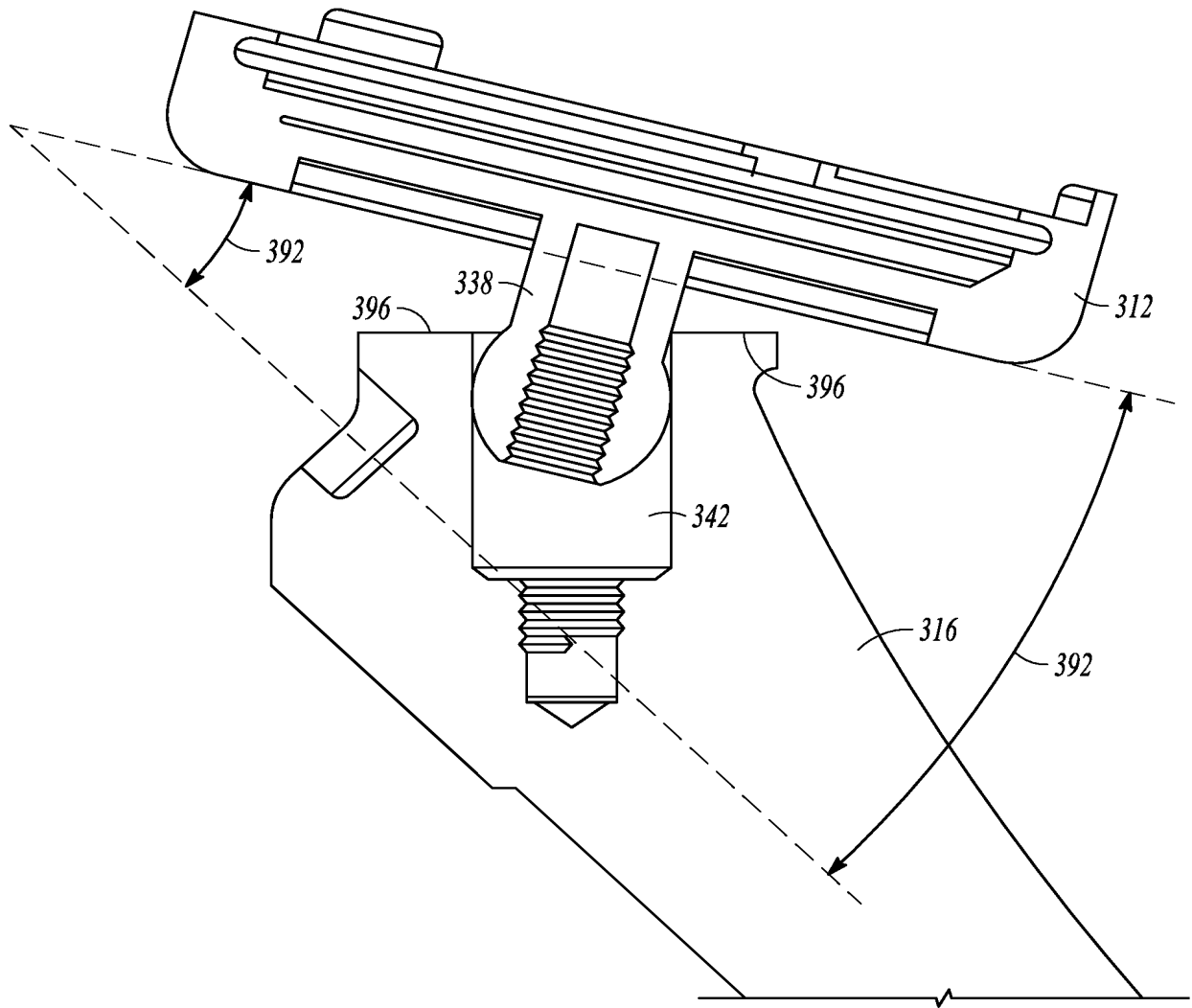


**FIG. 18**



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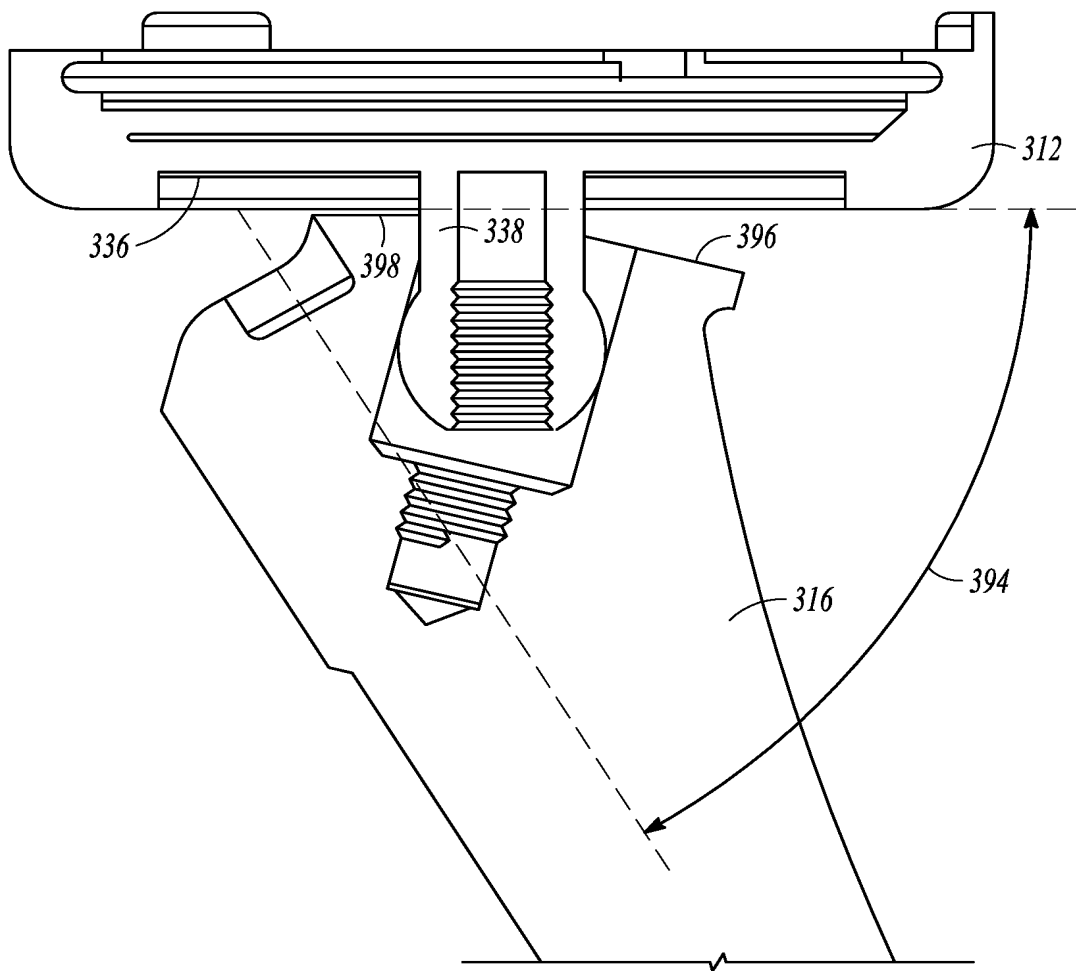


**FIG. 19**

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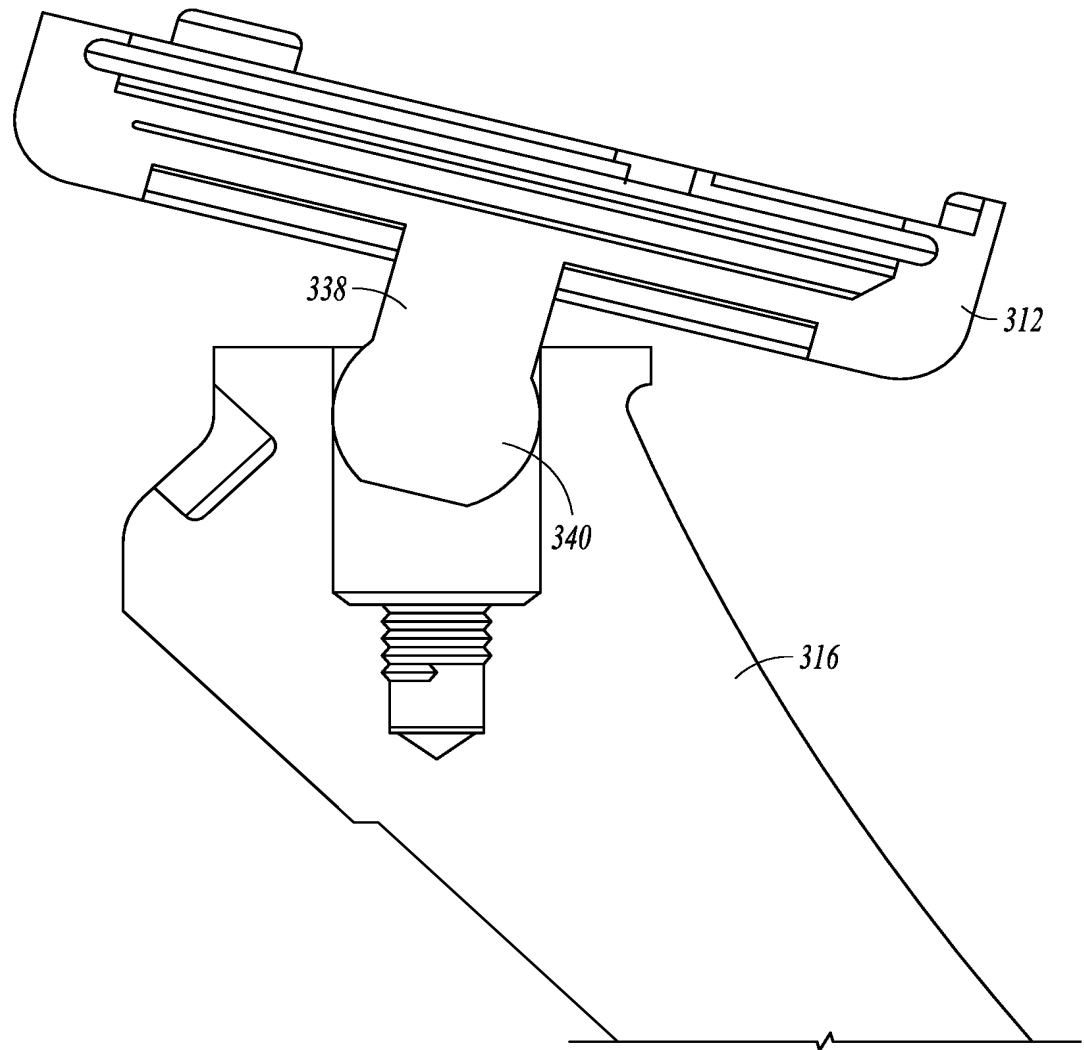
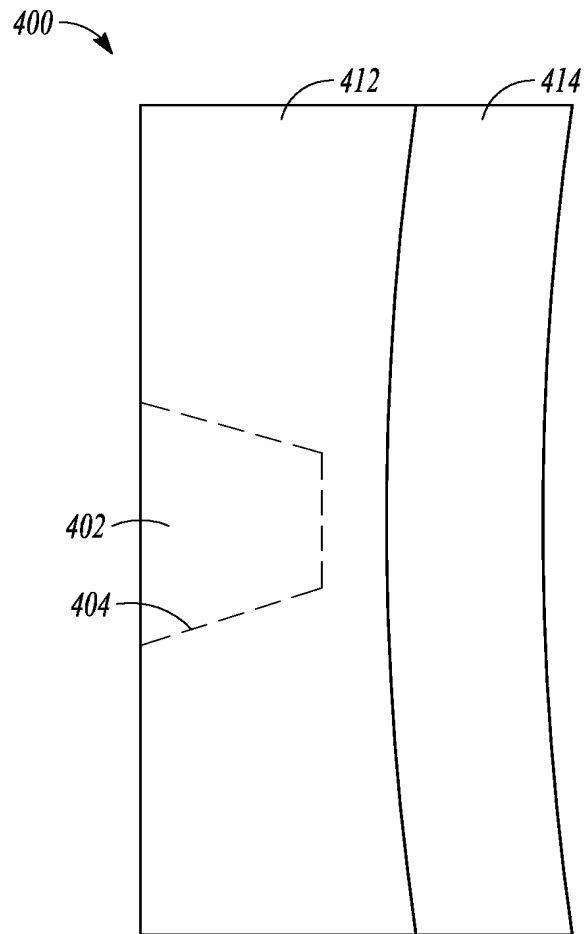


**FIG. 20**

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**FIG. 21**

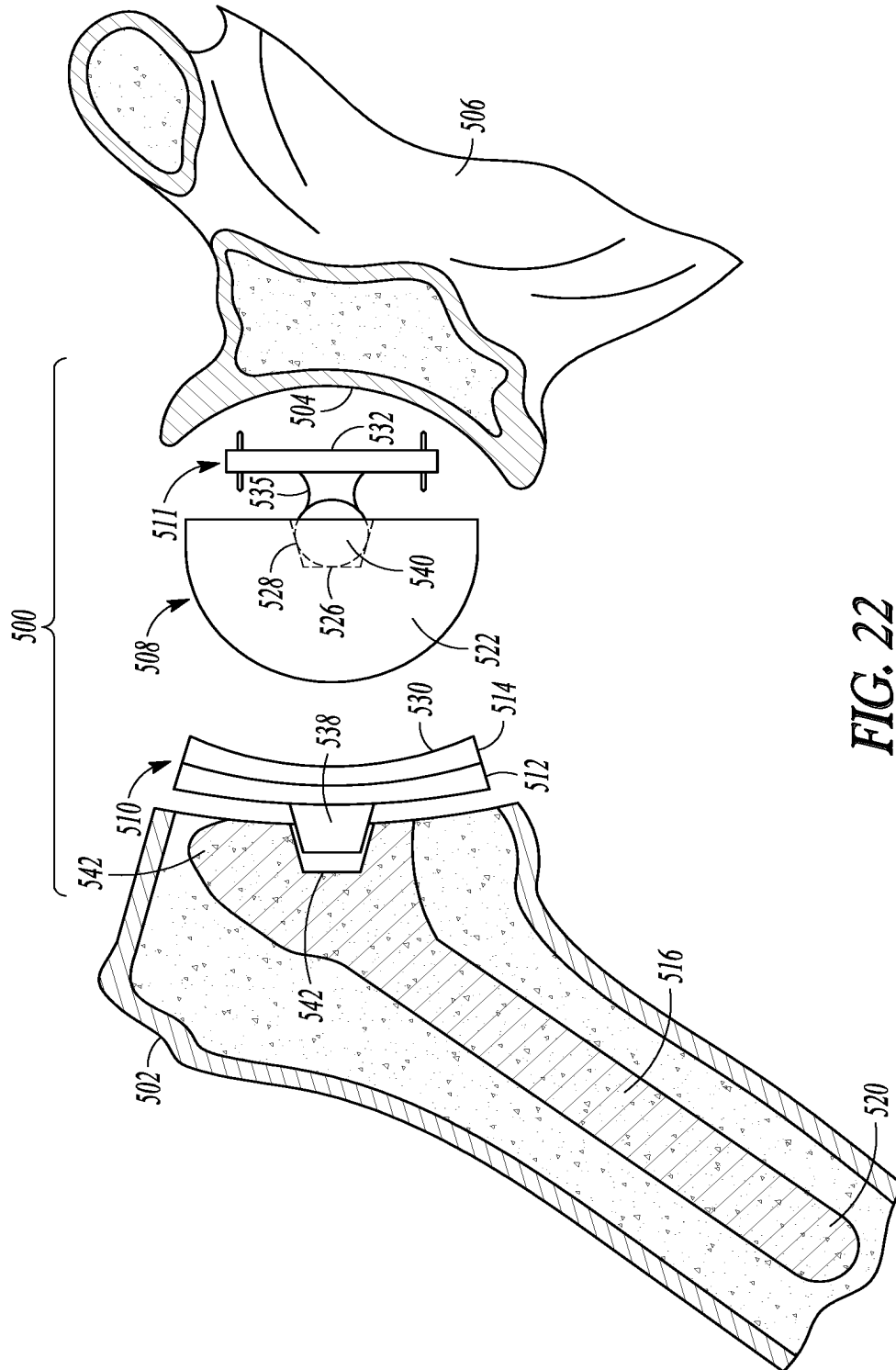


FIG. 22

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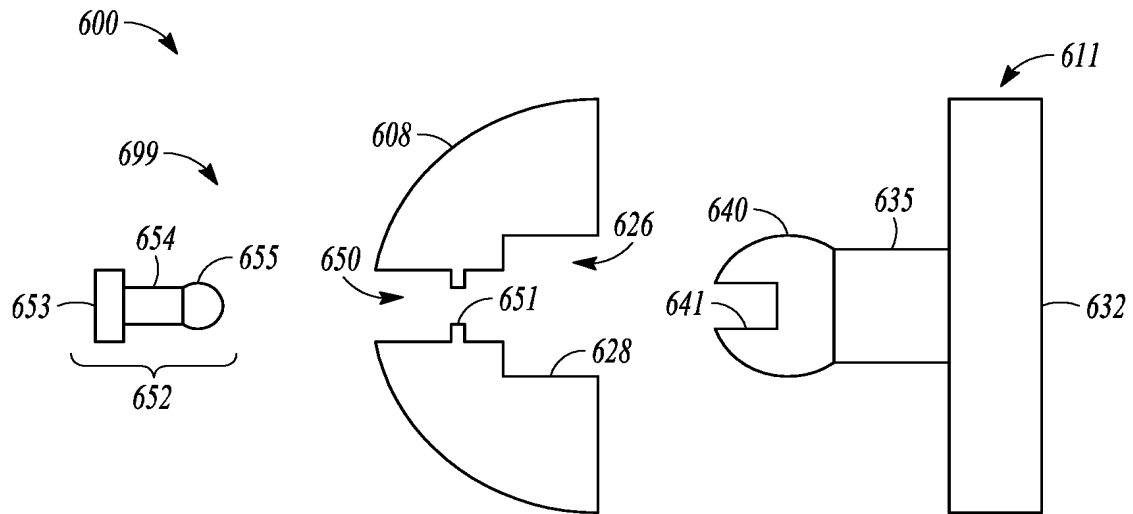


**FIG. 23**

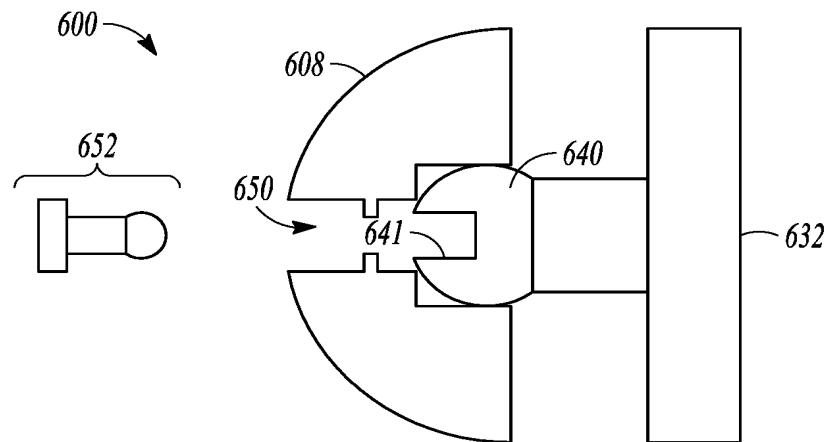


**FIG. 24**

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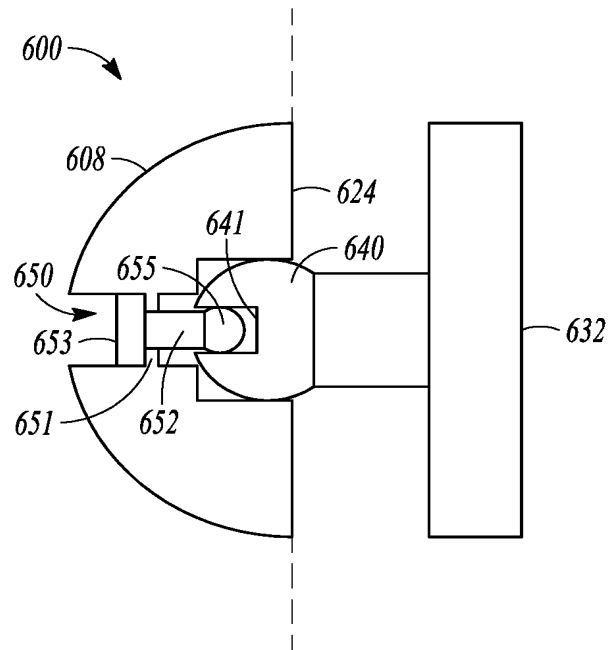


**FIG. 25**

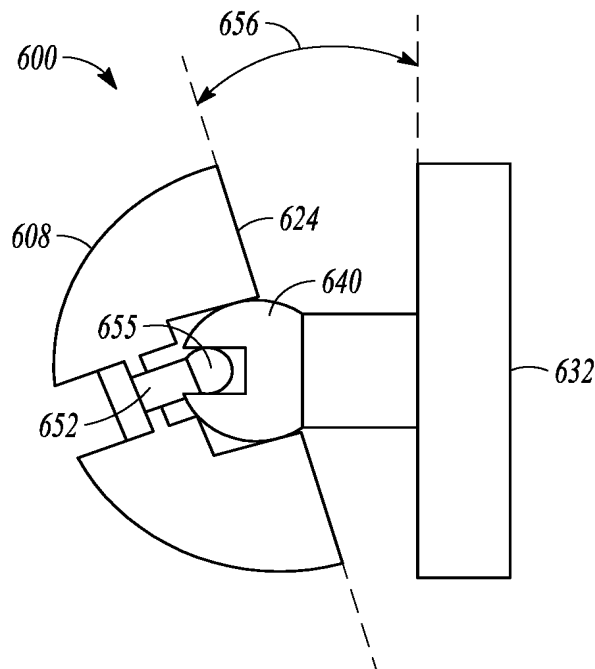


**FIG. 26**

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2018/012537

A. CLASSIFICATION OF SUBJECT MATTER  
 INV. A61F2/40 A61F2/30  
 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)

A61F

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. |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Y         | EP 1 402 854 A2 (DEPUY PRODUCTS INC [US])<br>31 March 2004 (2004-03-31)<br>paragraphs [0020] - [0026]; figure 2<br>-----                                                            | 1-22                  |
| Y         | US 2015/150687 A1 (HOPKINS ANDREW [CH])<br>4 June 2015 (2015-06-04)<br>paragraphs [0035] - [0046]<br>-----                                                                          | 1-22                  |
| Y         | WO 2007/109800 A2 (EXACTECH INC [US];<br>ROCHE CHRISTOPHER P [US]; MAULDIN MICHAEL<br>C [US]; F) 27 September 2007 (2007-09-27)<br>paragraph [0027]; claims 1-2; figure 49<br>----- | 2                     |
| A         | US 2009/192621 A1 (WINSLOW NATHAN A [US]<br>ET AL) 30 July 2009 (2009-07-30)<br>the whole document<br>-----                                                                         | 1-22                  |



Further documents are listed in the continuation of Box C.



See patent family annex.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2018/012537

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)  | Publication<br>date         |
|-------------------------------------------|---------------------|-----------------------------|-----------------------------|
| EP 1402854                                | A2                  | 31-03-2004                  | AT 475377 T 15-08-2010      |
|                                           |                     | AU 2003244030 A1 22-04-2004 |                             |
|                                           |                     | DK 1402854 T3 25-10-2010    |                             |
|                                           |                     | EP 1402854 A2 31-03-2004    |                             |
|                                           |                     | ES 2347777 T3 04-11-2010    |                             |
|                                           |                     | JP 4252412 B2 08-04-2009    |                             |
|                                           |                     | JP 2004121850 A 22-04-2004  |                             |
|                                           |                     | US 2004064190 A1 01-04-2004 |                             |
| -----                                     |                     |                             |                             |
| US 2015150687                             | A1                  | 04-06-2015                  | AU 2014357337 A1 21-07-2016 |
|                                           |                     | CA 2932585 A1 11-06-2015    |                             |
|                                           |                     | CN 105939682 A 14-09-2016   |                             |
|                                           |                     | EP 3079611 A1 19-10-2016    |                             |
|                                           |                     | JP 2016538929 A 15-12-2016  |                             |
|                                           |                     | KR 20160095059 A 10-08-2016 |                             |
|                                           |                     | US 2015150687 A1 04-06-2015 |                             |
|                                           |                     | WO 2015084791 A1 11-06-2015 |                             |
| -----                                     |                     |                             |                             |
| WO 2007109800                             | A2                  | 27-09-2007                  | AU 2007227382 A1 27-09-2007 |
|                                           |                     | BR PI0709103 A2 28-06-2011  |                             |
|                                           |                     | CA 2646995 A1 27-09-2007    |                             |
|                                           |                     | CN 101442961 A 27-05-2009   |                             |
|                                           |                     | EP 2001414 A2 17-12-2008    |                             |
|                                           |                     | EP 3042637 A1 13-07-2016    |                             |
|                                           |                     | JP 5180953 B2 10-04-2013    |                             |
|                                           |                     | JP 2009531085 A 03-09-2009  |                             |
|                                           |                     | NZ 571450 A 30-09-2011      |                             |
|                                           |                     | NZ 594967 A 22-02-2013      |                             |
|                                           |                     | US 2007244563 A1 18-10-2007 |                             |
|                                           |                     | US 2010087927 A1 08-04-2010 |                             |
|                                           |                     | WO 2007109800 A2 27-09-2007 |                             |
| -----                                     |                     |                             |                             |
| US 2009192621                             | A1                  | 30-07-2009                  | US 2009192621 A1 30-07-2009 |
|                                           |                     |                             | US 2012029647 A1 02-02-2012 |
|                                           |                     |                             | US 2016262902 A1 15-09-2016 |
| -----                                     |                     |                             |                             |



(19)



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(11)

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(54)

**Endoprothese für ein Gelenk.**

(57)

Endoprothese für ein Gelenk, bestehend aus einem Anschlußstück (1) mit einem in einem Röhrenknochen fixierbaren Stiel, einem darauf sitzenden Gelenkkopf (2) und/oder einem eine Gelenkpfanne nachbildenden Gelenkpfannenteil, wobei die Rotationsstellung des Gelenkkopfes (2) am Anschlußstück (1) und/oder des Gelenkpfannenteils einstellbar und fixierbar ist (Figuren 1 und 2).

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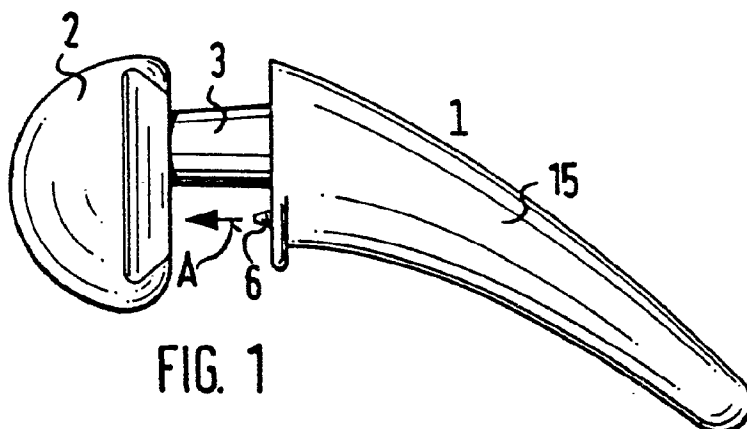


FIG. 1

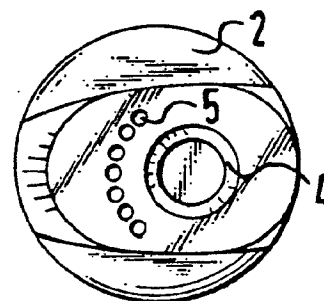


FIG. 2

## Endoprothese für ein Gelenk

Die Erfindung betrifft eine Endoprothese für ein Gelenk nach dem Oberbegriff des Anspruchs 1.

Derartige Prothesen bestehen im allgemeinen aus einem Anschlußstück mit einem Stiel, welcher in den Markraum eines resezierten Röhrenknochens einführbar ist und dort fixierbar ist, beispielsweise unter Anwendung von Zement.

Bekannte Gelenkendoprothesen tragen am distalen Ende einen Gelenkkopf, der entweder fest oder mittels einer konischen Steckverbindung form- und kraftschlüssig mit dem Stiel verbunden ist.

Bei einer vorgegebenen Form des in den Markraum des Knochens zu führenden Stiels des Anschlußstückes ergeben sich aufgrund der natürlichen individuellen Ausformung des Markraumes Probleme hinsichtlich der Stellung des Gelenkkopfes in bezug auf die Gelenkpfanne. So erfährt das Anschlußstück aufgrund einer Quasi-Torsion des Knochens vom distalen zum proximalen Ende, welche Größenordnungen bis zu 45° aufweisen können, beim Eintreiben des Stiel in den Markraum einer Drehung. Aufgrund einer gegebenen Ovalität des Gelenkkopfes ist ein optimales Zusammenarbeiten des Gelenkkopfes mit der Gelenkpfanne nach dem Einbau des Anschlußstückes dann nicht mehr gewährleistet.

Der Erfindung liegt nun die Aufgabe zugrunde, eine Endoprothese für ein Gelenk der eingangs genannten Art so weiterzubilden, daß eine individuelle Einstellung der Gelenkstellung trotz vorgegebener Form des in den Markraum des Röhrenknochens einzuführenden Stiels möglich ist.

Die Aufgabe wird gelöst durch eine Endoprothese mit den Merkmalen des Anspruchs 1.

Weitere vorteilhafte Ausgestaltungen ergeben sich aus den Unteransprüchen.

Gemäß diesem Lösungsvorschlag wird eine aus einem Anschlußstück mit einem in einem Röhrenknochen fixierbaren Stiel und einem konischen Steckzapfen, der mit einer konischen Steckhülse eines auf das Anschlußstück setzbaren Gelenkkopfes in eine selbsthemmende Verbindung bringbar ist, und aus einem am knöchernen Gegenstück des zu ersetzenden Gelenkes anbringbaren Gelenkpfannenteil bestehende Endoprothese so ausgebildet, daß die Rotationsstellung des Gelenkkopfes auf dem Konus des Anschlußstückes einstellbar und fixierbar ist.

Gemäß diesem Vorschlag ist es möglich, nach dem Eintreiben des Stiels des Anschlußstückes in den Markraum des Röhrenknochens, wobei dieser unvermeidlich der natürlichen individuellen Ausformung des Markraumes folgt, den Gelenkkopf auf den Steckkonus des Anschlußstückes zu setzen, dessen Lage optimal durch Verdrehen auf dem

Steckkonus einzustellen und in dieser zu fixieren.

Vorzugsweise erfolgt die Fixierung der Rotationsstellung mittels konzentrisch um die konische Steckhülse des Gelenkkopfes angeordnete Bohrungen und durch einen Fixierzapfen an der Stirnseite des Anschlußstückes, wobei der Fixierzapfen in eine der Bohrungen greift, so daß der Fixierzapfen die Winkelstellung des Gelenkkopfes auf dem Anschlußstück arretiert. Nach der Einstellung der Rotationsstellung des Gelenkkopfes wird die selbsthemmende Verbindung zwischen der konischen Steckhülse im Gelenkkopf und dem konischen Zapfen am Anschlußstück hergestellt, so daß der Gelenkkopf belastungsfest in seiner Lage gehalten wird.

Gemäß einer weiteren vorteilhaften Ausbildung der erfindungsgemäßen Prothese ist aber nicht nur der Gelenkkopf am Anschlußstück in seiner Lage einstellbar und fixierbar, sondern auch das Gelenkpfannenteil. Diese Maßnahme vergrößert die Bandbreite der Möglichkeiten von Gelenkstellungen erheblich, so daß eine optimale Einstellung des Gelenkes in Anpassung anatomischer Gegebenheiten gewährleistet ist.

Dazu besteht das Gelenkpfannenteil vorzugsweise aus einer an den Knochen anbringbaren Unterlage mit einem zentralen Zapfen, welcher in den Knochen getrieben wird und in dem eine konische Steckhülse ausgebildet ist, sowie aus einem eine Gelenkpfanne nachbildenden Adaptionsteil, welches einen konischen Steckzapfen aufweist. Die Verbindung zwischen der Unterlage und dem Adaptionsteil erfolgt dabei über eine selbsthemmende Konusverbindung zwischen dem konischen Steckzapfen der Unterlage und dem Steckzapfen des Adaptionsteils.

Vor der Herstellung der selbsthemmenden Konusverbindung kann die Rotationsstellung des Adaptionsteils auf der Unterlage eingestellt werden, und zwar durch einfaches Drehen um die Achse seines konischen Steckzapfens. Die Fixierung der Rotationsstellung kann mittels konzentrisch um den Steckzapfen des Adaptionsteils angeordnete Bohrungen einerseits und durch mindestens einen Fixierzapfen an der Stirnseite der Unterlage andererseits erfolgen, wobei der Fixierzapfen in eine der Bohrungen greift.

Nach Einstellung der Rotationsstellung und ihrer Fixierung mittels des Fixierzapfens wird die selbsthemmende Konusverbindung hergestellt, so daß das Adaptionsteil belastungsfest in Lage gehalten wird.

Die Fixierung der Unterlage des Gelenkpfannenteils am Knochen kann durch mindestens einen in den Knochen treibbaren Zapfen an der Unterseite der Unterlage erfolgen.

Das mit dem Gelenkkopf nach Einbau der Prothese zusammenarbeitende Teil des Gelenkpfannenteils, also das Adaptionsteil, besteht für eine optimale Funktion der Prothese aus einem Kunststoff mit niedrigem Reibungskoeffizienten.

Für eine zementlose Fixation des Stiels des Anschlußstückes im Röhrenknochen und des zentralen Zapfens der Unterlage des Gelenkpfannenteils können deren Oberflächenstruktur den spongiösen Knochen nachgebildet sein.

Die Erfindung wird anhand der Zeichnungen näher erläutert. Hierbei zeigt:

Figur 1 eine Seitenansicht eines Anschlußstückes der Endoprothese mit Gelenkkopf,

Figur 2 eine Ansicht auf die Unterseite des Gelenkkopfes in Richtung des Pfeiles A in Fig. 1,

Figur 3 eine seitliche Schnittansicht des Gelenkpfannenteils mit Unterlage und Adaptionsteil,

Figur 4 eine Ansicht auf die Unterseite des Adaptionsteils des Gelenkpfannenteils in Richtung des Pfeiles B in Fig. 3, und

Figur 5 eine Schnittansicht einer weiteren Ausführungsform des Adaptionsteils des Gelenkpfannenteils.

Gemäß Figur 1 besteht das Anschlußstück 1 aus einem in einem Röhrenknochen fixierbaren Stiel 15. Am gelenkseitigen Ende weist das Anschlußstück 1 einen konischen Steckzapfen 3 auf. Auf den konischen Steckzapfen 3 ist ein Gelenkkopf 2 aufsteckbar. Hierzu weist der Gelenkkopf 2 eine konische Steckhülse 4 auf. Die Verbindung zwischen dem Gelenkkopf 2 und dem Anschlußstück 1 erfolgt über eine selbsthemmende Konusverbindung zwischen dem Steckzapfen 3 und der Steckhülse 4.

Wie in Fig. 2 dargestellt, weist der Gelenkkopf 2 an seiner Unterseite konzentrisch um die konische Steckhülse 4 angeordnete Bohrungen 5 auf. Nach dem Aufsetzen des Gelenkkopfes 2 auf den konischen Steckzapfen 3 des Anschlußstückes 1 kann dessen Stellung durch Verdrehen auf dem Steckzapfen 3 eingestellt werden und durch ein Eingreifen eines Fixierzapfens 6 an der Stirnseite des Anschlußstückes 1 in eine der Bohrungen 5 im Gelenkkopf 2 fixiert werden. Nach Herstellung der selbsthemmenden Konusverbindung zwischen Gelenkkopf 2 und dem Anschlußstück 1 wird der Gelenkkopf belastungsfest in seiner Lage auf dem Anschlußstück 1 gehalten.

Das Gelenkpfannenteil gemäß Figur 3 besteht aus einer Unterlage, die am Knochen befestigt wird, und einem Adaptionsteil 11. Die Unterlage 8 weist einen zentralen Zapfen 9 auf, der in den Knochen eingesetzt wird. Im Inneren des zentralen Zapfens 9 ist eine konische Steckhülse 10 vorgesehen. Das Adaptionsteil 11 weist einen konischen Steckzapfen 12 auf, der in die konische Steckhülse

10 der Unterlage 8 steckbar ist. Vor dem Herstellen einer selbsthemmenden Konusverbindung zwischen dem Steckzapfen 12 des Adaptionsteils 11 und der konischen Steckhülse 10 im zentralen Zapfen 9 der Unterlage 8 kann das Adaptionsteil 11 um den Steckzapfen 12 verdreht werden, um die Stellung des als Gelenkpfanne ausgebildeten Adaptionsteils 11 zu justieren.

Gemäß Figur 4 weist das Adaptionsteil 11 an seiner Unterseite konzentrisch um den Steckzapfen 12 angeordnete Bohrungen 13 zur Fixierung seiner Stellung in bezug auf die Unterlage 8 auf.

Die Fixierung der Stellung des Adaptionsteils 11 in bezug auf die Unterlage 8 erfolgt durch ein Eingreifen mindestens eines Fixierzapfens 14 an der Stirnseite der Unterlage 8, von denen in Figur 3 zwei Stück dargestellt sind. Nach Herstellung der selbsthemmenden Konusverbindung zwischen der Unterlage 8 und dem Adaptionsteil 11 wird dieses in der justierten Lage belastungsfest gehalten.

Für die Fixierung der Unterlage 8 am Knochen weist diese an seiner dem Knochen zugewandten Seite mindestens einen in den Knochen treibbaren Zapfen 16 auf, von denen in Figur 3 zwei Stück dargestellt sind.

In der dargestellten Ausführungsform der Unterlage 8 bildet der Fixierzapfen 14 mit dem Zapfen 16 eine bauliche Einheit in Form eines Stiftes.

In Figur 5 ist ein etwas abgewandeltes Ausführungsbeispiel für das Adaptionsteil 11 dargestellt. In Abweichung von dem in Figur 3 dargestellten Adaptionsteil weist dessen Ausführungsform gemäß Figur 5 eine andere Gestaltung der eigentlichen Gelenkpfanne auf, und zwar mit einer dachförmigen Auswölbung, welche den Gelenkkopf weiter umschließt.

In an sich bekannter Weise ist das die eigentliche Gelenkpfanne darstellende Adaptionsteil 11 aus einem Kunststoff mit niedrigem Reibungskoeffizienten gefertigt.

Wie in Figur 1 und Figur 3 angedeutet, sind die Oberflächenstrukturen des Stiels 15 des Anschlußstückes 1 und des zentralen Zapfens 9 der Unterlage 8 dem spongiösen Knochen nachgebildet, so daß die Fixation der Endoprothese im Knochen vorteilhafterweise zementlos erfolgen kann.

## Ansprüche

1. Endoprothese für ein Gelenk, bestehend aus einem Anschlußstück mit einem in einem Röhrenknochen fixierbaren Stiel und einem konischen Steckzapfen, der mit einer konischen Steckhülse eines auf das Anschlußstück setzbaren Gelenkkopfes in eine selbsthemmende Verbindung bringbar ist und aus einem am knöchernen Gegenstück des zu ersetzenden Gelenkes anbringbaren Ge-

lenkpfannenteil,

dadurch gekennzeichnet, daß die Rotationsstellung des Gelenkkopfes (2) auf den Konus(3) des Anschlußstückes (1) einstellbar und fixierbar ist.

2. Endoprothese nach Anspruch 1, dadurch gekennzeichnet, daß die Fixierung der Rotationsstellung des Gelenkkopfes (2) auf dem Anschlußstück (1) mittels konzentrisch um die konische Steckhülse (4) des Gelenkkopfes (2) angeordnete Bohrungen (5) einerseits und durch einen Fixierzapfen (6) an der Stirnseite des Anschlußstückes (1) andererseits erfolgt, wobei der Fixierzapfen (6) in eine der Bohrungen (5) greift.

3. Endoprothese nach einem der Ansprüche 1 bis 2, dadurch gekennzeichnet, daß das Gelenkpfannenteil (7) aus einer an den Knochen anbringbaren Unterlage (8) mit einem zentralen Zapfen (9) , in dem eine konische Steckhülse (10) ausgebildet ist, und aus einem eine Gelenkpfanne nachbildenden Adaptionsteil (11) besteht, das einen konischen Steckzapfen (12) aufweist, der in eine selbsthemmende Klemmverbindung mit der konischen Steckhülse(10) der Unterlage (8) bringbar ist.

4. Endoprothese nach Anspruch 3, dadurch gekennzeichnet, daß die Rotationsstellung des Adaptionsteils (11) auf der Unterlage (8) einstellbar und fixierbar ist.

5. Endoprothese nach Anspruch 4, dadurch gekennzeichnet, daß die Fixierung der Rotationsstellung des Adaptionsteils (11) auf der Unterlage (8) mittels konzentrisch um seinen Steckzapfen (12) angeordnete Bohrungen (13) einerseits und durch mindestens einen Fixierzapfen(14) an der Stirnseite der Unterlage (8) andererseits erfolgt, wobei der Fixierzapfen (14) in eine der Bohrungen (13) greift.

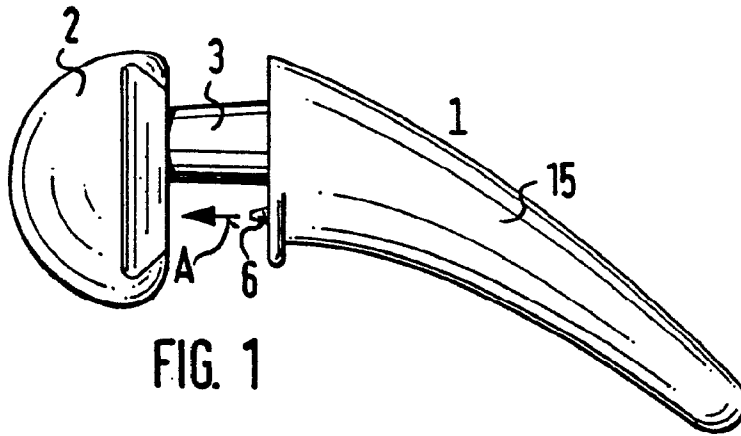
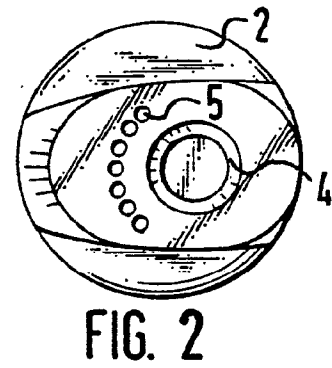
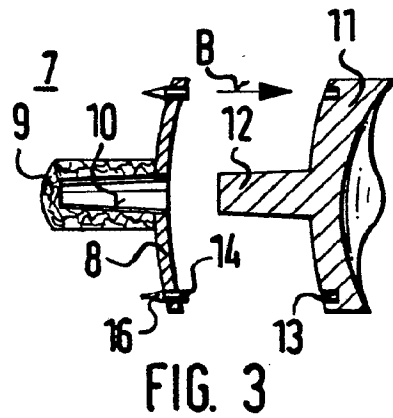
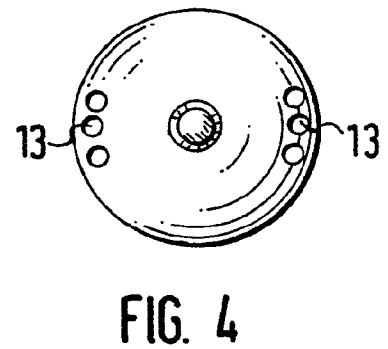
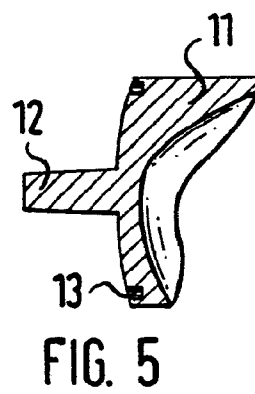
6. Endoprothese nach einem der Ansprüche 3 bis 5, dadurch gekennzeichnet, daß die Unterlage (8) des Gelenkpfannenteils(7) mittels mindestens eines in den Knochen treibbaren Zapfens(16) an ihrer Unterseite am Knochen fixierbar ist.

7. Endoprothese nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß das mit dem Gelenkkopf (2) nach Einbau zusammenarbeitende Teil des Gelenkpfannenteils (7) aus einem Kunststoff mit niedrigem Reibungskoeffizienten besteht.

8. Endoprothese nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß die Oberflächenstruktur des Stiels (15) des Anschlußstückes (1) dem spongiösen Knochen nachgebildet ist.

9. Endoprothese nach einem der Ansprüche 3 bis 8, dadurch gekennzeichnet, daß die Oberflächenstruktur des zentralen Zapfens(9) der Unterlage (8)dem spongiösen Knochen nachgebildet ist.

55





Espacenet

**Bibliographic data: EP1858453 (A2) — 2007-11-28**

# SHOULDER IMPLANT FOR GLENOID REPLACEMENT

**Inventor(s):** GUNTHER STEPHEN B [US] ± (GUNTHER, STEPHEN B, ; Gunther, Stephen B)

**Applicant(s):** GUNTHER STEPHEN B [US] ± (GUNTHER, STEPHEN B, ; Shoulder Innovations, LLC)

**Classification:** - international: A61B17/00; A61F2/40  
 - cooperative: A61B17/15 (EP, US); A61B17/1684 (EP, US);  
A61F2/4059 (EP, US); A61F2/4081 (EP, US);  
A61B17/00234 (EP, US); A61B17/1659 (EP, US);  
A61B17/86 (EP, US); A61F2/30767 (EP, US);  
A61F2/30771 (EP, US); A61F2/40 (EP, US);  
A61F2/4684 (EP, US); A61F2002/30112 (EP, US);  
A61F2002/30113 (EP, US); A61F2002/30118 (EP, US);  
A61F2002/30125 (EP, US); A61F2002/30153 (EP, US);  
A61F2002/30332 (EP, US);  
A61F2002/30574 (EP, US); A61F2002/30606 (EP, US);  
A61F2002/30609 (EP, US); A61F2002/3069 (EP, US);  
A61F2002/30822 (EP, US); A61F2002/30827 (EP, US);  
A61F2002/30878 (EP, US);  
A61F2002/30884 (EP, US); A61F2002/4033 (EP, US);  
A61F2002/4051 (EP, US); A61F2002/4062 (EP, US);  
A61F2002/4631 (EP, US); A61F2002/4635 (EP, US);  
A61F2220/0033 (EP, US); A61F2230/0004 (EP, US);  
A61F2230/0006 (EP, US); A61F2230/0008 (EP, US);  
A61F2230/0019 (EP, US); A61F2310/00011 (EP, US);  
A61F2310/00179 (EP, US)

**Application number:** EP20060735834 20060222 Global Dossier

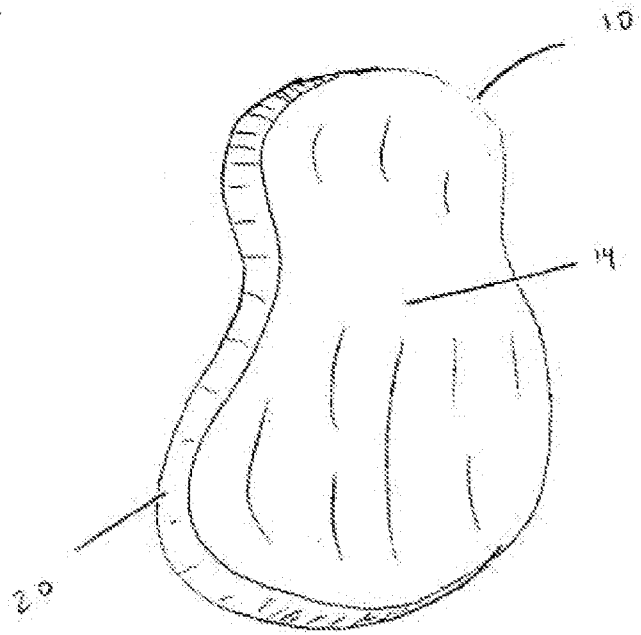
**Priority number(s):** US20050066978 20050225 ; WO2006US06330 20060222

**Also published as:** EP1858453 (A4) EP1858453 (B1) AU2006218936 (A1) AU2006218936 (B2) CA2598659 (A1) more

Abstract not available for EP1858453 (A2)

Abstract of corresponding document: US2006195194 (A1)

The invention features a glenoid (shoulder socket) implant prosthesis, a humeral implant prosthesis, devices for implanting glenoid and humeral implant prostheses, and methods of their use for the treatment an injured or damaged shoulder.





Espacenet

**Description: EP1858453 (A2) — 2007-11-28**

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## SHOULDER IMPLANT FOR GLENOID REPLACEMENT

### Description of EP1858453 (B1)

**A high quality text as facsimile in your desired language may be available amongst the following family members:**

[AU2006218936 \(B2\)](#), [CA2598659 \(A1\)](#), [US2006195194 \(A1\)](#), [WO2006093763 \(A2\)](#),  
[US2010087876 \(A1\)](#), [US2010087877 \(A1\)](#), [US2011112648 \(A1\)](#), [US2013166033 \(A1\)](#),  
[US2017360456 \(A1\)](#).

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### Field of the Invention

[0001] The present invention relates to the field of total shoulder replacement.

### Background of the Invention

[0002] The invention provides a glenoid shoulder implant as defined by claim 1.

[0003] Shoulder replacement surgery is currently used to treat patients suffering from disabling pain due to worn or damaged shoulder joints, which can be caused by, e.g., arthritis or injury. The humeral implants currently in use are typically made from metal, and the implants are affixed to the bone using bone cement (e.g., polymethylmethacrylate) or by press fitting the implant into the bone using a roughened outer surface coating on the metal for bony integration. Most glenoid (shoulder socket) implants are made completely from polyethylene and affixed to the cortical bone using bone cement. Some glenoid implants have a metal base plate with a polyethylene insert. Current glenoid implants are made to sit on the surface of a reamed glenoid, which is prepared by removing any remaining cartilage and flattening the bony surface. These implants use either a keel or multiple elongated pegs on the back of the prosthetic glenoid implant to secure the glenoid implant inside the glenoid vault.

[0004] Keeled and pegged glenoid implants suffer from several disadvantages, which limit their lifespan once implanted and reduce the number of indications for which they can be used when the age of the patient is a factor. For example, the glenoid implants can loosen due to poor fixation within the bone, and they are prone to wear and fatigue failure of the polyethylene due to adhesion, abrasion, and shear stress. Because of



these deficiencies, surgeons hesitate to perform glenoid replacement surgery on young or middle aged patients with glenoid articular cartilage injuries or damage due to early arthritis for fear that the implant may not last more than 10-15 years in the body, thus subjecting the patient to the possibility of two or more surgeries during the lifetime of the patient to preserve the function and pain-free state of the joint. Finally, current glenoid implants with a long keel or pegs are sometimes contraindicated in patients with significant glenoid bone loss. As arthritis progresses, the humeral head can wear medially and destroy the foundation of glenoid bone. In these cases, the glenoid vault can be significantly reduced in volume and depth. Thus, a typical keel or peg design can breach the glenoid vault and injure the suprascapular nerve along the suprascapular notch or spinoglenoid notch with resultant denervation injury to the rotator cuff muscles. Breaching through the glenoid vault can also fracture the body of the scapula and cause early implant loosening.

[0005] There are also several disadvantages associated with current glenoid replacement surgical techniques. Current techniques require extensive shoulder exposure with capsular releases in order to fully expose the glenoid surface circumferentially. Since the axillary nerve is located within 1 cm of the inferior capsule, there is potential risk of axillary nerve injury with resultant denervation injury to the deltoid muscle when these releases are performed. However, use of the current keeled or pegged glenoid implants requires this extensive glenoid exposure for proper fitting and placement. Current glenoid replacement surgery also requires a long skin incision and extensive soft tissue stripping in order to fully expose the glenoid circumferentially, which produces a cosmetically unappealing scar. Finally, current glenoid replacement surgical techniques require advanced surgical training and expertise within the specialty of shoulder surgery, yet the majority of shoulder implants performed in the U.S. every year are performed by orthopedic surgeons who do not have advanced training in the subspecialty of shoulder surgery. Therefore, many surgeons have difficulty preparing the glenoid site for a total shoulder replacement using the current techniques.

[0006] US5489310 shows a glenoid shoulder prosthesis according to the preamble of claim 1 in combination with a tapered medial surface.

[0007] US4261062 equally teaches a glenoid implant comprising an elongated keel extending from the implant's backside. US5080673 discloses a glenoid prosthesis having a flat medial surface but requiring a pair of pegs extending medially of the medial surface.

[0008] Because there are more than 20,000 shoulder arthroplasty surgeries performed per year, many U.S. patients incur a risk of continued pain and disability, neuromuscular injuries, or failed shoulder prostheses requiring revision surgery. Thus, there remains a need for an improved glenoid implant and improved methods for performing replacement shoulder surgery.

#### Summary of the Invention

[0009] In one aspect, the invention features an inset glenoid shoulder implant that is implanted within the glenoid vault, thereby allowing circumferential cortical support along the rim of the prosthesis, which improves fixation strength in comparison to current glenoid implants. Another advantage of the glenoid implant is that it requires only a minimal amount of bone removal for implantation.

[0010] The glenoid implant according to claim 1 includes a body portion having (i) a

smooth concave lateral articulating surface adapted to be engaged by a humeral component, (ii) a flat medial surface adapted for positioning within a cavity reamed in the glenoid and adapted for securing within said glenoid cavity, (iii) a peripheral edge in the shape of a circle having a diameter circumferentially surrounding the body portion, and (iv) a central cylindrical peg extending coaxially from the center of the medial surface, wherein the body portion is cylindrical.

[0011] Further preferred embodiments are defined by the appended dependent claims.

#### Brief Description of the Drawings

[0012]

FIG. 1A is an anterior surface view of a circular glenoid implant.

FIG. 1B is an anterior surface view of an oval glenoid implant.

FIG. 1C is a backside view of the circular glenoid implant of FIG. 1A .

FIG. 2A is an anterior surface view of the circular glenoid implant of the invention that includes a single short backside peg.

FIG. 2B is a backside view of the circular glenoid implant of FIG. 2A .

FIG. 3 is an anterior (frontal) view of a typical prior art glenoid implant with a keel design situated in the glenoid.

FIG. 4 is an anterior (frontal) view of a scapula containing a typical prior art glenoid implant with a multiple peg design situated in the glenoid.

FIG. 5 is a backside view of a scapula containing a typical prior art pegged glenoid implant which was removed from a patient.

FIG. 6 is a lateral view of the prior art pegged glenoid implant of Fig. 5 .

FIG. 7 is an anterior (frontal) view of a scapula containing an inset glenoid implant of the invention situated in the glenoid.

FIG. 8A is an anterior surface view of a typical prior art glenoid implant.

FIG. 8B is an anterior surface view of the circular glenoid of the invention.

FIG. 9A is a backside view of a typical prior art keeled glenoid trial implant.

FIG. 9B is a backside view of the circular glenoid of the invention showing a short backside peg.

FIG. 10A is a surface view of the glenoid bone with an inset circular glenoid implant of the invention.

FIG. 10B is a surface view of the glenoid bone with an inset oval glenoid implant.

FIG. 11 is a surface view of the glenoid bone with a typical prior art onlay glenoid implant, which does not sit inset to the glenoid bone.

FIG. 12 is a photograph of a model depicting the glenoid (G), scapula (S), clavicle (C), Acromio-Clavicular Joint (AC), and Coracoid (Co). The glenoid is shaded to designate the placement surface for the glenoid implant of the invention.

FIG. 13 is a view showing the use of a straight drill of the prior art for preparing the glenoid for implantation.

FIG. 14 is a view of a 90° drill.

FIG. 15 is an anterior (frontal) view of the scapula showing the use of the 90° drill.

FIG. 16 is a view of a reamer.

FIG. 17 is frontal view of a humeral cutting jig.

FIG. 18 is side view of the humeral cutting jig of FIG. 17 placed in position on a humerus. The cutting jig can be secured by K-wires (shown), pins, or screws.

FIG. 19 is a view of the humerus and humeral cutting jig of FIG. 18 after resection of humeral head along the axis of the cutting jig.

FIG. 20A is an anterior (frontal) view of a humeral implant.

FIG. 20B is a lateral view of the humeral implant.

FIG. 20C is an anterior (frontal) view of the humeral implant with a collar.

FIG. 20D is a lateral view of the humeral implant with a collar.

FIGS. 21, 22, and 23 are photographs showing the inset circular glenoid implant of the invention implanted in the glenoid of a patient.

FIG. 24 is a photograph showing the 15 cm incision from a typical prior art total shoulder replacement surgery.

FIG. 25 is a photograph showing the 9 cm incision from the "mini-incision" total shoulder replacement surgery.

FIG. 26A is a view showing a right angle drill attachment for use in preparing a glenoid for implantation of a glenoid implant.

FIG. 26B is a view showing a drill with the right angle drill attachment and drill bits for use in preparing a glenoid for implantation of a glenoid implant.

#### Detailed Description of the Invention

[0013] The invention features an inset glenoid implant prosthesis.

[0014] The design of the glenoid implant of the invention provides increased implant fixation strength to glenoid bone and therefore decreases the rate of glenoid implant loosening. This implant is also designed for use in cases of deficient glenoid bone which would preclude the use of a current glenoid implant since they require adequate bone in the glenoid vault to support multiple long pegs or a keel.

[0015] The disclosure also features a humeral implant, which is less than 70 mm in length, preferably about 60 mm in length, and is less than 40 mm wide from anterior to posterior (preferably 20-30 mm). The humeral implant is significantly shorter and thinner (in the anterior to posterior dimension) than most current stems, which are about 70-115 mm in length and bulkier in the proximal (metaphyseal) area than distally both in the anterior to posterior dimension and medial to lateral dimension. Because the humeral implant is shorter, it can be implanted in a narrower metaphyseal area and does not require the removal of a significant amount of bone. Fixation of the present humeral implant depends upon good interference fixation in the medial-lateral plane when press fit (similar to some current total hips). The humeral implant can be fixed using a bone cement, such as polymethylmethacrylate (PMMA) or a compatible fixation material. Alternatively, the humeral implant can be press-fit.

[0016] The disclosure also features a minimal incision shoulder arthroplasty, not forming part of the claimed invention, that allows replacement of the glenoid surface and humeral head with only a small incision and less extensive soft tissue stripping. The "mini-incision" procedure also leaves the pectoralis tendon and the majority of the inferior capsule intact. The glenoid labrum can also be left intact. The central portion of the glenoid bone is then reamed while leaving the peripheral cortex intact. The advantages of this "mini-incision" procedure include a shorter incision with less scarring, increased safety, and a more simple exposure of the glenoid, thus allowing general orthopedists to perform a shoulder replacement with less difficulty and potentially fewer complications.

[0017] The glenoid implant of the invention lacks a keel and multiple long pegs, which are typically present in the prior art glenoid implants. Instead, the glenoid implant of the invention includes only a single short (less than about 8 mm), central backside peg which stabilizes the glenoid implant. The glenoid implant of the invention does not require a long extended keel or long pegs because the majority of the fixation strength is concentrated on the rim of the embedded implant. This obviates the need for significant backside fixation. The fixation, with either cement or press fit techniques, offers circumferential cortical bone fixation around the prosthesis. The shear stresses placed on the implant are therefore supported by a circumferential buttress of bone,

which is more mechanically sound than an onlay prosthesis with an extended backside keel or multiple long pegs.

[0018] An object of the invention is to minimize the common complications of glenoid implant loosening and fatigue failure that exist with current glenoid implants. All previous glenoid implants sit on the surface of a reamed articular surface and utilize a keel or multiple pegs to secure the implant inside the glenoid vault (see, e.g., FIGS. 3-6 ). This invention features a glenoid implant (which can be polyethylene, metal, ceramic, or combinations thereof) that is not designed to be placed on the surface of the reamed glenoid articular cartilage, but rather is designed to be inset partially or fully within the glenoid vault (see FIG. 7 ). The implant may be press fit or cemented in the reamed slot within the glenoid bone.

[0019] Patients who can benefit from the use of the glenoid implant of the invention and the improved methods for performing a total shoulder arthroplasty include young, middle, and older patients with arthritis (typical total shoulder replacement (TSR) patients) or damage or injury to the shoulder. This new inset glenoid implant allows TSR surgery for new, previously contraindicated applications, including applications in which the patient presents with bone defects on the glenoid. The glenoid implant of the invention can also be utilized in revision surgeries.

#### Glenoid Implant

[0020] Referring now to FIGS. 1A, 1B, and 1C , there is provided glenoid implant (10), which is intended to be implanted in the glenoid as part of a TSR arthroplasty. Glenoid implant (10) replaces the natural glenoid cavity (see G of FIG. 15 ) and provides a bearing surface against which the head of a humerus or humeral component may articulate. Glenoid implant (10) includes concave articulating surface (14) and convex or flat backside surface (16), which can, optionally, include roughened or textured surface (18). Glenoid implant (10) can be provided as a circular design ( FIG. 1A and 1C ) or as an oblong, oval design ( FIG. 1B ).

[0021] Referring now to FIGs. 2A and 2B , the inventive glenoid implant (10) includes short, backside peg (12) on the medial, flat backside surface (16) of glenoid implant (10). Short, backside peg (12) is situated centrally on the medial (back) side of glenoid implant (10) and is a cylindrical peg shape that extends outwardly from glenoid implant (10) away from the back of the implant (16).

[0022] Glenoid implant (10), including or excluding short, backside peg (12), is adapted to be implanted in a prepared cavity of the glenoid (see, e.g., FIG. 12 ), such that it is partially or fully inset to the cortical bone of the glenoid, and is retained with bone cement or using press-fit techniques. Glenoid implant (10) can be further secured to the glenoid using one or more screws.

[0023] Glenoid component (10) of the present invention includes concave lateral articulating surface (14) against which the head of a humerus or humeral component moves. Glenoid implant (10) is manufactured using a suitable material, for example, polyethylene, metal, ceramic, or combinations thereof, with lateral articulating surface (14) being smoothly contoured. The radius of curvature of the articulating glenoid surface can match the humeral head surface or it can be slightly larger than the radius of curvature of the humeral head implant.

[0024] In preferred embodiments, glenoid implant (10) has a lateral articulating surface (14) having a concave circular surface encircled by circular edge (20). Circular edge

(20) has a thickness in the range of about 3-6 mm, preferably about 3 mm.

[0025] The medial, back side of glenoid implant (10) is preferably roughened or textured. For example, glenoid implant (10) can include a series of elongated groves (18) in multiple locations for receiving bone cement to assist in the cement augmentation and retention of glenoid implant (10).

[0026] In preparing the glenoid to receive glenoid implant (10), the glenoid (G; see, e.g., FIG. 12 ) is reamed to receive all or a portion of glenoid implant (10) so that glenoid implant (10) is circumferentially surrounded by cortical bone of the glenoid (G), which aids in the stabilization and security of glenoid implant (10).

#### Glenoid Drill and Reamer

[0027] Referring now to FIGs. 13-16 , there will be described a method, not forming part of the claimed subject-matter, for preparing a cavity in the glenoid for receiving a glenoid implant of the present invention and apparatus to be used therewith.

[0028] In preparing the cavity in the glenoid (G) to receive glenoid implant (10), the surgeon will initially determine the position of the drill site using a guide known in the art (see, e.g., U.S. Patent Nos. 6,712,823 ; 6,364,910 ; 5,030,219 ; and 5,489,310 ).

[0029] A reamer of appropriate size is then chosen based on the size of the sizer guide previously chosen. The reamer has a symmetrical head with a plurality of cutting blades and a peripheral stop surface. The previously drilled hole is used as a center guide for the reamer. The reamer is used to create a cavity in the glenoid surface of the scapula in which the prosthetic glenoid component will be installed. After the cavity has been created, the circular or oval glenoid component is installed in the cavity, with or without the use of bone cement.

[0030] A method for implanting glenoid implant (10) will now be described with reference to FIGS. 13-16 . Initially, if a total shoulder arthroplasty is performed, a humeral implant having a head portion, discussed below, and a glenoid implant are implanted. Prior to implantation of the humeral component into the humerus, glenoid preparation begins. With the glenoid cavity (G) of the scapula (S) exposed, an alignment or pilot hole is first drilled substantially in the center of the glenoid cavity (G) using, e.g., the drill shown in FIGS. 14 , 15 , and 26 . Once the pilot hole is drilled, the glenoid cavity (G) is reamed using a glenoid surface rasp (see bit attached to the drill depicted in FIG. 16 ) attached to a 90° reamer shaft with driver (see FIG. 26 ). The glenoid surface rasp may include a guide pin and a roughened cutting surface to create a trough for the glenoid component. The 90° angle of the shaft of the driver permits drilling in tight glenoid cavities. Thus, the procedure can be performed in a minimally invasive manner because it does not require full circumferential exposure of the glenoid, nor does it require a complete capsular release. The 90° shaft of the drill includes a quick-connect attachment which receives the quick-connect drill bit. The reamer is rotated by suitable power means or by hand to ream the glenoid cavity. Following such reaming, the reamer and the guide wire/drill are removed leaving a cavity which is wholly contained within the glenoid cavity (G).

[0031] Once the holes have been drilled and the glenoid reamed, a provisional glenoid implant may be used prior to cementing the final glenoid implant to verify hole placement, range of motion, and appropriate glenoid size, and to verify that the glenoid implant is sufficiently inset. After the proper sized glenoid implant has been selected, suitable bone cement, such as polymethylmethacrylate (PMMA) or a compatible

fixation material, is placed in the reamed cavity of the glenoid vault and in the roughened outer portions and applied to the medial (back) surface of glenoid implant (10), if cement is to be used. Glenoid implant (10) can then be positioned in the prepared cavity. Glenoid implant (10) is then held in place until the cement cures to assure strong fixation of glenoid implant (10) in the scapula. The head portion of the humerus or humeral component may then engage the concave articulating surface of the glenoid implant (14).

[0032] As can be appreciated, the reaming is contained wholly within the boundary of the glenoid cavity (G) and therefore does not destroy the peripheral margin of the glenoid surface. Additionally, as can be seen in FIG. 7, there is preferably a slight overhang of glenoid implant (10) beyond the margin of the natural glenoid cavity.

[0033] This method can be performed using a deltopectoral or anterolateral surgical approach. For most cases, a limited deltopectoral incision will be adequate to allow exposure to all involved structures. Use of glenoid implant (10) in the shoulder arthroplasty procedure allows the surgeon to use a "mini-incision technique," similar to techniques utilized for total knee surgery and total hip surgery.

[0034] The glenoid implant of the invention has already been implanted in several patients according to the patient matched implant (PMI) rules and regulations. The implants were designed specifically for patients with inadequate glenoid bone stock which could not support a typical keel or peg design.

#### Humeral Head Cutting Jig

[0035] Referring now to FIGS 17-19, humeral head cutting jig (26) is a simple, low profile humeral cutting jig that can be a full circle or part thereof. Cutting jig (26) can be secured to the humeral head using K-wires, pins, or screws (27) and is removed after completion of humeral head resection. Cutting jig (26) includes handle portion (28).

[0036] The cutting jig should be placed along the anatomic neck of the humeral head. Osteophytes which obscure the junction of the humeral head and humeral shaft should be removed in order to accurately mark the level of the anatomic neck circumferentially from anterior to inferior to posterior. The cutting jig can be fixed to the humerus using wires, pins, or screws at the appropriate angle and version as determined by the surgeon. The rotator cuff should be carefully protected with retractors, and then the humeral cut is performed using an oscillating saw or osteotome along the surface of the cutting jig.

[0037] The cutting jig can be manufactured using metal.

#### Humeral Implant

[0038] Referring now to FIGS. 20A-D, humeral implant prosthesis (38) includes stem (40) having elongated portion (42) optionally including collar (44), which prevents humeral implant prosthesis (38) from embedding too deeply in the humerus. Humeral implant (38) also includes flange (fin) (46), which aids in the fixation of the stem in the humerus and prevents rotation of humeral implant in the humerus. There may be just one lateral flange (fin), or there may be two or three flanges (fins), e.g., with one lateral, one anterior, and one posterior. The stem length is preferably less than about 70 mm, and the stem width is preferably less than about 40 mm (preferably about 30 mm).

[0039] At the distal end of the stem, there is rounded portion (48) and at the proximal

end of the stem is a support surface extending radially from the stem. The support surface has an upper planar surface (50) that includes bore (hole with morse taper) (52) extending inwardly from the top plane thereof, and which is adapted to be engaged by a humeral head implant with a morse taper extension. Modular humeral head implants (both concentric and eccentric) are known in the art (see, e.g., U.S. Patent Nos. 4,865,605 ; 5,314,479 ; 5,462,563 , and 5,489,309 , and U.S. Patent Application Nos. 2004/0167629 , 2004/0064187 . The plane of upper planar surface (50) is preferably between about 45 degrees and about 60 degrees to the axis of the stem.

[0040] The entire stem portion, or a portion thereof, is preferably coated with a porous material for aiding in the fixation of the humeral implant in the humerus for a press fit stem. The implants made for cement fixation can have a smooth surface or a roughened, textured surface.

[0041] Humeral implant (38) can be rectangular or rounded edges, but is significantly thinner anterior to posterior than medial to lateral. It will have a morse taper for securing a standard humeral head implant.

[0042] An advantage of the humeral implant over current humeral implant stems is that the humeral implant is significantly shorter than most current stems, which are about 70-115 mm in length. Because the humeral implant is shorter, it saves bone because of the narrow metaphyseal area required for implantation. The present humeral implant is less than 70 mm in length, preferably about 60 mm in length, and less than 40 mm anterior-posterior width (preferably about 30 mm). Fixation of the present humeral implant depends upon good interference fixation in the medial-lateral plane when press fit (similar to some current total hips). The humeral implant can be fixed using a bone cement, such as polymethylmethacrylate (PMMA) or a compatible fixation material, or it can be press-fit.

[0043] The following examples are meant to illustrate the invention. They are not meant to limit the invention in any way.

## EXAMPLES

### Example 1

[0044] A 62 year old woman presented with progressive, debilitating shoulder pain from osteoarthritis, which she had experienced for approximately 15 years. She had constant pain (rated 9/10) and difficulty washing her hair, fastening her bra, lifting a cup of coffee, and performing other daily activities. The preoperative radiographs and CT scan showed severe shoulder arthritis and glenoid bone loss that would preclude the use of a keeled or pegged glenoid implant. There was concern that a hemiarthroplasty procedure (replacement of the humeral ball, which would leave the arthritic glenoid socket bare) would not relieve the patient's pain.

[0045] A total shoulder replacement using an inset glenoid implant of the invention and a standard humeral implant was performed. The smaller size and circumferential fixation of the inset glenoid implant allowed safe placement of the prosthesis within the confines of the patient's deficient glenoid cavity.

[0046] The deficient glenoid vault was not fractured and the fixation was very stable. The patient had 100% relief of pain only 1 week after surgery. Her own assessment of shoulder function 4 weeks after surgery was 56% of normal (American Shoulder and Elbow Society validated outcome score [ASES score]) was 56 compared to 16% of

normal before the surgery (ASES score 16).

[0047] This surgery was performed through the "mini-incision total shoulder technique" described above. Figure 25 shows the surgical incision 4 weeks postoperatively. Figure 24 , which shows a more typical total shoulder incision, clearly demonstrates the improved cosmetic appearance and reduced incision size achieved using the "mini-incision total shoulder technique" described above. Figures 21-23 are intraoperative pictures of the implanted inset glenoid prosthesis in this patient.

## Example 2

[0048] An 81 year old woman presented with severe shoulder pain and stiffness. She had severe shoulder arthritis with medial wear causing glenoid bone loss. Her own assessment of shoulder function was 25% of normal (American Shoulder and Elbow Society validated outcome score [ASES score] was 25).

[0049] A total shoulder replacement using an inset glenoid implant prosthesis was performed. Two months after her surgery, the patient had no pain and exhibited improved function. Her own assessment of shoulder function was 70% of normal (American Shoulder and Elbow Society validated outcome score [ASES score] was 70).





## Claims: EP1858453 (A2) — 2007-11-28

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### SHOULDER IMPLANT FOR GLENOID REPLACEMENT

#### Claims of EP1858453 (B1)

**A high quality text as facsimile in your desired language may be available amongst the following family members:**

[AU2006218936 \(B2\)](#) [CA2598659 \(A1\)](#) [US2006195194 \(A1\)](#) [WO2006093763 \(A2\)](#)  
[US2010087877 \(A1\)](#) [US2011112648 \(A1\)](#) [US2017360456 \(A1\)](#) [US9693784 \(B2\)](#)

- [Original claims](#)
- [Claims tree](#)

The EPO does not accept any responsibility for the accuracy of data and information originating from other authorities than the EPO; in particular, the EPO does not guarantee that they are complete, up-to-date or fit for specific purposes.

1. An inset glenoid implant (10) comprising a body portion having (i) a smooth concave lateral articulating surface (14) adapted to be engaged by a humeral component (38), (ii) a medial surface (16) adapted for positioning within a cavity reamed in the glenoid and adapted for securing within said glenoid cavity, (iii) a peripheral edge (20) in the shape of a circle having a diameter circumferentially surrounding the body portion, and (iv) a central cylindrical peg (12) extending coaxially from the center of the medial surface (16), wherein the body portion is cylindrical; characterized by the medial surface (16) being flat.

2. The inset glenoid implant (10) of claim 1, wherein said peg (12) is 10 mm or less in length.

3. The inset glenoid implant (10) of claim 1, wherein said implant (10) is manufactured using polyethylene, metal, ceramic, or a combination thereof.

4. The glenoid implant (10) of claim 1, wherein said implant (10) has bone cement adhered thereto.

5. The glenoid implant (10) of claim 1, wherein the peg (12) has a length of 5 mm or less.

6. The glenoid implant (10) of claim 1, wherein the peripheral edge (20) of the glenoid implant (10) has a thickness of between 3 mm and 6 mm.

7. The glenoid implant (10) of claim 1, comprising a series of elongated grooves (18) on the medial surface (16).

8. The glenoid implant (10) of claim 1, wherein medial surface (16) includes a roughened or textured surface.

9. The glenoid implant (10) of claim 1, wherein the central cylindrical peg (12) is a single cylindrical peg.

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FIG. 1C

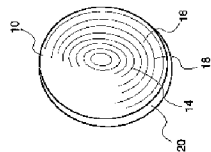


FIG. 1B

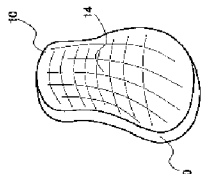
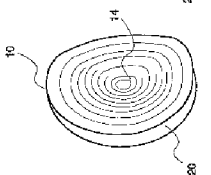


FIG. 1A



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FIG. 2B

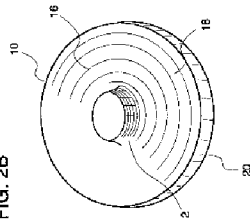
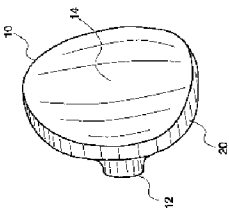


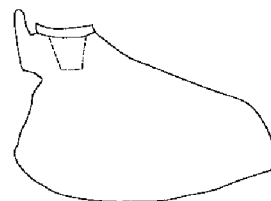
FIG. 2A



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FIG. 3

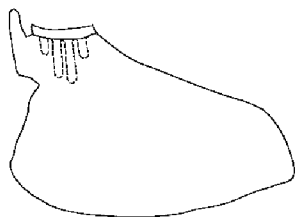


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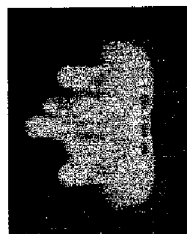
FIG. 4



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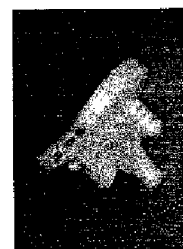
FIG. 5



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FIG. 6



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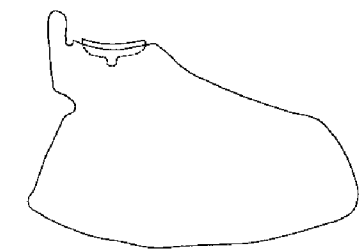


FIG. 7

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FIG. 8B



FIG. 8A



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FIG. 9B



FIG. 9A



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FIG. 10B

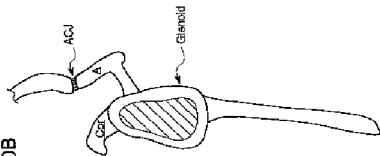
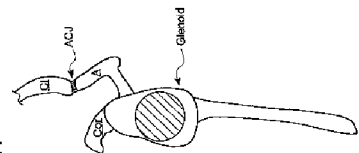


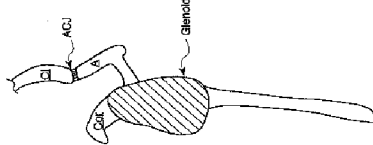
FIG. 10A



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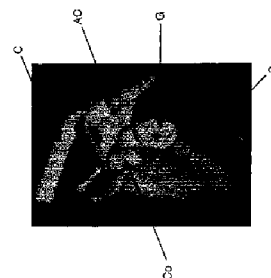
FIG. 11



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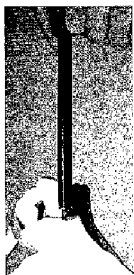
FIG. 12



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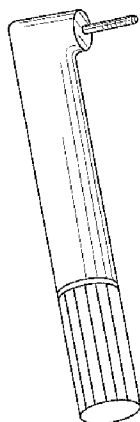
FIG. 13



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FIG. 14



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FIG. 15

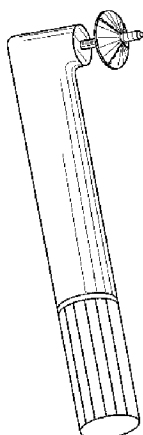


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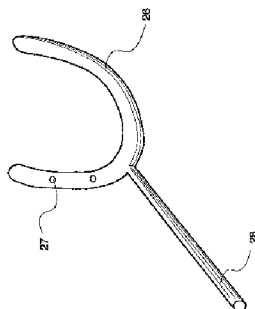
FIG. 16



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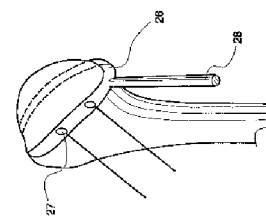
FIG. 17



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FIG. 18



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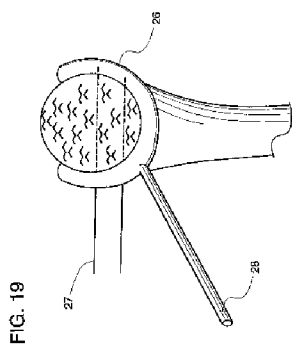


FIG. 19

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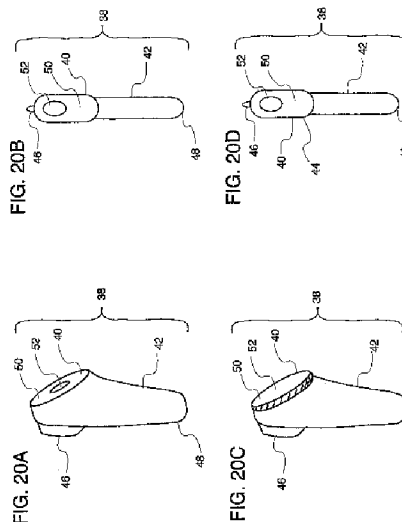


FIG. 20A

FIG. 20B

FIG. 20C

FIG. 20D

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FIG. 21

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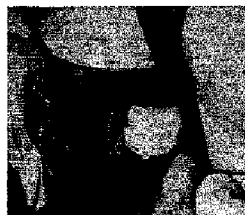


FIG. 22

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FIG. 23

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FIG. 24

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FIG. 25



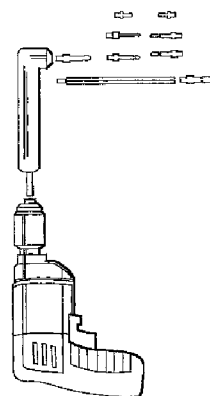
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FIG. 26A



FIG. 26B



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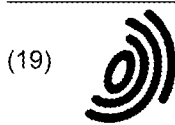
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**EP 1 464 305 A2**

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**(54) Orthopaedic joint replacement prosthesis**

(57) A prosthesis (20) for use in performing joint arthroplasty is provided. The prosthesis (20) is to be fitted to a long bone (3). The prosthesis includes a first body (22) having a first body articulating surface (24) defining a generally circular outer periphery (26) of the first body articulating surface (24). The first body (22) has a support surface (28) opposed to the articulating surface (24). The support surface (28) is adapted to receive the head of the long bone (3). The prosthesis (20) also includes a second body (30) operably associated with the first body (22). The second body (30) has a second body articulating surface (32) extending from a portion of the circular outer periphery (26) of the first body articulating surface (24).

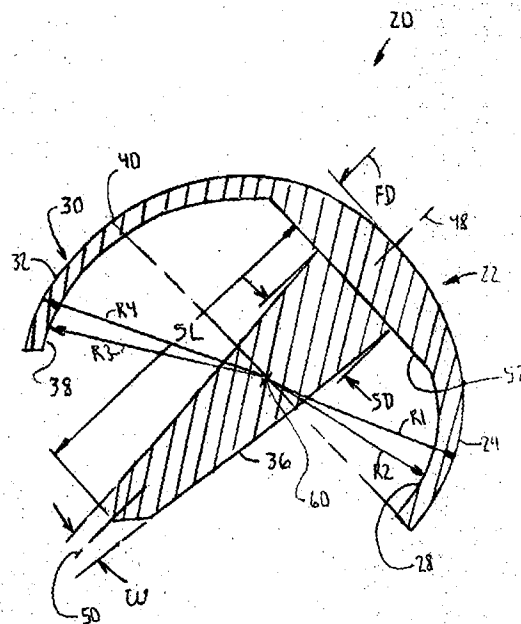


**FIGURE 11**

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## Description

[0001] The present invention relates generally to the field of orthopaedics, and more particularly, to an implant for use in arthroplasty.

[0002] The invention relates to implantable articles and methods for implanting such articles. More particularly, the invention relates to a bone prosthesis and a method for implanting the same.

[0003] There are known to exist many designs for and methods of implanting implantable articles, such as bone prostheses. Such bone prostheses include components of artificial joints, such as elbows, hips, knees and shoulders.

[0004] Early designs of implantable articles relied upon the use of cements to anchor the implant. However, the current trend is to use cements to a lesser extent because of their tendency to lose adhesive properties over time and the possibility that cement contributes to wear debris within a joint.

[0005] Recently, implantable bone prostheses have been designed such that they encourage the growth of hard bone tissue around the implant. Such implants are often implanted without cement and the bone grows around surface irregularities, for example, porous structures on the implant.

[0006] One such implantable prosthesis is a shoulder prosthesis. During the lifetime of a patient it may be necessary to perform a total shoulder replacement procedure on a patient as a result of, for example, disease or trauma, for example, disease from osteoarthritis or rheumatoid arthritis. Currently, most implantable shoulder prostheses are total shoulder prostheses. In a total shoulder replacement procedure, a humeral component having a head portion is utilized to replace the natural head portion of the upper arm bone or humerus. The humeral component typically has an elongated intramedullary stem, which is utilized to secure the humeral component to the patient's humerus. In such a total shoulder replacement procedure, the natural glenoid surface of the scapula is resurfaced or otherwise replaced with a glenoid component that provides a bearing surface for the head portion of the humeral component.

[0007] With the average age of patients requiring shoulder arthroplasty decreasing, device manufacturers are developing bone sparing implants for the initial treatment of degenerative arthritis. Surface replacement prostheses are being developed to replace the articulating surface of the proximal humerus with a minimal bone resection and minimal disruption of the metaphysis and diaphysis. Current designs utilize a semi-spherical articular dome with a small stem for rotational stability. The under surface of the articular head is also semi-spherical and mates with the spherically machined humeral head.

[0008] The need for a shoulder replacement procedure may be created by the presence of one of a number of conditions. One such condition is the deterioration of

the patient's rotator cuff. Specifically, an intact rotator cuff stabilizes the humeral head in the glenoid fossa of a scapula during abduction of the arm. While it is stabilized in such a manner abduction of the arm causes the humeral head to translate only a short distance in the superior direction (e.g. a few millimetres), whereby a space is maintained between the humeral head and the acromion. However, for patients with rotator cuff arthropathy, significantly greater humeral excursion is observed.

[0009] Referring to FIGURE 2, a healthy long bone in the form of humerus 1 is shown. The humerus 1 includes a healthy humeral head 2.

[0010] Referring now to FIGURE 3, a diseased humerus 3 is shown. The diseased humerus 3 includes a diseased or flattened humeral head 4. Whereas the healthy humeral head 2 of the healthy humerus 1 of FIGURE 2 has a generally hemispherical shape, the flattened humeral head 4 is quite flat and only slightly domed.

[0011] Referring now to FIGURES 4, 5 and 6, a prior art prosthesis 5 is shown. Referring first to FIGURE 4, the prosthesis 5 is shown installed on the diseased humerus 3. The prosthesis 5 is positioned over flattened head or bony defect 4. The prosthesis 5 includes a hollow generally hemispherical cup 6. Extending distally from the interior of the cup 6 is a generally conically shaped stem 7 that anchors the prosthesis 5 into the humerus 3.

[0012] Referring now to FIGURES 5 and 6, the prosthesis 5 is shown implanted in a shoulder joint. As shown in FIGURE 5, the humerus 3 is shown in a position in which the arm is resting against the patient's torso. Articulating surface of the cup 6 of the prosthesis 5 is shown in contact with the scapula 7, the clavicle 8, and the acromion 9. As can be seen in FIGURE 5, in this downward position of the humerus 3 the prosthesis 5 provides the articulating surface of cup 6 in contact with the acromion 9, the clavicle 8, and the scapula 7 to provide for a acceptable artificial joint in this position.

[0013] However, referring to FIGURE 6, the humerus 3 is shown abducted in the direction of arrow 10 such that the long bone or humeral centerline 11 is at an angle  $\alpha$  of about  $15^\circ$  with the vertical centerline 12. As can be seen in FIGURE 6, on a slight abduction of  $15^\circ$ , the acromion 9 is positioned outside the articulating surface 6 of the prosthesis 5 causing the acromion 9 to impinge upon the humerus 3 causing great pain to the patient and severely limited motion of the humerus 3.

[0014] In particular, hyper-translation of the humeral head in the superior direction is observed in patients with massive rotator cuff deficiency, thereby resulting in articulation between the superior surface of the humeral head and both the inferior surface of the acromion and the acromioclavicular joint during abduction of the patient's arm. Such articulation between these components accelerates humeral articular destruction and the erosion of the acromion and acromioclavicular joint.

Moreover, such bone-to-bone contact is extremely painful for the patient, thereby significantly limiting the patient's range of motion. In short, patients with massive rotator cuff tear and associated glenohumeral arthritis, as is seen in cuff tear arthropathy, may experience severe shoulder pain, as well as reduced function of the shoulder.

**[0015]** In order to treat patients suffering from cuff tear arthropathy, a number of prostheses and techniques utilizing existing prostheses have heretofore been designed. For example, surgeons heretofore utilized a relatively large humeral head prosthesis in an attempt to completely fill the shoulder joint space. It was believed that such use of a large prosthesis would increase the efficiency of the deltoid muscle, thereby improving motion of the shoulder. However, clinical experience has shown that such use of a large humeral head prosthesis (overstuffs) the shoulder joint thereby increasing soft tissue tension, reducing joint range of motion, and increasing shoulder pain. Moreover, such use of an oversized prosthetic head fails to resurface the area of the greater tubercle of the humerus, thereby allowing for bone-to-bone contact between the greater tubercle and the acromion during abduction of the patient's arm.

**[0016]** A number of humeral head bipolar prostheses have also been utilized in an attempt to address the problems associated with cuff tear arthropathy. It was believed that the relatively unstrained motion of the bipolar head would improve shoulder motion. However, heretofore designed bipolar prosthetic heads include relatively large offsets, thereby overstuffing the shoulder joint in a similar manner as described above. Moreover, scar tissue may form around the bipolar head thereby (freezing) the dual articulating motion of the prosthesis that has been known to create a large hemi arthroplasty that likewise overstuffs the shoulder joint. In addition, such bipolar prosthetic heads do not cover the articulating surface between the greater tubercle and the acromion, thereby creating painful bone-to-bone contact between them.

**[0017]** Yet further, a number of techniques have heretofore been designed in which the relatively rough surface of the greater tubercle is resurfaced with an osteotome or high speed burr. Although this approach results in a smoother tubercle contact surface, relatively painful bone-to-bone articulating contact still occurs, thereby reducing the patient's range of motion.

**[0018]** A recently developed technique disclosed in EP-A-1228739 provides for treating cuff tear arthroplasty utilizing a total shoulder replacement prosthesis. This prosthesis includes an artificial head as well as a stem that extends into a rimmed medullary canal. Such a prosthesis is limited to use with a total shoulder prosthesis and is not suitable for use with bone sparing implants for the initial treatment of the degenerative arthritis.

**[0019]** The present invention provides a technique for performing bone sparing arthroplasty shoulder replace-

ment surgery utilizing bone sparing implants for the initial treatment of degenerative arthritis, which will be useful in the treatment of cuff tear arthroplasty, which overcomes one or more of the aforementioned drawbacks.

The technique can help to minimise painful articulation between the great tubercle of the humerus and the acromion.

**[0020]** The present invention provides for an extended articulation resurfacing shoulder that provides a low-friction prosthetic bearing surface for articulation between the greater tuberosity and the acromion. Such a prosthesis is utilized with a bone sparing minimal resection of a portion of the humeral head.

**[0021]** The present invention provides for an extended articulation resurfacing shoulder with superior/lateral flange for extended articulation into the coracoacromial arch.

**[0022]** According to one embodiment of the present invention, a prosthesis for use in performing joint arthroplasty is provided. The prosthesis is to be fitted to a long bone. The prosthesis includes a first body having a first body articulating surface defining a generally circular outer periphery of the first body articulating surface. The first body has a support surface opposed to first body articulating surface. The support surface is adapted to receive the head of the long bone. The prosthesis also includes a second body operably associated with the first body. The second body has a second body articulating surface extending from a portion of the circular outer periphery of the first body articulating surface.

**[0023]** According to another embodiment of the present invention, a tool kit for preparing a humerus to receive a prosthesis is provided. The prosthesis has a first body having a first articulating surface and an opposed first support surface and has a second body having a second articulating surface and an opposed second support surface. The kit is used to prepare the humerus to receive the prosthesis. The tool kit includes a reamer for preparing a first prepared surface on the humerus. The first prepared surface receives the first support surface. The tool kit also includes a bone cutting tool for preparing a second prepared surface on the humerus. The second prepared surface receives the second support surface.

**[0024]** According to a further embodiment of the present invention, a method for performing shoulder arthroplasty for an indication of rotator cuff tear arthropathy is provided. The method includes the step of providing a prosthesis with a first body having a first articulating surface and an opposed first support surface and with a second body having a second articulating surface and an opposed second support surface. The method also includes the step of providing a tool kit for preparing a humerus for receiving the prosthesis. The method includes the step of preparing a first prepared surface for cooperation with the first support surface with the tool kit. The method further includes the step of preparing a second prepared surface for cooperation with the sec-

ond support surface with the tool kit. The method also includes the step of implanting the prosthesis onto the first prepared surface and the second prepared surface. The method also includes the step of providing an instrument for preparing a surface on a long bone, providing a plurality of trials, each of said trials being adapted to mate with the surface, selecting one of the plurality of trials, performing a trial reduction on said one of said plurality of trials, determining if said one of said plurality of trials is satisfactory, performing additional trial reductions as required, selecting one of a plurality of joint prostheses corresponding to one of said plurality of trials based upon the trial reductions, and implanting the selected one prosthesis onto the long bone.

**[0025]** The prosthesis of the invention can be used in a method of performing shoulder arthroplasty for an indication of rotator cuff tear arthropathy comprising the steps of:

- providing a prosthesis with a first body having a first articulating surface and an opposed first support surface and with a second body having a second articulating surface and an opposed second support surface;
- providing a tool kit for preparing a humerus for receiving the prosthesis;
- preparing a first prepared surface for cooperation with the first support surface with the tool kit;
- preparing a second prepared surface for cooperation with the second support surface with the tool kit; and
- implanting the prosthesis onto the first prepared surface and the second prepared surface.

**[0026]** A technical advantage of the present invention includes the ability to provide a low friction bearing surface between the greater tuberosity and the acromion. For example, according to one aspect of the present invention, a superior/lateral flange extends from a periphery of the hemispherical body of the prosthesis, which flange provides for extended articulation in the coracoacromial arch. Thus, the present invention provides a low friction bearing surface between the greater tuberosity and the acromion.

**[0027]** The technical advantages of the present invention further include the ability to provide for an effective remedy for rotator cuff tear arthropathy as part of a bone saving surgical procedure. For example, according to one aspect of the present invention, a prosthesis is provided which includes a generally hollow hemispherical body which mates with a slightly resected humeral head. Thus, the present invention provides for a surgical procedure with minimal bone loss.

**[0028]** Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a plan view of a extended head hu-

meral prosthesis according to the present invention shown in position implanted on a diseased humerus;

FIGURE 2 is a plan view of a healthy humerus;

FIGURE 3 is a plan view of a diseased humerus;

FIGURE 4 is a plan view of a prior art humeral prosthesis;

FIGURE 5 is a plan view of a prior art humeral prosthesis shown in position implanted on a diseased humerus with the humerus shown in the retracted position;

FIGURE 6 is a plan view of a prior art humeral prosthesis shown in position implanted on a diseased humerus with the humerus shown in the extended position with the humerus impinged on the distal acromion;

FIGURE 7 is an enlarged plan view of the extended head humeral prosthesis of Figure 1;

FIGURE 8 is a plan view of the extended head humeral prosthesis of Figures 1 and 7 shown in position implanted on a diseased humerus and in cooperation with the glenoid cavity shown in the retracted position;

FIGURE 9 is a plan view of the extended head humeral prosthesis of Figures 1 and 7 shown in position implanted on a diseased humerus and in cooperation with the glenoid cavity shown in the abducted position free from impingement in the glenoid cavity;

FIGURE 10 is an enlarged plan view of the extended head humeral prosthesis of Figures 1 and 7;

FIGURE 11 is a cross sectional view of the extended head humeral prosthesis of Figure 10;

FIGURE 12 is an auxiliary view of the extended head humeral prosthesis of Figure 10 along the lines 12-12 in the direction of the arrows;

FIGURE 13 is a plan view of a reamer assembly to prepare a humeral head for the extended head humeral prosthesis of Figures 1 and 7;

FIGURE 14 is a plan view, partially in cross section of a cutting guide for use with a cutter to prepare a humeral head for the extended head humeral prosthesis of Figures 1 and 7;

FIGURE 15 is a top view of the cutting guide of Figure 14;

FIGURE 16 is plan view of a tool kit for preparing a humeral head for the extended head humeral prosthesis of Figures 1 and 7;

FIGURE 17 is plan view of an end mill for preparing a humeral head for the extended head humeral prosthesis of Figures 1 and 7;

FIGURE 18 is a plan view of another cutting guide for use with a cutter to prepare a humeral head for the extended head humeral prosthesis of Figures 1 and 7;

FIGURE 19 is a top view of the cutting guide of Figure 18;

FIGURE 20 is plan view of another tool kit for pre-

paring a humeral head for the extended head humeral prosthesis of Figures 1 and 7;

FIGURE 21 is a plan view of another embodiment of a extended head humeral prosthesis according to the present invention;

FIGURE 22 is a cross sectional view of the extended head humeral prosthesis of Figure 21;

FIGURE 23 is an auxiliary view of the extended head humeral prosthesis of Figure 21 along the lines 23-23 in the direction of the arrows;

FIGURE 24 is a plan view of a tool kit for preparing a humeral head for the extended head humeral prosthesis of Figures 21-23; and

FIGURE 25 is a process flow chart for a method of performing shoulder arthroplasty surgery according to another embodiment of the present invention.

**[0029]** Referring to the drawings, FIGURE 7 shows a prosthesis 20 which can be used in performing bone preserving joint arthroplasty. The prosthesis 20 is to be fitted to the head of a long bone. For example, the long bone as shown in FIGURE 7 is in the form of humerus 3. The prosthesis 20 includes a first body 22 having an articulating surface 24 defining a generally circular outer periphery 26. The first body 22 also includes a second surface 28 opposed to the articulating surface 24. The second surface 28 is adapted to receive the head of the humerus 3.

**[0030]** The prosthesis 20 further includes a second body 30 operably associated with the first body 22. The second body 30 has a second body articulating surface 32 extending from a portion 34 of the circular periphery 26 of the first articulating surface 24. The second body articulating surface 32 is adapted to prevent impingement of the acromion 9 (see FIGURE 1) with the humerus 3 when the humerus 3 is in the abducted position (see FIGURE 8).

**[0031]** While the prosthesis of the present invention may be secured to the humerus by securing of the second surface 28 to the humerus and bony ingrowth there between, preferably and as shown in FIGURE 7, the prosthesis 20 further includes a stem 36 operably associated with the first body 22 or the second body 30. As shown in FIGURE 7, the stem 36 is associated with the first body 22. The stem 36 is adapted to assist in securing the prosthesis 20 to the humerus 3. As shown in FIGURE 7, the prosthesis 20 is an integral or one-piece item. It should be appreciated that the prosthesis 20 may be modular. For example, the stem 36 may be a separate component from the first body 22 or the second body 30. Likewise, the second body 30 may be a separate component from the first body 22.

**[0032]** As shown in FIGURE 7, the first body 22 may have any shape capable for articulating motion with the glenoid cavity (see FIGURE 8), however, preferably the articulating surface 24 is generally convex. For example, and as shown in FIGURE 7, the articulating surface 24 may be generally hemispherical. Likewise, the sec-

ond surface 28 may likewise be generally hemispherical with the first body 22 being generally a hollow hemisphere. Similarly, the second body articulating surface 32 is preferably convex and may have a generally spherical shape. Likewise, the second body second surface 38 may likewise be generally spherical. The second body 30 may thus also be generally a sector of a hollow sphere.

**[0033]** To provide for smooth motion of the humerus 3 through the abduction of the humerus 3 with respect to glenoid cavity 14 (see FIGURE 8) boundary portion 40 of the prosthesis 20 located between the second articulating surface 32 and the first articulating surface 24 where the second articulating surface 32 extends from the first articulating surface 24 is generally smooth and continuous.

**[0034]** Referring now to FIGURE 1, the prosthesis 20 of the present invention is shown installed in the humerus 3 with the adjacent bones of the clavicle 8, scapula 7 and acromion 9 shown in position. As shown in FIGURE 1, the humerus 3 is abducted into an angle  $\beta$  with respect to vertical erect body reference line 42. As can be seen in FIGURE 3, the acromion 9 extends past the boundary portion 40 separating the first body 22 of the prosthesis 20 from the second body 30 of the prosthesis 20. Thus, the second body articulating surface 32 is utilized to prevent the acromion 9 from impinging on the humerus 3.

**[0035]** Referring now to FIGURES 8 and 9, the humerus 3 is again shown in position with the adjacent skeletal structure. In FIGURE 8, the long bone or humerus 3 is shown in position when the upper arm is in position against the torso. At the humeral position as shown in FIGURE 8, the angle P between the vertical centerline 42 and humeral centerline 44 is represented by an angle  $\beta\beta$  of approximately  $15^\circ$ . In this position of the humerus 3, it can be seen that the acromion 9 is in contact with the first articulating surface 24 at acromion distal edge or outer edge 13.

**[0036]** Referring now to FIGURE 9, the humerus 3 is shown being abducted in the direction of arrow 46 with the respective angle  $\beta$  equalling approximately  $60^\circ$ . In this abducted position, the outer edge 13 of the acromion 9 is in a position such that the second articulating surface 32 of the second body 30 is used to provide a smooth articulating surface for the outer edge 13 of the acromion 9.

**[0037]** Referring now to FIGURE 10, the prosthesis 20 is shown in greater detail. While the stem 36 of the prosthesis 20 may have any suitable shape capable of providing support for the prosthesis 20 in the humerus 3, preferably, and as shown in FIGURE 10, the stem 36 has a general cylindrical shape. The first body 22 as shown in FIGURE 10 may be in the form of a hollow hemisphere having a first longitudinal body centerline 48. The stem 36 has a stem longitudinal centerline 50. As shown in FIGURE 10, the prosthesis 20 may be such that the first longitudinal body centerline 48 and the stem

longitudinal centerline 50 are coincident. Such a configuration provides for a preferred central location of the stem 36.

**[0038]** The diseased humerus may become flattened around the humeral head, to provide adequate support to the prosthesis 20 in a diseased humerus, the support surface opposed to the articulating surface 24 of the prosthesis 20 may include at least part of the second surface 28 to include a support surface 52 opposed to the first articulating surface 24. Preferably, for simplicity, the support surface is generally planar.

**[0039]** To assist the prosthesis 20 in its strength and stability in the humerus 3 and to promote the bony ingrowth around the prosthesis 20, the prosthesis 20 may include a porous coating 53 secured to, for example, the second surface 28 of the first body 22, the second surface 38 of the second body, the planar portion 52 of the second surface 28, as well as on the periphery of the stem 36. Any commercially available porous coating will assist in the bony ingrowth of the prosthesis 20 to the humerus 3. Components having one particular porous coating is available from DePuy Orthopaedics Inc under the trade mark POROCOAT. Details of such porous coatings are disclosed in US-3855638.

**[0040]** As shown in FIGURE 20, the circular outer periphery 26 of the articulating surface 24 of the first body 22 defines a first plane 54. Similarly, the second articulating surface 32 of the second body 30 defines a second surface periphery 56. The second surface periphery 56 defines a second plane 58. The first plane 54 and the second plane 58 are non-coincident. The first plane 54 and the second plane 58, therefore, define an angle  $\alpha$  there between. As shown in FIGURE 20, the angle  $\alpha$  is obtuse. While the angle  $\alpha$  may approach  $180^\circ$ , the angle  $\alpha$  may likewise have a range of about  $120^\circ$  to  $180^\circ$ . As shown in FIGURE 20, the angle  $\alpha$  may be around  $138^\circ$ .

**[0041]** Referring now to FIGURES 11 and 12, the prosthesis 20 is shown in greater detail. As shown in FIGURE 11, the stem 36 may be generally cylindrical having stem diameter SD and a length SL. The stem 36 may be tapered and defined by an angle  $\omega$ . The angle  $\omega$  may be around  $5^\circ$  to  $30^\circ$ .

**[0042]** The planar portion 52 of the prosthesis 20 may have any reasonable location with respect to the articulating surface 24 of the prosthesis 20. The proper position of the planar portion 52 will depend on the flattening of the humeral head and how much corresponding amount of resection may be required to the humeral head. The position of the planar portion 52 with respect to the articulating surface 24 may be defined by a flat dimension FD.

**[0043]** The hemispherical body 22 and second body 30 of the prosthesis 20 may be defined with respect to a prosthetic centre point 60. The articulating surface 24 may be defined by a radius R1 extending from centre point 60 to the articulating surface 24. The second surface 28 may be defined by a radius R2 extending from the

prosthetic centre point 60 to the second surface 28. Similarly, the second articulating surface 32 may be defined by radius R4 from the prosthetic centre point 60 to the second articulating surface 32. Similarly, the second surface of the second body 38 may be defined by radius R3 from the prosthetic centre point 60 to the second surface 28. For simplicity, the radii R1 and R4 may be identical and for simplicity the radii R2 and R3 may be identical.

**[0044]** FIGURE 12 shows the underside of the prosthesis 20. The prosthesis 20 may have any size compatible with the humerus. Preferably, and as shown in FIGURES 7 through 12, the prosthesis 20 preferably blends with the periphery of the humerus. Thus, the size of the prosthesis 20 is governed generally by the size of the anatomical humerus.

**[0045]** The prosthesis 20 may be made of any suitable durable material that is compatible with the human anatomy. For example, the prosthesis 20 may be made of a ceramic, a plastic or a metal. If made of a metal, the prosthesis 20 may be made, for example, of a cobalt chromium alloy, a titanium alloy, or a stainless steel alloy.

**[0046]** Referring now to FIGURE 16, an instrument in the form of, for example, a reamer assembly 62 is shown for use in reaming, for example, the articulating surface 24 of the prosthesis 20 of FIGURE 7.

**[0047]** As shown in FIGURE 13, the reamer assembly 62 includes a tool driver 64. The tool driver 64 includes a body 66 having a cutting tool adaptor 68 and a drive adapter 70. The reamer assembly 62 also includes a reamer 72. The reamer 72 is connected to the tool driver 64 by the cutting tool adaptor 68. The reamer 72 may be a hemispherical grater type reamer.

**[0048]** FIGURES 14 and 15 show a bone cutting tool guide 74. The tool guide 74 may include a body 76 having a cylindrical bore 78 for receiving a guide pin 80 and a elongated slot 82 for receiving a cutting tool in the form of osteotome 84. The tool guide 74 is used to prepare surface 88 of humerus 3.

**[0049]** FIGURE 16 shows a tool kit 86 for preparing a humerus to receive a prosthesis, for example, prosthesis 20 of FIGURES 7 through 12.

**[0050]** As shown in FIGURES 7 through 12, the prosthesis 20 includes the first body 22 having the first articulating surface 24 and an opposed first surface support surface 28. The prosthesis 20 also includes the second body 30 that has the second articulating surface 32 and an opposed second support surface 38.

**[0051]** Referring again to FIGURE 16, the kit 86 is used for preparing the first support surface 28 and the second support surface 38. The tool kit 86 of FIGURE 16 includes the reamer 72 and may include the tool driver 64 to form the reamer assembly 62. The tool kit 86 further includes a bone cutting tool 84 for preparing a second prepared surface on the humerus 3 for receiving the second support surface 38 of, for example, the prosthesis 20.

[0052] As shown in FIGURE 15, the bone cutting tool 84 is used to prepare second prepared surface 88 on the humerus 3. As shown in FIGURE 15, the second prepared surface 88 represents the inside surface of a cylinder. Such a shape on the humerus is necessary to accommodate the inner edge 90 of the second body 30 of the prosthesis 20. (See FIGURE 11).

[0053] Preferably and as shown in FIGURE 16, the kit 86 further includes the bone cutting tool guide 74 for guiding the osteotome 84 through the elongated slot 82 of the bone cutting tool guide 74. The osteotome 84 may be struck with mallet 96.

[0054] Referring now to FIGURE 10, it should be appreciated that if the angle  $\alpha\alpha$  approaches  $180^\circ$ , it may be possible to provide for the reaming of the humerus with a reamer assembly 62 (see FIGURE 13) and merely pivot the reamer assembly 62 to form a contour for both the second surfaces 28 and 38.

[0055] It should be appreciated, however, as the angle  $\alpha\alpha$  moves from  $180^\circ$  to something less, for example,  $140^\circ$  the inner edge 90 of second body 30 of prosthesis 20 (see FIGURE 11) moves closer to the stem centerline 50 such that a generally hemispherical grater-type reamer such as that of FIGURE 13 may not be appropriate to prepare the hemispherical head of the humerus. Therefore, the guide 74 of the kit 86 provides for a surface 88 that is generally cylindrical to permit the corner 90 of the prosthesis 20 to be fully seated into the humerus.

[0056] It should be appreciated that the bone cutting tool necessary to prepare the humerus may include a drill, a reamer, a broach, a saw or an osteotome.

[0057] Referring now to FIGURES 17 through 20, an alternate tool kit 186 for preparing a humerus is shown. Referring first to FIGURE 17, end mill 192 is shown. End mill 192 may be any commercially available milling cutter capable of end cutting.

[0058] Referring now to FIGURES 18 and 19, a bone cutting tool guide 174 is shown for use with the end mill 192 of FIGURE 17. The guide 174 includes a body 176. The body 176 includes an opening 178 for cooperation with location pin 180. The location pin 180 is used to orient the guide 174 with respect to the humerus 3. The guide 174 further defines a plurality of slots 182 formed in the body 176.

[0059] Referring to FIGURE 19, the slots 182 extend an angle  $\theta\theta$  about the periphery of concave inner surface 194 of the guide 174. The slots 182 are aligned somewhat parallel to each other and slightly spaced apart. The slots 182 are close enough to minimize the amount of material not covered by the slots but far enough apart to provide enough strength to the guide 174, particularly around the slots 182.

[0060] Referring now to FIGURE 20, the kit 186 is shown. The kit 186 includes reamer assembly 162 for preparing the first prepared surface on the humerus. The reamer assembly 162 is similar to reamer assembly 62 of FIGURE 13 and includes a tool driver 164 similar

to the tool driver 64 of FIGURE 13 as well as a grater type hemispherical reamer 172 similar to the reamer 72 of the reamer assembly 62 of FIGURE 13. The kit 20 further includes end mill 192 as well as an osteotome 184 similar to osteotome 84 of the kit 86 of FIGURE 16. The osteotome 184 serves to remove the material remaining after the end mill 192 removes materials in alignment with the slots 182 of the guide 174. Preferably and as shown in FIGURE 20, the kit 186 may further include the guide 174. Further, the kit 20 may include a surgical mallet 196. The surgical mallet 196 is used to strike the osteotome 184.

[0061] Referring now to FIGURES 21, 22 and 23, an alternate embodiment of the present invention is shown as prosthesis 120. Prosthesis 120 is similar to prosthesis 20 of FIGURES 7 through 12 except that prosthesis 120 is designed to take into consideration the limit in installing the prosthesis onto the prepared humeral head. Mainly, the prosthesis 120 takes into consideration the inability to clear the edge 90 of the prosthesis 20 when utilizing a spherically shaped humeral head.

[0062] Referring now to FIGURE 21, the prosthesis 120 includes a first body 122 having a hemispherical articulating surface 124 and an opposed concave arcuate surface 128. The first body 122 also has a planar portion 152 opposing the articulating surface 124. The prosthesis 120 further includes a tapered cylindrical stem 136 extending inwardly from the planar portion 152 of the first body 122. The prosthesis 120 further includes a second body 130 extending from circular outer periphery 126 of the first body 122. A boundary portion 140 is located between the first body 122 and the second body 130 and is preferably smooth and continuous. Unlike the prosthesis 20, the second body 130 of the prosthesis 120 has an opposed surface in the form of a cylindrical inner periphery 138. The cylindrical periphery 138 is designed to matingly fit with the cylindrical surface prepared on the humeral head.

[0063] Referring now to FIGURE 22, the cylindrical periphery 138 is shown in greater detail. The cylindrical periphery 138 is defined by a radius  $R_c$  extending from stem centerline 150.

[0064] Referring now to FIGURE 23, another view of the cylindrical periphery 135 of the prosthesis 120 is shown. The cylindrical periphery 135 is again defined by a radius  $R_c$  from stem centerline 150.

[0065] Referring now to FIGURE 24, an alternate tool kit is shown as tool kit 286. The tool kit 286 is used to prepare a humerus for the prosthesis of the present invention. The tool kit 286 includes a reamer assembly 262 similar to the reamer assembly 162 of the kit 186 of FIGURE 20. The tool kit 286 further includes a cylindrical end cutting reamer 292 having a cylindrical cutting surface 297 and a guiding surface 298. The kit 286 further includes a guide 274 for guiding the cylindrical reamer 292 in a proper path to properly prepare the humerus. The guide 274 includes a body 276 defining an opening 278 for cooperation with location pin 280, which

is utilized to properly position the guide 274 on the humerus. The body 276 of the guide 274 further includes an arcuate elongated slot 282 that cooperates with the guiding surface 298 of the reamer 292 to guide the reamer along a proper path. The arcuate slot 282 is defined by an included angle  $\theta\theta\theta$ .

[0066] Referring now FIGURE 25, an alternate embodiment of the present invention is shown as surgical method 300. The method 300 includes the first step 302 of providing a prosthesis with a first body having a first articulating surface and an opposed first support surface and with a second body having a second articulating surface and an opposed second support surface. The method 300 further includes a second step 304 providing a tool kit for preparing a humerus for receiving the prosthesis. The method 300 further includes a third step 306 of preparing a first prepared surface for cooperation with the first support surface with the tool kit. The method 300 also includes a fourth step 308 of preparing a second prepared surface for cooperation with the second support surface with the tool kit. The method 300 further includes a fifth step 310 of implanting the prosthesis onto the first prepared surface and the second prepared surface.

#### Claims

1. A prosthesis for use in performing joint arthroplasty, said prosthesis to be fitted to a long bone, said prosthesis comprising:
  - a first body having a first body articulating surface defining a generally circular outer periphery thereof and having a support surface opposed to the first body articulating surface adapted to receive the head of the long bone; and
  - a second body operably associated with said first body, said second body having a second body articulating surface extending from a portion of the circular outer periphery of said first body articulating surface.
2. The prosthesis of claim 1, further comprising a stem operably associated with one of said first body and said second body, said stem adapted to assist in securing said prosthesis to the long bone.
3. The prosthesis of claim 2, wherein said stem extends from said first body.
4. The prosthesis of claim 2, wherein at least two of said first body, said second body and said stem are integral with each other.
5. The prosthesis of claim 1, wherein said first body is generally hemispherical.
6. The prosthesis of claim 1, wherein said second body is a generally a sector of a hollow sphere.
7. The prosthesis of claim 1, wherein said first body and said second body are generally in the shape of a sector of a hollow sphere.
8. The prosthesis of claim 1, wherein said second articulating surface and said first articulating surface define a boundary portion there between; and wherein the boundary portion is generally smooth and continuous.
9. The prosthesis of claim 2, wherein said first body defines a first body longitudinal centerline; wherein said stem defines a stem longitudinal centerline; and
  - wherein said first body longitudinal centerline and said stem longitudinal centerline are coincident.
10. The prosthesis of claim 1, wherein the second body articulating surface defines a second surface periphery opposed to said first body; wherein the generally circular outer periphery defines a first plane; and wherein the second surface periphery defines a second plane, the first plane and the second plane being non-coincident.
11. A tool kit for preparing a humerus to receive a prosthesis with a first body having a first articulating surface and an opposed first support surface and with a second body having a second articulating surface and an opposed second support surface, said kit for preparing the humerus for receiving the prosthesis, said tool kit comprising:
  - a reamer for preparing a first prepared surface on the humerus for receiving the first support surface; and
  - a bone cutting tool for preparing a second prepared surface on the humerus for receiving the second support surface.



**FIG. 1**

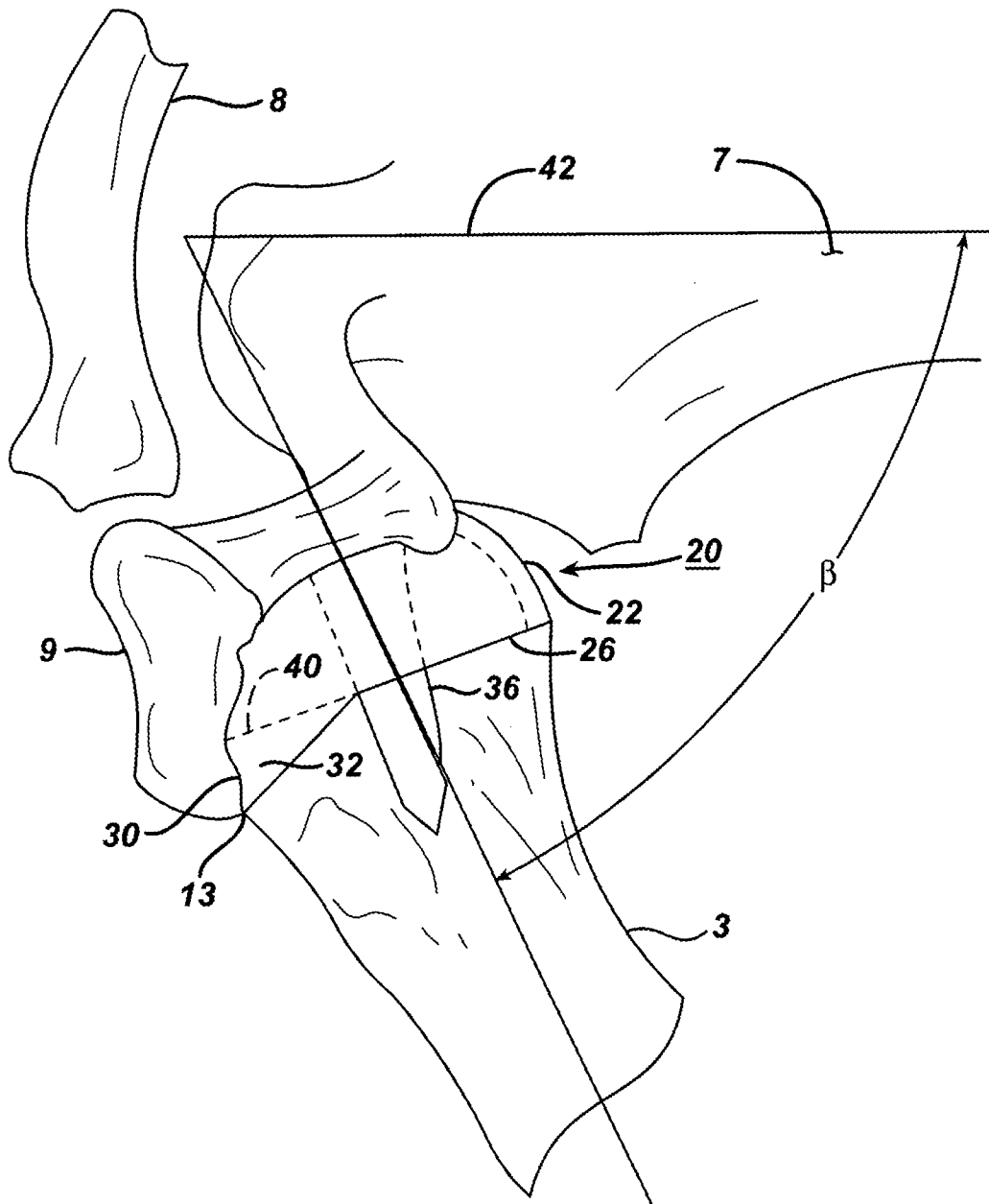


**FIG. 2** PRIOR ART

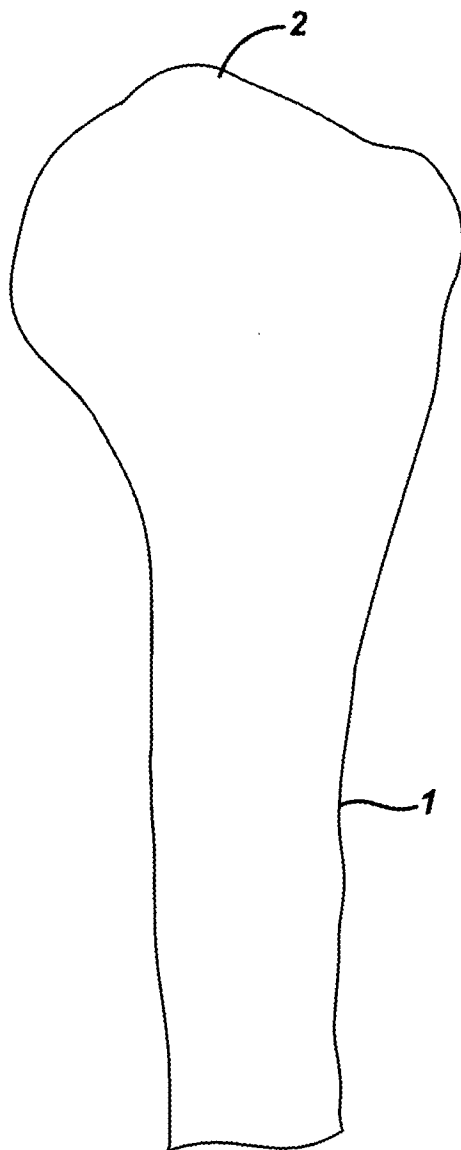


**FIG. 3** PRIOR ART

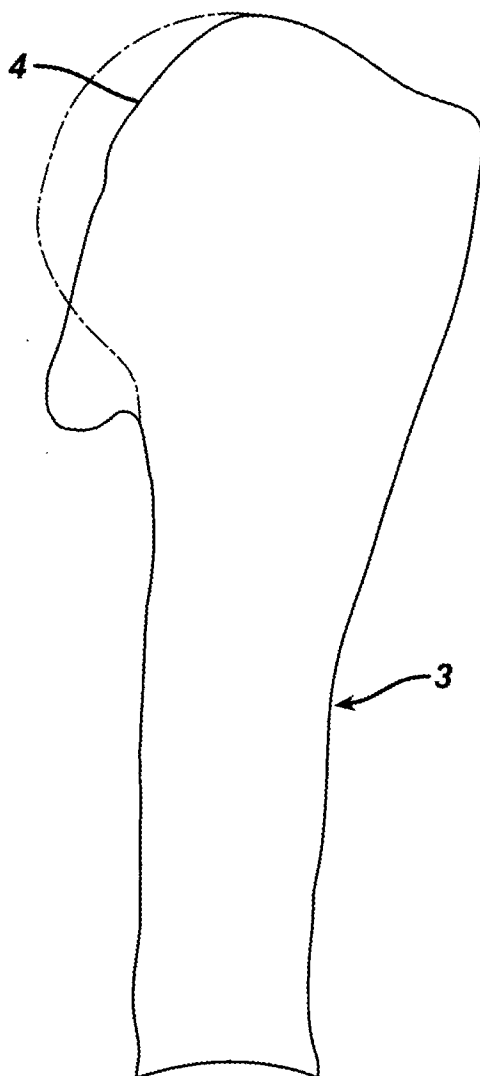


**FIG. 4** PRIOR ART

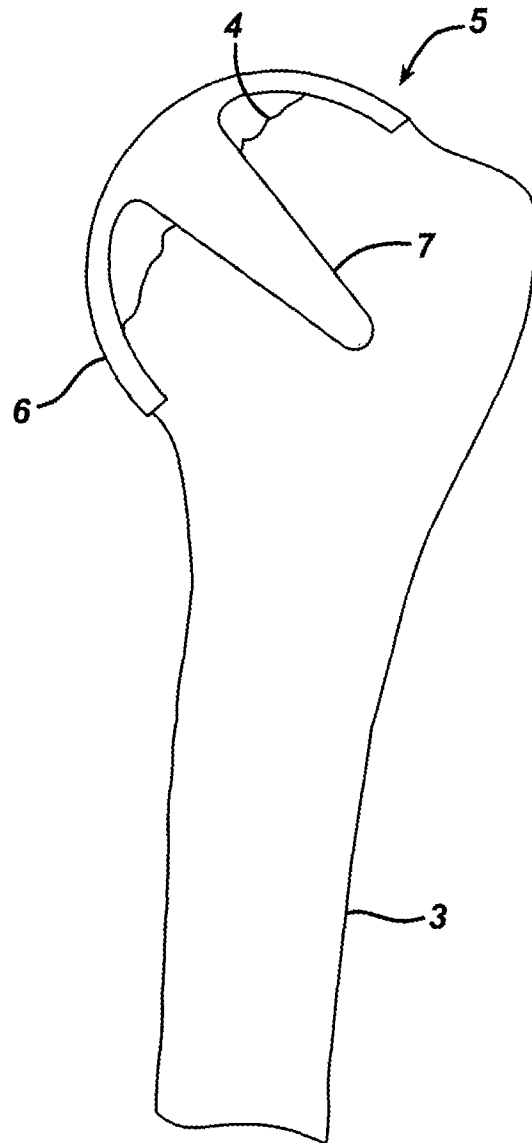


**FIG. 5** PRIOR ART

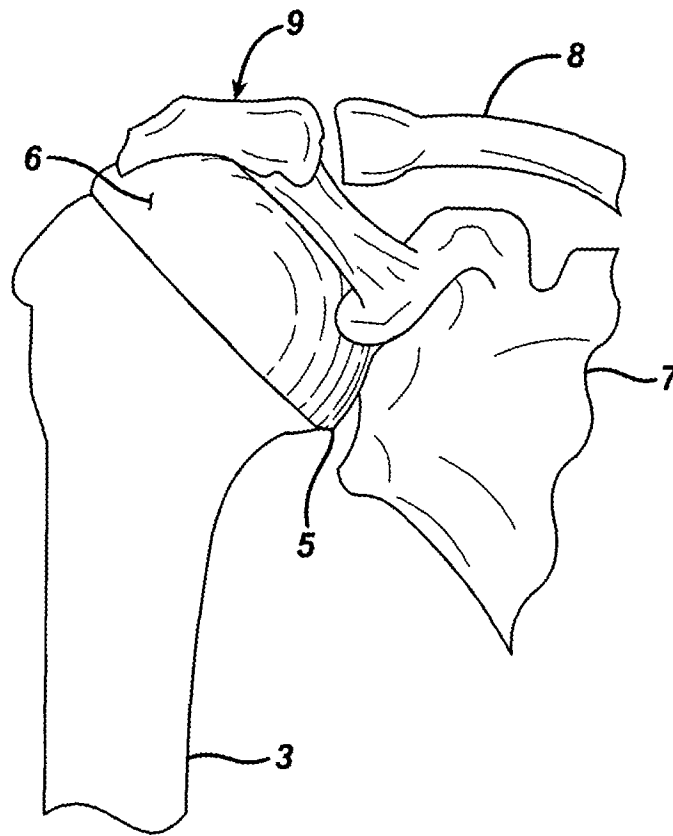


**FIG. 6** PRIOR ART

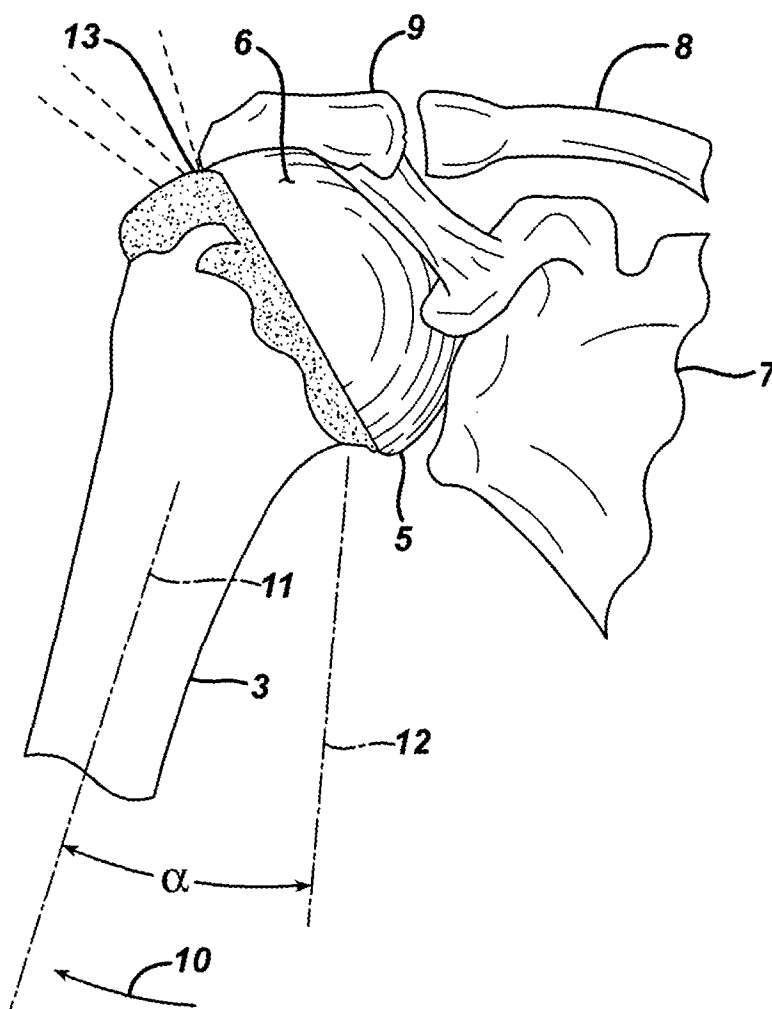


**FIG. 7**

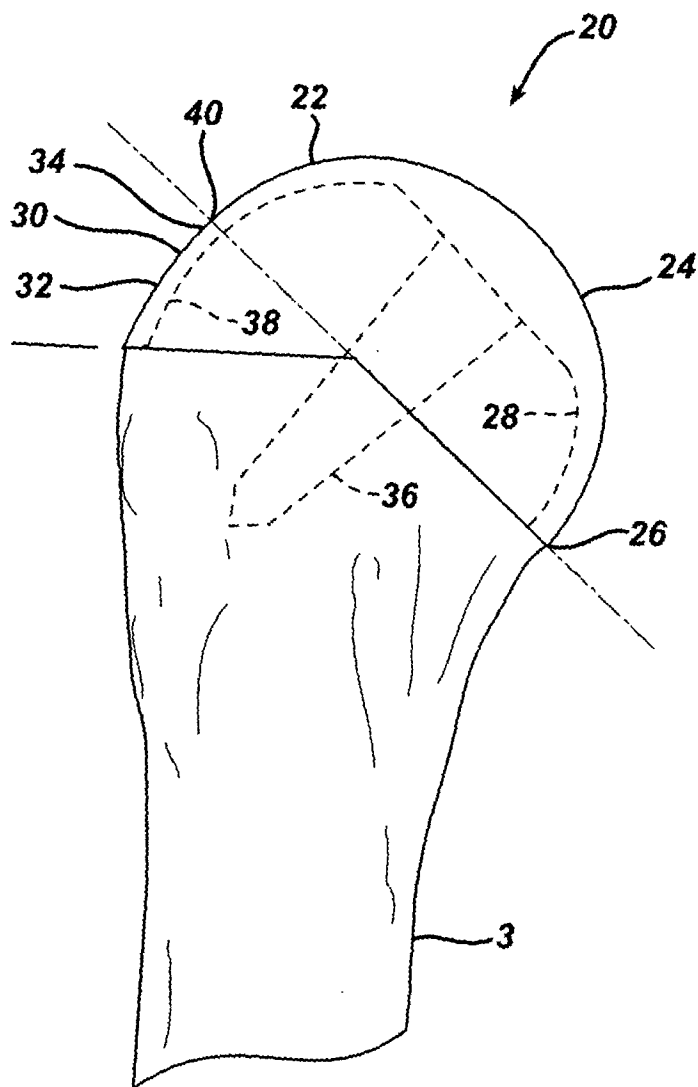


**FIG. 8**

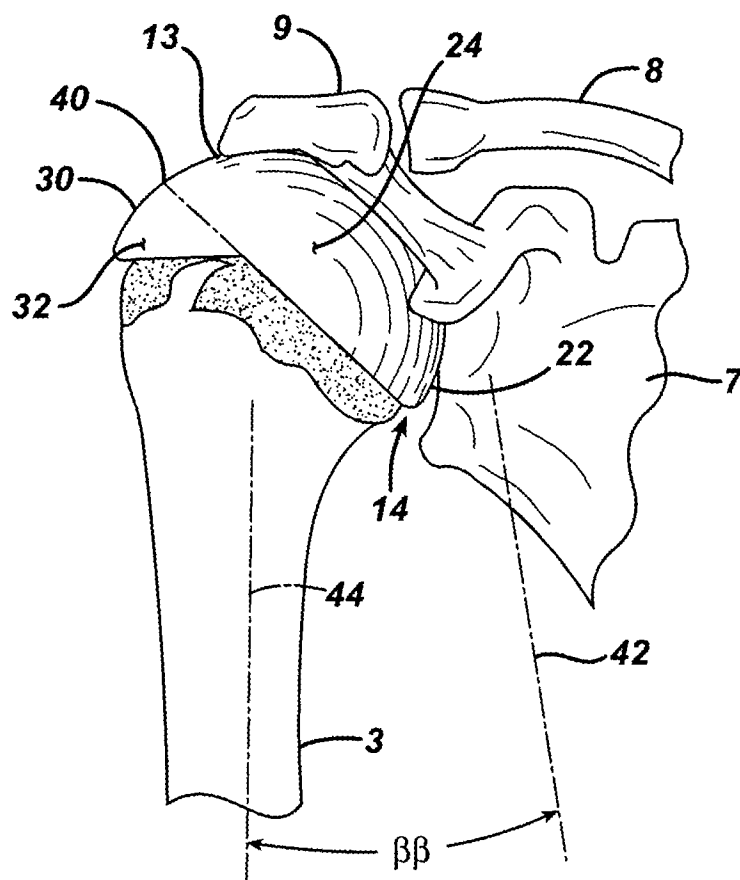




**FIG. 9**

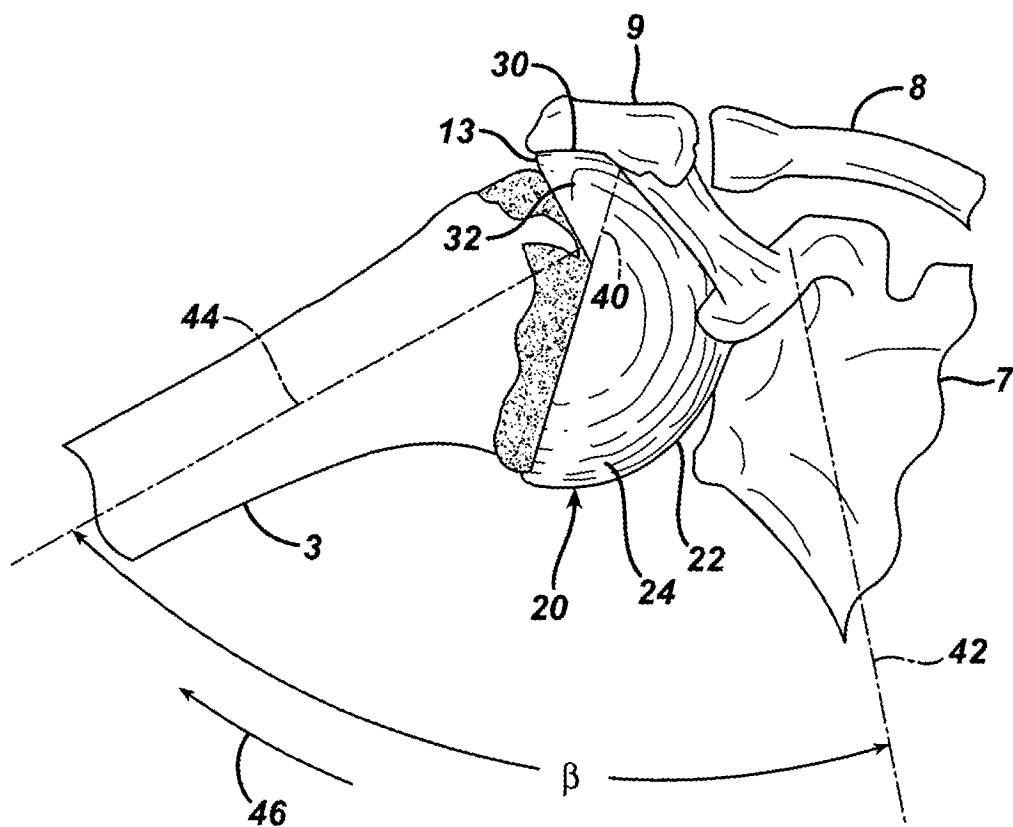
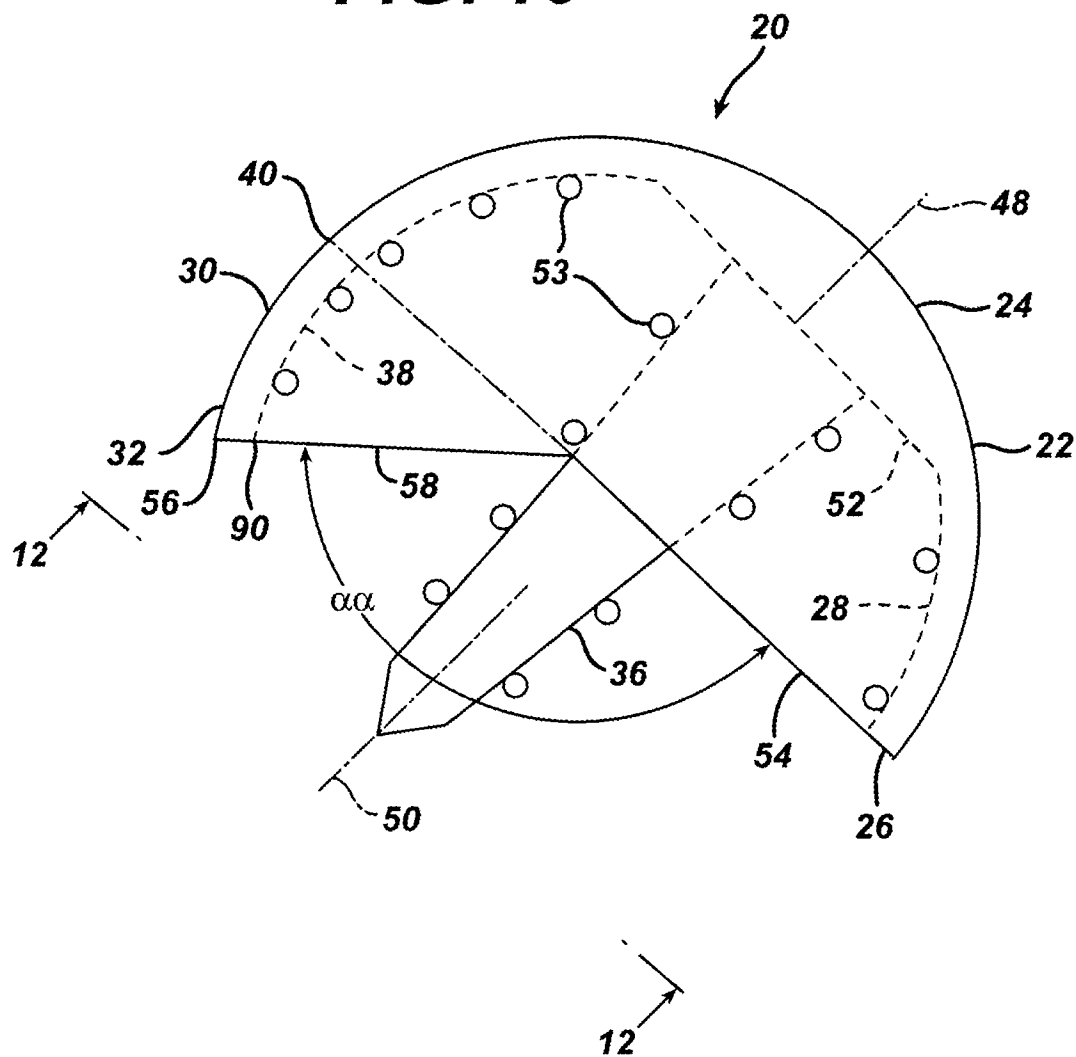


**FIG. 10**



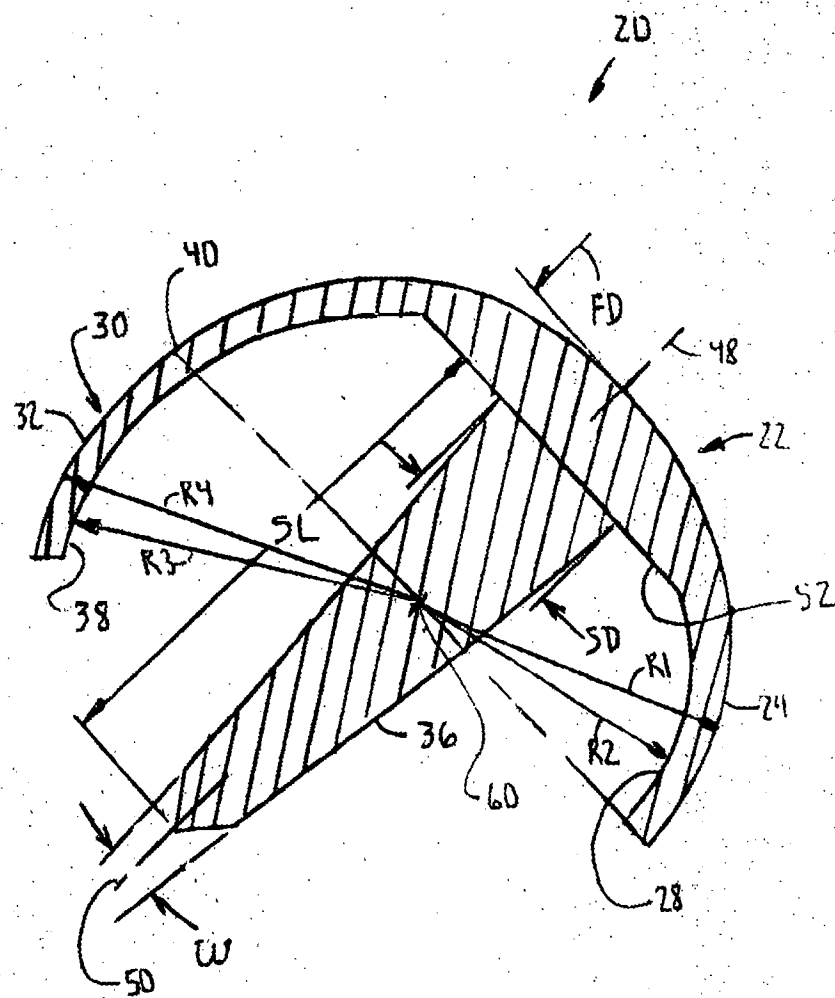


FIGURE 11

**FIG. 12**

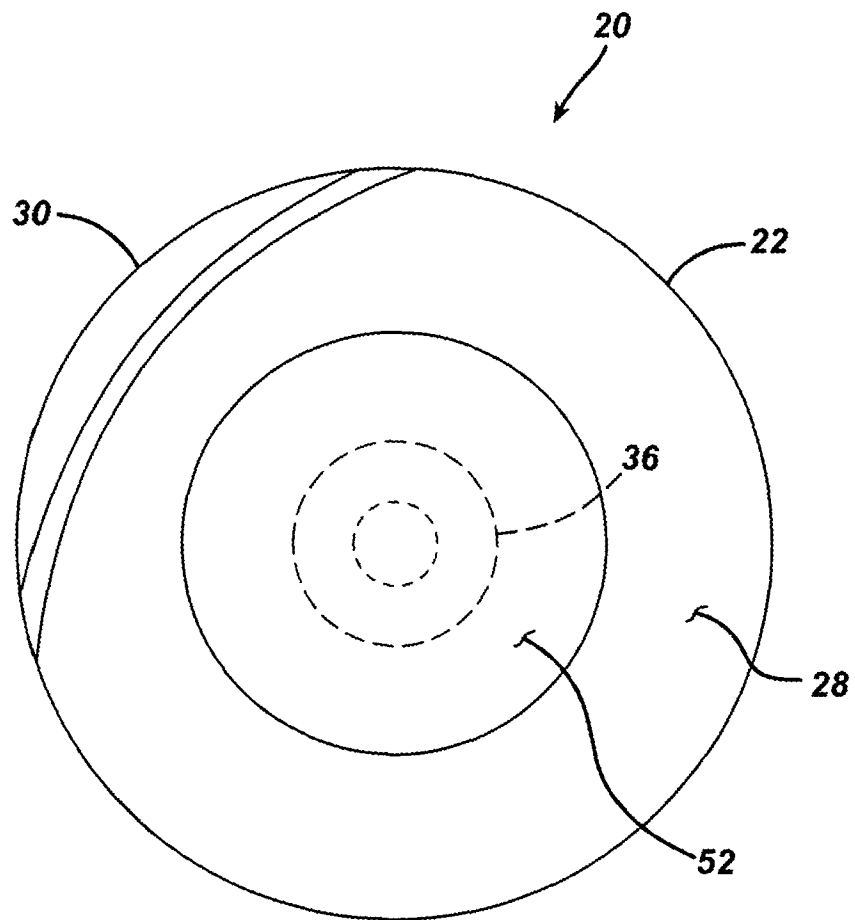


**FIG. 13**

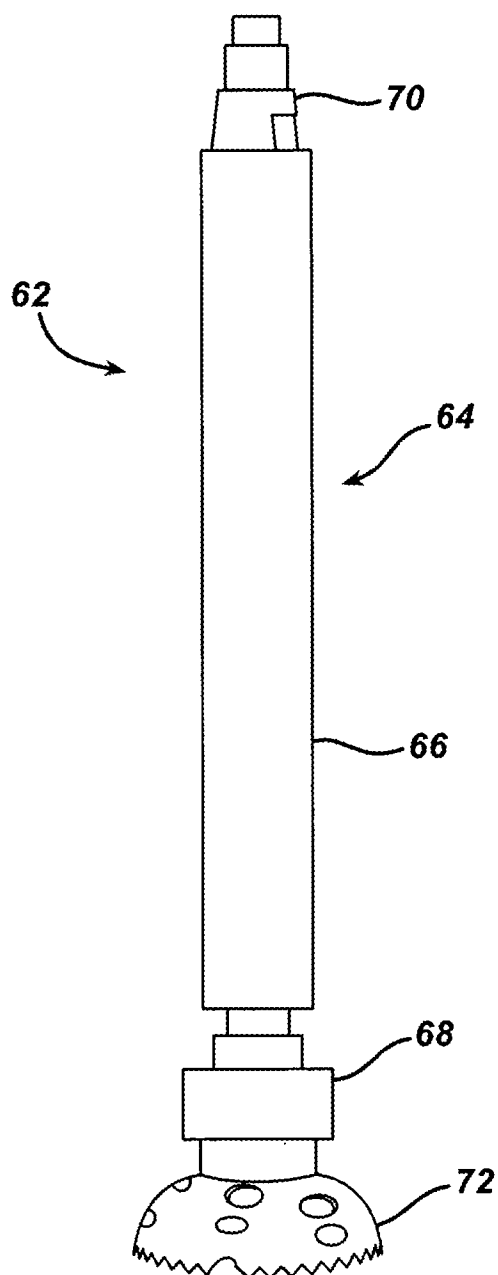


**FIG. 14**

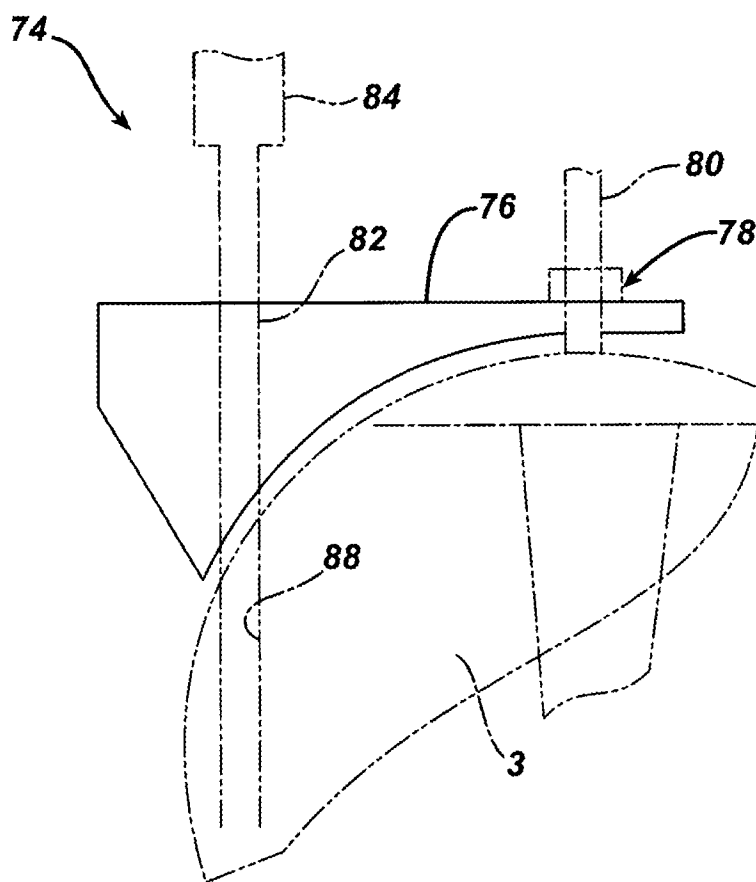


**FIG. 15**

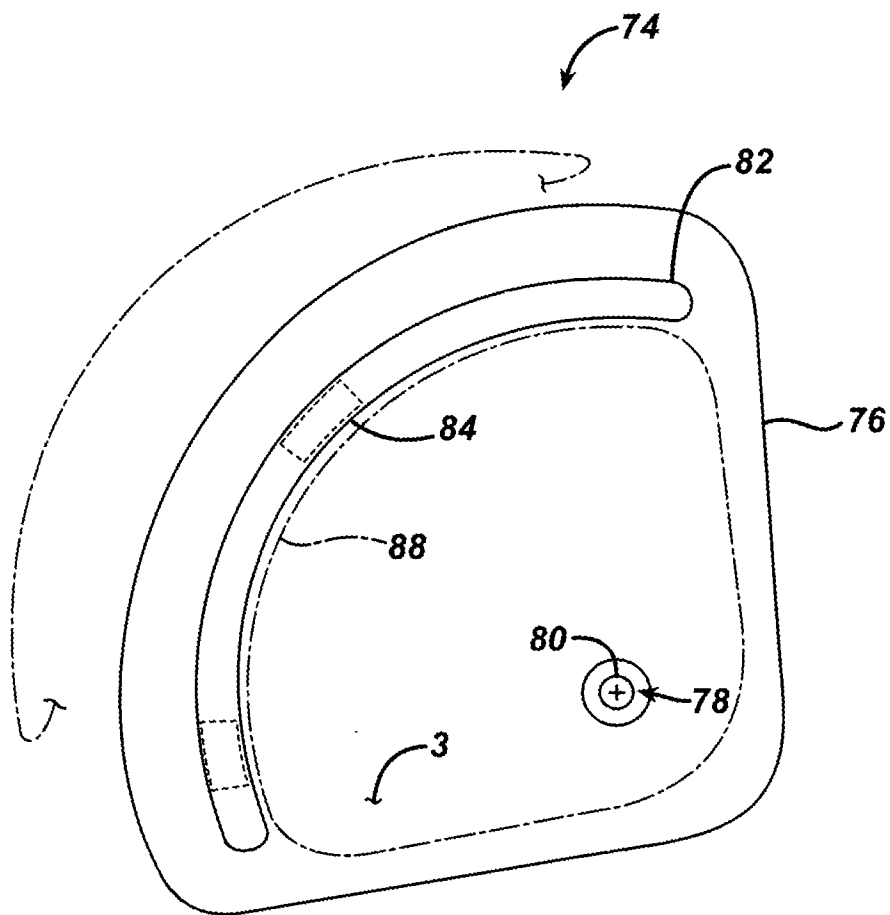


**FIG. 16**

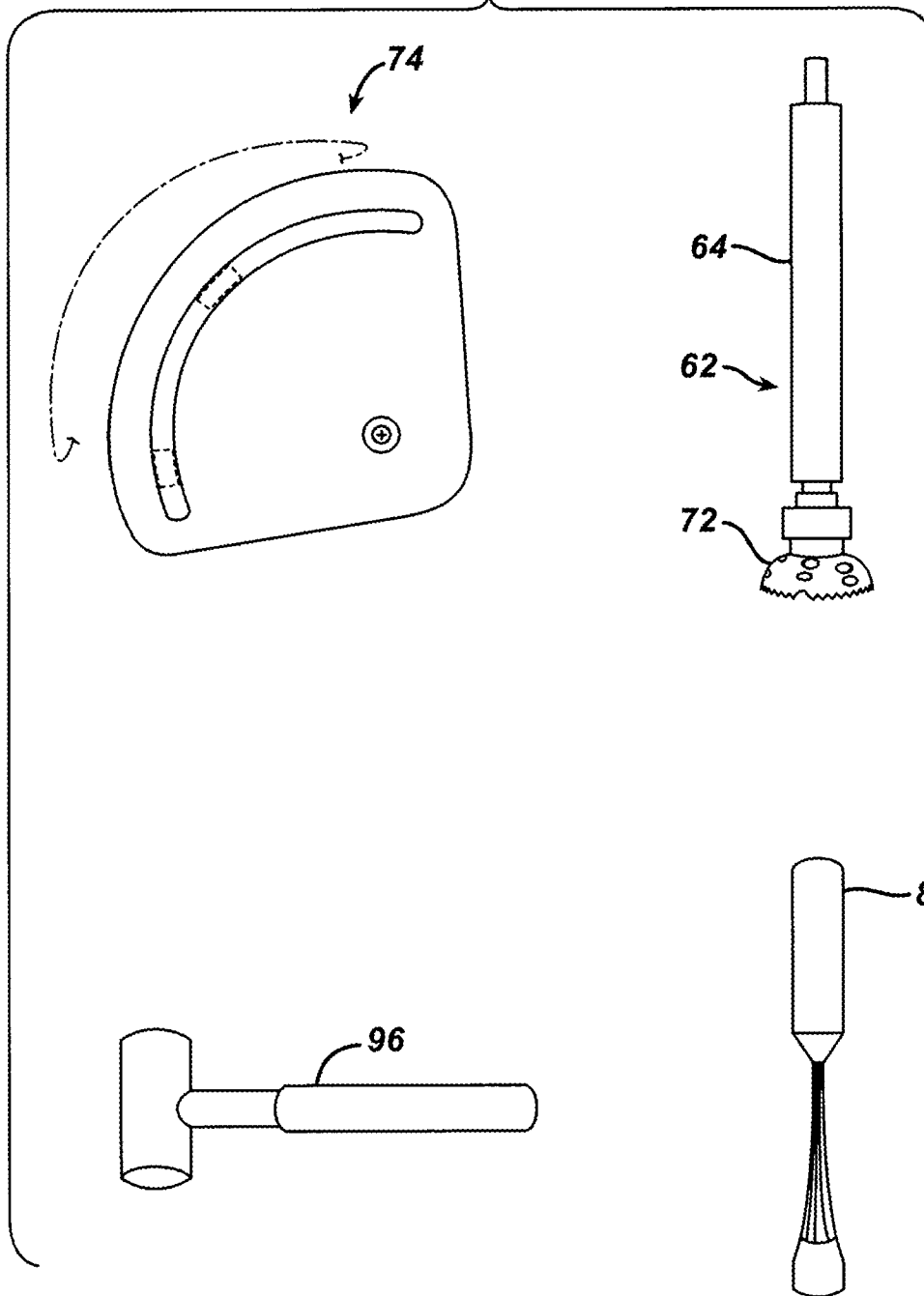




**FIG. 17**

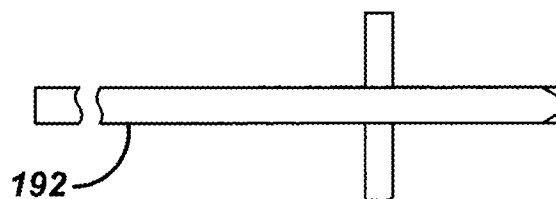


**FIG. 18**

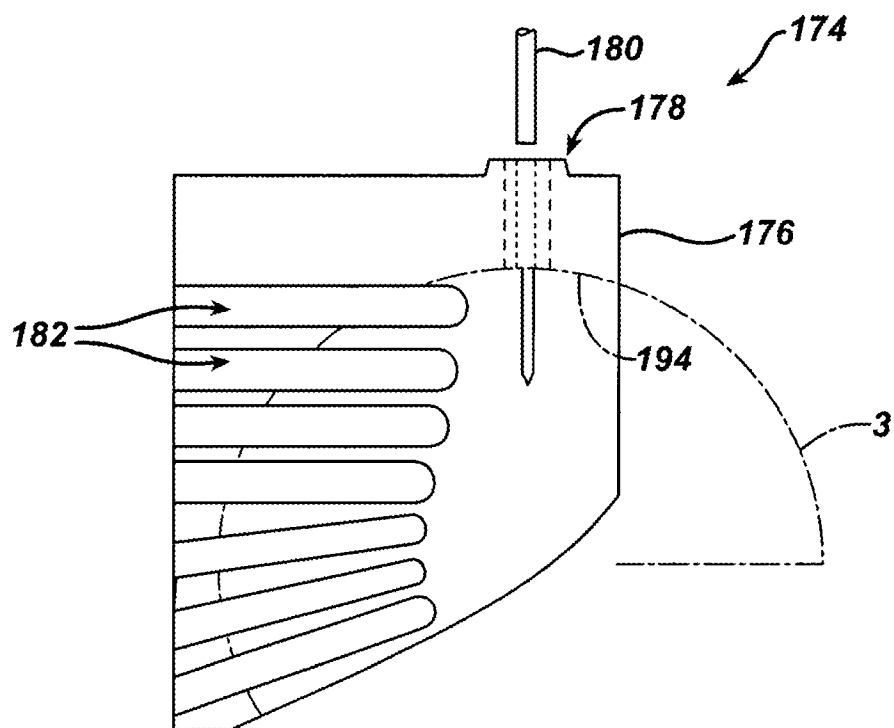


**FIG. 19**

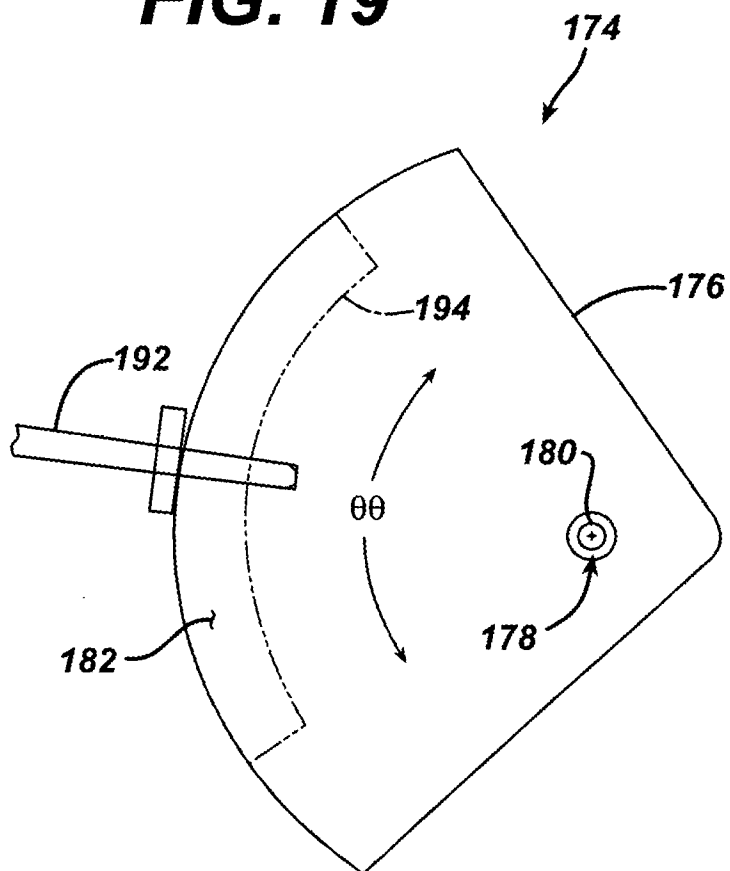


**FIG. 20**

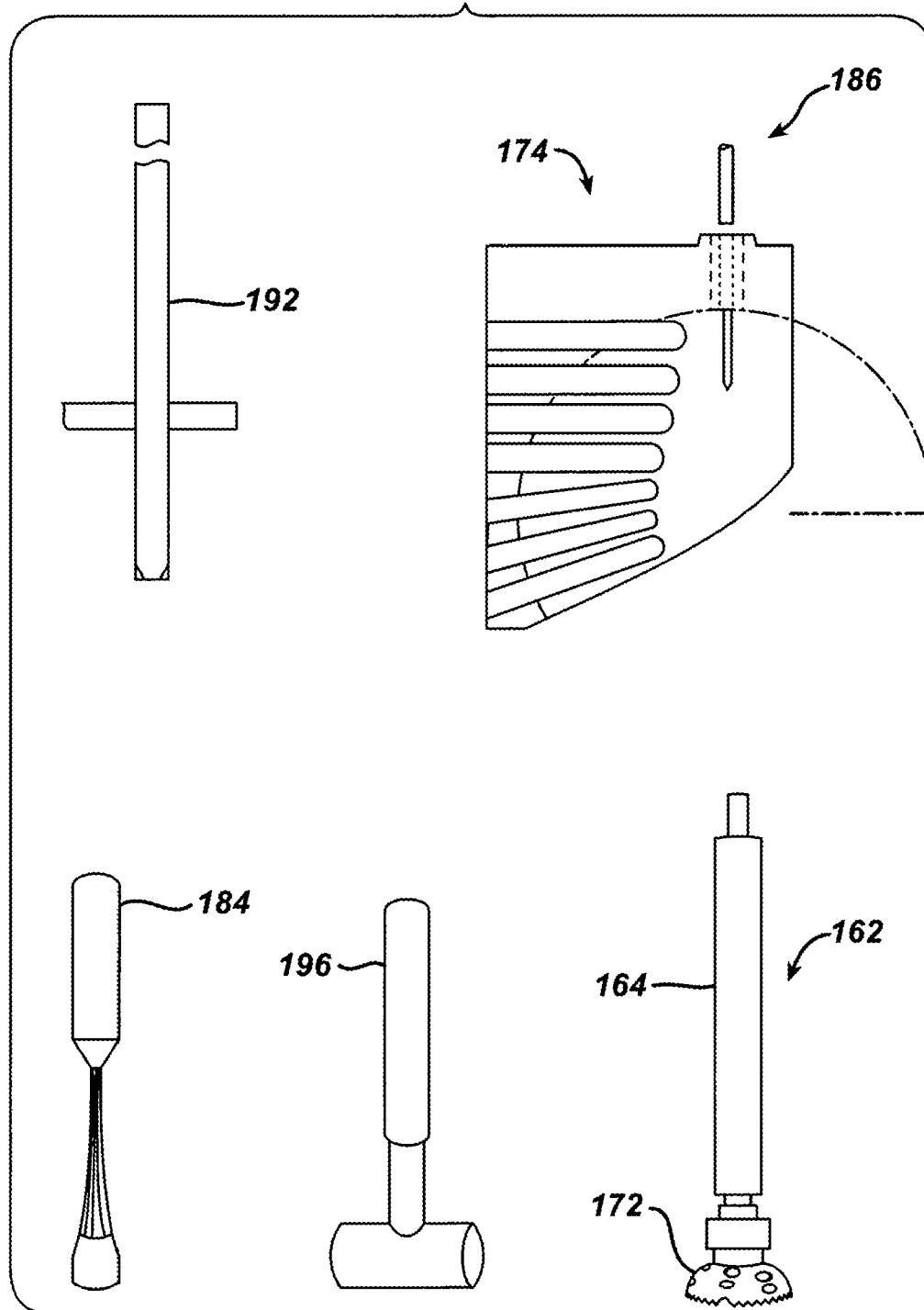


**FIG. 21**

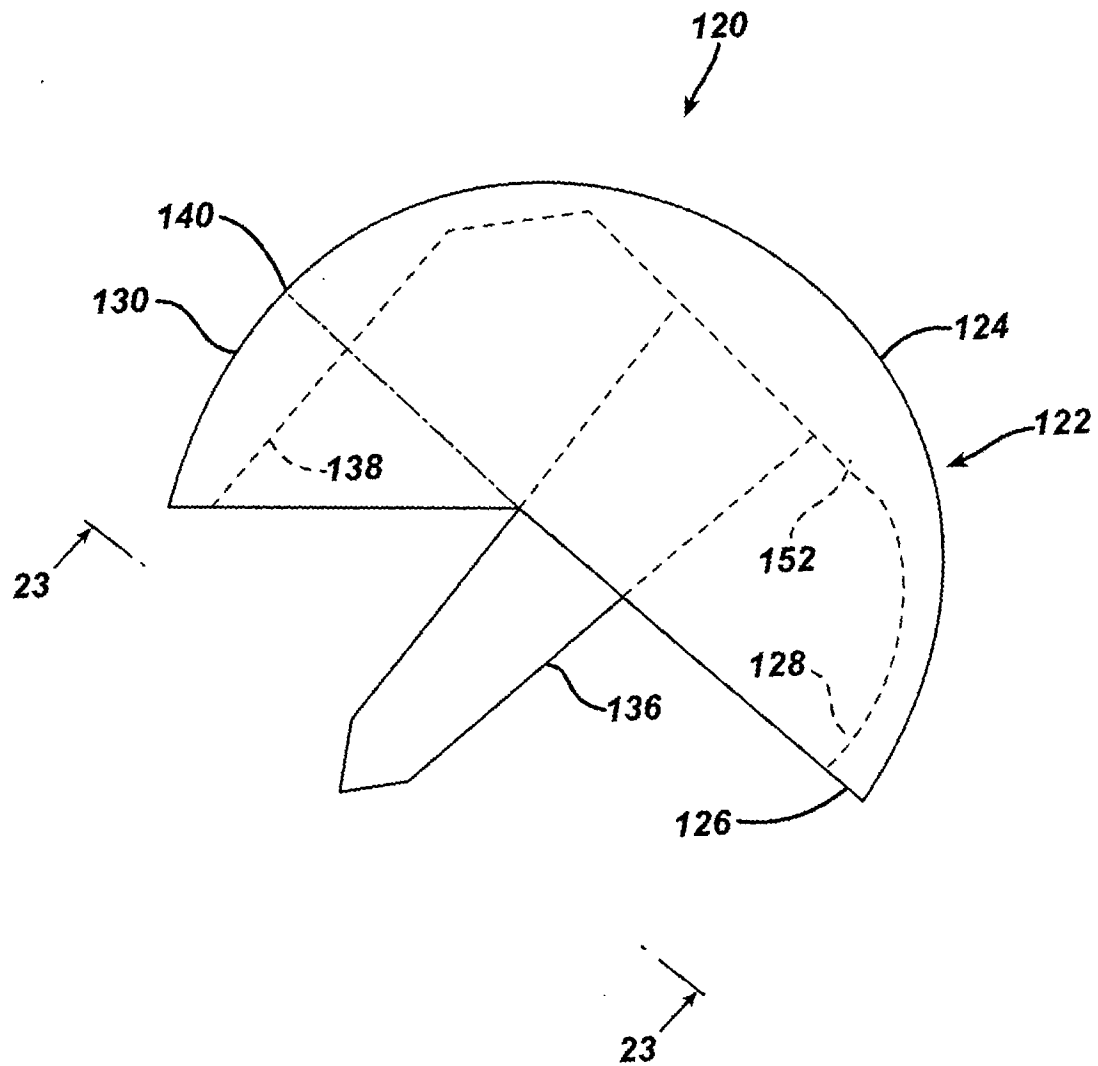


**FIG. 22**

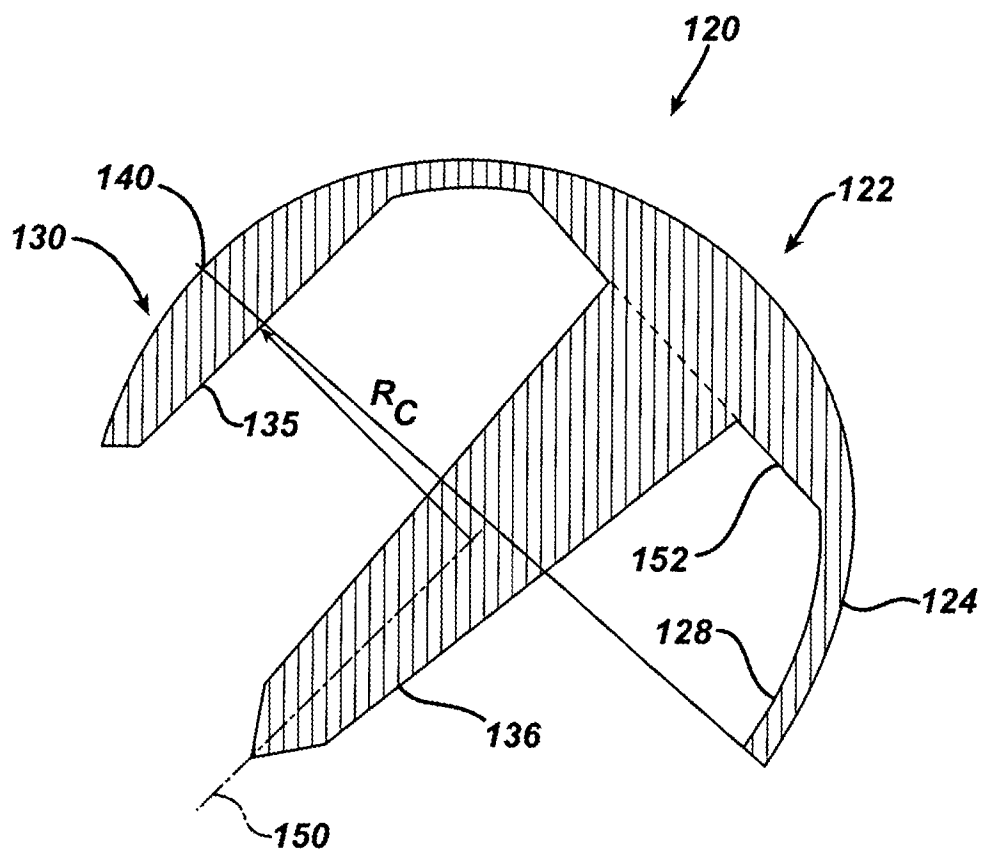


**FIG. 23**

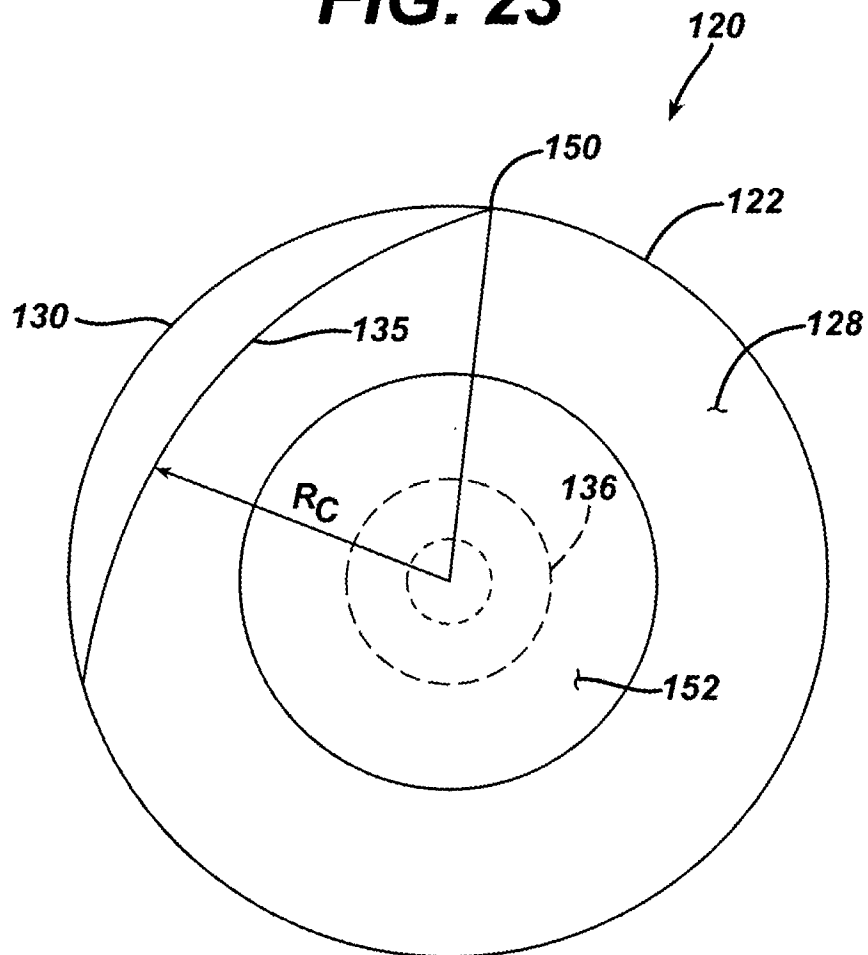


**FIG. 24**

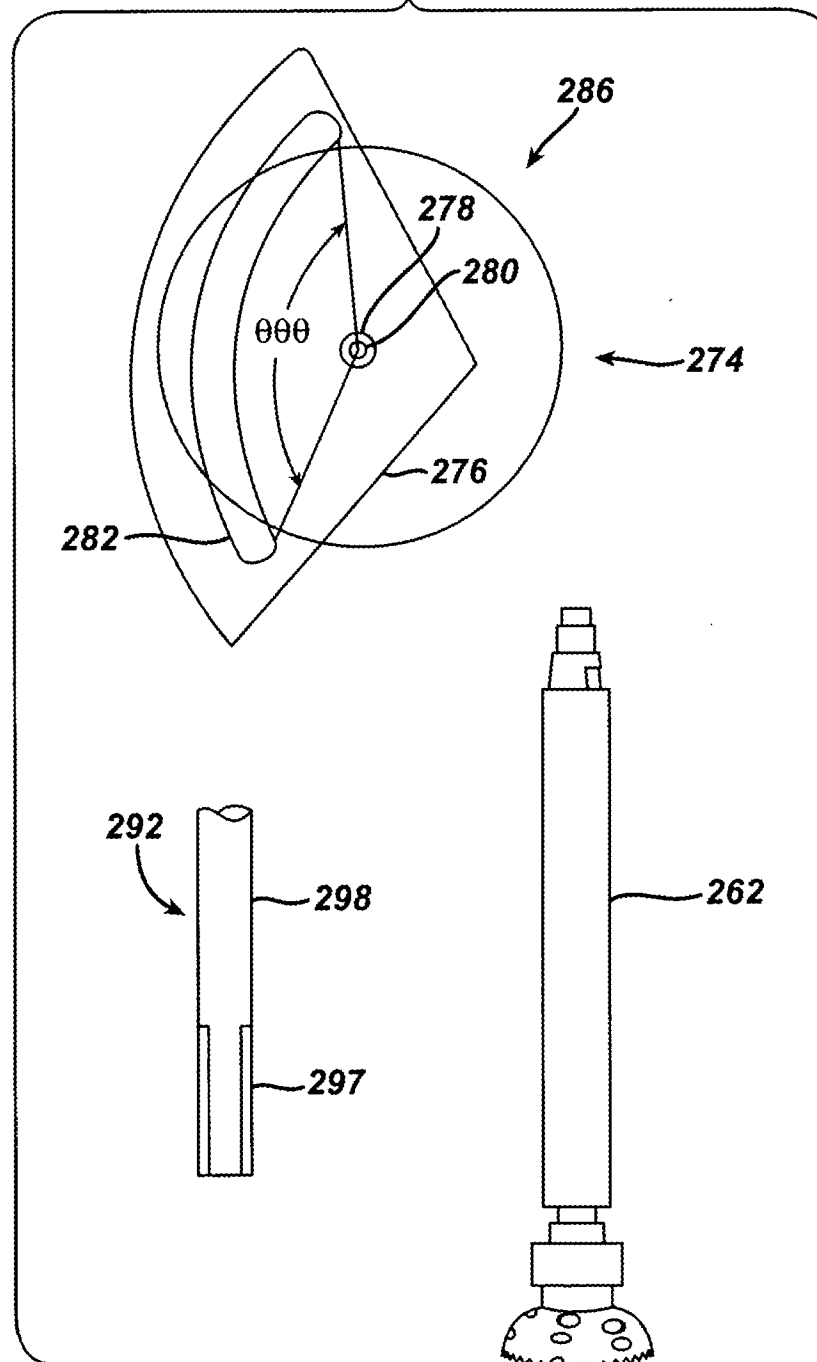
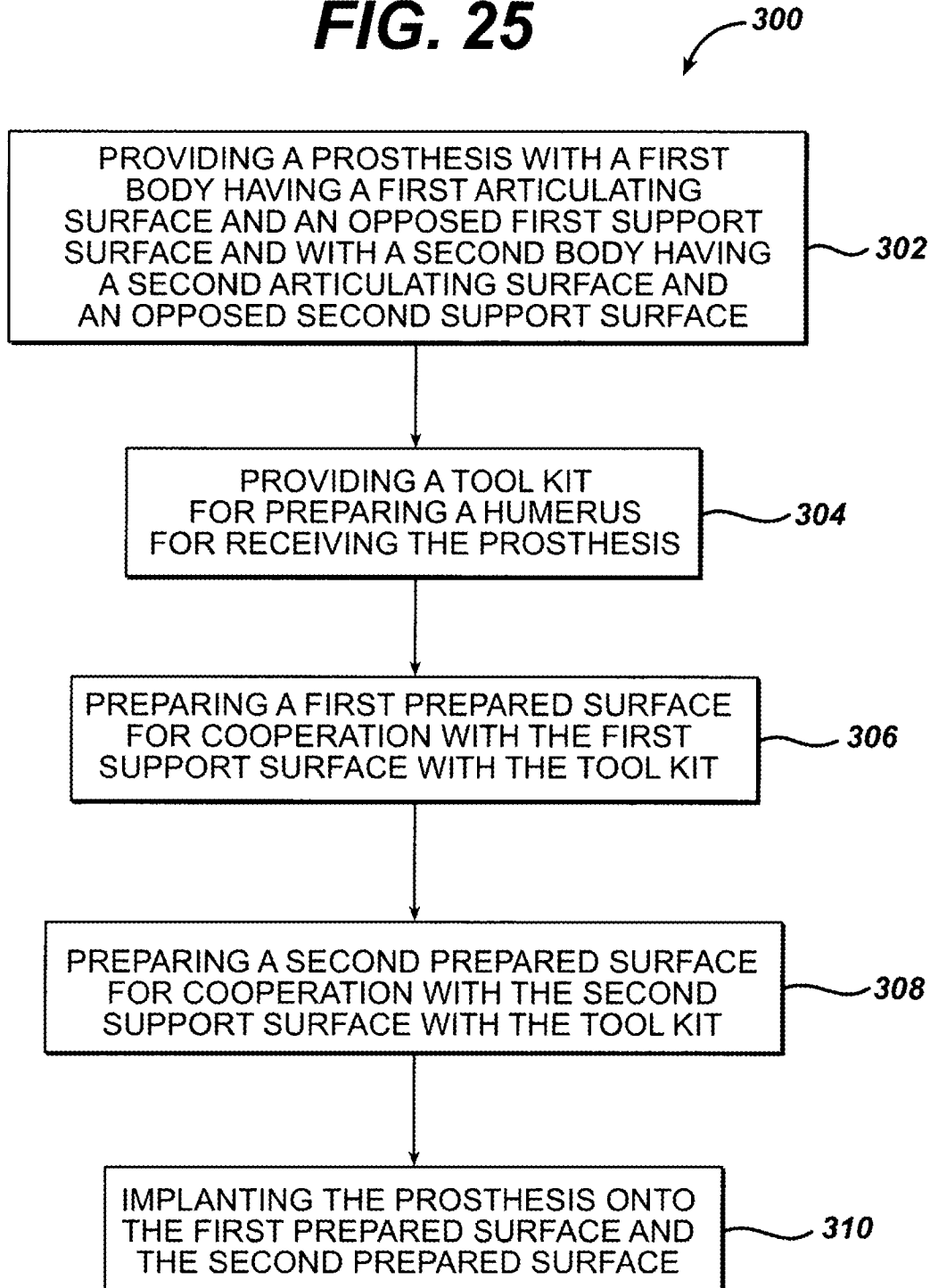


**FIG. 25**



# Copeland<sup>TM</sup>

Humeral Resurfacing Head



**BIOMET**

CATALYST, EX-1005, INC.

PAGE 228

# Copeland<sup>TM</sup>

## Humeral Resurfacing Head

### Anatomical Alignment<sup>1,2</sup>

- Exact retroversion
- Exact angle of inclination
- Exact posterior offset

### Minimal Bone Removal

- Surface-only replacement
- No penetration of intramedullary canal

### Proven Clinical Results<sup>3,4</sup>

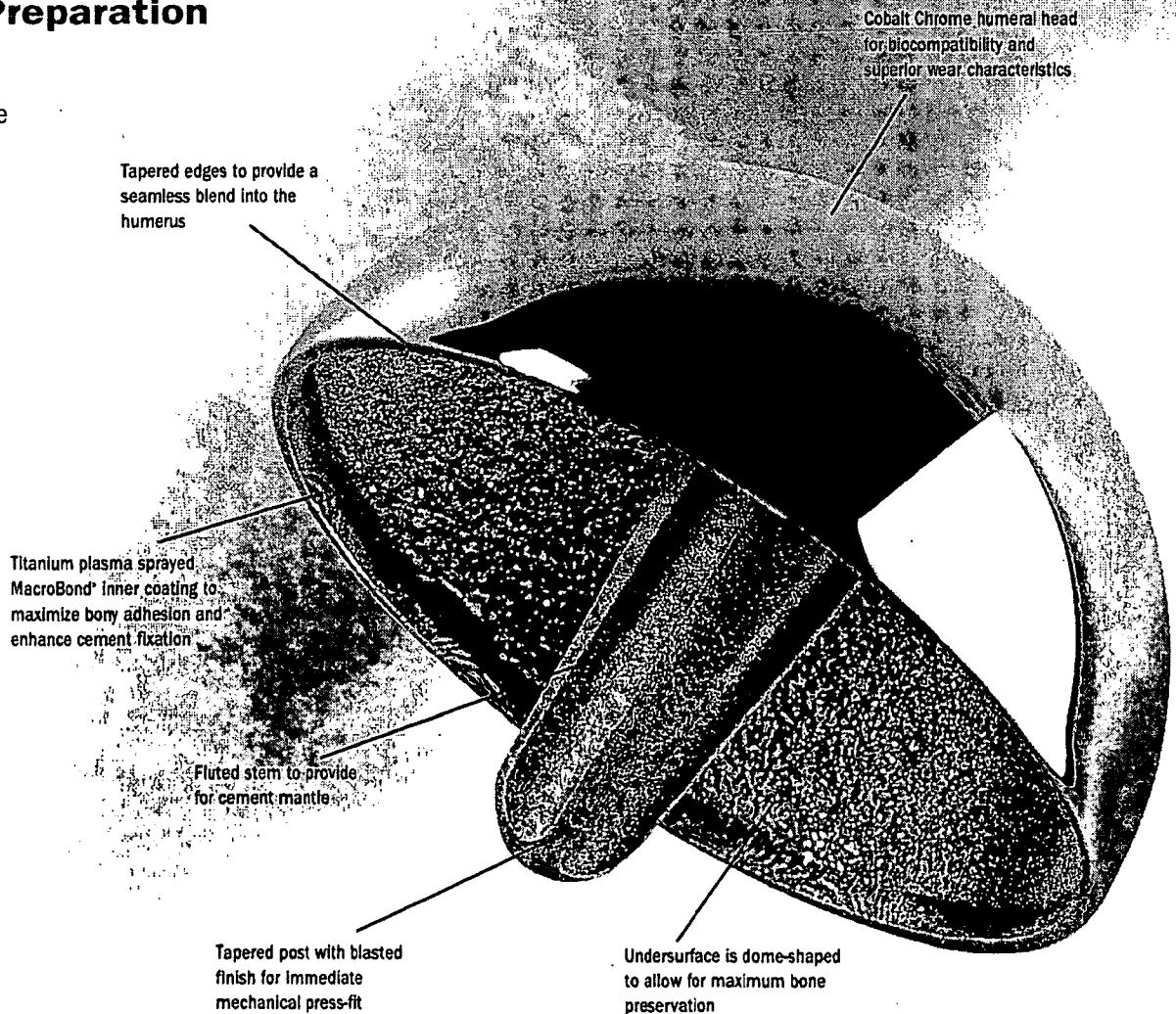
- Cementless Surface Replacement Arthroplasty of the Shoulder: 11 Years Experience
- Cementless Surface Replacement Arthroplasty of the Shoulder: 5-10 Year Results with the Copeland, Mark-2 Prostheses

### Uncomplicated Revisions

- Removal of resurfacing component only and replace; or
- Resect the humeral head and component together and continue with a stemmed component

### 3-Step Bone Preparation

1. Find head center
2. Drill for central peg
3. Ream to define head shape



## Surgical Technique

### General Considerations

The prosthesis is suitable for insertion via either technique:

- A. The standard anterior deltopectoral approach
- B. The antero-superior "Mackenzie"<sup>15</sup> approach

The advantages of the antero-superior technique are:

- Smaller and more cosmetic scar
- Quicker post-operative recovery
- Easier access via rotator interval
- Easier access for glenoid resurfacing
- Better access to reconstruct the posterior and superior rotator cuff
- Easy access for acromioplasty and excision arthroplasty of the acromioclavicular (AC) joint, if indicated

If the rotator cuff is intact or a repairable rotator cuff defect is seen, then an anterior acromioplasty can be made with partial resection of the coracoacromial ligament. (The coracoacromial arch is left undisturbed if there is complete loss of rotator cuff.) If preoperative X-rays have indicated an arthritic change at the acromioclavicular joint and symptoms suggest this is a site of pain, then an excision arthroplasty can be done at this stage. (Excision of the AC joint improves exposure.)

## Patient Positioning

### Preoperative Preparation and Patient Position

Preoperative prophylactic antibiotics should be given intravenously either one hour prior to surgery or at the time of anaesthetic induction. In patients who are not sensitive to iodine, a skin pre-preparation using povidone iodine is performed in the ward prior to surgery.

A soaked surgical dressing is placed into the axilla, which may be clipped no more than 6 hours before the operation.

The patient should be placed in a semi-sitting or beach chair position at about 45° of head-up tilt with the head on a neurosurgical headpiece and the arm on a short arm board attached to the side of the operating table [Fig. 1]. It is important to have the patient close to the edge of the table and the short arm board to permit hyperextension of the arm during surgery to allow delivery of the humeral head into the anterior wound and to facilitate insertion of the humeral component [Fig. 2]. The shoulder blade is best stabilized by placing a small (500ml) plastic infusion bag or a sandbag under the medial border of the scapula.

Routine antiseptic preparation of the skin of the whole of the arm is carried out. The preparation is continued as far proximally as the ear and as far distally as the breast, as far medially as the midline anteriorly and as far as the infusion bag or sandbag posteriorly. The forearm and arm should be covered with a sterile stockinette and either an upper limb isolation drape or a "U" drape should be used to provide a safe sterile field. An adhesive plastic sterile drape is then applied to ensure the drapes do not "migrate" during the operation.

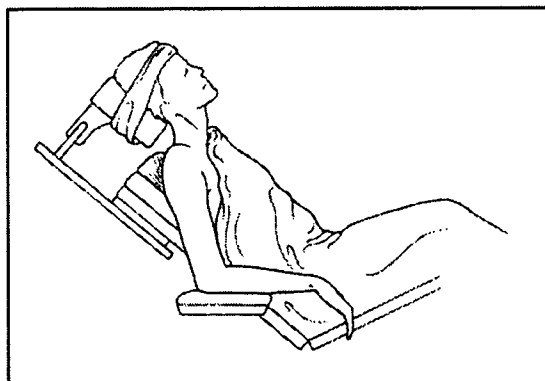


Fig. 1

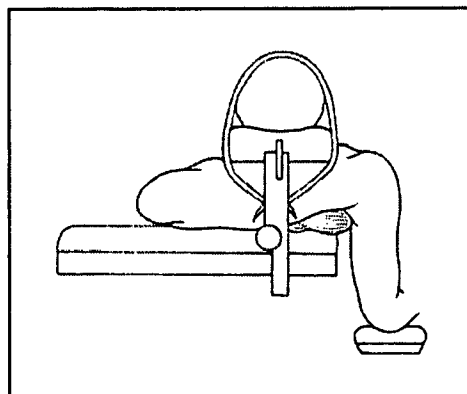


Fig. 2

# Surgical Incision

## Option A

### Deltopectoral Approach

#### Access

This approach provides an exposure of the front of the gleno-humeral joint, the upper humeral shaft and the humeral head.

#### Incision

A 15cm incision is made from the clavicle down across the tip of the coracoid and continued in a straight line to the anterior border of the insertion of the deltoid [ Fig. 3 ].

#### Approach

The cephalic vein is mobilized lateral in the deltopectoral groove. The vein is retracted laterally with the deltoid. The arm is abducted 40° to 60°. The clavipectoral fascia is incised. The subacromial space is cleared and a broad elevator is placed beneath the acromion as a retractor. At this stage improved exposure will be obtained by dividing the proximal 2cm of the insertion of pectoralis major [ Fig. 4 ].

The shoulder is flexed and externally rotated to facilitate coagulation of the anterior circumflex humeral vessels. It is very important at this stage to insert stay sutures into the subscapularis muscle to control retraction [ Fig. 5 ]. The tendon is divided 2cm medial to the bicipital groove. If the subscapularis appears tight it should be divided in an oblique or "Z" manner to allow repair with lengthening of the tendon.

The joint capsule is then released anteriorly and inferiorly while taking care to protect the axillary nerve with a blunt elevator where it passes through the quadrilateral space. The glenohumeral joint may now be dislocated anteriorly by external rotation and extension, allowing a full exposure of the humeral head and neck.

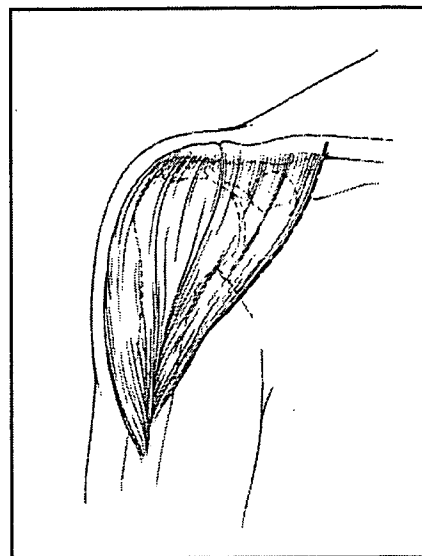


Fig. 3

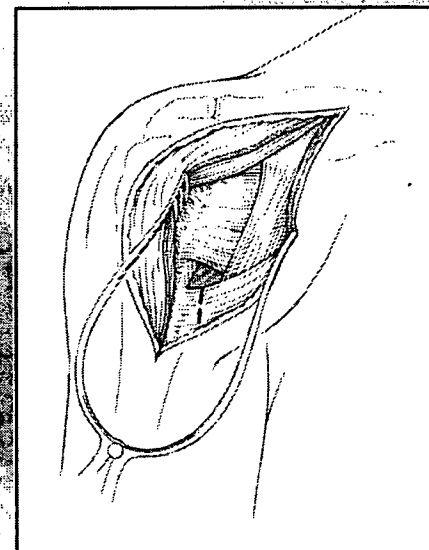
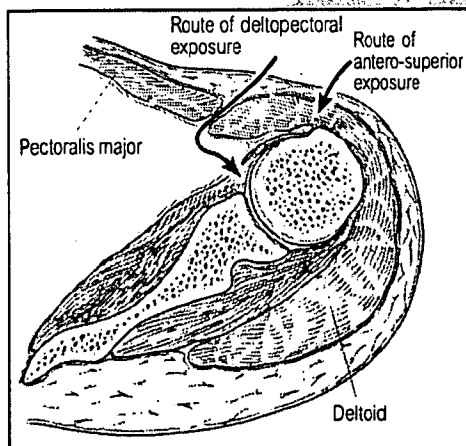


Fig. 4



Approach Comparisons

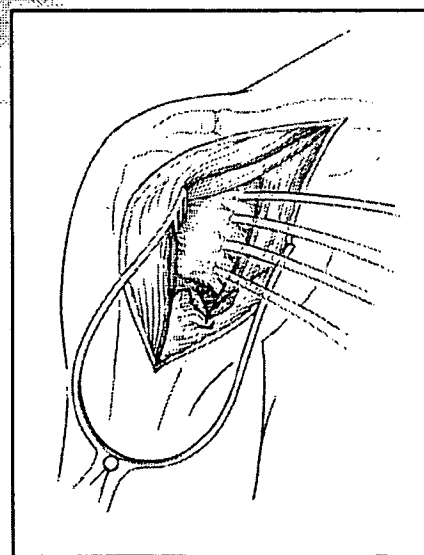


Fig. 5

## Surgical Incision

### Option B Antero-superior “Mackenzie” Approach

#### Access

This approach provides an exposure of the glenohumeral joint, the humeral head, and the tuberosities, as well as exposure of the acromion and AC joint.

#### Incision

The skin incision extends distally in a straight line from just posterior to the acromioclavicular joint for a distance of 9cm [ Fig. 6 ].

#### Approach

The anterior deltoid fibers are split for a distance of not more than 6cm, and a loose No. 1 stay suture is placed in the distal end of the split to prevent further extension and possible injury to the axillary nerve. The acromial attachment of the deltoid is lifted with an osteo-periosteal flap to expose the anterior acromion and preservation of the superior acromioclavicular ligament [ Fig. 7 ].

An anterior acromioplasty according to the technique of Neer is performed.

If further exposure is needed, then excision of the lateral end of 1cm of clavicle considerably enhances this.

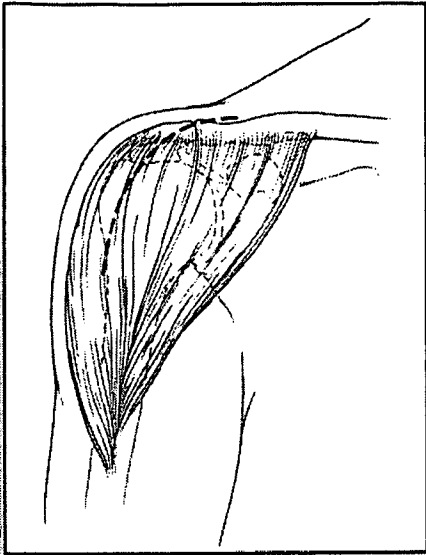


Fig. 6

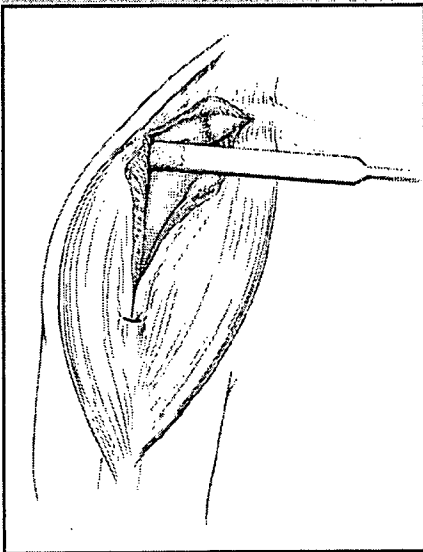


Fig. 7

### Both Approaches:

The rotator interval is identified and longitudinally incised along the line of the long head of the biceps to identify the exact insertion of the subscapularis. The subscapularis is held by stay sutures and disinserted [ Fig. 8 ]. The shoulder is dislocated anteriorly and the long head of biceps, if intact, is dislocated posteriorly over the humeral head [ Fig. 9 ].

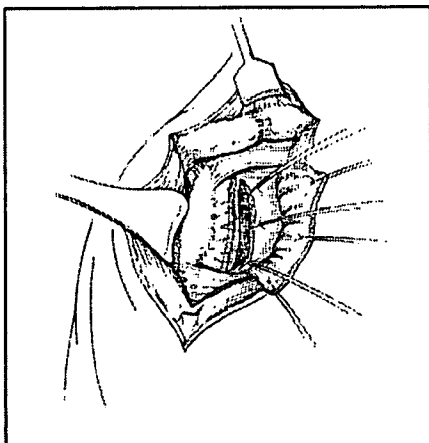


Fig. 8

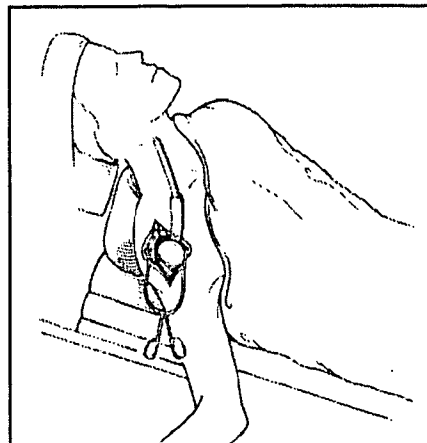


Fig. 9

## Preparation of Humeral Head

The anatomical neck of the humerus is defined (the line of insertion of the cuff and capsule) to determine the exact neck shaft angle. Osteophytes are nibbled away from the superior and the anterior aspect of the humeral neck while further external rotation and positioning of the arm allows removal of inferior osteophytes [ Fig. 10 ]. The preoperative radiographs are helpful to assess the extent of these osteophytes. Anterior osteophytes can contribute to loss of external rotation by relatively shortening the subscapularis. Removal of these osteophytes also allows better positioning and rotation of the head to gain access to the posterior and superior osteophytes that also need removal. (Removal of these osteophytes is essential to determine the anatomical neck, not to shape the humeral head. Shaping is done utilizing the humeral surface cutter.)

The humeral drill guide is then placed on top of the humeral head. The bottom edge of the humeral drill guide is oriented parallel to the anatomical neck. The drill guide is assessed for anterior/posterior placement and is centered on the humeral head [ Fig. 11 ]. This position automatically builds in the anatomical degrees of retroversion and inclination. A K-wire or Steinman pin guide wire is then passed down the humeral drill guide into the humeral head [ Fig. 12 ] and through to the lateral cortex to provide stability.

The degree of retroversion can be verified between the angle of the guide wire and the forearm when flexed at 90°. There is no fixed degree of version attempted because our goal is a reproduction of the anatomical version (ranging from 5 to 55° of retroversion). The humeral drill guide is removed and the position of the K-wire checked to ensure that it is both anatomical and centered in the humeral head.

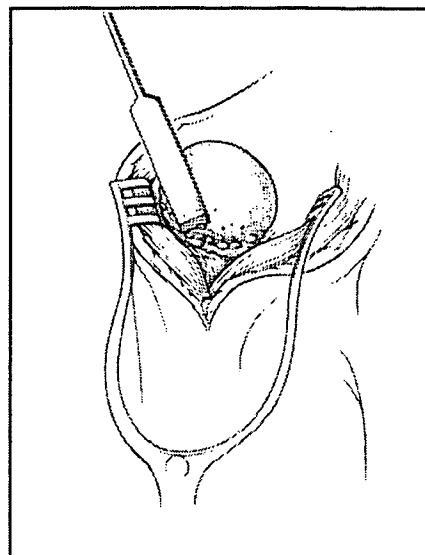


**Fig. 10**

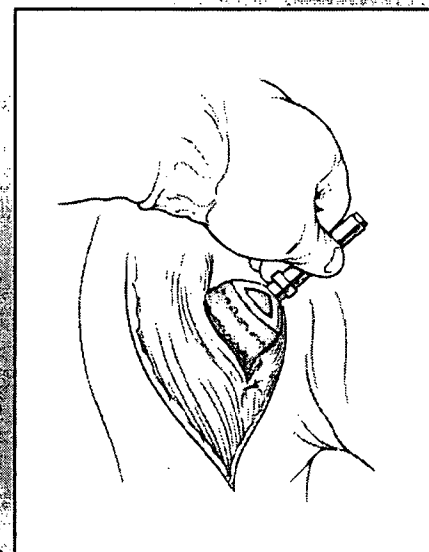


**Fig. 11**

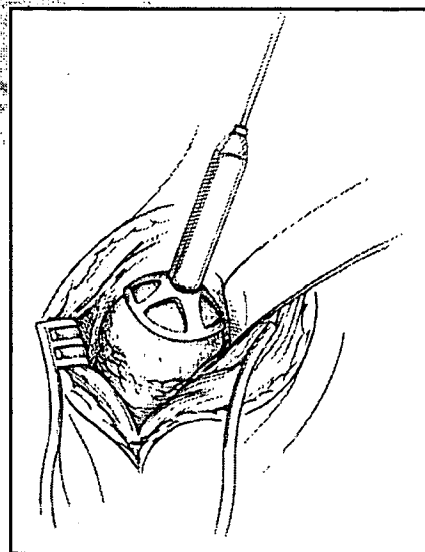


**Fig. 12**



## Preparation of Humeral Head

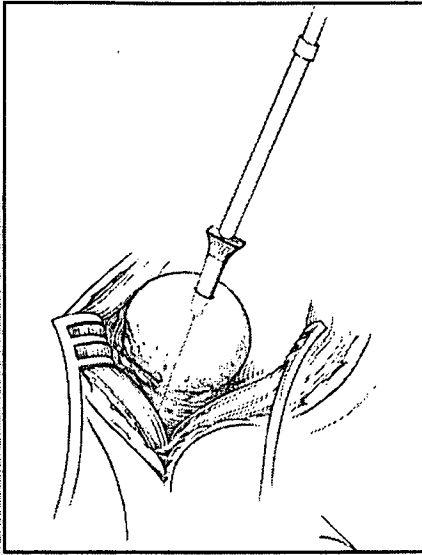


Fig. 13

The cannulated spade bit is passed over the guide wire and, using a cannulated power drill with a 1/4" Jacobs chuck, the central pilot hole is made down to the "stop" of the bit [ Fig. 13 ]. The bit and guide wire are removed. (All morselized bone generated by making this drill hole should be saved and used for later grafting.)

The humeral surface cutter is then used to shape the humeral head. The central locating peg is directed into the pilot hole and the grater action used to shape the humeral head. The surface cutter is gently pressed down onto the humeral head such that while it is rotating, bone appears through all the holes in the surface cutter [ Fig. 14 ]. This facilitates complete bony apposition to the undersurface of the prosthesis. The surface cutter also delineates the edge of where the prosthesis will meet the bone. This marks further bone to be removed from the periphery of the head using a small osteotome or bone nibblers. The edge of this cut now appears beneath the normal surface of the bone. Note: The hard osteochondral plate should be left intact, if possible, as this provides good prosthetic support.

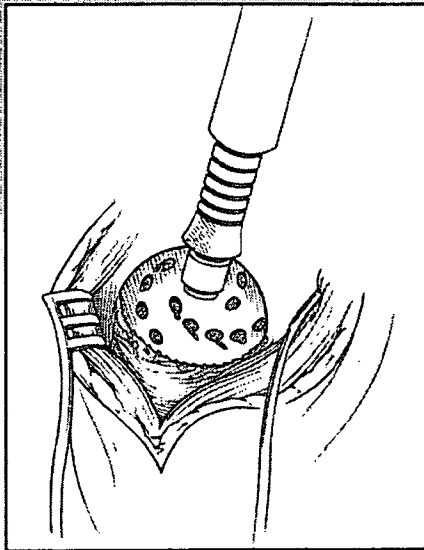


Fig. 14

It is intended that the depth of the prosthesis will build up this new cut surface back to the normal anatomical surface of the bone. The trial humeral prosthesis is then placed onto the prepared bone and a trial reduction is made [ Fig 15 ]. Stability and range of motion can be tested at this time (i.e. that the hand can easily go to the opposite axilla and at least 30° of external rotation can be achieved before anterior translocation). The prosthesis is also checked for stability in flexion/extension.

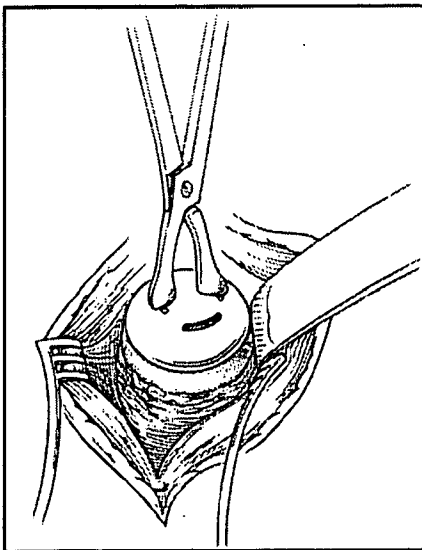


Fig. 15

## Insertion of Component

The trial humeral component is now removed and the humeral head viewed. Irregularities in the humeral head are routinely grafted using bone from osteophytes which had previously been removed. Press-fit the component by placing the resurfacing head onto the prepared humeral head and seating the component about two-thirds of the way with finger pressure. (When cementing, fill the peg hole with cement before placing the component.) The humeral prosthesis is then impacted until it is flush against the bone. While applying tension to the subscapularis stay sutures, assess the position of reattachment of the subscapularis. Usually, because of the resultant lateralization of the center of rotation, an attempt is made to gain relative length in the subscapularis. This can be gained in two ways: (1) by performing a Z-plasty on the subscapularis when entering the joint and (2) by medialization of the insertion of the subscapularis to the free edge of the prosthesis [ Fig. 16 ].

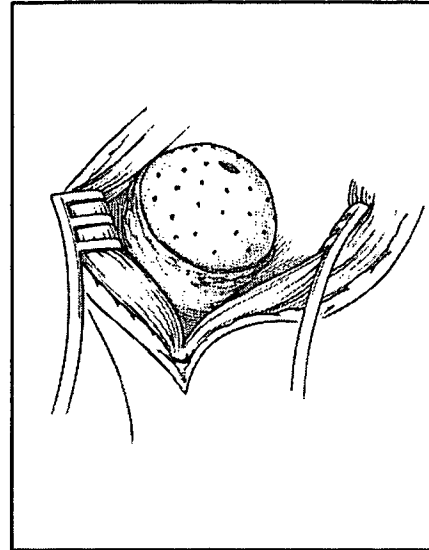


**Fig. 16**



## Closure

### Deltopectoral Approach

The subscapularis is repaired using No. 1 suture material (absorbable [ PDS ] or non-absorbable) without plicating the subscapularis or with through bone sutures. The rotator interval is closed. If there is any rotator cuff deficiency then full rotator cuff repair is made in the normal manner at this stage. Every attempt is made to close the rotator cuff completely.

The delto-pectoral interval is closed using 2 or 3 interrupted absorbable sutures.

Subcutaneous fat is opposed with absorbable sutures and appropriate skin closure undertaken with Intra-dermal continuous absorbable suture (3/0 Monocryl).

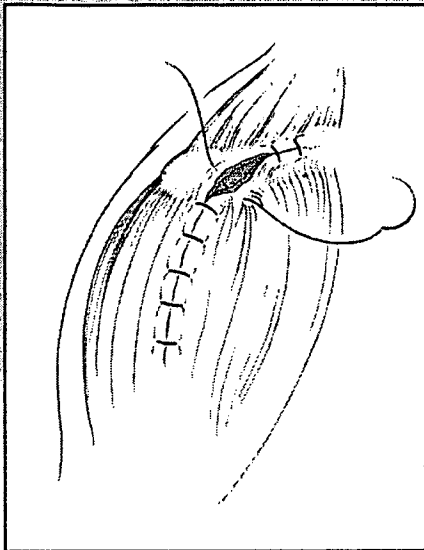


**Fig. 17**

### Antero-superior “Mackenzie” Approach

The subscapularis is repaired using No. 1 suture material (absorbable [ PDS ] or non-absorbable) without plicating the subscapularis or with through bone sutures. The rotator interval is closed. If there is any rotator cuff deficiency then full rotator cuff repair is made in the normal manner at this stage. Every attempt is made to close the rotator cuff completely.

The deltoid is reattached to the acromion with No. 1 absorbable sutures (PDS) through bone [ Fig. 17 ].

The deltoid split is approximated with 2/0 absorbable suture.

Subcutaneous fat is opposed with absorbable sutures and appropriate skin closure undertaken with Intra-dermal continuous absorbable suture (3/0 Monocryl).

### Postoperative Management

The patient is placed in a sling with bodybelt and brachial block analgesia is used. Passive mobilizing is recommended for the first 48 hours and passive assistance for five days thereafter. Active movements are then started as pain allows and the sling abandoned at three weeks. A stretching and strengthening program is then advised standard for all shoulder replacements.

## References

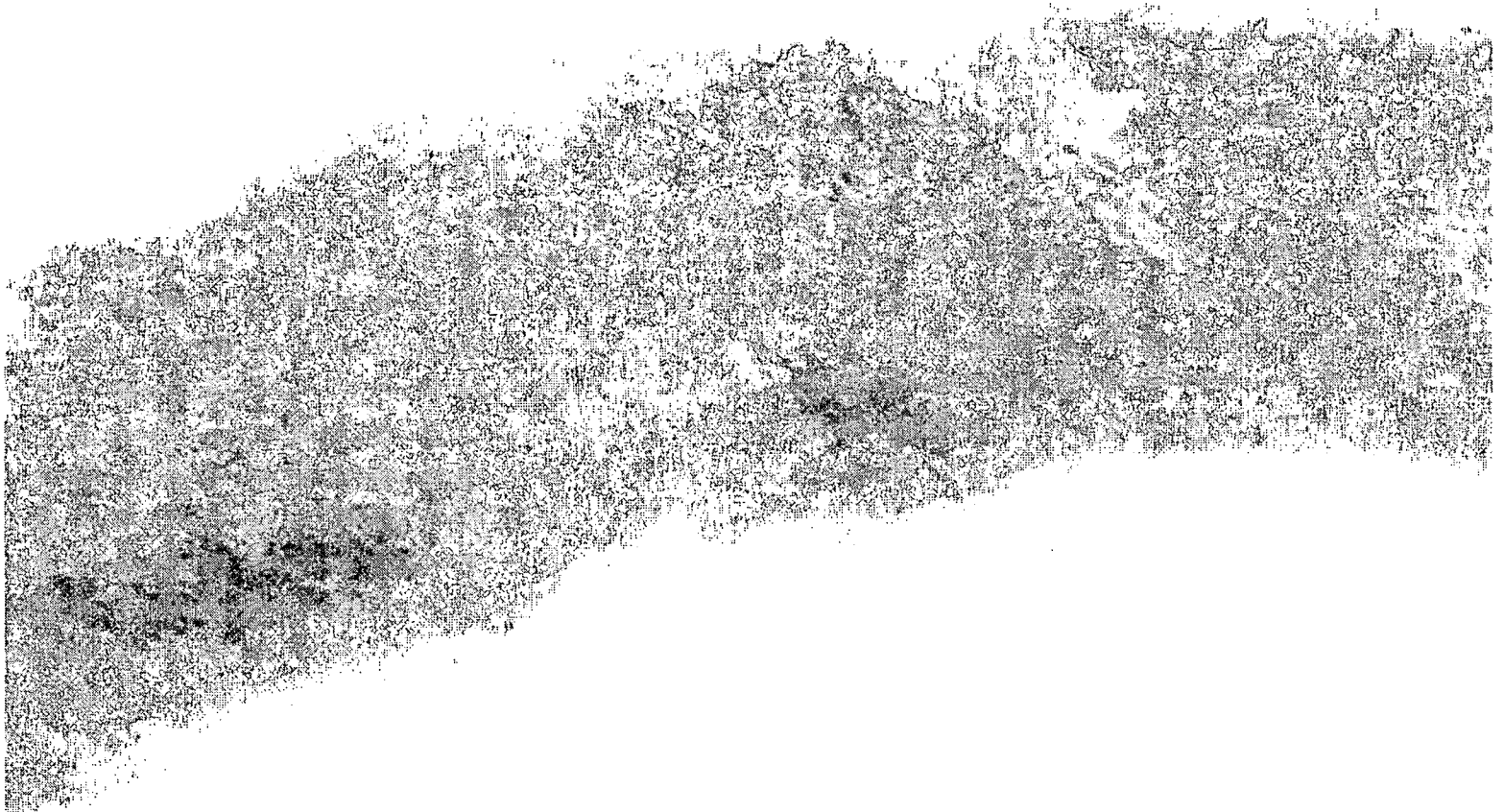
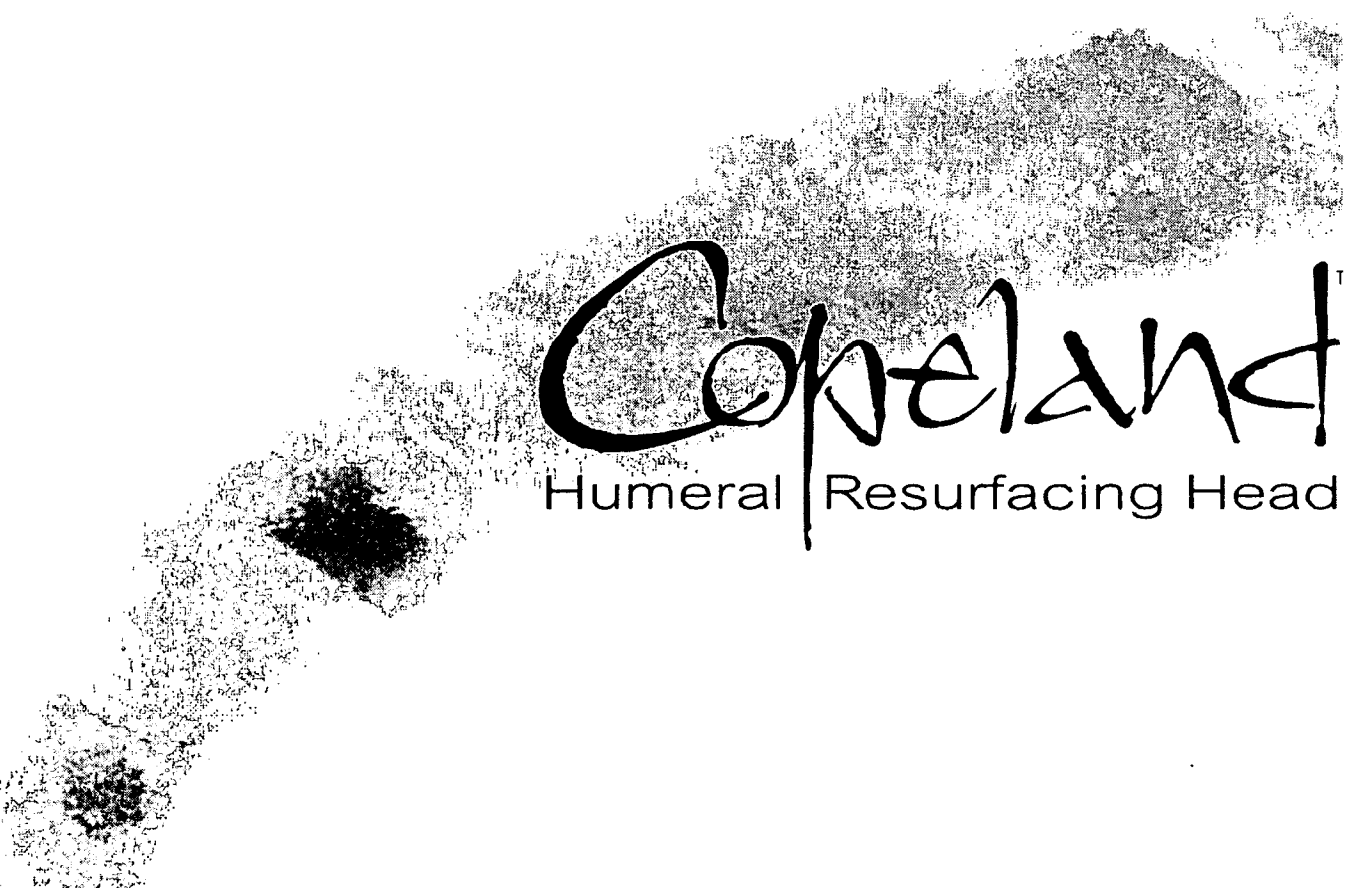
- <sup>1</sup>Williams GR, Iannotti JP: "Anatomy and biomechanics of the glenohumeral joint related to shoulder arthroplasty." *Seminars in Arthroplasty* 11(1):2-15, 2000.
- <sup>2</sup>Boileau P, Walch G: "Three-dimensional geometry of the proximal humerus: Implications for surgical technique and prosthetic design." *J Bone Joint Surg (B)* 1997; 79-B: 857-65.
- <sup>3</sup>Levy O, Bruguera J, Kelly C: Copeland SA: "Cementless surface replacement arthroplasty of the shoulder — 11 years experience." *ICCS*, Sydney, 1998.
- <sup>4</sup>Levy O, Copeland SA: "Cementless surface replacement arthroplasty of the shoulder: 5 to 10 year results with the Copeland, Mark-2 prostheses." *J Bone Joint Surg (B)*, 2000; 83-B: 213-21.
- <sup>5</sup>Mackenzie DB: "The antero-superior exposure for total shoulder replacement." *Orthop. Traumatol* 1993; 2:71-7.

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The Copeland™ Surface Replacement Arthroplasty (CSRA) of the shoulder was developed by Steven A. Copeland, F.R.C.S., Consultant Orthopaedic Surgeon at the Royal Berkshire Hospital, Reading, England, U.K.

This device is intended to be used in the United States as described in the product labeling.

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# Copeland<sup>®</sup>

Humeral Resurfacing Head



# Glenoid resurfacing: What are the limits to asymmetric reaming for posterior erosion?

Philippe Clavert, MD, Peter J. Millett, MD, MSc, and Jon J. P. Warner, MD, Boston, MA

*Eccentric posterior glenoid erosion is a common condition in osteoarthritis. No limits have ever been placed on the degree of eccentric erosion that can be corrected while still maintaining sufficient bone stock to implant a glenoid securely. Five cadaveric scapulae were dissected. Posterior glenoid erosion was created to simulate retroversion of 15° or more. A computed tomography (CT) scan confirmed the degree of glenoid retroversion. The glenoid was then reshaped to correct the glenoid retroversion to neutral, and a glenoid component with central and peripheral pegs was inserted. A second CT scan confirmed the correction to neutral and also evaluated the fit of the component into the glenoid. In all 5 experimental cases, at least 1 of the 4 pegs penetrated the glenoid vault. In 1 case, there was a fracture of the anterior rim. Glenoid retroversion of 15° or more cannot be satisfactorily corrected simply by reaming to lower the anterior edge of the glenoid and restore neutral version when using a glenoid component with peripheral pegs. (J Shoulder Elbow Surg 2007;16:843–848.)*

In individuals with glenohumeral osteoarthritis, the pattern of eccentric posterior glenoid erosion and anterior soft tissue contracture is not uncommon. Surgical technique generally includes correction of glenoid orientation to neutral and anterior soft tissue releases. Biomechanically, this will balance the forces across the joint and promote more normal biomechanical loads across the glenoid, as well as a better range of motion. Despite these goals, correcting severe posterior glenoid erosions when implanting a total shoulder may be challenging. Three potential solutions exist for implanting a glenoid component and restoring proper version<sup>2,3,23</sup>: (1) posterior cement augmenta-

tion/custom implant with augments, (2) posterior bone grafting, and (3) asymmetric reaming of the anterior glenoid to lower the high side and correct retroversion.

No quantitative limits, however, have ever been determined for the degree of posterior glenoid wear that can be corrected by eccentric reaming and still allow for sufficient bone stock to implant a glenoid component. Only guidelines have been suggested based on empirical experience. Therefore, the aim of this study was to define the limits of eccentric glenoid erosion that can be corrected by reaming to neutral, while still maintaining adequate bone stock for secure placement of a glenoid component.

## MATERIAL AND METHODS

Five healthy shoulders from 5 fresh-frozen cadavers were used. These specimens had no evidence of glenoid dysplasia, arthritis, or former surgery. The mean age of the donors (4 women and 1 man, 4 right and 1 left) was 64.4 years.

Dissections were done after overnight thawing at room temperature. The soft tissues of the shoulder were removed, and only the scapula and the proximal humerus were retained. The glenoid and the humeral head sizes were measured so that the correct glenoid component might be selected to match the anatomic reconstruction of the humeral head. This is based on the manufacturer's guidelines to obtain a proper mismatch of glenoid to humeral head radius of curvature (Anatomical Shoulder, Zimmer-Centerpulse, Wintatur, Switzerland). Each scapula was fixed in a block of epoxy to permit stable fixation of the specimen for power reaming.

### *Creation of posterior glenoid erosion*

The Anatomical Shoulder cannulated guide system was centered on the glenoid and used to create a posterior glenoid defect to simulate erosion such as might be encountered in a patient with osteoarthritis. The center of the glenoid was determined as superoinferior alignment of the Kirschner wire was done under visual monitoring, as well as anteroposterior alignment, so that the positioning instrument perfectly fit to the glenoid (Figure 1). A 3-mm Kirschner guidewire was introduced using the cannulated positioning goniometer. The angle of introduction was 20° of retroversion. This guide system allowed control of glenoid reaming and provided a reference point in each specimen in order to create a posterior erosion of 20° retroversion.

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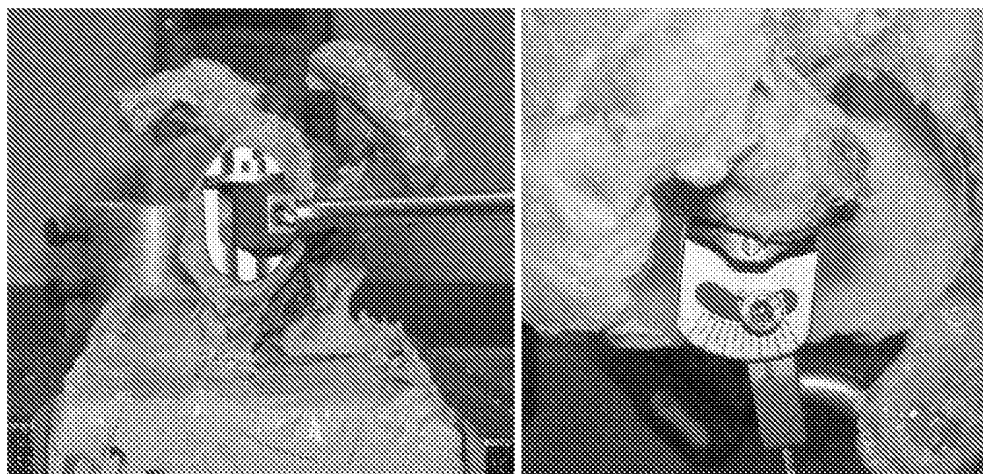


**Figure 1** **A**, A 3-mm Kirschner guide wire is introduced using the cannulated positioning goniometer. **B**, The angle of introduction is of 20° of retroversion.

The created glenoid retroversion was then measured with a computed tomography (CT) scan.<sup>21</sup> Contiguous sections of 1 and 3 mm were obtained, allowing reconstructions in all planes as well as 3-dimensional (3D) reconstructions. The glenoid version was measured, as described by Friedman et al,<sup>10</sup> by using the computerized instrument of the CT scan machine. With computerized measurement, the retroversion of each scapula was determined on the first film on which the tip of the coracoid process was not visible:

1. A line was drawn between the anterior and posterior osseous margins of the glenoid fossa.
2. The transverse axis of the scapula was drawn parallel to the scapular body from the medial border of the scapula to the center of the glenoid (middle of the line extending from the anterior to the posterior edges of the glenoid). A line drawn perpendicular to this was defined as a line of neutral version.
3. A line drawn perpendicular to transverse axis of the scapula was defined as a line of neutral version.
4. The angle between the line of neutral version and the line connecting the anterior and posterior margins of the glenoid was measured and recorded as the degree of retroversion created (Figure 2, A).

This measurement technique should be done preoperatively; only the edges of the glenoid are taken into account and not eventual osteophytes.

#### *Correction of retroversion by glenoid reaming*

According to Anatomical Shoulder glenoid instrumentation and standard surgical technique, the glenoid was prepared for reaming using the Anatomical Shoulder cannulated positioning goniometer.<sup>22</sup> The correction angles corresponded to the angle measured on the CT scan. This corrected angle was then entered on the glenoid positioning instrument, on which 1 graduation line corresponds to 5°. The 3-mm Kirschner wire guided the cannulated reamers. In all cases, reaming started with the small reamer and pro-

gressed to the appropriate final size for the selected glenoid (small, medium, or large). The end point for reaming was uniform contact of the reamer and confirmation of a congruent concave glenoid with a special glenoid template without pegs (Figure 3).

The glenoid drill guide was then positioned along the 3-mm Kirschner wire so that it lay on the glenoid surface. The glenoid drill was used to drill the upper hole with a diameter of 6.2 mm, as far as the stop on the glenoid drilling guide. This drilled hole was fixed with a centering pin. That maneuver was repeated for both inferior holes. The 3-mm Kirschner wire was then removed, so that the central hole was drilled. A pegged glenoid component of appropriate size was then inserted based on initial measurements of the humeral head and glenoid. The liner has 4 pegs in an inverted T-shape fashion, 1 of 11.7 mm centering the implant and 3 of 7 mm (one 11 mm above the central peg and 2 located 9.5 mm below it; Figure 4). These measurements are constant whatever the size of the component (small, medium, or large). Each glenoid was prepared after reaming as follows: a central and 3 peripheral drill holes with a diameter of 6.2 mm were made by using a drill guide.

A second CT scan was then performed with the same protocol as the first to confirm the correction of glenoid version to neutral (with the protocol described above) and to evaluate the fit of the component into the glenoid vault. Complications were an anterior or posterior malposition, a bone fracture, or a polyethylene break out, as shown in Figure 2, B.

#### **RESULTS**

Preoperative glenoid measurement indicated that 2 small, 2 medium, and 1 large glenoid would fit. The humeral head size measured extended from 40 to 48 mm. In every case, the glenoid size measured by comparison with the trial component, corresponded to the humeral head size measured.

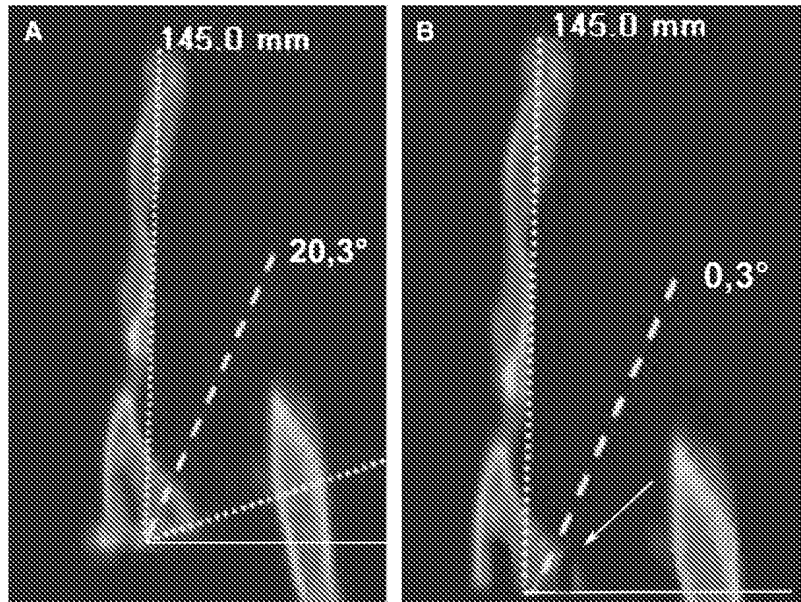


**Figure 2 A,** A computed tomography scan of the lesion shows a posterior retroversion of  $20.3^\circ$  (dotted lines: first between the anterior and posterior margins of the glenoid fossa and second, transverse axis of the scapula; plain line: perpendicular line to the transverse axis of the scapula). The break-off line shows the angle measured by the computer. **B,** A control computed tomography scan fracture of the posterior vault and image of polyethylene breakout (arrow).

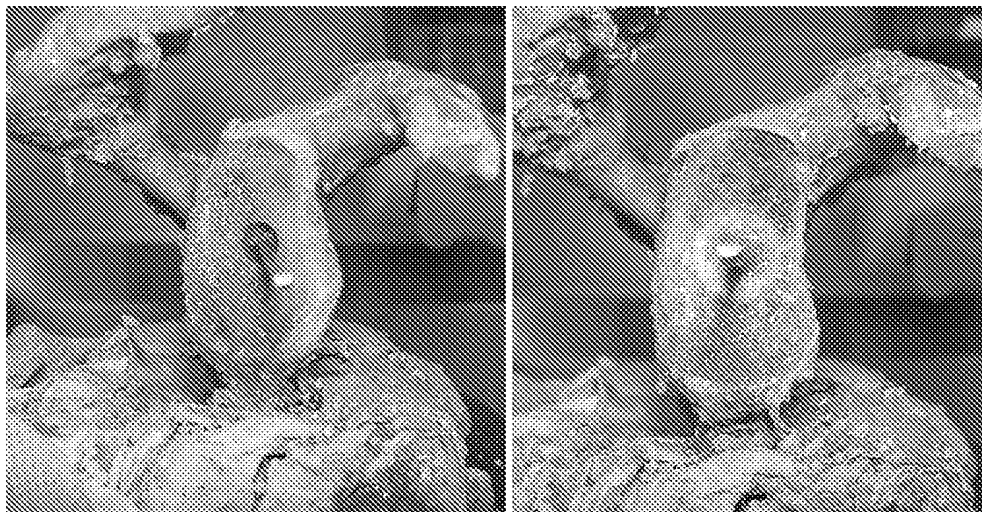


**Figure 3** Glenoid before and after asymmetric reaming to restore the normal version. The end point for reaming was uniform contact of the reamer and confirmation of a congruent concave glenoid with a special glenoid template without pegs.

The mean created defect, calculated with the CT scan, was of  $24^\circ$  (from  $15^\circ$  to  $31^\circ$ ). In all 5 experimental cases, the glenoid version was corrected to neutral after the asymmetric reaming, restoring the normal version.<sup>5</sup> At least 1 peg of the 4 penetrated the glenoid vault, not only the drill hole but also the peg itself. In 1 case, 3 of 4 pegs penetrated the glenoid vault (Figure 5).

A fracture of the anterior glenoid rim after reaming occurred in 1 case where a  $20^\circ$  retroversion had been corrected to neutral. In another case, although a medium size glenoid was appropriate for the diameter of the humeral head, a small glenoid was the only size that could fit on the remaining glenoid surface after reaming (Figure 2, B; Figure 5).



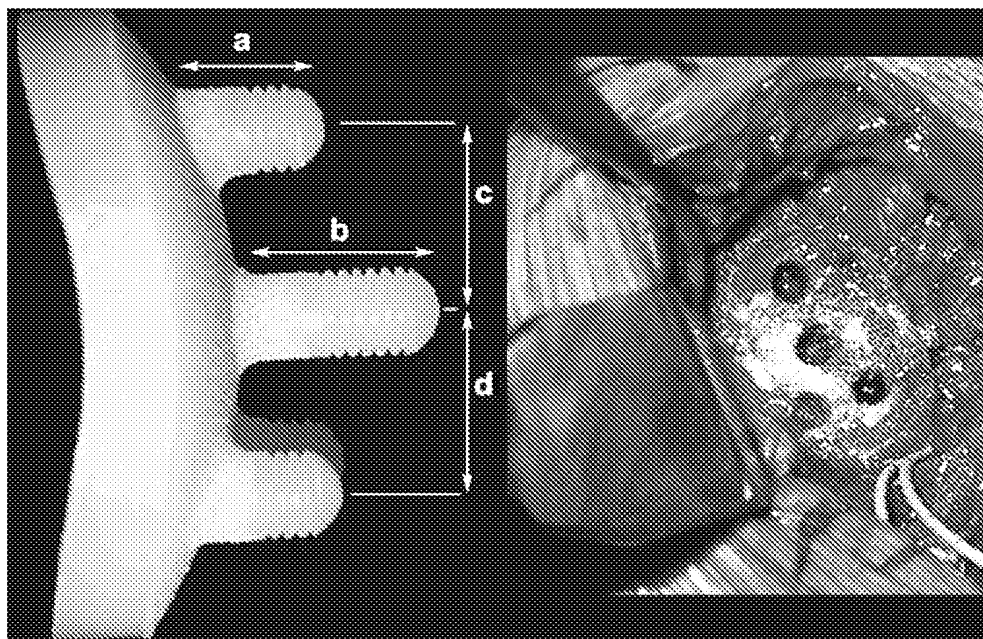


**Figure 4** Sample of a medium glenoid component. Four pegs in an inverted T-shape fashion: 1 of 11.7 mm (**A**) centering the implant and 3 of 7 mm (**B**) and (**C**) 11 mm above the central one, and (**D**) 2 located 9.5 mm below it.

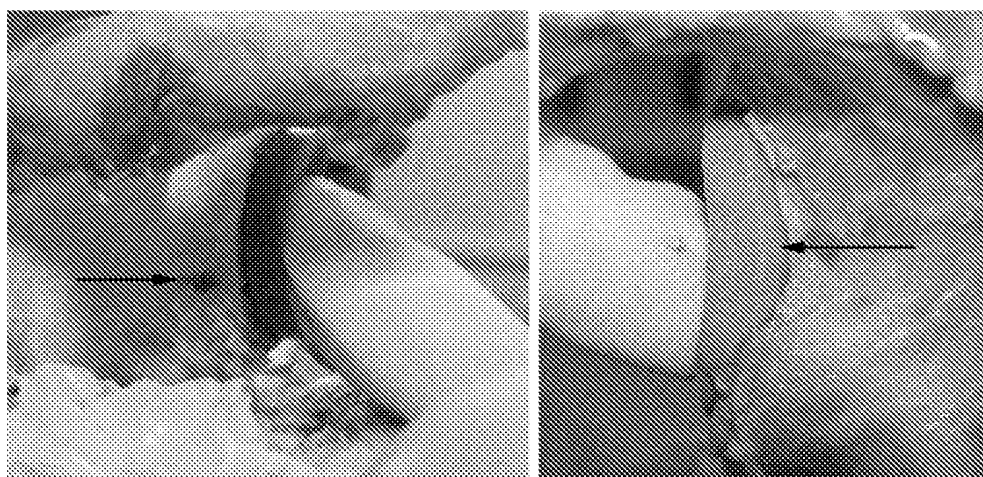


**Figure 5** Left: penetration of the glenoid vault and neck by a pin (arrow); Right: the normal glenoid component is oversized (arrow).

## DISCUSSION

Posterior glenoid bone loss through progressive erosion may occur in some patients who require total shoulder arthroplasty for arthritis. This can be associated with an acquired retroversion and, in some patients, posterior subluxation of the humeral head.<sup>27,28</sup> Although most patients have only mild degrees of posterior erosion, failure to correct glenoid orientation to neutral in the more severe cases can result in a suboptimal outcome with hemiarthroplasty or glenoid loosen-

ing with total shoulder arthroplasty.<sup>2,6,8,9,19,23</sup> Thus, several authors<sup>2,8,19,20,22,26</sup> have recommended correction of the bony deformity. The most common method for correction of the glenoid orientation is to ream the anterior (high side) to neutral; however, no guidelines exist for the extent of reaming that is possible to achieve this goal.

Iannotti et al<sup>14</sup> defined severe posterior bony erosion of the glenoid as more than 10 mm of bone loss. This definition does not adapt to all scapulae, because the retroversion resulting from this bone loss will



vary in proportion to the original size of the glenoid. Walch et al<sup>28</sup> developed a classification for degrees of bony erosion and posterior subluxation of the humeral head and correlated this to outcome after total shoulder replacement. Nyffeler et al<sup>22</sup> demonstrated that the risk of loosening is significantly enhanced by placement of the glenoid component in an orientation of more than 5° retroversion.

For the purposes of our study, we selected more than 15° of retroversion as the definition of severe glenoid erosion or wear. We attempted to define the limits of correction to neutral orientation through reaming of the glenoid and placement of a commercially available glenoid component that has both central and peripheral pegs. We chose to use this component design on the basis of biomechanical data that suggest that a peg design with peripheral pegs is more stable than a central keel component design.<sup>1</sup> Our results cannot be extrapolated to other component designs, such as keel or pegs in-line. In fact, there may be glenoid geometry problems that lend themselves to these designs better than to a component with peripheral pegs.

There is a range of normal glenoid version. Friedman et al<sup>10</sup> found an average value of 2° of retroversion, whereas Saha<sup>24,25</sup> showed that glenoid orientation may vary from 0° to 7.5°. In our study, the defect was added to each glenoid, thus a potentially retroverted glenoid might have been further retroverted through reaming and then corrected to neutral version. That means that the correction we achieved may have been more than what was normal for that specimen. This is 1 shortcoming of our study.

The rationale for correcting glenoid retroversion to neutral is based on clinical experience that positioning the glenoid component with more retroversion leads to unsatisfactory results.<sup>3,9,18</sup> Moreover, biomechanical work from Nyffeler et al has demonstrated that failure to restore glenoid version within 5° will result in significant shear loads across the glenoid, with increased risk of glenoid loosening from edge loading.<sup>22</sup> Hopkins et al<sup>13</sup> found similar results in a finite-element model simulating glenoid retroversions.

We observed that, using a component with a central and peripheral pegs, fracture of the glenoid or penetration of peripheral pegs through the glenoid vault were limiting factors when attempting to correct more than 20° of retroversion. The option in these situations is to perform a posterior bone graft<sup>3,4,7,12,16,17,19,26</sup> before placement of the glenoid component or perhaps to use a component with either a keel or central peg design. We did not, however, study the limits for use of these kinds of components. Unfortunately, no good guidelines are available to determine what size of glenoid osseous deficiency requires bone grafting.

Another alternative is to accept glenoid correction to less than neutral. This might compromise forces across the joint, while allowing secure glenoid component fixation. It is not clear if this will have clinical ramifications; moreover, little clinical experience with this technique has been reported.<sup>12,18,26</sup>

Asymmetric reaming of the anterior glenoid bone to correct excessive glenoid retroversion remains the simplest technique and is also the most widely used. This technique has the advantages of reorienting the joint surface and medializing the center of rotation of the joint. Theoretically, this protects the soft tissue reconstruction (subscapularis tendon) and reduces joint compression, which might otherwise add to polyethylene wear. The results of this study show that this solution is acceptable in cases with small or mild defects. Indeed, this study clearly demonstrated that our assumption that more than 15° retroversion was severe was reasonable, because in every experimental subject, the glenoid vault was compromised by at least 1 peg hole.

Biomechanical and animal work has shown that pegs have some advantages in neutrally oriented glenoids.<sup>11,13,15,29</sup> Whether a keeled glenoid would be better than a glenoid with peripheral pegs in the setting of severe retroversion remains unanswered, although theoretically, if more than 16 mm of bone is left in the center of the glenoid, most of the existing keeled glenoid may be implanted, and probably some custom glenoid with pegs in a vertical line.

We conclude that in cases where glenoid erosion exceeds 15°, the surgeon should consider bone grafting as an alternative to reaming the anterior glenoid. We believe that this study emphasizes the need to obtain a CT analysis of the glenoid preoperatively to understand the 3D anatomy of the glenoid, to evaluate for defects, and to be prepared to address the defects with appropriate glenoid preparation and component implantation.

## REFERENCES

1. Anglin C, Wyss U, Nyffeler R, Gerber C. Loosening performance of cemented glenoid prosthesis design pairs. *Clin Biomech* 2001; 16:144-50.
2. Bishop J, Flatow E. Management of bony insufficiency of the glenoid and humerus with arthroplasty. In: Warner J, Iannotti J, Flatow E, editors. *Management of bony insufficiency of the glenoid and humerus with arthroplasty*. Philadelphia, PA: Lippincott Williams & Wilkins; 2005. p. 515-30.
3. Boileau P, Mole D, Walch G. Technique of glenoid resurfacing in shoulder arthroplasty. In: Walch G, Boileau P, editors. *Technique of glenoid resurfacing in shoulder arthroplasty*. Heidelberg, Germany: Springer-Verlag; 1999. p. 147-62.
4. Brems J. The glenoid component in total shoulder arthroplasty. *J Shoulder Elbow Surg* 1993;2:47-54.
5. Churchill R, Brems J, Kotoschi H. Glenoid size, inclination, and version: an anatomic study. *J Shoulder Elbow Surg* 2001;10: 327-32.

6. Collins D, Tencer A, Sidles J, Matsen FJ. Edge displacement and deformation of glenoid component in response to eccentric loading. *J Bone Joint Surg Am* 1992;74:501-7.
7. Connor P, Flatow E. Surgical considerations of bony deficiency in total shoulder arthroplasty. In: Warner J, Iannotti J, Gerber C, editors. *Surgical considerations of bony deficiency in total shoulder arthroplasty*. Philadelphia, PA: Lippincott-Raven; 1997. p. 339-54.
8. Edwards T, Boulahia A, Kempf J, Boileau P, Nemoz C, Walch G. Shoulder arthroplasty in patients with osteoarthritis and dysplastic glenoid morphology. *J Shoulder Elbow Surg* 2004;13:1-4.
9. Edwards T, Kadakia N, Boulahia A, et al. A comparison of hemiarthroplasty and total shoulder arthroplasty in the treatment of primary glenohumeral osteoarthritis: results of multicenter study. *J Shoulder Elbow Surg* 2003;12:207-13.
10. Friedman R, Hawthorne K, Genez B. The use of the computerized tomography in the measurement of glenoid version. *J Bone Joint Surg Am* 1992;74:1032-7.
11. Gartsman G, Elkousy H, Warnock K, Edwards T, O'Connor D. Radiographic comparison of pegged end keeled glenoid components. *J Shoulder Elbow Surg* 2005;14:252-7.
12. Hill J, Norris T. Long-term results of total shoulder arthroplasty following bone-grafting of the glenoid. *J Bone Joint Surg Am* 2001;83:877-83.
13. Hopkins A, Hansen U, Amis A, Emery R. The effects of glenoid component alignment variations on cement mantle stresses in total shoulder arthroplasty. *J Shoulder Elbow Surg* 2004;13:668-75.
14. Iannotti J, Norris T. Influence of preoperative factors on outcome of shoulder arthroplasty for glenohumeral osteoarthritis. *J Bone Joint Surg Am* 2003;85:251-8.
15. Lazarus M, Jensen K, Southworth C, Matsen F. The radiographic evaluation of keeled end pegged glenoid component insertion. *J Bone Joint Surg Am* 2002;84:1174-82.
16. Levine W, Djurasovic M, Glasson J, Pollock R, Flatow E, Bigliani L. Hemiarthroplasty for glenohumeral osteoarthritis: results correlated to degree of glenoid wear. *J Shoulder Elbow Surg* 1997;6:449-54.
17. Morrison D. Glenoid deficiency in total shoulder arthroplasty. In: Bigliani L, editor. *Glenoid deficiency in total shoulder arthroplasty*. Baltimore, MD: Williams and Wilkins; 1993. p. 73-80.
18. Neer C. Glenohumeral arthroplasty. In: Neer CS 2nd, editor. *Shoulder reconstruction*. Philadelphia, PA: WB Saunders; 1990. p. 146-271.
19. Neer C, Morrison D. Glenoid bone-grafting in total shoulder arthroplasty. *J Bone Joint Surg Am* 1988;70:1154-62.
20. Nyffeler R, Gerber C. The relevance of anatomical reconstruction. In: Walch G, Boileau P, Mole D, editors. *The relevance of anatomical reconstruction*. Paris, France: Sauramps Medical; 2001. p. 57-9.
21. Nyffeler R, Jost B, Pfirrmann C, Gerber C. Measurement of glenoid version: conventional radiographs versus computed tomography scans. *J Shoulder Elbow Surg* 2003;12:493-6.
22. Nyffeler R, Sheikh R, Jacob H, Gerber C. Influence of version on loading pattern of glenoid components: an experimental investigation [abstract]. *J Shoulder Elbow Surg* 2000;9:549.
23. Rodosky M, Bigliani L. Indications for glenoid resurfacing in shoulder arthroplasty. *J Shoulder Elbow Surg* 1996;5:231-48.
24. Saha A. Dynamic stability of the glenohumeral joint. *Acta Orthop Scand* 1971;42:491-505.
25. Saha A. Mechanism of shoulder movements and a plea for the recognition of "zero position" of glenohumeral joint. *Clin Orthop* 1983;173:3-10.
26. Steinmann S, Cofield R. Bone grafting for glenoid deficiency in total shoulder replacement. *J Shoulder Elbow Surg* 2000;9:361-7.
27. Walch G, Ascani C, Boulahia A, Nove-Josserand L, Edwards T. Static posterior subluxation of the humeral head: an unrecognized entity responsible for glenohumeral osteoarthritis in the young adult. *J Shoulder Elbow Surg* 2002;11:309-14.
28. Walch G, Badet R, Boulahia A, Khoury A. Morphologic study of the glenoid in primary glenohumeral osteoarthritis. *J Arthroplasty* 1999;14:756-60.
29. Wirth M, Korvick D, Basamania C, Toro F, Aufdemorte T, Rockwood C. Radiologic, mechanical, and histological evaluation of 2 glenoid prosthesis designs in a canine model. *J Shoulder Elbow Surg* 2001;10:140-8.

August 24, 2012

Third, the prior art also clearly calls into question the validity of the claims of the '538 and '719 patents. For example, U.S. Patent Application Publication No. 2004/0220674, which names Paolo Dalla Pria as the inventor ("Dalla Pria"), qualifies as prior art under 35 U.S.C. § 102(e). Dalla Pria plainly discloses a glenoid that is at least partially inlaid (see Fig. 1); in fact, it is fully inlaid.

Fourth, inset implants have been used for decades, such as in knee implants. Prior art relating to knee implants is certainly analogous to shoulder implants. In fact, this was admitted during the prosecution of the application for the '538 patent in connection with U.S. Patent No. 7,294,149 to Hazack et al. As one example, U.S. Patent No. 5,383,937 to Mikhail that issued on January 24, 1995 plainly discloses the subject matter of most (if not all) of the claims of the '538 and '719 patents (see, e.g., Figure 4 and col. 3, line 60 to col. 4, line 35). The only difference is that the articulating surface is convex as opposed to concave, which clearly would have been an obvious modification based on the anatomy of the knee versus the anatomy of the shoulder.

Fifth, your firm filed a Revised Accelerated Examination Support Document on June 2, 2011 in the prosecution of the application for the '719 patent. In that document, your firm attempted to distinguish Dalla Pria on the grounds that it did not disclose:

inserting a glenoid implant having a body and a peg, the body having a bearing surface on peripheral edge thereof into the cavity, such that at least a portion of the peripheral edge of the body resides below the adjacent glenoid surface and the portion residing below the adjacent glenoid surface is circumferentially surrounded by cortical bone of the glenoid.

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This is plainly shown in Figure 1 of Dalla Pria. Therefore, we question the candor behind this argument made by your firm.

Sixth, we need to consider in this discussion your clients' Australian patent application No. 2006218936 and European application No. EP1858453.

The grounds for the oppositions will include the work by Drs. Mark Ross and Philip Duke in Australia and Lima-Lto and Mr. Paolo Dalla Pria in both Australia and Europe. More specifically, Drs. Ross and Duke worked with Lima-Lto to design a "miniglenoid." Lima-Lto marketed and sold its miniglenoid under product No. 7560.50.030 as early as 2000. A page from the Lima-Lto catalogue and a Lima-Lto engineering drawing of this product are attached hereto. As you can see from this material, the miniglenoid includes a body with a central peg on one side and a concave articulating surface on the other. From 2001 to 2006, Drs. Ross and Duke implanted the Lima-Lto miniglenoid in at least six patients. In each of these cases, the miniglenoid was implanted flush with the remaining articular cartilage. We enclose a copy of a publication in the November 4, 2006 Shoulder and Elbow Society of Australia Conference Handbook reporting on these cases.

Further, Mr. Dalla Pria was employed by Lima-Lto from 1989 to 2009. During this time, he personally assisted Drs. Ross and Duke in the development of Lima-Lto's miniglenoid. In 2000, Mr. Dalla Pria made a presentation, entitled "Shoulder Prosthesis Design and Evolution, to the Naples International Shoulder Congress in Italy. He created a slide deck and used it at this presentation. A copy of Mr. Dalla Pria's slide deck is attached hereto. Slide 53 of the slide deck illustrates Lima-Lto's miniglenoid (also known as a button glenoid), implanted into a glenoid model. This also was the glenoid product used by Drs. Ross and Duke.

A1

**DEMANDE  
DE BREVET D'INVENTION**

(21)

**N° 73 38500**

(54) **Prothèse totale de l'articulation entre deux os et notamment prothèse d'épaule.**

(51) Classification internationale (Int. Cl.<sup>2</sup>). **A 61 F 1/00.**

(22) Date de dépôt ..... **29 octobre 1973, à 15 h 51 mn.**

(33) (32) (31) Priorité revendiquée :

(41) Date de la mise à la disposition du  
public de la demande ..... **B.O.P.I. — «Listes» n. 21 du 23-5-1975.**

(71) Déposant : **Société dite : S.A. BENOIST GIRARD & CIE, résidant en France.**

(72) Invention de : **Francis Demigneux.**

(73) Titulaire : *Idem* (71)

(74) Mandataire : **Cabinet Kessler, 14, rue de Londres, 75009 Paris.**

La présente invention concerne une prothèse totale de l'articulation entre deux os entre lesquels doit intervenir un mouvement relatif.

On sait que les prothèses d'articulation sont constituées de deux pièces qui sont implantées de façon rigide, respectivement dans l'un des deux os à articuler l'un à l'autre. En général, ces prothèses connues tentent de reconstituer l'articulation osseuse naturelle et comportent, de ce fait, d'une part un bloc femelle présentant une cuvette en portion de sphère qui est fixé à l'un des os et, d'autre part un bloc mâle en forme de sphère qui est fixé à l'autre os, le bloc sphérique mâle étant engagé dans le bloc femelle.

10 Mais ce type d'articulation présente l'inconvénient de pouvoir se déboîter, surtout dans le cas d'articulations travaillant en traction. De plus, les prothèses de ce type sont relativement encombrantes et, en outre, elles ne permettent pas des amplitudes de mouvements aussi importantes que l'articulation naturelle.

15 La présente invention propose un type de prothèse totale d'articulation de conception totalement nouvelle et éliminant les inconvénients ci-dessus.

Selon un aspect général de l'invention, la prothèse est constituée de deux pièces destinées à s'implanter dans les os à réunir et elle présente une liaison permanente articulée qui accouple les deux pièces de façon à empêcher leur séparation quels que soient les mouvements et les efforts auxquels est soumise l'articulation. On réalise donc une prothèse qui ne pourra jamais se luxer.

Selon un aspect plus particulier de l'invention, la liaison permanente est constituée par deux anneaux toriques fermés engagés l'un dans l'autre, l'un au moins des anneaux étant monté de façon mobile dans l'une des pièces fixées aux os. Ainsi, l'anneau mobile pourra être prolongé par un axe de rotation monté de façon tournante dans un logement pratiqué dans ladite pièce.

De préférence, le second anneau sera solidaire de l'autre pièce et en suivra tous les déplacements.

Selon un aspect plus spécifique de l'invention, la prothèse s'est révélée d'un intérêt particulier lorsqu'elle est utilisée pour les articulations travaillant presque exclusivement en traction et très peu en compression.

Le type d'une telle articulation est celle de l'épaule.

Une articulation prothétique d'épaule doit répondre à certaines conditions et, entre autres :

35 - elle doit permettre la conservation des mouvements de grande am-

plitude qui sont ceux de l'épaule normale ; l'articulation de l'épaule a des amplitudes de mobilité très importantes autour de trois axes : transversal, antéro-postérieur et vertical. Il s'y ajoute des mouvements de rotation de l'humérus autour de son axe. La combinaison de ces différents mouvements élémentaires  
5 entraîne la possibilité de mouvements de circumduction dans lesquels le bras occupe une infinie variété de positions et d'orientations ;

- elle doit être de faible encombrement pour pouvoir être mise en place en conservant toutes les insertions musculaires et tendineuses entourant l'articulation de l'épaule. En pratique, son encombrement ne doit pas être su-  
10 périeur à celui de la tête de l'humérus, c'est-à-dire de la position de l'os encroûté de cartilage, seule zone dépourvue d'insertions et elle ne doit pas gêner le jeu des éléments musculo-aponévrotiques péri-articulaires ;

- elle doit pouvoir être mise en place sans créer de dégâts irréparables dans les structures péri-articulaires ;

15 - elle doit avoir une bonne tenue dans l'omoplate qui est un os de faible volume, aux corticales minces, à l'épaisseur réduite. La fixation dans l'omoplate doit résister aux efforts d'arrachement correspondant au poids du membre supérieur au repos et aux contraintes développées par les sollicitations exercées sur la prothèse lors des mouvements du bras ;

20 - elle doit avoir une bonne tenue dans l'humérus et résister aux efforts de traction exercés dans l'axe du membre ;

- elle doit être inluxable, faute de quoi elle perd tout intérêt physiologique.

La difficulté de mettre au point une prothèse de faible encombrement, respectant le jeu complexe des éléments péri-articulaires, autorisant des mou-  
25 vements de grande amplitude et ne se luxant pas, n'a pas permis d'obtenir des résultats vraiment satisfaisants avec les modèles d'articulation prothétique d'épaule qui ont pu être proposés jusqu'à présent et qui étaient du type indiqué plus haut à cuvette et tête sphériques.

30 La prothèse selon l'invention répond aux conditions ci-dessus et pour s'adapter au cas de l'épaule, la pièce destinée à être insérée dans l'humérus est constituée par une tige allongée solidaire d'un des anneaux à une extrémité et terminée à son extrémité opposée par un crochet, la tige étant implantée oblique-ment dans l'os et le crochet se logeant radialement dans une perforation de la  
35 corticale externe de l'os. L'ensemble est ensuite cimenté et grâce à cette dis-

position, les contraintes de traction ne peuvent entraîner le descellement de la prothèse comme ce serait le cas avec une tige démunie de crochet à son extrémité.

De plus, la pièce destinée à être fixée à l'omoplate est constituée  
5 d'une platine épousant sensiblement la forme de la cavité glénoïde dans laquelle elle sera fixée par des vis, ladite platine présentant à sa partie supérieure un ergot en forme de crochet qui est conçu pour être enfoncé dans l'épaisseur de l'omoplate, au-dessus de la cavité glénoïde. Cet ergot oppose une bonne résistance aux contraintes d'arrachement s'exerçant verticalement de haut en bas, ce qui  
10 est le sens des sollicitations mécaniques les plus dangereuses.

L'encombrement de la prothèse d'épaule est tel qu'il est très réduit et comparable à celui de la tête humérale, laquelle est réséquée pour la mise en place de la prothèse. Ce faible encombrement autorise la mise en place par une voie chirurgicale économique, habituelle en chirurgie de l'épaule et dont la réparation ne pose pas de problème.  
15

Il faut noter que la mobilité de l'épaule prothétique selon l'invention dépasse la mobilité d'une épaule classique et ne sera limitée que par la mise en tension de l'appareil capsulo-ligamentaire péri-articulaire.

En effet, l'anneau mobile logé dans l'omoplate en tournant sur lui-même engendre une sphère et permet à l'anneau solidaire de l'humérus de se placer dans tous les plans de l'espace. La prothèse autorisera donc tous les mouvements naturels de l'épaule avec leur amplitude maximale.  
20

On décrira à présent, à titre d'exemple non limitatif, une prothèse selon l'invention destinée à l'épaule, en référence aux dessins annexés dans lesquels :  
25

- la figure 1 est une vue générale d'une prothèse d'épaule montée entre l'omoplate et l'humérus ;
- la figure 2 est une vue en élévation à plus petite échelle de la prothèse de l'invention ;
- 30 - les figures 3 et 4 sont des vues de dessus et de côté de la prothèse de la figure 2, et
- la figure 5 est une vue en coupe partielle à plus grande échelle de la prothèse.

A la figure 1, on a représenté une omoplate 1 (face antérieure) reliée à l'humérus droit 2 par la prothèse d'épaule de l'invention. En 3 on a indi-  
35



qué la surface de la cavité glénoïde de l'omoplate sur laquelle la prothèse est fixée par des vis 4. La tête humérale a été réséquée en 5 et le canal médullaire évidé pour permettre l'introduction de la prothèse scellée en place par un ciment 6.

5 Comme on pourra le voir plus particulièrement en référence aux figures 2 à 5, la prothèse est constituée de deux pièces 7 et 8 reliées l'une à l'autre de façon indétachable par une articulation à anneaux toriques.

A cet effet, la partie 8 de la prothèse destinée à être insérée dans l'humérus est constituée par une tige 9, de préférence de section non circulaire 10 (par exemple polygonale) se terminant à une extrémité par un anneau torique 10 et s'effilant progressivement vers son autre extrémité qui est recourbée pour constituer un crochet 11 destiné à s'engager, lorsque la prothèse est mise en place, dans un orifice 12 pratiqué radialement dans l'humérus comme on le voit bien à la figure 1. On comprend immédiatement que, pour que le crochet 11 occupe 15 cette position, la tige 9 sera implantée dans l'os de façon inclinée par rapport au canal médullaire.

Quant à la partie 7 de la prothèse (voir en particulier la figure 5), elle est constituée d'une platine 13 de forme légèrement bombée dont la face convexe 14 est destinée à s'appliquer sur la surface 3 de la cavité glénoïde de 20 l'omoplate.

Cette platine qui présente, vue de face (voir figure 4) une forme sensiblement elliptique comporte, de préférence, une surépaisseur centrale 15, du côté de sa face concave 16 et est percée centralement d'un trou 17 dans lequel est engagé, de façon tournante, un axe 18 solidaire d'un anneau torique 19.

25 L'anneau 19 et son axe 18 sont libres de tourner autour de l'axe géométrique X-X' mais ne peuvent se déplacer en translation par rapport à la platine par le fait qu'une collerette 20 située entre l'axe et l'anneau se trouve en appui contre la face plane de la surépaisseur 15 et que sur l'extrémité 21 de l'axe est fixée (par exemple par soudure) une couronne de butée 22 prenant appui contre 30 une partie plane de la face convexe de la platine. On notera qu'entre l'axe 18 et le trou 17 il n'existera pratiquement aucun jeu, les tolérances étant cependant ajustées pour permettre une rotation douce et aisée entre ces organes ; par contre, de préférence, on ménagera un jeu 23 d'environ 0,1 mm entre la couronne 22 et la platine.

35 Un chapeau 24 vient coiffer l'extrémité de l'axe 18, ce chapeau

étant soudé à la platine 13.

De plus, un ergot 25 en forme de crochet prolonge la platine 13 sur son grand axe, cet ergot étant contrecoudé de façon à être placé du côté de la face convexe de la platine, son extrémité 26 dentelée étant orientée vers l'axe X-X'. Cet ergot est appelé à s'insérer et être cimenté dans un logement 27 pratiqué dans l'épaisseur de l'omoplate, au-dessus de la cavité glénoïde (voir figure 1).

Enfin, la platine est percée de six trous 28 disposés régulièrement. On notera à ce propos que la platine ne sera fixée à l'omoplate que par quatre vis, comme on le voit à la figure 1, à savoir deux vis  $V_1$  disposées selon le grand axe de la platine et qui existeront pour les prothèses d'épaule droite et gauche et deux vis  $V_2$  qui seront placées d'un côté ou de l'autre du grand axe selon que l'on a affaire à une prothèse droite ou gauche. Ainsi, avec une prothèse d'épaule droite, comme représenté, les vis  $V_2$  occuperont la position représentée sur la figure 1.

On signalera que les deux anneaux toriques 10 et 19 engagés l'un dans l'autre présenteront entre eux un léger jeu 30 nécessaire à un bon fonctionnement, par exemple un jeu compris entre 0,05 et 1 mm.

En ce qui concerne le processus permettant de réaliser l'articulation et notamment l'engagement des anneaux 10 et 19 l'un dans l'autre, on comprendra qu'il pourrait être quelconque. Ainsi, par exemple, on pourrait procéder de la manière suivante, l'un des anneaux se présentant ouvert, l'autre anneau (fermé) est introduit dans l'anneau ouvert qui est ensuite fermé, par exemple par soudure ou par déformation suivie de soudure. On comprendra, toutefois, que toutes les techniques appropriées pourront être utilisées.

Comme le montrent les figures 2 et 3, la prothèse permet théoriquement, par sa conception, des amplitudes de mouvement très importantes. Ainsi, la ligne 31 de la figure 2 délimite le débattement vertical possible alors que la ligne 32 de la figure 3 montre le débattement dans le plan horizontal, la pointe des flèches indiquant les positions limites que peut prendre la tige 9.

Naturellement, les amplitudes réelles seront moins importantes et limitées par les insertions musculaires et tendineuses autour de l'articulation.

L'invention ayant maintenant été exposée et son intérêt justifié sur un exemple détaillé, la demanderesse s'en réserve l'exclusivité pendant toute la durée du brevet sans limitation autre que celle des termes des revendications ci-après.

## REVENDEICATIONS

1. Prothèse d'articulation constituée de deux pièces destinées à être implantées de façon rigide, respectivement dans l'un des deux os entre lesquels doit intervenir un mouvement relatif, caractérisée en ce qu'elle comporte  
5 une liaison permanente articulée accouplant les deux pièces.

2. Prothèse selon la revendication 1, caractérisée en ce que la liaison permanente est constituée par deux anneaux toriques engagés l'un dans l'autre.

3. Prothèse selon les revendications 1 et 2 prises ensemble, caractérisée en ce que l'un au moins des anneaux est monté de façon mobile dans l'une  
10 des pièces.

4. Prothèse selon la revendication 3, caractérisée en ce que l'anneau monté de façon mobile dans la pièce correspondante est prolongé par un axe de rotation monté de façon tournante dans un logement pratiqué dans ladite pièce.

5. Prothèse selon les revendications 3 et 4 prises ensemble, caractérisé en ce que l'axe de rotation de l'anneau mobile est immobilisé en translation.  
15

6. Prothèse selon les revendications 1 et 2 prises ensemble, caractérisé en ce que le deuxième anneau torique est solidaire de l'autre pièce et en suit les déplacements.

7. Prothèse selon l'une des revendications 1, 2, 3, 4, 5 ou 6 conçue  
20 notamment pour l'articulation d'épaule et destinée à relier l'humérus à l'omoplate, caractérisée en ce que la pièce destinée à être insérée dans l'humérus est constituée par une tige allongée solidaire d'un des anneaux à une extrémité et terminée à son extrémité opposée par un crochet, la tige étant implantée à l'intérieur de l'os et sensiblement obliquement de façon que le crochet vienne se lo-  
25 ger radialement dans une perforation de la corticale externe de l'os.

8. Prothèse selon la revendication 7, caractérisée en ce que la pièce destinée à être fixée à l'omoplate est constituée d'une platine destinée à être fixée dans la cavité glénoïde par des vis, ladite platine présentant à sa partie supérieure un ergot en forme de crochet destiné à être enfoncé dans l'épaisseur  
30 de l'os au-dessus de la cavité glénoïde.

FIG. 1

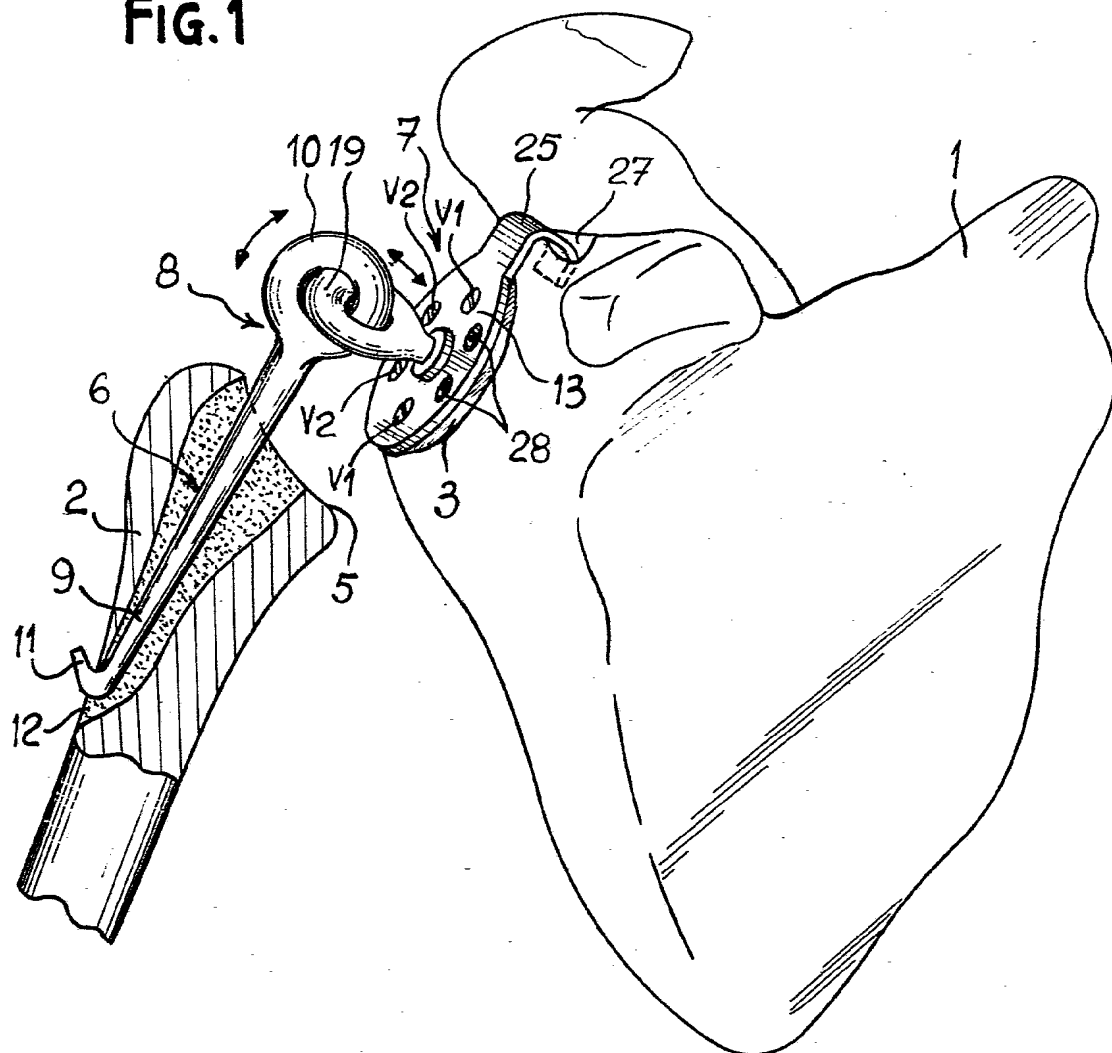


FIG. 5

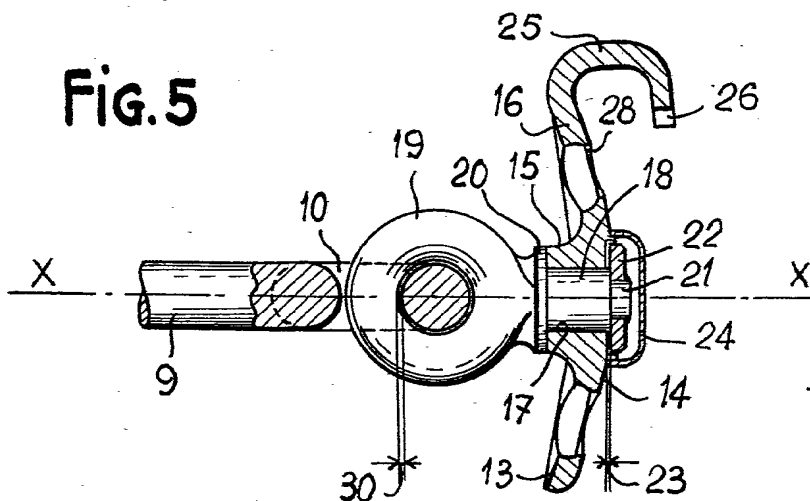


FIG. 2

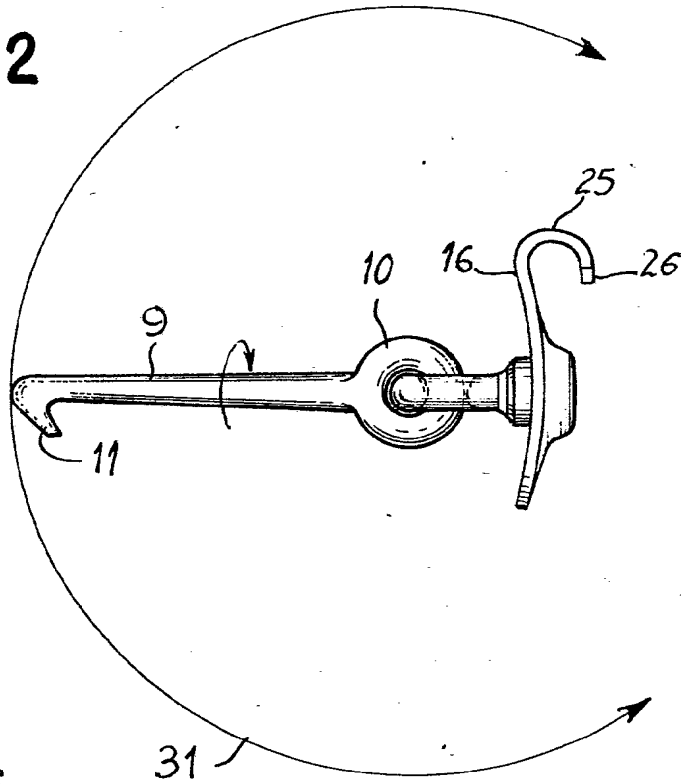


FIG. 4

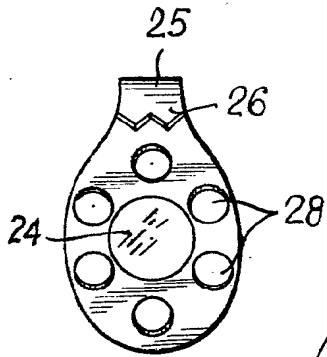
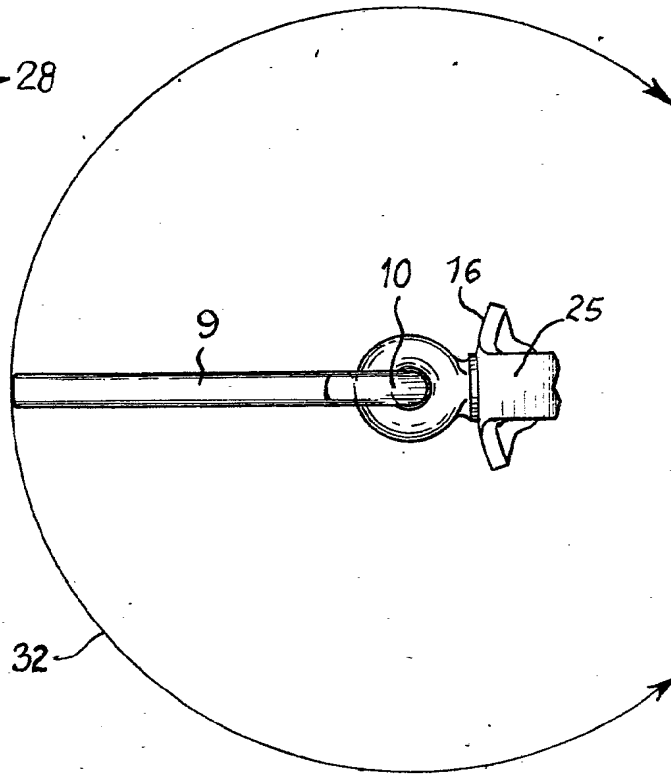


FIG. 3





# UNITED STATES PATENT AND TRADEMARK OFFICE

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IRVINE, CA 92614

EXAMINER

SCHILLINGER, ANN M

ART UNIT

PAPER NUMBER

3774

DATE MAILED: 04/18/2023

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 18/058,058      | 11/22/2022  | Donald E. Running    | SHOLD.013C1         | 5500             |

TITLE OF INVENTION: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | SMALL         | \$480         | \$0.00              | \$0.00               | \$480            | 07/18/2023 |

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**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.**

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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 18/058,058      | 11/22/2022  | Donald E. Running    | SHOLD.013C1         | 5500             |

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|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | SMALL         | \$480         | \$0.00              | \$0.00               | \$480            | 07/18/2023 |

| EXAMINER           | ART UNIT | CLASS-SUBCLASS |
|--------------------|----------|----------------|
| SCHILLINGER, ANN M | 3774     | 623-019130     |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 \_\_\_\_\_  
2 \_\_\_\_\_  
3 \_\_\_\_\_

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☐ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

☐ Electronic Payment via Patent Center or EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. \_\_\_\_\_

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature \_\_\_\_\_

Date \_\_\_\_\_

Typed or printed name \_\_\_\_\_

Registration No. \_\_\_\_\_



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| APPLICATION NO.                                                                                                                                                               | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------|---------------------|------------------|
| 18/058,058                                                                                                                                                                    | 11/22/2022  | Donald E. Running    | SHOLD.013C1         | 5500             |
| <div>20995      7590      04/18/2023</div> <div>KNOBBE MARTENS OLSON &amp; BEAR LLP</div> <div>2040 MAIN STREET</div> <div>FOURTEENTH FLOOR</div> <div>IRVINE, CA 92614</div> |             |                      |                     |                  |
| <div>EXAMINER</div> <div>SCHILLINGER, ANN M</div>                                                                                                                             |             |                      |                     |                  |
| <div>ART UNIT      PAPER NUMBER</div> <div>3774</div>                                                                                                                         |             |                      |                     |                  |
| DATE MAILED: 04/18/2023                                                                                                                                                       |             |                      |                     |                  |

## Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.



## OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

### Privacy Act Statement

**The Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law.

|                               |                                      |                                       |                                 |
|-------------------------------|--------------------------------------|---------------------------------------|---------------------------------|
| <b>Notice of Allowability</b> | <b>Application No.</b><br>18/058,058 | <b>Applicant(s)</b><br>Running et al. |                                 |
|                               | <b>Examiner</b><br>ANN SCHILLINGER   | <b>Art Unit</b><br>3774               | <b>AIA (FITF) Status</b><br>Yes |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the claims response filed on 1/12/2023.  
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 17-32. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

**Certified copies:**

a) ☐ All      b) ☐ Some\*      c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.  
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_.

**Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

|                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)<br>2. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO/SB/08),<br>Paper No./Mail Date ____.<br>3. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br>of Biological Material ____.<br>4. <input type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date _____. | 5. <input checked="" type="checkbox"/> Examiner's Amendment/Comment<br>6. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance<br>7. <input checked="" type="checkbox"/> Other <u>See Continuation Sheet.</u> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

/ANN SCHILLINGER/  
Primary Examiner, Art Unit 3774

Continuation of Attachment(s) 7. Other: EP2601912A1; WO2013/148437A1; EP3090705A1; WO2018/022227A1; WO2019/006205A1; EP3598957A1; WO2020/023975A1; WO2014/195909A1

## **DETAILED ACTION**

### ***Notice of Pre-AIA or AIA Status***

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

### **EXAMINER'S AMENDMENT**

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in an interview with Andrew Kimmel on 4/6/2023.

The application has been amended as follows:

Claim 25, line 11, the phrase "secure the locking nut to" has been replaced with the following language --engage--

Claim 25, line 14, after the term "baseplate" the following language has been added --  
; and a glenosphere screw, sized to pass at least partially within the glenosphere central channel and having external threads sized to secure the glenosphere screw to the internal thread on the internal surface of the locking nut to secure the glenosphere to the locking nut--

### ***Reasons for Allowance***

The following is an examiner's statement of reasons for allowance: the prior art does not disclose the claimed configuration of the central screw, the locking nut, and the glenosphere screw. In particular, it fails to disclose reverse shoulder implant, comprising: a baseplate having

a lateral end, a medial end, and a central channel extending therethrough from the lateral end to the medial end; a central screw sized to at least partially pass through the central channel and secure the baseplate to the glenoid of the patient; a locking nut having a cylindrical shape, an external thread on an outside surface of the locking nut and an internal thread on an internal surface of the locking nut, the locking nut directly engaging the central screw when the central screw and baseplate are implanted within the medical patient, wherein the external thread is configured to secure the locking nut to the central channel of the baseplate; a glenosphere, having a lateral, convex articular side, a medial side, and a central channel extending from the convex articular side to the medial side and interfacing with the baseplate; and a glenosphere screw, sized to pass at least partially within the glenosphere central channel and having external threads sized to secure the glenosphere screw to the internal thread on the internal surface of the locking nut to secure the glenosphere to the locking nut.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANN SCHILLINGER whose telephone number is (571)272-6652. The examiner can normally be reached Monday-Friday 9 a.m.-5 p.m. EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is

Art Unit: 3774

encouraged to use the USPTO Automated Interview Request (AIR) at

<http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jerrah Edwards can be reached on (408)918-7557. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: <https://patentcenter.uspto.gov>. Visit <https://www.uspto.gov/patents/apply/patent-center> for more information about Patent Center and <https://www.uspto.gov/patents/docx> for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ANN SCHILLINGER/  
Primary Examiner, Art Unit 3774

|                                          |                                       |  |                                                              |             |
|------------------------------------------|---------------------------------------|--|--------------------------------------------------------------|-------------|
| <b><i>Notice of References Cited</i></b> | Application/Control No.<br>18/058,058 |  | Applicant(s)/Patent Under<br>Reexamination<br>Running et al. |             |
|                                          | Examiner<br>ANN SCHILLINGER           |  | Art Unit<br>3774                                             | Page 1 of 3 |

**U.S. PATENT DOCUMENTS**

| * |   | Document Number<br>Country Code-Number-Kind Code | Date<br>MM-YYYY | Name                          | CPC Classification | US Classification |
|---|---|--------------------------------------------------|-----------------|-------------------------------|--------------------|-------------------|
| * | A | US-20080294268-A1                                | 11-2008         | Baum; Ines                    | A61F2/4081         | 623/18.11         |
| * | B | US-20130150972-A1                                | 06-2013         | Iannotti; Joseph P.           | A61F2/4059         | 623/18.11         |
| * | C | US-10357373-B2                                   | 07-2019         | Gargac; Shawn M.              | A61F2/4081         | 1/1               |
| * | D | US-11564802-B2                                   | 01-2023         | Ball; Robert J.               | A61F2/4637         | 1/1               |
| * | E | US-5702447-A                                     | 12-1997         | Walch; Gilles                 | A61F2/4081         | 606/327           |
| * | F | US-20040199260-A1                                | 10-2004         | Pope, Bill J.                 | A61F2/442          | 623/23.5          |
| * | G | US-6953478-B2                                    | 10-2005         | Bouttens; Denis               | A61F2/4081         | 623/23.11         |
| * | H | US-20070156246-A1                                | 07-2007         | Meswania; Jayantilal Mohanlal | A61F2/40           | 623/19.12         |
| * | I | US-20070179624-A1                                | 08-2007         | Stone; Kevin T.               | A61F2/4081         | 623/22.36         |
| * | J | US-7766969-B2                                    | 08-2010         | Justin; Daniel F.             | A61F2/30721        | 623/20.15         |
| * | K | US-9114017-B2                                    | 08-2015         | Lappin; Kyle E.               | A61F2/4603         | 1/1               |
| * | L | US-9283083-B2                                    | 03-2016         | Winslow; Nathan A.            | A61F2/4014         | 1/1               |
| * | M | US-20160302934-A1                                | 10-2016         | CHAVARRIA; JASON M.           | A61F2/40           | 1/1               |

**FOREIGN PATENT DOCUMENTS**

| * |   | Document Number<br>Country Code-Number-Kind Code | Date<br>MM-YYYY | Country | Name        | CPC Classification |
|---|---|--------------------------------------------------|-----------------|---------|-------------|--------------------|
|   | N | EP-2601912-A1                                    | 06-2013         | EP      | LOREK J D   | A61F2/4081         |
|   | O | WO-2013148437-A1                                 | 10-2013         | WO      | LAPPIN K E  | A61B17/8042        |
|   | P | EP-3090705-A1                                    | 11-2016         | EP      | GARGAC S M  | A61F2/4081         |
|   | Q | WO-2018022227-A1                                 | 02-2018         | WO      | CARDON J    | A61B17/1684        |
|   | R | WO-2019006205-A1                                 | 01-2019         | WO      | FRANKLE M A | A61F2/30734        |
|   | S | EP-3598957-A1                                    | 01-2020         | EP      | MURPHY W    | A61F2/30749        |
|   | T | WO-2020023975-A1                                 | 01-2020         | WO      | AUSTIN L    | A61F2/30749        |

**NON-PATENT DOCUMENTS**

| * |   | Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages) |
|---|---|-------------------------------------------------------------------------------------------|
|   | U |                                                                                           |
|   | V |                                                                                           |
|   | W |                                                                                           |
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\*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)  
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|------------------------------------------|---------------------------------------|--|--------------------------------------------------------------|-------------|
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|                                          | Examiner<br>ANN SCHILLINGER           |  | Art Unit<br>3774                                             | Page 2 of 3 |

**U.S. PATENT DOCUMENTS**

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|---|---|--------------------------------------------------|-----------------|------------------------|--------------------|-------------------|
| * | A | US-9615839-B2                                    | 04-2017         | Olson; Nicholas        | A61B17/8897        | 1/1               |
| * | B | US-20170202674-A1                                | 07-2017         | Gunther; Stephen B.    | A61F2/30749        | 1/1               |
| * | C | US-20180078377-A1                                | 03-2018         | Gargac; Shawn M.       | A61F2/4081         | 1/1               |
| * | D | US-10925745-B2                                   | 02-2021         | Cardon; Jean-Emmanuel  | A61F2/4637         | 1/1               |
| * | E | US-20200261209-A1                                | 08-2020         | Stchur; Robert Patrick | A61F2/4607         | 1/1               |
| * | F | US-20210236292-A1                                | 08-2021         | Chavarria; Jason M.    | A61F2/40           | 1/1               |
| * | G | US-11166733-B2                                   | 11-2021         | Neichel; Nicolas       | A61B34/10          | 1/1               |
| * | H | US-11464645-B2                                   | 10-2022         | Cardon; Jean-Emmanuel  | A61F2/30724        | 1/1               |
| * | I | US-20030163202-A1                                | 08-2003         | Lakin, Ryan C.         | A61F2/3601         | 623/22.21         |
|   | J |                                                  |                 |                        |                    |                   |
|   | K |                                                  |                 |                        |                    |                   |
|   | L |                                                  |                 |                        |                    |                   |
|   | M |                                                  |                 |                        |                    |                   |

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|---|---|-------------------------------------------------------------------------------------------|
|   | U |                                                                                           |
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|-----------------------------------|---------------------------------------|--------------------------------------------------------------|-------------|
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|                                   | Examiner<br>ANN SCHILLINGER           | Art Unit<br>3774                                             | Page 3 of 3 |

**U.S. PATENT DOCUMENTS**

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|---|---|--------------------------------------------------|-----------------|------|--------------------|-------------------|
|   | A |                                                  |                 |      |                    |                   |
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| * |   | Document Number<br>Country Code-Number-Kind Code | Date<br>MM-YYYY | Country | Name      | CPC Classification |
|---|---|--------------------------------------------------|-----------------|---------|-----------|--------------------|
|   | N | WO-2014195909-A1                                 | 12-2014         | WO      | DALLA P P | A61F2/4014         |
|   | O |                                                  |                 |         |           |                    |
|   | P |                                                  |                 |         |           |                    |
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| <b>Issue Classification</b><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |
|                                                                                                                  | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |

| CPC    |   |      |   |       |      |            |
|--------|---|------|---|-------|------|------------|
| Symbol |   |      |   |       | Type | Version    |
| A61F   | / | 2    | / | 4081  | F    | 2013-01-01 |
| A61B   | / | 17   | / | 1778  | I    | 2016-11-01 |
| A61F   | / | 2    | / | 30749 | I    | 2013-01-01 |
| A61F   | / | 2002 | / | 30616 | A    | 2013-01-01 |
| A61F   | / | 2002 | / | 4085  | A    | 2013-01-01 |

| CPC Combination Sets |   |  |   |      |     |
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| Symbol               |   |  |   | Type | Set |
|                      | / |  | / |      |     |

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|------------------------------------------------------|---------------|------------------------------|-------------------|
| NONE                                                 |               | <b>Total Claims Allowed:</b> |                   |
| (Assistant Examiner)                                 | (Date)        | 16                           |                   |
| /ANN SCHILLINGER/<br>Primary Examiner, Art Unit 3774 | 06 April 2023 | O.G. Print Claim(s)          | O.G. Print Figure |
| (Primary Examiner)                                   | (Date)        | 1                            | 8                 |

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|------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------|
| <b>Issue Classification</b><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |
|                                                                                                                  | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |

|                                     |   |    |   |    |  |
|-------------------------------------|---|----|---|----|--|
| <b>INTERNATIONAL CLASSIFICATION</b> |   |    |   |    |  |
| <b>CLAIMED</b>                      |   |    |   |    |  |
| A61F                                | / | 2  | / | 40 |  |
| A61F                                | / | 2  | / | 30 |  |
| A61B                                | / | 17 | / | 80 |  |
| A61B                                | / | 17 | / | 86 |  |
| <b>NON-CLAIMED</b>                  |   |    |   |    |  |
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| <b>US ORIGINAL CLASSIFICATION</b> |                 |
| <b>CLASS</b>                      | <b>SUBCLASS</b> |
|                                   |                 |

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|----------------------------|------------------------------------------|--|--|--|--|--|
| <b>CROSS REFERENCES(S)</b> |                                          |  |  |  |  |  |
| <b>CLASS</b>               | <b>SUBCLASS (ONE SUBCLASS PER BLOCK)</b> |  |  |  |  |  |
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|----------------------------------------------------------------------------|-------------------------|------------------------------|------------------------|
| NONE                                                                       |                         | <b>Total Claims Allowed:</b> |                        |
| (Assistant Examiner)                                                       | (Date)                  | 16                           |                        |
| /ANN SCHILLINGER/<br>Primary Examiner, Art Unit 3774<br>(Primary Examiner) | 06 April 2023<br>(Date) | O.G. Print Claim(s)<br>1     | O.G. Print Figure<br>8 |

|                                                                                                                  |                                              |                                                                  |
|------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------|
| <b>Issue Classification</b><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |
|                                                                                                                  | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |

|                                                                                                                                                                                   |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|
| <input type="checkbox"/> Claims renumbered in the same order as presented by applicant <input type="checkbox"/> CPA <input type="checkbox"/> T.D. <input type="checkbox"/> R.1.47 |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |
| <b>CLAIMS</b>                                                                                                                                                                     |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |
| <b>Final</b>                                                                                                                                                                      | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> |
|                                                                                                                                                                                   | 1               |              | 10              | 3            | 19              | 12           | 28              |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 2               |              | 11              | 4            | 20              | 13           | 29              |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 3               |              | 12              | 5            | 21              | 14           | 30              |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 4               |              | 13              | 6            | 22              | 15           | 31              |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 5               |              | 14              | 7            | 23              | 16           | 32              |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 6               |              | 15              | 8            | 24              |              |                 |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 7               |              | 16              | 9            | 25              |              |                 |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 8               | 1            | 17              | 10           | 26              |              |                 |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 9               | 2            | 18              | 11           | 27              |              |                 |              |                 |              |                 |              |                 |              |                 |

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|-----------------------------------------------------------------------------------------------|--|------------------------------------|----------------------------------------------|
| NONE<br><br>(Assistant Examiner) _____ (Date) _____                                           |  | <b>Total Claims Allowed:</b><br>16 |                                              |
| /ANN SCHILLINGER/<br>Primary Examiner, Art Unit 3774<br>(Primary Examiner) _____ (Date) _____ |  | 06 April 2023<br>(Date)            | O.G. Print Claim(s) 1<br>O.G. Print Figure 8 |

|                                                                                                                 |                                              |                                                                  |
|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------|
| <b><i>Search Notes</i></b><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |
|                                                                                                                 | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |

| CPC - Searched*                                                                                                                                                                                                                                                                                                               |            |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------|
| Symbol                                                                                                                                                                                                                                                                                                                        | Date       | Examiner |
| A61F2/4081 OR A61F2/30749 OR A61F2002/30616 OR A61F2002/4085 OR A61F2/4612 OR A61F2002/30011 OR A61F2002/30433 OR A61F2002/30507 OR A61F2002/30604 OR A61F2002/30774 OR A61F2002/30827 OR A61F2002/30901 OR A61F2002/3092 OR A61F2002/3093 OR A61F2002/4659 OR A61F2002/4662 OR A61F2002/4668 OR A61F2002/4681 (text limited) | 04/06/2023 | AS       |
| A61B17/1778 OR A61B17/8605 (text limited)                                                                                                                                                                                                                                                                                     | 04/06/2023 | AS       |

| CPC Combination Sets - Searched* |      |          |
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| Symbol                           | Date | Examiner |
|                                  |      |          |

| US Classification - Searched* |          |      |          |
|-------------------------------|----------|------|----------|
| Class                         | Subclass | Date | Examiner |
|                               |          |      |          |

\* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

| Search Notes                                                               |            |          |
|----------------------------------------------------------------------------|------------|----------|
| Search Notes                                                               | Date       | Examiner |
| PE2E search, inventor name, and family search, IDS search, assignee search | 04/06/2023 | AS       |
| lp.com text search                                                         | 04/06/2023 | AS       |
| Interference search PE2E, see printout                                     | 04/06/2023 | AS       |

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| /A.S./<br>Primary Examiner, Art Unit 3774 |  |
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| <b><i>Search Notes</i></b><br><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |
|                                                                                                                     | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |

| Interference Search |                                                                                                                                                                                                                                                                                                                |            |          |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------|
| US Class/CPC Symbol | US Subclass/CPC Group                                                                                                                                                                                                                                                                                          | Date       | Examiner |
| A61F                | A61F2/4081 OR A61F2/30749 OR A61F2002/30616 OR A61F2002/4085 OR A61F2/4612 OR A61F2002/30011 OR A61F2002/30433 OR A61F2002/30507 OR A61F2002/30604 OR A61F2002/30774 OR A61F2002/30827 OR A61F2002/30901 OR A61F2002/3092 OR A61F2002/3093 OR A61F2002/4659 OR A61F2002/4662 OR A61F2002/4668 OR A61F2002/4681 | 04/06/2023 | AS       |
| A61B                | A61B17/1778 OR A61B17/8605                                                                                                                                                                                                                                                                                     | 04/06/2023 | AS       |

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| /A.S./<br>Primary Examiner, Art Unit 3774 |  |
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PTO/SB/08 Equivalent

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|----------------------------------------------------------|----------------------|---------------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> | Application No.      | 18/058058           |
|                                                          | Filing Date          | November 22, 2022   |
|                                                          | First Named Inventor | Running, Donald E.  |
|                                                          | Art Unit             | Unknown             |
| (Multiple sheets used when necessary)                    | Examiner             | Schillinger, Ann M. |
| SHEET 1 OF 12                                            | Attorney Docket No.  | SHOLD.013C1         |

| U.S. PATENT DOCUMENTS |          |                                                                           |                                |                       |                                                                                |
|-----------------------|----------|---------------------------------------------------------------------------|--------------------------------|-----------------------|--------------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br>Number - Kind Code (if known)<br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name                  | Pages, Columns, Lines Where<br>Relevant Passages or<br>Relevant Figures Appear |
|                       | 1        | 2,781,758                                                                 | 02-19-1957                     | Jacques               |                                                                                |
|                       | 2        | 3,979,778                                                                 | 09-14-1976                     | Stroot                |                                                                                |
|                       | 3        | 4,003,095                                                                 | 01-18-1977                     | Gristina              |                                                                                |
|                       | 4        | 4,045,826                                                                 | 09-06-1977                     | Stroot                |                                                                                |
|                       | 5        | 4,206,517                                                                 | 06-10-1980                     | Pappas et al.         |                                                                                |
|                       | 6        | 4,261,062                                                                 | 04-14-1981                     | Amstutz et al.        |                                                                                |
|                       | 7        | 4,404,693                                                                 | 09-20-1983                     | Zweymuller            |                                                                                |
|                       | 8        | 4,550,450                                                                 | 11-05-1985                     | Kinnett               |                                                                                |
|                       | 9        | 4,865,605                                                                 | 09-12-1989                     | Dines, et al.         |                                                                                |
|                       | 10       | 4,964,865                                                                 | 10-23-1990                     | Burkhead et al.       |                                                                                |
|                       | 11       | 4,986,833                                                                 | 01-22-1991                     | Worland               |                                                                                |
|                       | 12       | 4,990,161                                                                 | 02-05-1991                     | Kampner               |                                                                                |
|                       | 13       | 5,030,219                                                                 | 07-09-1991                     | Matsen, III, et al.   |                                                                                |
|                       | 14       | 5,032,132                                                                 | 07-16-1991                     | Matsen, III, et al.   |                                                                                |
|                       | 15       | 5,080,673                                                                 | 01-14-1992                     | Burkhead, et al.      |                                                                                |
|                       | 16       | 5,108,440                                                                 | 04-28-1992                     | Grundei               |                                                                                |
|                       | 17       | 5,282,865                                                                 | 02-01-1994                     | Dong                  |                                                                                |
|                       | 18       | 5,314,479                                                                 | 05-24-1994                     | Rockwood, Jr., et al. |                                                                                |
|                       | 19       | 5,314,489                                                                 | 05-24-1994                     | Hoffman et al.        |                                                                                |
|                       | 20       | 5,344,458                                                                 | 09-06-1994                     | Bonutti               |                                                                                |
|                       | 21       | 5,358,525                                                                 | 10-25-1994                     | Fox, et al.           |                                                                                |
|                       | 22       | 5,370,694                                                                 | 12-06-1994                     | Davidson              |                                                                                |
|                       | 23       | 5,437,677                                                                 | 08-01-1995                     | Shearer et al.        |                                                                                |
|                       | 24       | 5,462,563                                                                 | 10-31-1995                     | Shearer, et al.       |                                                                                |
|                       | 25       | 5,489,309                                                                 | 02-06-1996                     | Lackey, et al.        |                                                                                |
|                       | 26       | 5,489,310                                                                 | 02-06-1996                     | Mikhail               |                                                                                |
|                       | 27       | 5,507,819                                                                 | 04-16-1996                     | Wolf                  |                                                                                |
|                       | 28       | 5,514,184                                                                 | 05-07-1996                     | Doi                   |                                                                                |
|                       | 29       | 5,549,683                                                                 | 08-27-1996                     | Bonutti               |                                                                                |

|                                                                                                                                                                                                                                                  |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Examiner Signature                                                                                                                                                                                                                               | Date Considered |
| <b>*Examiner:</b> Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. |                 |

T<sup>1</sup> - Place a check mark in this area when an English language Translation is attached. **CATALYST, EX-1005**

PTO/SB/08 Equivalent

|                                                          |                      |                     |
|----------------------------------------------------------|----------------------|---------------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> | Application No.      | 18/058058           |
|                                                          | Filing Date          | November 22, 2022   |
|                                                          | First Named Inventor | Running, Donald E.  |
|                                                          | Art Unit             | Unknown             |
| (Multiple sheets used when necessary)                    | Examiner             | Schillinger, Ann M. |
| SHEET 2 OF 12                                            | Attorney Docket No.  | SHOLD.013C1         |

| U.S. PATENT DOCUMENTS |          |                                                                           |                                |                   |                                                                                |
|-----------------------|----------|---------------------------------------------------------------------------|--------------------------------|-------------------|--------------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br>Number - Kind Code (if known)<br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name              | Pages, Columns, Lines Where<br>Relevant Passages or<br>Relevant Figures Appear |
|                       | 30       | 5,593,448                                                                 | 01-14-1997                     | Dong              |                                                                                |
|                       | 31       | 5,702,486                                                                 | 12-30-1997                     | Craig et al.      |                                                                                |
|                       | 32       | 5,755,811                                                                 | 05-26-1998                     | Tanamal et al.    |                                                                                |
|                       | 33       | 5,769,856                                                                 | 06-23-1998                     | Dong, et al.      |                                                                                |
|                       | 34       | 5,800,551                                                                 | 09-01-1998                     | Williamson et al. |                                                                                |
|                       | 35       | 5,928,285                                                                 | 07-27-1999                     | Bigliani et al.   |                                                                                |
|                       | 36       | 6,037,724                                                                 | 03-14-2000                     | Buss et al.       |                                                                                |
|                       | 37       | 6,228,119                                                                 | 05-08-2001                     | Ondria, et al.    |                                                                                |
|                       | 38       | 6,231,913                                                                 | 05-15-2001                     | Schwimmer et al.  |                                                                                |
|                       | 39       | 6,290,726                                                                 | 09-18-2001                     | Pope, et al.      |                                                                                |
|                       | 40       | 6,334,874                                                                 | 01-01-2002                     | Tornier et al.    |                                                                                |
|                       | 41       | 6,364,910                                                                 | 04-02-2002                     | Shultz et al.     |                                                                                |
|                       | 42       | 6,368,353                                                                 | 04-09-2002                     | Arcand            |                                                                                |
|                       | 43       | 6,379,386                                                                 | 04-30-2002                     | Resch, et al.     |                                                                                |
|                       | 44       | 6,458,136                                                                 | 10-01-2002                     | Allard, et al.    |                                                                                |
|                       | 45       | 6,514,287                                                                 | 02-04-2003                     | Ondria, et al.    |                                                                                |
|                       | 46       | 6,520,964                                                                 | 02-18-2003                     | Tallarida, et al. |                                                                                |
|                       | 47       | 6,589,281                                                                 | 07-08-2003                     | Hyde, Jr.         |                                                                                |
|                       | 48       | 6,610,067                                                                 | 08-26-2003                     | Tallarida, et al. |                                                                                |
|                       | 49       | 6,620,197                                                                 | 09-16-2003                     | Maroney           |                                                                                |
|                       | 50       | 6,673,115                                                                 | 01-06-2004                     | Resch, et al.     |                                                                                |
|                       | 51       | 6,783,549                                                                 | 08-31-2004                     | Stone et al.      |                                                                                |
|                       | 52       | 6,679,916                                                                 | 01-20-2004                     | Frankle et al.    |                                                                                |
|                       | 53       | 6,679,917                                                                 | 01-20-2004                     | Ek                |                                                                                |
|                       | 54       | 6,699,289                                                                 | 03-02-2004                     | Iannotti, et al.  |                                                                                |
|                       | 55       | 6,709,463                                                                 | 03-23-2004                     | Pope et al.       |                                                                                |
|                       | 56       | 6,712,823                                                                 | 03-30-2004                     | Grusin, et al.    |                                                                                |
|                       | 57       | 6,761,740                                                                 | 07-13-2004                     | Tornier           |                                                                                |
|                       | 58       | 6,783,549                                                                 | 08-31-2004                     | Stone, et al.     |                                                                                |

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Examiner Signature                                                                                                                                                                                                                               | Date Considered |
| <b>*Examiner:</b> Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. |                 |

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PTO/SB/08 Equivalent

|                                                          |                      |                     |
|----------------------------------------------------------|----------------------|---------------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> | Application No.      | 18/058058           |
|                                                          | Filing Date          | November 22, 2022   |
|                                                          | First Named Inventor | Running, Donald E.  |
|                                                          | Art Unit             | Unknown             |
| (Multiple sheets used when necessary)                    | Examiner             | Schillinger, Ann M. |
| SHEET 3 OF 12                                            | Attorney Docket No.  | SHOLD.013C1         |

| U.S. PATENT DOCUMENTS |          |                                                                           |                                |                    |                                                                                |
|-----------------------|----------|---------------------------------------------------------------------------|--------------------------------|--------------------|--------------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br>Number - Kind Code (if known)<br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name               | Pages, Columns, Lines Where<br>Relevant Passages or<br>Relevant Figures Appear |
|                       | 59       | 6,875,234                                                                 | 04-05-2005                     | Lipman et al.      |                                                                                |
|                       | 60       | 7,011,686                                                                 | 03-14-2006                     | Ball et al.        |                                                                                |
|                       | 61       | 7,044,973                                                                 | 05-16-2006                     | Rockwood et al.    |                                                                                |
|                       | 62       | 7,238,089                                                                 | 07-03-2007                     | Tsumuraya et al.   |                                                                                |
|                       | 63       | 7,238,208                                                                 | 07-03-2007                     | Camino et al.      |                                                                                |
|                       | 64       | 7,294,149                                                                 | 11-13-2007                     | Hozack et al.      |                                                                                |
|                       | 65       | 7,320,709                                                                 | 01-22-2008                     | Felt et al.        |                                                                                |
|                       | 66       | 7,329,284                                                                 | 02-12-2008                     | Maroney et al.     |                                                                                |
|                       | 67       | 7,465,319                                                                 | 12-16-2008                     | Tornier            |                                                                                |
|                       | 68       | 7,517,364                                                                 | 04-14-2009                     | Long et al.        |                                                                                |
|                       | 69       | 7,618,462                                                                 | 11-17-2009                     | Ek                 |                                                                                |
|                       | 70       | 7,678,151                                                                 | 03-16-2010                     | Ek                 |                                                                                |
|                       | 71       | 7,749,278                                                                 | 07-06-2010                     | Frederick et al.   |                                                                                |
|                       | 72       | 7,776,098                                                                 | 08-17-2010                     | Murphy             |                                                                                |
|                       | 73       | 7,892,287                                                                 | 02-22-2011                     | Deffenbaugh        |                                                                                |
|                       | 74       | 7,922,769                                                                 | 04-12-2011                     | Deffenbaugh et al. |                                                                                |
|                       | 75       | 8,007,538<br>(SHOLD.001A)                                                 | 08-30-2011                     | Gunther            |                                                                                |
|                       | 76       | 8,038,719<br>(SHOLD.001C3)                                                | 10-18-2011                     | Gunther            |                                                                                |
|                       | 77       | 8,048,161                                                                 | 11-01-2011                     | Guederian et al.   |                                                                                |
|                       | 78       | 8,048,167                                                                 | 11-01-2011                     | Dietz et al.       |                                                                                |
|                       | 79       | 8,529,629                                                                 | 09-10-2013                     | Angibaud et al.    |                                                                                |
|                       | 80       | 8,608,805                                                                 | 12-17-2013                     | Forrer et al.      |                                                                                |
|                       | 81       | 8,778,028<br>(SHOLD.001CP1)                                               | 07-15-2014                     | Gunther et al.     |                                                                                |
|                       | 82       | 8,840,671                                                                 | 09-23-2014                     | Ambacher           |                                                                                |
|                       | 83       | 8,920,508                                                                 | 12-30-2014                     | Iannotti et al.    |                                                                                |
|                       | 84       | 8,940,054                                                                 | 01-27-2015                     | Wiley et al.       |                                                                                |
|                       | 85       | 9,283,083                                                                 | 03-15-2016                     | Winslow et al.     |                                                                                |

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Examiner Signature                                                                                                                                                                                                                               | Date Considered |
| <b>*Examiner:</b> Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. |                 |

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| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> | Application No.      | 18/058058           |
|                                                          | Filing Date          | November 22, 2022   |
|                                                          | First Named Inventor | Running, Donald E.  |
|                                                          | Art Unit             | Unknown             |
| (Multiple sheets used when necessary)                    | Examiner             | Schillinger, Ann M. |
| SHEET 4 OF 12                                            | Attorney Docket No.  | SHOLD.013C1         |

| U.S. PATENT DOCUMENTS |          |                                                                           |                                |                       |                                                                                |
|-----------------------|----------|---------------------------------------------------------------------------|--------------------------------|-----------------------|--------------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br>Number - Kind Code (if known)<br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name                  | Pages, Columns, Lines Where<br>Relevant Passages or<br>Relevant Figures Appear |
|                       | 86       | 9,381,086<br>(SHOLD.003A)                                                 | 07-05-2016                     | Ries et al.           |                                                                                |
|                       | 87       | 9,545,311                                                                 | 01-17-2017                     | Courtney, Jr. et al.  |                                                                                |
|                       | 88       | 9,545,312                                                                 | 01-17-2017                     | Tornier et al.        |                                                                                |
|                       | 89       | 9,610,166<br>(SHOLD.001P1C1)                                              | 04-04-2017                     | Gunther et al.        |                                                                                |
|                       | 90       | 9,693,784<br>(SHOLD.001C4)                                                | 07-04-2017                     | Gunther               |                                                                                |
|                       | 91       | 9,867,710                                                                 | 01-16-2018                     | Dalla Pria et al.     |                                                                                |
|                       | 92       | 10,143,559<br>(SHOLD.003C1)                                               | 12-04-2018                     | Ries et al.           |                                                                                |
|                       | 93       | 10,492,926<br>(SHOLD.006A)                                                | 12-03-2019                     | Gunther               |                                                                                |
|                       | 94       | 10,702,390                                                                | 07-07-2020                     | Chavarria et al.      |                                                                                |
|                       | 95       | 10,779,952<br>(SHOLD.001P1C2)                                             | 09-22-2020                     | Gunther et al.        |                                                                                |
|                       | 96       | 10,786,265<br>(SHOLD.001C5)                                               | 09-29-2020                     | Gunther               |                                                                                |
|                       | 97       | 11,065,125<br>(SHOLD.009A)                                                | 07-20-2021                     | Ball                  |                                                                                |
|                       | 98       | D 977,643<br>(SHOLD.014DA)                                                | 02-07-2023                     | Ball et al.           |                                                                                |
|                       | 99       | 2001/0011192                                                              | 08-02-2001                     | Ondria et al.         |                                                                                |
|                       | 100      | 2001/0037153                                                              | 11-01-2001                     | Rockwood, Jr., et al. |                                                                                |
|                       | 101      | 2001/0047210                                                              | 11-29-2001                     | Wolf                  |                                                                                |
|                       | 102      | 2002/0055783                                                              | 05-09-2002                     | Tallarida et al.      |                                                                                |
|                       | 103      | 2002/0082702                                                              | 06-27-2002                     | Resch et al.          |                                                                                |
|                       | 104      | 2002/0087213                                                              | 07-04-2002                     | Bertram, III          |                                                                                |
|                       | 105      | 2002/0095214                                                              | 07-18-2002                     | Hyde, Jr.             |                                                                                |
|                       | 106      | 2002/0111689                                                              | 08-15-2002                     | Hyde, Jr., et al.     |                                                                                |
|                       | 107      | 2002/0138148                                                              | 09-26-2002                     | Hyde, Jr., et al.     |                                                                                |
|                       | 108      | 2003/0100952                                                              | 05-29-2003                     | Rockwood, Jr. et al.  |                                                                                |
|                       | 109      | 2003/0114933                                                              | 06-19-2003                     | Bouttens et al.       |                                                                                |

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|----------------------------------------------------------|----------------------|---------------------|
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|                                                          | First Named Inventor | Running, Donald E.  |
|                                                          | Art Unit             | Unknown             |
| (Multiple sheets used when necessary)                    | Examiner             | Schillinger, Ann M. |
| SHEET 5 OF 12                                            | Attorney Docket No.  | SHOLD.013C1         |

| U.S. PATENT DOCUMENTS |          |                                                                           |                                |                   |                                                                                |
|-----------------------|----------|---------------------------------------------------------------------------|--------------------------------|-------------------|--------------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br>Number - Kind Code (if known)<br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name              | Pages, Columns, Lines Where<br>Relevant Passages or<br>Relevant Figures Appear |
|                       | 110      | 2003/0125809                                                              | 07-03-2003                     | Iannotti et al.   |                                                                                |
|                       | 111      | 2003/0144738                                                              | 07-31-2003                     | Rogalski          |                                                                                |
|                       | 112      | 2003/0158605                                                              | 08-21-2003                     | Tournier          |                                                                                |
|                       | 113      | 2003/0163202                                                              | 08-28-2003                     | Lakin             |                                                                                |
|                       | 114      | 2003/0236572                                                              | 12-25-2003                     | Bertram, III      |                                                                                |
|                       | 115      | 2004/0002766                                                              | 01-02-2004                     | Hunter et al.     |                                                                                |
|                       | 116      | 2004/0039449                                                              | 02-26-2004                     | Tournier          |                                                                                |
|                       | 117      | 2004/0039451                                                              | 02-26-2004                     | Southworth        |                                                                                |
|                       | 118      | 2004/0059424                                                              | 03-25-2004                     | Guederian, et al. |                                                                                |
|                       | 119      | 2004/0064187                                                              | 04-01-2004                     | Ball, et al.      |                                                                                |
|                       | 120      | 2004/0064189                                                              | 04-01-2004                     | Maroney, et al.   |                                                                                |
|                       | 121      | 2004/0064190                                                              | 04-01-2004                     | Ball, et al.      |                                                                                |
|                       | 122      | 2004/0107002                                                              | 06-03-2004                     | Katsuya           |                                                                                |
|                       | 123      | 2004/0122519                                                              | 06-24-2004                     | Wiley et al.      |                                                                                |
|                       | 124      | 2004/0122520                                                              | 06-24-2004                     | Lipman et al.     |                                                                                |
|                       | 125      | 2004/0167629                                                              | 08-26-2004                     | Geremakis et al.  |                                                                                |
|                       | 126      | 2004/0167630                                                              | 08-26-2004                     | Rolston           |                                                                                |
|                       | 127      | 2004/0193168                                                              | 09-30-2004                     | Long et al.       |                                                                                |
|                       | 128      | 2004/0193275                                                              | 09-30-2004                     | Long et al.       |                                                                                |
|                       | 129      | 2004/0193276                                                              | 09-30-2004                     | Maroney et al.    |                                                                                |
|                       | 130      | 2004/0193277                                                              | 09-30-2004                     | Long et al.       |                                                                                |
|                       | 131      | 2004/0193278                                                              | 09-30-2004                     | Maroney et al.    |                                                                                |
|                       | 132      | 2004/0220674                                                              | 11-04-2004                     | Pria              |                                                                                |
|                       | 133      | 2004/0230311                                                              | 11-18-2004                     | Cyprien et al.    |                                                                                |
|                       | 134      | 2004/0260398                                                              | 12-23-2004                     | Kelman            |                                                                                |
|                       | 135      | 2005/0043805                                                              | 02-24-2005                     | Chudik            |                                                                                |
|                       | 136      | 2005/0049709                                                              | 03-03-2005                     | Tornier           |                                                                                |
|                       | 137      | 2005/0065612                                                              | 03-24-2005                     | Winslow           |                                                                                |
|                       | 138      | 2005/0107882                                                              | 05-19-2005                     | Stone et al.      |                                                                                |

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|                                                          | First Named Inventor | Running, Donald E.  |
|                                                          | Art Unit             | Unknown             |
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| SHEET 6 OF 12                                            | Attorney Docket No.  | SHOLD.013C1         |

| U.S. PATENT DOCUMENTS |          |                                                                           |                                |                    |                                                                                |
|-----------------------|----------|---------------------------------------------------------------------------|--------------------------------|--------------------|--------------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br>Number - Kind Code (if known)<br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name               | Pages, Columns, Lines Where<br>Relevant Passages or<br>Relevant Figures Appear |
|                       | 139      | 2005/0119531                                                              | 06-02-2005                     | Sharratt           |                                                                                |
|                       | 140      | 2005/0177241                                                              | 08-11-2005                     | Angibaud et al.    |                                                                                |
|                       | 141      | 2005/0261775                                                              | 11-24-2005                     | Baum et al.        |                                                                                |
|                       | 142      | 2005/0278030                                                              | 12-15-2005                     | Tornier et al.     |                                                                                |
|                       | 143      | 2006/0036328                                                              | 02-16-2006                     | Parrott et al.     |                                                                                |
|                       | 144      | 2006/0069443                                                              | 03-30-2006                     | Deffenbaugh et al. |                                                                                |
|                       | 145      | 2006/0069444                                                              | 03-30-2006                     | Deffenbaugh et al. |                                                                                |
|                       | 146      | 2006/0069445                                                              | 03-30-2006                     | Ondrla et al.      |                                                                                |
|                       | 147      | 2006/0195194<br>(SHOLD.001A)                                              | 08-31-2006                     | Gunther            |                                                                                |
|                       | 148      | 2006/0200249                                                              | 09-07-2006                     | Beguin et al.      |                                                                                |
|                       | 149      | 2007/0038302                                                              | 02-15-2007                     | Shultz et al.      |                                                                                |
|                       | 150      | 2007/0050042                                                              | 03-01-2007                     | Dietz et al.       |                                                                                |
|                       | 151      | 2007/0055380                                                              | 03-08-2007                     | Berelsman et al.   |                                                                                |
|                       | 152      | 2007/0112433                                                              | 05-17-2007                     | Frederick et al.   |                                                                                |
|                       | 153      | 2007/0225817                                                              | 09-27-2007                     | Ruebelt et al.     |                                                                                |
|                       | 154      | 2007/0225818                                                              | 09-27-2007                     | Reubelt et al.     |                                                                                |
|                       | 155      | 2008/0021564<br>(SHOLD.002A)                                              | 01-24-2008                     | Gunther            |                                                                                |
|                       | 156      | 2008/0082175                                                              | 04-03-2008                     | Holovacs et al.    |                                                                                |
|                       | 157      | 2008/0177327                                                              | 07-24-2008                     | Malandain et al.   |                                                                                |
|                       | 158      | 2008/0234820                                                              | 09-25-2008                     | Felt et al.        |                                                                                |
|                       | 159      | 2009/0105837                                                              | 04-23-2009                     | LaFosse et al.     |                                                                                |
|                       | 160      | 2009/0125113                                                              | 05-14-2009                     | Guederian, et al.  |                                                                                |
|                       | 161      | 2009/0228112                                                              | 09-10-2009                     | Clark et al.       |                                                                                |
|                       | 162      | 2009/0287309                                                              | 11-19-2009                     | Walch et al.       |                                                                                |
|                       | 163      | 2010/0087876<br>(SHOLD.001C2)                                             | 04-08-2010                     | Gunther            |                                                                                |
|                       | 164      | 2010/0087877<br>(SHOLD.001C1)                                             | 04-08-2010                     | Gunther            |                                                                                |
|                       | 165      | 2010/0114326                                                              | 05-06-2010                     | Winslow et al.     |                                                                                |

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|                                                          | Art Unit             | Unknown             |
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| SHEET 7 OF 12                                            | Attorney Docket No.  | SHOLD.013C1         |

| U.S. PATENT DOCUMENTS |          |                                                                           |                                |                    |                                                                                |
|-----------------------|----------|---------------------------------------------------------------------------|--------------------------------|--------------------|--------------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br>Number - Kind Code (if known)<br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name               | Pages, Columns, Lines Where<br>Relevant Passages or<br>Relevant Figures Appear |
|                       | 166      | 2010/0161066                                                              | 06-24-2010                     | Ionetti et al.     |                                                                                |
|                       | 167      | 2010/0217399                                                              | 08-26-2010                     | Groh               |                                                                                |
|                       | 168      | 2010/0249938<br>(SHOLD.001CP1)                                            | 09-30-2010                     | Gunther et al.     |                                                                                |
|                       | 169      | 2010/0274360<br>(SHOLD.002C1)                                             | 10-28-2010                     | Gunther            |                                                                                |
|                       | 170      | 2011/0029089                                                              | 02-03-2011                     | Giuliani et al.    |                                                                                |
|                       | 171      | 2011/0106266                                                              | 05-05-2011                     | Schwyzer et al.    |                                                                                |
|                       | 172      | 2011/0112648<br>(SHOLD.001C3)                                             | 05-12-2011                     | Gunther            |                                                                                |
|                       | 173      | 2011/0137424                                                              | 06-09-2011                     | Lappin et al.      |                                                                                |
|                       | 174      | 2011/0144758                                                              | 06-16-2011                     | Deffenbaugh        |                                                                                |
|                       | 175      | 2011/0276144                                                              | 11-10-2011                     | Wirth et al.       |                                                                                |
|                       | 176      | 2011/0313533<br>(SHOLD.002C2)                                             | 12-22-2011                     | Gunther            |                                                                                |
|                       | 177      | 2012/0172996<br>(SHOLD.003A)                                              | 07-05-2012                     | Ries et al.        |                                                                                |
|                       | 178      | 2012/0209392                                                              | 08-16-2012                     | Angibuad et al.    |                                                                                |
|                       | 179      | 2012/0239156                                                              | 09-20-2012                     | De Wilde et al.    |                                                                                |
|                       | 180      | 2013/0060346                                                              | 03-07-2013                     | Collins            |                                                                                |
|                       | 181      | 2013/0090736                                                              | 04-11-2013                     | Katrana et al.     |                                                                                |
|                       | 182      | 2013/0166033<br>(SHOLD.001C4)                                             | 06-27-2013                     | Gunther            |                                                                                |
|                       | 183      | 2013/0197651                                                              | 08-01-2013                     | McDaniel et al.    |                                                                                |
|                       | 184      | 2014/0107794                                                              | 04-17-2014                     | Deffenbaugh et al. |                                                                                |
|                       | 185      | 2014/0253641                                                              | 09-11-2014                     | Furuya             |                                                                                |
|                       | 186      | 2014/0257499                                                              | 09-11-2014                     | Winslow et al.     |                                                                                |
|                       | 187      | 2015/0105861<br>(SHOLD.001P1C1)                                           | 04-16-2015                     | Gunther et al.     |                                                                                |
|                       | 188      | 2015/0223941                                                              | 08-13-2015                     | Lang               |                                                                                |
|                       | 189      | 2015/0265411                                                              | 09-24-2015                     | Deransart et al.   |                                                                                |
|                       | 190      | 2016/0045323                                                              | 02-18-2016                     | Kovacs et al.      |                                                                                |

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| SHEET 8 OF 12                                            | Attorney Docket No.  | SHOLD.013C1         |

| U.S. PATENT DOCUMENTS |          |                                                                           |                                |                    |                                                                                |
|-----------------------|----------|---------------------------------------------------------------------------|--------------------------------|--------------------|--------------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br>Number - Kind Code (if known)<br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name               | Pages, Columns, Lines Where<br>Relevant Passages or<br>Relevant Figures Appear |
|                       | 191      | 2017/0000617<br>(SHOLD.003C1)                                             | 01-05-2017                     | Ries et al.        |                                                                                |
|                       | 192      | 2017/0056187                                                              | 03-02-2017                     | Humphrey et al.    |                                                                                |
|                       | 193      | 2017/0071749                                                              | 03-16-2017                     | Lappin et al.      |                                                                                |
|                       | 194      | 2017/0202674<br>(SHOLD.001P1C2)                                           | 07-20-2017                     | Gunther et al.     |                                                                                |
|                       | 195      | 2017/0273806                                                              | 09-28-2017                     | Cardon et al.      |                                                                                |
|                       | 196      | 2017/0304063                                                              | 10-26-2017                     | Hatzidakis et al.  |                                                                                |
|                       | 197      | 2017/0360456<br>(SHOLD.001C5)                                             | 12-21-2017                     | Gunther            |                                                                                |
|                       | 198      | 2018/0071104                                                              | 03-15-2018                     | Kovacs et al.      |                                                                                |
|                       | 199      | 2018/0078377                                                              | 03-22-2018                     | Gargac et al.      |                                                                                |
|                       | 200      | 2018/0161169                                                              | 06-14-2018                     | Cardon et al.      |                                                                                |
|                       | 201      | 2018/0193150                                                              | 07-12-2018                     | Winslow et al.     |                                                                                |
|                       | 202      | 2018/0200067                                                              | 07-19-2018                     | Axelso, Jr. et al. |                                                                                |
|                       | 203      | 2018/0368982<br>(SHOLD.009A)                                              | 12-27-2018                     | Ball               |                                                                                |
|                       | 204      | 2019/0336293                                                              | 11-07-2019                     | Kehres             |                                                                                |
|                       | 205      | 2021/0038401<br>(SHOLD.009NP)                                             | 02-11-2021                     | Ball et al.        |                                                                                |
|                       | 206      | 2021/0137692                                                              | 05-13-2021                     | Budge              |                                                                                |
|                       | 207      | 2021/0137693<br>(SHOLD.011NP)                                             | 05-13-2021                     | Ball et al.        |                                                                                |
|                       | 208      | 2021/0244547<br>(SHOLD.001P1C3)                                           | 08-12-2021                     | Gunther et al.     |                                                                                |
|                       | 209      | 2021/0251640<br>(SHOLD.001C6)                                             | 08-19-2021                     | Gunther            |                                                                                |
|                       | 210      | 2021/0338446<br>(SHOLD.009C1)                                             | 11-04-2021                     | Ball               |                                                                                |
|                       | 211      | 2022/0151795<br>(SHOLD.013NP)                                             | 05-19-2022                     | Running et al.     |                                                                                |
|                       | 212      | 2022/0175543<br>(SHOLD.009C2)                                             | 06-09-2022                     | Ball               |                                                                                |

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| U.S. PATENT DOCUMENTS |          |                                                                           |                                |                |                                                                          |
|-----------------------|----------|---------------------------------------------------------------------------|--------------------------------|----------------|--------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br>Number - Kind Code (if known)<br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name           | Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear |
|                       | 213      | 2022/0175544<br>(SHOLD.009NPC1)                                           | 06-09-2022                     | Ball et al.    |                                                                          |
|                       | 214      | 2023/0078024<br>(SHOLD.001P1C4)                                           | 03-16-2023                     | Gunther et al. |                                                                          |
|                       | 215      | 2023/0080207<br>(SHOLD.001P1C5)                                           | 03-16-2023                     | Gunther et al. |                                                                          |
|                       | 216      | 2023/0081505<br>(SHOLD.001C7)                                             | 03-16-2023                     | Gunther        |                                                                          |
|                       | 217      | 13/018,341<br>(SHOLD.001C3)                                               | 01-31-2011                     | Gunther        |                                                                          |
|                       | 218      | 13/088,976<br>(SHOLD.002C2)                                               | 04-18-2011                     | Gunther        |                                                                          |
|                       | 219      | 16/701118<br>(SHOLD.006C1)                                                | 12-02-2019                     | Gunther        |                                                                          |
|                       | 220      | 29/870,666<br>(SHOLD.014DD1)                                              | 02-01-2023                     | Ball et al.    |                                                                          |

| FOREIGN PATENT DOCUMENTS |          |                                                                                       |                                |                                    |                                                                          |                |
|--------------------------|----------|---------------------------------------------------------------------------------------|--------------------------------|------------------------------------|--------------------------------------------------------------------------|----------------|
| Examiner Initials        | Cite No. | Foreign Patent Document<br>Country Code-Number-Kind<br>Code<br>Example: JP 1234567 A1 | Publication Date<br>MM-DD-YYYY | Name                               | Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear | T <sup>1</sup> |
|                          | 221      | DE 4220217                                                                            | 12-01-1993                     | S & G IMPLANTS GmbH                |                                                                          | Abs            |
|                          | 222      | DE 10164328 A1                                                                        | 07-17-2003                     | HOHMANN, ET AL.                    |                                                                          | Abs            |
|                          | 223      | EP 0299889 A2                                                                         | 01-08-1989                     | GRAMMONT                           |                                                                          |                |
|                          | 224      | EP 0339530 A2                                                                         | 11-02-1989                     | S&G IMPLANTS GMBH                  |                                                                          |                |
|                          | 225      | EP 1464305 A1                                                                         | 10-06-2004                     | DEPUY PRODUCTS, INC.               |                                                                          |                |
|                          | 226      | EP 0570816 A1                                                                         | 11-24-1993                     | MITSUBISHI ELECTRIC CORP.          |                                                                          |                |
|                          | 227      | EP 1858453 B1<br>(SHOLD.001VEP)                                                       | 11-28-2007                     | SHOULDER INNOVATIONS, LLC          |                                                                          |                |
|                          | 228      | EP 1952788 A1                                                                         | 08-06-2008                     | TORNIER                            |                                                                          |                |
|                          | 229      | EP 2083759 B1                                                                         | 09-02-2015                     | INNOVATIVE DESIGN ORTHOPAEDICS LTD |                                                                          |                |
|                          | 230      | FR 2248820 A1                                                                         | 05-23-1975                     | BENOIST GIRARD                     |                                                                          | Abs            |

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| SHEET 10 OF 12                                           | Attorney Docket No.  | SHOLD.013C1         |

| FOREIGN PATENT DOCUMENTS |          |                                                                                       |                                |                           |                                                                                   |                |
|--------------------------|----------|---------------------------------------------------------------------------------------|--------------------------------|---------------------------|-----------------------------------------------------------------------------------|----------------|
| Examiner Initials        | Cite No. | Foreign Patent Document<br>Country Code-Number-Kind<br>Code<br>Example: JP 1234567 A1 | Publication Date<br>MM-DD-YYYY | Name                      | Pages, Columns, Lines<br>Where Relevant Passages<br>or Relevant Figures<br>Appear | T <sup>1</sup> |
|                          | 231      | FR 2567019 A1                                                                         | 01-10-1986                     | FOURNIER                  |                                                                                   | Abs            |
|                          | 232      | FR 2695313 A1                                                                         | 03-11-1994                     | SOCIETE DE FABRICATION    |                                                                                   | Abs            |
|                          | 233      | JP 2013-158909                                                                        | 08-19-2013                     | SEIKO EPSON CORP.         |                                                                                   | Abs            |
|                          | 234      | JP 2014-515651                                                                        | 07-03-2014                     | ZIMMER GmbH               |                                                                                   | Abs            |
|                          | 235      | WO 2006/093763 A3<br>(SHOLD.001VPC)                                                   | 8/9/2006                       | GUNTHER                   |                                                                                   |                |
|                          | 236      | WO 2008/011078 A2                                                                     | 01-24-2008                     | GUNTHER                   |                                                                                   |                |
|                          | 237      | WO 2009/071940 A1                                                                     | 06-11-2009                     | BISHOP, ET AL.            |                                                                                   |                |
|                          | 238      | WO 2011/112425<br>(SHOLD.001P1WO)                                                     | 09-15-2011                     | SHOULDER INNOVATIONS, LLC |                                                                                   |                |
|                          | 239      | WO 2012/075183<br>(SHOLD.003WO)                                                       | 04-10-2014                     | SHOULDER INNOVATIONS, LLC |                                                                                   |                |
|                          | 240      | WO 2014/0195909                                                                       | 12-11-2014                     | LIMACORPORATE S.P.A.      |                                                                                   |                |
|                          | 241      | WO 2018/022227                                                                        | 02-01-2018                     | TORNIER INC.              |                                                                                   |                |
|                          | 242      | WO 2018/129286                                                                        | 07-12-2018                     | ZIMMER INC.               |                                                                                   | Abs            |
|                          | 243      | WO 2018/181420<br>(SHOLD.009WO)                                                       | 10-18-2018                     | SHOULDER INNOVATIONS, LLC |                                                                                   |                |
|                          | 244      | WO 2019/178104<br>(SHOLD.009WO2)                                                      | 09-19-2019                     | SHOULDER INNOVATIONS, LLC |                                                                                   |                |
|                          | 245      | WO 2019/178104                                                                        | 09-19-2019                     | SHOULDER INNOVATIONS, LLC |                                                                                   |                |
|                          | 246      | WO 2019/213073<br>(SHOLD.011WO)                                                       | 11-07-2019                     | SHOULDER INNOVATIONS, LLC |                                                                                   |                |
|                          | 247      | WO 2020/185893<br>(SHOLD.013WO)                                                       | 09-17-2020                     | SHOULDER INNOVATIONS, LLC |                                                                                   |                |

| NON PATENT LITERATURE DOCUMENTS |          |                                                                                                                                                                                                                                                                 |                |
|---------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Examiner Initials               | Cite No. | Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published. | T <sup>1</sup> |
|                                 | 248      | Biomet, "Absolute <sup>TM</sup> Bi-Polar." 2001 in 2 pages.                                                                                                                                                                                                     |                |

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Examiner Signature                                                                                                                                                                                                                               | Date Considered |
| <b>*Examiner:</b> Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. |                 |

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| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> | Application No.      | 18/058058           |
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### NON PATENT LITERATURE DOCUMENTS

| Examiner Initials | Cite No. | Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.               | T <sup>1</sup> |
|-------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|                   | 249      | Biomet, "Copeland"™ Humeral Resurfacing Head, Interlok®/HA Coated Implant Information," 2003 in 1 page.                                                                                                                                                                       |                |
|                   | 250      | Biomet, "Copeland"™ Humeral Resurfacing Head," 2001 in 12 pages.                                                                                                                                                                                                              |                |
|                   | 251      | Biomet, "Copeland™ Humeral Resurfacing Head, Macrobond™ Implant Information," 2003 in 1 page.                                                                                                                                                                                 |                |
|                   | 252      | Biomet, "Copeland™ Humeral Resurfacing Head, Surgical Technique," 2003 in 2 pages.                                                                                                                                                                                            |                |
|                   | 253      | Boileau et al., "The Three-Dimensional Geometry of the Proximal Humerus. Implications for Surgical Technique and Prosthetic Design," J. Bone Joint Surg. Br. 79: 857-865, 1997.                                                                                               |                |
|                   | 254      | Braun, et al., Modular Short-stem Prosthesis in Total Hip Arthroplasty: Implant Positioning and the Influence of Navigation, ORTHO SuperSite (Oct. 2007) in 8 pages.                                                                                                          |                |
|                   | 255      | Clavert et al. Glenoid resurfacing: what are the limits to asymmetric reaming for posterior erosion? J. Shoulder and Elbow Surg. 2007 November/December: 843-848                                                                                                              |                |
|                   | 256      | Dalla Pria, Paolo. Slide presentation, entitled "Shoulder Prosthesis Design and Evolution", to the Naples International Shoulder Congress in Italy (2000) in 55 pages.                                                                                                        |                |
|                   | 257      | DePuy, "Global C.A.P., Surgical Technique Resurfacing Humeral Head Implant," 2004 in 23 pages.                                                                                                                                                                                |                |
|                   | 258      | Inset Mini-glenoid Brochure, Titan Modular Shoulder System Brochure, Ascension Orthopedics, 2011, 4 pages                                                                                                                                                                     |                |
|                   | 259      | Karduna et al. Glenohumeral Joint Translations before and after Total Shoulder Arthroplasty. J. Bone and Joint Surg. 79(8) (1997): 1166-1174.                                                                                                                                 |                |
|                   | 260      | Redacted letter from a third party dated August 24, 2012 in 2 pages.                                                                                                                                                                                                          |                |
|                   | 261      | Levy et al., "Cementless Surface Replacement Arthroplasty of the Should. 5- to 10-year Results with the Copeland Mark-2 Prosthesis," J. Bone Joint Surg. Br. 83: 213-221, 2001.                                                                                               |                |
|                   | 262      | Lima-Lto Medical Systems Glenoidi/Glenoids catalogue (2001) in 1 page.                                                                                                                                                                                                        |                |
|                   | 263      | Lima-Lto MINIGLENOIDE CEMENTATA document 7560.50.030 (1999) in 1 page.                                                                                                                                                                                                        |                |
|                   | 264      | Panisello, et al., Bone remodelling after total hip arthroplasty using an uncemented anatomic femoral stem: a three-year prospective study using bone densitometry, J Ortho Surg 14(1):32-37 (2006)                                                                           |                |
|                   | 265      | Ross, Mark and Duke, Phillip, "Early Experience In The Use of a New Glenoid Resurfacing Technique" Glenoid Presentation, SESA November 4, 2006, Session 4/0800-0930 p. 93 in 1 page.                                                                                          |                |
|                   | 266      | Tight Fit Tools, Right Angle Drill Attachment, Serial No. 00400 www.tightfittools.com/riganat.html in 1 page/downloaded March 11, 2005.                                                                                                                                       |                |
|                   | 267      | TITAN™ Modular Shoulder System Brochure, 2011, available at <a href="http://www.ascensionortho.com/Assets/PDF/TitanModular/TITANModularShoulder_Brochure-revD.pdf">http://www.ascensionortho.com/Assets/PDF/TitanModular/TITANModularShoulder_Brochure-revD.pdf</a> (2 pages) |                |

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### NON PATENT LITERATURE DOCUMENTS

| Examiner Initials | Cite No. | Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published. | T <sup>1</sup> |
|-------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|                   | 268      | Tournier et al., Enhancement of Glenoid Prosthesis Anchorage using Burying Technique. Techniques in Shoulder & Elbow Surgery 9(1)(2008): 35-42.                                                                                                                 |                |
|                   | 269      | Wang et al., Biomechanical Evaluation of a Novel Glenoid Design in Total Shoulder Arthroplasty. J. Shoulder & Elbow Surgery (2005) 15: 129S-140S.                                                                                                               |                |
|                   | 270      | Statement of Grounds and Particulars of Opposition for Australian Patent Application No. 2006218936 dated October 5, 2012 in 8 pages.                                                                                                                           |                |

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A. **PAGE 285**

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(54) **GLENOID IMPLANT**

(57) The glenoid implant includes a base plate and an articular component. The base plate can include a body and a support structure extending from a distal surface of the body. The body can include a plurality of openings. The articular component can be configured to removably couple to the base plate. The articular component can include a recessed portion configured to at least partially receive the body of the base plate. At least one

engagement structure can protrude from a distal facing surface of the recessed portion. Each engagement structure can correspond to one of the plurality of openings in the body. A proximal surface of the base plate is spaced apart from the distal facing surface of the recessed portion when the articular component is coupled to the base plate.

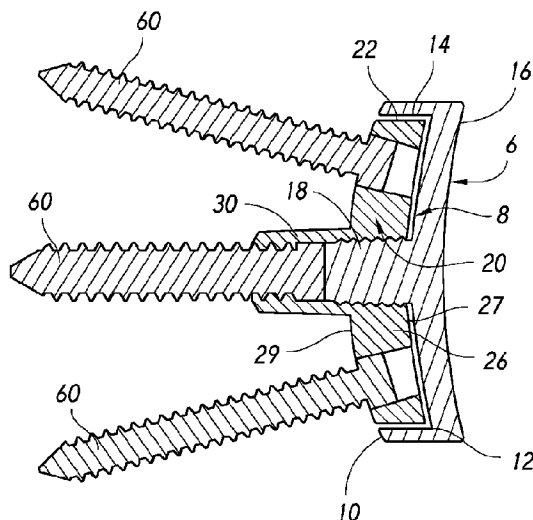


**FIG. 2B**

**EP 3 090 705 A1**

## Description

### Field

**[0001]** The present disclosure relates to a glenoid implant of a shoulder joint prosthesis.

### Description of the Related Art

**[0002]** In a shoulder joint, the head of the humerus interacts with the glenoid cavity of the scapula in a manner similar to a "ball and socket" joint. Over time, it may become necessary to replace the shoulder joint with a prosthetic shoulder joint including a glenoid implant.

**[0003]** The glenoid implant typically includes an articular component that is adapted to articulate with the head of a humeral component, for example, the anatomical head of the humerus or a portion of a humeral implant. In some cases, the glenoid implant may provide an anatomical configuration in which the articular component includes a cavity that replaces the glenoid cavity. In other cases, the glenoid implant may provide a reversed configuration in which the articular component includes a hemispherical dome that cooperates with a complementary cavity defined by a humeral implant.

## SUMMARY

**[0004]** Some glenoid implants can include a base plate for fixing the articular body to the glenoid. The base plate can be permanently secured in the glenoid by the surgeon before an articular component is positioned on the base plate. In some cases, the glenoid implant needs to be replaced. The base plate remains coupled to the glenoid and the articular body is replaced. The surgeon may provide a new articular component of a different configuration. For example, the implant may be converted from an anatomical configuration to a reversed configuration.

**[0005]** When the base plate is positioned on the subchondral bone, the combination of the base plate and the articular component (e.g., a glenoid component or a reverse component) can be too thick and further displace the glenoid from the humeral component.

**[0006]** In some cases, a base plate can be at least partially loaded into the glenoid, such that a distal facing surface of the base plate is positioned in the glenoid and beyond the subchondral bone. However, milling the glenoid to insert the base plate can be difficult and require removal of a large portion of the bone. Further, loading the glenoid implant into the glenoid leaves no subchondral bone support behind the base plate. Since there is no subchondral support behind the glenoid implant, surgeons cannot lag screws to achieve the desired compression and the glenoid implant can subside. Thus, it can be desirable for the base plate to be positioned on the subchondral bone to avoid milling the bone. Positioning the base plate on the subchondral bone can also lag the screws into the glenoid to achieve initial fixation.

**[0007]** The base plate may include metal, such as a titanium alloy, while the articular body can include a synthetic material, such as polyethylene. However, the direct interaction between the metal base plate and synthetic articular body can cause the synthetic articular body to wear and displace the articular surface of the glenoid component. Thus, it may be desirable for a proximal surface of the base plate to be spaced apart from a distal facing surface of the articular component when the articular component is coupled to the base plate.

**[0008]** Certain aspects of the disclosure are directed toward a glenoid implant including a base plate and an articular component configured to removably couple to the base plate. The base plate can include a body and a support structure extending from a distal surface of the body. The body can include a plurality of openings. The articular component can include a recessed portion configured to at least partially receive the body of the base plate. At least one engagement structure can protrude from a distal facing surface of the recessed portion. Each engagement structure can correspond to one of the plurality of openings in the body. In certain aspects, a proximal surface of the base plate can be spaced apart from the distal facing surface of the recessed portion when the articular component is coupled to the base plate, and/or a distal face of the articular component surrounding the recessed portion can be configured to abut the subchondral bone.

**[0009]** Certain aspects of the disclosure are directed toward methods of implanting a glenoid implant. The method can include inserting a base plate into a glenoid cavity such that a support structure of the base plate is inserted into a subchondral bone portion and a body of the base plate is positioned thereon a subchondral bone surface. The body can include a plurality of openings. A screw can be advanced through one of the plurality of openings and into the subchondral bone. A first articular component can be secured to the base plate such that a recessed portion of the first articular component is advanced over the body of the base plate and an engagement member of the first articular component is inserted into a corresponding opening of the plurality of openings.

**[0010]** The above-mentioned method can further include removing the first articular component from the base plate and securing a second articular component to the base plate. The first articular component can be a glenoid component and the second articular component can be a reverse component.

**[0011]** Certain aspects of the disclosure are directed toward a glenoid system including a base plate, a glenoid component, and a reverse component. The base plate can include a body and a support structure extending from a distal surface of the body. The body can include a plurality of openings. The glenoid component can be configured to removably couple to the base plate and can include a recessed portion configured to at least partially receive the body of the base plate. A proximal surface of the base plate can be spaced apart from a distal

facing surface of the anatomical recessed portion when the glenoid component is coupled to the base plate. The reverse component can be configured to removably couple to the base plate and can include a reverse recessed portion configured to at least partially receive the body of the base plate. The proximal surface of the base plate can be spaced apart from a distal facing surface of the reverse recessed portion when the reverse component is coupled to the base plate.

**[0012]** Any feature, structure, or step disclosed herein can be replaced with or combined with any other feature, structure, or step disclosed herein, or omitted. Further, for purposes of summarizing the disclosure, certain aspects, advantages, and features of the inventions have been described herein. It is to be understood that not necessarily any or all such advantages are achieved in accordance with any particular embodiment of the inventions disclosed herein. No individual aspects of this disclosure are essential or indispensable.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0013]** Various embodiments are depicted in the accompanying drawings for illustrative purposes, and should in no way be interpreted as limiting the scope of the embodiments. Furthermore, various features of different disclosed embodiments can be combined to form additional embodiments, which are part of this disclosure.

Figure 1 represents a cross-sectional view of a prior art embodiment of modular glenoid implant.

Figure 2A illustrates a bottom perspective view of an embodiment of a glenoid implant.

Figure 2B illustrates a cross-section of the glenoid implant shown in Figure 2A taken along line 2B-2B. Figure 2C illustrates an exploded view of the glenoid implant shown in Figure 2A.

Figure 2D illustrates an embodiment of a reverse component that can interface with the base plate shown in Figures 2A-2C.

Figure 2E illustrates a cross-section of an embodiment of a glenoid implant including the reverse component shown in Figure 2D.

Figure 2F illustrates an exploded view of the reverse glenoid implant shown in Figure 2E.

Figure 3A illustrates a base plate secured to a glenoid.

Figure 3B illustrates a glenoid component secured to the base plate shown in Figure 3A. Figure 3C illustrates a cross-section of the glenoid implant shown in Figure 3B taken along line 3C-3C.

Figure 3D illustrates a perspective view of the reverse glenoid implant of FIGS 2D-2F secured to the glenoid.

Figure 4A illustrates a cross-section of another embodiment of a glenoid implant.

Figure 4B illustrates a bottom perspective view of the glenoid component shown in Figure 3A.

Figure 4C illustrates a bottom perspective view of the base plate shown in Figure 3B.

Figure 4D illustrates a bottom perspective view of an embodiment of a reverse component that can interface with the base plate shown in Figure 4C.

Figure 4E illustrates an exploded view of the glenoid implant shown in Figure 4A.

Figure 5A illustrates a cross-section of another embodiment of a glenoid implant.

Figure 5B illustrates a bottom perspective view of the glenoid component shown in Figure 4A.

Figure 5C illustrates a bottom perspective view of the base plate shown in Figure 4A.

Figure 5D illustrates a bottom perspective view of another embodiment of a reverse component that can interface with the base plate shown in Figure 4C.

Figure 5E illustrates an exploded view of the glenoid implant shown in Figure 5A.

Figure 5F illustrates an exploded view of a reverse glenoid implant with the reverse component shown in Figure 5D.

#### DETAILED DESCRIPTION

**[0014]** Some glenoid implants can include a base component for fixing the articular body to the glenoid. The base component can be permanently secured in the glenoid by the surgeon, for example by using screws, before an articular component is positioned on the base plate. In some cases, the glenoid implant needs to be replaced. The base component remains coupled to the glenoid and the articular body is replaced. The surgeon may provide a new articular component of a different configuration. For example, the implant may be converted from an anatomical configuration to a reversed configuration.

**[0015]** Glenoid components known in the art have typically been constructed from metal. Figure 1 illustrates one such example of a glenoid component 1100 having a metal body 1105 and a metal base plate 900. The body 1105 defines circumferential recess 1107, which extends from the medial side 1102 towards the lateral side 1104. The tapered trunnion 1106 extends from the base 1109 of recess 1107 towards the medial side 1102, tapers from base 1009 to its proximal end, and is adapted to be received and attached to the tapered cavity 910 of the baseplate 900. Recess 1107 is adapted to receive a portion, or the entirety of, the body 902 of the baseplate 900.

#### Single Engagement Structure

**[0016]** Figures 2A-2F illustrate glenoid implants 2, 1002 that can be implanted in a glenoid. Each of the glenoid implants 2, 1002 can include an articular component (e.g., a glenoid component 6 or a reverse component 40) removably secured to a base plate 20. For example, the glenoid implant 2 can include a glenoid component 6 configured to be removably coupled to the base plate 20 (see Figures 2A and 2B).

**[0017]** As shown in Figure 2C, the base plate 20 can include a body 26 and a support structure 30. The body 26 can include an outer peripheral wall 22 having generally curved and/or flat surfaces. The outer peripheral wall 22 can extend between a lateral surface 27 (or proximal face) and a medial surface 29 (or distal face) of the body 26 (see Figure 2C). A thickness of the body 26 can be defined from the lateral surface 27 to the medial surface 29 of the body 26. A length  $L_1$  of the body 26 can be defined from a superior edge 23 of the body 26 to an inferior edge 25 of the body 26 (see Figure 2C) and extend along an axis generally perpendicular to a longitudinal axis of the glenoid implant 2 when the implant 2 is secured to the glenoid (see Figures 3A and 3B). A width  $W_1$  of the body 26 can be measured perpendicular to the length  $L_1$ .

**[0018]** The body 26 can be generally elongate. For example, the body 26 can be generally rectangular, generally elliptical, or any other elongate shape. A length  $L_1$  of the body 26 can be substantially longer than a width  $W_1$  of the body 26, e.g., the length  $L_1$  can be at least about three times longer than the width  $W_1$ , at least about four times longer than the width  $W_1$ , or more (see Figure 2C).

**[0019]** The body 26 can include a plurality of openings 32 (e.g., two, three, four, five, or more). At least some or all of the plurality of openings 32 can be aligned along the length  $L_1$  of the body 26. For example, as shown in Figure 2C, the body 26 can include three openings 32a, 32b, 32c aligned along the length  $L_1$  of the body 26. One or more of the openings 32 may be threaded on an internal wall thereof and adapted to engage a screw 60 (e.g., having a single lead, double lead, triple lead, or other number of leads and/or right or left-handed threads).

**[0020]** The support structure 30 can extend from the medial surface 29 of the body 26 and extend generally perpendicular to the body 26 (see Figure 2C). The support structure 30 can include a circumferential wall portion extending from a proximal portion 30a to a distal portion 30b of the support structure 30. The wall portion can include an exterior surface 31a and an interior surface 31b defining a lumen extending through the support structure 30. The exterior surface 31a can be generally smooth and without any threads, ribs, grooves, or other structures. The interior surface 31b can be threaded and adapted to engage a screw 60 and/or an engagement structure 18 of the glenoid component 6.

**[0021]** The lumen of the support structure 30 can be aligned with one of the openings 32. In some instances, as shown in Figure 2C, the opening 32b aligned with the lumen of the support structure 30 can have a larger diameter than the peripheral openings 32a, 32c. Accordingly, a larger screw 60 can be advanced through the support structure opening 32b than the peripheral openings 32a, 32c.

**[0022]** As shown in Figure 2C, the support structure 30 can taper from the proximal portion 30a toward the distal portion 30b. For example, the support structure 30

can be generally frustoconical and/or include a chamfer edge at the distal portion 30b of the support structure 30. In certain variants, the support structure 30 can be generally cylindrical and include a generally uniform diameter.

**[0023]** Figure 2C also illustrates an embodiment of the glenoid component 6 adapted to engage the base plate 20. The glenoid component 6 can include a lateral surface 16 (or proximal face) and a medial surface 10 (or distal face). The medial surface 10 can have a recessed portion 8 with a peripheral wall 14 and a medial-facing surface 12 (or distal-facing surface). The recessed portion 8 can be shaped and sized to receive at least a partial thickness of the body 26. More particularly, when assembled, the lateral surface 27 of the base plate 8 can be positioned adjacent to and spaced away from the medial-facing surface 12 of the recessed portion 8.

**[0024]** The recessed portion 8 can have generally the same shape as the body 26 such that the recessed portion can at least partially or entirely receive the body 26 therein. For instance, the recessed portion 8 can have a generally elongate shape. A length  $L_2$  of the recessed portion 8 can be substantially longer than a width  $W_2$  of the body 26, e.g., the length  $L_2$  can be at least about three times longer than the width  $W_2$ , at least about four times longer than the width  $W_2$ , or more. In embodiments, the shape of the recessed portion 8 is complementary to the body 26, such that the recessed portion is shaped to receive the body 26 therein. The recessed portion 8 can be centrally located with respect to the glenoid component 6.

**[0025]** The length  $L_2$  and/or width  $W_2$  of the recessed portion 8 can be greater than the length  $L_1$  and/or width  $W_1$  of the body 26, respectively (see Figure 2C), such that a space remains between the peripheral walls 14 of the recessed portion 8 and the outer peripheral wall 22 of the body 26 when the glenoid implant 2 is fully assembled (see Figure 2B). A thickness of the peripheral wall 14 of the recessed portion 8 can be greater than a thickness of the peripheral wall 22 of the body 26, such that when the glenoid implant 2 is fully assembled, a space remains between the lateral surface 27 of the body 26 and the medial-facing surface 12 of the recessed portion 8. When the implant 2 is fully assembled, the medial surface 29 of the body 26 can be aligned or flush with the medial surface 10 of the glenoid component 6.

**[0026]** The spacing between the recessed portion 8 and the body 26 can prevent wear between the glenoid component 6 and the base plate 20, particularly when the base plate 20 comprises a metal (e.g., a titanium alloy) and when the glenoid component 6 comprises a polymer (e.g., polyethylene). Although not shown, the space between the recessed portion 8 and the body 26 can be filled with a shock absorbing material, such as polymers and copolymers, including, but not limited to silicones and polyurethanes.

**[0027]** At least one engagement structure 18 (e.g., one, two, three, four, five or more engagement struc-

tures) can extend from the medial-facing surface 12 of the recessed portion 8 and extend generally perpendicular to the length  $L_2$  of the recessed portion 8. Each engagement structure 18 can be a peg, a barb, a screw, or other protruding structure, configured to be received by one of the openings 32 of the body 26 by a screw fit, snap fit, interference fit, or otherwise. As shown in Figure 2C, the glenoid component 6 can include a single engagement structure 18 configured to interface with the opening 32b and/or the support structure 30.

**[0028]** Each engagement structure 18 can include an outer wall portion that can be threaded to threadably engage of the openings 32. The outer wall portion can extend from a proximal portion 19a to a distal portion 19b of the engagement structure 18. A length of the engagement structure 18 can be greater than a thickness of the recessed portion 8, such that the distal portion 19b of the engagement structure 18 extends distally of the medial surface 10 of the glenoid component 6. The distal portion 19b of the engagement structure 18 can be tapered to facilitate insertion of the engagement structure 18 into one of the openings 32 and/or the support structure 30.

**[0029]** As shown in Figures 2E and 2F, a reverse component 40 can interface with the base plate 20 shown in Figures 2A-2C to form the glenoid implant 1002. The reverse component 40 can include a medial surface 46 (or distal surface) and an articulating surface 44 configured to interface with a portion of a humeral component. The medial surface 46 can include a recessed portion 42 having a peripheral wall 50 and a medial-facing surface 52 (or distal-facing surface).

**[0030]** The recessed portion 42 can be eccentric with respect to the reverse component 40. For example, the recessed portion 42 can be closer to an inferior anatomic edge of the reverse component 40 than to a superior anatomic edge of the reverse component 40. The reverse component 40 can be placed more inferior on the glenoid surface than the glenoid component 6 to prevent scapular notching. The medial surface 46 of the reverse component 40 can be curved to fit the curve of the glenoid.

**[0031]** The recessed portion 42 can be shaped and sized to receive at least a partial thickness of the body 26. For instance, the recessed portion 42 can have a generally elongate shape. A  $L_3$  of the recessed portion 42 can be substantially longer than a width  $W_3$  of the body 26, e.g., the length  $L_3$  can be at least about three times longer than the width  $W_3$ , at least about four times longer than the width  $W_3$ , or more. A width  $W_4$  of a section of the recessed portion 42 surrounding the engagement structure 48 can be greater than the width  $W_3$  at another section of the recessed portion 42. A thickness of the recessed portion 42 surrounding the engagement structure 48 can be greater than a thickness of the recessed portion 42 at other sections of the recessed portion 42.

**[0032]** The recessed portion 42 can be larger than the body 26, such a space remains between the recessed portion 8 and the body 26 when the implant 1002 is fully assembled (see Figure 2E). For example, the lateral sur-

face 27 of the body 26 can be spaced apart from the medial-facing surface 52 of the recessed portion 42 and/or the peripheral walls 22 of the body 26 can be spaced apart from the peripheral walls 50 of the recessed portion 42. When the implant 1002 is fully assembled, the medial surface 29 of the body 26 can be aligned or flush with the medial surface 46 of the reverse component 40 (See Figure 2E). Although not shown, the space between the recessed portion 8 and the body 26 can be filled with a shock absorbing material, such as polymers and copolymers, including but not limited to silicone and polyurethane.

**[0033]** At least one engagement structure 48 (e.g., one, two, three, four, five or more engagement structures) can protrude from the medial-facing surface 52 of the recessed portion 42 and extend generally perpendicular to the length  $L_3$  of the recessed portion 42. Each engagement structure 48 can be a peg, a barb, a screw, or other protruding structure, configured to be received by one of the openings 32 by a screw fit, snap fit, interference fit or otherwise. As shown in Figure 2D, the reverse component 40 can include a single, engagement structure 48 configured to interface with the opening 32b and/or the support structure 30.

**[0034]** Each engagement structure 48 can include an outer wall portion that can be threaded to threadably engage of the openings 32. The outer wall portion can extend from a proximal portion 48a to a distal portion 48b of the engagement structure 48. A length of the engagement structure 48 can be greater than a thickness of the recessed portion 42, such that the distal portion 48b of the engagement structure 48 extends distally of the medial surface 46 of the reverse component 40. The distal portion 48b of each engagement structure 18 can be tapered to facilitate insertion of the engagement structure 18 into one of the openings 32 and/or the support structure 30.

**[0035]** Figures 3A-3C illustrate the glenoid implant 2 secured to the glenoid G. As shown in Figure 3A, the base plate 20 can be secured to the glenoid G with the length of the body 26 extending in a superior-inferior direction. After the base plate 20 has been secured to the glenoid G using one or more screws 60, the glenoid component 6 can be secured over the base plate 20 (see Figure 3B). When the glenoid component 6 is coupled to the base plate 20, a peripheral edge of the glenoid component 6 can form an entire peripheral edge of the glenoid implant 2. That is to say, the entire peripheral edge exterior to the glenoid G (e.g., from the lateral surface 16 to the medial surface 10 of the glenoid implant) can be the glenoid component 6 wherein the base plate 20 is captured between the glenoid component 6 and the glenoid G.

**[0036]** As shown in Figure 2B, the medial surface 29 of the body 26 can be substantially flush with the medial surface 10 of the glenoid component 6 when the glenoid implant 2 is assembled. In this configuration, the medial surface 10 of the glenoid component 6 and the medial

surface 29 of the body 26 can be configured to abut the subchondral bone S. That is to say, at least a portion of each of the medial surface 10 of the glenoid component 6 and the medial surface 29 of the body 26 are in direct contact with the subchondral bone S. When the medial surface 29 of the body 26 is positioned on the subchondral bone S, a surgeon can lag one or more screws 60 into the subchondral bone S to achieve the desired compression and fix the base plate 20 to the glenoid G. Additionally, since the medial surface 29 of the body can be positioned on the subchondral bone S, it is unnecessary to mill or ream the glenoid G before inserting the glenoid implant 2.

**[0037]** Figure 3D illustrates a perspective view of the glenoid implant 1002 secured to the glenoid G for use in a reverse shoulder arthroplasty. The glenoid implant 1002 includes the reverse component 40, baseplate 20, and screws 60. The reverse component 40 can be secured to the same base plate 20 shown in Figures 3A-3C. When the reverse component 40 is secured to the base plate 20, the medial surface 46 of the reverse component 40 can be configured to abut the subchondral bone S.

#### Multiple, Aligned Engagement Structures

**[0038]** Figures 4A-4E illustrate additional embodiments of the glenoid components. The glenoid components resemble or are identical to the glenoid components discussed above except as described below. Accordingly, numerals used to identify features of the glenoid components shown in Figures 2A-2E are incremented by a factor of one hundred (100) to identify like features of the glenoid components shown in Figures 4A-4E. Any component or step disclosed in any embodiment in this specification can be used in other embodiments.

**[0039]** The glenoid component 106 can include a plurality of engagement structures 118 (e.g., two, three, four, five, or more engagement structures). Each engagement structure 118 can be similar to the engagement structure 18 described above. The number of the engagement structures 118 can be the same as the number of openings 132 in the base plate 120. At least some of the engagement structures 118 can be aligned along a transverse axis of the glenoid component 106.

**[0040]** As shown in Figures 4A and 4E, the glenoid component 106 can include three engagement structures 118a, 118b, 118c aligned along the length of the recessed portion 108. Each engagement structure 118a, 118b, 118c can interface with the respective corresponding opening 132a, 132b, 132c. The central engagement structure 118b can be longer than the peripheral engagement structures 118a, 118c.

**[0041]** The base plate 120 can include a plurality of support structures 130a, 130b, 130c extending from the medial surface 129 of the body 126. Each of the support structures 130a, 130b, 130c can include features similar to the support structure 30 described above and be

aligned with one of the openings 132a, 132b, 132c. Each support structure 130a, 130b, 130c can be configured to receive a corresponding engagement structure 118a, 118b, 118c. A length of the support structures 130a, 130b, 130c can be sufficient to accommodate a proximal portion of a screw 160 and the corresponding engagement structure 118a, 118b, 118c (see Figure 4A). A central support structure 130b can be longer than peripheral support structures 130a, 130c.

**[0042]** Figure 4D illustrates a reverse component 140 that can interface with the base plate 120 shown in Figure 4C. As shown, the reverse component 140 can include a single engagement structure 148. However, in other embodiments, the reverse component 140 can include a plurality of engagement structures 148 (e.g., two, three, four, five, or more engagement structures). The number of engagement structures 148 can correspond to the number of openings 132 in the base plate 120. At least some of the engagement structures 148 can be aligned along a transverse axis of the reverse component 140. As one example, the reverse component 140 can include three engagement structure 148 aligned along the transverse axis of the reverse component 140.

#### Lateral Engagement Structures

**[0043]** Figures 5A-5F illustrate additional embodiments of the glenoid components. The glenoid components resemble or are identical to the glenoid components discussed above in many respects. Accordingly, numerals used to identify features of the glenoid components shown in Figures 4A-4E are incremented by a factor of 100 hundred (100) to identify like features of the glenoid components shown in Figures 5A-5F. This numbering convention generally applies to the remainder of the figures. Any component or step disclosed in any embodiment in this specification can be used in other embodiments.

**[0044]** As shown in Figure 5B, the glenoid component 206 can include a plurality of engagement structures 218 (e.g., two, three, four, five, or more engagement structures). Each engagement structure 218 can be similar to the engagement structure 18 described above. The number of engagement structures 218 can be the same as the number of openings 232 in the base plate 220 (see Figures 5E). At least some of the engagement structures 218 can be aligned along a transverse axis of the glenoid component 206. For example, at least three engagement structures 218a, 218b, 218c can be aligned along the transverse axis of the glenoid component 206. Additional engagement structures 218d, 218e can be laterally displaced from the aligned engagement structures 218a, 218b, 218c and/or from a central transverse axis A (see Figure 5B). The laterally displaced engagement structures 218d, 218e can be positioned such that the arrangement of engagement structures 218 is symmetrical about an axis extending through the aligned engagement structures 218a, 218b, 218c. The laterally displaced



engagement structures 218d, 218e can be offset from the aligned engagement structures 218a, 218b, 218c, for example, the laterally displaced engagement structures 218d, 218e can be positioned between the engagement structures 218b, 218c.

**[0045]** As shown in Figure 5C, the base plate 220 can include laterally displaced openings 232d, 232e to accommodate the laterally displaced engagement structures 218d, 218e. For example, the base plate 220 can include three openings 232a, 232b, 232c aligned along the transverse axis of the base plate 220 and two openings 232d, 232e displaced from the aligned openings 232a, 232b, 232c. The laterally displaced openings 232d, 232e can be positioned such that the arrangement of openings 232 is symmetrical about the aligned openings 232a, 232b, 232c. The laterally displaced openings 232d, 232e can be offset from the aligned openings 232a, 232b, 232c, for example, the laterally displaced openings 232d, 232e can be positioned between the engagement structures 232b, 232c.

**[0046]** The base plate 220 can include a plurality of support structures 230a, 230b, 230c extending from the medial surface 229 of the body 226. Each of the support structures 230a, 230b, 230c can include features similar to the support structure 30 described above and can be aligned with one of the openings 232. At least some of the openings 232 can provide access to a corresponding support structure 230a, 230b, 230c. As shown in Figure 5C, the support structures 230a, 230b, 230c can extend from the aligned openings 232a, 232b, 232c, but not the laterally displaced openings 232d, 232e. However, other quantities of support structures can be imagined, for example, the number of support structures can be the same as the number of openings.

**[0047]** Figure 5E illustrates a reverse component 240 that can interface with the base plate 220 shown in Figure 5C. The reverse component 240 can include a recessed portion 242 that can be sized to accommodate the base plate 230, including the laterally displaced openings 218e, 218d.

**[0048]** As shown in Figures 5E and 5F, the reverse component 240 can include a single engagement structure 248 similar to engagement structure 48. However, in other embodiments, the reverse component 240 can include a plurality of engagement structures 248 (e.g., two, three, four, five, or more engagement structures). The number of engagement structures 248 can correspond to the number of openings 232 and/or support structures 230a, 230b, 230c in the base plate 220. At least some of the engagement structures 248 can be aligned along a transverse axis of the reverse component 240, similar to the engagement structures 218a, 218b, 218c in Figure 5B. As one example, the reverse component 240 can include three engagement structures 248 aligned along the transverse axis of the reverse component 240. As another example, a subset of the engagement structures 248 can be aligned along the transverse axis of the reverse component 240, while additional en-

gagement structures 248 can be laterally displaced from the aligned engagement structures 248, e.g., to correspond with the arrangement of openings 232 in the base plate 220. Accordingly, the section of the recessed portion 248 accommodating the laterally displaced openings 232d, 232e can be wider than a remaining section of the recessed portion 248.

#### Method of Implantation

**[0049]** Referring back to the glenoid implants 2, 1002 shown in Figures 3A-3D, in use, the base plate 20 can be secured to the glenoid G by inserting a support structure 30 of the base plate 20 into a subchondral bone portion S and positioning a medial surface 29 of the body 26 of the base plate 20 on the subchondral bone surface S. As shown in Figure 3A, the body 26 can be positioned such that the length of the body 26 extends in the superior-inferior direction. A screw 60 can be advanced through at least one of the plurality of openings 32 of the body 26 and into the subchondral bone S.

**[0050]** The glenoid component 6 can be secured to the base plate 20 by advancing the recessed portion 8 of the glenoid component 6 over the body 26 of the base plate 20 and inserting an engagement member 18 of the glenoid component 6 into a corresponding opening of the plurality of openings 32 (e.g., the opening 32b extending through the support structure 30). A proximal portion of a screw 60 and the engagement structure 18 can be positioned in the support structure 30. A space is maintained between the lateral surface 27 of the body 26 and the medial-facing surface 12 of the recessed portion 8 and/or the peripheral wall 22 of the body 26 and the peripheral wall 14 of the recessed portion 8. After the glenoid component 6 is advanced over the base plate 30, the medial 10 of the glenoid component 6 can abut the subchondral bone S.

**[0051]** It may become necessary to remove the glenoid component 6 from the base plate, for example, if the glenoid implant 2 begins to wear or the bone further deteriorates. The reverse component 40 can be secured to the base plate 20 to form the glenoid implant 1002.

**[0052]** Although this method is described in the context of the glenoid components shown in Figures 3A-3D, a similar method can be used to implant glenoid implants 102 and 202.

#### Terminology

**[0053]** Although certain embodiments have been described herein with respect to an anatomic component or a reverse component, the implants and methods described herein can interchangeably use any articular component, including the anatomic and reverse components described herein, as the context may dictate.

**[0054]** As used herein, the relative terms "proximal" and "distal" shall be defined from the perspective of the implant. Thus, proximal refers to the direction of the ar-

ticular component and distal refers to the direction of the base plate when the implant is assembled.

**[0055]** Note that the terms "first" and "second" articular components can be used interchangeably and to refer to the anatomic components or the reverse components. Accordingly, the "first" and "second" openings can be used interchangeably and to refer to any one of the openings in the baseplate.

**[0056]** Conditional language, such as "can," "could," "might," or "may," unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include, while other embodiments do not include, certain features, elements, and/or steps. Thus, such conditional language is not generally intended to imply that features, elements, and/or steps are in any way required for one or more embodiments.

**[0057]** The terms "comprising," "including," "having," and the like are synonymous and are used inclusively, in an open-ended fashion, and do not exclude additional elements, features, acts, operations, and so forth. Also, the term "or" is used in its inclusive sense (and not in its exclusive sense) so that when used, for example, to connect a list of elements, the term "or" means one, some, or all of the elements in the list.

**[0058]** The terms "approximately," "about," and "substantially" as used herein represent an amount close to the stated amount that still performs a desired function or achieves a desired result. For example, the terms "approximately," "about," and "substantially" may refer to an amount that is within less than 10% of the stated amount, as the context may dictate. As an example, in certain embodiments, the term "generally perpendicular" refers to a value, amount, or characteristic that departs from exactly perpendicular by less than about 10 degrees.

**[0059]** Although certain embodiments and examples have been described herein, it will be understood by those skilled in the art that many aspects of the glenoid implants shown and described in the present disclosure may be differently combined and/or modified to form still further embodiments or acceptable examples. All such modifications and variations are intended to be included herein within the scope of this disclosure. A wide variety of designs and approaches are possible. No feature, structure, or step disclosed herein is essential or indispensable.

**[0060]** Some embodiments have been described in connection with the accompanying drawings. However, it should be understood that the figures are not drawn to scale. Distances, angles, etc. are merely illustrative and do not necessarily bear an exact relationship to actual dimensions and layout of the devices illustrated. Components can be added, removed, and/or rearranged. Further, the disclosure herein of any particular feature, aspect, method, property, characteristic, quality, attribute, element, or the like in connection with various embodiments can be used in all other embodiments set forth herein. Additionally, it will be recognized that any meth-

ods described herein may be practiced using any device suitable for performing the recited steps.

**[0061]** For purposes of this disclosure, certain aspects, advantages, and novel features are described herein. It is to be understood that not necessarily all such advantages may be achieved in accordance with any particular embodiment. Thus, for example, those skilled in the art will recognize that the disclosure may be embodied or carried out in a manner that achieves one advantage or a group of advantages as taught herein without necessarily achieving other advantages as may be taught or suggested herein.

**[0062]** Moreover, while illustrative embodiments have been described herein, the scope of any and all embodiments having equivalent elements, modifications, omissions, combinations (e.g., of aspects across various embodiments), adaptations and/or alterations as would be appreciated by those in the art based on the present disclosure. The limitations in the claims are to be interpreted broadly based on the language employed in the claims and not limited to the examples described in the present specification or during the prosecution of the application, which examples are to be construed as non-exclusive. Further, the actions of the disclosed processes and methods may be modified in any manner, including by reordering actions and/or inserting additional actions and/or deleting actions. It is intended, therefore, that the specification and examples be considered as illustrative only, with a true scope and spirit being indicated by the claims and their full scope of equivalents.

**[0063]** Any methods disclosed herein need not be performed in the order recited. The methods disclosed herein include certain actions taken by a practitioner; however, they can also include any third-party instruction of those actions, either expressly or by implication. For example, actions such as "inserting a base plate into a glenoid cavity" include "instructing insertion of a base plate into a glenoid cavity."

## EXAMPLE EMBODIMENTS

**[0064]** The following example embodiments identify some possible permutations of combinations of features disclosed herein, although other permutations of combinations of features are also possible.

### 1. A glenoid implant comprising:

a base plate comprising a body and at least one support structure extending from a distal surface of the body, the body comprising a plurality of openings; and  
an articular component configured to removably couple to the base plate, the articular component comprising:

a recessed portion configured to at least partially receive the body of the base plate;

and

at least one engagement structure protruding from a distal facing surface of the recessed portion, each of the at least one engagement structure corresponding to one of the plurality of openings in the body;

wherein a proximal surface of the base plate is spaced apart from the distal facing surface of the recessed portion when the articular component is coupled to the base plate.

2. The implant of Embodiment 1, further comprising a shock absorbing material between the proximal surface of the base plate and the distal facing surface of the recessed portion.

3. The implant of Embodiment 2, wherein the shock absorbing material is selected from the group consisting of silicone and polyurethane.

4. The implant of any one of Embodiments 1 to 3, wherein the recessed portion is eccentric with respect to the articular component.

5. The implant of any one of Embodiments 1 to 4, wherein the recessed portion is closer to an inferior anatomic edge of the articular component than a superior anatomic edge of the articular component.

6. The implant of any one Embodiments 1 to 5, wherein a peripheral edge of the articular component forms an entire peripheral edge of the implant when the articular component is coupled to the base plate.

7. The implant of any one of Embodiments 1 to 6, wherein sidewalls of the recessed portion are spaced apart from side walls of the body when the articular component is coupled to the base plate.

8. The implant of any one of Embodiments 1 to 7, wherein the plurality of openings comprises a first opening, a second opening, and a third opening, and wherein the first opening, the second opening, and the third opening are axially aligned along a transverse axis of the body.

9. The implant of Embodiment 7, further comprising a fourth opening laterally displaced from the axially aligned openings.

10. The implant of any one of Embodiments 1 to 9, wherein the at least one support structure comprises a plurality of support structures, each of the plurality of openings of the body providing access to a corresponding support structure.

11. The implant of Embodiment 10, wherein each of the plurality of support structures corresponds to one of the at least one engagement structures.

12. The implant of any one of Embodiments 1 to 11, wherein the plurality of openings are configured for insertion of at least one screw into at least one of the plurality of openings.

13. The implant of any one of Embodiments 1 to 12, wherein the articular component is a reverse component or a glenoid component.

14. A glenoid implant comprising:

a base plate comprising a body and a support structure extending from a distal surface of the body, a length of the body being greater than a width of the body, the body comprising a plurality of openings, the base plate comprising a metal; and  
an articular component comprising a polymer, the articular component configured to removably couple to the base plate, the articular component comprising:

a recessed portion configured to at least partially receive the body of the base plate; and  
at least one engagement structure protruding from a distal facing surface of the recessed portion, each of the at least one engagement structure corresponding to one of the plurality of openings in the body, wherein a distal face of the articular component surrounding the recessed portion is configured to abut the subchondral bone.

15. The glenoid implant of Embodiment 14, wherein the distal surface of the body is configured to abut the subchondral bone.

16. The glenoid implant of Embodiment 14 or 15, wherein the base plate is configured such that at least one screw can be screwed through at least one of the plurality of openings and into the subchondral bone.

17. A method of implanting a glenoid implant in a glenoid cavity, the method comprising:

inserting a base plate into a glenoid cavity such that a support structure of the base plate is inserted into a subchondral bone portion and a body of the base plate is positioned thereon a subchondral bone surface, the body comprising a plurality of openings;  
advancing a screw through one of the plurality of openings and into the subchondral bone; and  
securing a first articular component to the base plate such that a recessed portion of the first articular component is advanced over the body of the base plate and an engagement member of the first articular component is inserted into a corresponding opening of the plurality of openings.

18. The method of Embodiment 17, wherein securing the first articular component to the base plate comprises maintaining a space between a proximal surface of the body and a distal facing surface of the recessed portion.

19. The method of Embodiment 17 or 18, wherein

securing the first articular component to the base plate comprises positioning a distal face of the first articular component to abut the subchondral bone.

20. The method of any one of Embodiments 17 to 19, wherein securing the first articular component comprises inserting the engagement member into said one of the plurality of openings housing the screw.

21. The method of any one of Embodiments 17 to 20, further comprising advancing each of a plurality of screws into each of the plurality of openings.

22. The method of any one of Embodiments 17 to 21, further comprising:

removing the first articular component from the base plate; and  
securing a second articular component to the base plate,  
wherein the first articular component is a glenoid component and the second articular component is a reverse component.

23. A glenoid system comprising:

a base plate comprising a body and a support structure extending from a distal surface of the body, the body comprising a plurality of openings; and

an glenoid component configured to removably couple to the base plate, the glenoid component comprising an anatomical recessed portion configured to at least partially receive the body of the base plate, a proximal surface of the base plate being spaced apart from a distal facing surface of the anatomical recessed portion when the glenoid component is coupled to the base plate,

a reverse component configured to removably couple to the base plate, the reverse component comprising a reverse recessed portion configured to at least partially receive the body of the base plate, the proximal surface of the base plate being spaced apart from a distal facing surface of the reverse recessed portion when the reverse component is coupled to the base plate.

## Claims

1. A glenoid implant comprising:

a base plate comprising a body and at least one support structure extending from a distal surface of the body, the body comprising a plurality of openings; and  
an articular component configured to removably couple to the base plate, the articular component comprising:

a recessed portion configured to at least partially receive the body of the base plate; and

at least one engagement structure protruding from a distal facing surface of the recessed portion, each of the at least one engagement structure corresponding to one of the plurality of openings in the body;

wherein a proximal surface of the base plate is spaced apart from the distal facing surface of the recessed portion when the articular component is coupled to the base plate.

2. The implant of Claim 1, further comprising a shock absorbing material between the proximal surface of the base plate and the distal facing surface of the recessed portion.

3. The implant of Claim 2, wherein the shock absorbing material is selected from the group consisting of silicone and polyurethane.

4. The implant of any one of Claims 1 to 3, wherein the recessed portion is eccentric with respect to the articular component.

5. The implant of any one of Claims 1 to 4, wherein the recessed portion is closer to an inferior anatomic edge of the articular component than a superior anatomic edge of the articular component.

6. The implant of any one of Claims 1 to 5, wherein a peripheral edge of the articular component forms an entire peripheral edge of the implant when the articular component is coupled to the base plate.

7. The implant of any one of Claims 1 to 6, wherein sidewalls of the recessed portion are spaced apart from side walls of the body when the articular component is coupled to the base plate.

8. The implant of any one of Claims 1 to 7, wherein the plurality of openings comprises a first opening, a second opening, and a third opening, and wherein the first opening, the second opening, and the third opening are axially aligned along a transverse axis of the body.

9. The implant of Claim 8, further comprising a fourth opening laterally displaced from the axially aligned openings.

10. The implant of any one of Claims 1 to 9, wherein the at least one support structure comprises a plurality of support structures, each of the plurality of openings of the body providing access to a corresponding support structure.

11. The implant of Claim 10, wherein each of the plurality of support structures corresponds to one of the at least one engagement structures.
12. The implant of any one of Claims 1 to 11, wherein the plurality of openings are configured for insertion of at least one screw into at least one of the plurality of openings. 5
13. The implant of any one of Claims 1 to 12, wherein the articular component is a reverse component or a glenoid component. 10

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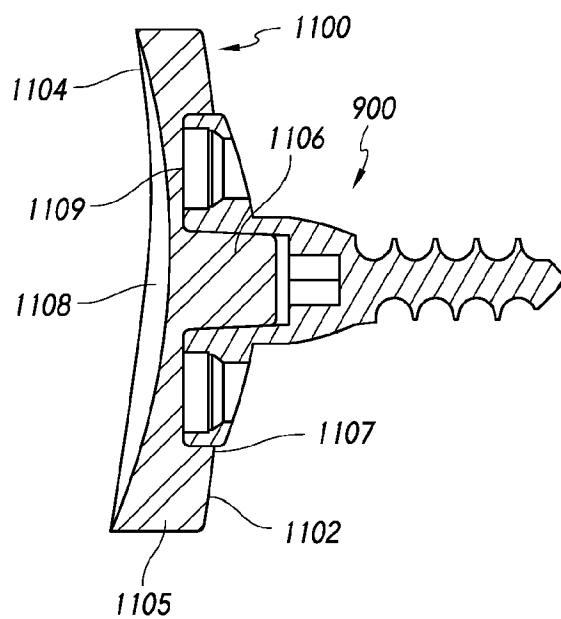


FIG. 1  
(PRIOR ART)

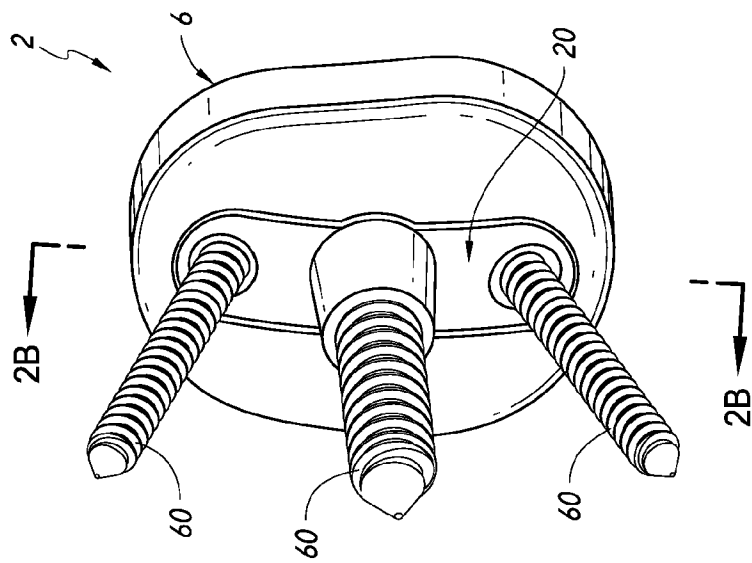


FIG. 2A

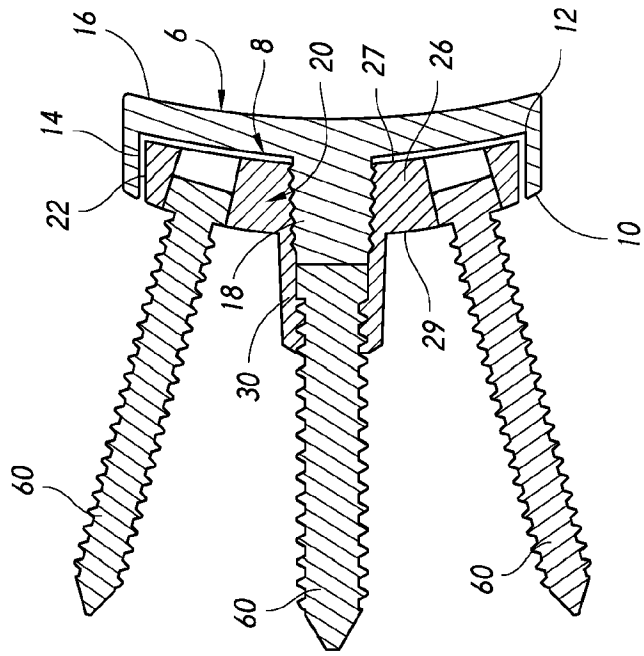


FIG. 2B

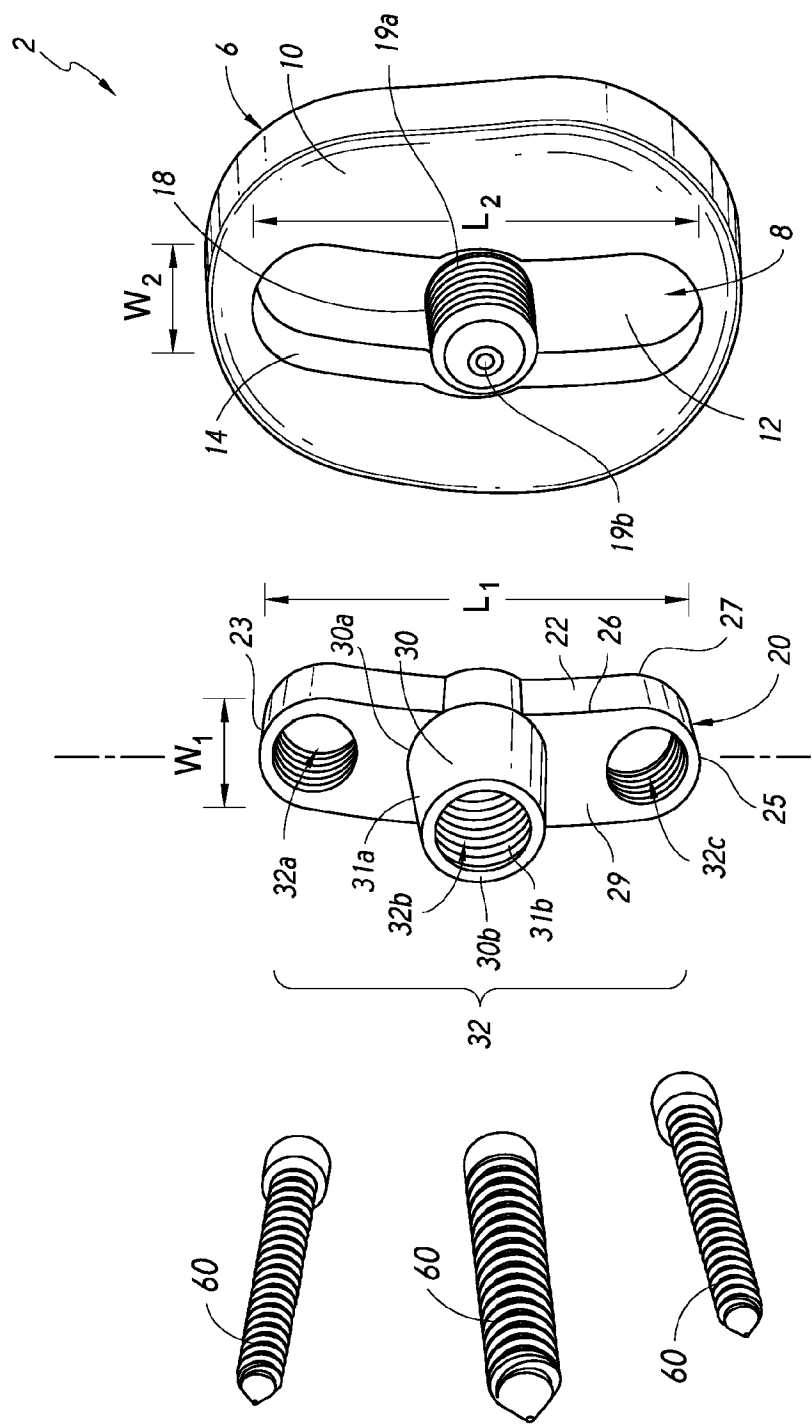


FIG. 2C



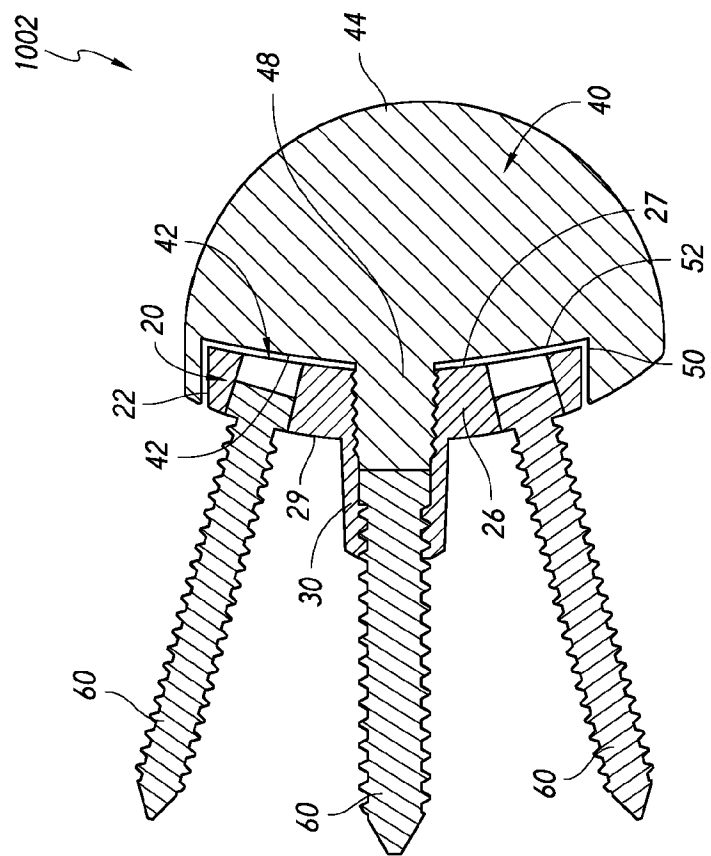


FIG. 2E

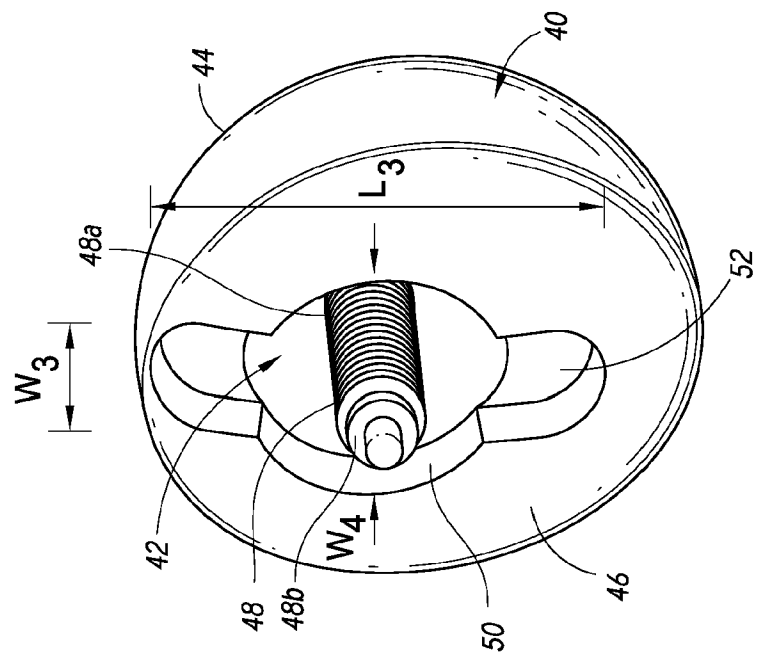


FIG. 2D

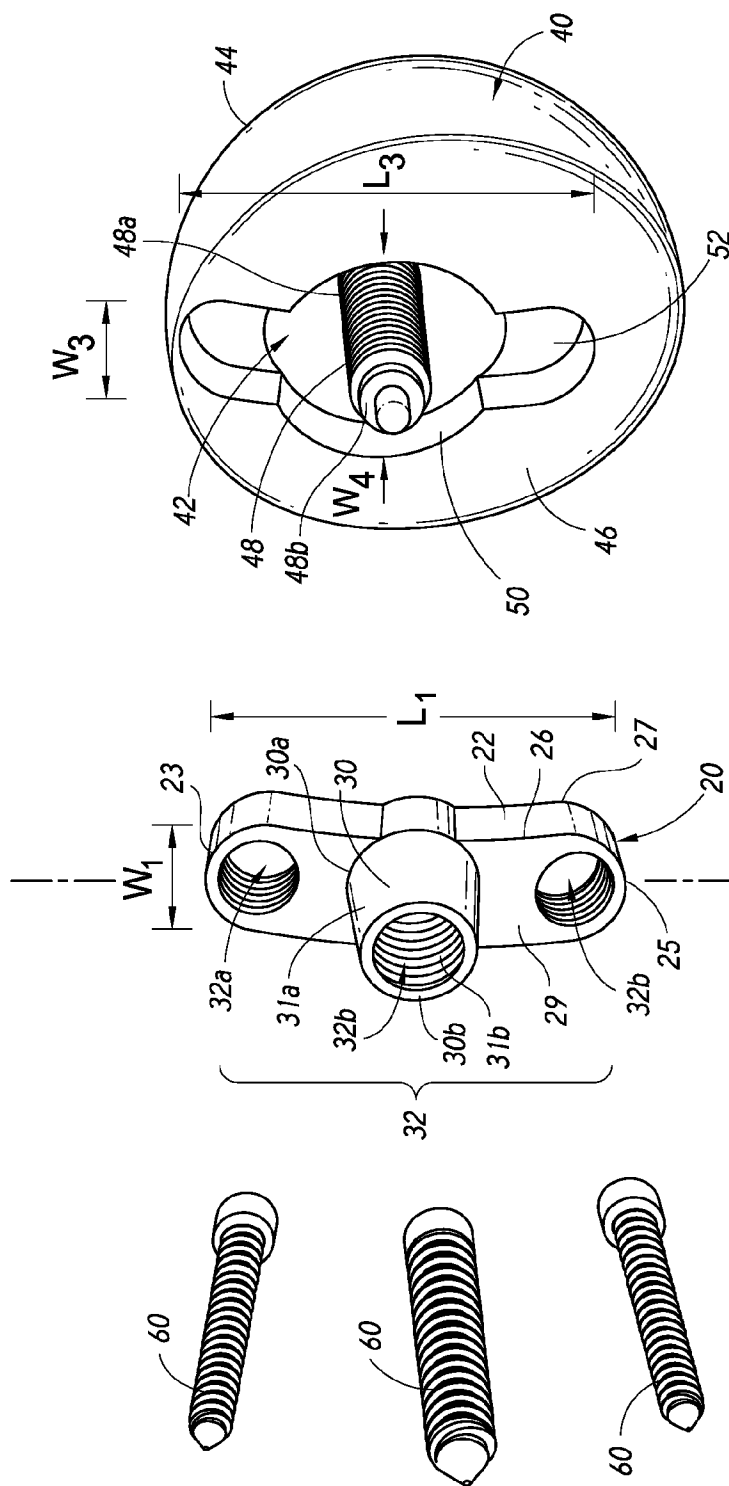


FIG. 2F

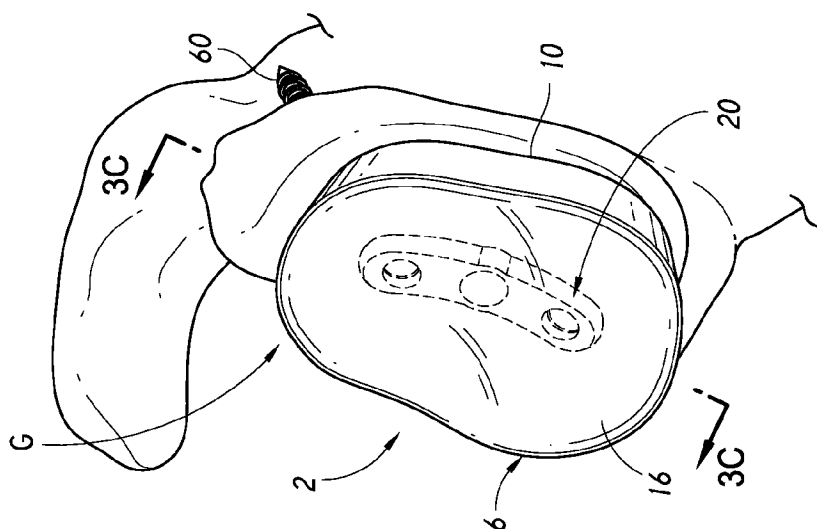


FIG. 3B

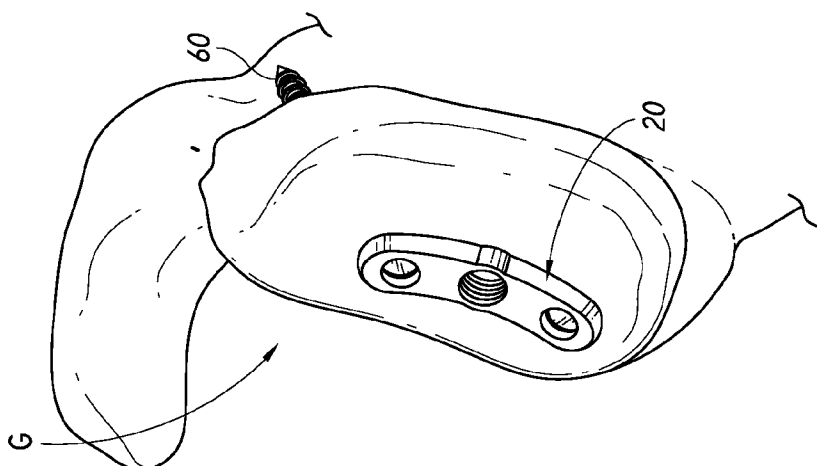


FIG. 3A

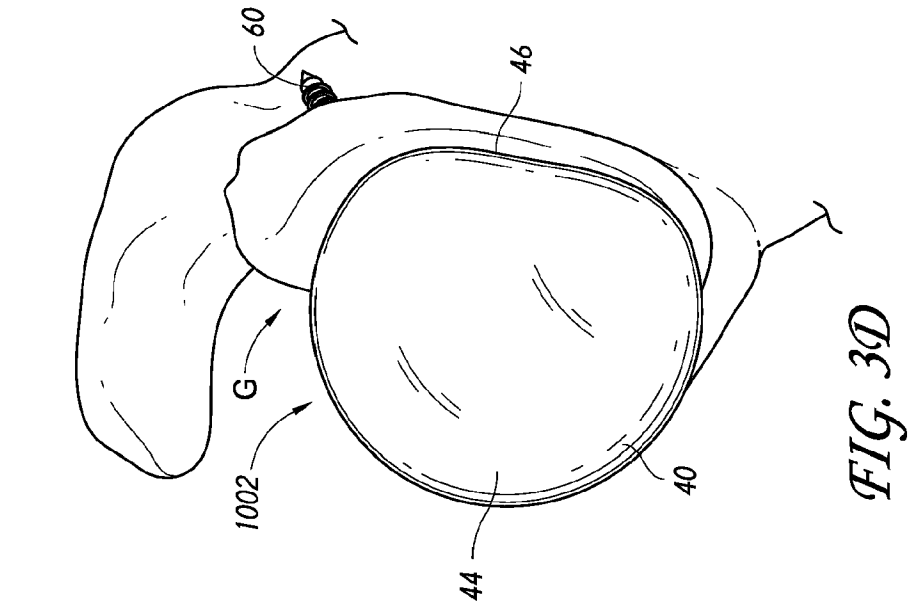


FIG. 3D

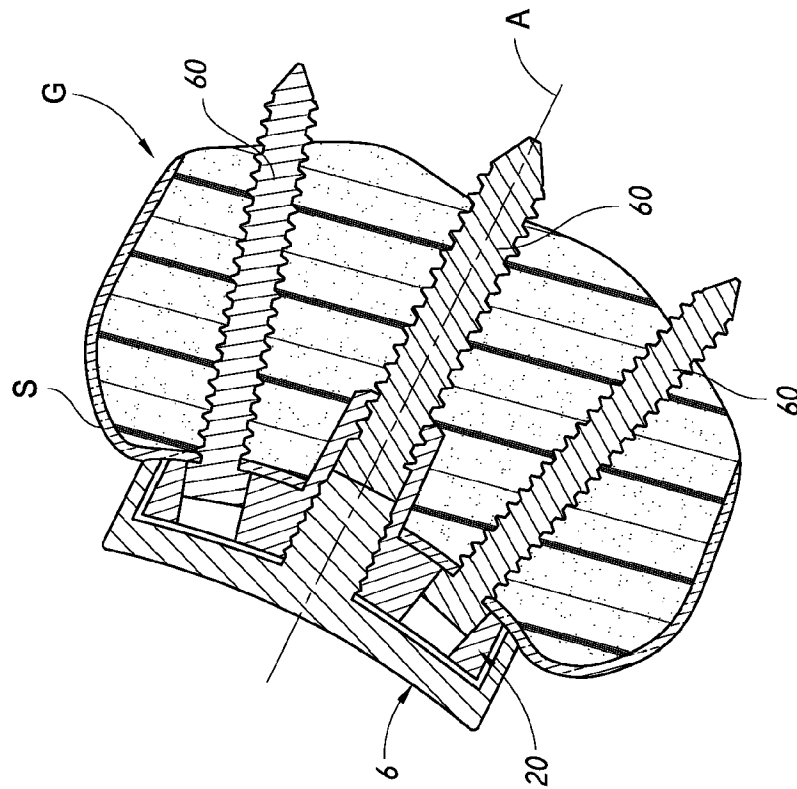


FIG. 3C

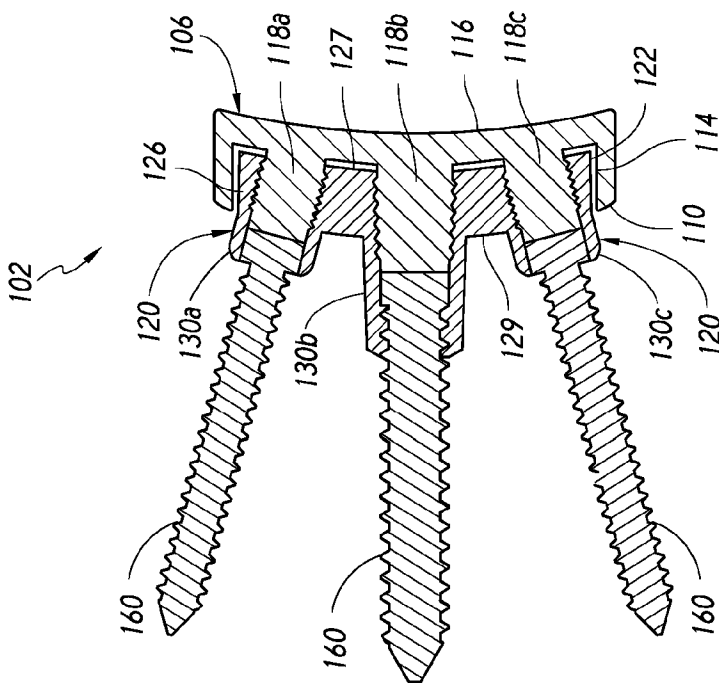


FIG. 4A

FIG. 4C

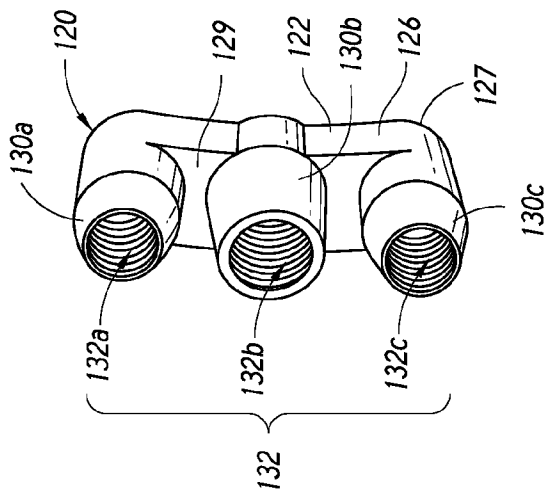
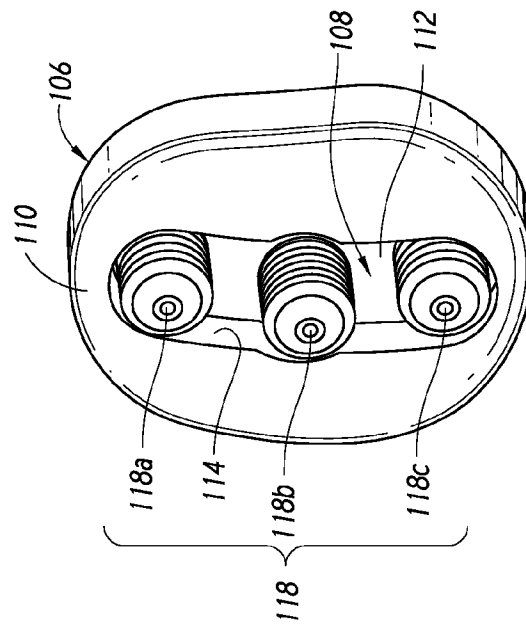


FIG. 4B

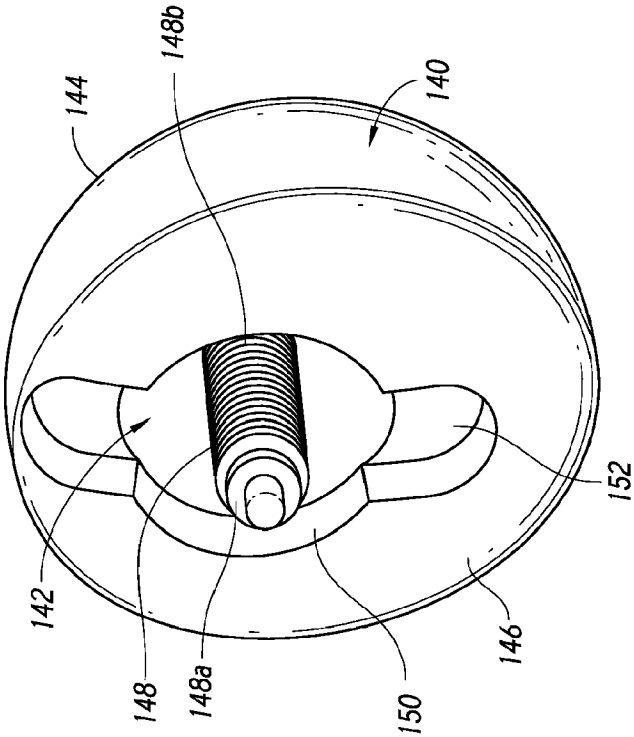


FIG. 4D

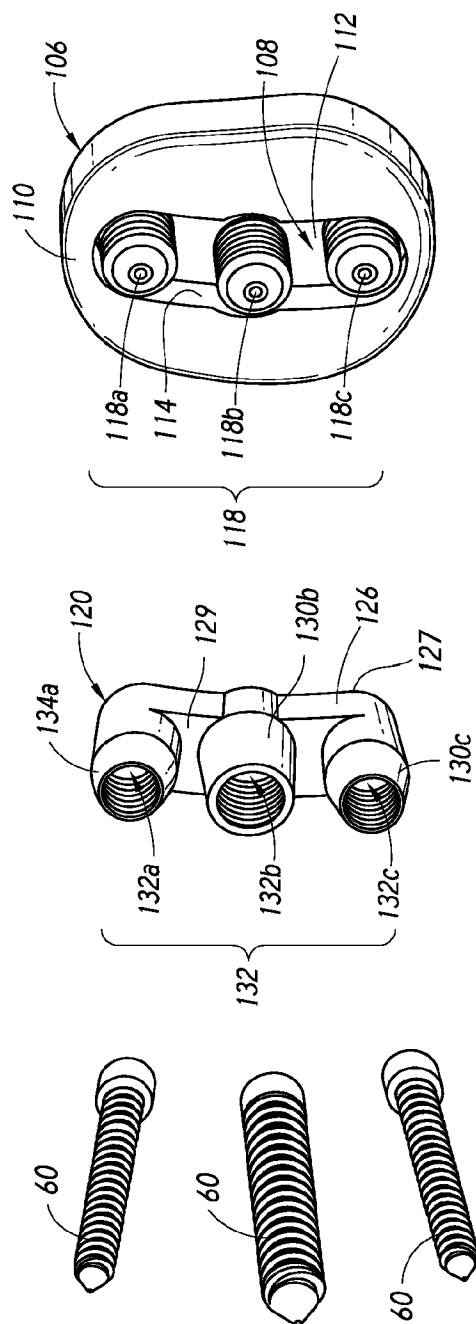


FIG. 4E

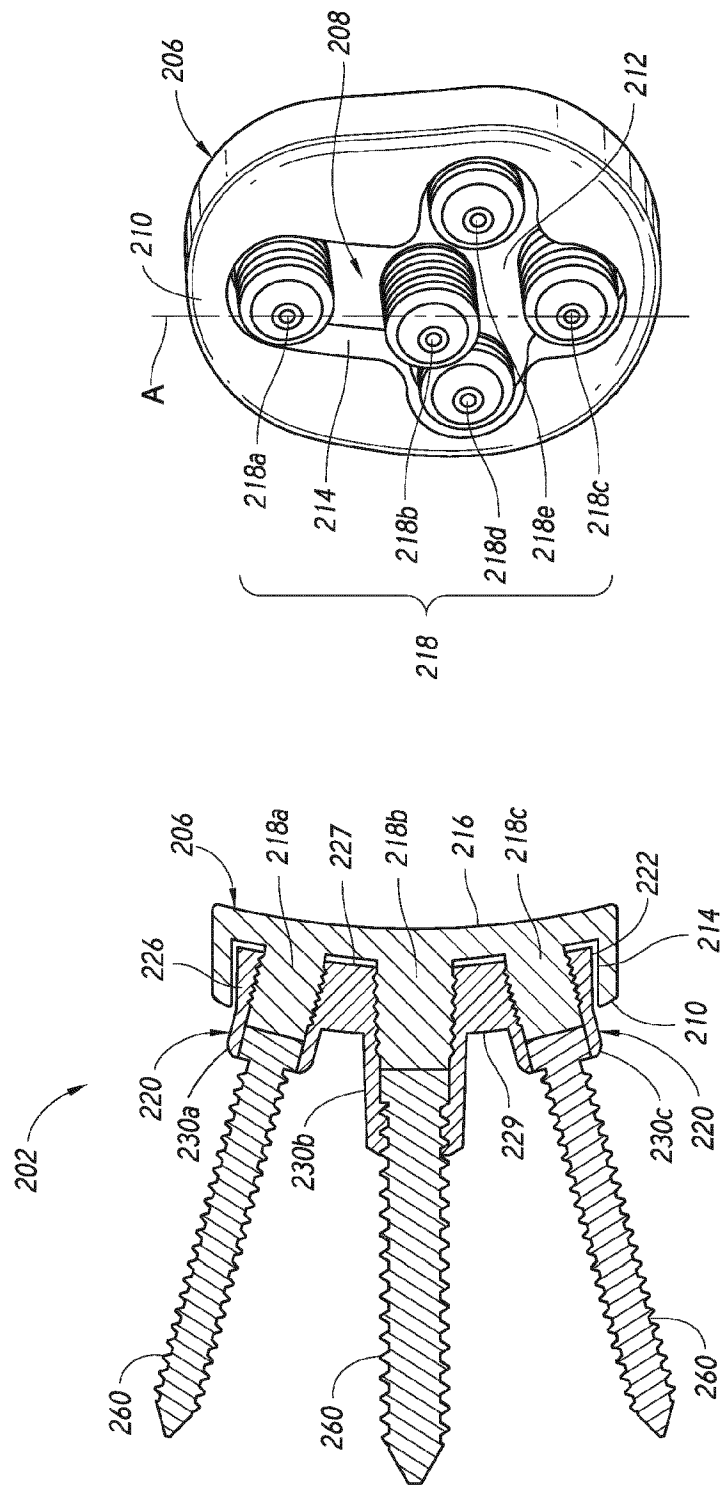


FIG. 5B

FIG. 5A



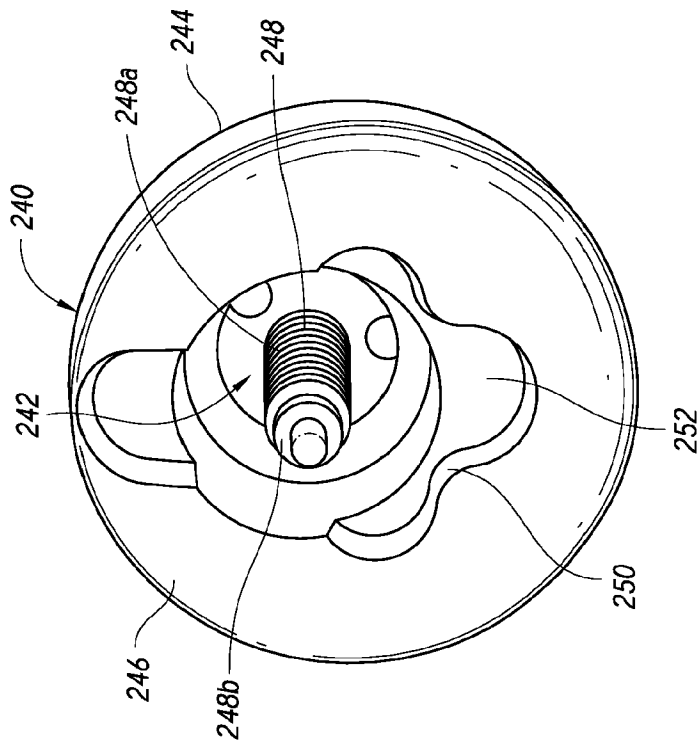


FIG. 5E

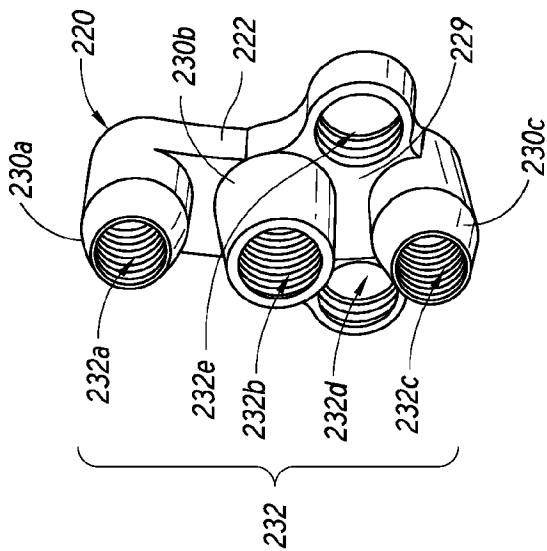


FIG. 5C

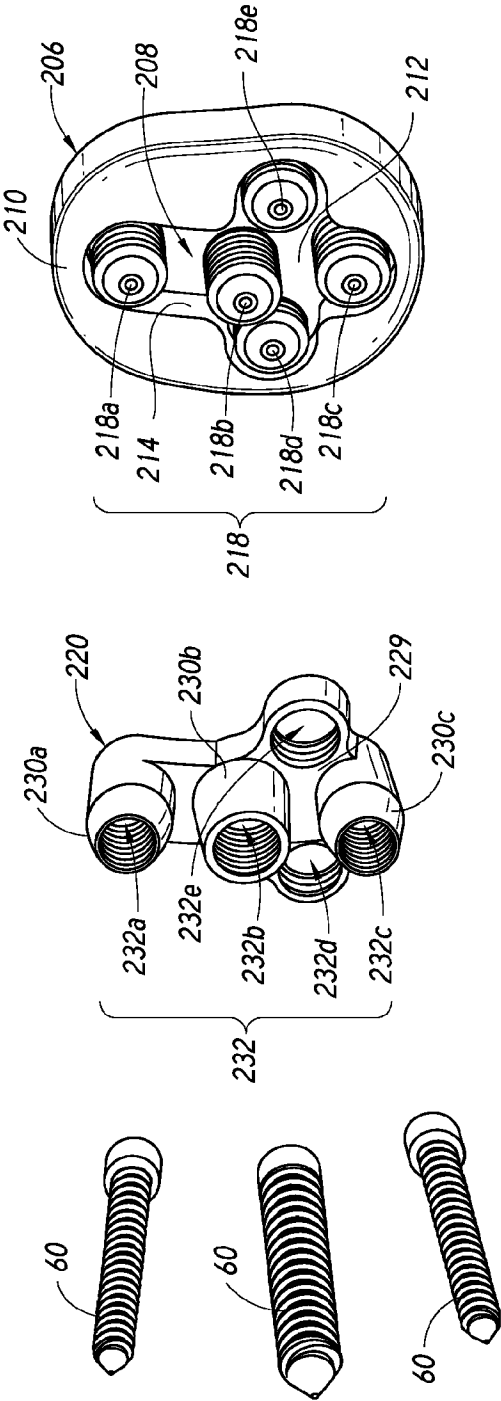


FIG. 5D

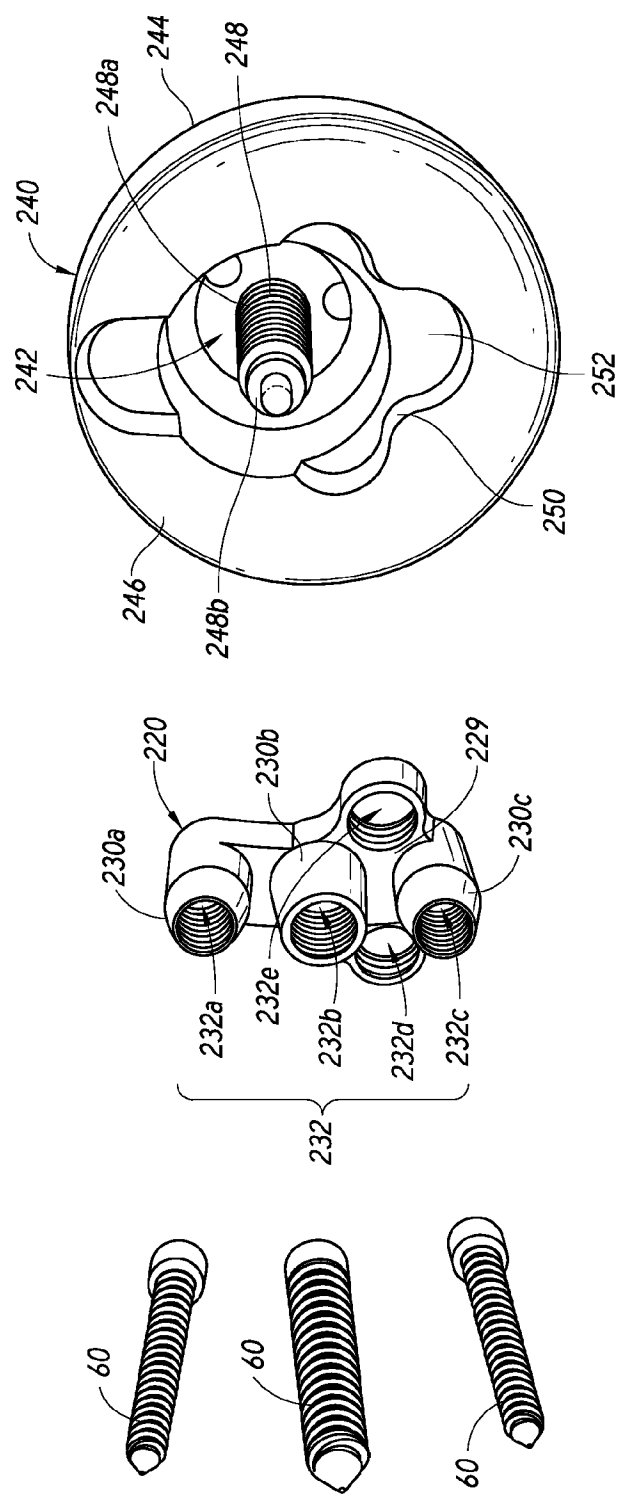


FIG. 5F



## EUROPEAN SEARCH REPORT

Application Number  
EP 16 16 1842

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                               |                                                       |                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                                                                                 | Relevant to claim                                     | CLASSIFICATION OF THE APPLICATION (IPC) |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | FR 2 977 791 A1 (CIE FINANCIERE ET MEDICALE [FR])<br>18 January 2013 (2013-01-18)                                                                                                             | 1,4-6,<br>8-13                                        | INV.<br>A61F2/40                        |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | * page 3, line 28 - page 5, line 25 *<br>-----                                                                                                                                                | 2,3,7                                                 | ADD.<br>A61F2/30                        |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 2010/023068 A1 (BOUTTENS DENIS [FR] ET AL) 28 January 2010 (2010-01-28)<br>* paragraphs [0030] - [0040] *                                                                                  | 1,6,8,9,<br>12,13                                     |                                         |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | WO 2011/150180 A2 (ORBIS MEDICAL GROUP LLC [US]; FLAHERTY J CHRISTOPHER [US]; FENTON PAUL) 1 December 2011 (2011-12-01)<br>* page 28, lines 26-30 *<br>* page 30, line 11 - page 32, line 3 * | 2,3                                                   |                                         |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | WO 2011/073169 A1 (TORNIER SA [FR]; MUTCHLER AUSTIN W [US]; FERRAND LUCILE [FR]; RATRON Y) 23 June 2011 (2011-06-23)<br>* page 13, line 27 - page 14, line 11 *<br>-----                      | 7                                                     |                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                               |                                                       | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                               |                                                       | A61F                                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                               |                                                       |                                         |
| Place of search<br>Munich                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                               | Date of completion of the search<br>19 September 2016 | Examiner<br>Buchmann, Gerhard           |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                                                                               |                                                       |                                         |

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 16 1842

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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19-09-2016

10

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| FR 2977791 A1                             | 18-01-2013          | NONE                       |                     |
| -----                                     |                     |                            |                     |
| US 2010023068 A1                          | 28-01-2010          | AU 780176 B2               | 03-03-2005          |
|                                           |                     | AU 2526201 A               | 09-07-2001          |
|                                           |                     | FR 2802799 A1              | 29-06-2001          |
|                                           |                     | GB 2375052 A               | 06-11-2002          |
|                                           |                     | JP 4464026 B2              | 19-05-2010          |
|                                           |                     | JP 2003518408 A            | 10-06-2003          |
|                                           |                     | NO 20023063 A              | 24-06-2002          |
|                                           |                     | US 2003114933 A1           | 19-06-2003          |
|                                           |                     | US 2005256583 A1           | 17-11-2005          |
|                                           |                     | US 2010023068 A1           | 28-01-2010          |
|                                           |                     | WO 0147442 A1              | 05-07-2001          |
|                                           |                     | ZA 200205014 B             | 18-03-2003          |
| -----                                     |                     |                            |                     |
| WO 2011150180 A2                          | 01-12-2011          | AU 2011258241 A1           | 10-01-2013          |
|                                           |                     | BR 112012030045 A2         | 09-08-2016          |
|                                           |                     | CA 2800091 A1              | 01-12-2011          |
|                                           |                     | EP 2575689 A2              | 10-04-2013          |
|                                           |                     | JP 2013538591 A            | 17-10-2013          |
|                                           |                     | US 2013090737 A1           | 11-04-2013          |
|                                           |                     | US 2016067049 A1           | 10-03-2016          |
|                                           |                     | WO 2011150180 A2           | 01-12-2011          |
| -----                                     |                     |                            |                     |
| WO 2011073169 A1                          | 23-06-2011          | EP 2512382 A1              | 24-10-2012          |
|                                           |                     | FR 2955247 A1              | 22-07-2011          |
|                                           |                     | US 2013144393 A1           | 06-06-2013          |
|                                           |                     | WO 2011073169 A1           | 23-06-2011          |
| -----                                     |                     |                            |                     |

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82



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[Continued on nextpage]

(54) Title: REVERSE SHOULDER ORTHOPAEDIC IMPLANT HAVING A METAGLENE COMPONENT WITH A SCREW  
LOCKING CAP

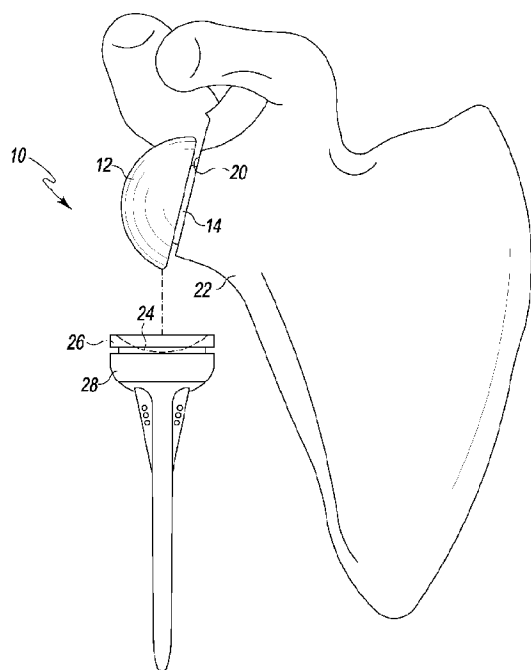


Fig. 1

(57) Abstract: A reverse shoulder orthopaedic implant includes a  
glenosphere component having a lateral bearing surface configured  
to articulate with a humeral cup of a humeral prosthesis. A  
metaglene component includes a platform configured to receive  
glenosphere component.

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).

— *as to the applicant's entitlement to claim the priority of  
the earlier application (Rule 4.1 7(Hi))*

**Published:**

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

**Declarations under Rule 4.17:**

- *as to the identity of the inventor (Rule 4.1 7(i))*
- *as to applicant's entitlement to apply for and be granted  
a patent (Rule 4.1 7(H))*

-1-

REVERSE SHOULDER ORTHOPAEDIC IMPLANT HAVING A  
METAGLENE COMPONENT WITH A SCREW LOCKING CAP

[0001] Cross reference is made to co-pending U.S. patent application Serial No. 13/431,416 (Attorney Docket No. 265280-220507), entitled "REVERSE SHOULDER ORTHOPAEDIC IMPLANT HAVING AN ELLIPTICAL GLENOSPHERE COMPONENT" by Kyle Lappin which is assigned to the same assignee as the present invention and which is filed concurrently herewith.

#### TECHNICAL FIELD

[0002] The present disclosure relates generally to orthopaedic implants, and more particularly to reverse shoulder orthopaedic implants.

#### BACKGROUND

[0003] During the lifetime of a patient, it may be necessary to perform a total shoulder replacement procedure on the patient as a result of, for example, disease or trauma. In a total shoulder replacement procedure, a humeral prosthesis is used to replace the natural head of the patient's humerus. The humeral prosthesis typically includes an elongated stem component that is implanted into the intramedullary canal of the patient's humerus and a hemispherically-shaped prosthetic head component that is secured to the stem component. In such a total shoulder replacement procedure, the natural glenoid surface of the scapula is resurfaced or otherwise replaced with a glenoid component that provides a bearing surface upon which the prosthetic head component of the humeral prosthesis articulates.



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[0004] However, in some cases the patient's natural shoulder, including its soft tissue, has degenerated to a severe degree of joint instability and pain. In many such cases, it may be necessary to change the mechanics of the shoulder. Reverse shoulder implants are used to do so. As its name suggests, a reverse shoulder implant reverses the anatomy, or structure, of the healthy shoulder. In particular, a reverse shoulder implant is designed such that the prosthetic head (i.e., the "ball" in the ball-and-socket joint) known as a glenosphere component is secured to the patient's scapula, with the corresponding concave bearing (i.e., the "socket" in the ball-and-socket joint) known as a humeral cup being secured to the patient's humerus. Such a reverse configuration allows the patient's deltoid muscle, which is one of the larger and stronger shoulder muscles, to raise the arm.

#### SUMMARY

[0005] According to one aspect, a reverse shoulder orthopaedic implant includes a glenosphere component having a curved lateral bearing surface configured to articulate with a humeral cup of a humeral prosthesis, and a medial surface having a tapered bore formed therein. The glenosphere component has an anterior/posterior width defined by the distance between an anterior-most point of the lateral bearing surface and a posterior-most point of the lateral bearing surface, and a superior/inferior width defined by the distance between a superior-most point of the lateral bearing surface and an inferior-most point of the lateral bearing surface. The anterior/posterior width of the glenosphere component is greater than its superior/inferior width.

[0006] The lateral bearing surface of the glenosphere component may be hemi-ellipsoidal in shape. The glenosphere component may be metallic.

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[0007] An imaginary line segment extends from a superior-most point of the medial surface to an inferior-most point of the medial surface. The center of the tapered bore may be positioned between the midpoint of the imaginary line segment and the superior-most point of the medial surface. Alternatively, the center of the tapered bore may be positioned at the midpoint of the imaginary line segment.

[0008] The reverse shoulder orthopaedic implant may also include a metaglene component having an annular-shaped platform with an elongated stem extending outwardly from a medial surface thereof. A tapered outer surface of the annular-shaped platform may be taper locked in the tapered bore of the glenosphere component.

[0009] According to another aspect, a reverse shoulder orthopaedic implant includes a glenosphere component having a curved lateral bearing surface configured to articulate with a humeral cup of a humeral prosthesis, and a medial surface having a bore formed therein to receive a metaglene component. The glenosphere component has an anterior/posterior width defined by the distance between an anterior-most point of the glenosphere component and a posterior-most point of the glenosphere component, and a superior/inferior width defined by the distance between a superior-most point of the glenosphere component and an inferior-most point of the glenosphere component. The anterior/posterior width of the glenosphere component is greater than the superior/inferior width of the glenosphere component.

[0010] The lateral bearing surface of the glenosphere component may be hemi-ellipsoidal in shape. The glenosphere component may be metallic.

[0011] An imaginary line segment extends from a superior-most point of the medial surface to an inferior-most point of the medial surface. The center of the bore may be positioned between the midpoint of the imaginary line segment and the superior-

-4-

most point of the medial surface. Alternatively, the center of the bore may be positioned at the midpoint of the imaginary line segment.

[0012] The reverse shoulder orthopaedic implant may also include a metaglene component having an annular-shaped platform with an elongated stem extending downwardly from a lower surface thereof. The bore formed in the glenosphere component may include a tapered bore, with a tapered outer surface of the annular-shaped platform being taper locked in such a tapered bore.

[0013] According to another aspect, a reverse shoulder orthopaedic implant includes a glenosphere component having a lateral bearing surface configured to articulate with a humeral cup of a humeral prosthesis. The lateral bearing surface is hemi-ellipsoidal in shape with its longitudinal axis extending in the anterior/posterior direction. The reverse shoulder orthopaedic implant also includes a metaglene component secured to the glenosphere component.

[0014] An anterior/posterior width of the glenosphere component may be defined by the distance between an anterior-most point of the lateral bearing surface and a posterior-most point of the lateral bearing surface, with its superior/inferior width being defined by the distance between a superior-most point of the lateral bearing surface and an inferior-most point of the lateral bearing surface. The anterior/posterior width of the glenosphere component is greater than the superior/inferior width of the glenosphere component.

[0015] A tapered bore may be formed in the medial surface of the glenosphere component, with a tapered outer surface of the metaglene component being taper locked therein.

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[0016] An imaginary line segment extends from a superior-most point of the medial surface to an inferior-most point of the medial surface. The center of the tapered bore may be positioned between the midpoint of the imaginary line segment and the superior-most point of the medial surface. Alternatively, the center of the tapered bore may be positioned at the midpoint of the imaginary line segment.

[0017] Both the glenosphere component and the metaglene component may be metallic.

[0018] The platform of the metaglene component may include a number of screw holes extending therethrough.

[0019] According to another aspect, a reverse shoulder orthopaedic implant includes a metaglene component having a platform with a number of screw holes extending therethrough, and an elongated stem extending downwardly from a medial surface thereof. The elongated stem is configured to be implanted into the scapula of a patient. The elongated stem has a bore formed therein. The reverse shoulder orthopaedic implant also includes a screw cap having a shaft positioned in the bore of the metaglene component, and a locking flange extending outwardly from the shaft so as to at least partially cover each of the number of screw holes of the metaglene component.

[0020] Each of the number of screw holes defines a circumference. An outer edge of the locking flange of the screw cap overlaps at least a portion of the circumference of each of the number of screw holes of the metaglene component.

[0021] The bore formed in the elongated stem of the metaglene component may be embodied as a threaded bore and the shaft of the screw cap may be embodied as a threaded shaft that is threaded into the threaded bore of the metaglene component.

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[0022] The locking flange may be annular shaped, with the shaft extending outwardly from a lower surface of the locking flange. A drive socket may be formed in the upper surface of the locking flange.

[0023] The reverse shoulder orthopaedic implant may also include a glenosphere component having a bore formed therein, with the screw cap being captured in the bore of the glenosphere component.

[0024] The reverse shoulder orthopaedic implant may also include a retaining ring secured within the bore of the glenosphere component so as to retain the screw cap therein.

[0025] The reverse shoulder orthopaedic implant may further include a number of compression screws positioned in the number of screw holes of the metaglene component. Each of such compression screws has a screw head having a round outer edge, with an outer edge of the locking flange of the screw cap overlapping at least a portion of the round outer edge of each of the number of screw holes of the metaglene component.

[0026] According to another aspect, a reverse shoulder orthopaedic implant includes a metaglene component having a platform with a number of screw holes extending therethrough, and an elongated stem extending downwardly from a medial surface thereof. The elongated stem has a bore formed therein. The reverse shoulder orthopaedic implant also includes a glenosphere component having a bore formed therein and a screw cap captured in the bore of the glenosphere component. The screw cap is rotatable relative to the glenosphere component. The screw cap has a shaft positioned in the bore of the metaglene component, and a locking flange extending outwardly from the

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shaft so as to at least partially cover each of the number of screw holes of the metaglene component.

[0027] The locking flange of the screw cap may include an annular-shaped beveled surface.

[0028] The screw cap may also include a cylindrically-shaped surface extending upwardly from the annular-shaped beveled surface, and a retaining flange extending outwardly from the cylindrically-shaped surface. A retaining ring may be positioned around the cylindrically-shaped surface of the screw cap and secured to the sidewalls of the glenosphere defining the bore. The diameter of the retaining flange of the screw cap is larger than the inner diameter of the retaining ring and smaller than the outer diameter of the retaining ring.

[0029] A drive socket is formed in an upper surface of the retaining flange of the screw cap.

[0030] The retaining ring may be press fit within the bore of the glenosphere component so as to retain the screw cap therein.

[0031] Each of the number of screw holes defines a circumference. An outer edge of the locking flange of the screw cap overlaps at least a portion of the circumference of each of the number of screw holes of the metaglene component.

[0032] The bore formed in the elongated stem of the metaglene component may be embodied as a threaded bore and the shaft of the screw cap may be embodied as a threaded shaft that is threaded into the threaded bore of the metaglene component.

[0033] The reverse shoulder orthopaedic implant may also include a number of compression screws positioned in the number of screw holes of the metaglene component. The locking flange of the screw cap may include an annular-shaped beveled

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surface, with each of the number of compression screws has a screw head having a round outer edge. The beveled surface of the locking flange of the screw cap contacts the round outer edge of each of the number of screw holes of the metaglene component.

[0034] According to another aspect, a reverse shoulder orthopaedic implant includes a metaglene component configured to be implanted into the scapula of a patient. The metaglene component has a platform with a number of screw holes extending therethrough. A number of compression screws are positioned in the number of screw holes of the metaglene component. Each of the number of compression screws has a screw head with a round outer edge. A screw cap is secured to the metaglene component. The screw cap has a locking flange that includes an outer edge that overlaps at least a portion of the round outer edge of each of the number of screw holes of the metaglene component.

[0035] Each of the number of screw holes defines a circumference, with the outer edge of the locking flange of the screw cap overlapping at least a portion of the circumference of each of the number of screw holes of the metaglene component.

[0036] The platform of the metaglene component may include an elongated stem with a threaded bore formed therein, with the screw cap having a threaded shaft extending downwardly for a lower surface of the locking flange. The threaded shaft of the screw cap may be threaded into the threaded bore of the metaglene component.

[0037] A drive socket may be formed in an upper surface of the screw cap.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0038] The detailed description particularly refers to the following figures, in which:

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[0039] FIG. 1 is an anterior elevational view showing a reverse shoulder orthopaedic implant that has been implanted into the shoulder of a patient;

[0040] FIG. 2 is a lateral elevational view showing the elliptical glenosphere component of the reverse shoulder orthopaedic implant of FIG. 1 implanted on the scapula of a patient;

[0041] FIG. 3 is an elevational view of the lateral bearing surface of the elliptical glenosphere component of FIG. 2;

[0042] FIG. 4 is a cross sectional view of the elliptical glenosphere component taken along the line 4-4 of FIG. 3, as viewed in the direction of the arrows;

[0043] FIG. 5 is a medial elevational view of the elliptical glenosphere component of FIG. 3 showing the tapered bore positioned in a centered position;

[0044] FIG. 6 is a view similar to FIG. 5, but showing the tapered bore positioned in an offset position;

[0045] FIG. 7 is a cross sectional view showing the elliptical glenosphere component of FIG. 3 implanted on the scapula of a patient;

[0046] FIG. 8 is an exploded perspective view showing a screw cap used to lock the compression screws within a metaglene component;

[0047] FIG. 9 is a cross sectional view showing the compression screws and screw cap installed on the metaglene component;

[0048] FIG. 10 is a plan view showing the compression screws and screw cap installed on the metaglene component;

[0049] FIG. 11 is an exploded perspective view showing a screw cap that is captured in a glenosphere component and used to lock the compression screws within a metaglene component;



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[0050] FIG. 12 is an assembled cross sectional view showing the screw cap captured in the glenosphere component by the retaining ring; and

[0051] FIG. 13 is a view similar to FIG. 12, but showing the glenosphere component secured to the metaglene component.

#### DETAILED DESCRIPTION OF THE DRAWINGS

[0052] While the concepts of the present disclosure are susceptible to various modifications and alternative forms, specific exemplary embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that there is no intent to limit the concepts of the present disclosure to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention.

[0053] Terms representing anatomical references, such as anterior, posterior, medial, lateral, superior, inferior, etcetera, may be used throughout this disclosure in reference to both the orthopaedic implants described herein and a patient's natural anatomy. Such terms have well-understood meanings in both the study of anatomy and the field of orthopaedics. Use of such anatomical reference terms in the specification and claims is intended to be consistent with their well-understood meanings unless noted otherwise.

[0054] Referring now to FIGS. 1-6, there is shown a reverse shoulder orthopaedic implant 10 for replacing the natural shoulder joint of a patient. The reverse shoulder orthopaedic implant 10 includes an elliptical glenosphere component 12 that is secured to the glenoid surface 20 of the patient's scapula 22 by a metaglene component 14

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implanted in the bone tissue of the scapula 22. The elliptical glenosphere component 12 articulates on the bearing surface 24 of a humeral cup 26 of a humeral prosthesis. As can be seen in FIG. 1, the humeral cup 26 is secured to a humeral stem component 28 that is implanted in the intramedullary canal of a patient's humerus (not shown).

[0055] The elliptical glenosphere component 12 includes a body 32 having a curved lateral surface 34. The curved lateral surface 34 of the body 32 provides a smooth bearing surface upon which the bearing surface 24 of the humeral cup 26 articulates. As can be seen in FIG. 2-4, the lateral bearing surface 34 is hemi-ellipsoidal in shape. That is, the lateral bearing surface 34 defines the general shape of ellipsoid sliced in half along its longitudinal plane.

[0056] The elliptical glenosphere component 12 also includes a substantially flat medial surface 36 opposite its lateral bearing surface 34. The medial surface 36 has a tapered bore 38 formed therein. The tapered sidewalls 40 defining the bore 38 extend laterally away from the medial surface 36 to a bottom wall 42. As will be discussed below in more detail, an annular-shaped tapered surface of the metaglene component 14 may be inserted into the tapered bore to engage the sidewalls 40 thereby taper locking the elliptical glenosphere component 12 to the metaglene component 14.

[0057] As can be seen in FIG. 4, one end of an installation hole 44 opens into the bottom wall 42 of the tapered bore 38, with the other end of the installation hole 44 opening into the lateral bearing surface 34. As will be discussed below in greater detail, a surgical instrument, such as a hex head driver, may be passed through the installation hole 44 during a surgical procedure to implant the elliptical glenosphere component 12.

[0058] As alluded to above, unlike conventional hemispherically-shaped components, the glenosphere component 12 described herein is hemi-ellipsoidal in shape.

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As can be seen in FIGS. 2 and 3, the glenosphere component 12 is wider in the anterior/posterior direction than it is in the superior/inferior direction. Specifically, as can best be seen in FIG. 2, the longitudinal axis 46 of the glenosphere component 12 extends in the anterior/posterior direction, with its shorter lateral axis 48 extending in the superior/inferior direction. This is demonstrated geometrically in the elevational view of the glenosphere component's lateral bearing surface 34 shown in FIG. 3 where both the anterior/posterior and the widths of the glenosphere component 12 are shown as a pair of imaginary line segments extending through the glenosphere component 12 in their respective directions. In particular, an imaginary line segment 52 extends between an anterior-most point 54 of the glenosphere component 12 (i.e., the anterior-most point on the glenosphere component's lateral bearing surface 34) and a posterior-most point 56 (i.e., the posterior-most point on the glenosphere component's lateral bearing surface 34) of the glenosphere component 12. The length of the imaginary line segment 52 defines the anterior/posterior width of the glenosphere component 12. As can be seen in FIG. 3, in the illustrative embodiment described herein, the line segment 52 extends orthogonally between an imaginary tangent line 58 passing through the anterior-most point 54 of the glenosphere component 12 and an imaginary tangent line 60 passing through the posterior-most point 56 of the glenosphere component 12. Similarly, an imaginary line segment 62 extends between a superior-most point 64 of the glenosphere component 12 (i.e., the superior-most point on the glenosphere component's lateral bearing surface 34) and an inferior-most point 66 of the glenosphere component 12 (i.e., the inferior-most point on the glenosphere component's lateral bearing surface 34). As can be seen in FIG. 3, in the illustrative embodiment described herein, the line segment 62 extends orthogonally between an imaginary tangent line 68 passing through the superior-most

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point 64 of the glenosphere component 12 and an imaginary tangent line 70 passing through the inferior-most point 66 of the glenosphere component 12. The length of the imaginary line segment 62 defines the superior/inferior width of the glenosphere component 12. Because the glenosphere component 12 is wider in the anterior/posterior direction than it is in the superior/inferior direction, the imaginary line segment 52 is longer than the imaginary line segment 62.

[0059] It should be appreciated that such an arrangement in which the glenosphere component 12 is wider in the anterior/posterior direction than it is in the superior/inferior direction may reduce the occurrences of notching in some patients. In particular, depending on the anatomy of a specific patient, a glenosphere component that is wider in the anterior/posterior direction than it is in the superior/inferior direction may reduce the occasions in which the medial side of the glenosphere component contacts the scapula relative to a hemispherically-shaped glenosphere component.

[0060] As can be seen in the elevational views of the glenosphere component's medial surface 36 shown in FIGS. 5 and 6, the glenosphere component's tapered bore 38 may be centered in the superior/inferior direction (see FIG. 6) or offset superiorly in the superior/inferior direction (see FIG. 7). In particular, the central axis 72 of the tapered bore 38 may be positioned at the center of the superior/inferior width of the elliptical glenosphere component 12, or it may be positioned superiorly of the center of the superior/inferior width of the elliptical glenosphere component 12. This is demonstrated in the elevational views of the glenosphere component's medial surface 36 shown in FIGS. 5 and 6 where the position of the central axis 72 of the tapered bore 38 is shown relative to a midpoint 74 that bisects the imaginary line segment 62 defining the superior/inferior width of the glenosphere component 12. As can be seen in FIG. 5, in

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the case of a centered glenosphere component 10, the central axis 72 of the tapered bore 38 is positioned on the midpoint 74 of the imaginary line segment 62 defining the superior/inferior width of the glenosphere component 12. However, as can be seen in FIG. 6, in the case of an offset glenosphere component 10, the central axis 72 of the tapered bore 38 is still positioned on the imaginary line segment 62 defining the superior/inferior width of the glenosphere component 12, but is spaced apart from its midpoint 74 in the superior direction. In other words, in the case of an offset glenosphere component 10, the central axis 72 of the tapered bore 38 is positioned on the imaginary line segment 62 at a location between its midpoint 74 and the superior-most point 64.

[0061] Such offset of the tapered bore 38 in the superior direction offsets the glenosphere component 12 in the inferior direction when it is secured to the metaglene component 14 implanted in the patient's glenoid surface. Such an implanted offset glenosphere component 12 is shown in FIG. 2. It should be appreciated that such an inferior offset of the glenosphere component 12 may reduce the occurrences of notching in some patients. In particular, depending on the anatomy of a specific patient, a glenosphere component offset inferiorly may reduce the occasions in which the medial side of the glenosphere component contacts the scapula relative to a centered glenosphere component.

[0062] It should be appreciated that the tapered bore 38 of the elliptical glenosphere component 12 may also be offset in other directions. For example, the tapered bore 38 of the elliptical glenosphere component 12 may be offset anteriorly or posteriorly relative to the center of the glenosphere component's medial surface 36 (i.e., it may be offset anteriorly or superiorly relative to the midpoint 74 that bisects the imaginary line segment 62). Moreover, the tapered bore 38 of the elliptical glenosphere

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component 12 may be offset inferiorly relative to the center of the glenosphere component's medial surface 36. Yet, further, the tapered bore 38 of the elliptical glenosphere component 12 may be offset in a combination of directions relative to the center of the glenosphere component's medial surface 36. For example, the tapered bore 38 of the elliptical glenosphere component 12 may be offset both superiorly and anteriorly (or superiorly and posteriorly) relative to the center of the glenosphere component's medial surface 36.

**[0063]** The glenosphere component 12 may be constructed with an implant-grade biocompatible metal, although other materials may also be used. Examples of such metals include cobalt, including cobalt alloys such as a cobalt chrome alloy, titanium, including titanium alloys such as a Ti6Al4V alloy, and stainless steel. The lateral bearing surface 34 of such a metallic glenosphere component 12 may be polished or otherwise treated to enhance its smooth bearing surface.

**[0064]** The glenosphere component 12 may be provided in various different configurations to provide the flexibility necessary to conform to varying anatomies from patient to patient. For example, the glenosphere component 12 may be provided in various superior/inferior diameters to match the needs of a given patient. For example, in one illustrative embodiment, the glenosphere component 12 may be provided in two different superior/inferior diameters - 38mm and 42mm.

**[0065]** As shown in FIG. 7, the glenosphere component 12 is installed on the metaglene component 14 implanted in the bone tissue of the glenoid surface 20 of the patient's scapula 22. To do so, the surgeon first aligns the glenosphere component 12 relative to the implanted metaglene component 14 such that its tapered bore 38 is aligned with the an annular-shaped tapered outer surface 108 of the metaglene component 14.

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The surgeon then advances the glenosphere component 12 such that the tapered outer surface 108 of the metaglene component 14 is inserted into the tapered bore 38 of the glenosphere component 12. The surgeon then strikes the glenosphere component 12 (or a head impaction tool positioned thereon) with a surgical mallet, sledge, or other impaction tool to drive the glenosphere component 12 medially so as to urge the sidewalls 40 defining the glenosphere component's tapered bore 38 into contact with the tapered outer surface 108 of the metaglene component 14 thereby taper locking the glenosphere component 12 to the implanted metaglene component 14. Such final assembly of the glenosphere component 12 to the implanted metaglene component 14 is shown in FIGS. 2 and 7.

[0066] Referring now to FIGS. 8-10, there is shown the metaglene component 14 in more detail. The metaglene component 14 includes a platform 102 having a stem 104 extending outwardly from its medial surface 106. The metaglene component's stem 104 is configured to be implanted into the surgically-prepared bone tissue of the glenoid surface 20 of the patient's scapula 22. As described above, the glenosphere component 12 is securable to metaglene component 14. In particular, the outer annular surface 108 of the metaglene component's platform is tapered. As described in detail above, the glenosphere component 12 may be installed on the metaglene component 14 such that the tapered outer surface 108 of the metaglene component 14 is inserted into the tapered bore 38 of the glenosphere component 12. So positioned, the glenosphere component 12 may be driven or otherwise urged toward the metaglene component 14 such that the sidewalls 40 defining the glenosphere component's tapered bore 38 are urged into contact with the tapered outer surface 108 of the metaglene component 14 thereby taper locking the glenosphere component 12 to the metaglene component 14.

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[0067] As best seen in FIGS. 8 and 90, the metaglene component's stem 104 has a threaded bore 110 formed therein. The threaded bore 110 extends through the entire length of the stem 104, although it could be embodied as a blind bore. A number of threads 112 are formed in the sidewall that defines the threaded bore 110. The threads 112 are sized to match, and hence threadingly receive, the threads of a screw cap 140 and a retraction tool (not shown).

[0068] As can be seen in FIGS. 8-10, the metaglene component's platform 102 has a number of screw holes 114 extending therethrough. One end of each of the screw holes 114 opens into the medial surface 106 of the platform 102, with its other end opening into the platform's opposite lateral surface 116. As can be seen best in FIG. 9, each of the screw holes 114 is counterbored to accommodate the screw heads of the compression screws used to secure the metaglene component 12 to the bone tissue of the patient's scapula 22. As such, the upper end of the screw holes 114 has a larger diameter than does the lower end of the screw holes 114. Each of the screw holes 114 is located in one of the four quadrants of the metaglene component's platform 102. As such, each of the screw holes 114 is positioned about 90° from one another.

[0069] In the illustrative embodiment described herein, each of the screw holes 114 is spaced radially outwardly from the center of the metaglene component's platform 102 at a position between the threaded bore 110 and the outer annular edge 118 where the platform's lateral surface 116 meets its tapered outer surface 108. As can be seen in FIGS. 8 and 9, the lateral surface 116 of the metaglene component's platform 102 has a countersunk surface 120 formed therein. As can be seen in FIG. 8, each of the screw holes 114 opens partially into the countersunk surface 120 of the metaglene component's platform 102. In particular, as can be seen from the elevational view of the metaglene



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component's lateral surface 116 shown in FIG. 10, the external boundary or perimeter of each of the screw holes 114 defines a circumference 122. An inner section 124 of the circumference 122 of each of the screw holes 114 (i.e., a section positioned near the center of the metaglene component's platform 102) is positioned within the countersunk surface 120.

[0070] The metaglene component 14 may be constructed with an implant-grade biocompatible metal, although other materials may also be used. Examples of such metals include cobalt, including cobalt alloys such as a cobalt chrome alloy, titanium, including titanium alloys such as a Ti6Al4V alloy, and stainless steel. Such a metallic metaglene component 14 may also be coated with a surface treatment, such as hyaluronic acid (HA), to enhance biocompatibility. Moreover, the surfaces of the metaglene component 14 that engage the natural bone, such as the medial surface 106 of platform 102 and the outer surfaces of the stem 104 may be textured to facilitate securing the component to the bone. Such surfaces may also be porous coated to promote bone ingrowth for permanent fixation.

[0071] Unlike the glenosphere component 12 that may be provided in various sizes to provide the flexibility necessary to conform to varying anatomies from patient to patient, in the illustrative embodiment described herein, the metaglene component 14 may be provided in a single, "universal" size that accommodates glenosphere components of various sizes. For example, in one illustrative embodiment, a metaglene component 14 may be provided in a single size to accommodate both a 38mm glenosphere component 12 and a 42mm glenosphere component 12.

[0072] As can be seen in FIGS. 8-10, a compression screw 130 may be positioned in some or all of the screw holes 114 to secure the metaglene component 12 to the bone

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tissue of the patient's scapula 22. Each of the compression screws 130 includes a threaded shank 132 having a round screw head 134 on an end thereof. The diameter of the threaded shank 132 is smaller than the diameter of the lower end of the counterbored screw holes 114 of the metaglene component 12 so that the threaded shank 132 may pass through the entire length of the screw holes 114. The screw head 134, on the other hand, has a diameter smaller than the upper end of the counterbored screw holes 114, but larger than the lower end of the counterbored screw holes 114. As such, the screw heads 134 of the compression screws 130 are contained in the upper end of the counterbored screw holes 114 when installed in the metaglene component 12.

[0073] Like the metaglene component 14, the compression screws 130 may be constructed with an implant-grade biocompatible metal, although other materials may also be used. Examples of such metals include cobalt, including cobalt alloys such as a cobalt chrome alloy, titanium, including titanium alloys such as a Ti6Al4V alloy, and stainless steel.

[0074] As can be seen in FIGS. 8-10, a screw cap 140 is secured to the metaglene component 14. The screw cap 140 includes a locking flange 142 having a threaded shaft 144 extending away from its lower surface 146. The screw cap's threaded shaft 144 may be threaded into the threaded bore 110 of the metaglene component's stem 104 to secure the screw cap 140 to the metaglene component. A drive socket 148, such as a hex drive socket, is formed in an upper surface 150 of the screw cap's locking flange 142. A drive tool, such as a hex driver (not shown), may be inserted into the drive socket 148 to drive (i.e., rotate) the screw cap 140 relative to the metaglene component 14. Rotation in one direction (e.g., clockwise) may be used to tighten, and hence secure, the screw cap 140 to the metaglene component 14, with rotation in the opposite direction (e.g.,

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counterclockwise) being used to loosen, and hence, remove the screw cap 140 from the metaglene component 14.

[0075] As can be seen in FIG. 9, the lower surface 146 of the screw cap's locking flange 142 defines a generally conical annular-shaped beveled surface 152. The annular-shaped beveled surface 152 is sized and shaped to be received into and closely compliment the countersunk surface 120 of the metaglene component's platform 102. In such a way, the locking flange 142 partially covers the metaglene component's screw holes 114 and hence the heads 134 of the compression screws 130 positioned therein. What is meant herein by "cover" in regard to the position of the locking flange 142 relative to the screw holes 114 of the metaglene component 14 and/or the heads 134 of the compression screws 130 is that the outer annular edge 154 overlays or overlaps at least a section of the circumference 122 of the screw holes 114 and/or the round outer edge 136 of the compression screws 130. This is best demonstrated in the lateral elevational or plan view of FIG. 10. Specifically, when viewed laterally such as the case of FIG. 10, the outer annular edge 154 of the screw cap's locking flange 142 intersects, and hence overlaps, the circumference 122 of each of the screw holes 114 and the round outer edge 136 of each of the compression screws 130. In such a way, the locking flange 142 prevents the compression screws 130 from backing out and escaping the screw holes 114.

[0076] As can be seen in FIG. 9, when the screw cap 140 is installed to the metaglene component 14, the annular-shaped beveled surface 152 of the screw cap's locking flange 142 contacts or otherwise engages the round outer edge 136 of each screw head 134 of any of the compression screws 130 installed in the metaglene component 14.

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Such contact generates a clamping force to resist the compression screws 130 from backing out from the bone tissue of the patient's scapula 22.

[0077] Like the metaglene component 14 and the compression screws 130, the screw cap 140 may be constructed with an implant-grade biocompatible metal, although other materials may also be used. Examples of such metals include cobalt, including cobalt alloys such as a cobalt chrome alloy, titanium, including titanium alloys such as a Ti6Al4V alloy, and stainless steel.

[0078] As shown in FIG. 7, the metaglene component 14 may first be implanted into the surgically-prepared glenoid surface 20 of the patient's scapula 22 by positioning it at the desired location and orientation, and thereafter fixing it in place by inserting one or more compression screw(s) 130 through the screw holes 114 and driving them into the bone tissue. Once the compression screws 114 have been seated, the surgeon may then install the screw cap 140 by inserting its threaded shaft 144 into the threaded bore 110 of the metaglene component's stem 104 and thereafter rotating the screw cap 140 with a hex driver (not shown) inserted into the drive socket 148 formed in the upper surface 150 of the screw cap's locking flange 142. Tightening of the screw cap 140 in such a manner urges the annular-shaped beveled surface 152 of the screw cap's locking flange 142 into contact with the round outer edge 136 of each screw head 134 of the compression screws 130 installed in the metaglene component 14 thereby asserting a clamping force on the screw heads 134 to resist the compression screws 130 from backing out the bone tissue of the patient's scapula 22. Once the screw cap 140 has been installed, the surgeon may then taper lock the glenosphere component 12 to the implanted metaglene component 14 in the manner described above.

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[0079] If the metaglene component 14 subsequently needs to be removed during, for example, a revision procedure, the surgeon may first remove the glenosphere component 12 from the implanted metaglene component 14 by breaking the taper lock connection between the two components and lifting the glenosphere component 12 away. Thereafter, the surgeon may insert a hex driver (not shown) into the drive socket 148 formed in the upper surface 150 of the screw cap's locking flange 142 and rotating the screw cap 140 in a direction opposite to the direction used to install the screw cap 140. Loosening of the screw cap in such a manner moves the annular-shaped beveled surface 152 of the screw cap's locking flange 142 out of contact with the round outer edge 136 of each screw head 134 of the compression screws 130 installed in the metaglene component 14 thereby releasing the clamping force from the screw heads 134. Continued loosening of the screw cap 140 allows its threaded shaft 144 to escape the threaded bore 110 of the metaglene component's stem 104 thereby allowing the screw cap 140 to be lifted away. Thereafter, the surgeon may use a drive tool (not shown) to remove the compression screws 130. An extraction tool (not shown) may be threaded into the threaded bore 110 of the metaglene component's stem 104 and thereafter used to extract the metaglene component 14 from the bone tissue of the patient's scapula 22.

[0080] Referring now to FIGS. 11-13, there is shown an embodiment in which the screw cap 140 is captured in the glenosphere component 14. In such an embodiment, slight modification has been made to the glenosphere component 14 and the screw cap 140 as shown in FIGS. 11-13. The same reference numerals are used in FIGS. 11-13 to designate components similar to those discussed above in regard to FIGS. 1-10. As can be seen in FIG. 11, the screw cap 140 is captured and retained in the tapered bore 38 of the glenosphere component 12 by a retaining ring 160. To do so, the screw cap 140 of

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the design of FIGS. 11-13 includes a cylindrically-shaped surface 162 that mates at one end with the annular-shaped beveled surface 152 of the screw cap's locking flange 142 and at its opposite end with an annular retaining flange 164. The retaining ring 160 is captured on the cylindrically-shaped surface 162 of the screw cap 140. That is, the cylindrically-shaped surface 162 of the screw cap 140 is positioned in the retaining ring's opening 166. As can be seen in FIGS. 11 and 12, the inner diameter of the retaining ring 160 (i.e., the diameter of its opening 166) is greater than the diameter of the cylindrically-shaped surface 162 of the screw cap 140, but less than the diameter of the screw cap's retaining flange 164. The outer diameter of the retaining ring 160 (i.e., the diameter of its outer surface 168) is greater than the diameter of the screw cap's retaining flange 16 and is sized and configured to be press fit, welded (or press fit and welded), or taper locked to the tapered sidewalls 40 defining the glenosphere component's tapered bore 38. As such, when assembled, the retaining ring 160 captures the screw cap 140 in the glenosphere component's tapered bore 38. So captured, both free rotation and limited linear movement of the screw cap 140 relative to the glenosphere component 12 are allowed, but it is prevented from escaping the glenosphere component's tapered bore 38.

**[0081]** The design of FIGS. 11-13 may be installed in a similar manner to as described above in regard to the design of FIGS. 8-10. In particular, the metaglene component 14 may first be implanted into the surgically-prepared glenoid surface 20 of the patient's scapula 22 by positioning it at the desired location and orientation, and thereafter fixing it in place by inserting one or more compression screw(s) 130 through the screw holes 114 and driving them into the bone tissue. Once the compression screws 114 have been seated, the surgeon may then install the glenosphere component 12, and hence the screw cap 140 captured therein, by inserting the screw cap's threaded shaft 144

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into the threaded bore 110 of the metaglene component's stem 104. Thereafter, the drive tip of a hex driver (not shown) may be advanced through the glenosphere component's installation hole 44 and into the screw cap's drive socket 148. The surgeon then rotates the screw cap 140 with the hex driver. Such tightening of the screw cap 140 urges the annular-shaped beveled surface 152 of the screw cap's locking flange 142 into contact with the round outer edge 136 of each screw head 134 of the compression screws 130 installed in the metaglene component 14 thereby asserting a clamping force on the screw heads 134 to resist the compression screws 130 from backing out of the bone tissue of the patient's scapula 22. Once the screw cap 140 has been installed, the surgeon may then taper lock the glenosphere component 12 to the implanted metaglene component 14 in the manner described above.

[0082] If the metaglene component 14 subsequently needs to be removed during, for example, a revision procedure, the surgeon may first remove the glenosphere component 12, and hence the captured screw cap 140, from the implanted metaglene component 14 by inserting the drive tip of a hex driver through the glenosphere component's installation hole 44 and into the screw cap's drive socket 148. The surgeon then rotates the screw cap 140 with the hex driver in a direction opposite to the direction used to install the screw cap 140. Loosening of the screw cap in such a manner moves the annular-shaped beveled surface 152 of the screw cap's locking flange 142 out of contact with the round outer edge 136 of each screw head 134 of the compression screws 130 installed in the metaglene component 14 thereby releasing the clamping force from the screw heads 134. The surgeon may then break the taper lock connection between the glenosphere component 12 and the metaglene component 14 and continue loosening the screw cap 140 until its threaded shaft 144 escapes the threaded bore 110 of the metaglene

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component's stem 104 thereby allowing the glenosphere component 12, and hence the screw cap 140 captured therein, to be lifted away from the metaglene component 14. Thereafter, the surgeon may use a drive tool (not shown) to remove the compression screws 130. An extraction tool (not shown) may be threaded into the threaded bore 110 of the metaglene component's stem 104 and thereafter used to extract the metaglene component 14 from the bone tissue of the patient's scapula 22.

[0083] It should be appreciated that the screw caps 140 described above in regard to FIGS. 8-13 provide efficiency during a surgical procedure to implant the metaglene component 14. For example, the screw caps 140 allow for implantation of the metaglene component 14 without the use of self-locking surgical screws. Surgical installation of self-locking surgical screws requires the use of a guide wire and other surgical considerations. By providing a locking function, the screw cap 140 allows compression screws, which are much easier to surgically install, to be used in lieu of self-locking surgical screws.

[0084] It should be appreciated that the concepts and features disclosed herein may be used in various combinations with one another or independently of one another. For example, the elliptical glenosphere component 12 of FIGS. 1-6 may be used in combination with either the metaglene component 14 of FIGS. 8-10 or the metaglene component 14 of FIGS. 11-13. Moreover, the elliptical glenosphere component 12 of FIGS. 1-6 may be used in combination with other metaglene components, including metaglene components without the screw caps 140 described herein. Similarly, the metaglene component 14 of FIGS. 8-10 may be used in combination with the elliptical glenosphere component 12 of FIGS. 1-6, or, alternatively, may be used with a conventional hemispherically-shaped or other type of glenosphere component. Along the



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same line, the metaglene component 14 of FIGS. 11-13 may be used in combination with the elliptical glenosphere component 12 of FIGS. 1-6, or, alternatively, may be used with a conventional hemispherically-shaped or other type of glenosphere component.

[0085] While the disclosure has been illustrated and described in detail in the drawings and foregoing description, such an illustration and description is to be considered as exemplary and not restrictive in character, it being understood that only illustrative embodiments have been shown and described and that all changes and modifications that come within the spirit of the disclosure are desired to be protected.

[0086] There are a plurality of advantages of the present disclosure arising from the various features of the apparatus, system, and method described herein. It will be noted that alternative embodiments of the apparatus, system, and method of the present disclosure may not include all of the features described yet still benefit from at least some of the advantages of such features. Those of ordinary skill in the art may readily devise their own implementations of the apparatus, system, and method that incorporate one or more of the features of the present invention and fall within the spirit and scope of the present disclosure as defined by the appended claims.

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## CLAIMS

1. A reverse shoulder orthopaedic implant, comprising:

a metaglene component having a platform with (i) a number of screw holes extending therethrough, and (ii) an elongated stem extending outwardly from a medial surface thereof, the elongated stem being configured to be implanted into the scapula of a patient and having a bore formed therein, and

a screw cap having (i) a shaft positioned in the bore of the metaglene component, and (ii) a locking flange extending outwardly from the shaft so as to at least partially cover each of the number of screw holes of the metaglene component.

2. The reverse shoulder orthopaedic implant of claim 1, wherein:

each of the number of screw holes defines a circumference, and

an outer edge of the locking flange of the screw cap overlaps at least a portion of the circumference of each of the number of screw holes of the metaglene component.

3. The reverse shoulder orthopaedic implant of claim 1, wherein:

the bore formed in the elongated stem of the metaglene component comprises a threaded bore,

the shaft of the screw cap comprises a threaded shaft, and

the threaded shaft of the screw cap is threaded into the threaded bore of the metaglene component.

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4. The reverse shoulder orthopaedic implant of claim 1, wherein:  
the locking flange is annular shaped,  
the shaft extends outwardly from a lower surface of the locking flange,  
and  
a drive socket is formed in the upper surface of the locking flange.

5. The reverse shoulder orthopaedic implant of claim 1, further comprising a glenosphere component having a bore formed therein, wherein the screw cap is captured in the bore of the glenosphere component.

6. The reverse shoulder orthopaedic implant of claim 5, further comprising a retaining ring, wherein the retaining ring is secured within the bore of the glenosphere component so as to retain the screw cap therein.

7. The reverse shoulder orthopaedic implant of claim 1, further comprising a number of compression screws positioned in the number of screw holes of the metaglene component, wherein:

each of the number of compression screws has a screw head having an outer edge, and

an outer edge of the locking flange of the screw cap overlaps at least a portion of the outer edge of each of the number of screw holes of the metaglene component.

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8. A reverse shoulder orthopaedic implant, comprising:

a metaglene component having a platform with (i) a number of screw holes extending therethrough, and (ii) an elongated stem extending outwardly from a medial surface thereof, the elongated stem having a bore formed therein,

a glenosphere component having a bore formed therein, and

a screw cap captured in the bore of the glenosphere component, the screw cap being rotatable relative to the glenosphere component and having (i) a shaft positioned in the bore of the metaglene component, and (ii) a locking flange extending outwardly from the shaft so as to at least partially cover each of the number of screw holes of the metaglene component.

9. The reverse shoulder orthopaedic implant of claim 8, wherein the locking flange of the screw cap comprises an annular-shaped beveled surface.

10. The reverse shoulder orthopaedic implant of claim 9, wherein the screw cap further comprises (i) a cylindrically-shaped surface extending upwardly from the annular-shaped beveled surface, and (ii) a retaining flange extending outwardly from the cylindrically-shaped surface, further comprising:

a retaining ring positioned around the cylindrically-shaped surface of the screw cap and secured to the sidewalls of the glenosphere component defining the bore.

11. The reverse shoulder orthopaedic implant of claim 10, wherein the diameter of the retaining flange of the screw cap is larger than the inner diameter of the retaining ring and smaller than the outer diameter of the retaining ring.

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12. The reverse shoulder orthopaedic implant of claim 10, wherein a drive socket is formed in an upper surface of the retaining flange of the screw cap.

13. The reverse shoulder orthopaedic implant of claim 10, wherein the retaining ring is press fit within the bore of the glenosphere component so as to retain the screw cap therein.

14. The reverse shoulder orthopaedic implant of claim 8, wherein:  
each of the number of screw holes defines a circumference, and  
an outer edge of the locking flange of the screw cap overlaps a least a section of the circumference of each of the number of screw holes of the metaglene component.

15. The reverse shoulder orthopaedic implant of claim 8, wherein:  
the bore formed in the elongated stem of the metaglene component comprises a threaded bore,  
the shaft of the screw cap comprises a threaded shaft, and  
the threaded shaft of the screw cap is threaded into the threaded bore of the metaglene component.

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16. The reverse shoulder orthopaedic implant of claim 8, further comprising a number of compression screws positioned in the number of screw holes of the metaglene component, wherein:

the locking flange of the screw cap comprises an annular-shaped beveled surface,

each of the number of compression screws has a screw head having a round outer edge, and

the beveled surface of the locking flange of the screw cap contacts the round outer edge of each of the number of screw holes of the metaglene component.

17. A reverse shoulder orthopaedic implant, comprising:

a metaglene component configured to be implanted into the scapula of a patient, the metaglene component having a platform with a number of screw holes extending therethrough,

a number of compression screws positioned in the number of screw holes of the metaglene component, each of the number of compression screws having a screw head with an outer edge, and

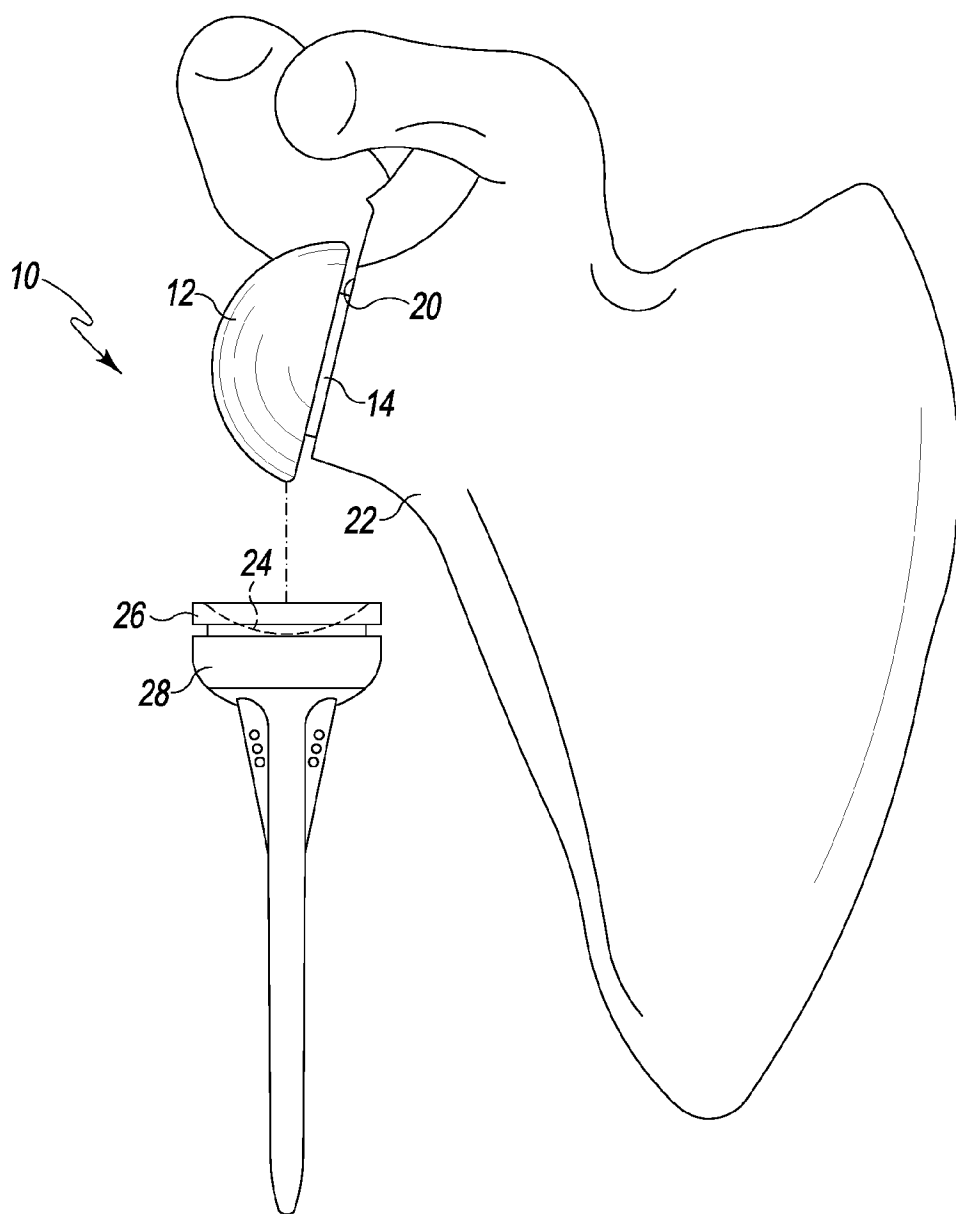
a screw cap secured to the metaglene component, the screw cap comprising a locking flange having an outer edge that overlaps at least a portion of the outer edge of each of the number of compression screws positioned in the number of screw holes of the metaglene component.

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18. The reverse shoulder orthopaedic implant of claim 17, wherein:  
each of the number of screw holes defines a circumference, and  
the outer edge of the locking flange of the screw cap overlaps at least a portion of the circumference of each of the number of screw holes of the metaglens component.

19. The reverse shoulder orthopaedic implant of claim 17, wherein:  
the platform of the metaglens component has an elongated stem with a threaded bore formed therein,  
the screw cap has a threaded shaft extending downwardly for a lower surface of the locking flange, and  
the threaded shaft of the screw cap is threaded into the threaded bore of the metaglens component.

20. The reverse shoulder orthopaedic implant of claim 17, wherein a drive socket is formed in an upper surface of the screw cap.

**Fig. 1**



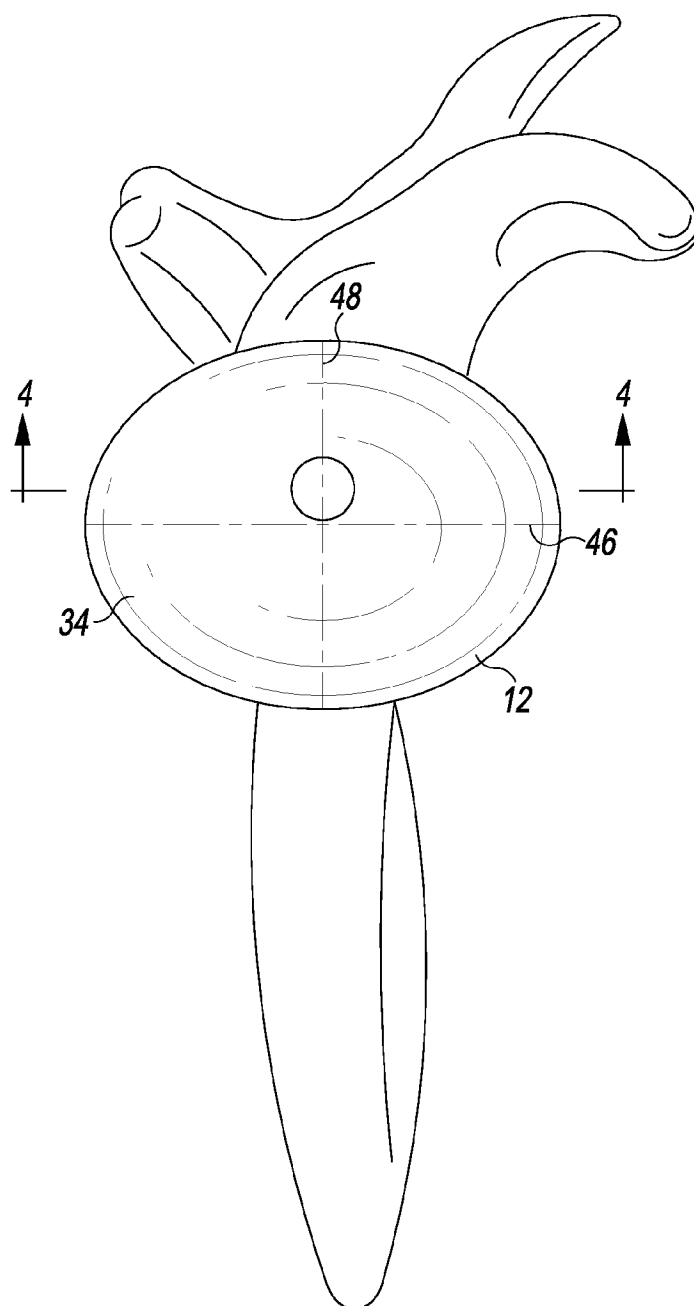


Fig. 2

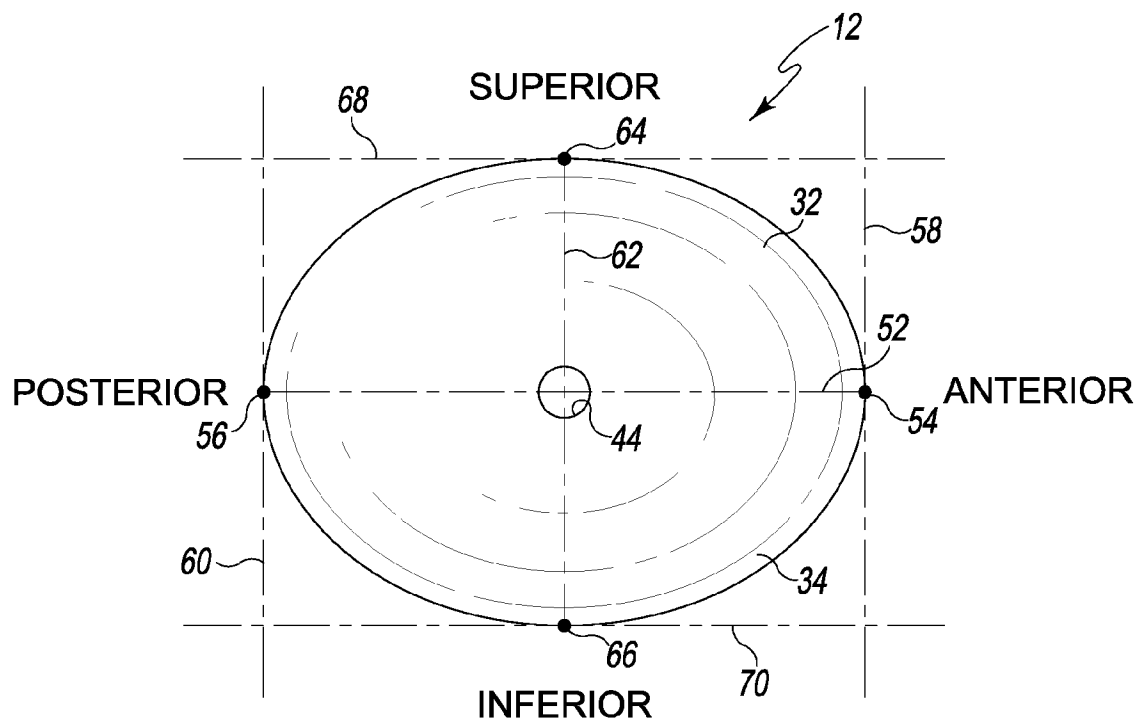


Fig. 3

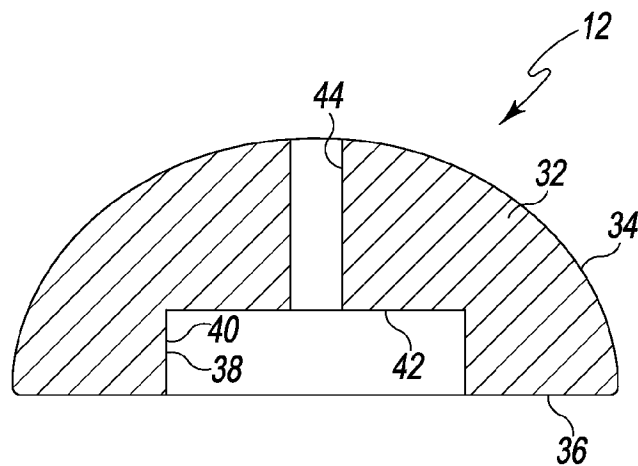


Fig. 4

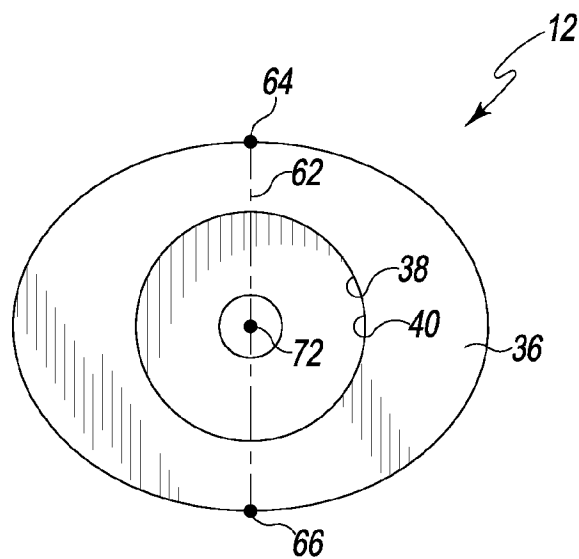


Fig. 5

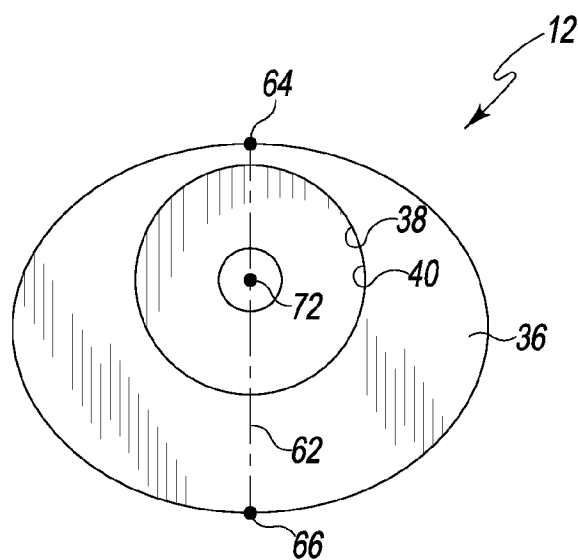


Fig. 6

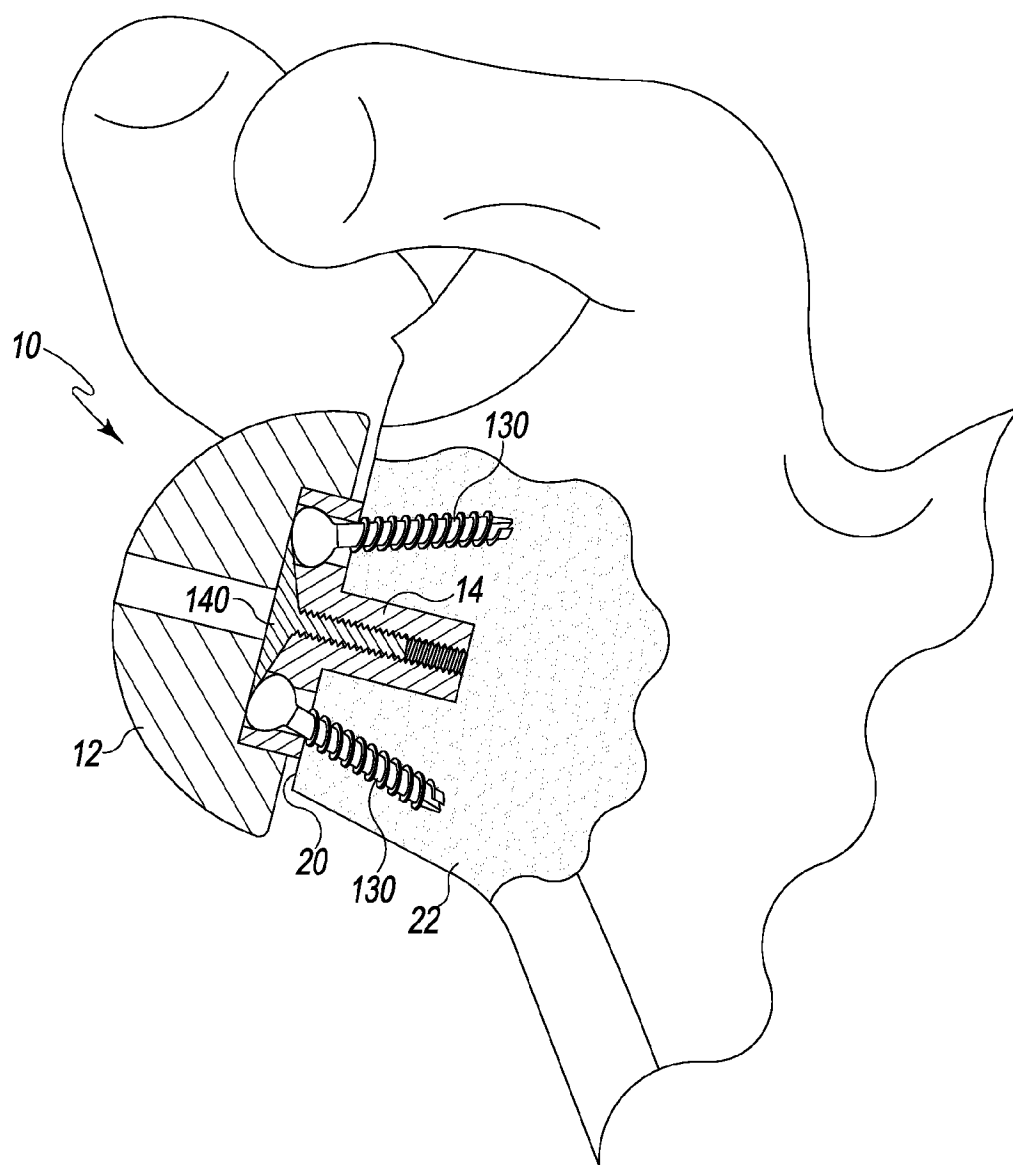


Fig. 7

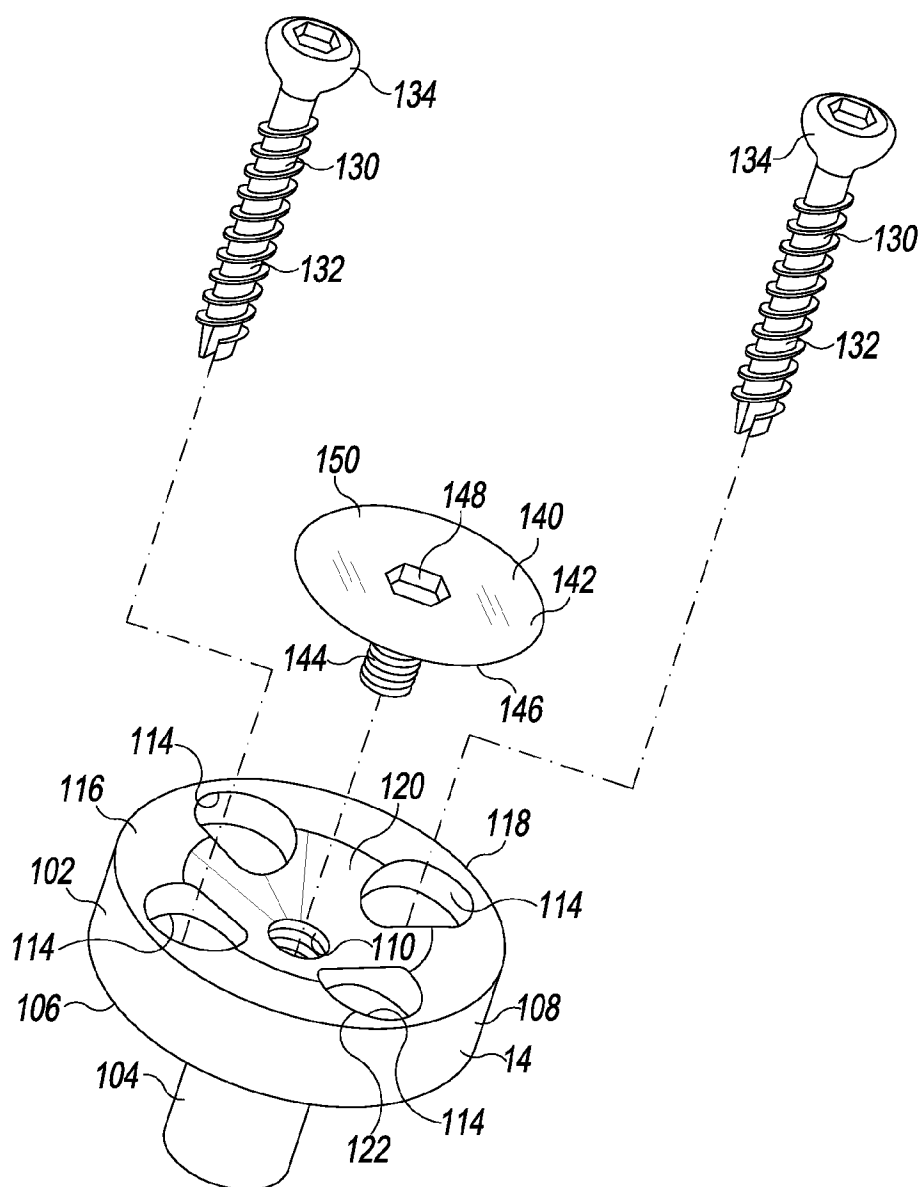


Fig. 8

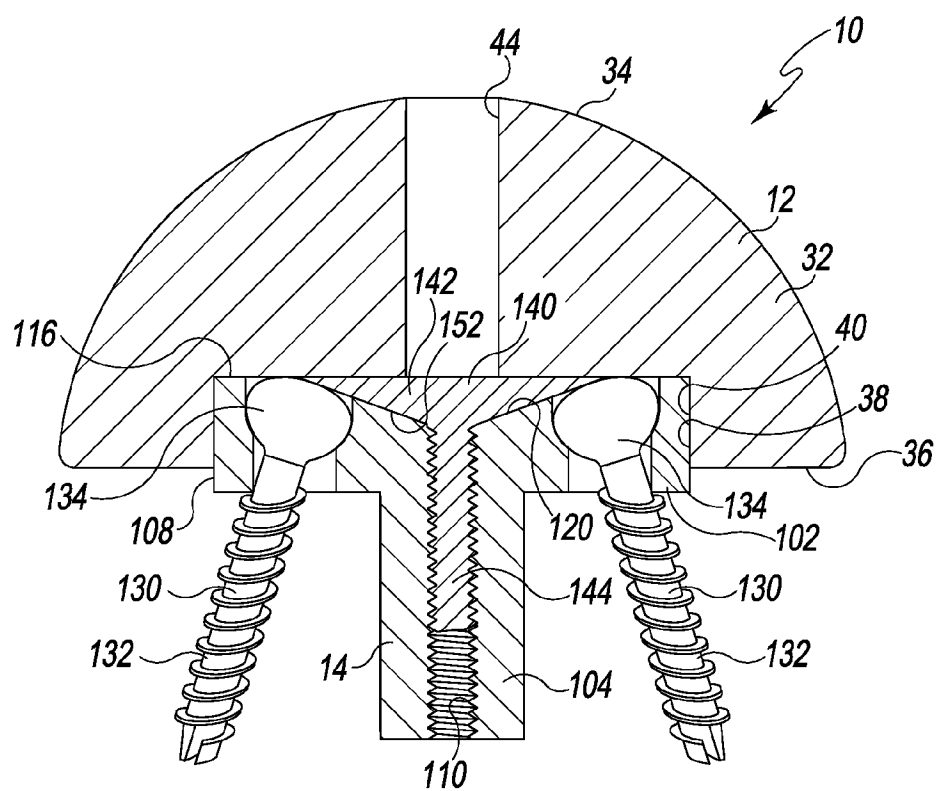


Fig. 9

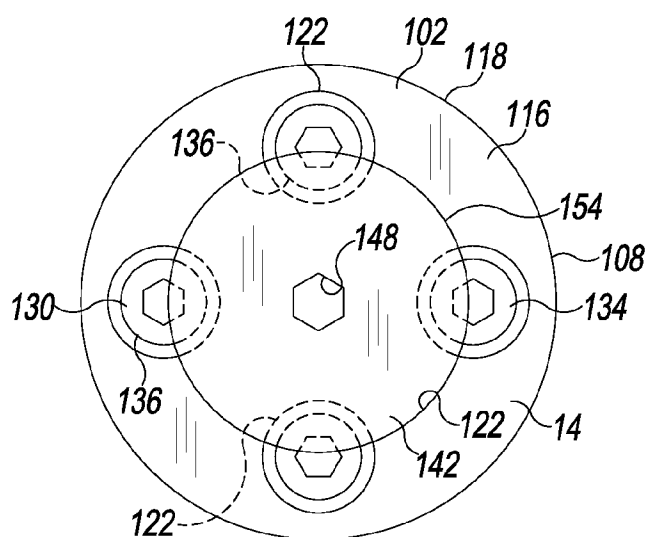


Fig. 10

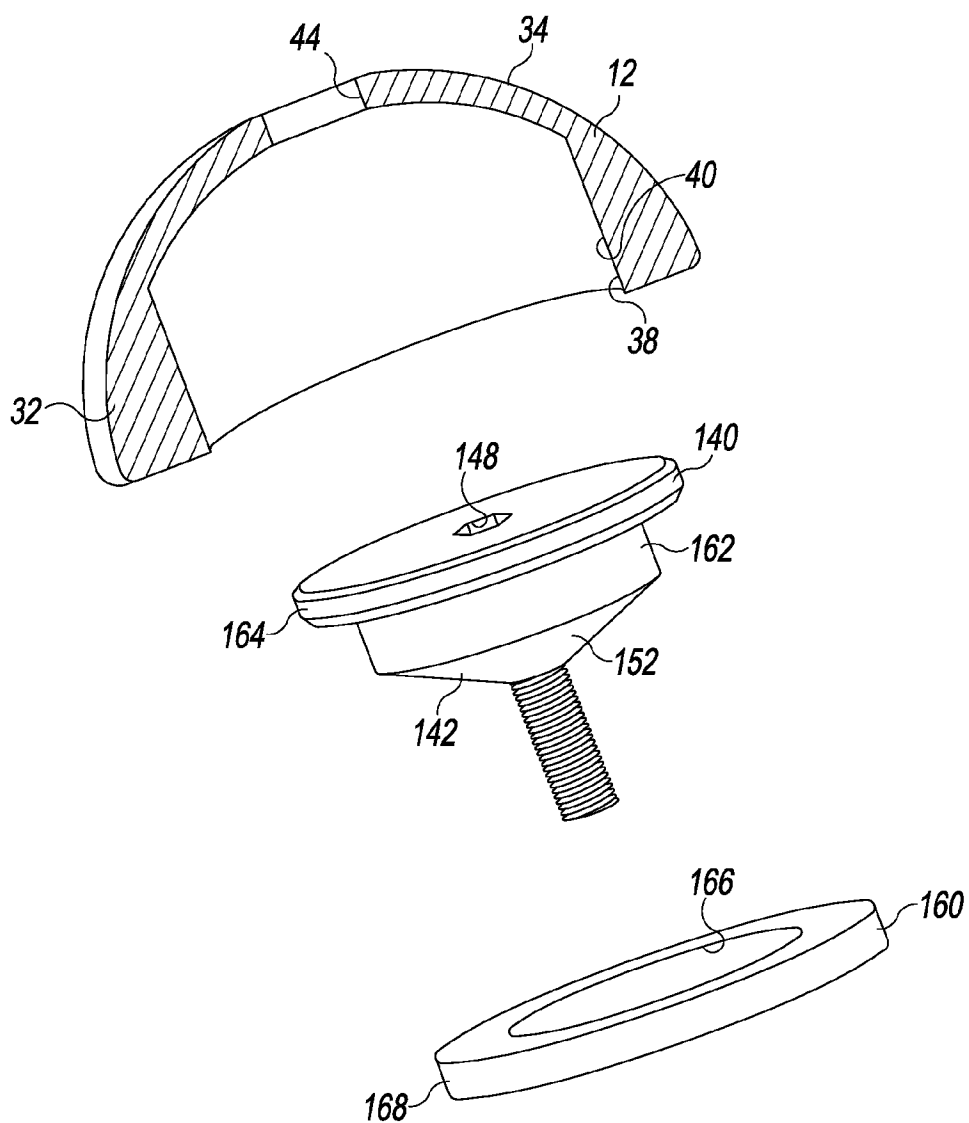


Fig. 11

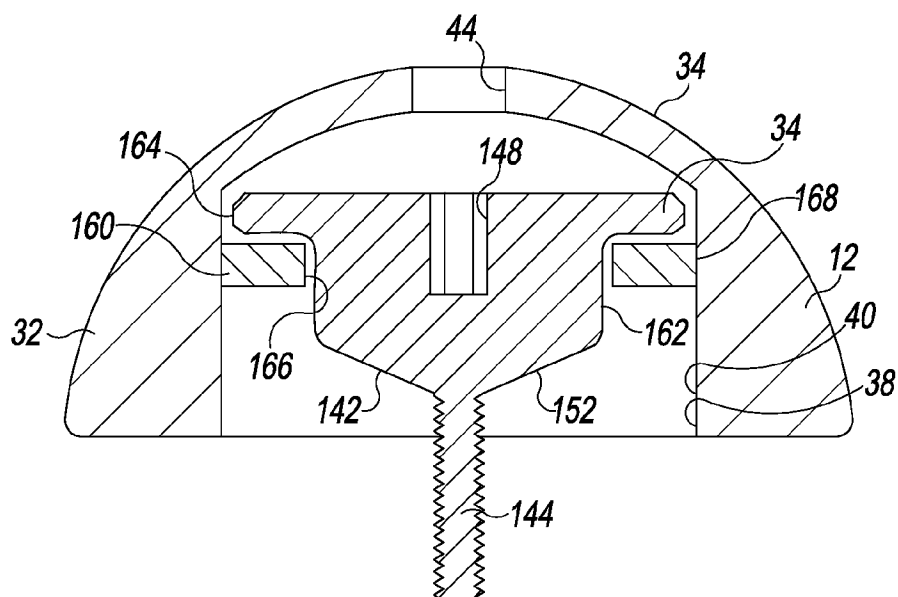


Fig. 12

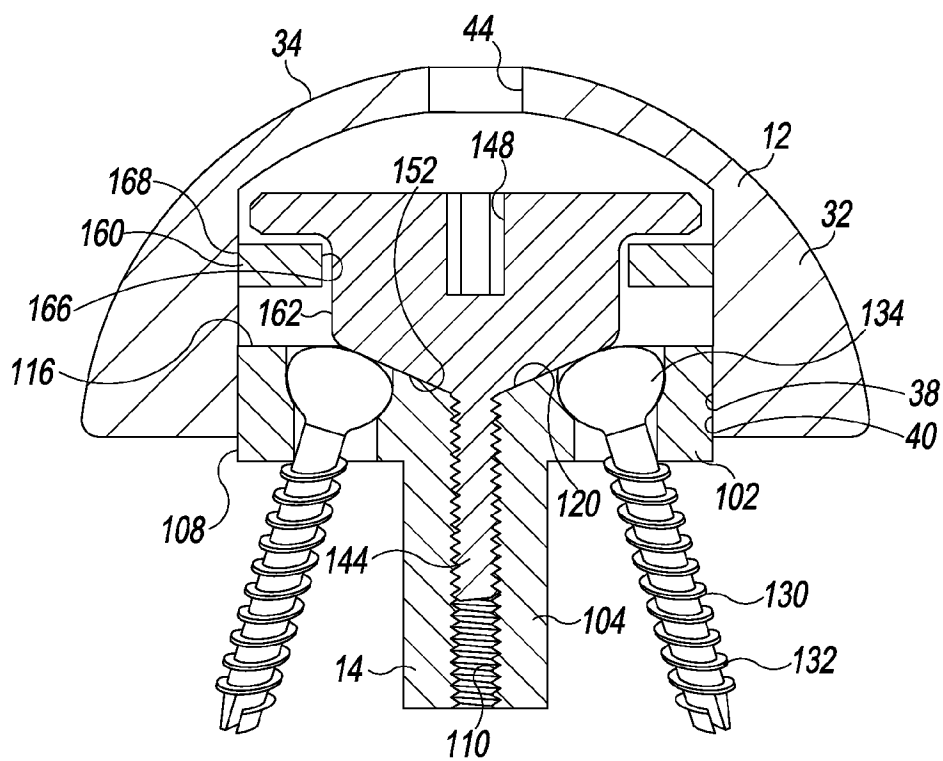


Fig. 13



# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2013/033124

A. CLASSIFICATION OF SUBJECT MATTER  
INV. A61F2/40  
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)  
A61F

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 2010/023068 AI (BOUTTENS DENIS [FR] ET AL) 28 January 2010 (2010-01-28)<br><br>figures 1,2,3<br>paragraph [0030] - paragraph [0040]<br>-----                          | 1-5 , 7,8,<br>14, 15 ,<br>17-20  |
| X         | FR 2 737 107 AI (MEDINOV SA [FR] )<br>31 January 1997 (1997-01-31)<br><br>figures 1,2<br>page 4 - page 6<br>-----                                                        | 1-5 , 7,8,<br>14, 15 ,<br>17-20  |
| X         | EP 1 656 910 AI (LIMA LTO SPA [IT] )<br>17 May 2006 (2006-05-17)<br><br>figures 1-3<br>paragraphs [0023] - [0027] , [0031] ,<br>[0035] , [0043] , [0044]<br>-----<br>-/- | 1, 2, 5, 7,<br>8, 14, 17 ,<br>18 |

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

☒ See patent family annex.

\* Special categories of cited documents :

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

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

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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

"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

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Date of the actual completion of the international search

5 July 2013

Date of mailing of the international search report

15/07/2013

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
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Fax: (+31-70) 340-3016

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# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2013/033124

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                  | Relevant to claim No. |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | FR 2 652 498 A1 (MEDINOV [FR] )<br>5 April 1991 (1991-04-05)<br>figures 1, 7                                                                                                        | 1, 2, 7,<br>17, 18    |
| X         | -----<br>EP 1 064 890 A1 (ASTON MEDICAL LTD [GB] ;<br>CAPON DIDIER [FR] ; TROUILLOUD PIERRE [FR] ;<br>BUT) 3 January 2001 (2001-01-03)<br>figures 8-10<br>paragraph [0028]<br>----- | 1, 7, 17              |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/033124

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| US 2010023068                             | AI                  | 28-01-2010                 |                     |
|                                           |                     | AU 780176 B2               | 03-03 -2005         |
|                                           |                     | AU 2526201 A               | 09- 07-2001         |
|                                           |                     | FR 2802799 AI              | 29-06 -2001         |
|                                           |                     | GB 2375052 A               | 06-11 -2002         |
|                                           |                     | JP 4464026 B2              | 19-05 -2010         |
|                                           |                     | JP 2003518408 A            | 10- 06-2003         |
|                                           |                     | NO 20023063 A              | 24-06 -2002         |
|                                           |                     | SE 526618 C2               | 18- 10-2005         |
|                                           |                     | SE 0201836 A               | 17-06 -2002         |
|                                           |                     | US 2003114933 AI           | 19- 06-2003         |
|                                           |                     | US 2005256583 AI           | 17- 11-2005         |
|                                           |                     | US 2010023068 AI           | 28-01 -2010         |
|                                           |                     | Wo 0147442 AI              | 05-07 -2001         |
|                                           |                     | ZA 200205014 A             | 18- 03-2003         |
| -----                                     |                     |                            |                     |
| FR 2737107                                | AI                  | 31-01-1997                 | NONE                |
| -----                                     |                     |                            |                     |
| EP 1656910                                | AI                  | 17-05-2006                 |                     |
|                                           |                     | AT 406854 T                | 15-09-2008          |
|                                           |                     | EP 1656910 AI              | 17-05-2006          |
|                                           |                     | EP 1980221 AI              | 15-10-2008          |
|                                           |                     | ES 2315804 T3              | 01-04-2009          |
| -----                                     |                     |                            |                     |
| FR 2652498                                | AI                  | 05-04-1991                 | NONE                |
| -----                                     |                     |                            |                     |
| EP 1064890                                | AI                  | 03-01-2001                 |                     |
|                                           |                     | DE 60022584 DI             | 20-10-2005          |
|                                           |                     | DE 60022584 T2             | 22-06-2006          |
|                                           |                     | EP 1064890 AI              | 03-01-2001          |
|                                           |                     | FR 2795304 AI              | 29-12-2000          |
| -----                                     |                     |                            |                     |



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22 June 2017 (22.06.2017)

## (25) Filing Language:

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10801 Nesbitt Avenue South, Bloomington, MN 55437 (US).

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(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, ST, 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, KM, ML, MR, NE, SN, TD, TG).

## (54) Title: STEMLESS PROSTHESIS ANCHOR COMPONENT

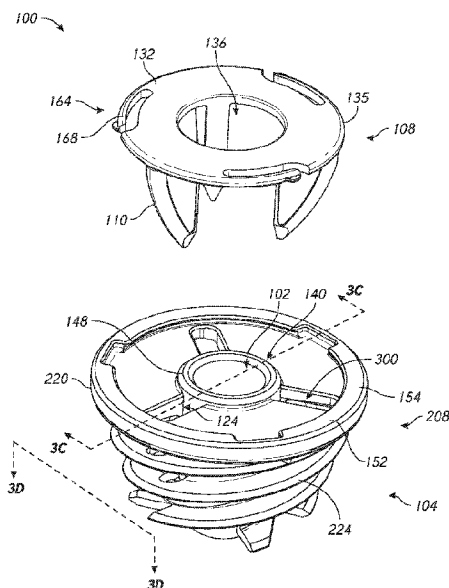


FIG. 2

(57) **Abstract:** A prosthesis assembly is provided that includes a base member (104) that has a helical structure (224) and one or more pathways. The helical structure extends between a first end and a second end. The pathway is accessible from the second end and is directed toward the first end through the helical structure. The pathway is located inward of an outer periphery of the helical structure, e.g., adjacent to an inner periphery of the helical structure. The pathway extends in a space between successive portions of the helical structure. The prosthesis assembly includes a locking device (108) that has a support member and an arm (110) that projects away from the support member. The arm is configured to be disposed in the pathway when the support member is disposed adjacent to the second end of the base member. The arm is disposed through bone in the space between successive portions of the helical structure when the prosthesis assembly is implanted.

**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))*

## STEMLESS PROSTHESIS ANCHOR COMPONENT

### BACKGROUND OF THE INVENTION

#### Field of the Invention

[0001] The present disclosure relates to a stemless prosthesis anchor component of a joint prosthesis.

#### Description of the Related Art

[0002] Skeletal joints have a variety of configurations providing for a wide range of smooth movement of two or more bones relative to each other. For example, in a shoulder joint, the head of the humerus interacts with the glenoid cavity of the scapula in a manner similar to a “ball and socket” joint. Over time, it may become necessary to replace a joint, such as the shoulder joint, with a prosthetic joint. The prosthetic joint can include components mounted to one, two or more than two bones at the joint. For example, the prosthetic joint can include a humeral component, a glenoid component or both a humeral and a glenoid component.

[0003] Conventional humeral components include a humeral head jointed to a stem. The stem is configured to be inserted into a medullary canal of the humerus. In certain cases, insertion of the stem disadvantageously requires bone to be removed to fit the stem to the medullary canal due to patient-to-patient anatomical variation. Another disadvantage of this approach is that integration of the stem into the bone through a natural process of bone ingrowth can make it difficult to remove the humeral component if it becomes necessary to replace the humeral component with another device.

[0004] A stemless humeral component may be used to address some of the disadvantages of conventional humeral components. Stemless humeral components can decrease the amount of bone loss in preparing the humerus to receive the component and decrease the complexity of the joint replacement procedure.

[0005] Stemless humeral component designs can be more challenging to secure to the humerus. Conventional stemless designs rely on bone ingrowth for strength. While such designs perform well over time, there is a risk in the early days and weeks after surgery where such ingrowth has not yet occurred that the stemless humeral component will be dislodged from the humerus. Dislodgement may also occur due to

backing out after being inserted, excessive wear, forces applied thereto during a revision surgery or other high load conditions.

#### SUMMARY OF THE INVENTION

**[0006]** Accordingly, there is a need for additional stemless components or prostheses designed to preserve bone in initial implantation while enhancing initial pull-out and back-out resistance. Preferably enhanced initial dislodgement resistance will also provide excellent long term fixation.

**[0007]** In one embodiment, a shoulder assembly is provided that includes a base member and a locking device. The base member includes a collar, a helical structure, and a first pathway projecting distally of the collar. The helical structure extends from the collar in a distal direction. The first pathway projects distally of the collar and through the helical structure. The first pathway is disposed adjacent to an inner periphery of the helical structure. The first pathway is generally transverse to the helical structure and extending in a space between successive portions of the helical structure. The locking device has a proximal support and a first arm that projects distally of the proximal support. The first arm is configured to be disposed in the first pathway that projects distally of the collar when the proximal support is disposed adjacent to the collar. The first arm is disposed through bone in the space between successive portions of the helical structure when the shoulder assembly is implanted.

**[0008]** In some embodiments, a kit can be provided that includes a shoulder assembly as described above, an anatomic articular component, and a reverse articular component. The anatomic articular component is mateable with the shoulder assembly. The anatomic articular component has a convex articular surface adapted to articulate with a concave surface of or on a scapula of a patient. The reverse articular component is mateable with the shoulder assembly. The reverse articular component comprises a concave articular surface adapted to articulate with a convex surface on a scapula of a patient. The reverse articular component can include a separate tray component for mating an articular surface to the base member.

**[0009]** In another embodiment, a prosthesis assembly is provided that includes a base member that has a helical structure and a first pathway. The base member has a first end and a second end. The helical structure extends between the first end and the second end. The first end comprises a distal or medial end in some applications. The second end comprises a proximal end or a lateral end in some applications. The first

pathway is accessible from the second end and is directed toward the first end through the helical structure. The first pathway is located inward of an outer periphery of the helical structure, e.g., adjacent to an inner periphery of the helical structure. The first pathway is generally transverse to the helical structure. The first pathway extends in a space between successive portions of the helical structure. The prosthesis assembly includes a locking device that has a support member and a first arm that projects away from the support member. The first arm is configured to be disposed in the first pathway when the support member is disposed adjacent to the second end of the base member. The first arm is disposed through bone in the space between successive portions of the helical structure when the prosthesis assembly is implanted.

[0010] The prosthesis assembly discussed above can be mated with a proximal humerus. The prosthesis assembly discussed above can be mated with other anatomy as well, such as a glenoid of a scapula. The prosthesis assembly discussed above can be mated with a bone adjacent to an elbow joint, such as a distal humerus or a proximal radius. The prosthesis assembly discussed above can be mated with a bone adjacent to a wrist joint, such as a distal radius. The prosthesis assembly discussed above can be mated with a bone adjacent to the hip, such as a proximal femur. The prosthesis assembly discussed above can be mated with a bone adjacent to a knee joint, such as a distal femur or a proximal tibia. The prosthesis assembly discussed above can be mated with a bone adjacent to an ankle joint, such as a distal tibia or a proximal talus

[0011] In another embodiment, a method of implanting a prosthesis is provided. The method includes advancing by rotation a base member into a bone adjacent to a joint. The bone can include an epiphysis of a humerus of a patient. The bone can include a glenoid of a scapula of a patient. The bone can include a distal portion of a humerus adjacent to an elbow joint. The bone can include a proximal portion of a radius adjacent to an elbow joint. The bone can include a distal portion of a radius adjacent to a wrist joint. The bone can include a proximal portion of a femur adjacent to a hip joint. The bone can include a distal portion of a femur adjacent to a knee joint. The bone can include a proximal portion of a tibia adjacent to a knee joint. The bone can include a distal portion of a tibia adjacent to an ankle joint. The bone can include a proximal portion of a talus adjacent to an ankle joint. The base member comprising a helical structure configured to engage cancellous bone of the epiphysis or other portion of any of the bones set forth above. A locking device is advanced by linear translation into



the base member. The locking device has at least one arm adapted to span a gap between adjacent portions of the helical structure. The locking device contacts the cancellous bone in the gap.

**[0012]** In another embodiment, a glenoid assembly is provided. The glenoid assembly includes a base member and a plate member. The base member has a medial end and a lateral end. The base member has a helical structure that extends between the medial end and the lateral end and a first pathway. The first pathway is accessible from the lateral end and is directed toward the medial end. The first pathway can extend through the helical structure and can be located inward of an outer periphery of the helical structure, e.g., adjacent to an inner periphery of the helical structure. The first pathway can be generally transverse to the helical structure and can extend in a space between successive portions of the helical structure. The plate member has a flange and a first arm that projects away from the flange. The first arm is configured to be disposed in the first pathway when the plate member is disposed adjacent to the lateral end of the base member. The first arm is disposed through bone in the space between successive portions of the helical structure when the prosthesis assembly is implanted.

**[0013]** Any feature, structure, or step disclosed herein can be replaced with or combined with any other feature, structure, or step disclosed herein, or omitted. Further, for purposes of summarizing the disclosure, certain aspects, advantages, and features of the inventions have been described herein. It is to be understood that not necessarily any or all such advantages are achieved in accordance with any particular embodiment of the inventions disclosed herein. No aspects of this disclosure are essential or indispensable.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0014]** These and other features, aspects and advantages are described below with reference to the drawings, which are intended to illustrate but not to limit the inventions. In the drawings, like reference characters denote corresponding features consistently throughout similar embodiments. The following is a brief description of each of the drawings.

**[0015]** Figure 1 is a perspective view of one embodiment of a stemless shoulder assembly shown mounted in a humerus, and further illustrating a kit including anatomic and reverse shoulder articular components;

**[0016]** Figure 2 is an exploded view of the stemless shoulder assembly shown in Figure 1;

[0017] Figure 3A is a side view of the base member of Figure 2;

[0018] Figure 3B is a top view of the base member of Figure 2;

[0019] Figure 3C is a cross-sectional view of the base member of Figure 2 taken at section plane 3C-3C;

[0020] Figure 3D is a cross-sectional view of the base member of Figure 2 taken at section plane 3D-3D;

[0021] Figure 4 is a side view of one embodiment of a locking component, which is a component configured to control, e.g., reduce or eliminate and/or control rotation of a base member or of a helical structure of a prosthesis assembly;

[0022] Figure 5 is a top, proximal side, or medial side view of the locking component of the Figure 4;

[0023] Figure 6A is a detail view of one embodiment of an engagement feature that causes the locking component of Figure 4 and the base member of Figures 3A and 3B to be engaged;

[0024] Figure 6B is a detail view of another embodiment of an engagement feature that causes the locking component and the base member to be engaged at a location within the helical structure;

[0025] Figure 7 is a cross-sectional view of the stemless shoulder assembly of Figure 2 with the assembly disposed in the humeral head;

[0026] Figures 8-16 illustrate various methods for implanting a prosthesis assembly of Figures 1-7 into a portion of a bone;

[0027] Figure 17 is a side view of the stemless shoulder assembly of Figure 2 coupled with an anatomic articular component of the kit illustrated in Figure 1;

[0028] Figure 18A is a side view of the stemless shoulder assembly of Figure 2 coupled with a reverse articular component of the kit illustrated in Figure 1;

[0029] Figure 18B shows a reverse shoulder prosthesis including a reverse articular component coupled with the humerus and a convex glenoid component, sometimes referred to as a glenoid sphere, coupled with the scapula;

[0030] Figure 19 is a schematic side view of a glenoid of a scapula of a shoulder of a patient with a reverse shoulder prosthesis assembly disposed therein;

[0031] Figure 20 is a cross-sectional view of the reverse shoulder prosthesis assembly shown in Figure 19 taken at section plane 20-20;

[0032] Figure 21 is an exploded perspective view of the reverse shoulder prosthesis assembly illustrated in Figure 20 showing features of the articular surface of a glenoid sphere;

[0033] Figure 22 is an exploded view of the reverse shoulder prosthesis assembly illustrated in Figure 20 showing features of a bone engaging side of a plate member;

[0034] Figure 23 is a cross-sectional view of the reverse shoulder prosthesis assembly of Figure 20 taken at section plane 23-23 shown in Figure 22;

[0035] Figure 23A shows aspects of a base member of the shoulder assembly of Figure 19;

[0036] Figure 24 is a schematic side view of a proximal femur having a prosthesis assembly similar to that of Figures 1-7 disposed therein in connection with a hip joint procedure;

[0037] Figure 25 is a schematic side view of a distal portion of a long bone of an arm, e.g., of the humerus or radius, having a prosthesis assembly similar to that of Figures 1-7 disposed therein in connection with an elbow or wrist joint procedure;

[0038] Figure 26 is a schematic side view of a knee joint showing a prosthesis assembly similar to that of Figures 1-7 disposed in the distal femur and in the proximal tibia thereof;

[0039] Figure 27 is a schematic side view of an ankle joint showing a prosthesis assembly similar to that of Figures 1-7 disposed in the distal tibia and in the proximal talus thereof; and

[0040] Figure 28 shows comparative tip out performance of an embodiment as disclosed herein compared to a conventional stemless implant.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0041] While the present description sets forth specific details of various embodiments, it will be appreciated that the description is illustrative only and should not be construed in any way as limiting. Furthermore, various applications of such embodiments and modifications thereto, which may occur to those who are skilled in the art, are also encompassed by the general concepts described herein. Each and every feature described herein, and each and every combination of two or more of such features, is included within the scope of the present invention provided that the features included in such a combination are not mutually inconsistent.

[0042] Figure 1 shows a kit 80 that includes a shoulder assembly 100. The kit 80 can include one or both of an anatomic articular component 84 and a reverse articular component 88. The anatomic articular component 84 can comprise a one-piece structure including a convex articular surface 90 disposed on a proximal or lateral side and a tapered projection 92 disposed on a distal side thereof. The reverse articular component 88 can comprise a two-piece structure including a tray 94 and an insert 96. In other embodiments, the articular component 88 has a one-piece configuration. In other embodiments, the articular component 88 has a monolithic configuration. Monolithic embodiments can comprise a one material configuration. Monolithic embodiments can comprise two or more material. The insert 96 can mate with the tray 94 in any suitable manner, such as by interference fit or snap fit. The tray 94 can include a tapered projection 98. Figure 18B shows that the kit 80 also can include a glenoid sphere 99 and corresponding components for anchoring the glenoid sphere in a glenoid. The insert 96 is shown in just one embodiment in which the tray is angled, such that a plane intersecting the medial side of the insert 96 is at an angle to the side that faces the shoulder assembly 100 providing a thicker superior portion. In other embodiments the insert 96 is angled, such that a plane intersecting the medial side of the insert 96 is at an angle to the side that faces the shoulder assembly 100 providing a thicker inferior portion. In other embodiments the insert 96 is not angled, such that the plane intersecting the medial side of the insert 96 is substantially parallel to the side that faces the shoulder assembly 100.

[0043] Figure 1 shows the shoulder assembly 100, as further described below in connection with Figures 2-7, implanted in an exposed face F of a humerus H. The assembly 100 has a recess 102 in which further components of a prosthetic shoulder joint can be secured. The assembly 100 and the recess 102 enable the humerus H to be fitted with either an anatomical shoulder by receiving the anatomic articular component 84, more particularly, the projection 92 or a reverse shoulder component 88 by receiving the projection 98 either initially or as part of a revision procedure. Methods of using the kit 80 to implant the shoulder assembly 100 as part of a shoulder prosthesis are discussed below in connection with Figures 8-16. Figures 19-26 show that further embodiments can be used beyond humeral application and beyond shoulder joint procedures. Figure 27 illustrates the performance of certain embodiments compared to a prior art design. While incremental differences in these embodiments and methods are discussed below, it is to

be understood that features of each embodiment can be combined with features of the other embodiments, as appropriate.

### **I. HUMERAL SHOULDER ASSEMBLIES HAVING ROTATION CONTROL LOCKING DEVICES**

[0044] Figures 1 and 7 show the shoulder assembly 100 applied to a shoulder joint. The assembly 100 can provide secure stemless connection to the humerus H. The shoulder assembly 100 provides for simple implantation because a base member thereof can be directly threaded into cancellous bone without being mated to another pre-placed base member. The shoulder assembly 100 can be fully retained within a head h of the humerus H. Figure 7 shows that the distal-most portion of the assembly 100 preferably can be disposed in the humeral head h. The assembly 100 does not have a stem or other member that protrudes beyond the head h into a medullary canal of the humerus. This approach is less invasive and simpler than procedures involving placement of a stem in a medullary canal. In other embodiments illustrated in part in Figure 10 by the creation of a recessed surface s having a depth accommodating a thickness of a proximal portion of the assembly 100, the assembly 100 may be recessed within the humeral head of the humerus H such that a proximal face 105 the assembly 100 is flush with respect to a cut surface of the bone.

[0045] Figure 2 shows that the assembly 100 includes a base member 104 and a locking device 108. The base member 104 is advanced into a bony structure such as cancellous bone in use. As discussed further below a bone surface may be exposed by resection or reaming, followed by threading of the base member 104 into a newly exposed bone surface. The assembly 100 also includes the locking device 108. The locking device 108 includes a plurality of arms 110. In particular, the arms 110 extend outward or distal from proximal support 132. The arms 110 can include a first arm, a second arm, and a third arm. The arms 110 can be circumferentially spaced equal distances from each other, e.g., about 120 degrees apart in one embodiment. In another variation, the arms 110 include three arms, with two of the three arms spaced 90 degrees from each other and a third arm spaced 135 degrees from one of the other two arms. The locking device 108 may include four or more arms 110. If the arms 110 include four arms, the arms can be circumferentially spaced 90 degrees apart. If the arms 110 include two arms, the arms can be circumferentially spaced 180 degrees apart. The arms 110 are

advanced through apertures 124 in the base member 104. In one embodiment, it should be noted that the number of arms 110 corresponds to an equal number of apertures 124. When so advanced, the arms 110 are disposed within the base member 104 in a manner that the arms 110 cross a space between portions, e.g., successive portions, of the base member 100. When so positioned, the arms 110 are also disposed within bone. Thus, two zones of the arms 110 can cross successive or adjacent portions of the base 104 and an intervening portion of the arms 110 can cross bone in a space between the successive or adjacent portion of the base. In this position, the arms 110 control, e.g., resist, rotation of the base member 104 relative to the bone such that the shoulder assembly 100 is secured against backing out of the bone upon implantation.

[0046] Figure 2 also shows that the locking device 108 also includes a proximal support 132. The proximal support 132 is coupled with the arms 110 in a manner discussed further below. The proximal support 132 has a central aperture 136 disposed within an inner periphery thereof and extends outward from the central aperture 136 to an outer periphery 135. The inner and outer periphery of the proximal support 132 are received in a recess 140 formed in the base member 104. In one configuration the recess 140 and the proximal support 132 are configured such that a flush connection is provided between the proximal support 132 and the proximal face of the base member 104. The proximal support 132 can be connected to the base member 104 in an at least partially recessed position in the proximal face of the base member as discussed further below in connection with Figure 6A.

[0047] Figures 2 and 3B show that the proximal face of the base member 104 can include a raised inner portion 148 and a raised outer portion 152. The outer raised portion 152 extends around an outer periphery 154 of the base member 104. The raised portion 148, 152 are proximally oriented projections relative to a recessed surface 156. The recessed surface 156 can be disposed distally of one or both of the inner portion 148 and the outer portion 152. The raised inner portion 148 can define an aperture for access into the recess 102, which is configured for mating with articular components as discussed below. Each of the raised inner portion and the raised outer portion 148, 152 can comprises annular structures. The recessed surface 156 can comprise an annular portion. The apertures 124 can be formed in the recessed surface 156. In one embodiment the apertures 124 extend radially between the inner raised portion 148 and

the outer raised portion 152. The apertures 124 can extend from the inner raised portion 148 to the outer raised portion 152.

**[0048]** The proximal face of the base member 104 also can include a tool interface 158 that enables the base member to be advanced by an inserter into bone, as discussed below in Figure 14. The tool interface 158 includes three notches in an inward side of the outer raised portion 152. In other embodiments, the tool interface 158 can include apertures in the recessed surface 156, notches in the inner raised portion 148, projections from any surface of the proximal face of the base member 104 or any combination of these features. Also, the tool interface 158 can provide access for a removal tool to engage the locking device 108. As discussed below, the locking device 108 includes a spring arm 168 and a removal tool can be applied at the tool interface 158 to compress the arm 168 to disengage the locking device from the base member 104. In some cases, an inserter tool can engage one or more apertures 124 in the base member 104 upon insertion.

**[0049]** One or more structures for securing the locking device 108 to the base member 104 can be provided as discussed further below. For example the locking device can have an engagement feature 164 disposed on the proximal support 132 that is adapted to engage a corresponding feature on the proximal face of the base member 104. The engagement feature 164 can include an actuatable member that can move into a secure position relative to the recess 140 of the base member 104. As discussed below in connection with Figures 5 and 6A, the engagement features 164 can include a spring arm 168 to engage an overhang of the recess 140. As shown in Figure 2, one embodiment comprises a plurality of actuatable members, e.g., a plurality of spring arms 168. The spring arms 168 can be spaced apart, e.g., providing equal angle separation between adjacent spring arms 168. In one embodiment, the number of spring arms 168 matches the number of arms 110. Each spring arm 168 can be spaced apart from each arm 110 as discussed further below.

**[0050]** In another embodiment, a serration 172 is provided between the arms 110 of the locking device 108 and the base member 104 as discussed in greater detail below in connection with Figure 6B. The serration 172 is an example of a one-way connection that can be provided between the arms 110 and the base member 104. Other one-way connections can be provided in addition or in place of the serration 172, such as a ratchet, a barb, or one or more spring arms.

**[0051]** Figures 2-3B show further details of embodiments of the base member 104. In some embodiments, the base member 104 can include various features described in PCT publication WO2016/094739, the entirety of which is hereby incorporated by reference herein. The base member 104 has a first end 204, a second end 208 and a body 212 that extends between the first end 204 and the second end 208. The base member 104 can comprise a length L between the first end 204 and the second end 208 that is less than a dimension of an articular surface of typical epiphysis to a medullary canal of a typical humerus. As such, the first end 204 can be disposed within the epiphysis when the second end 208 is at a surface of the bone, as shown in Figure 7. The second end 208 can be disposed at or on a superior medial resection plane of a humerus while the first end 204 is well within the epiphysis. This enables the first end 204 to stop short of a medullary canal of the humerus when the base 104 is fully implanted, which allows the bone between the first end 204 and the medullary canal to remain unaltered and also simplifies the procedure to the extent that any normal access to and preparation of the medullary canal is not needed. In various embodiments, the length L can be between about 15 mm and about 30 mm, between about 18 mm and about 25 mm, between about 18 mm and about 24 mm, between about 21 mm and about 27 mm, between about 24 mm and about 29 mm. The length L can be about 18 mm, about 21 mm, about 23 mm, about 24 mm, about 26 mm and about 29 mm. In one approach, at least a portion of the assembly 100 is patient specific. For example, the length L can be defined for a specific patient based on pre-operative planning, such as using two dimensional or three dimensional imaging. The base member 104 can thereafter be manufactured for that patient based on the determined dimension L.

**[0052]** The base member 104 can include a collar 220 and a helical structure 224. The helical structure 224 is disposed about a cylindrical portion 260 of the body 212 of the base member 104. In some embodiments, the helical structure 224 extends directly from the body 212 and may be considered threads of the body 212. The helical structure 224 can include one or a plurality of threads, e.g., two, three, four, or more threads, disposed between the first end 204 and the second end 208. The threads can start adjacent to the first end 204 and extend toward, e.g., entirely to the second end 208. Figure 3A shows that the threads or other helical structure 224 can end at or adjacent to the collar 220. The threads or other helical structure 224 can have inner portions 240 disposed at or on the body 212 about the recess 102 and outer portions 244 disposed



along the periphery of the base 104. Figure 3A shows that the helical structure 224 has a width defined as the distance between the inner and outer portions 240, 244 that is large, e.g., comprising more than one-quarter of, e.g., about one-third of, the width of the base 104 at a given location. These large threads or other helical structure 224 ensure large purchase in the bone. Large purchase provides strong resistance to pullout even prior to any bone ingrowth into the surfaces of the shoulder assembly 100. Generally one or more surfaces of the shoulder assembly 100 that are in direct contact with bone may be textured e.g., coated or layered with a porous material in order to accelerate tissue ingrowth such as bony ingrowth. Therefore good initial resistance to pull-out is advantageous for the patient. At least one turn of a thread or other helical structure 224 completely surrounds the recess 102, e.g., by completely surrounding the body 212, in some embodiments.

[0053] The body 212 surrounds the recess 102, which is configured to mate with an articular component, such as humeral head or a glenoid sphere. In one embodiment, the body 212 includes a cylindrical portion 260 within which the recess 102 is disposed. The cylindrical portion 260 can have any suitable outside configuration, such as including a textured surface that is well suited to encourage bony ingrowth. The cylindrical portion 260 can include a generally tapered profile in which a portion at or adjacent to the first end 204 of the base member 100 has a first width and a portion at or adjacent to the second end 208 of the base member 100 can have a second width, the second width being greater than the first width. In some embodiments, the cylindrical portion 260 is generally rounded and formed a blunt but tapered profile. The cylindrical portion 260 can have a flat distal surface in some embodiments.

[0054] Figure 7 shows that the cylindrical portion 260 can include a plurality of layers. For example, an inner layer 264 can be disposed adjacent to the recess 102. The inner layer 264 can include the surface surrounding the recess 102 and can extend away from that surface toward an outer surface of the cylindrical portion 260. In one embodiment an outer layer 268 can be disposed adjacent to the outer surface of cylindrical portion 260. The outer layer 268 can extend from the external surface of the cylindrical portion 260 toward the recess 102. In one embodiment, the outer layer 268 is formed directly on the inner layer 264 although other arrangements are possible as well. The outer layer 268 can be a porous structure that is suitable for bony ingrowth.

[0055] Figure 7 also shows that a tool interface 272 can be disposed at or adjacent to the first end 204 of the base member 104. The tool interface 272 can include

a threaded portion that can mate with a delivery tool, as discussed further below. A lumen 276 can be provided at the first end 204 such that access can be provided from the first end 204 through the wall of the cylindrical portion 212 into the recess 102. The lumen 276 and recess 102 together provide access for a K-wire or other guiding device such that implanting the base member 104 can be controlled in an appropriate manner.

**[0056]** The collar 220 can be disposed at or can comprise the second end 208 of the base member 104. The collar 220 can have a transverse width, e.g., a diameter that is suitable for a given condition. For example, the diameter of the collar 220 can be selected such that the entire outer periphery of the base 104 is within the bone exposed by resection and/or recessed into such an exposed bone portion, e.g., as illustrated in Figures 8-12. In some embodiments the collar 220 has a diameter of more than about 25 mm and less than about 60 mm. The collar 220 can have a diameter of between about 30 mm and about 45 mm. The collar 220 can have a diameter of about 33 mm in one embodiment. The collar 220 can have a diameter of about 42 mm in one embodiment. Making the collar 220 as large as possible within such bounds provides for better load transfer between the collar 220 and the humerus H. In one approach, the diameter of the collar 220 can be defined for a specific patient based on pre-operative planning, such as using two dimensional or three dimensional imaging. The base member 104 can thereafter be manufactured for that patient based on the determined diameter of the collar. For example, the diameter of the collar 220 can be selected such that the collar covers the cortical rim exposed by resection. The collar 220 can attach to or can be integrally formed with the cylindrical portion 260 of the body 212. In one embodiment the collar 220 comprises a transverse flange 290 that extends outward of the recess 102 that is also disposed at the second end 208. An inner portion of the flange 290 can be disposed adjacent to the recess 102 and can include the inner raised portion 148. An outer portion of the flange 290 can be disposed outward of the inner portion. The flange 290 can define the proximal face of the base member 104. The flange 290 can accommodate the proximal support 132 of the locking device 108. Figure 6A shows that in some embodiments, the flange 290 can at least partially surround a space 294 disposed therein to receive a portion of the locking device 108. The space 294 can be an annular recess located proximal of the recessed surface 156 and between the inner portion 148 and the outer portion. The space 294 can be bounded by an inner edge of the outer portion 152 and an outer edge of the inner portion 148. The flange 290 can engage the spring arm

168 of the locking device 108 in the space 294 such that the locking device 108 will not be inadvertently disengaged from the base 104 and protrude from or be removed from the space 294.

**[0057]** Figures 2 and 7 show that in some embodiment, the shoulder assembly 100 includes a pathway 300 that projects distally of the collar 220. The pathway 300 can comprise a first pathway. The shoulder assembly 100 can include a plurality of pathways, 300 with each pathway corresponding to an arm 110 of the locking device 108. Figure 3B shows that the base 104 can define a plurality of such pathways, e.g., two or three pathways configured to receive corresponding arms 110. There can be four or more than four pathways 300. The pathway 300 can have a first end located at the opening or apertures 124 in the collar 220. The pathway 300 can continue down through the base member 104. Figure 3C shows that the pathway 300 can have one or more segments disposed through the helical structure 224. A first segment 300A of the pathway 300 extends from the aperture 124 to a first portion, e.g., a proximal-most turn or portion of the helical structure 224 immediately distal of the collar 220, e.g., immediately distal of one of the apertures 124. A second segment 300B of the pathway 300 extends from the first segment 300A to a second turn or portion of helical structure 224 immediately distal of the first portion of the helical structure. A third segment 300C of the pathway 300 can extend from the second segment to a third turn or portion of helical structure 224 immediately distal of the second portion of the helical structure 224.

**[0058]** Figures 3A and 3D illustrate that at specific locations along the length of the base 104 from the first end 204 to the second end 208, the pathway 300 can have a first boundary 304 corresponding to an outer surface or layer of the cylindrical portion 260, for example corresponding to a surface of the outer layer 268. The pathway 300 can have a second boundary 308 at a same location along the length of the base 104 from the first end 204 to the second end 208 formed by an adjacent portion of helical structure 224. The second boundary 308 can include a U-shaped opening in the inner portion 240 of the helical structure 224. The U-shaped opening in the inner portion 240 can extend across the width of the helical structure toward the outer portion 244 of the helical structure 224. The U-shaped opening can extend 25%, 35%, 45%, 50%, 60%, 70%, 75% or up to 90% of the distance across the width of the helical structure 224 from the inner portion 240 toward the outer portion 244. In one embodiment, the helical structure 224 has a tapered configuration in which transverse distance between opposite sides of the helical structure

224 is decreased in the direction of the first end 204 compared to the same dimension toward the second end 208. The length of the U-shaped opening in successive portions of the helical structure 224 in the direction toward the first end 204 is progressively less in some embodiments. As a result the width bounded by a turn of the helical structure 224 and the cylindrical portion 260 in the first segment 300A of the pathway 300 can be greater than the width bounded by a turn of the helical structure 224 and the cylindrical portion 260 in the second segment 300B. The width in the second segment 300B can be greater than the width in the third segment 300C bounded by a turn of the helical structure 224 and the cylindrical portion 260. This configuration is advantageous in accommodating embodiments of the locking device 108 having arms 110 that are tapered as discussed further below.

**[0059]** The pathway 300 can extend through one or more spaces between adjacent threads of the helical structure 224. The pathway 300 can comprise two or more segments surrounded by portions of the base member 104 and at least one exposed segment ES. The exposed segments comprise portions of the first and second segments 300A, 300B and between the second and third segments 300B, 300C in some embodiment. The exposed segments ES are exposed in that, unlike the segments 300A, 300B, 300C, the exposed segments of the pathway 300 are not enclosed circumferentially and thus bone disposed within the helical portion 224 can directly contact the arms 110 in the exposed segment. As such the pathway 300 is bounded by bone matter in the exposed segments.

**[0060]** Figures 2, 4 and 5 show the locking device 108 in detail. As discussed above, the locking device 108 has a proximal support 132 and a first arm 110 that projects distally of the proximal support 132. The proximal support 132 includes an inner periphery 358, an outer periphery 362 and an annular member 366 disposed therebetween. The inner periphery 358 surrounds the central opening 136, which is sized to receive the inner raised portion 148 of the base member 104 if present. The annular member 366 is configured to be received in the recess 140, as discussed above.

**[0061]** The first arm 110 is configured to be disposed in the first pathway 300. The pathway 300 projects distally of the collar 220. The first arm 110 is disposed distal of the collar 220 when the proximal support 132 is disposed adjacent to a proximal side of the collar 220 and the first arm 110 is in the first pathway 300.

**[0062]** The first arm 110 includes an outer edge 370, an inner edge 374 and a span 378 disposed therebetween. The first arm 110 includes a first end 382 disposed away from the support 132 and a second end 386 disposed adjacent to and in some cases directly coupled to the support 132. The first arm 110 can be tapered, for example with the outer edge 370 approaching the inner edge 374 in the direction toward the first end 382 and/or with the outer edge 370 diverging away from the inner edge 374 in the direction toward the second end 386. In one embodiment, opposite faces 390 of the span 378 are also tapered with at least one of, e.g., both of, the opposite faces 390 approaching a longitudinal mid-plane M of an arm 110. The tapering of the arms between the edges 370, 374 facilitates providing a tapered profile in the base member 104. The tapering of the arms between the edges 370, 374, sometimes referred to herein as a radial taper, facilitates insertion of the first end 382 into the aperture 124 because the first end 382 is much narrower in the dimension between the edges 370, 374 than the aperture 124 is in the radial direction. The tapering of the arms 110 between the faces 390, sometimes referred to herein as a circumferential taper, facilitates insertion of the first end 382 into the aperture 124 because the first end 382 is much narrower in the dimension between the faces 390 than the aperture 124 is in the circumferential direction.

**[0063]** At least one of the circumferential and radial tapers of the arms 110 enables the locking device 108 to easily be advanced through bone matter that is disposed along the pathway 300.

**[0064]** As discussed above, the first arm 110 is disposed through bone in the space between successive portions of the helical structure 224, e.g., in the first segment of the path 300 and in the second segment of the path 300, when the humeral shoulder assembly is implanted. The span 378 and/or other parts of the arms 110 can be porous to enhance bony ingrown when the assembly 100 is implanted. The porous properties can be provided by a porous metal surface or structure or by other porous layers disposed on an underlying layer of metal or another material. At least the widening of the arms 110 toward the second end 386 increases the purchase of bone in the widened area, e.g., in the first segment of the path 300 and also in the second segment of the path 300 compared to an arm that is not tapered.

**[0065]** In some embodiments, the arms 110 are not tapered in the radial direction. For example the arms 110 can have a constant radial dimension between the edges 370 and 374 at a length between, e.g., along the entire length between, the first end

382 and the second end 386. In some embodiments, the arms 110 are not tapered in the circumferential direction. For example the arms 110 can have a constant circumferential dimension between the first end 382 and the second end 386.

[0066] As discussed above, the locking device 108 facilitates retaining the base member 104 in the bone at least by opposing, and in some cases completely preventing, rotation of the base member that would cause the base member to back out of the bone into which it has been advanced. Additionally, in some embodiments, it is beneficial to oppose, and in some cases completely prevent, axial movement of the locking device 108 away from the base member 104. At the extreme, such movement could result in the arms 110 of the locking device 108 completely coming out of the pathways 300 and, indeed, out of the base member 104 completely. It also may be desirable to prevent even lesser movements of the locking device 108 relative to the base member 104. As shown in Figure 6A, a distal face 402 of the annular member 366 may be positioned in direct contact with a proximal face 404 of the transverse flange 290. Such contact can correspond to a proximal face 406 of the annular member 366 being distal of a proximal face 408 of the raised outer portion 152. By recessing the annular member 366, the interaction of the assembly 100 with the articular member of the kit 80 of Figure 1 is controlled. For example, the annular member 366 will not impede advancement of the articular members into secure engagement with the recess 102.

[0067] Figures 5 and 6A illustrate various embodiments of axial locking configuration that can be provided in the shoulder assembly 100. An axial locking configuration can include the engagement feature 164 disposed on the proximal support 132. The spring arm 168 of the engagement feature can include a first end 420 disposed away from the annular member 366 and a second end 424 coupled with the annular member 366. The spring arm 168 also has an elongate portion 428 that extends between the first end 420 and the second end 424. The elongate portion 428 preferably has an arcuate form and can, in some embodiments, have the same curvature as a portion of the annular member 366 adjacent to the second end 424. The elongate portion 428 can be separated from the annular member 366 along a radially inner edge 432 of the elongate portion 428 by a gap G. The gap G and the length of the elongate portion 428 can be such that the first end 420 can be moved sufficiently to allow for a snap-fit connection as discussed further below. In one embodiment, the first end 420 of the spring arm 168 has a deflector 436 that facilitates movement of the elongate portion 428 and specifically

movement of the first end 420. Figure 6A shows that the deflector 436 can include an angled surface 460 that initially engages a corresponding angled surface 464 on the base member 104, e.g., on the raised outer portion 152 at the proximal face of the base member. As the arms 110 of the locking device 108 are advanced into the paths 300, the annular member 366 eventually is received in the space 294. At that time, the angled surfaces 460, 464 engage each other, which engagement causes the deflection of the first end 420 of the spring arm 168. The first end 420 is deflected radially inwardly such that the gap G is reduced at least at the first end 420. This allows a proximal facing surface 472 to move to a position distal of a distal facing surface 476. After the proximal facing surface 472 is at a position distal of the distal facing surface 476, the spring arm 168 resiliently moves the deflector 436 back to the configuration shown in Figure 5. At this point, the proximal facing surface 472 is distal of and aligned with, e.g., positioned under, the distal facing surface 476, as shown in Figure 6A. In this configuration, the proximal facing surface 472 blocks the distal facing surface 476 from moving proximally. Thus the surfaces 472, 476 prevent the locking device 108 from disengaging from the base member 104.

**[0068]** Another advantageous aspect of the assembly 100 is that the locking device 108 can be quickly and easily disengaged from the base 104. The tooling interface 158 allows an extraction tool to be disposed between the raised outer portion 152 and the spring arm 168. The extraction tool can apply a radially inward force on an outer periphery of the elongate portion 428 of the spring arm 168. Compression of the spring arm 168 decreases the gap G as the proximal facing surface 472 is moved radially inward of the distal facing surface 476. Once the first end 420 is entirely radially inward of the distal facing surface 476, the engagement feature 164 is disengaged from the base 104. If more than one spring arm 168 is provided some or all of the spring arms can be compressed to allow the locking device 108 to be withdrawn from the base 104.

**[0069]** Figure 6B shows additional axial locking configurations that can be provided in the shoulder assembly 100. In these embodiments, axial locking can occur at an interface 490 between one or more of the arms 110 and one or more of the pathways 300. For example, the serrations 172 discussed above can be provided at the interface. In one variation, serrations 172 are disposed along the pathway, e.g., on a surface of the cylindrical member 212 and/or on a surface of the helical structure 224. The serrations 172 can be placed at both the surface of the cylindrical member 212 and at the helical

structure 224. In another embodiment, the serrations 172 could be provided on a surface of the arm 110, e.g., on one of the outer edge 370, the inner edge 374, and/or on one of the faces 390. The serrations 172 allow for relatively easy insertion of the arms 110 but bite into and oppose withdrawal of the locking device 108 to oppose axial disengagement of the locking device 108 from the base member 104.

[0070] The serrations 172 can be disposed along the entire length of the interface between the arms 110 and the base member 104 or just at a position where the base member 104 and the locking device 108 are fully engaged.

## **II. METHOD OF APPLICATION TO AN END PORTION OF A LONG BONE**

[0071] Figures 8-16 illustrate various techniques for implanting the shoulder assembly 100 in a humerus H. The method illustrates placement in a proximal end of the humerus H, e.g., in the humeral head h.

[0072] Figure 8 illustrates an early step of one embodiment of a method including resecting the head h of the humerus H. Prior to resecting the head h of the humerus H a guide 600 is applied to the humerus H. The guide 600 includes structure for mating with the humerus H and the head h, for example, a plate 604 to mate with the humerus H and pins 608 to mate with the head h. The guide 600 also has a slot 612 to guide a saw to cut the humerus H to expose cancellous bone of the head h. Figure 9 shows that after resecting the head h of the humerus H the size of the head is evaluated with a template 620. To obtain a quick and accurate sizing, a guide pin 624 is first placed in the resected head h. The template 620 is advanced over the guide pin 624 into contact with the resected head. The size of the resected head h is determined from the template 620. The guide 600 can be a reusable guide that is not specific to any particular patients. In other embodiments, the guide 600 is formed with reference to a specific patient. That is, the guide 600 can be formed to mate with the patient, such as by conforming in whole in part on a bone facing side to the shape of the bone as observed or measured using imaging or other devices prior to surgery.

[0073] Figure 10 shows that the resected surface of the head h can be prepared, such as by using a planar or a reamer 632. The reamer 632 also can be guided by the guide pin 624. The reamer 632 can be used to form a recessed surface s to which the assembly 100 will be applied after further preparation.



[0074] Figure 11 shows a step of measuring depth of the recessed surface s. The purpose of this step is to provide a secondary confirmation that the assembly 100 will fit into the metaphysis without striking the lateral cortex. While the analysis of Figure 9 indicates a diameter of base member 104 that could be used, the depth gauge 637 of Figure 11 provides a depth sizing that confirms a maximum length, e.g., depth, that would fit in the recessed surface S surgeon is instructed to take the smaller of the two sizes determined.

[0075] Figures 12 illustrates that following depth measurement, a bore b is formed in the surface s in initial preparation of the surface s to receive the shoulder assembly 100. The bore b is formed using a drill 640. The drill 640 can be a convention cannulated design configured to be advanced over the guide pin 624. The drill 640 can be configured as a universal drill with a modular stop to obtain variable lengths. The drill 640 can be one of a plurality of drills, each drill of the plurality having a different size as appropriate. In certain methods, the process of forming the bore b and reaming the surface s as discussed above in connection with Figure 10 can be combined. For example, a drill 640 can have a reaming feature disposed proximally of the bore forming features such that a continuous motion toward the surface formed using the guide 600 can initially form the bore b and subsequently form the surface s. Figure 13 shows that once the bore b has been formed, the bore b can optionally be tapped to be prepared to receive the base member 104 of the shoulder assembly 100. The tapping process can be achieved by using a helical tap component 648 that is advanced over the guide pin 624. The helical tap 648 can follow the form of the helical structure 224 of the base member 104 such that the base member 104 can be easily advanced into the bore. The helical tap 648 can be secured to a shaft 654 that can be mounted to a motor driven drill or to a hand tool.

[0076] Figure 14 shows a step of inserting the base member 104. The base member 104 is secured to a distal end of an inserter 662. The inserter 662 has a stem 666 that is threaded at a distal end thereof. The threads of the stem 666 can be mated with the tool interface 272 (see Figure 7), e.g., with threads of the tool interface. Preferably the stem 666 is enlarged at a mid-section thereof providing at least a shoulder that can mate with the inner raised portion 148 of the base member 104. A separate member 668 of the inserter 662 is advanced over the stem 666 to the tool interface 158, and the force of advancing the base member 104 thus can be applied through the tool interface 272, through the inner raised portion 148, through the apertures 124 or through more than one

of these (or other) features of the base member 104. Splines 672 provide for good grip by the surgeon so that the surgeon can easily engage the stem 666 to the tool interface 272. In another variation, a driver with a torqueing device at a proximal end couples at its distal end directly with the tool interface 272, through the inner raised portion 148, through the apertures 124 or through more than one of these (or other) features of the base member 104 to enable more direct transfer of torque to the base member. Preferably inserting the base member 104 into the bone includes placing the outer periphery 154 in the recessed surface s, e.g., at least partially recessed into the resected bone of the humerus H.

[0077] Figure 15 shows that after the base member 104 has been inserted, the locking device 108 can be inserted. The base member 104 is inserted by a rotation of the member by rotation of the inserter which is directly connected to the base member as discussed above in connection with Figure 14. The locking device 108 is inserted along the pathway by linear translation, e.g., by a movement along a generally straight axis without rotation. An inserter 680 is provided that has an enlarged head 682 that can be secured to or can just rest upon the proximal face of the annular member 366 of the proximal support 132. The head 682 is then advanced over the splines 672 of the stem 666, with the stem 666 acting as an axial guide. In order to implant the locking device 108 the first end 382 of the arm 110 or arms is aligned with the aperture 124 or apertures if more than one. The arms 110 are radially and circumferentially tapered and the apertures 124 are sized for the wider proximal end of the arms.. This configuration helps guide the locking device 108 into the base member 104. The proximal end 684 of the inserter 680 is configured for impacting the locking device 108 into the base member 104.

[0078] Figure 16 shows later steps of a method of implanting an anatomic shoulder prosthesis. After the base member 104 and the locking device 108 are placed, an anatomic articular component 84 can be coupled with the recess 102. The anatomic articular component 84 comprises a convex surface 90, analogous to the natural anatomy. The anatomic articular component 84 is placed with an impactor 684A. Although shown as a separate, dedicated device the insertion and impaction functions illustrated in Figures 15 and 16 could be carried out by the same device. For example a contoured face to contact the surface 84 could have a portion configured for inserting the locking device 108 and/or the tray 94. Figure 16 shows an alternative step of a method of implanting a

reverse shoulder prosthesis. After the base member 104 and the locking device 108 are placed, a reverse articular component 88 can be coupled with the recess 102. In one form, the reverse articular component 88 includes a tray 94. The tray 94 can be coupled with an articular component 96 comprising a concave surface for articulating with a glenoid sphere disposed on a glenoid of a scapula (discussed further below). The tray 94 is placed with an impactor 684A. The reverse shoulder prosthesis including the shoulder assembly 100, the tray 94 and the articular component 96 is shown in Figures 18A and 18B. A glenoid sphere 99 mated with a glenoid is shown in Figure 18B. The shoulder joint provides movement of the patient's arm by articulating the component 96 over the glenoid sphere 99.

[0079] In one variation of these methods, assemblies, and kits the locking device 108 is inserted at the same time as some or all of the reverse articular component 88 or at the same time as the anatomic articular component 84. The locking device 108 can be a separate component that is loaded onto an inserter or impacting tool that can be previously loaded with the reverse articular component 88 or the anatomic articular component 84. The locking device 108 can be a separate component that is loaded onto an inserter or impactor with, but relatively moveable to, the reverse articular component 88 or the anatomic articular component 84. The locking device 108 and the reverse articular component 88 can be formed as a monolithic structure that can be loaded together onto an inserter. The locking device 108 and the anatomic articular component 84 can be formed as a monolithic structure that can be loaded together onto an inserter.

### **III. ADDITIONAL APPARATUSES AND METHODS**

[0080] Figures 19-23 illustrate a shoulder assembly 800 that is adapted for securement to a glenoid. The shoulder assembly 800 is similar to the shoulder assembly 100 described above, except as described differently below. Any feature discussed above can be substituted in and supplement the features of the shoulder assembly 800. The features of the shoulder assembly 800 can be substituted in and supplement the features of the shoulder assembly 100.

[0081] Figure 19 shows that the shoulder assembly 800 can be implanted into a glenoid region g of a scapula SC. The shoulder assembly 800 includes a base member 804 and a plate member 808. The base member 804 has a medial end 816 and a lateral end 820. Figures 21-23 show that the base member 804 includes a body 812 that extends between the medial end 816 and the lateral end 820. A lumen 822 extends in the body

812 from the lateral end 820 toward and in some cases entirely to the medial end 816. A distal portion of the lumen 822 includes a threaded zone 823, discussed below. The base member 804 includes a helical structure 824, which is disposed along the body 812 between the medial and lateral ends 816, 820, respectively. The helical structure 824 extends from the medial end 816 to the lateral end 820 in some embodiments. In some embodiments a tool interface 826 is disposed lateral of a lateral end of the helical structure 824.

**[0082]** The base member 804 includes a first pathway 830 accessible from the lateral end 820 of the base member 804. The first pathway 830 is directed toward the medial end 816 through the helical structure 824. The first pathway 830 can be located adjacent to an inner periphery of the helical structure 824, as discussed above. The first pathway 830 can be partly defined by an outer surface of the body 812. The first pathway 830 can be disposed generally transverse to the helical structure 824. The first pathway 830 extends in a space 832 between successive portions of the helical structure 824. In one embodiment, a first segment 830A of the first pathway 830 is disposed through a proximal portion of the helical structure 824, a second segment 830B of the first path 830 is located medial of the first segment 830A, and a third segment 830C of the first path 830 is disposed medial of the second segment 830B. Figure 23A shows the segments 830A, 830B, 830C of the path 830 in more detail.

**[0083]** Figure 23A also shows that the base member 804 can include one or more barbs 835. The barbs 835 are configured to facilitate softer material attachment. In some embodiment the internal portion of the base member 804 couples with a structure made of a soft material, such as polyethylene. One example of such an assembly is an anatomic configuration where a convex articular surface may be coupled with the scapula using the base member 804. Another example is a reverse configuration with an inverse bearing surface (e.g. polyethylene glenoid sphere). The mode of connection between the base 804 and an articular or other component can include an interference fit between the barbs 835 and a projection of such component received in a space around which the barbs 835 are located, as described in connection with Figures 8A and 8B of WO2016/094739. In other embodiments the barbs 835 can be replaced with mating threads, mating threads and fins and/or mating fins, as described in connection with Figure 2 of US20120221111. In other embodiments, the barbs 835 can be replaced by a groove and a C-ring or other deflectable member that spans between the base member 804 and an articular or other

component as described in connection with Figures 4 and 5 of WO2014/067951. The entireties of each of WO2016/094739, US20120221111, and WO2014/067961, including the specific portions of each reference noted above are incorporated by reference herein.

**[0084]** The plate member 808 has a flange 842 and a first arm 846 that projects distally, medially away from or generally in a direction of implantation of the plate member 808 from the flange 842. The plate member 808 can have a second arm 846 that projects away from the flange 842. The first arm 846 is configured to be disposed in the first pathway 830 when the plate member 808 is disposed adjacent to the lateral end 820 of the base member 804. The first arm 846 is disposed through bone in the space 832 between successive portions of the helical structure 824 when the shoulder assembly 800 is implanted.

**[0085]** The plate member 808 also includes a boss 850 that extends laterally of the flange 842. The boss 850 comprises an arcuate outer periphery 854 and an aperture 858 that provides access to a lumen 862 through the aperture 858. The lumen 862 is defined by a tapered surface 864 that mates with a glenoid sphere 870, as discussed below. In another embodiment, the glenoid sphere 870 and the boss 850 are configured such that the glenoid sphere 870 coupled with the outer surface of the boss 850.

**[0086]** The glenoid sphere 870 comprises a recess 874 disposed on a medial side and a convex side 878 disposed opposite the recess 874. The glenoid sphere 870 has a tapered surface 882 disposed within the recess 874. The tapered surface 882 is partly disposed in the recess 874 and partly extends medially of the recess 874. The tapered surface 882 is disposed on a projection 890. The boss 850 receives the projection of the glenoid sphere 870 therein. The tapered surface 864 on the boss 850 mates with the tapered surface 882 on the medial side of the glenoid sphere 870 to form a connection between the glenoid sphere 870 and the plate member 808. The mating tapered surfaces 864, 882 can form a Morse taper connection between the glenoid sphere 870 and the plate member 808.

**[0087]** Figure 23 illustrates further features of the shoulder assembly 800 that relate to connecting the components thereof together. The glenoid sphere 870 has a lateral opening 892 at the convex surface 878. The opening 892 extends to a lumen 894 that extends from the opening 892 to a medial opening 898. The lumen 894 includes a threaded zone 902 adjacent to the medial opening 898. The threaded zone 902 can be used to couple the glenoid sphere 870 with an inserter. That is the threaded zone 902 can

be threaded onto a corresponding threaded tip of the inserter. While threads are shown, other couplers can be used, such as a bayonet coupling in place of or along with the threaded zone 902.

**[0088]** A fastener 910 is used to secure the glenoid sphere 870, the plate member 808, and the base member 804 together. The fastener 910 includes a medial end 914 with a threaded zone 918 and a lateral end 922. The lateral end 922 includes a tool interface 926.

**[0089]** The connection between the components of the shoulder assembly 900 is shown in Figure 20. The base member 804 can be advanced into the glenoid g following preparations similar to that discussed in connection with of Figures 8-13. Once so placed, the plate member 808 can be advanced into the base member 804. The plate member 808 is advanced in a manner similar to the locking device 108. The arms 846 are advanced into the helical structure 824. Following placement of the plate member 808 into the base member 804, the glenoid sphere 870 can be mated to the plate member. The projection 890 can be advanced into the lumen 862 (see Figure 23). Once the projection 890 is placed in the lumen 862 the fastener 910 can be advanced relative to the projection 890 and mated with the threaded zone 823. Further advancing of the fastener 910 into the threaded zone 823 induces a friction fit, e.g., a Morse taper, at the tapered surfaces 864, 882. In one embodiment, the threaded zone 918 of the fastener 910 engages first the threaded zone 902 of the glenoid sphere 870 and then mates with the threaded zone 823. In that embodiment, if the threaded zone 918 inadvertently disengage from the threaded zone 823 the back-out of the fastener 910 is limited such that the lateral end 922 of the fastener 910 does not protrude outside of the convex side 878 of the glenoid sphere 870. For example, even if the threaded zone 918 is disengaged from the threaded zone 834, lateral motion of the fastener 910 will be limited when a lateral end of the threaded zone 918 is disposed against a medial end of the threaded zone 902. When in this position, in one embodiment the distance between the lateral end of the threaded zone 918 and the lateral end 922 of the fastener 910 will be less than the distance within the lumen 894 from the lateral end of the threaded zone 902 to the convex side 878 of the glenoid sphere 870. Thus, the disengaged state of the fastener 910 will not result in the lateral end 922 protruding from the convex side 878.

**[0090]** The plate member 808 includes additional features for enhancing securement to the bone. The plate member 808 can includes one or more apertures 920.

The apertures 920 can receive bone screws to enhance securement of the plate member 808 to the bone, e.g., to the scapula SC. Advantageously, the bone screw will lock into the apertures 920 by a thread engagement. In some embodiments, the locking mechanism will be multi-directional providing the possibility to lock the bone screws at a variable angle from the axis of the flange 842. Additionally, the medial side of the plate member 808 can include a textured surface 924 e.g., coated or layered with a porous material in order to accelerate tissue ingrowth such as bony ingrowth. Advantageously, the plate member 808 could be manufactured by additive manufacturing to incorporate the porous surface 924.

[0091] Though shown in use to secure a hard material (e.g. ceramic, pyrocarbon, or metal) glenoid sphere 99 to a glenoid, the assembly 800 could be used to secure a soft-material (e.g. polyethylene, polyurethane, PEEK) glenoid sphere. Though shown in use to secure a glenoid sphere 99 to a glenoid, the assembly 800 could be used to secure an atomic glenoid. Though shown in use to secure a glenoid sphere 99 to a glenoid, the assembly 800 could be used in other anatomy to achieve very secure connection to relatively shallow layers of bone, which can include cancellous bone that is exposed during a procedure.

#### **IV. ADDITIONAL APPLICATIONS**

[0092] Figures 24-26 show a number of other applications for the prosthesis assemblies described herein. In particular, the shoulder assemblies 100, 800 can be applied to other bones and joints.

[0093] Figure 24 shows that a proximal femur f can be fitted with a prosthesis assembly 100f similar to the prosthesis assembly 100. The prosthesis assembly 100f is different from the shoulder assembly 100 in that it would be configured more particularly for the proximal femur.

[0094] Figure 25 shows that a distal humerus h or to a distal radius r can be fitted with a prosthesis assembly 100h, r similar to the prosthesis assembly 100. The prosthesis assembly 100h, r is different from the shoulder assembly 100 in that it would be configured more particularly for the distal humerus or radius.

[0095] Figure 26 shows that a distal femur df and/or to a proximal tibia t can be fitted with a prosthesis assembly 100df, 100t similar to the prosthesis assembly 100.

The prosthesis assemblies 100df, t, are different from the shoulder assembly 100 in that they would be configured more particularly for the distal femur or proximal tibia. Also, on both side of the knee joint, implant sizing such as threads external diameter, core diameter, overall length could be sized according to patient anatomy per pre-operative planning based on CT-scan, MRI or any other medical images modality.

[0096] Figure 27 shows that a distal tibia dt and/or to a proximal talus tal can be fitted with a prosthesis assembly 100dt, 100tal similar to the prosthesis assembly 100. The prosthesis assemblies 100dt, tal, are different from the shoulder assembly 100 in that they would be configured more particularly for the distal tibia or proximal talus. Also, on both side of the ankle joint, implant sizing such as threads external diameter, core diameter, overall length could be sized according to patient anatomy per pre-operative planning based on CT-scan, MRI or any other medical images modality.

[0097] Each of the applications illustrated in Figures 24-26 can employ the prosthesis assembly 800 with modifications similar to those discussed above in connection with the prosthesis assemblies 100h, 100r, 100f, and 100t.

## **V. PERFORMANCE OF EMBODIMENTS DISCLOSED HEREIN**

[0098] Figure 28 shows comparative performance of embodiments disclosed herein with respect to a stemless apparatus that does not have the helical structures disclosed herein nor the locking devices. The graph shows maximum tip out force which is measured by applying an off axis load at a known or prescribed fixed distance from a surface at or to which a shoulder assembly similar to the assembly 100 was implanted. The tip out force represents the resistance of the device to tipping out or becoming dislodge from the surface when subject to off axis loading. The forces were observed using a load cell or force transducer. As can be seen, the force of one embodiment is more than four times the force that would dislodge the conventional stemless component. This represents a significant improvement in the retention of the apparatuses disclosed herein compared to conventional stemless design which rely to a large extent on ingrowth for securement which can be sufficient some time after implantation but which can be subject to dislodgement prior to full integration by ingrowth.

[0099] As used herein, the relative terms "proximal" and "distal" shall be defined from the perspective of the humeral shoulder assembly. Thus, distal refers the direction of the end of the humeral shoulder assembly embedded in the humerus, while



proximal refers to the direction of the end of the humeral shoulder assembly facing the glenoid cavity when the assembly is applied to the humerus. Distal refers the direction of the end of the humeral shoulder assembly embedded in the scapula, while proximal refers to the direction of the end of the humeral shoulder assembly facing the humerus when the assembly is applied to the glenoid. In the context of a glenoid component, the distal end is also sometimes referred to as a medial end and the proximal end is sometimes referred to as a lateral end.

**[0100]** Conditional language, such as “can,” “could,” “might,” or “may,” unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include, while other embodiments do not include, certain features, elements, and/or steps. Thus, such conditional language is not generally intended to imply that features, elements, and/or steps are in any way required for one or more embodiments or that one or more embodiments necessarily include logic for deciding, with or without user input or prompting, whether these features, elements, and/or steps are included or are to be performed in any particular embodiment.

**[0101]** The terms “approximately,” “about,” and “substantially” as used herein represent an amount close to the stated amount that still performs a desired function or achieves a desired result. For example, the terms “approximately,” “about”, and “substantially” may refer to an amount that is within less than 10% of, within less than 5% of, within less than 1% of, within less than 0.1% of, and within less than 0.01% of the stated amount. As another example, in certain embodiments, the terms “generally parallel” and “substantially parallel” refer to a value, amount, or characteristic that departs from exactly parallel by less than or equal to 15 degrees, 10 degrees, 5 degrees, 3 degrees, 1 degree, 0.1 degree, or otherwise.

**[0102]** Some embodiments have been described in connection with the accompanying drawings. However, it should be understood that the figures are not drawn to scale. Distances, angles, etc. are merely illustrative and do not necessarily bear an exact relationship to actual dimensions and layout of the devices illustrated. Components can be added, removed, and/or rearranged. Further, the disclosure herein of any particular feature, aspect, method, property, characteristic, quality, attribute, element, or the like in connection with various embodiments can be used in all other embodiments set

forth herein. Additionally, it will be recognized that any methods described herein may be practiced using any device suitable for performing the recited steps.

**[0103]** For purposes of this disclosure, certain aspects, advantages, and novel features are described herein. It is to be understood that not necessarily all such advantages may be achieved in accordance with any particular embodiment. Thus, for example, those skilled in the art will recognize that the disclosure may be embodied or carried out in a manner that achieves one advantage or a group of advantages as taught herein without necessarily achieving other advantages as may be taught or suggested herein.

**[0104]** Although these inventions have been disclosed in the context of certain preferred embodiments and examples, it will be understood by those skilled in the art that the present inventions extend beyond the specifically disclosed embodiments to other alternative embodiments and/or uses of the inventions and obvious modifications and equivalents thereof. In addition, while several variations of the inventions have been shown and described in detail, other modifications, which are within the scope of these inventions, will be readily apparent to those of skill in the art based upon this disclosure. It is also contemplated that various combination or sub-combinations of the specific features and aspects of the embodiments may be made and still fall within the scope of the inventions. It should be understood that various features and aspects of the disclosed embodiments can be combined with or substituted for one another in order to form varying modes of the disclosed inventions. Further, the actions of the disclosed processes and methods may be modified in any manner, including by reordering actions and/or inserting additional actions and/or deleting actions. Thus, it is intended that the scope of at least some of the present inventions herein disclosed should not be limited by the particular disclosed embodiments described above. The limitations in the claims are to be interpreted broadly based on the language employed in the claims and not limited to the examples described in the present specification or during the prosecution of the application, which examples are to be construed as non-exclusive.

## WHAT IS CLAIMED IS:

1. A shoulder assembly comprising:  
a base member comprising:  
a collar;  
a helical structure extending from the collar in a distal direction;  
and  
a first pathway projecting distally of the collar and through the helical structure adjacent to an inner periphery thereof, the first pathway being generally transverse to the helical structure and extending in a space between successive portions of the helical structure; and  
a locking device comprising a proximal support and a first arm projecting distally of the proximal support, the first arm configured to be disposed in the first pathway projecting distally of the collar when the proximal support is disposed adjacent to the collar;  
wherein the first arm is disposed through bone in the space between successive portions of the helical structure when the shoulder assembly is implanted.
2. The shoulder assembly of Claim 1, wherein the base member further comprises an inner core projecting distally from the collar, an outer periphery of the helical structure surrounding the inner core, the first arm being located between the outer periphery of the helical structure and the inner core.
3. The shoulder assembly of Claim 2, wherein the inner core is tapered in a distal direction.
4. The shoulder assembly of Claim 2 or 3, wherein the base member further comprises a female taper extending from a central opening in the collar and at least partially through the inner core, the female taper configured to receive a mounting member of an anatomical or reverse joint interface.
5. The shoulder assembly of any one of Claims 2 to 4, wherein the inner core comprises a porous structure to support bone ingrowth.
6. The assembly of any one of Claims 1 to 5, wherein the first arm comprises an inner edge and an outer edge positioned radially outward of the inner edge, at least the outer edge of the first arm disposed in the helical structure along the first pathway.

7. The shoulder assembly of Claim 6, wherein the outer edge of the first arm is positioned radially inward of an outer periphery of the helical structure when the anchor is advanced into the base member.

8. The shoulder assembly of Claim 6 or 7, wherein the first arm further comprises a planar surface extending from the outer edge to the inner edge and from the proximal support to a distal end of the first arm.

9. The shoulder assembly of any one of Claims 6 to 8, wherein the outer edge of the first arm is tapered between the proximal support and a location away from the proximal support.

10. The shoulder assembly of any one of Claims 6 to 9, wherein a longitudinal axis of the first arm extends parallel to the longitudinal axis of the anchor.

11. The shoulder assembly of any one of Claims 1 to 10, wherein the proximal support comprises an annular member.

12. The shoulder assembly of any one of Claims 1 to 11, further comprising a second arm, the second arm being circumferentially spaced apart from the first arm.

13. The shoulder assembly of Claim 12 wherein the first and the second arms are spaced 180 degrees apart

14. The shoulder assembly of Claim 12 further comprising a third arm, each of the arms being spaced 120 degrees from the other two arms.

15. The shoulder assembly of any one of Claims 1 to 14, wherein the proximal support comprises an engagement feature to engage the collar.

16. The shoulder assembly of Claim 15, wherein the engagement feature comprises a spring arm positioned at an outer periphery of the proximal support and configured to engage an outer rim of the collar.

17. The shoulder assembly of any one of Claims 1 to 16, wherein at least one of the first arm and the first pathway comprise an engagement feature to the other of the first arm and the first pathway.

18. The shoulder assembly of any one of Claim 17, wherein the first arm comprises serrations permitting advancement of the first arm into the first pathway and resisting withdrawal of the first arm out of the first pathway.

19. The shoulder assembly of any one of Claims 1 to 18, wherein the first arm is disposed through bone between the collar and the helical structure.

20. The shoulder assembly of any of Claims 1 to 19, wherein the base member comprises a recess projecting distally from the collar to a location within the helical structure, the recess configured to couple with an articular component.

21. The shoulder assembly of Claim 20, the recess being tapered and further comprising a hemispherical articular component having a tapered projection disposed in the tapered recess, wherein the recess and the projection form a Morse taper connection.

22. The shoulder assembly of Claim 20, the recess being tapered and further comprising a concave articular component having a tapered projection disposed in the tapered recess, wherein the recess and the projection form a Morse taper connection.

23. A kit comprising:

the shoulder assembly of any of Claim 1-23;

an anatomic articular component mateable with the shoulder assembly, the anatomic articular component comprising a convex articular surface adapted to articulate with a concave surface of or on a scapula of a patient; and

a reverse articular component mateable with the shoulder assembly, the reverse articular component comprising a concave articular surface adapted to articulate with a convex surface on a scapula of a patient.

24. A prosthesis assembly comprising:

a base member having a first end and a second end, the base member comprising:

a helical structure extending between the first end and the second end; and

a first pathway accessible from the second end and directed toward the first end through the helical structure and being located adjacent to an inner periphery of the helical structure, the first pathway being generally transverse to the helical structure and extending in a space between successive portions of the helical structure; and

a locking device comprising a support member and a first arm projecting away from the support member, the first arm configured to be disposed in the first pathway when the support member is disposed adjacent to the second end of the base member;

wherein the first arm is disposed through bone in the space between successive portions of the helical structure when the prosthesis assembly is implanted.

25. The prosthesis assembly of Claim 24, wherein the base member comprises a portion of a stemless shoulder assembly, the base member also comprising a recess projecting to a location within the helical structure.

26. The prosthesis assembly of Claim 24 or Claim 25, wherein the helical structure and the locking device comprise portions of a base plate assembly of a glenoid assembly, the locking device comprising a periphery configured to mate with an articular component of a reverse shoulder assembly.

27. The prosthesis assembly of Claim 26, wherein the support member comprises a flange extending transverse to the first arm, the flange comprising the periphery configured to mate with the articular component of the reverse shoulder assembly.

28. The prosthesis assembly of Claim 26 or Claim 27, wherein the support member comprises a boss projecting away from the first arm, the boss configured to be received within a recess of the articular component of the reverse shoulder assembly.

29. The prosthesis assembly of Claim 26-28, further comprising a glenoid sphere having a tapered inner surface configured to mate a tapered surface at the periphery of the locking device.

30. The prosthesis assembly of Claim 26, wherein the base member comprises a portion of a stemless femoral assembly, and further comprises a convex component configured to articulate within an acetabulum when applied to a patient.

31. The prosthesis assembly of Claim 26, wherein the base member comprises a portion of a stemless humeral assembly, the prosthesis assembly comprising a convex component configured to articulate within a concavity at a head of a radius bone of an elbow joint when applied to a patient.

32. The prosthesis assembly of Claim 26, wherein the base member comprises a portion of a stemless radial assembly, the prosthesis assembly comprising an articular surface configured to articulate with a scaphoid bone or an ulna when applied to a patient.

33. The prosthesis assembly of Claim 26, wherein the base member comprises a portion of a stemless femoral assembly, the prosthesis assembly comprising an articular surface configured to articulate over a tibia at a knee joint when applied to a patient.

34. The prosthesis assembly of Claim 26, wherein the base member comprises a portion of a stemless tibial assembly, the prosthesis assembly comprising an articular

surface configured to articulate relative to a femur at a knee joint when applied to a patient.

35. The prosthesis assembly of Claim 26, wherein the base member is configured to be positioned in at least one of a tibia, talus, calcaneus, and fibula.

36. A method of implanting a prosthesis, comprising:

advancing by rotation a base member into an epiphysis of a humerus of a patient, the base member comprising a helical structure configured to engage the cancellous bone of the epiphysis; and

advancing by linear translation a locking device into the base member, the locking device comprising at least one arm adapted to span a space between adjacent portions of the helical structure and to contact the cancellous bone in the space.

37. A glenoid assembly comprising:

a base member having a medial end and a lateral end, the base member comprising:

a helical structure extending between the medial end and the lateral end; and

a first pathway accessible from the lateral end and directed toward the medial end through the helical structure and being located adjacent to an inner periphery of the helical structure, the first pathway being generally transverse to the helical structure and extending in a space between successive portions of the helical structure; and

a plate member comprising a flange and a first arm projecting away from the flange, the first arm configured to be disposed in the first pathway when the plate member is disposed adjacent to the lateral end of the base member;

wherein the first arm is disposed through bone in the space between successive portions of the helical structure when the prosthesis assembly is implanted.

38. The glenoid assembly of Claim 37, further comprising a glenoid sphere comprising a tapered surface disposed within a recess disposed on a medial side thereof, the plate member comprising a tapered surface disposed on a side of the flange opposite the first arm, the tapered surface of the glenoid sphere and the tapered surface on the plate

member forming a Morse taper connection when the glenoid sphere and the plate member are coupled.

39. The glenoid assembly of Claim 38, wherein the plate member comprises a boss projecting away from the flange, the boss configured to be received within the recess of the glenoid sphere when the glenoid sphere and the flange are coupled.

40. The glenoid assembly of Claim 39 wherein the tapered surface of the plate member is disposed on an inner surface of the boss.

41. The prosthesis assembly of Claim 38 wherein the base member comprises a central body disposed within the helical structure, the central body comprising a threaded portion configured to couple with a fastener disposed through a lumen in the glenoid sphere, the fastener increasing pressure at an interface between the tapered surface of the plate member and the tapered surface of the glenoid sphere.

42. The glenoid assembly of Claim 41, wherein the articular surface of the glenoid sphere comprises an aperture connected to the lumen in the glenoid sphere.



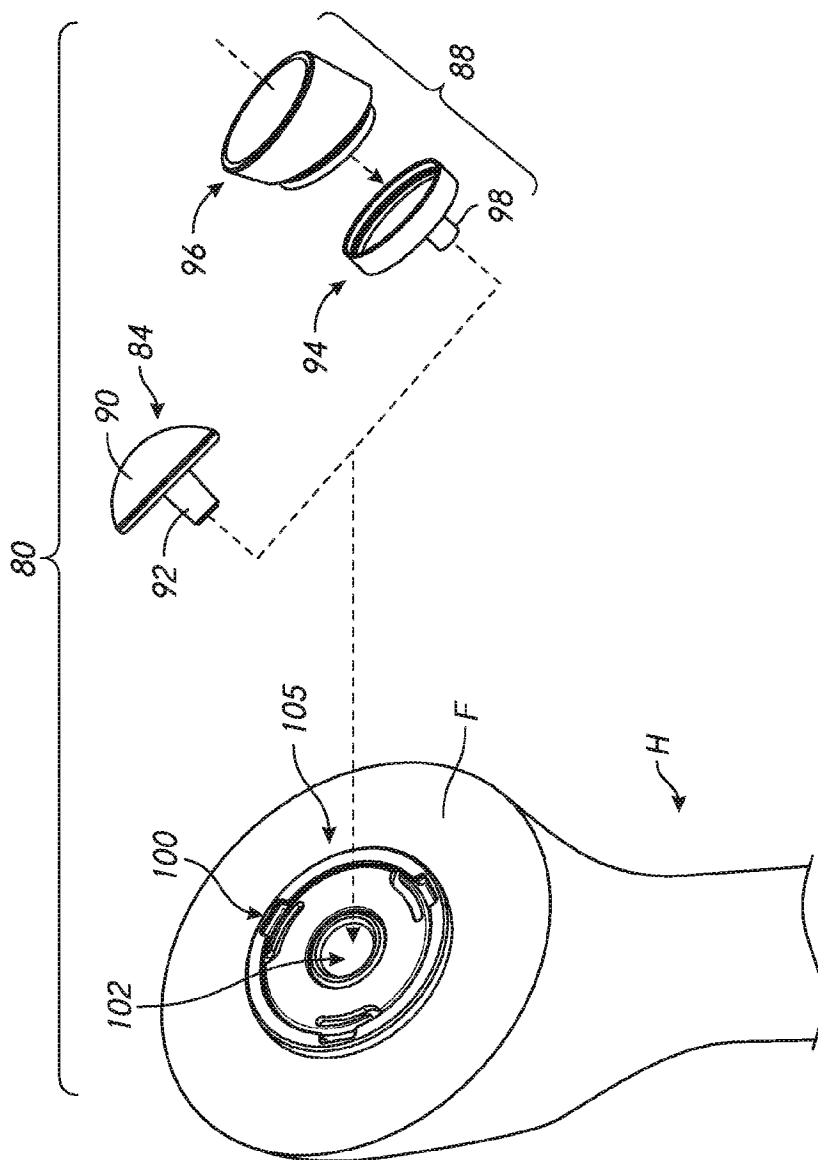


FIG. 1

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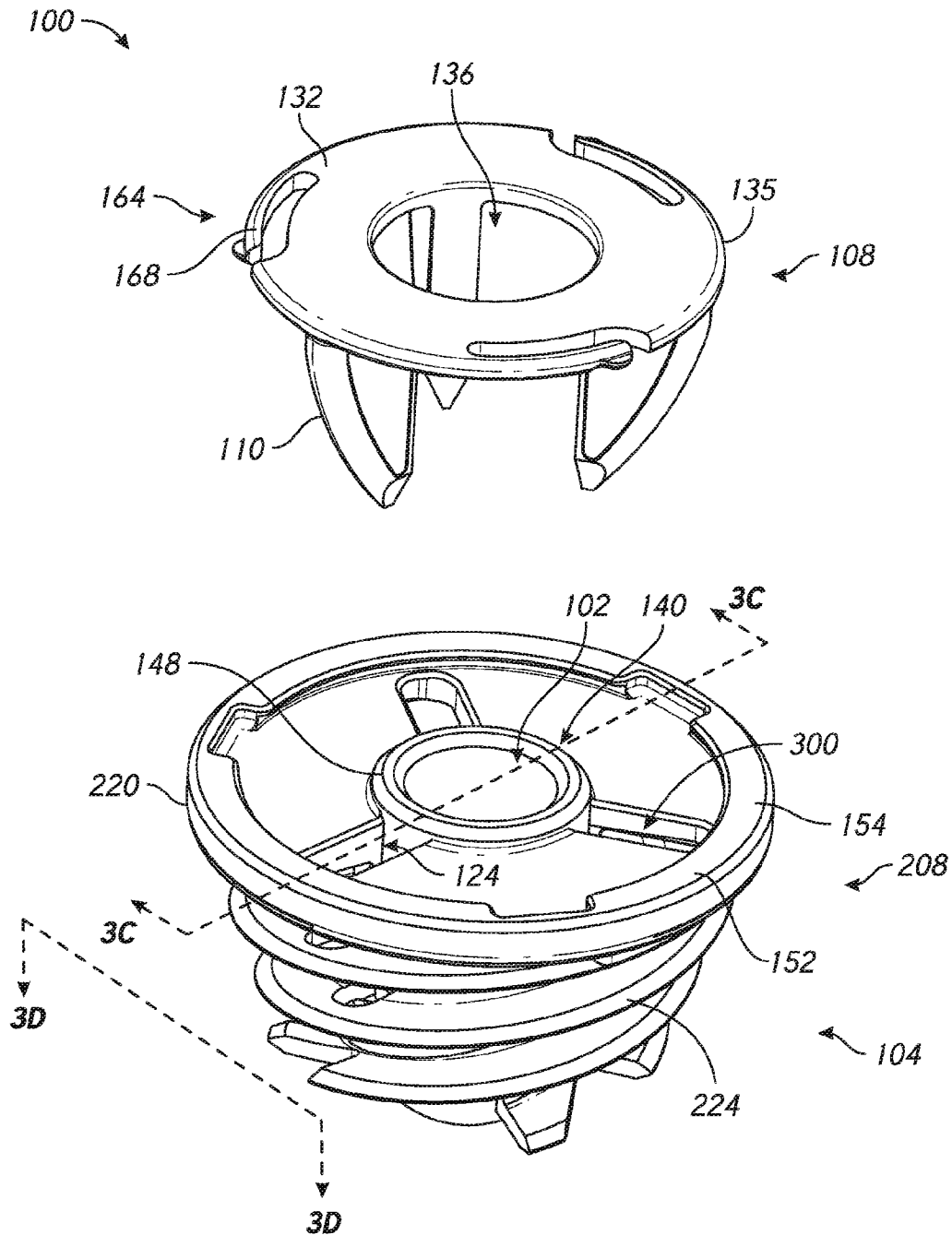


FIG. 2

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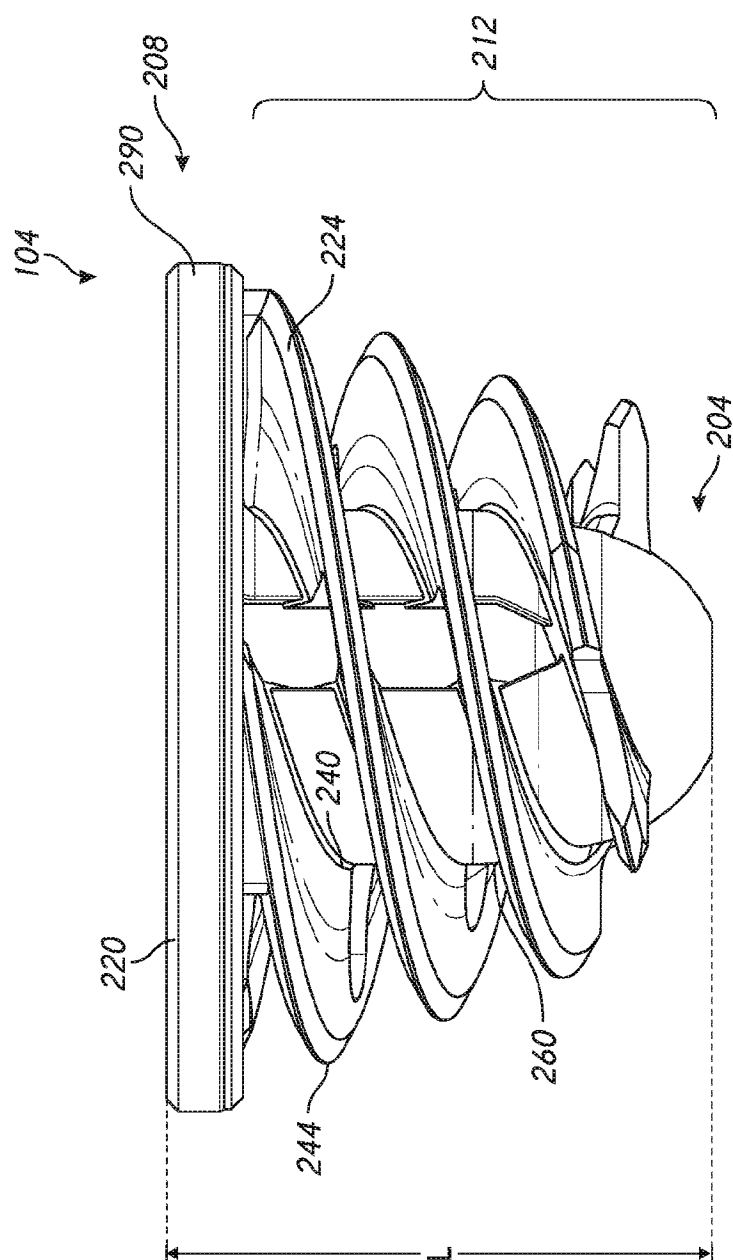


FIG. 3A

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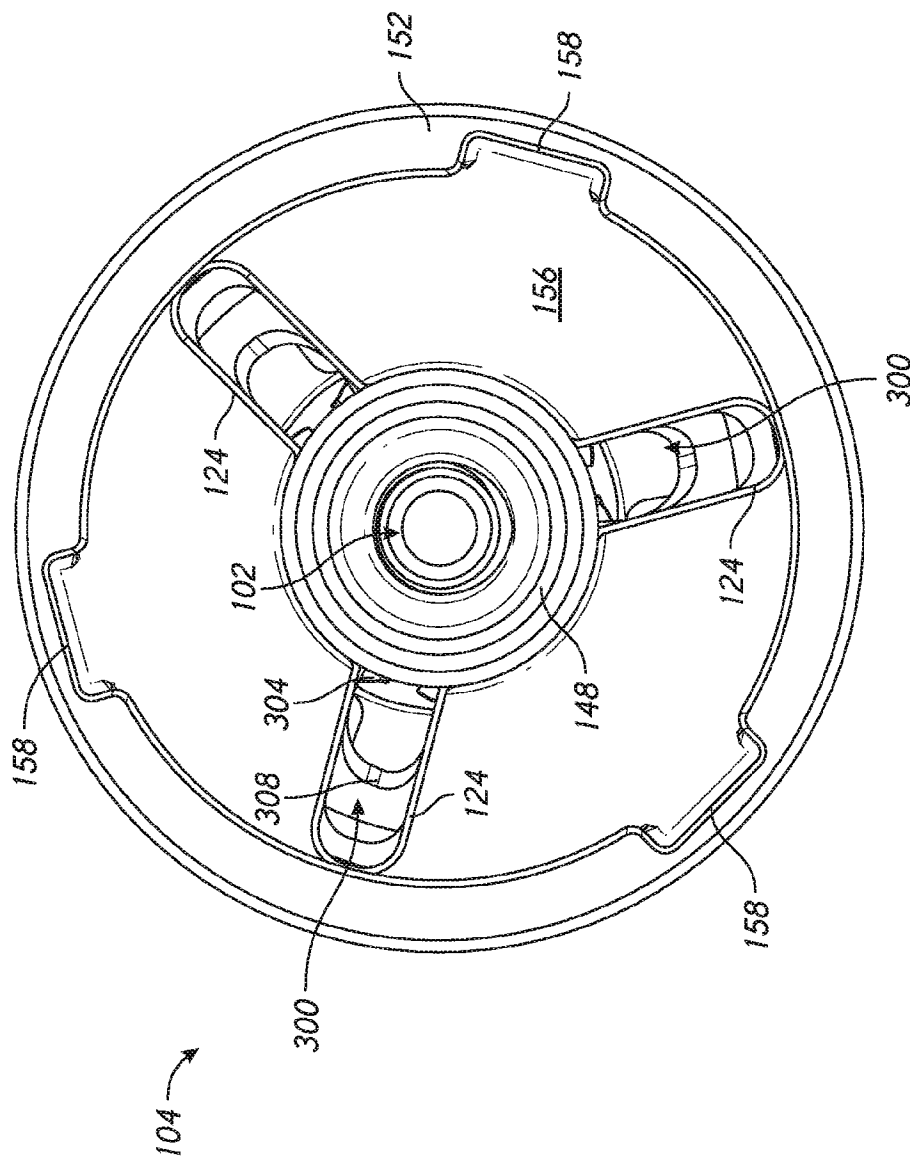


FIG. 3B

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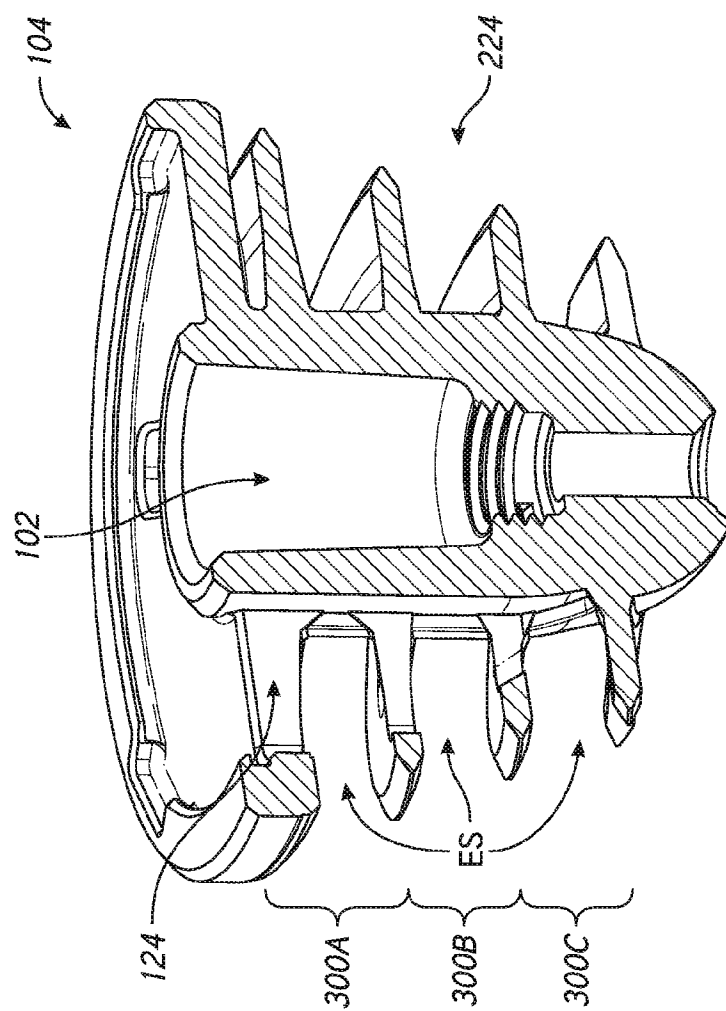


FIG. 3C

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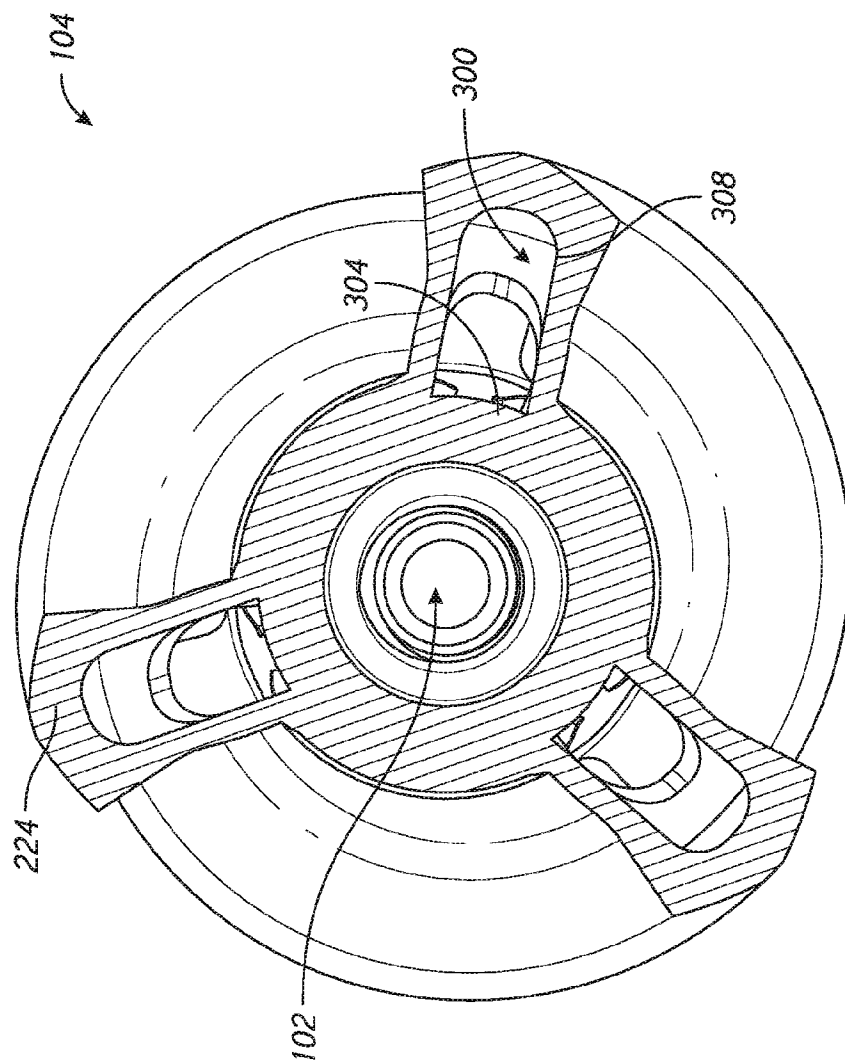


FIG. 3D

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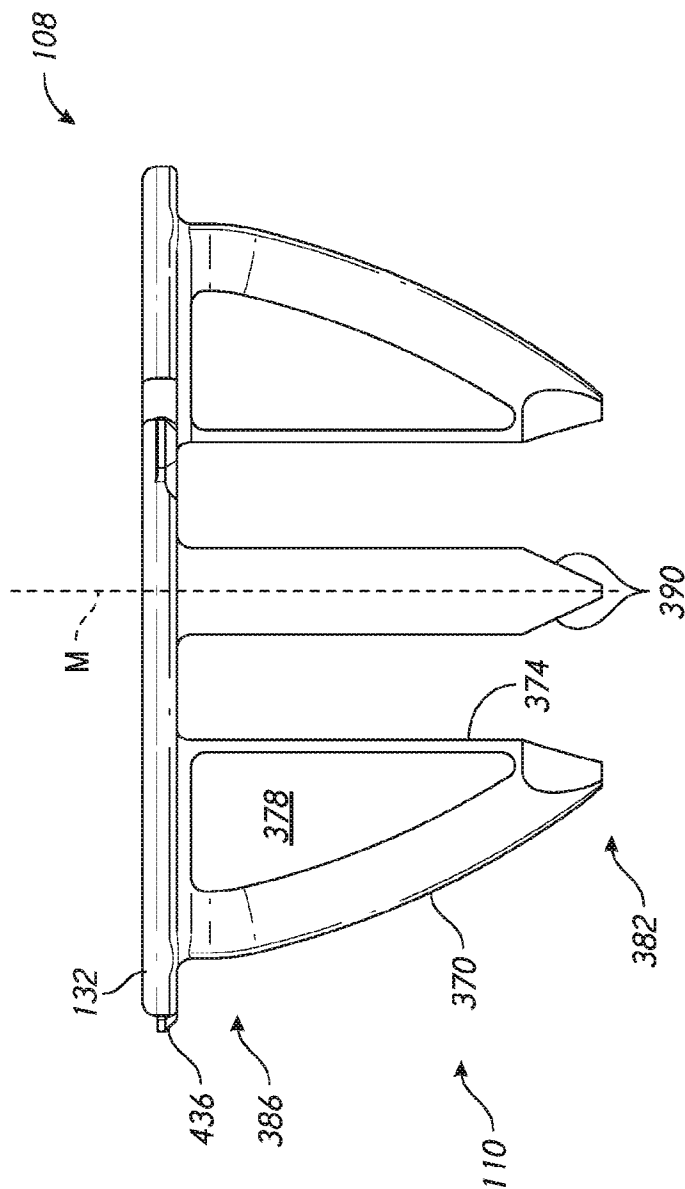


FIG. 4

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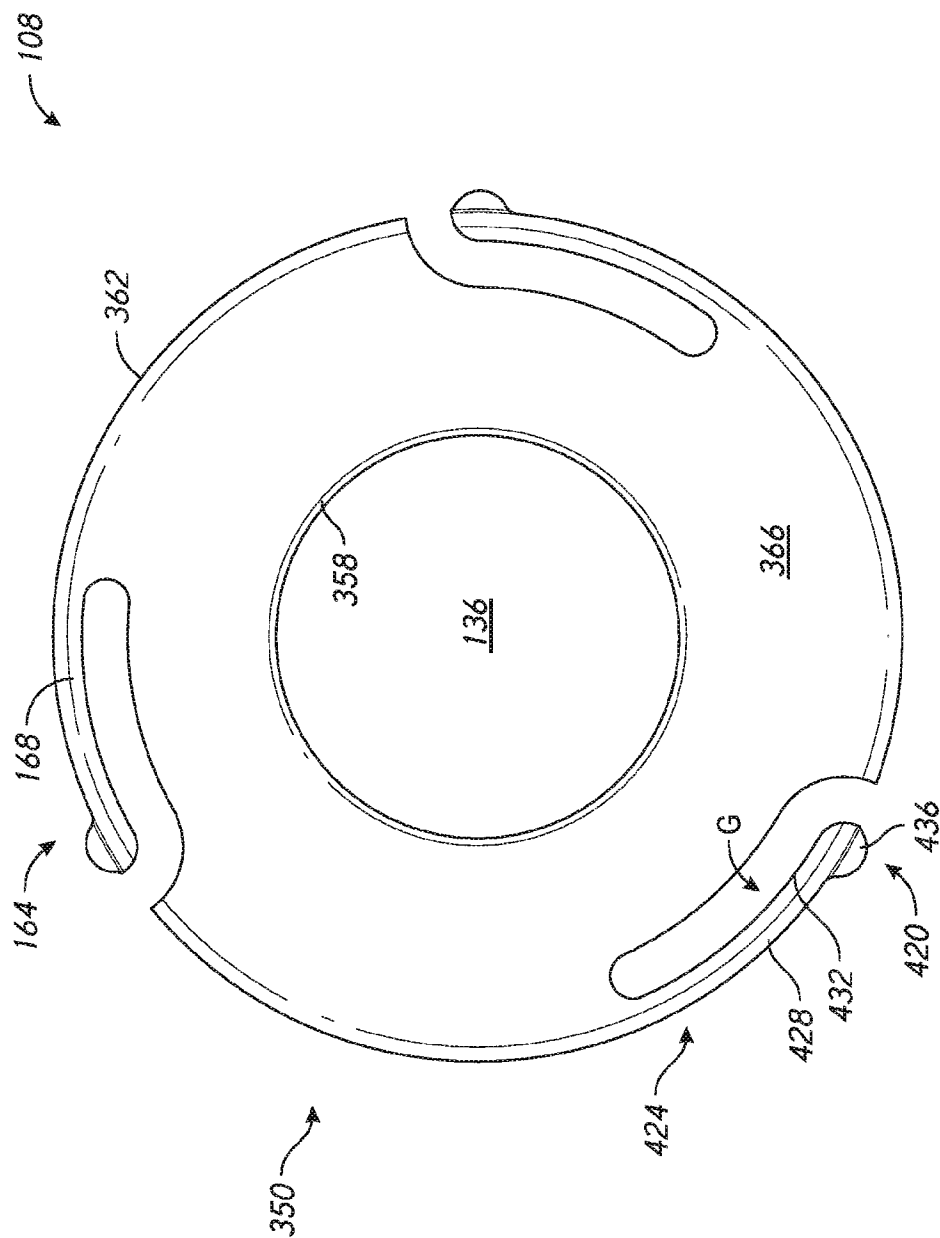


FIG. 5



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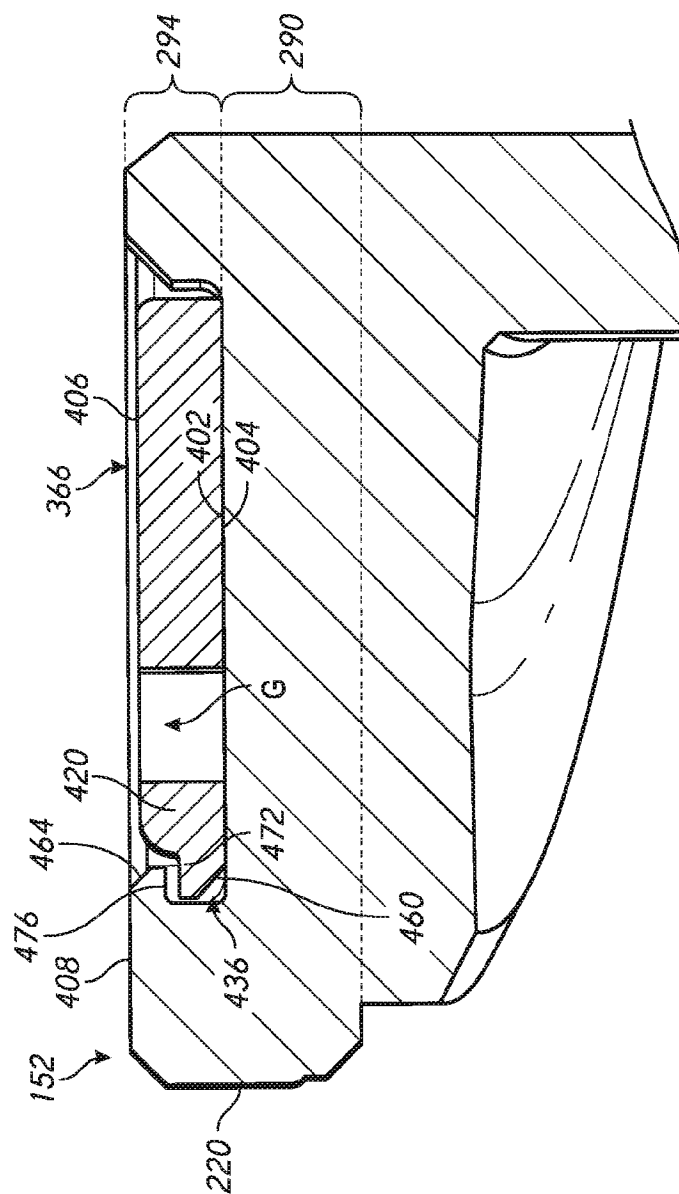


FIG. 6A

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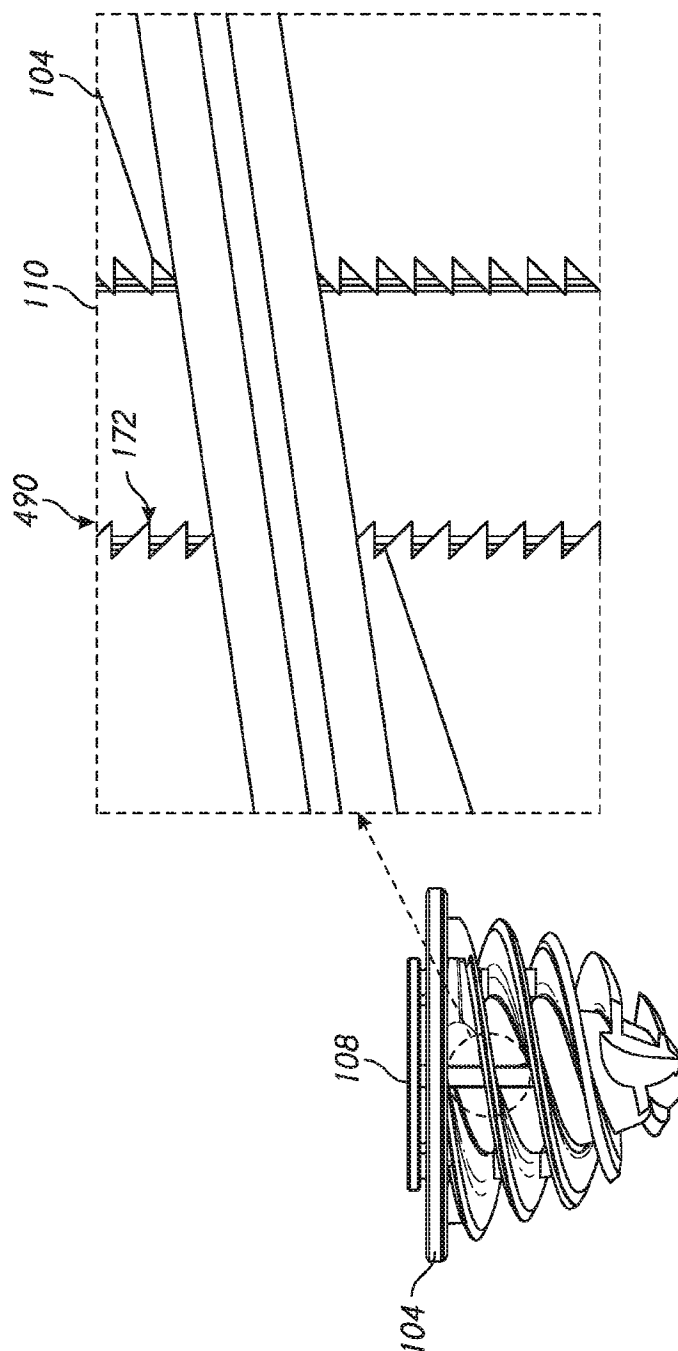


FIG. 6B

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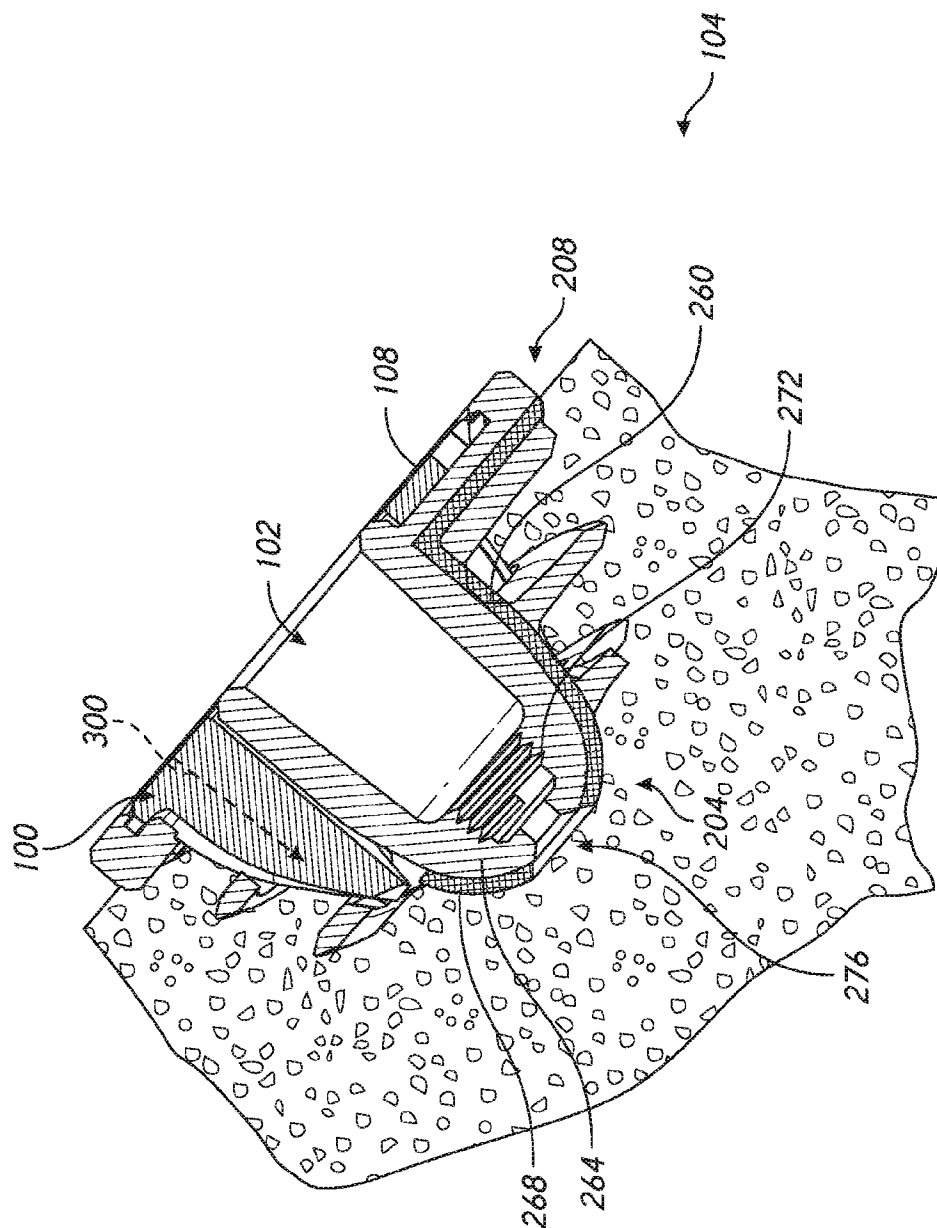


FIG. 7

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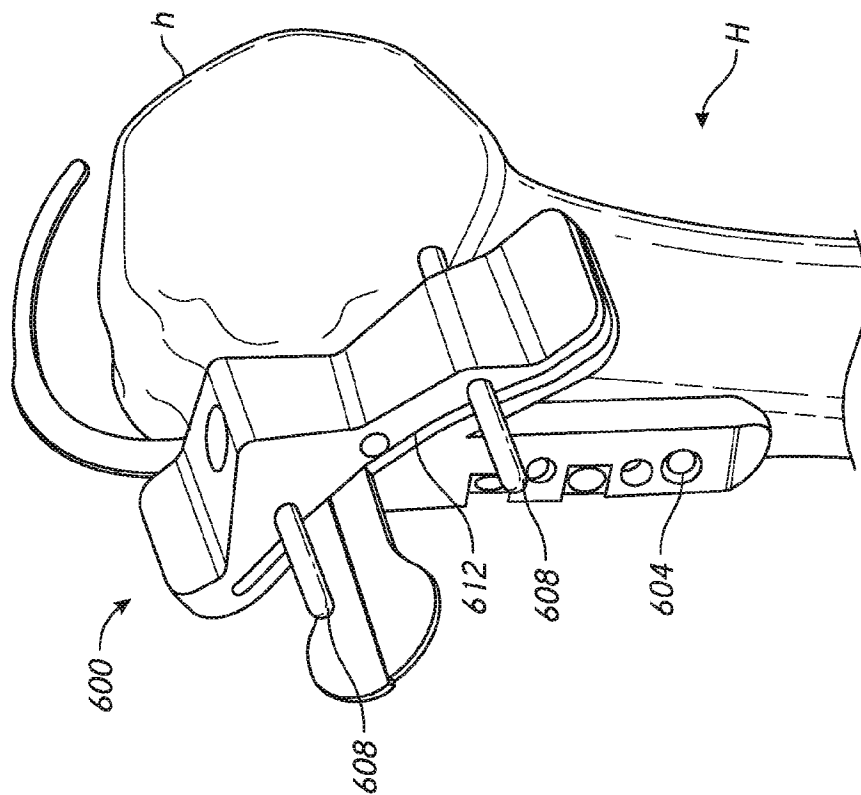


FIG. 8

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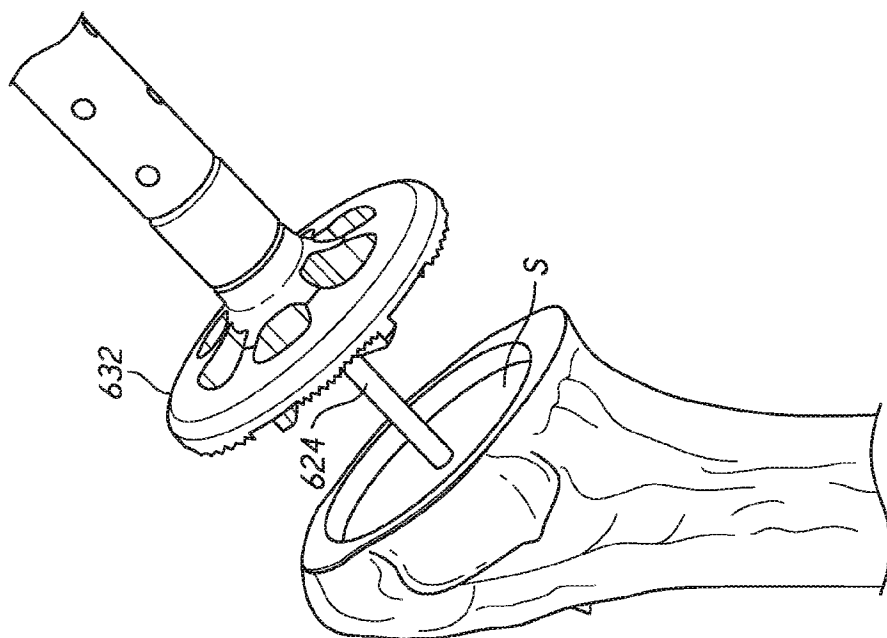


FIG. 10

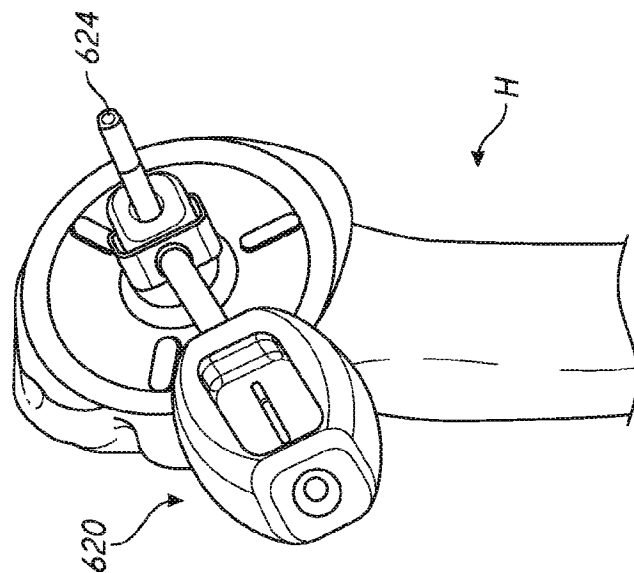


FIG. 9

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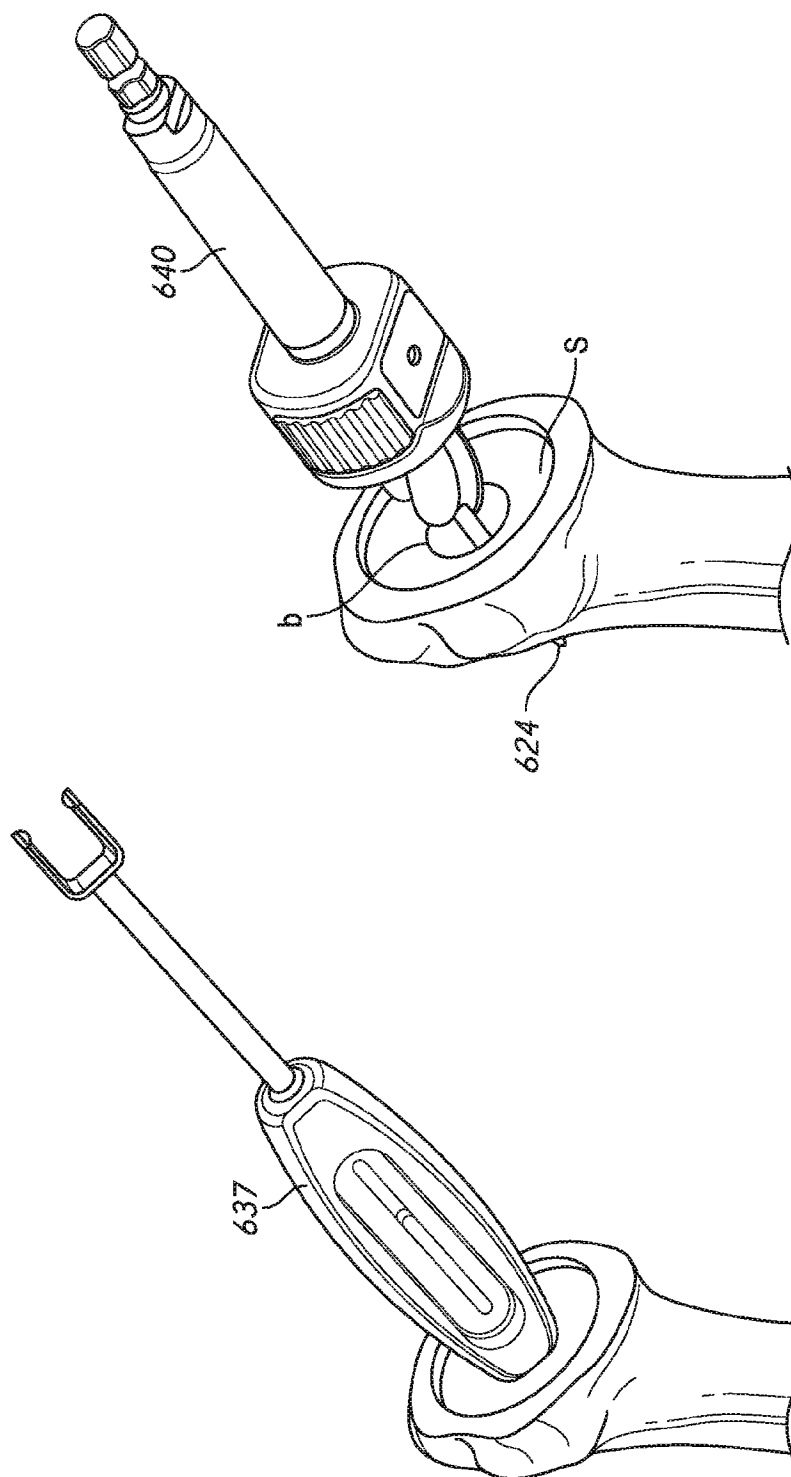


FIG. 12

FIG. 11

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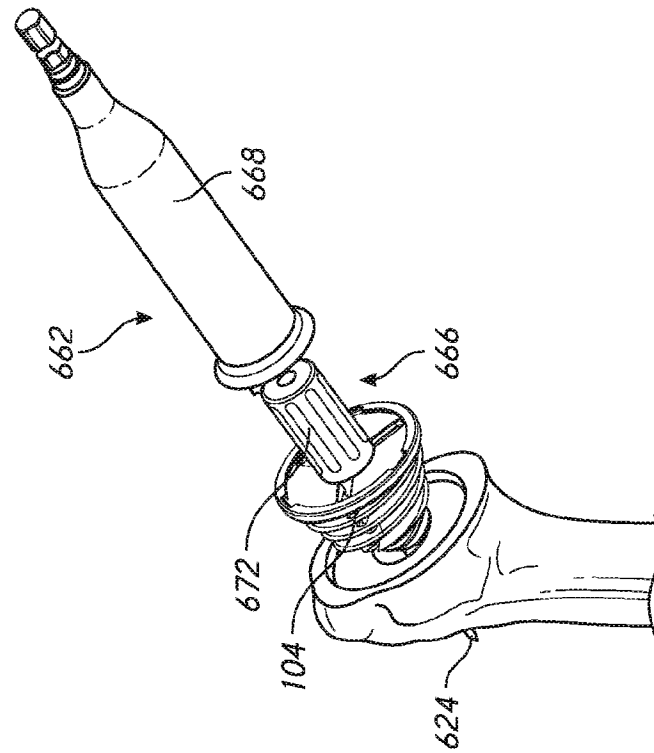


FIG. 14

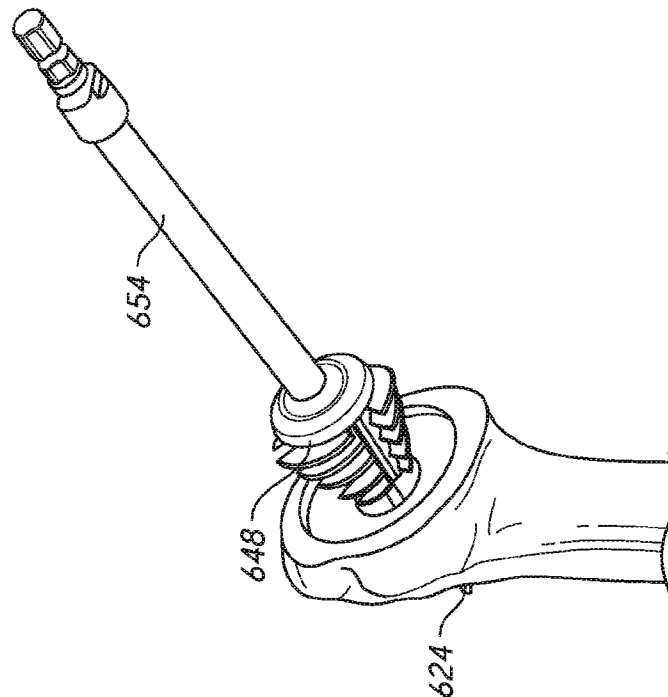


FIG. 13

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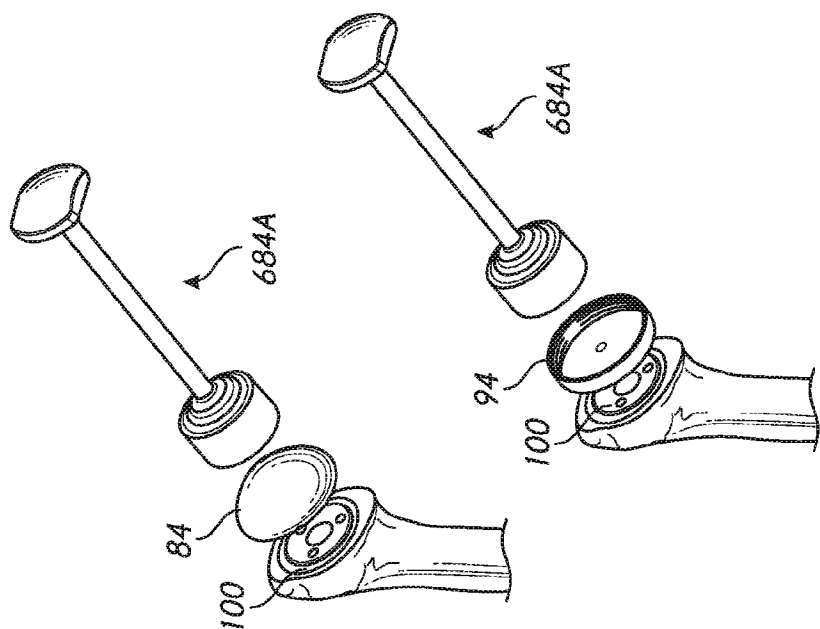


FIG. 16

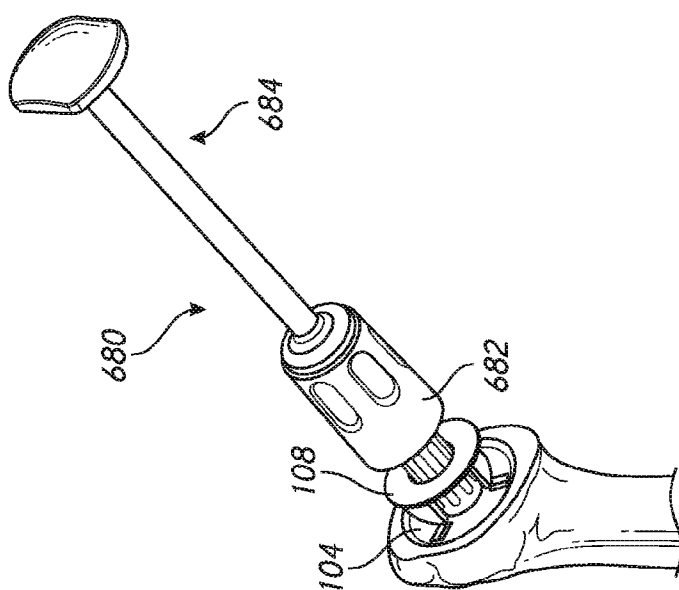


FIG. 15



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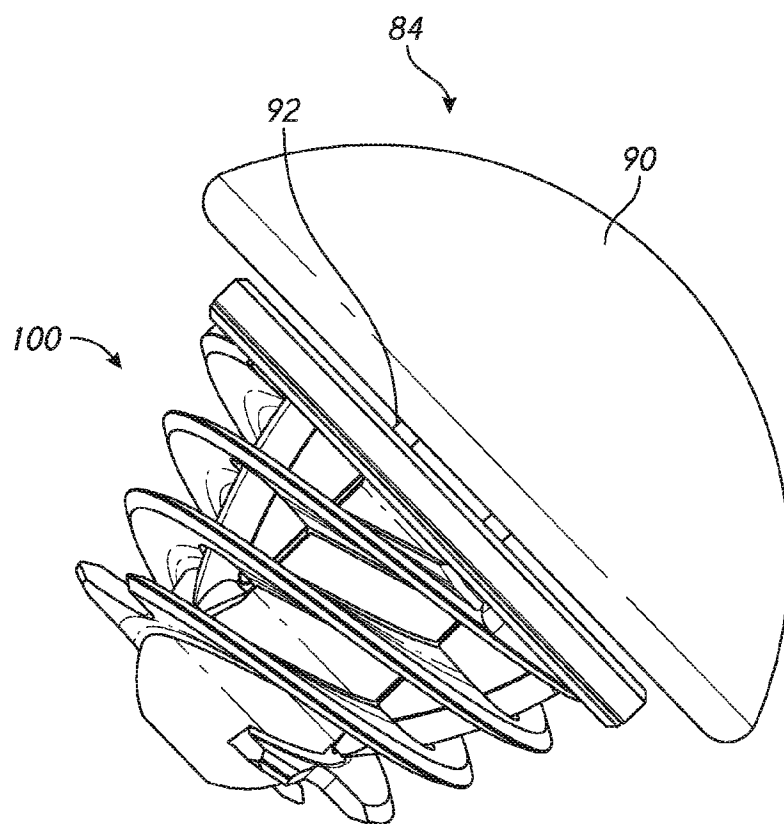


FIG. 17

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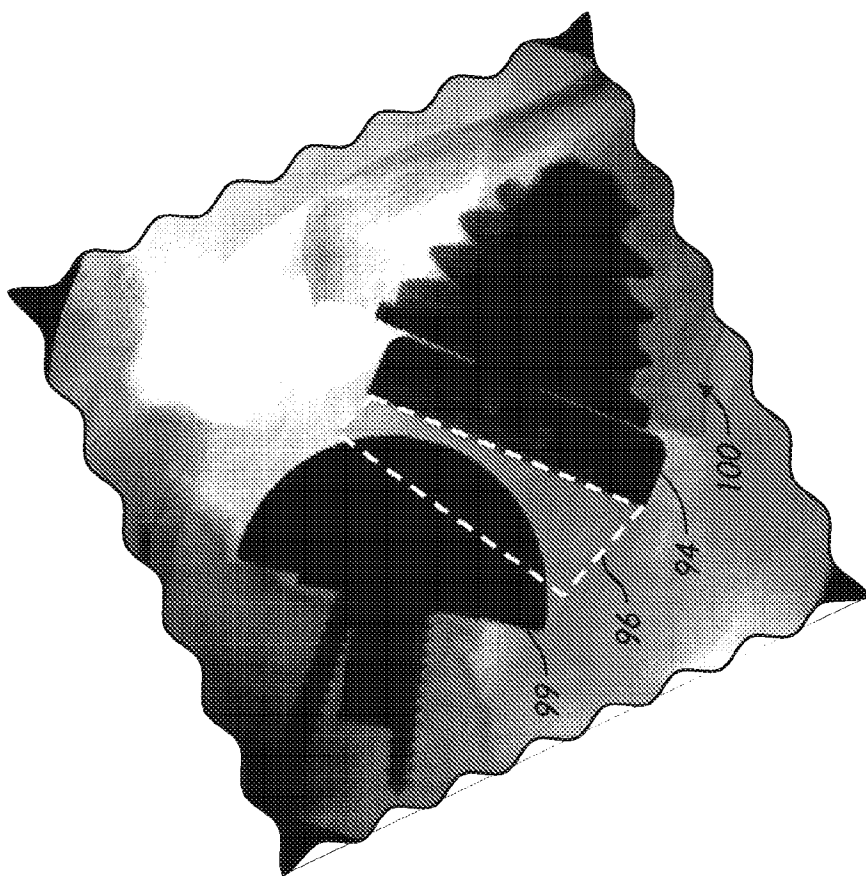


FIG. 18B

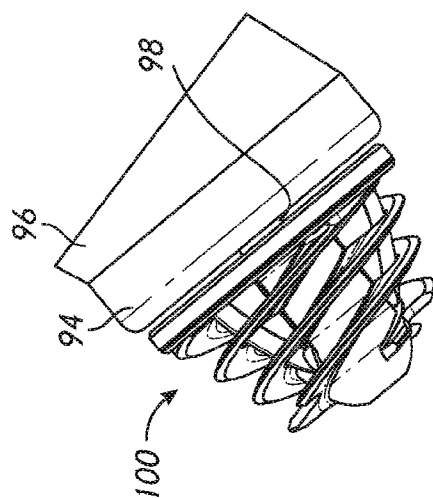


FIG. 18A

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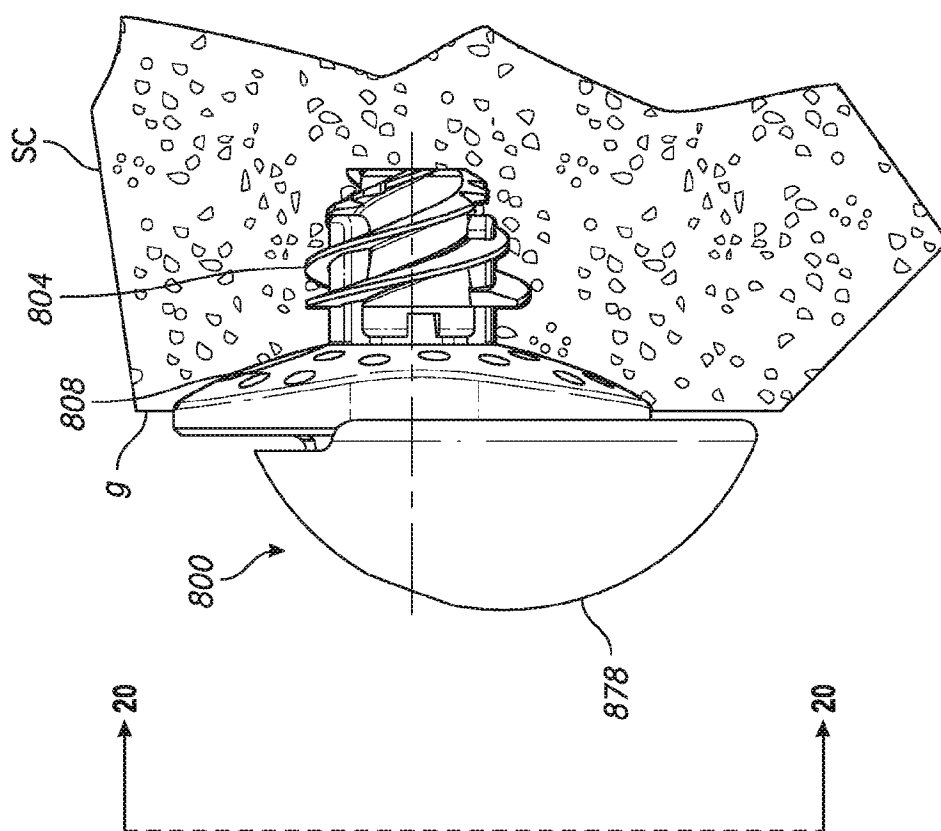


FIG. 19

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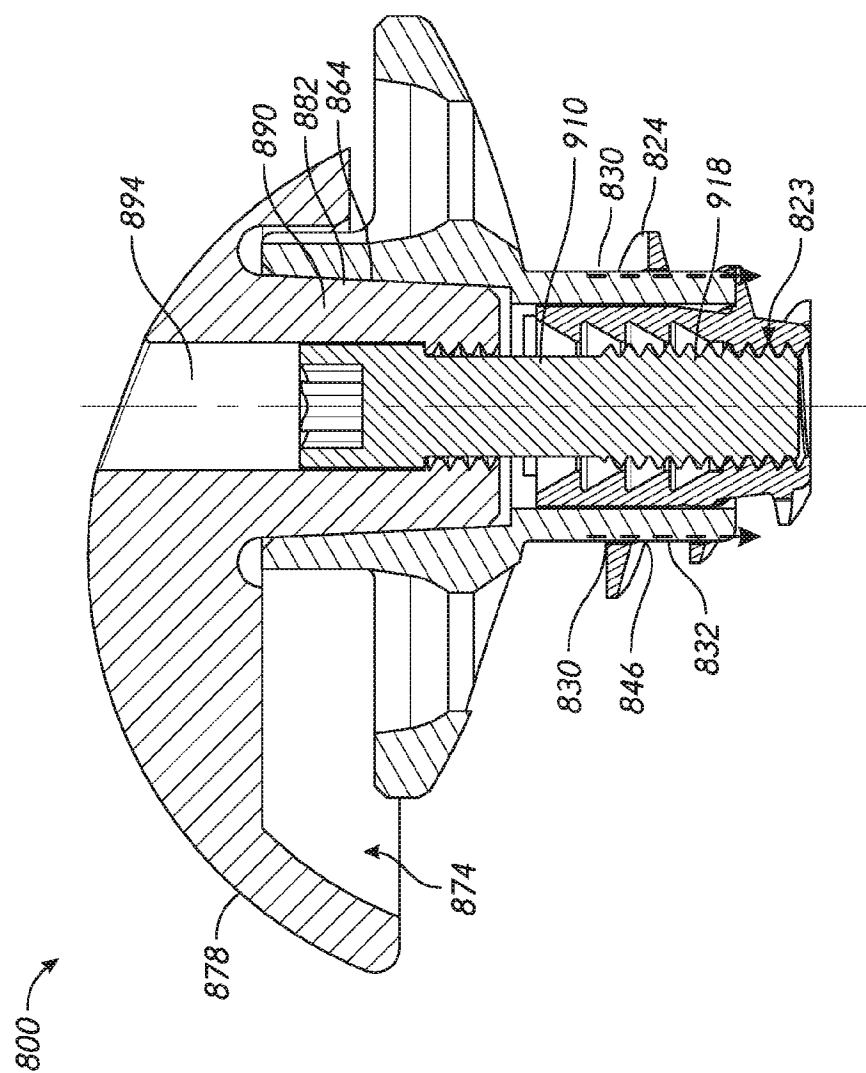


FIG. 20

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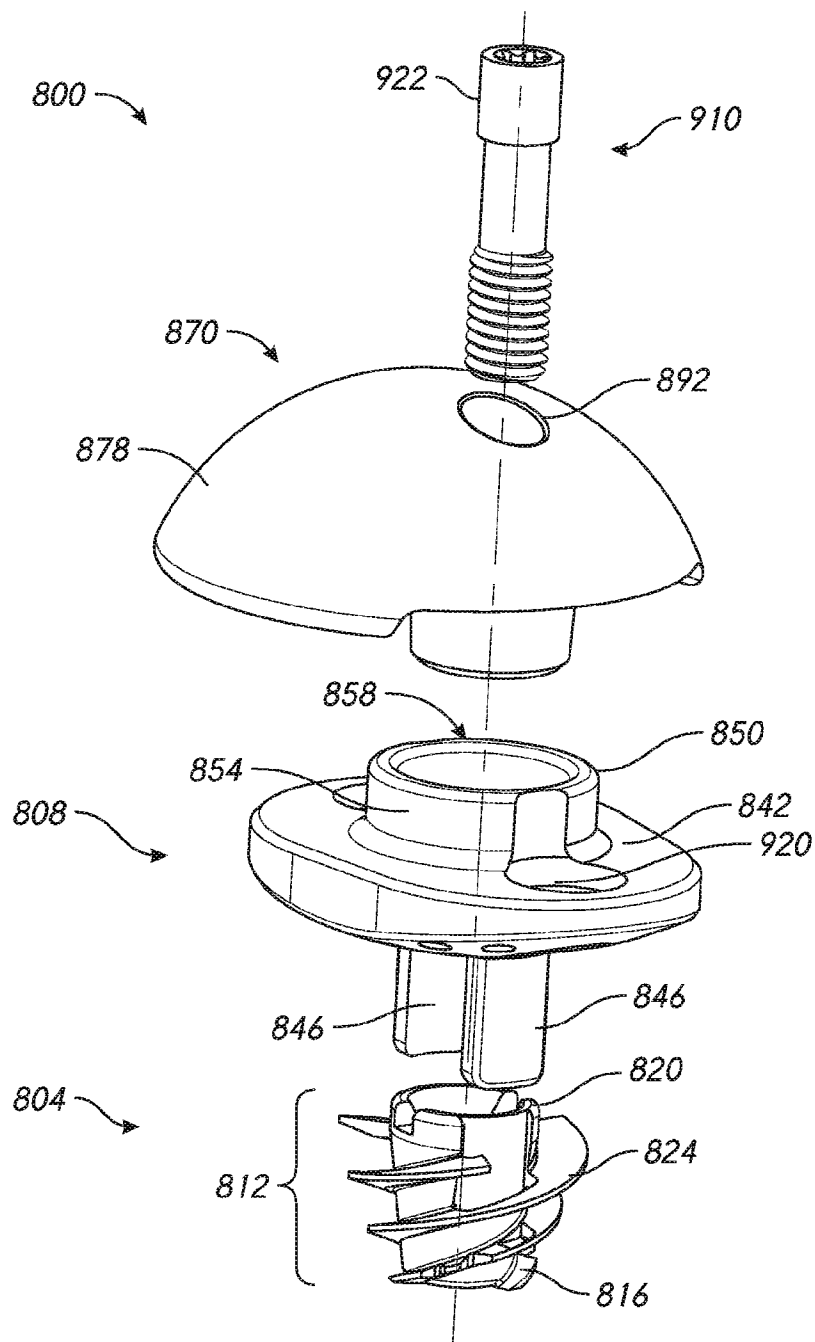


FIG. 21

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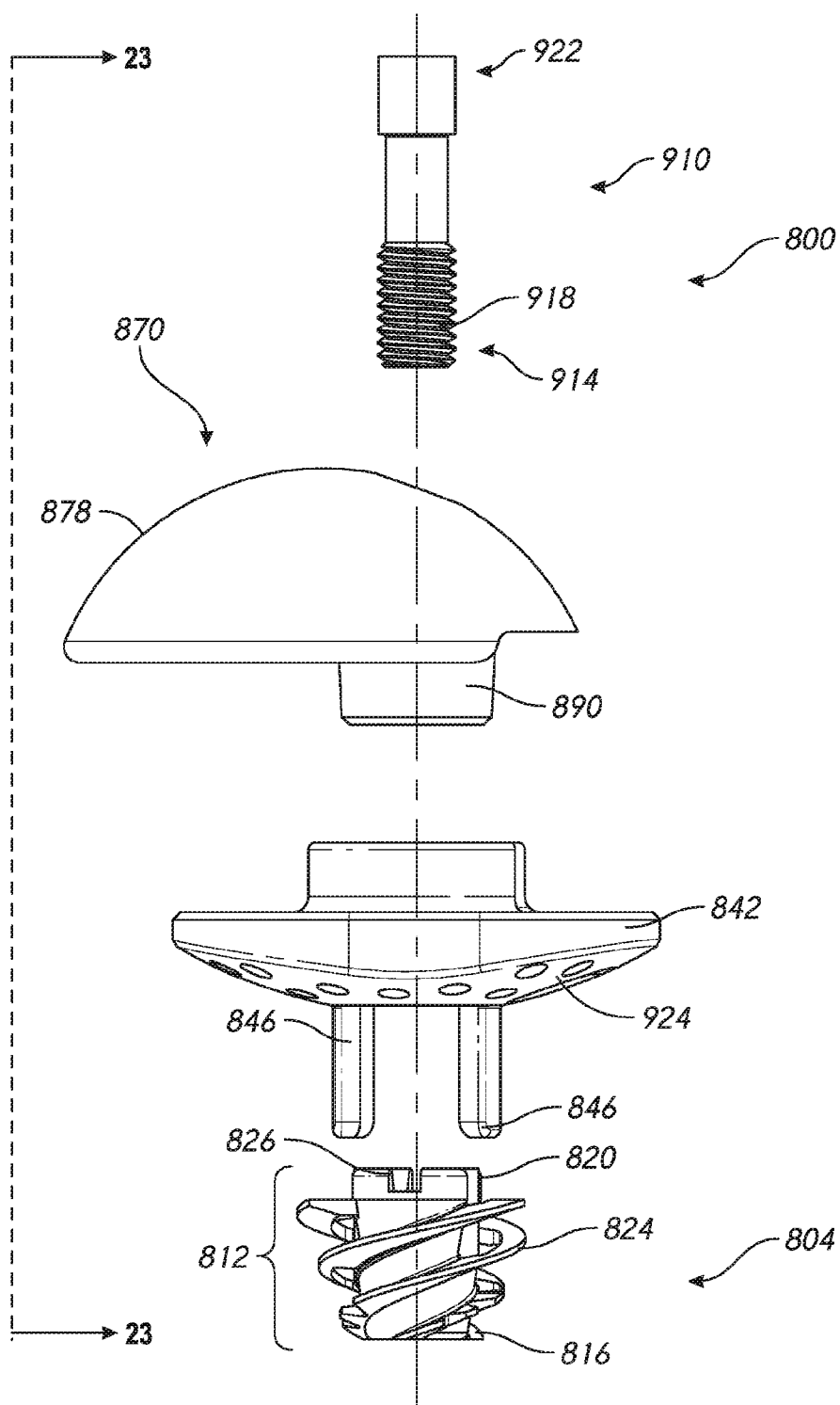


FIG. 22

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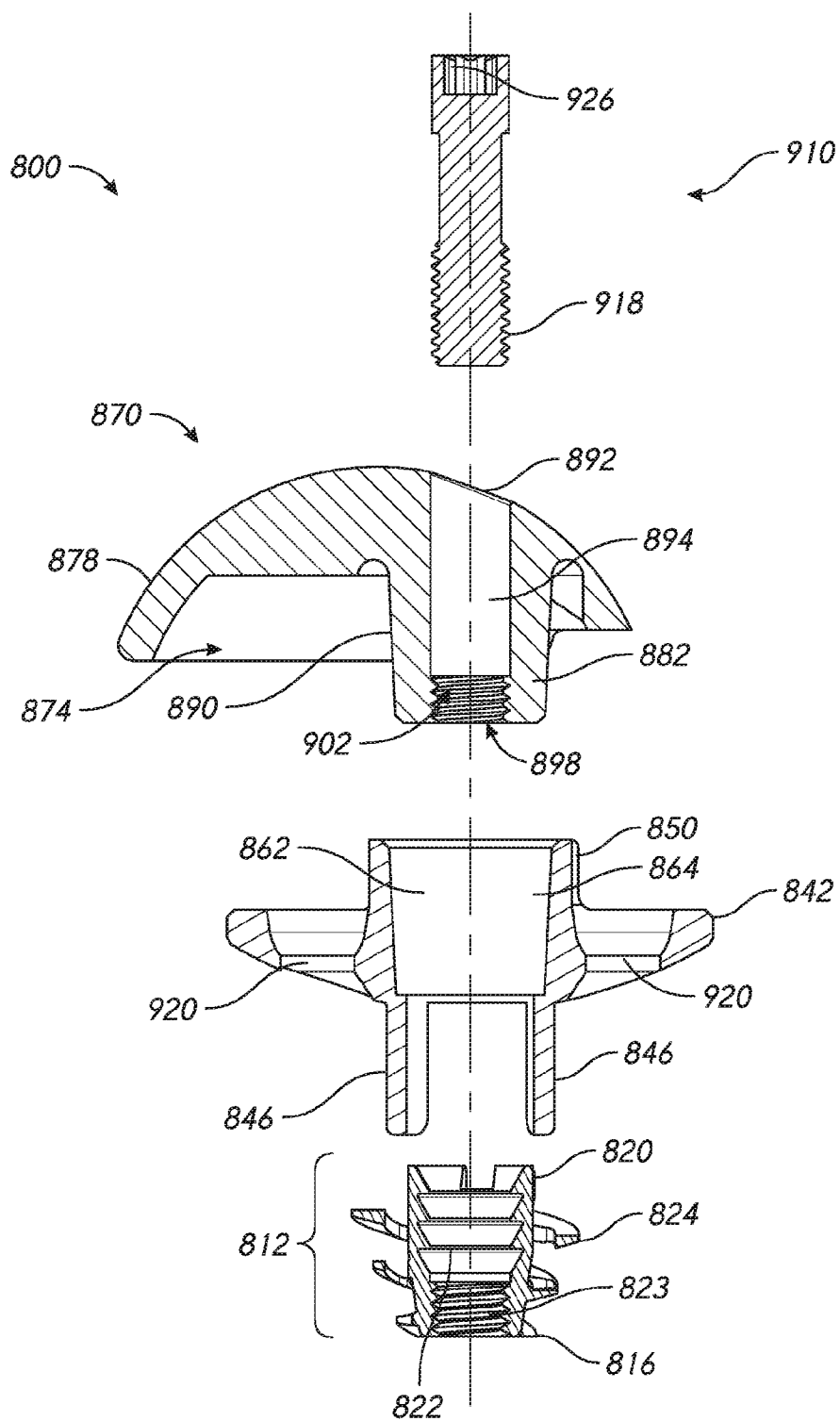


FIG. 23

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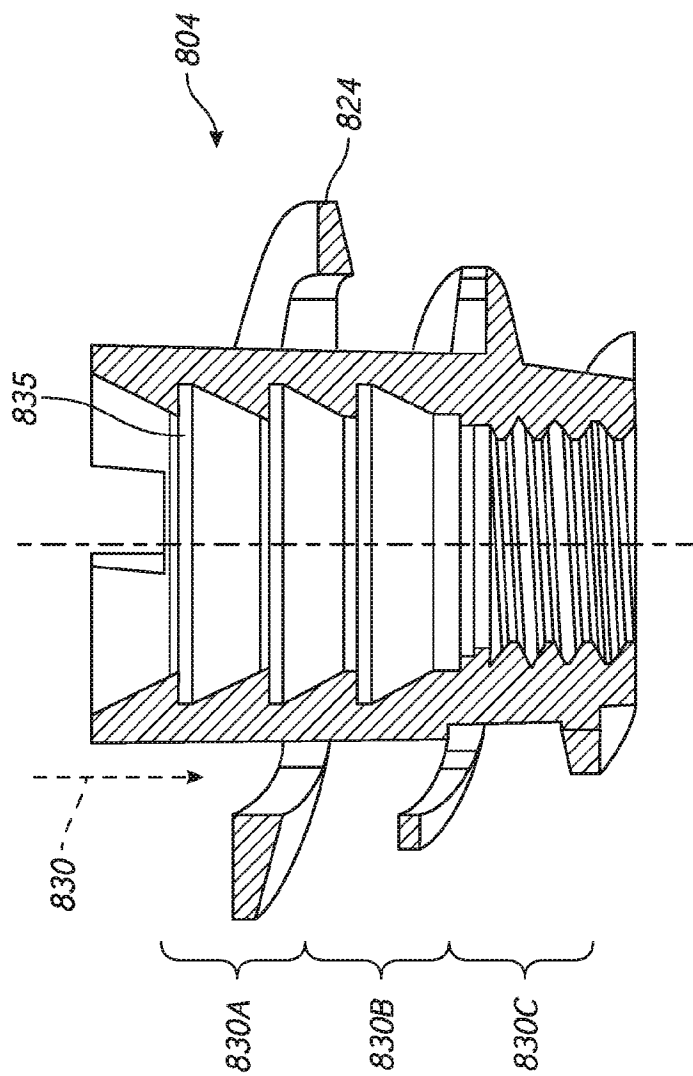


FIG. 23A



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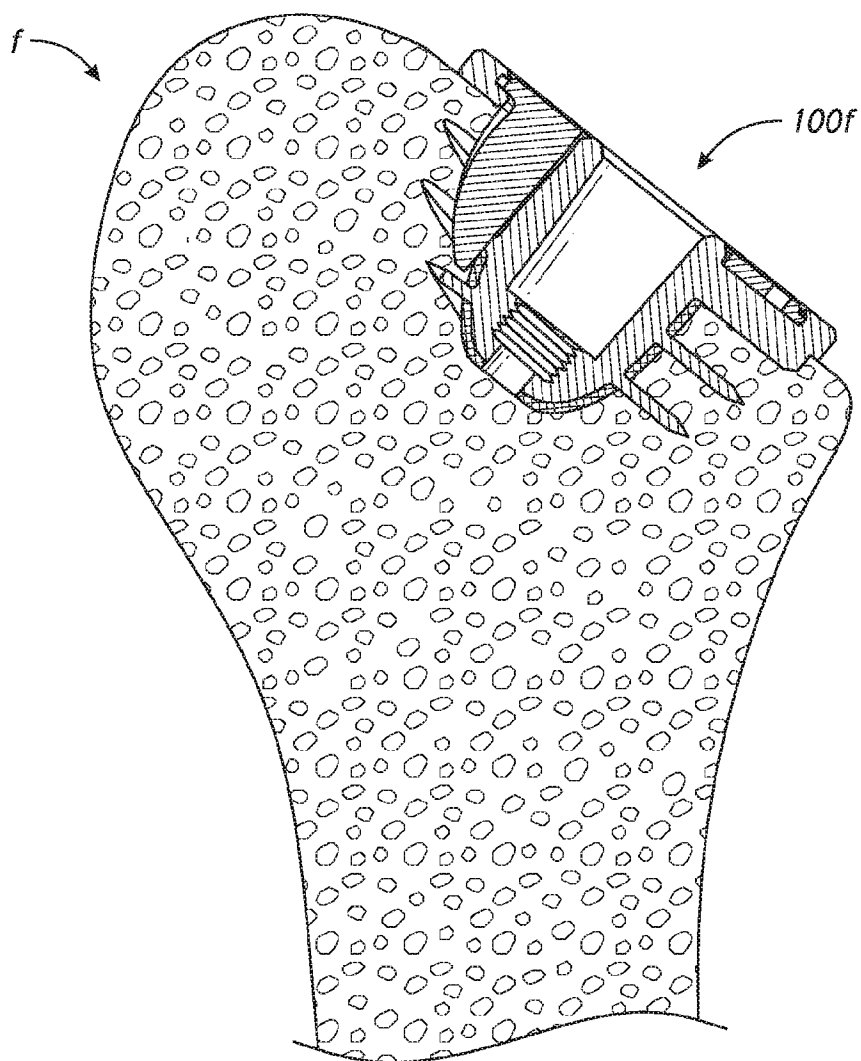


FIG. 24

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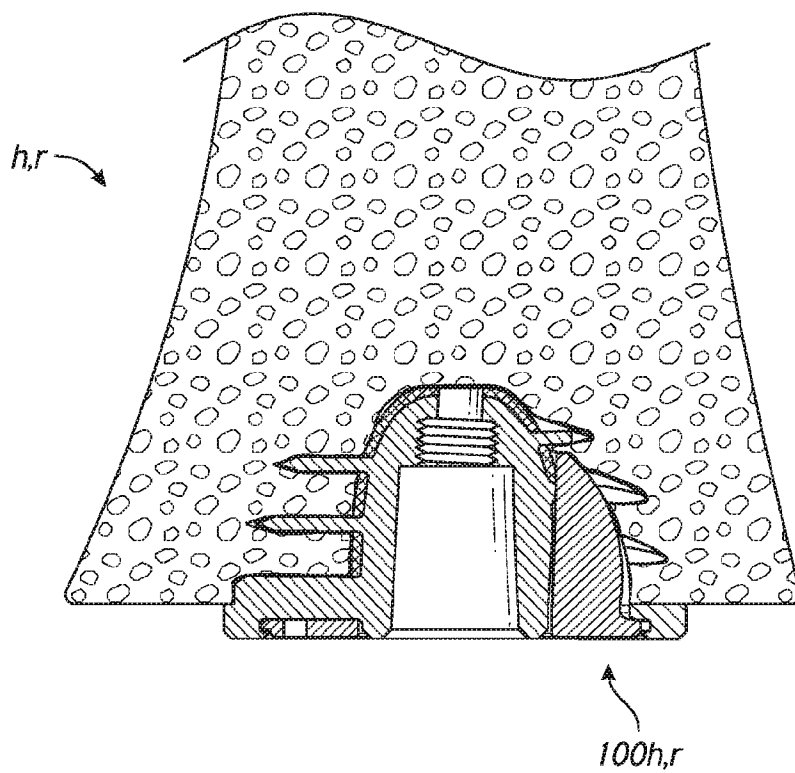


FIG. 25

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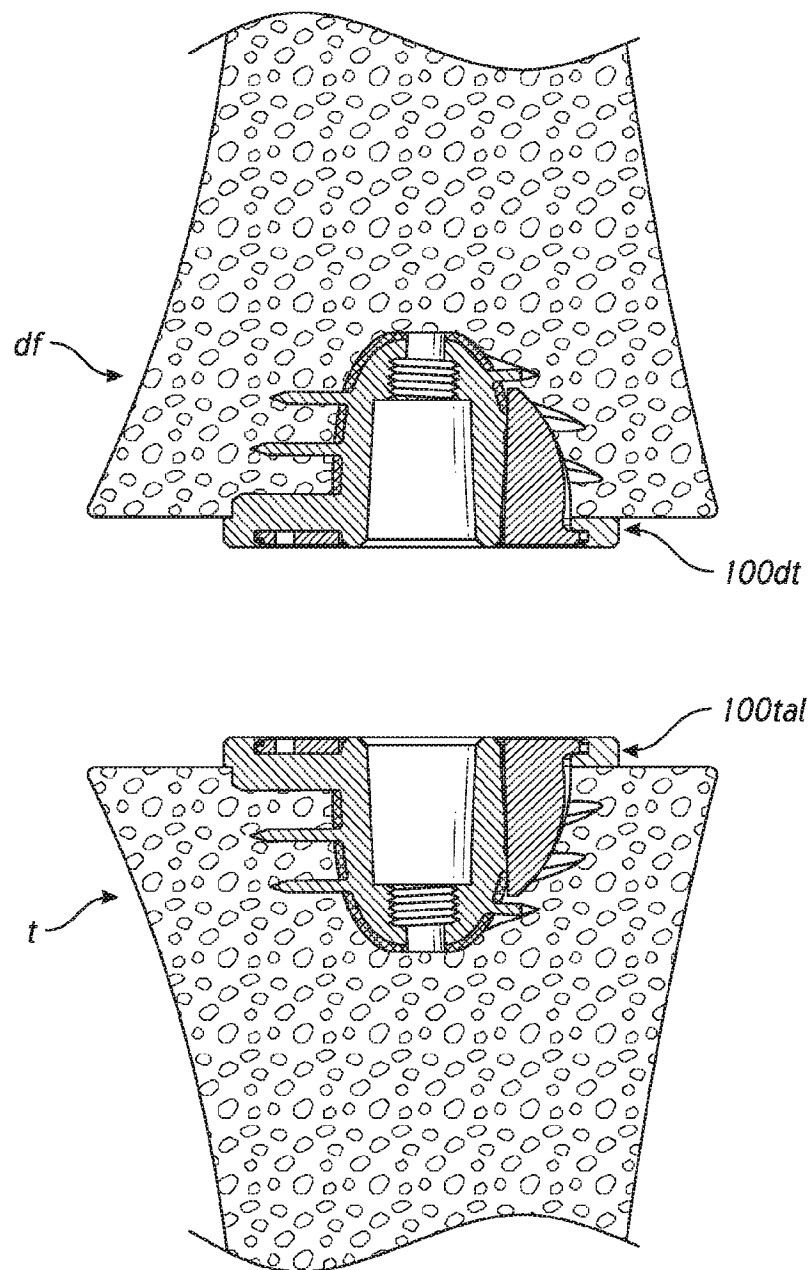


FIG. 26

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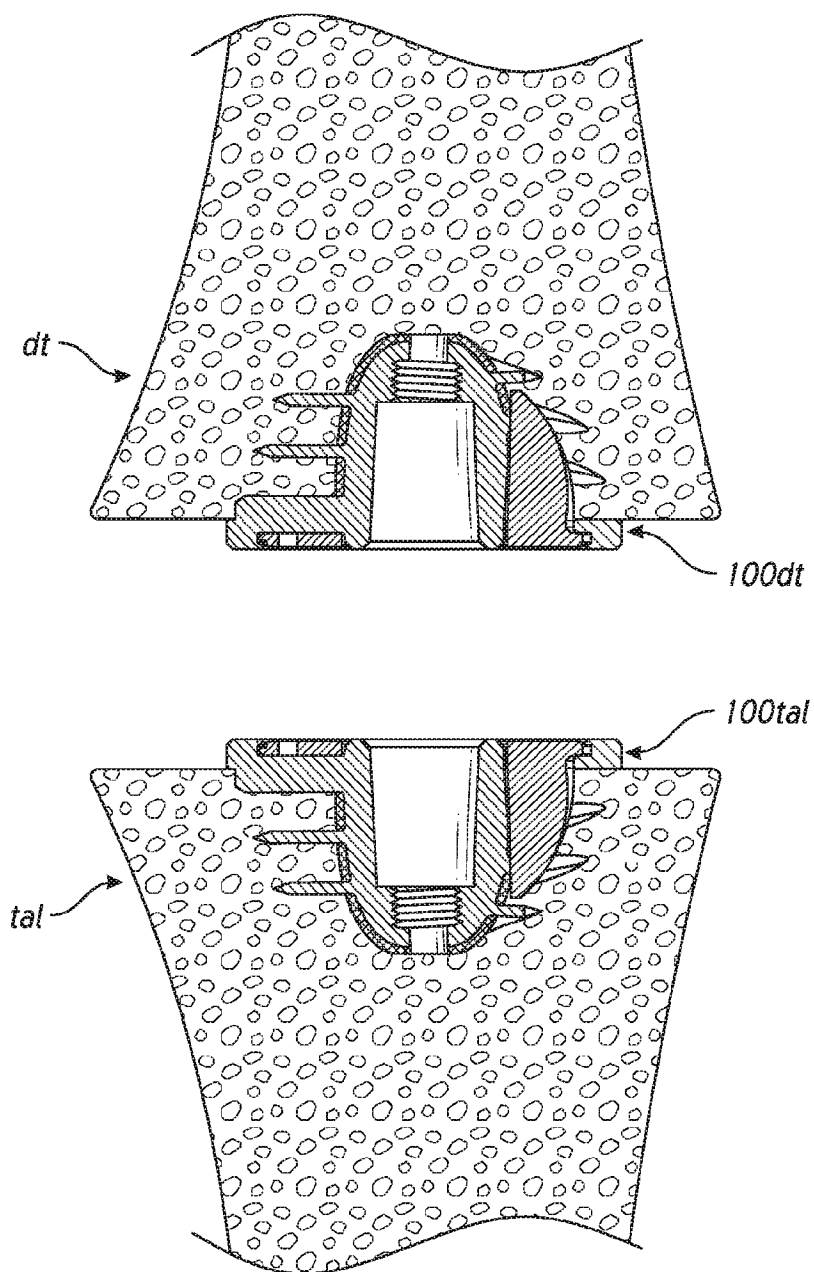


FIG. 27

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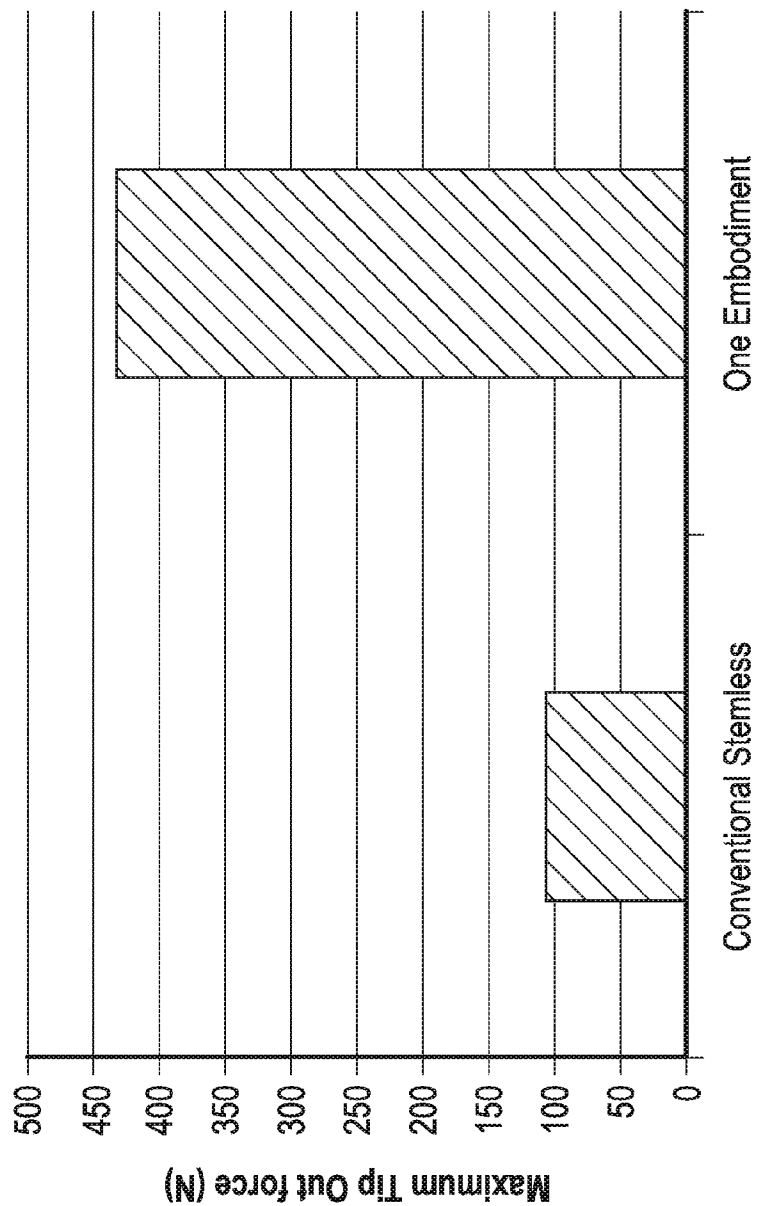


FIG. 28

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2017/038843

## A. CLASSIFICATION OF SUBJECT MATTER

INV. A61F2/40 A61F2/46  
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)

A61F 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)

EP0-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. |
|-----------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | WO 2015/112307 A1 (TORNIER INC [US])<br>30 July 2015 (2015-07-30)<br>the whole document<br>-----                            | 1-35,<br>37-42        |
| A         | US 2011/224673 A1 (SMITH MATTHEW J [US])<br>15 September 2011 (2011-09-15)<br>paragraphs [0037] - [0045]; figure 3<br>----- | 1-35,<br>37-42        |
| A         | EP 2 815 726 A1 (ARTHREX INC [US])<br>24 December 2014 (2014-12-24)<br>the whole document<br>-----                          | 1-35,<br>37-42        |



Further documents are listed in the continuation of Box C.



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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

17 August 2017

Date of mailing of the international search report

28/08/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
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Fax: (+31-70) 340-3016

Authorized officer

Mingrino, Alessandra

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2017/038843

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)                                                                                                      | Publication<br>date                                                                            |
|-------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| WO 2015112307 A1                          | 30-07-2015          | EP 3096714 A1<br>WO 2015112307 A1                                                                                               | 30-11-2016<br>30-07-2015                                                                       |
| US 2011224673 A1                          | 15-09-2011          | AU 2011224329 A1<br>CA 2790589 A1<br>CN 102802564 A<br>EP 2544629 A2<br>JP 2013521889 A<br>US 2011224673 A1<br>WO 2011112779 A2 | 30-08-2012<br>15-09-2011<br>28-11-2012<br>16-01-2013<br>13-06-2013<br>15-09-2011<br>15-09-2011 |
| EP 2815726 A1                             | 24-12-2014          | EP 2815726 A1<br>JP 2016522058 A<br>US 2014379089 A1<br>WO 2014202494 A1                                                        | 24-12-2014<br>28-07-2016<br>25-12-2014<br>24-12-2014                                           |

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2017/038843

### 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.: 36  
because they relate to subject matter not required to be searched by this Authority, namely:  
see FURTHER INFORMATION sheet PCT/ISA/210
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:

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.:

#### 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

Continuation of Box II.1

Claims Nos.: 36

According to Article 17(2)(a)(i) PCT and Rule 39.1(iv) PCT the International Search Authority, in the present case the EPO, is not required to carry out a search if the subject-matter of the international application relates to methods of treatment of the human or animal body by surgery or therapy, as well as diagnostic methods. The method of implanting a prosthesis claimed in claim 36 is a method of treatment of the human by surgery and thus no search is performed.



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## BIB DATA SHEET

CONFIRMATION NO. 5500

| SERIAL NUMBER                                                                                                                                                                                                                                                                    | FILING or<br>371(c) DATE                                                                                          | CLASS                                                    | GROUP ART UNIT                | ATTORNEY<br>DOCKET NO.                                                                                                                                                                                                                                                    |                           |                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|--------------------------------|
| 18/058,058                                                                                                                                                                                                                                                                       | 11/22/2022                                                                                                        | 623                                                      | 3774                          | SHOLD.013C1                                                                                                                                                                                                                                                               |                           |                                |
| <b>RULE</b>                                                                                                                                                                                                                                                                      |                                                                                                                   |                                                          |                               |                                                                                                                                                                                                                                                                           |                           |                                |
| <b>APPLICANTS</b><br>SHOULDER INNOVATIONS, INC., Holland, MI;                                                                                                                                                                                                                    |                                                                                                                   |                                                          |                               |                                                                                                                                                                                                                                                                           |                           |                                |
| <b>INVENTORS</b><br>Donald E. Running, Missoula, MT;<br>Robert J. Ball, Holland, MI;<br>Jason Slone, Silver Lake, IN;                                                                                                                                                            |                                                                                                                   |                                                          |                               |                                                                                                                                                                                                                                                                           |                           |                                |
| <b>** CONTINUING DATA *****</b><br>This application is a CON of 17/435,333 08/31/2021<br>which is a 371 of PCT/US2020/022094 03/11/2020<br>which claims benefit of 62/816,708 03/11/2019                                                                                         |                                                                                                                   |                                                          |                               |                                                                                                                                                                                                                                                                           |                           |                                |
| <b>** FOREIGN APPLICATIONS *****</b>                                                                                                                                                                                                                                             |                                                                                                                   |                                                          |                               |                                                                                                                                                                                                                                                                           |                           |                                |
| <b>** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** ** SMALL ENTITY **</b><br>12/09/2022                                                                                                                                                                                        |                                                                                                                   |                                                          |                               |                                                                                                                                                                                                                                                                           |                           |                                |
| Foreign Priority claimed <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>35 USC 119(a-d) conditions met <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>Verified and Acknowledged <u>/ANN SCHILLINGER/</u><br>Examiner's Signature |                                                                                                                   | <input type="checkbox"/> Met after Allowance<br>Initials | <b>STATE OR COUNTRY</b><br>MT | <b>SHEETS DRAWINGS</b><br>21                                                                                                                                                                                                                                              | <b>TOTAL CLAIMS</b><br>16 | <b>INDEPENDENT CLAIMS</b><br>1 |
| <b>ADDRESS</b><br>KNOBBE MARTENS OLSON & BEAR LLP<br>2040 MAIN STREET<br>FOURTEENTH FLOOR<br>IRVINE, CA 92614<br>UNITED STATES                                                                                                                                                   |                                                                                                                   |                                                          |                               |                                                                                                                                                                                                                                                                           |                           |                                |
| <b>TITLE</b><br>TOTAL REVERSE SHOULDER SYSTEMS AND METHODS                                                                                                                                                                                                                       |                                                                                                                   |                                                          |                               |                                                                                                                                                                                                                                                                           |                           |                                |
| <b>FILING FEE RECEIVED</b><br>0.00                                                                                                                                                                                                                                               | FEES: Authority has been given in Paper<br>No. _____ to charge/credit DEPOSIT ACCOUNT<br>No. _____ for following: |                                                          |                               | <input type="checkbox"/> All Fees<br><input type="checkbox"/> 1.16 Fees (Filing)<br><input type="checkbox"/> 1.17 Fees (Processing Ext. of time)<br><input type="checkbox"/> 1.18 Fees (Issue)<br><input type="checkbox"/> Other _____<br><input type="checkbox"/> Credit |                           |                                |

(51) International Patent Classification:  
A61F 2/30 (2006.01) A61F 2/40 (2006.01)

(21) International Application Number:  
PCT/US2018/040141

(22) International Filing Date:  
28 June 2018 (28.06.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
62/526,911 29 June 2017 (29.06.2017) US

(71) Applicant: ENCORE MEDICAL, L.P. (D/B/A DJO SURGICAL) [US/US]; 9800 Metric Boulevard, Austin, Texas 78758 (US).

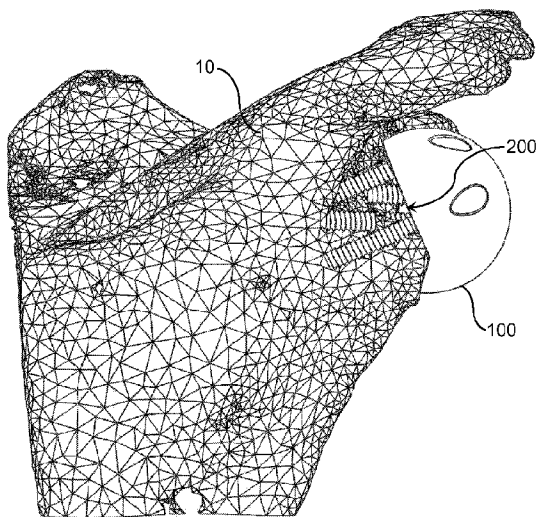
(72) Inventors: FRANKLE, Mark, A.; 915 Mooring Circle, Tampa, Florida 33602 (US). GUTIERREZ, Sergio; 805 Island Walk Dr., Tampa, Florida 33602 (US). WILLIAMS, Gerald; 859 Lesley Rd., Villanova, Pennsylvania 19085 (US). IANNOTTI, Joseph, P.; 30 Stonecreek Drive, Chagrin Falls, Ohio 44022 (US).

(74) Agent: BURNHAM, Daniel, J. et al.; Nixon Peabody LLP, 70 W. Madison St., Suite 3500, Chicago, Illinois 60602-4224 (US).

(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, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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, ST, 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, KM, ML, MR, NE, SN, TD, TG).

(54) Title: GLENOSPHERE WITH INSERTS FOR AUGMENTED FIXATION AND RELATED METHODS



(57) Abstract: An insert component includes an insert body (1410) and a cavity (1436) defined within the insert body. The insert body includes a first surface (1412), a second surface (1416) spaced from the first surface, and a third surface (1420). The second surface cooperates with the first surface to define at least one first channel (1428) configured to receive an engagement member. The third surface has a first (1430) and second (1432) surface end each extending from a perimeter of the first surface. A curved portion (1434) of the third surface between the first surface end and the second surface end extends into the insert body. The cavity includes a first cavity opening (1438) defined by the first surface. The cavity defines a first cavity region (1440) and a second cavity region (1442) each coextensive with a third cavity region (1444). The first cavity region and second cavity region each have a cavity diameter greater than a diameter of a plate engagement member (1482).

**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))*

**GLENOSPHERE WITH INSERTS FOR AUGMENTED FIXATION  
AND RELATED METHODS**

**CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] This application claims the benefit of and priority to U.S. Provisional Patent Application No. 62/526,911, filed June 29, 2017, which is hereby incorporated by reference herein in its entirety.

**TECHNICAL FIELD**

[0002] The present disclosure generally relates to the field of shoulder replacement surgery, and more specifically to apparatuses, systems, and methods relating to shoulder replacement using a glenosphere.

**BACKGROUND**

[0003] Shoulder replacement surgeries (e.g., total shoulder arthroplasty (TSA) and reverse shoulder arthroplasty (RSA)) are performed to repair a patient's shoulder joint, such as when joints have been damaged or lose functionality due to disease, bone loss, or other trauma. In some surgeries, a glenosphere acts as a connecting element between the patient's humerus and scapula, and may be oriented at an anatomic orientation to mimic the ball-and-joint configuration and movement of a natural shoulder joint. A base plate may be positioned between the glenosphere and the scapula, and a bone graft may be used to facilitate joining the base plate and glenosphere to the scapula. However, even with a bone graft, glenoid bone loss or other deterioration of the shoulder joint even after a shoulder replacement surgery may cause additional problems, reducing the effectiveness of the shoulder replacement surgery.

**SUMMARY**

[0004] According to an aspect of the present disclosure, an insert component for shoulder arthroplasty includes an insert body and a cavity. The insert body includes a first surface, a second surface, and a third surface. The first surface is configured to engage a bone. The second surface is spaced from the first surface and cooperates with the first surface to define at least one first channel configured to receive an engagement member. The third surface has a first surface end and second surface end each extending from a perimeter of the first surface. A curved portion of the third surface between the first surface end and the second surface end extends into the insert body. The curved portion is shaped to contact a bone engagement

member. The cavity is defined within the insert body and includes a first cavity opening defined by the first surface. The cavity defines a first cavity region and a second cavity region each coextensive with a third cavity region. The first cavity region and second cavity region each have a cavity diameter greater than a diameter of a plate engagement member.

[0005] According to another aspect of the present disclosure, a shoulder prosthesis system includes a plate, a glenosphere, and an insert component. The plate is configured to be attached to a portion of a shoulder bone, and includes a plate body including a first plate surface and a second plate surface opposite the first plate surface. The plate includes an engagement member extending from the second plate surface. The plate is configured to receive a plurality of plate fixation members to attach the plate to the portion of shoulder bone. The glenosphere includes a glenosphere body including a first body surface and a spherical second body surface. The first body surface includes an insert engagement region and a plate engagement region configured to engage with the engagement member of the plate. The insert component includes an insert body including a first insert surface, a second insert surface, and a third insert surface. The first insert surface is configured to engage the shoulder bone. The second insert surface is configured to engage with the insert engagement region of the glenosphere.

[0006] Some or all of the systems, components, and subcomponents of the present disclosure can be single-use or disposable. Also some or all of the systems, components, and subcomponents of the present disclosure can be made of a unitary construction (formed from a single piece of metal, plastic, or other material) or unitary modular construction (plurality of components and/or subcomponents permanently connected by standard means, such as welding or soldering), or of modular construction (plurality of components and/or subcomponents removably connected by standard means, such as threading or snap-fitting).

[0007] These and other features of various embodiments can be understood from a review of the following detailed description in conjunction with the accompanying drawings.

[0008] It is to be understood that both the foregoing general description and the following detailed description are explanatory and are not restrictive of the present disclosure, as claimed.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0009] FIG. 1 is a perspective view of an embodiment of a shoulder prosthesis system including a plate and a glenosphere fixated to a portion of a shoulder bone.

[0010] FIG. 2 is a perspective view of an embodiment of the plate and glenosphere of FIG. 1.

[0011] FIG. 3 is a detailed perspective view of an embodiment of the glenosphere of FIG. 1.

[0012] FIG. 4 is a side view transverse to a channel axis of an embodiment of the glenosphere of FIG. 1.

[0013] FIG. 5 is another side view transverse to a central axis of an embodiment of the glenosphere of FIG. 1.

[0014] FIG. 6 is another side view facing a cavity of an embodiment of the glenosphere of FIG. 1.

[0015] FIG. 7 is a side view of an embodiment of the plate and glenosphere of FIG. 1 with fixation members received in each of the plate and glenosphere.

[0016] FIG. 8 is a perspective view of an embodiment of the glenosphere of FIG. 1 with fixation members received in the plurality of channels of the glenosphere.

[0017] FIG. 9 is a perspective view of an embodiment of the plate of FIG. 1 with fixation members received in the plate.

[0018] FIG. 10 is a detailed perspective view of an embodiment of the plate of FIG. 1.

[0019] FIG. 11 is another perspective view of an embodiment of the plate of FIG. 1.

[0020] FIG. 12 is an end view of an embodiment of the plate of FIG. 1.

[0021] FIG. 13 is a block diagram of an embodiment of a method of securing a glenosphere to a portion of a shoulder bone to augment fixation of the glenosphere.

[0022] FIG. 14 is a perspective view of an embodiment of a glenosphere having a hood portion.

[0023] FIG. 15 is a sectional view of an embodiment of the glenosphere of FIG. 14.

[0024] FIG. 16 is an exploded perspective view of an embodiment of a glenosphere, a plate, and a fastening member for fastening the glenosphere to the plate.

[0025] FIG. 17 is a perspective view of an embodiment of the plate of FIG. 16.

[0026] FIG. 18 is a sectional view of an embodiment of the glenosphere of FIG. 16.

[0027] FIG. 19 is a perspective view of an embodiment of a glenosphere having an engagement segment for engaging a plate.

[0028] FIG. 20 is a perspective view of an embodiment of an assembly of a plate and a glenosphere in which channels of the glenosphere for receiving bone fixation members are oriented parallel to an engagement axis of the glenosphere.

[0029] FIG. 21 is an exploded perspective view of an embodiment of the assembly of FIG. 20.

[0030] FIG. 22 is a sectional view of an embodiment of the glenosphere of FIG. 20.

[0031] FIG. 23A is a perspective view of an embodiment of a glenosphere including a flange.

[0032] FIG. 23B is a front view of an embodiment of the glenosphere of FIG. 23A.

- [0033] FIG. 23C is a cross-sectional view of an embodiment of the glenosphere of FIG. 23A.
- [0034] FIG. 24 is a rear perspective of an embodiment of a glenosphere including a flange.
- [0035] FIG. 25A is a perspective view of an embodiment of a glenosphere in which the flange is offset from a center of the glenosphere.
- [0036] FIG. 25B is a cross-sectional view of an embodiment of the glenosphere of FIG. 25A.
- [0037] FIG. 26A is a perspective view of an embodiment of a glenosphere including an angled flange.
- [0038] FIG. 26B is a cross-sectional view of an embodiment of the glenosphere of FIG. 26A.
- [0039] FIG. 27A is a side view of an embodiment of a glenosphere including a curved flange.
- [0040] FIG. 27B is a cross-sectional view of an embodiment of the glenosphere of FIG. 27A.
- [0041] FIG. 28A is an exploded front perspective view of an embodiment of a glenosphere system including an insert component.
- [0042] FIG. 28B is an exploded top side perspective view of an embodiment of the glenosphere system of FIG. 28A.
- [0043] FIG. 28C is a side view of an embodiment of the glenosphere system of FIG. 28A when secured to a shoulder bone.
- [0044] FIG. 28D is a top perspective view of an embodiment of the glenosphere system of FIG. 28A.
- [0045] FIG. 28E is a cross-section view of an embodiment of the glenosphere system of FIG. 28A.
- [0046] FIG. 28F is an exploded left rear side perspective view of an embodiment of the glenosphere system of FIG. 28A.
- [0047] FIG. 28G is an exploded left front side perspective view of an embodiment of the glenosphere system of FIG. 28A.
- [0048] FIG. 29A is a rear perspective view of an embodiment of a glenosphere system including at least one second channel when secured to a shoulder bone.
- [0049] FIG. 29B is a rear perspective exploded view of an embodiment of the glenosphere system of FIG. 29A.
- [0050] FIG. 29C is a rear perspective view of an embodiment of an insert component of the glenosphere system of FIG. 29A.
- [0051] FIG. 29D is a front right perspective view of an embodiment of the insert component of FIG. 29C.
- [0052] FIG. 30A is a rear left perspective exploded view of an embodiment of a glenosphere system including a flange component.



[0053] FIG. 30B is a rear right perspective exploded view of an embodiment of the glenosphere system of FIG. 30A.

[0054] FIG. 30C is a rear top right perspective exploded view of an embodiment of the glenosphere system of FIG. 30A.

[0055] FIG. 30D is a front right perspective exploded view of an embodiment of the glenosphere system of FIG. 30A.

[0056] FIG. 31A is a rear right perspective exploded view of an embodiment of a glenosphere system including an angled surface insert component.

[0057] FIG. 31B is a front left perspective exploded view of an embodiment of the glenosphere system of FIG. 31A.

[0058] FIG. 31C is front perspective exploded view of an embodiment of the glenosphere system of FIG. 31A.

[0059] FIG. 32 is a front perspective exploded view of an embodiment of a glenosphere system including an insert component with parallel surfaces.

[0060] FIG. 33 is front perspective view of an embodiment of a glenosphere system including an insert component with parallel surfaces and channels.

[0061] FIG. 34 is a left perspective exploded view of an embodiment of a glenosphere system including an insert component with angled surfaces and channels.

[0062] FIG. 35A is a front perspective view of an embodiment of a glenosphere system including a plurality of insert components.

[0063] FIG. 35B is a front exploded perspective view of an embodiment of the glenosphere system of FIG. 35A including an insert component having continuous surfaces.

### DETAILED DESCRIPTION

[0064] The following detailed description and the appended drawings describe and illustrate various glenosphere systems, methods, and components. The description and drawings are provided to enable one of skill in the art to make and use one or more glenosphere systems and/or components, and/or practice one or more methods. They are not intended to limit the scope of the claims in any manner.

[0065] The use of “e.g.” “etc.,” “for instance,” “in example,” and “or” and grammatically related terms indicates non-exclusive alternatives without limitation, unless otherwise noted. The use of “optionally” and grammatically related terms means that the subsequently described element, event, feature, or circumstance may or may not be present/occur, and that the description includes instances where said element, event, feature, or circumstance occurs and

instances where it does not. The use of “attached” and “coupled” and grammatically related terms refers to the fixed, releasable, or integrated association of two or more elements and/or devices with or without one or more other elements in between. Thus, the term “attached” or “coupled” and grammatically related terms include releasably attaching or fixedly attaching two or more elements and/or devices in the presence or absence of one or more other elements in between. As used herein, the terms “proximal” and “distal” are used to describe opposing axial ends of the particular elements or features being described in relation to anatomical placement.

A. Glenosphere with Augmented Fixation and Related Methods

[0066] In existing solutions, shoulder replacement devices may lose effectiveness over time due to glenoid bone loss or other deterioration, which may be exacerbated by forces applied to a portion of a shoulder bone by a shoulder prosthesis. Although bone grafts may be used to supplement engagement between a plate contacting the portion of the shoulder bone and the portion of the shoulder bone, the usefulness of the bone grafts may be reduced by bone loss. The present solution provides systems, methods, and apparatuses for improving shoulder prostheses by augmenting fixation of a glenosphere to the portion of the shoulder bone. The glenosphere includes a body, a first surface, a second surface, a cavity, and a plurality of channels. The body defines a central axis passing through the body. The first surface includes a first rim and a second rim. The first rim is positioned radially outward from the second rim relative to the central axis. The second surface extends from the first rim of the first surface. The second surface has a convex shape. The cavity extends into the body from the first surface. The cavity includes a cavity wall extending from the second rim in a direction substantially parallel to the central axis into the body and a cavity surface. The cavity is configured to receive a plate defining an interference space. The plurality of channels extend from the first surface through the body to the second surface. Each channel defines a first opening positioned on the first surface between the first rim and the second rim and defines a second opening positioned on the second surface. Each channel is configured to be oriented to define a channel axis that passes through the channel and is positioned to be outside of the interference space when the plate is received in the cavity. A plurality of glenosphere fixation members can be received through the plurality of channels to secure the glenosphere to the portion of the shoulder bone. As such, fixation of the glenosphere to the shoulder can be augmented, in order to mitigate glenoid bone loss or other changes to the shoulder joint that would otherwise deteriorate the shoulder joint and reduce the effectiveness of the shoulder prosthesis.

[0067] Referring to FIG. 1, a perspective view of a shoulder prosthesis including a glenosphere 100 and a plate 200 fixated to a portion 10 of a shoulder bone is shown. The glenosphere 100 is coupled to the plate 200, such as by engagement of an engagement member of the glenosphere 100 and an engagement member of the plate 200. The glenosphere 100 can be oriented and further secured (e.g., fixated, attached, etc.) to the portion 10 outside of portions of bone different from portions of bone at which the plate 200 is attached. In some embodiments, securing the glenosphere to the portion 10 of the shoulder bone reduces stress on the portion 10 of the shoulder bone to mitigate glenoid bone loss damage.

[0068] In various embodiments, the glenosphere 100 is configured to be coupled to any of a variety of plates. For example, the plates can include various shapes (e.g., cylindrical, ovoid, rectangular, convex, concave, etc.). The plate can be formed as a single plate (e.g., similar or identical to plate 200 as shown in FIG. 1), or can be formed as a plurality of plates (e.g., a plurality of plates fixed to discrete portions of a shoulder bone). The glenosphere 100 can be configured to couple to plates in various ways, such as by using a variety of fastening members and/or engagement members (e.g., screws, bolts, press fits, frictional engagements, tabs, locks, etc.). In some embodiments, the glenosphere 100 can be configured to include one or more engagement features that are sized, configured or designed to engage with corresponding engagement features of a corresponding plate with which the glenosphere is to be coupled.

[0069] In some embodiments, the glenosphere 100 acts as a ball in a ball-and-socket joint between a humerus (not shown) and the shoulder bone. By augmenting the fixation of the glenosphere to the shoulder bone, the present solution can improve the effectiveness of a shoulder prosthesis for a patient, including improving the patient's ability to use their humerus. For example, augmenting the fixation of the glenosphere 100 to the shoulder bone can facilitate orienting the glenosphere 100 in an anatomic orientation, allowing a patient to use their humerus in an anatomic or natural range of motion.

[0070] In some embodiments, the glenosphere 100 and plate 200 are provided in a surgical kit or otherwise paired together, such as for being secured to the portion 10 of the shoulder bone in a single procedure. In some embodiments, the plate 200 has already been secured to the portion 10, and the glenosphere 100 is designed to complement the plate 200, to augment fixation of the plate 200, to replace an existing shoulder prosthesis component (e.g., an existing glenosphere), etc. The glenosphere 100 can be customized or otherwise designed to match a particular plate 200. The glenosphere 100 can have broad or universal compatibility with various plates 200.

[0071] In some embodiments, the glenosphere 100 is customized or otherwise designed for compatibility with a particular patient. For example, a model of the glenosphere 100 can be generated based on information regarding the shoulder of a patient, such as imaging data (e.g., MRI data, etc.) and/or based on information regarding the plate 200. The information can indicate target locations on the portion 10 for securing the glenosphere 100 to the portion 10. For example, the information can include target locations on a surface of the portion 10 through which fixation members will be driven to secure the glenosphere 100 to the portion 10. The information can indicate an interference space of the plate 200. The information can indicate locations on the portion 10 where bone loss has occurred or may occur, such as for avoiding these locations when securing the glenosphere 100 to the portion 10. For example, based on information regarding the shoulder of the patient and/or the plate 200, the glenosphere 100 can be manufactured such that fixation members used to secure the glenosphere 100 to the portion 10 are positioned outside of the interference space of the plate 200 and enter the portion 10 at locations that are stable with regards to bone loss. In some embodiments, this can be achieved by orienting a plurality of channels of the glenosphere 100 in which the fixation members are received. When the plate 200 is received in the glenosphere 100 and the fixation members are received in the plurality of channels, the fixation members pass through the channels, outside of the interference space, and can enter the portion 10 at locations outside of the interference space.

[0072] Referring to FIG. 2, a detailed perspective view of the glenosphere 100 and plate 200 when the plate 200 is received in the glenosphere 100 is shown. The glenosphere 100 includes a body 104. The body defines a central axis 108. The body 104 can include a variety of shapes. For example, in various embodiments, the body 104 can include a spherical shape, a substantially cylindrical shape, or any other shape allowing the glenosphere 100 to act as part of a shoulder prosthesis. The body 104 can be formed of a variety of materials, including bio-compatible materials, such as a metal, alloy, or ceramic material.

[0073] The central axis 108 of the glenosphere 100 generally defines an axis transverse to which the plate 200 is received in the glenosphere 100 (e.g., when the glenosphere 100 is positioned such that the glenosphere 100 contacts the plate 200, the plate 200 is at least partially positioned within a feature of the glenosphere 100 such as cavity 128 shown in FIGS. 3-6, etc.). For example, the glenosphere 100 may include receiving surface or an engagement member, such as an engagement member that allows for a Morse taper between the glenosphere 100 and the plate 200 that extends from the glenosphere 100 in a direction parallel or substantially

parallel to the central axis 108. The central axis 108 can pass through a center or close to a center or central plane of the glenosphere 100.

[0074] The glenosphere 100 includes a first surface 112 including a first rim 116 and a second rim 120. The first rim 116 is positioned radially outward from the second rim 120, such as by being radially outward relative to the central axis 108 and/or where the central axis 108 intersects the first surface 112. In some embodiments, the first surface 112 includes material configured to contact the portion 10 of the shoulder bone. For example, the first surface 112 can include a textured surface configured to engage the portion 10 to couple the glenosphere 100 to the portion 10.

[0075] The glenosphere 100 includes a second surface 124. The second surface 124 extends from the first rim 116 of the first surface 112. For example, as shown in FIG. 2, each of the first rim 116 and the second surface 124 include an arcuate shape, such that an edge of the second surface 124 follows the arcuate shape of the first rim 116.

[0076] The second surface 124 has a convex shape. The convex shape of the second surface 124 allows the second surface 124 to engage other portions of a shoulder prosthesis system, such as a joint attached to a humerus bone (not shown). For example, the convex shape of the second surface 124 can provide the glenosphere 100 with a spherical or substantially spherical shape, in order to act as a ball in a ball-and-joint prosthesis system such that the joint can articulate about the second surface 124.

[0077] In some embodiments, as shown, e.g., in FIGS. 2-8, the glenosphere 100 can have a shape that is greater than or equal to a hemispherical shape. For example, the glenosphere 100 occupies a greater volume than to a hemisphere defined by radii extending from a center of the glenosphere 100 (the center can be defined by a point at which radii of the glenosphere 100 intersect, at which radii of a full sphere superimposed on the glenosphere 100 would intersect, etc.). By having a shape that is greater than or equal to a hemispherical shape, the glenosphere 100 can be configured to contact the baseplate 200 further away from the portion 10, providing greater clearance for the glenosphere 100 relative to the shoulder bone when the glenosphere 100 is fixated to the portion 10, and can otherwise improve the kinematics of the glenosphere 100 for the patient.

[0078] In some embodiments, as shown, e.g., in FIG. 3, the central axis 108 is located or shifted towards an outer portion of the glenosphere 100 (e.g., towards the second surface 124, away from a plurality of channels 160 as shown in FIG. 3 and described herein) relative to an axis that would pass through the center of the glenosphere 100 (e.g., the central axis 108 is positioned between an axis that would pass through the center of the glenosphere 100 and an

axis that would be tangential to the second surface 124). By having the central axis 108 located towards the outer portion of the glenosphere 100, the glenosphere 100 can have improved kinematics for the patient.

**[0079]** The glenosphere 100 can be configured to receive one or more glenosphere fixation members 140. The glenosphere fixation members 140 are configured to secure the glenosphere 100 to the portion 10 of the shoulder bone. The glenosphere fixation members 140 are configured to be positioned outside an interference space of the plate 200. The glenosphere fixation members 140 can include engagement features (e.g., threads on an outer surface of the glenosphere fixation members 140) or other elements allowing the glenosphere fixation members 140 to be driven through the portion 10 to be frictionally secured in the shoulder bone. The glenosphere fixation members 140 can include a variety of components, including fasteners, screws (e.g., compression screws, tapered screws), bolts, etc.

**[0080]** The glenosphere 100 includes a plurality of channels 160. The plurality of channels 160 extend from the first surface 112 through the body 104 to the second surface 124. Each channel 160 defines a first opening (e.g., first opening 164 shown in FIG. 3) positioned on the first surface 112, and a second opening 168 positioned on the second surface 124. The plurality of channels 160 allow for a corresponding plurality of glenosphere fixation members 140 to be received through the plurality of channels 160. The channels 160 can be configured to receive corresponding glenosphere fixation members 140 such that the glenosphere fixation members 140 can be attachable to portions of bone that are different from portions of bone at which attachment fixation members that secure an attachment structure (e.g., the plate 200) to the bone are attached to the bone.

**[0081]** In various embodiments, the glenosphere 100 can include various numbers of channels 160 (e.g. 1, 2, 3, 4, 5, etc.). One or more of the plurality of channels 160 can be configured to receive a glenosphere fixation member 140. For example, one or more of the plurality of channels 160 can include engagement receiving features (e.g., slots, threads located on the surface of channels 160 extending from channels 160, etc.) configured to reciprocally engage engagement features of the glenosphere fixation members 140.

**[0082]** In some embodiments, fewer glenosphere fixation members 140 are received in the channels 160 than the number of channels 160. For example, the glenosphere 100 can include four channels 160 configured to receive glenosphere fixation members 140. Depending on factors including the positions at which plate fixation members 208 attach the plate 200 to the bone, the shape of the interference space defined by the plate 200 (or other components such as the bone engagement member 204, the plate fixation members 208, etc.), and/or the

condition of a surface of the portion 10 (e.g., a susceptibility to glenoid bone loss), three glenosphere fixation members 140 can be received in three of the four channels 160 such that the glenosphere fixation members 140 pass outside of the interference space to enter the portion 10 of the shoulder bone. Other such combinations of glenosphere fixation members 140 and channels 160 may be used.

**[0083]** In some embodiments, target locations on the portion 10 of the shoulder bone at which glenosphere fixation members 140 are to be secured to the portion 10 are determined based on at least one of imaging data of the portion 10 and a bone loss model of the portion 10. The glenosphere 100 can be configured or designed (e.g., designed in a custom design process to match a particular portion 10 and/or plate 200) and manufactured so that glenosphere fixation members 140 received through the channels 160 can be secured to the portion 10 at the target locations. The glenosphere 100 can be oriented (e.g., positioned and/or rotated) so that glenosphere fixation members 140 received through the channels 160 can be secured to the portion 10 at the target locations. The glenosphere 100 can be configured such that the channels 160 have channel axes 172 that do not intersect plate fixation members 208 received in the plate 200 based on a geometry of the plate 200 and the plate fixation members 208.

**[0084]** In some embodiments, the channels 160 are tapered (e.g., a cross-sectional area of a channel 160 changes from first opening 164 to second opening 168). For example, the channels 160 can be tapered to decrease in cross-sectional area from the second opening 168 to the first opening 164, which can facilitate orienting the glenosphere 100 by using the first opening 164 as a focus point, and which can improve the frictional fit between the channel 160 and a glenosphere fixation member 140.

**[0085]** The plate 200 can include a bone engagement member 204. The bone engagement member 204 extends from the plate 200. In some embodiments, the bone engagement member 204 extends along the central axis of the glenosphere 100 when the plate 200 is received in the glenosphere 100. In some embodiments, the bone engagement member 204 is offset and/or skew relative to the central axis of the glenosphere 100 when the plate is received in the glenosphere 100. In some embodiments, the bone engagement member 204 is integrally formed with the plate 200. In other embodiments, the bone engagement member 204 can be separate from the plate 200 and received in an opening of the plate 200.

**[0086]** The bone engagement member 204 can be configured to secure the plate 200 to the portion 10 of the shoulder bone. The bone engagement member 204 can include engagement features (e.g., threads located on an outer surface of the bone engagement member 204) or

other elements allowing the bone engagement member 204 to be driven through a surface of the portion 10 to be frictionally secured in the shoulder bone.

[0087] The plate 200 can be configured to receive plate fixation members 208. The plate fixation members 208 can be similar or identical to the glenosphere fixation members 140. The plate fixation members 208 can extend in a direction parallel to the bone engagement member 204 from the plate 200. The plate fixation members 208 can extend in directions that are offset and/or skew relative to the bone engagement member 204. In some embodiments, the plate fixation members 208 are oriented at an offset angle relative to the central axis 108 when the plate 200 is received in the cavity 128 of the glenosphere 100. In various embodiments, the plate 200 can be configured to receive various numbers of plate fixation members 208 (e.g. 1, 2, 3, 4, 5, etc.).

[0088] In some embodiments, the plate fixation members 208 and glenosphere fixation members 140 can include engagement features having opposite directions (e.g., threads located on outer surfaces of the plate fixation members 208 and glenosphere fixation members 140 having opposite threadforms), such that forces applied to the plate 200 and the glenosphere 100 can be distributed via the plate 200 or the glenosphere 100 depending on the direction of the forces.

[0089] In some embodiments, the plate 200 can define an interference space. The interference space indicates a region in space in which fixation members used to secure the glenosphere 100 to the portion 10 (e.g., glenosphere fixation members 140), do not pass through. As such, the glenosphere 100 can be oriented so that the glenosphere 100 does not interfere with the fixation of the plate 200 to the portion 10. Instead, the fixation of the glenosphere 100 to the portion 10 is augmented by the glenosphere fixation members 140, which strengthens the connection between the plate 200 and glenosphere 100 to the portion 10, helping to mitigate bone loss damage. In some embodiments, the interference space extends to a surface of the portion 10. In some embodiments, such as if a plate is formed as a plurality of plates, the interference space can include a plurality of regions, such as a plurality of discrete and/or overlapping regions corresponding to one or more of the plurality of plates.

[0090] In some embodiments, the plate fixation members 208 of the plate 200 can define the interference space. For example, the interference space can include a volume occupied by the plate fixation members 208, such as a volume exactly occupied by the plate fixation members 208, a volume substantially occupied by the plate fixation members 208, a volume exactly occupied by the plate fixation members 208 supplemented by a boundary region (e.g., a boundary region consisting of a volume of space extending outward from the plate fixation



members 208, such as by a fractional distance relative to a dimension of the plate fixation members 208), etc. The interference space can also be at least partially defined by the bone engagement member 204 of the plate 200. In some embodiments, the interference space can be a volume or region within the bone to which the plate 200 is coupled that is occupied by the plate fixation members

**[0091]** In some embodiments, the interference space is defined to include at least a portion of an interior volume between the plate fixation members 208, such that the glenosphere 100 can be oriented such that any glenosphere fixation members 140 are positioned outside of multiple plate fixation members 208. In other embodiments, the interference space is defined to exclude at least a portion of an interior volume between the plate fixation members 208, such that the glenosphere 100 can be oriented such that at least one glenosphere fixation member 140 can be positioned at least partially between at least two plate fixation members 208.

**[0092]** Referring now to FIGS. 3-6, the glenosphere 100 is shown isolated from the plate 200 and any fixation members. The glenosphere 100 includes a cavity 128. The cavity 128 extends into the body from the first surface 112. The cavity is defined by a cavity wall 132 that extends from the second rim 120 of the first surface 112 in a direction substantially parallel to the central axis 108 to a cavity surface 136, and by the cavity surface 136.

**[0093]** The cavity 128 is configured to receive the plate 200 such that the cavity surface 136 contacts a surface of the plate 200 (e.g., second plate surface 216 shown in FIG. 10, etc.). For example, the cavity 128 can include a shape that matches at least a part of a shape of the second plate surface 216 of the plate 200. The cavity 128 can include a circumference that corresponds to a circumference of the plate surface 216. As shown in FIGS. 3 and 6, the cavity 128 includes a generally circular shape configured to match a shape of the plate 200, such that the cavity wall 132 can engage an outer edge of the plate 200.

**[0094]** As shown in FIG. 3, the cavity 128 is positioned such that the central axis 108 defined by the body 104 passes through the cavity 128 transverse (e.g., perpendicular) to the cavity surface 136. As such, the plate 200 may be received in the cavity 128 such that a bone engagement member of the plate 200 is positioned along the central axis 108.

**[0095]** In some embodiments, the cavity surface 136 of the cavity 128 includes frictional elements configured to frictionally engage the second plate surface 216 of the plate 200. For example, the cavity surface 136 can include a textured surface that enhances frictional engagement between the cavity 128 and the plate 200. The frictional engagement between the surfaces can help distribute forces applied to the glenosphere 100 to the plate 200 in order to

distribute the forces transferred to the portion 10 of the shoulder bone. In some embodiments, the cavity 128 includes locking elements (e.g., hooks, latches, flanges, etc.) configured to engage a corresponding locking element (e.g., hooks, latches, flanges, etc.) of the plate 200. For example, orienting the glenosphere 100 so that the cavity 128 receives the plate 200 can include aligning the locking elements and pressing together the glenosphere 100 to the plate 200 or rotating the glenosphere 100 relative to the plate 200 to lock the glenosphere 100 to the plate 200.

[0096] In some embodiments, the first surface 112 includes a first region 176 substantially perpendicular to the central axis 108 and a second region 180 disposed at an angle to the first region 176. For example, the second region 180 can form an obtuse angle with the first region 176. A length of the cavity wall 132 between the cavity surface 136 and the first surface 112 can increase continuously between the first region 176 and the second region 180, such that the cavity surface 136 maintains a flat or planar shape adjacent to both the first region 176 and the second region 180. A first portion of the cavity wall 132 extends from a portion of the second rim 120 adjacent to the first region 176, and a second portion of the cavity wall 132 extends from a second portion of the second rim 120 adjacent to the second region 180.

[0097] In some embodiments, one or more of the first openings 164 of the plurality of channels 160 are positioned on the second region 180. As shown in FIG. 3, each of the first openings 164 of the plurality of channels 160 are positioned on the second region 180. Positioning the first openings 164 on the second region 180 can facilitate orienting the glenosphere 100 such that glenosphere fixation members (e.g., glenosphere fixation members 140 shown in FIG. 2, etc.) can be positioned to pass through the plurality of channels 160 outside of an interference space defined by the plate 200. In some embodiments, at least one of the first openings 164 is positioned on the first region 176 so as to orient at least one glenosphere fixation member 140 at an angle to other glenosphere fixation members 140.

[0098] The plurality of channels 160 define a plurality of channel axes 172 passing through the plurality of channels 160. As shown in FIG. 3, the channel axes 172 are positioned perpendicular to the first surface 112. The plurality of channels extend from a first opening 164 on the first surface 112 to a second opening 168 on the second surface 124. As shown in FIGS. 3-6, the channel axes 172 can be oriented parallel to one another. In various embodiments, the orientation of the plurality of channels 160 and thus of the channel axes can be varied in order to alter the direction that glenosphere fixation members 140 passing through the plurality of channel axes 172 extend. For example, while FIG. 3 shows the channels 160 oriented perpendicular to the first surface 112 (e.g., the channels axes 172 are perpendicular to

the first surface 112), in other embodiments, the channels 160 can be oriented at an acute angle to the first surface 112. For example, orienting a channel 160 at an acute angle to the first surface 112, so that a distance between the channel axis 172 of the channel 160 and the central axis 108 decreases as the axes 108, 172 extend away from the glenosphere 100 (e.g., extend towards the portion 10 of the shoulder bone, extend in a direction substantially perpendicular to first surface 112 or second surface 116, etc.), allows the glenosphere fixation members 140 to be secured to the portion 10 at locations that are relatively close to where the plate 200 is secured to the portion 10, which can reduce the surface area of the portion 10 required for the shoulder prosthesis. In another example, orienting a channel 160 at an acute angle to the first surface 112, so that a distance between the channel axis 172 of the channel 160 and the central axis 108 increases as the axes 108, 172 extend away from the glenosphere 100 (e.g., extend towards the portion 10 of the shoulder bone, extend in a direction substantially perpendicular to first surface 112 or second surface 116, etc.), allows the glenosphere fixation members 140 to be secured to the portion 10 at locations that are relatively close to where the plate 200 is secured to the portion 10, which can reduce the stress on the surface of portion 10 required for the shoulder prosthesis. In some embodiments, at least one the plurality of channels 160 is oriented perpendicular to the first surface 112, and at least one of the plurality of channels 160 is oriented at an acute angle to the first surface 112.

**[0099]** In embodiments in which the glenosphere 100 includes a first surface 112 having a first region 176 and a second region 180 disposed at an angle to the first region 176, the channel axes 172, which are perpendicular to the first surface 112 and the second region 180, are oriented at an angle to the central axis 108. For example, if the second region 180 is disposed at an obtuse angle relative to the first region 176, the channel axes 172 will be oriented at an acute angle relative to the central axis 108. In this manner, the glenosphere fixation members 140 received through the plurality of channels 160 and positioned along the channel axes 172 can be positioned outside of the interference space of the plate 200 yet engage a portion of the portion 10 proximate to where plate engagement members of the plate engage the portion 10.

**[0100]** Referring further to FIGS. 3 and 6, in some embodiments, the cavity 128 includes an inner cavity portion 184. The inner cavity portion 184 can include a second cavity wall 186 and a second cavity surface 188. The inner cavity portion 184 can be configured to receive a component extending from a surface of a plate (e.g., plate 200). For example, the inner cavity portion 184 can act as an engagement member for engaging a corresponding engagement member of the plate 200 (e.g., engagement member 236 as shown in FIG. 11, etc.). For example, the inner cavity portion 184 can be or include a first engagement member configured

to engage a second engagement member 236 of the plate 200. In some embodiments, the inner cavity portion 184 is configured to form a Morse taper with the engagement member 236 of the plate 200. In some embodiments, the inner cavity portion 184 and engagement member 236 include complementary engagement elements (e.g., hooks, latches, flanges, threaded couplings, etc.) for securing the glenosphere 100 to the plate 200.

**[0101]** Referring now to FIGS. 7-9, the glenosphere 100 and plate 200 are shown in various configurations with fixation members. In FIG. 7, an end view of the glenosphere 100 and plate 200 with fixation members is shown. The plurality of glenosphere fixation members 140 are received in the plurality of channels 160 of the glenosphere 100. The plurality of plate fixation members 208 extend from the plate 200. In FIG. 8, a perspective view of the glenosphere 100 with glenosphere fixation members 140 is shown. In FIG. 9, a perspective view of the plate 200 with plate fixation members 208 is shown.

**[0102]** In FIG. 7, the glenosphere 100 and plate 200 are shown looking down the central axis (e.g., central axis 108 shown in FIG. 8) of the glenosphere 100, and the bone engagement member 204 of the plate 200 is oriented along the central axis 108. In other words, an axis of the bone engagement member 204 and the plate 200 is coaxial with the central axis 108 of the glenosphere 100. As further shown in FIG. 7, the plurality of plate fixation members 208 are oriented in the same direction as the bone engagement member 204, such that they are parallel to and offset from the central axis 108 and the bone engagement member 204.

**[0103]** The plurality of glenosphere fixation members 140 can extend at an angle relative to the central axis 108 and the bone engagement member 204 and plate fixation members 208. For example, as shown in FIGS. 7 and 8, the first surface 112 of the glenosphere 100 includes a first region 176 and a second region 180 oriented at an obtuse angle relative to the first region 176. The plurality of first openings 164 of the plurality of channels 160 are positioned in the second region 180 of the first surface 112, such that the plurality of glenosphere fixation members 140 extend out from the glenosphere 100 at an angle to the central axis 108, and thus at an angle relative to components extending from the plate 200 when the plate 200 is received in the glenosphere 100. The glenosphere fixation members 140 are configured to extend out of the first openings 164, past an interference space of the plate 200 when the plate 200 is received in the glenosphere 100, to secure the glenosphere 100 to the portion 10 of the shoulder bone.

**[0104]** Referring further to FIG. 9, the plate fixation members 208 extend from the plate 200 in the same direction as the bone engagement member 204. The plate fixation members 208 can have a variety of lengths. For example, the plate fixation members 208 can have a similar

length to the bone engagement member 204, such as by having a length that is slightly less than the length of the bone engagement member 204. The length of the plate fixation members 208 can be selected based on imaging data indicating compatibility of the portion 10 of the shoulder bone for receiving an engagement member.

**[0105]** Referring now to FIGS. 10-12, the plate 200 is shown isolated from the glenosphere 100 and any fixation members. The plate 200 includes a first plate surface 212 on a side of the plate 200 from which the bone engagement member 204 extends, and a second plate surface 216 on an opposite side of the plate 200 from the first plate surface 212. A plate body 220 is disposed between the first plate surface 212 and the second plate surface 216. The plate body 220 includes a plate wall 224 along an outer portion (e.g., circumference) of the plate body 220. In some embodiments, the plate body 220 and plate wall 224 are configured to be received in a cavity of a glenosphere such that the plate wall 224 is positioned flush against the a wall of the cavity (e.g., cavity 128, cavity wall 132 of glenosphere 100 as shown in FIG. 3, etc.). The second plate surface 216 of the plate 200 can be positioned flush against a surface of the cavity 128 (e.g., cavity surface 136 as shown in FIG. 3, etc.).

**[0106]** The plate 200 includes a plurality of plate channels 228. Each plate channel 228 extends from an opening on the first surface 212 to an opening on the second plate surface 216. The plurality of plate channels 228 are configured to receive the plurality of plate fixation members (e.g., plate fixation members 208 shown in FIG. 9, etc.). The plurality of plate channels 228 can include engagement receiving surfaces (e.g., threaded surfaces) configured to receive and engage with engagement features (e.g., threads) of the plate fixation members 208 in order to frictionally couple the plate 200 to the plate fixation members 208 as the plate 200 is secured to the portion 10 of the shoulder bone. The plurality of plate channels 228 can be oriented transverse (e.g., perpendicular) to a plate axis 232 along with the bone engagement member 204 is oriented, such that the plate fixation members 208 can be oriented parallel to the bone engagement member 204 when the plate fixation members are received through the plurality of plate channels 228. In various embodiments, the plurality of plate channels 228 can be oriented at various angles relative to the plate axis 232, and can be oriented at heterogeneous angles relative to one another. For example, each of the plurality of plate channels 228 can be oriented at an angle offset to the plate axis 232. Each of the plurality of plate channels 228 can be oriented at an angle offset to the central axis 108 when the plate 200 is received in the cavity 128 of the glenosphere 100.

[0107] As shown in FIGS. 10-12, the bone engagement member 204 is integrally formed with the plate 200. In some embodiments, the plate 200 can include a receiving surface configured to receive the bone engagement member 204.

[0108] In some embodiments, as shown in FIGS. 11 and 12, the plate 200 includes an engagement member 236 configured to engage the plate 200 to a glenosphere 100 such that the plate 200 can be secured and received in a cavity of the glenosphere 100 (e.g., by engaging inner cavity portion 184 of cavity 128 of glenosphere 100 as shown in FIG. 6, etc.). For example, the glenosphere 100 and plate 200 can be secured to one another by engaging the engagement member 236 and the cavity 128 (e.g., by forming a Morse taper between the inner cavity portion 184 of the cavity 128 and the engagement member 236). The engagement member 236 can extend from the second plate surface 216 of the plate 200 in an opposite direction as the bone engagement member 204. For example, the engagement member 236 can be oriented along the plate axis 232 such that the bone engagement member 204 and the engagement member 236 are coaxial with a central axis (e.g., central axis 108 shown in FIG. 3, etc.) of the glenosphere 100 when the plate 200 is received in the glenosphere 100.

[0109] In some embodiments, the plurality of channels 160 include markings configured to facilitate orienting the glenosphere 100 when receiving the plate 200 such that glenosphere fixation members 140 passed through the glenosphere 100 will be positioned outside of the interference space. For example, the markings can be positioned parallel to the channel axes 172 passing through the channels 160, such that a line of sight following the markings can indicate an intersection with the interference space of the plate 200. The markings can include fluorescent material or other material configured to visually aid orientation of the glenosphere 100.

[0110] In some embodiments, channel guides having similar form factors to the plurality of glenosphere fixation members 140 can be used to facilitate orienting the glenosphere 100. For example, the guides can be inserted through the plurality of channels 160 in a similar manner as the glenosphere fixation members 140, in order to determine whether the glenosphere fixation members 140 would intersect or pass outside of the interference space of the plate 200. The channel guides can be removably inserted in the plurality of channels 160 so as to facilitate quick orientation of the glenosphere 100 prior to securing of the glenosphere 100 using the glenosphere fixation members 140.

[0111] Referring now to FIG. 13, a block diagram of a method 400 of securing a glenosphere to a portion of a shoulder bone and to a plate fixated to the portion of the shoulder bone, such as a method that is performed as part of a shoulder arthroplasty, is shown. The method 400

can be implemented using any of the devices and systems disclosed herein, including the glenosphere 100 and plate 200 described with regards to FIGS. 1-12. A variety of actors can perform the method 400, including but not limited to a medical care professional (e.g., doctor, nurse), etc.

**[0112]** At 410, a glenosphere is positioned adjacent to a plate. The plate is fixated to a portion of a shoulder bone. The glenosphere includes a body defining a central axis passing through the body. The glenosphere includes a first surface including a first rim and a second rim, and a second surface extending from the first rim. The second surface has a convex shape. The glenosphere includes a cavity extending into the body from the first surface. The cavity is configured to receive the plate. The glenosphere includes a plurality of channels extending from the first surface through the body to the second surface. Each channel defines a first opening positioned on the first surface between the first rim and the second rim, defines a second opening positioned on the second surface, and defines a channel axis passing through the channel. Positioning the glenosphere can include holding the glenosphere adjacent to the plate, such as within a distance of the plate such that components of the plate are visible through the channels of the glenosphere. For example, a surgeon or other medical professional can position the glenosphere adjacent to the plate, so that the surgeon can manipulate the glenosphere in relation to the plate.

**[0113]** At 420, the glenosphere is oriented relative to the plate. For example, the glenosphere can be oriented such that a central axis of the glenosphere is coaxial with a plate axis of the plate. In some embodiments, the plate is already secured to the portion of the shoulder bone, and thus the glenosphere can be oriented relative to a fixed plate and fixed plate axis of the plate. The glenosphere can be oriented such that the glenosphere will be in an anatomic position, allowing for a natural range of motion when the shoulder arthroplasty is complete. In some embodiments, the glenosphere can be oriented off-axis or otherwise offset from an anatomic position, allowing for a different range of motion. For example, a surgeon or other medical professional can orient the glenosphere relative to the plate.

**[0114]** At 430, the channel axes of the glenosphere are positioned outside of an interference space of the plate. The interference space can be defined by plate fixation members and/or a bone engagement member of the plate. The interference space can include an exact volume of the plate fixation members and/or bone engagement member, or can include a volume lesser or greater than these components. Positioning the channel axes outside of the interference space facilitates positioning glenosphere fixation members such that the glenosphere fixation members do not collide with the plate fixation members or the bone engagement member. The

interference space can be determined visually, by using marking guides, or by a combination thereof. For example, a surgeon or other medical professional can determine an extent of the interference space, and position the glenosphere—and thus the channels axes which are fixed relative to the glenosphere—such that the channel axes are positioned outside of the interference space.

[0115] In some embodiments, positioning the channel axes includes positioning marking guides in the plurality of channels to align the plurality of channels. For example, the marking guides may indicate a direction of the channel axes. In some embodiments, positioning the channel axes includes removably receiving channel guides in the plurality of channels. The channel guides can include a form factor similar or identical to glenosphere fixation members. For example, the channel guides can be received in the plurality of channels in a similar orientation as the glenosphere fixation members would be received, and the orientation of the glenosphere can be adjusted until the channel guides (and thus the channel axes) are positioned outside of the interference space. For example, orienting the glenosphere can include receiving a plurality of channel guides in the plurality of channels and modifying the orientation of the glenosphere until each of the channel guides is positioned outside of the interference space. A surgeon or other medical professional can insert the channel guides through the plurality of channels and modify the orientation of the glenosphere based on whether each of the channel guides are positioned outside of the interference space.

[0116] In some embodiments, positioning the channel axes includes orienting the glenosphere such that the channel axes are positioned outside the interference space (e.g., the channel axes do not intersect the interference space). In some embodiments, positioning the channel axes includes orienting the glenosphere such that a volume about each respective channel axis is positioned outside of the interference space (e.g., a volume about each respective channel axis does not intersect the interference space). The volume about each respective channel axis can be an extrapolation of the respective channels, such as a cylindrical volume extending from the openings of the channels.

[0117] In some embodiments, positioning the channel axes includes positioning the channel axes based on an offset between a first position of the glenosphere before the plate is received in the glenosphere, and a second position of the glenosphere after the plate is received in the glenosphere. For example, in the first position, the glenosphere may be positioned and oriented such that the channel axes intersect the interference space, yet as the plate is received in the glenosphere (such as by decreasing a distance between the glenosphere and the plate by moving the glenosphere towards the portion of the shoulder bone and the plate along the plate axis of



the plate), the channel axes become positioned outside of the interference space. In some embodiments, channel guides are used that have a shape and a guide length that is offset relative to a length of a glenosphere fixation member, such as an offset based on a dimension of the cavity of the glenosphere, such that the channel guides match the position of the channel axes when the plate is received in the cavity of the glenosphere.

[0118] In some embodiments, orienting the glenosphere includes orienting the channels such that the glenosphere fixation members received in the channels are attached to a portion of the bone that is different from a portion of the bone at which plate fixation members are attached to the bone. In some embodiments, the interference space is defined by regions of the bone occupied by the plate fixation members to reduce failure of the attachment of the plate to the bone.

[0119] At 440, the plate is received into the cavity of the glenosphere. For example, the glenosphere can be pressed against the plate such that the plate fits into the cavity. The channel axes will continue to be positioned outside of the interference space of the plate. In some embodiments, receiving the plate includes engaging a first engagement member of the glenosphere with a second engagement member of the plate, such as for forming a Morse taper between the glenosphere and the plate. In some embodiments, a cavity wall of the cavity is configured to be positioned flush against a plate wall of the plate, and a cavity surface of the cavity is configured to be positioned flush against a surface of the plate when the plate is received in the cavity. For example, a surgeon, having positioned and oriented the glenosphere such that the central axis of the glenosphere is coaxial with the plate axis of the plate and the channel axes are positioned outside of the interference space, can shift the glenosphere towards the plate and the portion of the shoulder bone so that the plate fits into the cavity.

[0120] At 450, a plurality of glenosphere fixation members are received in the plurality of channels. Because the glenosphere has been oriented such that the channel axes (or volumes about the channel axes) are positioned outside of the interference space of the plate, the glenosphere fixation members when received in the plurality of channels will also be positioned outside of the interference space. A surgeon can place the glenosphere fixation members into the channels so that the glenosphere fixation members are positioned outside of the interference space, and so that the glenosphere fixation members contact the portion of the shoulder bone to which they will be secured.

[0121] At 460, the plurality of glenosphere fixation members are secured to the portion of the shoulder bone in order to augment fixation of the glenosphere to the portion of the shoulder bone. The glenosphere fixation members can include engagement features (e.g., threads or

other frictional elements) configured to engage the portion of the shoulder bone. Securing the glenosphere fixation members to the portion of the shoulder bone thus allows for forces transmitted through the glenosphere and plate to the portion of the shoulder bone to be transmitted to positions other than the positions where the bone engagement member and/or plate fixation members are secured to the portion of the shoulder bone, helping to distribute stresses on the portion of the shoulder bone and mitigate bone loss. For example, a surgeon can use a driver, drill, or other tool to drive the glenosphere fixation members into the portion of the shoulder bone to secure the glenosphere to the portion of the shoulder bone.

**[0122]** In some embodiments, the method includes positioning one or more of the plate and the glenosphere based on imaging data regarding the patient. The imaging data can identify preferred positions for the plate and/or glenosphere in order to provide the shoulder prosthesis system in an anatomic position, to mitigate bone loss or minimize the effects of bone loss, etc. The imaging data can indicate target positions for fixation members to be secured to the portion of the shoulder bone.

**[0123]** In some embodiments, a method of securing a glenosphere to a portion of a shoulder bone and to a plate fixed to the portion of the shoulder bone includes positioning the glenosphere adjacent to the plate. The glenosphere can include a body defining a central axis passing through the body, a first surface including a first rim and a second rim, a second surface extending from the first rim of the first surface, the second surface having a convex shape, a cavity extending into the body from the first surface, the cavity configured to receive the plate, and a plurality of channels extending from the first surface through the body to the second surface. Each channel can define a first opening positioned on the first surface between the first rim and the second rim. Each channel can define a second opening positioned on the second surface. Each channel can be configured to receive a bone fixation member configured to secure the glenosphere to the bone. The method can include orienting the glenosphere relative to the plate such that each glenosphere fixation member received by the channels is attachable to a portion of bone that is different from a portion of bone at which plate fixation members attach the plate to the bone. The method can include orienting the glenosphere relative to the plate such that each glenosphere fixation members received by the channels is attachable to a portion of bone outside of an interference space defined by regions of bone occupied by plate fixation members that attach the plate to the bone. The method can include receiving the plate into the cavity. The method can include receiving a plurality of glenosphere fixation members in the plurality of channels via the plurality of second openings such that the plurality of glenosphere fixation members are positioned outside of the interference space and

contact the portion of the shoulder bone. The method can include securing the plurality of glenosphere fixation members to the portion of the shoulder bone. In some embodiments, orienting the glenosphere includes receiving a plurality of channel guides in the plurality of channels and modifying the orientation of the glenosphere until each of the channel guides is positioned outside of the interference space.

**B. Further Embodiments of Glenospheres for Augmented Fixation and Related Methods**

**[0124]** Referring now to FIGS. 14-22, various embodiments of glenospheres for augmented fixation are illustrated. The glenospheres described with reference to FIGS. 14-22 can be similar to the glenosphere 100 described with references to FIGS. 1-13, and can be configured to engage or otherwise interact with various baseplates, including the plate 200 described with reference to FIGS. 1-13. While the hood feature and offset engagement axis for glenospheres is described herein with reference to FIGS. 14-22, the glenosphere 100 of FIGS. 1-13 can also include a hood or other extended structure (e.g., an hood located in or around the second region 180 of the glenosphere 100). In some embodiments, a glenosphere having a hood is kinematically advantageous for a patient with a shoulder prosthesis, as the hood provides an additional point of contact between the shoulder prosthesis and a shoulder bone to prevent rocking (e.g., unintended movement of the glenosphere, such as rotation in a coronal plane of a body of a patient) as the patient moves an arm connected to the shoulder by the glenosphere. In some embodiments, a glenosphere having an engagement axis that is offset or spaced from a center of the glenosphere can improve the kinematics of the glenosphere by increasing the effective surface area of the shoulder bone that can be engaged by the glenosphere (or the glenosphere together with the baseplate) without significantly increasing the form factor of the glenosphere. In some embodiments, such as where the glenosphere includes one or more channels for receiving glenosphere fixation members that attach the glenosphere to the shoulder bone, the offset engagement axis and hood may cooperate to provide greater freedom in selecting the orientation of the channels and thus the portions of the shoulder bone at which the shoulder prosthesis is fixated.

**[0125]** Referring now to FIGS. 14-15, a glenosphere 500 is shown. The glenosphere 500 can be similar in structure and function to various glenospheres described herein (e.g., glenosphere 100). The glenosphere 500 includes a body 504 defining a center 506 and an engagement axis 508 passing through the body 504. The glenosphere 500 includes a first surface 512 including a first rim 516 and a second rim 520, the first rim 516 positioned radially outward from the second rim 520.

[0126] The glenosphere 500 also includes a second surface 524 extending from the first rim 516 of the first surface 512. The second surface 524 can have a convex shape. The second surface 524 can have a spherical shape (e.g., all or substantially all points on the second surface are equidistant from a center point, such as a center of the glenosphere 500). The second surface 524 and first surface 512 can extend from each other along an edge between the first surface 512 and the second surface 524, the edge defining a closed path about the body 504. Unlike the second surface 124 of the glenosphere 100, the second surface 524 has a continuous shape (e.g., the second surface 524 is not interrupted by openings), as the glenosphere 500 does not include a plurality of channels for receiving fixation members for attaching the glenosphere 500 to the shoulder bone; instead, by coupling to a plate (e.g., plate 200), the glenosphere 500 is attached to the shoulder bone.

[0127] The center 506 can be defined based on the second surface 524. For example, the center 506 can be a point that is equidistant from every point of the second surface 524, or a point that is equidistant from the most points on the second surface 524. In some embodiments, where a humeral component (not shown) is configured to articulate about the second surface 524, the center 506 will thus be a center for movement of the humeral component.

[0128] Similar to the central axis 108 of the glenosphere 100, the engagement axis can be an axis transverse to which a plate (e.g., plate 200) is received in the glenosphere 500 (e.g., transverse to cavity surface 532 as described below). In embodiments where the plate includes a bone engagement member (e.g., bone engagement member 204) that is centrally oriented on the plate, the bone engagement member will align with the engagement axis 508.

[0129] In some embodiments, the first surface 512 includes a base surface portion 576 and a hood surface portion 580. The hood surface portion 580 extends from the base surface portion 576. For example, as shown in FIG. 14, the hood surface portion 580 is continuous with the base surface portion 576. A plane 510 can be defined by or include the base surface portion 576. For example, as shown in FIGS. 14-15, the base surface portion 576 is substantially planar (e.g., any set of three points selected on the base surface portion 576 can define the same plane 510). As shown in FIG. 15, the hood surface portion 580 can be oriented at an acute angle  $\alpha$  relative to the plane 510, and/or at an obtuse angle  $\beta$  relative to the base surface portion 576. The glenosphere 500 includes a hood portion 582 between the hood surface portion 580 and the plane 510. As shown in FIG. 15, the hood surface portion 580 is substantially planar (e.g., any set of three points selected on the hood surface portion 580 can define the same plane, that plane being oriented at the angle  $\alpha$  relative to the plane 510). In some embodiments, the hood portion 582 is on an opposite side of the center 506 from the engagement axis 508. In some

embodiments, the hood portion 582 is angled (e.g., angled relative to another portion of the body 504, such as by having the hood surface portion 580 oriented at an acute angle  $\alpha$  relative to the plane 510, and/or at an obtuse angle  $\beta$  relative to the base surface portion 576).

[0130] The glenosphere 500 includes a cavity 528. The cavity 528 is configured to receive an attachment structure attachable to a bone (e.g., a plate such as plate 200). The cavity 528 is defined within the body 504. The cavity includes a perimeter defined by the second rim 520. The cavity can include a first cavity portion (e.g., a first cavity portion including a cavity wall 532 and a cavity surface 536), and a second cavity portion (e.g., inner cavity portion 584). The first cavity portion can be configured to engage with an attachment structure attachable to the shoulder bone (e.g., the plate 200). In some embodiments, rather than a cavity defined within the body 504 or recessed from the first surface 512, the glenosphere includes a plate receiver portion of the first surface 512 configured to receive and attach to the plate 200 (e.g., the plate receiver portion can be or include an engagement feature configured to couple to an engagement member of the plate 200).

[0131] The inner cavity portion can define an inner cavity surface 586. In some embodiments, the inner cavity surface 586 tapers (e.g., decreases in radius) from a first end at the cavity surface 536 to a second end at a second surface rim 588 defined on the second surface 524. In some embodiments, an inner body surface 590 is defined in the body 504 and extends between the second surface rim 588 and the inner cavity surface 586. In some embodiments, the inner cavity portion 584 is configured to or shaped and sized to engage an engagement member of the attachment structure (e.g., to engage second engagement member 236 of plate 200). As shown in FIG. 14, the inner cavity portion 584 can be oriented along the engagement axis 508 (e.g., a plane perpendicular to the inner cavity surface 586 is also perpendicular to the engagement axis 508). In some embodiments, the cavity 528 (e.g., the cavity wall 532 and/or the inner cavity surface 586) has a cylindrical or tapered cylindrical (e.g., frustum-like) shape.

[0132] In some embodiments, the base surface portion 576 and/or the hood surface portion 580 may have non-planar shapes (e.g., curved, concave, etc.). In such embodiments, the hood portion 582 may be defined as a portion of the body 504 between the hood surface portion 580 and the plane 510, or between the hood surface portion 580 and a plane that (1) passes through (or includes) a point (or an arc segment) where the first surface 512 intersects the second surface 524, and (2) is parallel to the cavity surface 536, is perpendicular to the cavity wall 532, and/or is parallel to at least a portion of an intersection of the cavity surface 536 and the cavity wall 532. The hood portion 582 may thus extend towards a shoulder bone relative to the base surface portion 576, with an end of the hood portion 582 that is furthest from the base

surface portion 576 being closest to the shoulder bone, when a plate is received in the glenosphere 500 and the glenosphere 500 and plate are attached to the shoulder bone.

[0133] In some embodiments, the base surface portion 576 and the hood surface portion 580 can form a single, substantially planar or planar surface (rather than the hood surface portion 580 being at an angle to the base surface portion 576). If the cavity 528 is recessed from the base surface portion 576, then the hood portion 582 can be defined as a portion of the body 504 between (1) a plane transverse to the cavity, such as that is tangent to the cavity wall 532 at the farthest point along the cavity wall 532 from where the cavity wall 532 is closest to the second surface 524, and (2) a plane that includes at least some points on the cavity surface 536.

[0134] The engagement axis 508 can be an axis perpendicular to a surface against which the plate is received (e.g., cavity surface 532), or an axis perpendicular to the most points on the surface (e.g., cavity surface 532). The engagement axis 508 can pass through a channel defined by the inner cavity surface 586, and/or can be defined to be equidistant from all (or the most) points on the inner cavity surface 586.

[0135] In some embodiments, such as shown in FIG. 15, the center 506 is spaced by an offset 507 from the engagement axis 508. The offset 507 increases a distance between the hood surface portion 580 and the engagement axis 508, and thus may increase a distance between the hood surface portion 580 and a plate received by the glenosphere 500 (e.g., received in cavity 528). In some embodiments, the spacing caused by the offset 507 allows the hood surface portion 580 to engage portions of a shoulder bone that would not otherwise be accessible.

[0136] In some embodiments, the hood surface portion 580 includes a rough surface, or other surface configured to engage a shoulder bone. For example, the hood surface portion 580 can have a surface with a coefficient of friction that is greater than a coefficient of friction of the base surface portion. The rough surface can facilitate frictional engagement between the hood surface portion 580 and a first portion of the shoulder bone to prevent rocking of the glenosphere 500 when the glenosphere 500 is attached to a second portion of the shoulder bone (e.g., when the glenosphere 500 is coupled to the plate 200, the plate 200 being fixated to the second portion of the shoulder bone).

[0137] Referring now to FIGS. 16-18, a glenosphere 600 is illustrated. The glenosphere 600 can be similar in structure and function to various glenospheres described herein (e.g., glenosphere 500), with the exception of the cavity of the glenosphere 600 as described further below. The glenosphere 600 can be configured to attach to a plate 700. The plate 700 can be similar in structure and function to the plate 200. The plate 700 includes a plate body 704

having a first plate surface 708 on a same side as a bone fixation member 716, and a second plate surface 712 opposite the first plate surface 708. The plate 700 also includes an engagement feature 720. As shown in FIG. 17, the engagement feature 720 includes a recess (e.g., opening, channel).

**[0138]** As shown in FIGS. 16-18, the glenosphere 600 includes an engagement segment 684. The engagement segment 684 is shown to have a tapered cylinder shape (e.g., frustrum-like); in various embodiments, the engagement segment 684 can have various shapes, such as a non-tapered cylinder shape (e.g., the diameter of the engagement segment 684 is constant), a polygonal solid (e.g., rectangular solid), etc. The engagement segment 684 extends along the engagement axis 608. In some embodiments, the engagement segment 684 tapers from a first engagement end at which the engagement segment 684 intersects (or extends from) the cavity surface 636, to a second engagement end at which the engagement segment 684 terminates. The engagement segment 684 can be configured to engage (e.g., form a Morse taper, attach to, receive or be received in, couple) the engagement feature 720 of the plate 700.

**[0139]** In some embodiments, the engagement segment 684 includes an outer engagement surface 686. The outer engagement surface 686 can taper from a first end adjacent to the cavity surface 632 to a second end at which the outer engagement surface 686 terminates. In some embodiments, the engagement segment 684 (and/or the outer engagement surface 686) extends from the cavity surface 632 out to a plane that is parallel to the cavity surface 632 and tangent to a point on the glenosphere body 604 furthest from the cavity surface 632.

**[0140]** The glenosphere 600 can include a second surface 624 that is convex or spherical. The second surface 624 can define a second surface rim 688. The second surface rim 688 is located at the intersection of the second surface 624 and an inner body surface 690 defined within the body 604. In some embodiments, the inner body surface 690 is oriented parallel to and/or along the engagement axis 608. For example, when the glenosphere 600 receives the plate 700 in the cavity 628, such that the bone fixation member 716 and the engagement feature 720 are each oriented along the engagement axis 608, the inner body surface 690 will also be oriented along the engagement axis 608, such as for receiving a fastening member through the inner body surface 690 to engage (e.g., attach to) the engagement feature 720 through the inner body surface 690.

**[0141]** The inner body surface 690 can be configured to receive a fastening member 750. The fastening member 750 can be configured to secure the glenosphere 600 to the plate 700, such as by providing additional fixation to the fixation between the engagement segment 684 and the engagement feature 720. The inner body surface 690 can have a radius (e.g., a radius

defined from the engagement axis 608) that is greater than a maximum radius of the fastening member 750.

[0142] The engagement segment 684 can define an inner cavity surface 692. The inner cavity surface 692 can extend through an interior of the engagement segment 684. In some embodiments, the inner cavity surface 692 includes a first portion 694 extending from a terminal end of the inner cavity surface and a second portion 696 adjacent to the first portion 694.

[0143] In some embodiments, the second portion 696 is connected to the inner body surface 690. In some embodiments, the first portion 694 has a radius that is equal to or greater than a radius of threaded features 752 of the fastening member 750 (e.g., greater than by less than 10 percent, by less than 5 percent, by less than 2 percent), and the second portion 696 has a radius that is equal to or greater than a maximum radius of the fastening member 750 (e.g., greater than by less than 10 percent, by less than 5 percent, by less than 2 percent), such that the fastening member 750 can be inserted through the second surface rim 688 into the inner body surface 690 and received in the inner cavity surface 692, with the threaded features 752 aligning with the first portion 694.

[0144] In some embodiments, a continuous engagement opening (e.g., the opening is defined by one or more surfaces that are adjacent to at least one other of the surfaces of the opening) in which the fastening member 750 can be received and used to attach the glenosphere 600 to the plate 700 can be defined by the inner body surface 690 and the inner cavity surface 692.

[0145] Referring now to FIG. 19, a glenosphere 800 is illustrated. The glenosphere 800 can be similar to various glenospheres described herein (e.g., glenosphere 800), with the exception of the engagement segment of the glenosphere 800. The glenosphere 800 includes a body 804, a second surface 824, and a cavity 828 defined at least in part by a cavity surface 832 and a cavity wall 836. An engagement segment 884 extends along an engagement axis 808 from the cavity surface 832. The engagement segment 884 can taper from a first end at which the engagement segment 884 is adjacent to the cavity surface 832 to a second end opposite the first end. Unlike the engagement segment 684 of the glenosphere 600, the engagement segment 884 does not include an inner surface in which a fastening member can be received. In other words, engagement segment 884 is defined by an outer engagement surface 888 that extends from the cavity surface 832 to a transverse engagement surface 886. The transverse engagement surface 886 defines a continuous face (e.g., the transverse engagement surface 886 is solid, does not define an opening, etc.). In addition, unlike the glenosphere 600, the second



surface 924 is continuous (e.g., does not include an opening or rim such as second surface rim 688).

[0146] Referring now to FIGS. 20-22, a glenosphere 900 is illustrated. The glenosphere 900 can be similar to various glenospheres described herein, with the exception of the orientation of channels for receiving bone fixation members. The glenosphere 900 is shown for engagement with a plate 1000. The plate 1000 can be similar to various plates described herein (e.g., plate 200, plate 700). The plate 1000 includes a plate body 1004, a first plate surface 1008, and a bone engagement member 1016 extending from a same side of the plate body 1004 as the first plate surface 1008.

[0147] In some embodiments, the first plate surface 1008 includes engagement features (e.g., relatively rough features as shown in FIGS. 20-21) that facilitate bone growth, such as for augmenting fixation between the plate 1000 and a shoulder bone. The plate 1000 can receive plate fixation members 1050 through plate channels 1052.

[0148] The glenosphere 900 includes a body 904 having a first surface 912 and a second surface 924. The glenosphere 900 defines an engagement axis 908. The glenosphere 900 includes one or more channels 960 that can receive bone fixation members 940 for attaching the glenosphere 900 to a shoulder bone. As shown in FIG. 22, the channel(s) 960 can be defined by a first channel opening 964 on the first surface 912, a second channel opening 968 on the second surface 924, and a channel surface 972 connecting the first channel opening 964 to the second channel opening 968.

[0149] Unlike the channels 160 of the glenosphere 100, the channel 960 is oriented to be parallel to the engagement axis 908, such that a bone fixation member 940 received through the channel 960 would be oriented parallel to the engagement axis 908, and/or the bone engagement member 1016 and/or plate fixation members 1050 when the glenosphere 900 is attached to the plate 1000 and the shoulder bone. For example, the channel 960 can define a channel axis 976 that is parallel to the engagement axis 908. The channel axis 976 can be defined as the axis for which the most points defined by intersections between planes perpendicular to the axis and the channel surface 972 are equidistant from the axis (e.g., the channel axis 976 is centrally oriented for the most or all cross-sections of the channel surface 972 that are perpendicular to the channel axis 976).

[0150] In some embodiments, orienting the channels 960 to be parallel to the engagement axis 908 allows the glenosphere 900 to secure a greater surface area or disparate surface areas of the shoulder bone (though the glenosphere 900 may have a less secure attachment to a specific surface area of the shoulder bone as compared to the glenosphere 100).

[0151] In some embodiments, a glenosphere includes a spherical body. The spherical body can include a first edge that defines a complete path about the body. A first surface can extend from a first side of the first edge, and a second surface can extend from a second side of the first edge opposite the first side. For example, the first surface can be adjacent to the second surface along the first edge, and together the first surface and the second surface can define a complete outer surface of the spherical body. The spherical body can define a center such that each point on the first surface is equidistant from the center (or such that the greatest possible number of points on the first surface are equidistant from the center). The first edge can define (or include) a first point and a second point. A first shortest path between the first point and the second point along the first surface (e.g., such that the only points on the first shortest path that coincide with the first edge are the first point and the second point) is greater than half of a circumference of a spherical region defined by all points equidistant from the center. In some embodiments, such a glenosphere can thus include a hooded portion (e.g., the second point is located on the hooded portion), or has a greater-than-hemispherical form factor.

C. Glenosphere with Flange for Augmented Fixation and Related Methods

[0152] Referring now to FIGS. 23A-27B, various embodiments of glenospheres including a flange-type component for augmented fixation are illustrated. The glenospheres described with reference to FIGS. 23-27B can be similar to the glenospheres described with reference to FIGS. 1-22, and can be configured to engage or otherwise interact with various baseplates. In some embodiments, a glenosphere having a flange component is kinematically advantageous for a patient having a shoulder prosthesis, as the flange enables the glenosphere to contact and be supported against a greater surface area of the shoulder bone surrounding a fixation site at which fixation elements of the glenosphere and/or baseplate are secured, helping to stabilize the glenosphere against rocking or other disadvantageous movements. In some embodiments, a glenosphere having a surface for receiving the baseplate that is offset relative to the center of the glenosphere can advantageously bring the flange closer to the shoulder bone and/or away from a fixation site at which the baseplate is fixated to the shoulder bone, further improving stability. In some embodiments, the flange can facilitate distribution of forces between the shoulder prosthesis and the baseplate that could otherwise damage the baseplate. The flange can be configured to be positioned in or contact a superior aspect of the glenoid cavity. Unlike existing systems in which portions of a glenosphere may extend beyond a hemispherical shape or arrangement, but which cannot improve operation in bone loss applications, a glenosphere having a flange according to various embodiments of the present disclosure can advantageously

improve operation of a shoulder prosthesis in applications with bone loss (e.g., bone loss model applications).

[0153] Referring now to FIGS. 23A-23C, a glenosphere 1100 is shown. The glenosphere 1100 can be similar in structure and function to various glenospheres described herein. The glenosphere 1100 includes a body 1104 and a flange 1150. The body 1104 includes a first body surface 1108 and a second body surface 1112. The second body surface 1112 can be spherical (e.g., define a surface for which many, most, or all points are equidistant from a reference point, such as a center of the body 1104). The body 1104 includes an engagement feature 1120 configured to engage with an attachment structure (e.g., a plate or baseplate) attachable to the shoulder bone.

[0154] In some embodiments, the body 1104 has or defines a center 1116. The center 1116 can be a point that equidistant from many, most, or all points on an exterior of the body 1104, and/or equidistant from many, most, or all points of the second body surface 1112. In some embodiments, the center 1116 can be a center of rotation for a humeral component (not shown) coupled to the body 1104 and configured to articulate about the second body surface 1112.

[0155] The engagement feature 1120 can be a cavity similar to various embodiments of cavities as described herein. As shown in FIGS. 23A-23C, the engagement feature 1120 includes a first cavity portion 1124 configured to receive an attachment structure (e.g., a plate), and a second cavity portion 1132 configured to engage the attachment structure. The first cavity portion 1124 can include a cavity surface 1126 (e.g., an engagement surface) against which the attachment structure can be positioned or received. In some implementations, the cavity surface 1126 may be separated from the first body surface 1108 by a wall defining a depth of the cavity.

[0156] The body 1104 can define an engagement axis 1118. The engagement axis 1118 can be an axis passing through the engagement feature 1120 and indicating a direction against which the glenosphere 1100 generally is brought towards the shoulder bone. In some embodiments, the engagement axis 1118 is perpendicular or substantially perpendicular to the cavity surface 1126. The engagement axis 1118 may align with a plate fixation member of the plate when the plate is received in the first cavity portion 1124. In some embodiments, such as shown in FIG. 23C, the engagement axis 1118 passes through (e.g., includes, is collinear with) the center 1116.

[0157] In some embodiments, the engagement feature 1120 and/or the cavity surface 1126 is offset by an engagement offset 1127 from the center 1116 of the body 1104 (or from a plane 1128 including the center 1116 and parallel to the cavity surface 1126 or to an outer edge of

the cavity surface 1126). This offset can increase the range of motion for articulation enabled by the second body surface 1112, as the second body surface 1112 may occupy a space greater than a hemispherical space defined as being equidistant from the center 1116, and can bring the flange 1150 closer to the shoulder bone when the plate is received and secured by the engagement feature 1120 and the glenosphere 1100 is fixated to the shoulder bone. In some embodiments, the engagement offset 1127 is approximately 6 mm (e.g., greater than or equal to 4 mm and less than or equal to 8 mm; greater than or equal to 5 mm and less than or equal to 9 mm). In some embodiments, the engagement offset 1127 is approximately 10 mm (e.g., greater than or equal to 8 mm and less than or equal to 12 mm; greater than or equal to 9 mm and less than or equal to 11 mm).

**[0158]** The flange 1150 extends radially outward from the body 1104 and includes a first flange surface 1154 contiguous with the first body surface 1108 and a second flange surface 1156 contiguous with the second body surface 1112. The flange 1150 can extend further radially outward from the body 1104 than the second body surface 1112 (e.g., at least a portion of the flange 1150 is at a greater distance from the center 1116 than any point on the second body surface 1112). In some embodiments, the flange 1150 has a flange length (e.g., a length defined along an outer rim 1151 of the flange 1150) extending from a first end 1158 and a second end 1162 such that an angle  $\gamma$  defined by a first line 1159 from the center 1116 to the first end 1158 and a second line 1163 from the center 1116 to the second end 1162 is less than 180 degrees (e.g., less than 150 degrees, less than 120 degrees, less than 90 degrees, less than 180 degrees and greater than 45 degrees). The body 1104 can include a glenosphere body surface 1110 that includes the first body surface 1108 and the first flange surface 1154. The flange 1150 can provide additional support for the glenosphere 1100 by adding surface area for stabilizing the glenosphere 1100 against the shoulder bone. The angle  $\gamma$ , or other measures of a size of the flange 1150 can be selected to reduce or minimize a total size or volume occupied by the glenosphere 1100. For example, in some configurations, as the size of the flange 1150 increases, it may become more difficult to place the glenosphere 1100 in the glenohumeral joint; if a too large flange 1150 is used, it may interfere with range of motion of the humerus as well as interfere with soft tissue such as the subscapularis, supraspinatus, and/or infraspinatus tissue. At the same time, increasing or maximizing a surface area of the flange 1150 that can contact the shoulder bone can increase stability of the glenosphere 1100 or otherwise improve the kinematics of the glenosphere 1100.

**[0159]** In some embodiments, the flange 1150 includes a hole 1164 extending from a first hole opening 1166 defined by the first flange surface 1154 to a second hole opening 1168

defined by the second flange surface 1156. The hole 1164 can be configured to receive a glenosphere fixation member 1101 (e.g., a fixation member similar or identical to glenosphere fixation member 140) configured to attach the glenosphere to the shoulder bone. As shown in FIGS. 23A-23C, the glenosphere 1100 includes three holes 1164. In various embodiments, various numbers of holes 1164 can be included by the flange 1150 (e.g., 1, 2, 3, 4, 5, holes). In other embodiments (e.g., as shown in FIG. 24, the flange 1150 does not include a hole, e.g. has a continuous or uninterrupted surface).

**[0160]** In some embodiments, the second body surface 1112 defines a hole path 1168. The hole path 1168 can be recessed within the second body surface 1112. The hole path can be recessed towards the center 1116 (e.g., is recessed into the body 1104 from the second body surface 1112; a surface of the hole path 1168 is closer to the center 1116 than an adjacent portion of the second body surface 1112). The hole path 1168 is in communication with the second hole opening 1168 (e.g., is contiguous with, transitions to), and can guide the glenosphere fixation member 1101 into the hole 1164. When the glenosphere fixation member 1101 is received in the hole path 1168 and through the hole 1164, a portion of the glenosphere fixation member will be positioned closer to the center 1116 relative to the second body surface 1112.

**[0161]** The hole 1164 can be configured to receive a plurality of glenosphere fixation members 1101, or, as shown in FIGS. 23A-23C, can receive glenosphere fixation members 1101 at different positions and/or orientations. For example, the hole 1164 can be configured to receive the glenosphere fixation member 1101 at a first angle corresponding to a first channel 1165 of the hole or at a second angle corresponding to a second channel 1166 of the hole. The first channel 1165 can define a first channel axis 1173, and the second channel 1166 can define a second channel axis 1175 (e.g., the channel axes can be defined as being equidistant from many, most, or all points on the corresponding surfaces). The channels 1165, 1166 can be contiguous with each other. The hole path 1168 can include portions aligned with each channel axis 1173, 1175.

**[0162]** The channels 1165, 1166 can be configured to receive and/or secure the glenosphere fixation member. For example, the channels 1165, 1166 can include thread receiving surfaces configured to engage threads of the glenosphere fixation member 1101. The first channel axis 1173 can define a channel offset 1176 from the second channel axis 1175, such that a position of the glenosphere fixation member 1101 when received in the first channel 1165 is offset from when received in the second channel 1166. In some embodiments, the channel offset 1176 is approximately 3 mm (e.g., greater than or equal to 1 mm and less than or equal to 10 mm,

greater than or equal to 1 mm and less than or equal to 5 mm, greater than or equal to 2 mm and less than or equal to 4 mm, 3mm). In some embodiments, the first channel axis 1173 is parallel to the cavity surface 1126 or the engagement axis 1118, and the second channel axis 1175 is angled towards the cavity surface 1126 or the engagement axis 1118 relative to the first channel axis 1173 (e.g., angled by 10 degrees, by an angle greater than or equal to 5 degrees and less than or equal to 20 degrees; greater than or equal to 7.5 degrees and less than or equal to 15 degrees; greater than or equal to 9 degrees and less than or equal to 11 degrees). The angle between the first channel axis 1173 and the second channel axis 1175 can provide more options for orienting and implanting the glenosphere 1100 in patients having varied sizes and/or glenoid bone loss in the glenoid cavity. As the angle increases, there may be more options for where the glenosphere fixation member can be fixed to the shoulder bone. For example, the angle can enable the glenosphere fixation member to be fixed to a bone location (e.g., a bone location that increases or optimizes stability) at the base of the coracoid or the acromion.

**[0163]** The hole 1164 can define a hole center 1178 that is equidistant from the channel axes 1173, 1175, and falls within (e.g., is included within) a plane that includes the channels 1165, 1166. In embodiments where the flange 1150 includes more than one hole 1164, the channel centers 1178 can be oriented at an angle  $\delta$  defined from the center 1116 (e.g., an angle defined by lines from the center 1116 to the channel centers 1178 or the channel axes 1173, 1175). The angle  $\delta$  can indicate or be a measure of an arcuate range of space (or a portion thereof) covered by the flange 1150. The angle  $\delta$  can be approximately 35 degrees (e.g., greater than or equal to 20 degrees and less than or equal to 50 degrees; greater than or equal to 30 degrees and less than or equal to 40 degrees; greater than or equal to 34 degrees and less than or equal to 36 degrees).

**[0164]** Referring now to FIGS. 25A-25B, the glenosphere 1100 is shown having an offset flange 1150. In some embodiments, the flange 1150 is configured to be offset from the first body surface 1108. The flange 1150 can be offset such that the flange 1150 is closer to the shoulder bone than the first body surface 1108 when the glenosphere 1100 is secured to the shoulder bone, and/or extends out and over the plate when the plate is received and engagement by the engagement feature 1120. In embodiments where the flange 1150 is offset, the glenosphere 1100 can thus be adapted to various geometries of the shoulder bone, such as for drawing the flange 1150 closer to a portion of the shoulder bone that is away from where the plate is fixated to the shoulder bone. In some embodiments, the offset of the flange 1150 can beneficially position the channels 1165, 1166 further away from the center 1116 of the glenosphere 1100 (as compared to a glenosphere that does include the flange 1150), and thus

a range of motion of a humeral component articulating about the second body surface 1112. Such positioning can reduce the likelihood of osteolysis that might result from friction between the humeral component and the glenosphere 1100 that would generate wear particles that can be pushed through the channels 1165, 1166 into the shoulder joint by the articulating humeral component.

**[0165]** The flange 1150 can be offset from the plane 1128 by a first offset distance 1180 (e.g., as measured to the first flange surface 1154), the first offset distance 1180 being greater than a second offset distance 1182 by which the first body surface 1108 is offset from the plane. In some embodiments, a difference between the first offset distance 1180 and the second offset distance 1182 is approximately 3 mm (e.g., greater than or equal to 2 mm and less than or equal to 4 mm), 5 mm (e.g., greater than or equal to 4 mm and less than or equal to 6 mm), or 7 mm (e.g., greater than or equal to 6 mm and less than or equal to 8 mm). The offsets may also be defined relative to a cavity surface 1126, or a plane passing through an outer edge of the cavity surface 1126.

**[0166]** Referring now to FIGS. 26A-26B, a glenosphere 1200 is shown. The glenosphere 1200 can be similar to the glenosphere 1100, with the exception of the shape and/or orientation of the glenosphere body surface (e.g., the first flange surface and/or first body surface). The glenosphere 1200 can include a body 1204, a first body surface 1208, and a second body surface 1212. The glenosphere 1200 can define a center 1216 and an engagement axis 1218. The glenosphere 1200 can include a flange 1250 extending radially outward from the body 1204. The flange 1250 can include a first flange surface 1254 and a second flange surface 1256. The glenosphere 1200 can include a glenosphere body surface 1210 including the first body surface 1208 and the first flange surface 1254. The glenosphere 1200 can define a plane 1228 that includes or passes through the center 1216.

**[0167]** In some embodiments, the first flange surface 1254 and/or the glenosphere body surface 1204 is oriented at an angle to the plane 1228. For example, a first end 1291 of the first flange surface 1254 (e.g., an end of the first flange surface 1254 that is further from the center 1216, the engagement axis 1218, and/or adjacent to an exterior rim of the flange 1250) can be offset by a flange offset 1290 from the plane 1228, while a second end 1209 of the first body surface 1208 (e.g., an end or point where the first body surface 1208 meets the second body surface 1212 and furthest from the flange 1250, the engagement axis 1218, and/or the center 1216) is offset by a body offset 1292 from the plane 1228, the body offset 1292 being less than the flange offset 1290. The glenosphere body surface 1210 can be planar or substantially planar. A line 1293 between the first end 1291 and the second end 1292 can

define an angle  $\varepsilon$  relative to the body offset 1292, or may similarly define an angle at an intersection (not shown) of the line 1293 and the plane 1228, such that the glenosphere body surface 1204 is angled relative to the plane 1228. The glenosphere body surface 1204 can be angled such that the body offset 1292 is approximately 3 mm (e.g., greater than or equal to 2 mm and less than or equal to 4 mm), 5 mm (e.g., greater than or equal to 4 mm and less than or equal to 6 mm), or 7 mm (e.g., greater than or equal to 6 mm and less than or equal to 8 mm). The body offset can also be measured from the center 1216 to a plane 1295 including or passing through the first point 1219 and parallel to the plane 1228.

[0168] Referring now to FIGS. 27A-27B, a glenosphere 1300 is shown. The glenosphere 1300 can be similar to the glenosphere 1200, with the exception of the shape of the first flange surface and/or glenosphere body surface as described herein. The glenosphere 1300 can include a body 1304, a first body surface 1308, and a second body surface 1312. The glenosphere 1300 can define a center 1316, an engagement axis 1318 passing through the center 1316, and a plane 1328 including the center 1316. A flange 1350 can extend radially outward from the body 1304 and include a first flange surface 1354 and a second flange surface 1356. A glenosphere body surface 1310 can include the first body surface 1308 and the first flange surface 1354. The glenosphere can include an engagement feature including a cavity surface 1326.

[0169] In some embodiments, the glenosphere 1300 has a curved or non-linear (or non-planar) glenosphere body surface 1310 and/or a curved or non-linear (or non-planar) first flange surface 1310. A first flange offset 1393, defined from the plane 1328 to a first flange end 1392 (e.g., a point at which the first body surface 1308 is adjacent to the first flange surface 1354), can be greater than a second flange offset 1391, defined from the plane 1328 to an outer flange end 1390 (e.g., an outermost point on the first flange surface 1354). The first flange offset 1393 can also be greater than a first body offset 1394a defined between the plane 1328 and a first body end 1309a (e.g., an outermost point of the body 1304 where the first body surface 1308 meets the second body surface 1312 and which may be furthest from the flange 1354), and may be greater than a second body offset 13094 defined between the plane 1328 and a second body end 1309b (e.g., a point at which a rim 1327 of an engagement feature 1324 intersects the first body surface 1308 and furthest from the flange 1350). The offsets may also be defined relative to a cavity surface 1326, or a plane passing through an outer edge of the cavity surface 1326. In some embodiments, the first flange end 1392 is positioned closest to the shoulder bone when the glenosphere 1300 is fixated to the shoulder bone and/or to a plate, allowing glenosphere fixation members received through the glenosphere to be closely secured



to the shoulder bone while a significant portion of the body 1304 is positioned away from the shoulder bone.

D. Glenosphere with Inserts for Augmented Fixation and Related Methods

[0170] Referring now to FIGS. 28A-35B, various embodiments of glenosphere systems implementing inserts (e.g., insert components) are illustrated. In various embodiments, the use of an insert component can improve the efficacy of shoulder arthroplasty by stabilizing glenospheres against shoulder bones, such as the scapula, allowing for improved range of motion of the humerus, maintaining an anatomic or other desired center of rotation even when glenoid bone loss or other bone loss has occurred, and/or enabling the glenosphere to be secured directly to the shoulder bone (additionally or alternatively to securing the glenosphere to the shoulder bone via a baseplate) to distribute the load between the glenosphere and the shoulder bone away from the baseplate to reduce the risk of baseplate failure. The insert component may be modular to allow for a surgeon to have more flexibility in performing shoulder arthroplasty, such as to install new or replacement glenospheres on existing baseplates (e.g., after removing an existing glenosphere, install a new glenosphere on a baseplate already secured to the shoulder bone).

[0171] In some embodiments, such as shown in FIGS. 28A-35B, a glenosphere system 1400 includes an insert component 1410, a glenosphere 1460, and a baseplate 1480. The glenosphere 1460 can be similar to various glenospheres described herein. The baseplate 1480 can be similar to various baseplates described herein. The baseplate 1480 may receive plate fixation members 1482, which may be similar to various fixation members described herein. The baseplate 1480 may include or be associated with a bone engagement member 1484, which may be similar to various bone engagement members described herein.

[0172] In some embodiments, the glenosphere 1460 includes a first surface 1464, a second surface 1468, a plate engagement region 1472, and an insert engagement region 1476. The plate engagement region 1472 is configured to engage the baseplate 1480. For example, the plate engagement region 1472 may include a cavity configured to receive the baseplate 1480. The insert engagement region 1476 is configured to engage the insert component 1410. As shown in FIG. 28A, the insert engagement region 1476 may include a cavity (e.g., recess) configured to receive the insert component 1410. The insert engagement region 1476 may include protrusions configured to be received by the insert component 1410. The insert engagement region 1476 may be configured to couple to the insert component 1410 using a Morse taper.

[0173] In some embodiments, the insert component 1410 (e.g., a body of the insert component 1410) includes a first surface 1412, a second surface 1416, and a third surface 1420. The first surface 1412 may extend from a first end 1413 to a second end 1414. The first surface 1412 can be configured to engage a bone. For example, the first surface 1412 may include bony growth surfaces (e.g., rough surfaces, etched surfaces) configured to facilitate bone growth. The second surface 1416 is spaced from the first surface 1412. The second surface 1416 can cooperate with the first surface 1412 to define at least one channel 1428. The at least one channel 1428 can be configured to receive an engagement member to secure the insert component 1410 to a bone. In some embodiments, the insert component 1410 includes a fourth surface 1424.

[0174] The third surface 1420 may include a first end 1430 and a second end 1432. The first end 1430 and second end 1432 may be adjacent to the first surface 1412, such that the first end 1430 and second end 1432 extend from a perimeter of the first surface 1412. The third surface 1420 may include or define a curved portion 1434 between the first end 1430 and second end 1432. The curved portion may be shaped to contact a bone engagement member (e.g., bone engagement member 1484), such as to enable the insert component 1410 to be positioned against a portion of the baseplate 1484 adjacent to the bone engagement member 1484, which may help stabilize the glenosphere system 1400 and/or distribute load from the baseplate 1480 to the insert component 1410. In some embodiments, the first surface 1412 defines a first arc length (e.g., along an edge of the first surface 1412) from the first end 1413 to the second end 1414, and the third surface 1420 defines a second arc length (e.g., along an edge of the third surface 1420) from the first end 1430 to the second end 1432. The first arc length may be greater than the second arc length, such as to increase a surface profile of the insert component 1410 in a region where the insert component is configured to contact (e.g., engage) a shoulder bone to stabilize the glenosphere system 1400, while maintaining a low profile near where the insert component 1410 may be adjacent to the baseplate 1480, which may facilitate assembly of the glenosphere system 1400 during surgical procedures with varying geometries of components of the glenosphere system 1400.

[0175] In some embodiments, the insert component 1410 includes a cavity 1436. The cavity 1436 may include a first cavity opening 1438 defined by the first surface 1412. The cavity 1436 may include a second cavity opening 1439 defined by the second surface 1424 (or a surface of the insert component 1410 adjacent to the second surface 1424). The cavity 1436 may be defined within the insert component 1410 (e.g., within a body of the insert component 1410). The cavity 1436 may define a first cavity region 1440 and a second cavity region 1442,

which may each be coextensive with a third cavity region 1444. As shown in FIG. 28A, the curved portion 1434 of the third surface 1420 may extend into the insert component 1410 and thus define a portion of the third cavity region 1444.

[0176] In some embodiments, the first cavity region 1440 defines a first cavity diameter 1446, the second cavity region 1442 defines a second cavity diameter 1448, and the diameters 1446, 1448 are each greater than a diameter of a plate fixation member 1482, such that at least one of the first cavity region 1440 or the second cavity region 1442 may receive the plate fixation member 1482. The cavity 1436 may be between the third surface 1420 and the at least one channel 1428.

[0177] In some embodiments, the at least one first channel 1428 defines a first channel axis 1429. The cavity 1436 can define a cavity axis 1437. The first channel axis 1429 may be parallel to the cavity axis 1437, which may help align the insert component 1410 with the baseplate 1480.

[0178] As shown in FIGS. 28A, 28C, and 28F, in some embodiments, the fourth surface 1424 is configured to engage a first surface 1481 of the baseplate 1480. For example, a first plane parallel to the fourth surface (e.g., where the fourth surface 1424 defines the second opening 1439) may be spaced from a second plane parallel to the second surface 1416 (e.g., where the second surface 1416 defines an opening of the at least one first channel 1428). For example, the first plane may be closer to the first surface 1412 than the second plane. In some such embodiments, the insert component 1410 may thus be configured to stabilize the baseplate 1480 and glenosphere 1460 by securing the baseplate 1480 to the glenosphere 1460 while securing the glenosphere 1460 to the shoulder bone.

[0179] Referring now to FIGS. 29A-29D, in some embodiments, a glenosphere system 1500 includes an insert component 1510, a glenosphere 1560, and a baseplate 1580. The glenosphere system 1500 can be similar to and include features of the glenosphere system 1400. As described herein, the glenosphere system 1500 can include an insert component 1510 including at least one second channel 1550.

[0180] For example, as shown in FIGS. 29A-29D, the insert component 1510 includes at least one first channel 1528, and also includes the at least one second channel 1550. The at least one second channel 1550 may be on an opposite side of the at least one first channel 1528 from a cavity 1536, such that the at least one second channel 1550 allows for the insert component 1510 to be secured to portions of bone further from the portions secured by the baseplate 1580 than the at least one first channel 1528. The insert component 1510 may include a channel surface 1518, extending above the portion of the insert component 1510 defining the

at least one first channel 1528, the channel surface 1518 cooperating with the first surface 1512 to define the at least one second channel 1550. The at least one second channel 1550 is configured to receive a bone fixation member (e.g., bone fixation member 1509) configured to secure the insert component 1510 to bone. The at least one second channel 1550 may have a diameter greater than a diameter of the at least one first channel 1528, such as to accommodate bone fixation members 1509 having a greater diameter than those for the at least one first channel 1528 (e.g., to improve fixation of the insert component 1510 via the at least one second channel 1550).

**[0181]** In some embodiments, the at least one second channel 1550 defines at least one second channel axis 1551. The at least one second channel 1550 may be configured such that the second channel axis 1551 is not parallel to a first channel axis 1529 of the at least one first channel 1528.

**[0182]** In some embodiments, the portion of the insert component 1510 defining the at least one second channel 1550 is configured to extend above the glenosphere 1560 when the insert component 1510 is engaged to the glenosphere 1560. For example, a first distance from a first rim 1545 where the first surface 1512 is adjacent to the third surface 1520 to a second rim 1546 of the first surface 1512 opposite the first rim 1545 and adjacent to the at least one second channel 1550 can be greater than a second distance from a point of an insert engagement region of the glenosphere 1560 (e.g., an insert engagement region similar to insert engagement region 1476 of glenosphere 1460) to a glenosphere rim where a first surface 1564 is adjacent to a second surface 1568.

**[0183]** Referring now to FIGS. 30A-30D, in some embodiments, a glenosphere system 1600 includes at least one of an insert component 1610 or a flange component 1650. The glenosphere system also includes a glenosphere 1660 and a baseplate 1680. The glenosphere system 1600 may be similar to the glenosphere systems 1400, 1500 described herein. The insert component 1610 may be similar to the insert components 1410, 1510. The glenosphere 1660 may be similar to the glenospheres 1460, 1560. The baseplate 1680 may be similar to the baseplates 1480, 1580. In some embodiments, the flange component 1650 can include features of and perform similar functions as the flange components described with respect to FIGS. 23A-27B.

**[0184]** As shown in FIGS. 30A-30D, the glenosphere system 1600 may include one or both of the insert component 1610 and the flange component 1650. For example, the flange component 1650 may enable additional securing of the glenosphere 1660 to shoulder bones (e.g., to portions of shoulder bones not secured by the insert component 1610). As shown in

FIG. 30D, in some embodiments, the glenosphere 1550 includes an insert engagement region 1662 configured to engage the insert component 1610, and may similarly include a flange engagement region 1664 configured to engage the flange component 1650. The insert engagement region 1662 may be radially spaced from the flange engagement region 1664, such as to allow the insert component 1610 and flange component 1650 to couple to differing portions of bones. In some embodiments, the flange component 1650 includes at least one first channel 1652 configured to receive at least one first bone fixation member 1654, and at least one second channel 1656 configured to receive at least one second bone fixation member 1658 (which may have a greater diameter than the at least one first bone fixation member 1654). The at least one second channel 1656 may be oriented at an angle relative to the at least one first channel 1652. The glenosphere system 1600 may be configured such that the at least one first channel 1652 is parallel to at least one first channel 1628 of the insert component 1610 (e.g., based on the configuration of the engagement regions 1662, 1664 and the channels 1628, 1652).

[0185] Referring now to FIGS. 31A-31C, in some embodiments, a glenosphere system 1700 includes an insert component 1710, a glenosphere 1760, and a baseplate 1780. The glenosphere system 1700 can be similar to the glenosphere systems 1400, 1500, and 1600. The insert component 1710 includes an angled first surface 1720. For example, the insert component 1710 may be configured such that an angle  $\alpha$ , defined between a channel axis 1722 of at least one channel 1721 and a cavity axis 1724 (of cavity 1724) which is in a same plane as and intersects the channel axis 1722, is perpendicular or nearly perpendicular (e.g., less than 120 degrees, less than 105 degrees, less than 90 degrees, less than 75 degrees, greater than 45 degrees and less than 120 degrees, or various combinations thereof).

[0186] Referring now to FIG. 32, in some embodiments, a glenosphere system 1800 includes an insert component 1810, a glenosphere 1860, and a baseplate 1880. The glenosphere system 1800 can be similar to the various glenosphere systems described herein (e.g., glenosphere systems 1400, 1500, 1600, 1700), with the exception of the configuration of the insert component 1810. As shown in FIG. 32, the insert component 1810 includes a first surface 1812, second surface 1816, and third surface 1820. The second surface 1816 is spaced from and parallel to the first surface 1812. The third surface 1820 extends from the first surface 1812 and second surface 1816, and can be shaped to receive a rim surface 1881 of the baseplate 1880. In some embodiments, the first surface 1812 and second surface 1816 form continuous surfaces (e.g., devoid of openings, such as openings for channels or cavities as described with respect to insert component 1410).

[0187] Referring now to FIG. 33, in some embodiments, a glenosphere system 1900 includes an insert component 1910, a glenosphere 1960, and a baseplate 1980. The glenosphere system 1900 can be similar to the various glenosphere systems described herein (e.g., glenosphere systems 1400, 1500, 1600, 1700, 1800), with the exception of the configuration of the insert component 1910. As shown in FIG. 33, the insert component 1910 can be similar to the insert component 1810, and can include at least one channel 1928 configured to receive at least one bone fixation member 1902.

[0188] Referring now to FIG. 34, in some embodiments, a glenosphere system 2000 includes an insert component 2010, a glenosphere 2060, and a baseplate 2080. The glenosphere system 2000 can be similar to the various glenosphere systems described herein (e.g., glenosphere systems 1400, 1500, 1600, 1700, 1800, 1900), with the exception of the configuration of the insert component 2010. As shown in FIG. 34, the insert component 2010 can be similar to the insert component 1910, and can include a first surface 2012 that is spaced from and at an angle relative to second surface 2016 (e.g., a plane parallel to the first surface 2012 may intersect a plane parallel to the second surface 2016 at an acute angle), which can facilitate securing the glenosphere system 2000 to corresponding shoulder bone geometries.

[0189] Referring now to FIGS. 35A-35B, in some embodiments, a glenosphere system 2100 includes a plurality of insert components 2110, a glenosphere 2160, and a baseplate 2180. The glenosphere system 2100 can be similar to the various glenosphere systems described herein (e.g., glenosphere systems 1400, 1500, 1600, 1700, 1800, 1900, 2000), and is configured to provide the plurality of insert components. As shown in FIGS. 35A-35B, the glenosphere 2160 includes a first surface 2164, a second surface 2168, and a plurality of insert engagement regions 2176 which may be spaced radially outward from and surrounding a plate engagement region 2172. The plurality of insert engagement regions 2176 can be configured to engage corresponding insert components 2110. As shown in FIG. 35A, the insert components 2110 may include channels for receiving bone fixation members (e.g., similar to insert component 1910), while as shown in FIG. 35B, the insert components may include continuous surfaces (e.g., void of channels), similar to insert component 1810.

**CLAIMS****WHAT IS CLAIMED IS:**

1. An insert component for use with a glenosphere, comprising:  
an insert body including first surface, a second surface, and a third surface;  
the first surface configured to engage a bone;  
the second surface spaced from the first surface and cooperating with the first surface to define at least one first channel, the at least one first channel configured to receive an engagement member;  
the third surface having a first surface end and a second surface end each extending from a perimeter of the first surface, a curved portion of the third surface between the first surface end and the second surface end extending into the insert body, the curved portion shaped to contact a bone engagement member; and  
a cavity defined within the insert body, the cavity including a first cavity opening defined by the first surface, the cavity defining a first cavity region and a second cavity region each coextensive with a third cavity region, the first cavity region and second cavity region each having a cavity diameter greater than a diameter of a plate engagement member.
2. The insert component of claim 1, further comprising a fourth surface extending from the third surface, the fourth surface defining a second cavity opening of the cavity opposite the first cavity opening.
3. The insert component of claim 1, wherein at least one first channel defines a first channel axis parallel to a cavity axis defined by the cavity.
4. The insert component of claim 1, wherein the first surface is configured to promote bone growth.
5. The insert component of claim 1, wherein the cavity is between the third surface and the at least one channel.
6. The insert component of claim 1, wherein a first arc length along a first rim of the first surface is greater than a second arc length of the curved portion of the third surface.

7. The insert component of claim 1, further comprising at least one second channel on an opposite side of the at least one first channel from the cavity, the at least one second channel configured to receive a bone fixation member configured to secure the insert component to the bone.

8. The insert component of claim 7, wherein a first plane parallel to a first opening of the at least one first channel defined by the second surface is spaced from a second plane parallel to a second opening of the at least one second channel.

9. The insert component of claim 7, wherein the at least one second channel defines a second channel axis that is not parallel to a first channel axis defined by the at least one first channel.

10. A shoulder prosthesis system, comprising:

a plate configured to be attached to a portion of a shoulder bone, the plate including a plate body including a first plate surface and a second plate surface opposite the first plate surface, the plate including an engagement member extending from the second plate surface, the plate configured to receive a plurality of plate fixation members, the plurality of plate fixation members configured to attach the plate to the portion of the shoulder bone;

a glenosphere including a glenosphere body including a first body surface and a spherical second body surface, the first body surface including an insert engagement region and a plate engagement region, the plate engagement region configured to engage with the engagement member of the plate; and

an insert component including an insert body including a first insert surface, a second insert surface, and a third insert surface, the first insert surface configured to engage the shoulder bone, the second insert surface configured to engage with the insert engagement region of the glenosphere.

11. The shoulder prosthesis system of claim 10, wherein the second insert surface is spaced from the first insert surface and cooperates with the first insert surface to define at least one first channel, the at least one first channel configured to receive an engagement member.

12. The shoulder prosthesis system of claim 10, wherein the third insert surface includes a first surface end and a second surface end each extending from a perimeter of the first insert



surface, a curved portion of the third insert surface between the first surface end and the second surface end extending into the insert body, the curved portion shaped to contact a bone engagement member associated with the plate.

13. The shoulder prosthesis system of claim 10, further comprising a cavity defined within the insert body, the cavity including a first cavity opening defined by the first insert surface, the cavity defining a first cavity region and a second cavity region each coextensive with a third cavity region, the first cavity region and second cavity region each having a cavity diameter greater than a diameter of the plate fixation member.

14. The shoulder prosthesis system of claim 10, further comprising a flange component configured to engage the first body surface of the glenosphere, the flange component including at least one flange channel configured to receive a bone fixation member for securing the flange to the shoulder bone.

15. The shoulder prosthesis system of claim 10, wherein the insert component includes at least one second channel on an opposite side of the at least one first channel from the cavity, the at least one second channel configured to receive a bone fixation member configured to secure the insert component to the bone.

16. The shoulder prosthesis system of claim 15, wherein a first distance from a first rim of the first surface where the first surface is adjacent to the third surface to a second rim of the first surface opposite the first rim and adjacent to the at least one second channel is greater than a second distance from a point of the insert engagement region where the third surface contacts the insert engagement region to a glenosphere rim at which the first body surface is adjacent to the second body surface.

17. The shoulder prosthesis system of claim 15, wherein the at least one second channel defines a second channel axis that is not parallel to a first channel axis defined by the at least one first channel.

18. The shoulder prosthesis system of claim 15, wherein a first plane parallel to a first opening of the at least one first channel defined by the second surface is spaced from a second plane parallel to a second opening of the at least one second channel.

19. The shoulder prosthesis system of claim 10, further comprising a fourth insert surface extending from the third insert surface, the fourth insert surface defining a second cavity opening of the cavity opposite the first cavity opening.
20. The shoulder prosthesis system of claim 10, wherein the cavity is between the third insert surface and the at least one channel.
21. The shoulder prosthesis system of claim 10, wherein a first arc length along a first rim of the first insert surface is greater than a second arc length of the curved portion of the third insert surface.
22. The shoulder prosthesis system of claim 10, wherein the insert component is configured to be adjacent to the first plate surface while the insert component is engaged with the insert engagement region and the plate is engaged with the plate engagement region.

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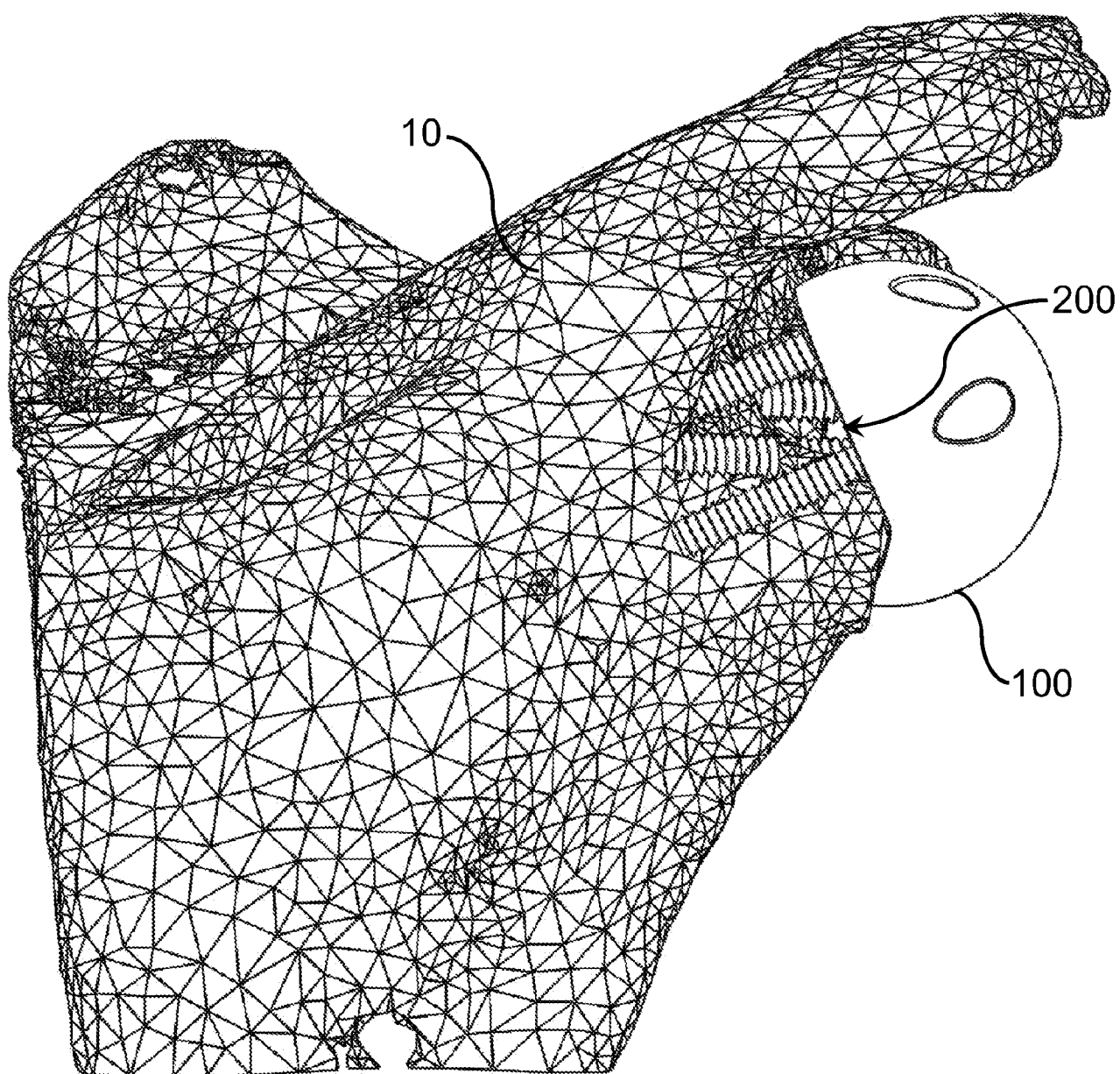


FIG. 1



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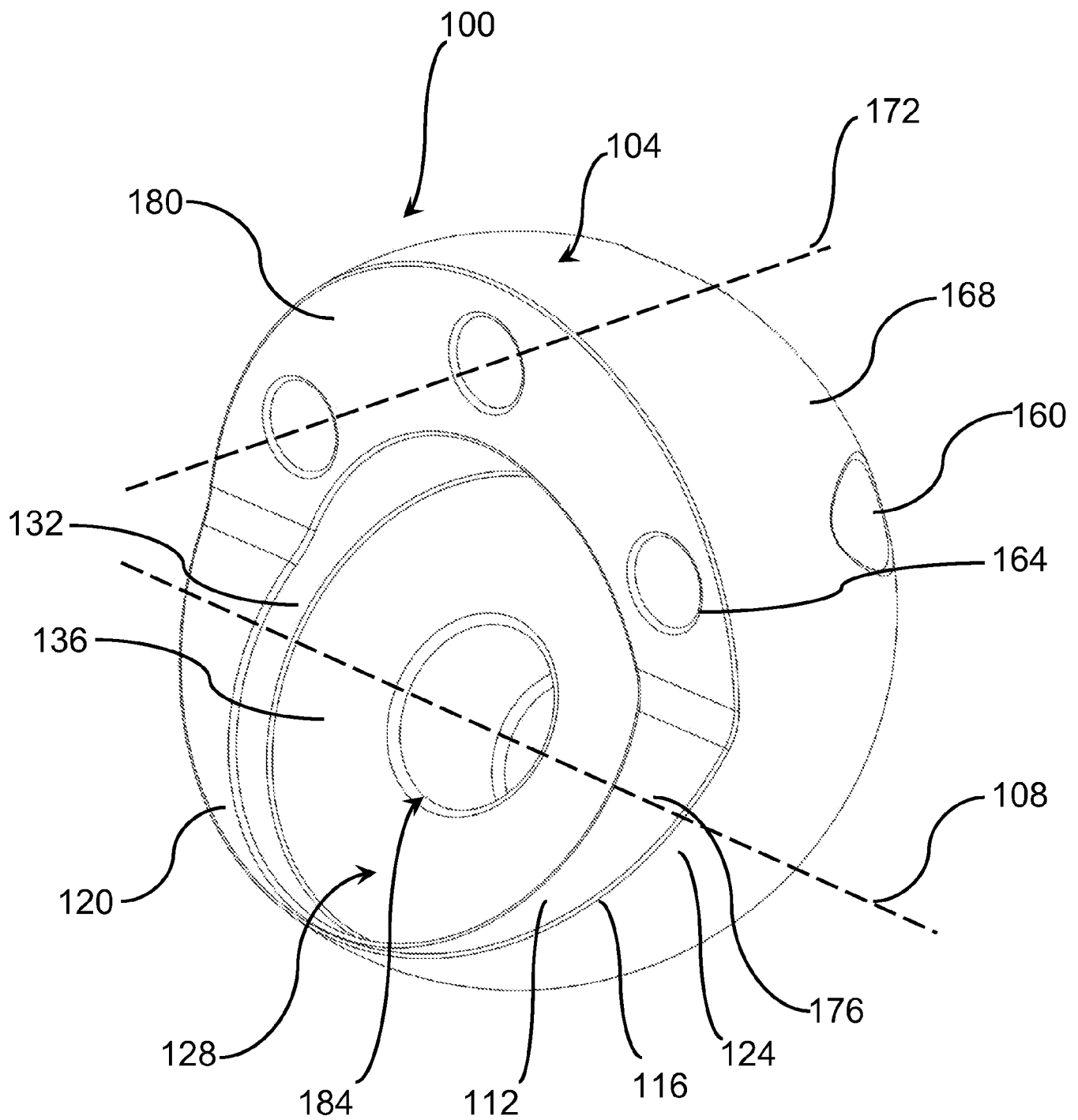


FIG. 3

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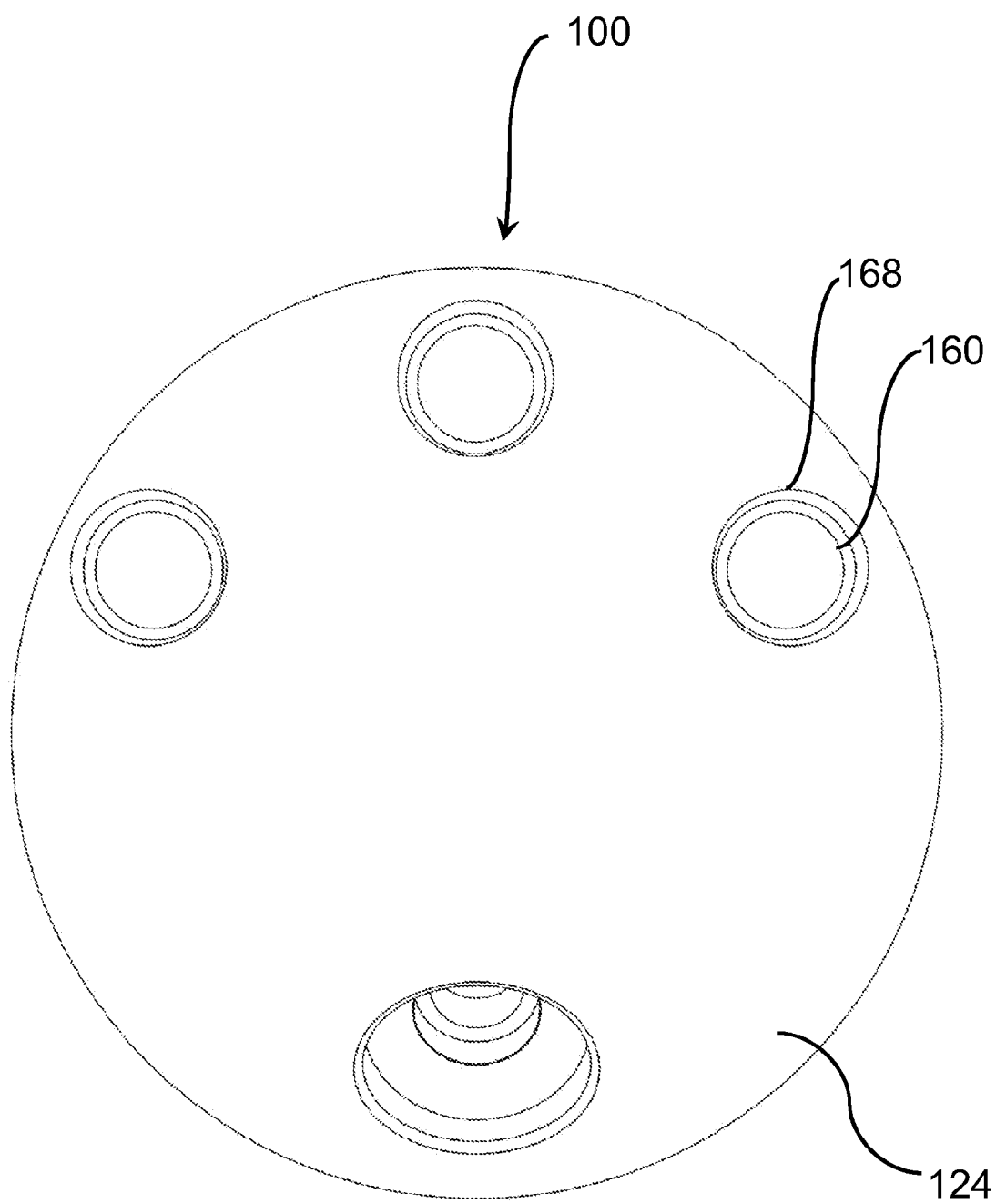


FIG. 4

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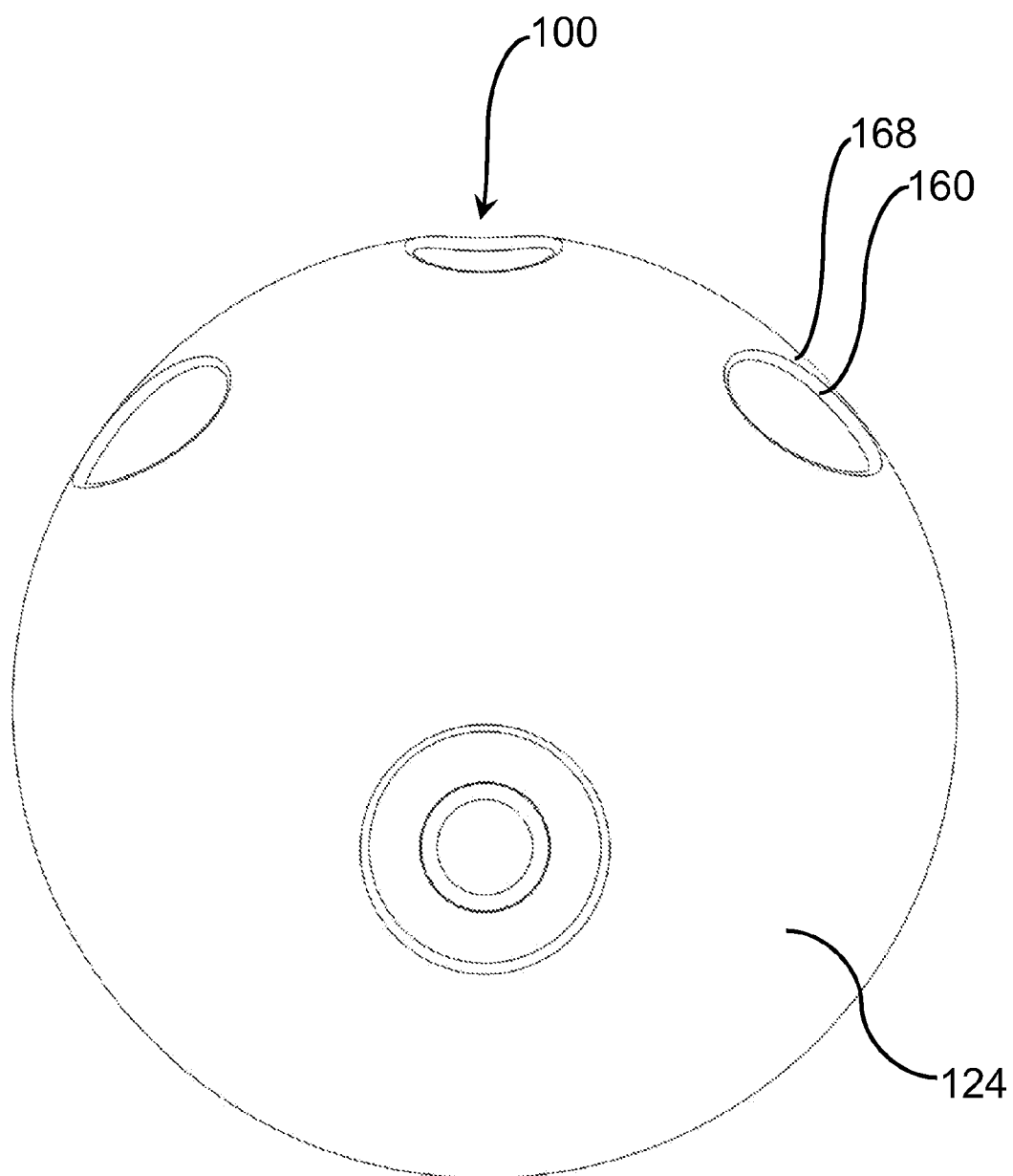


FIG. 5

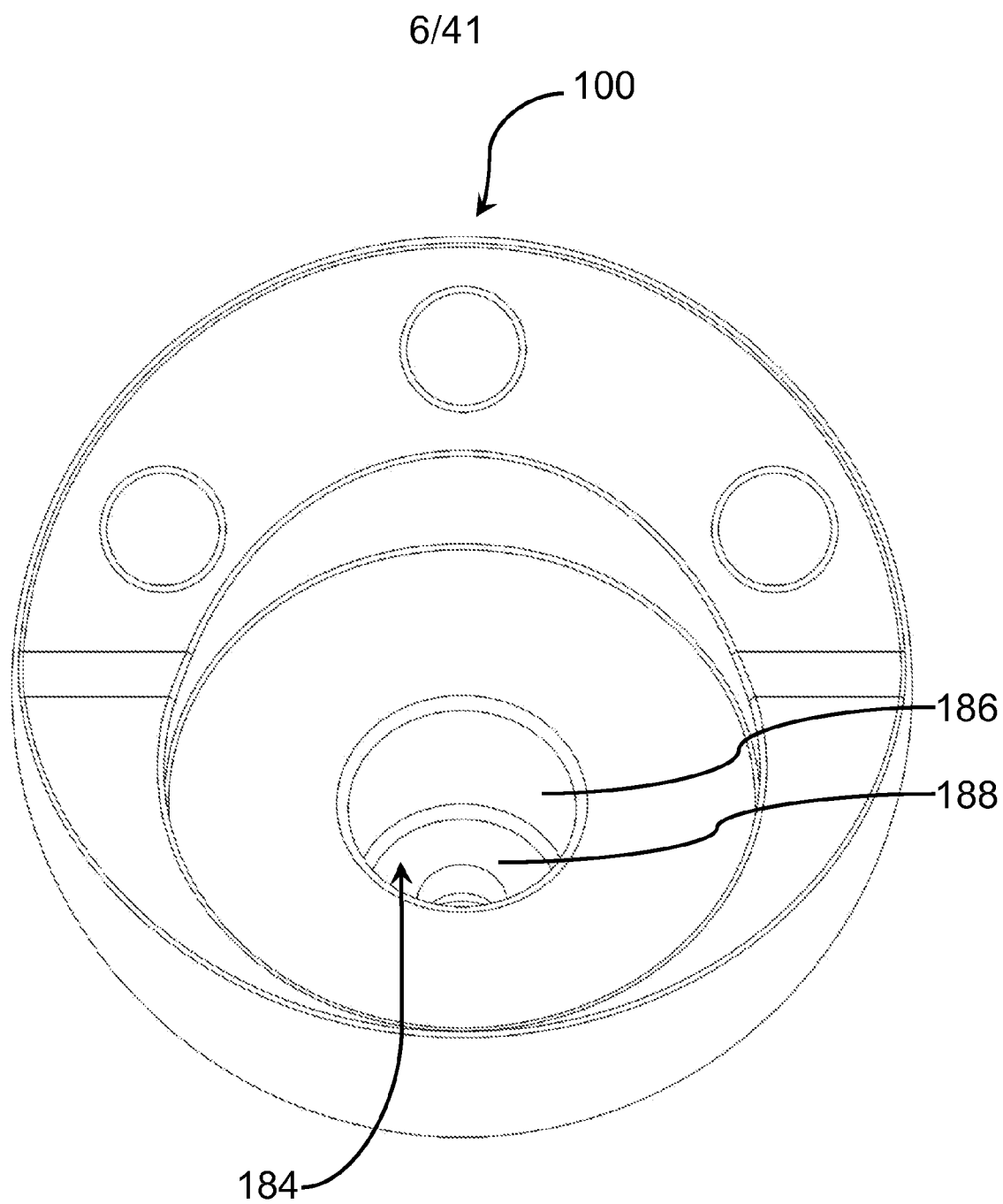


FIG. 6



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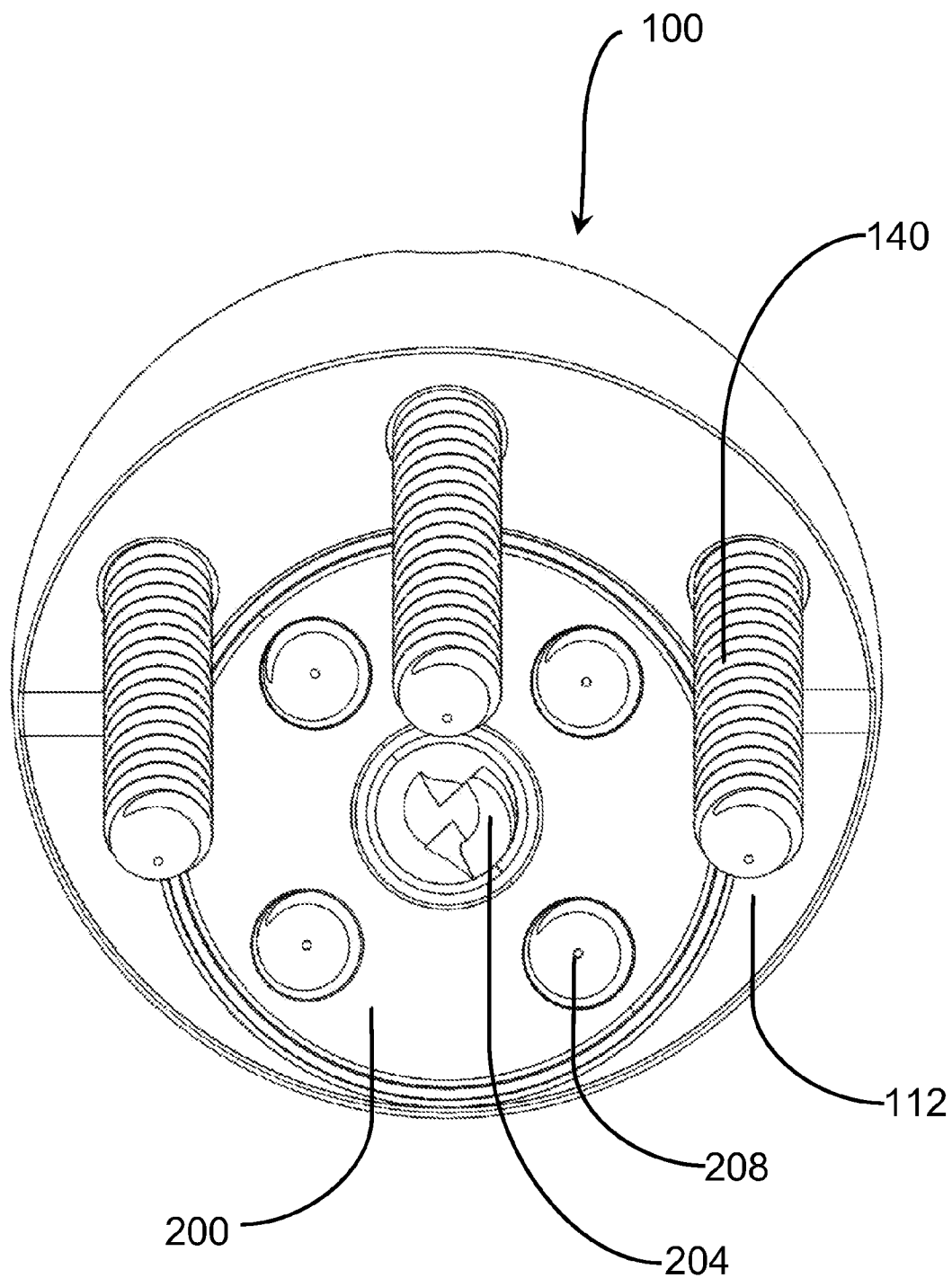


FIG. 7

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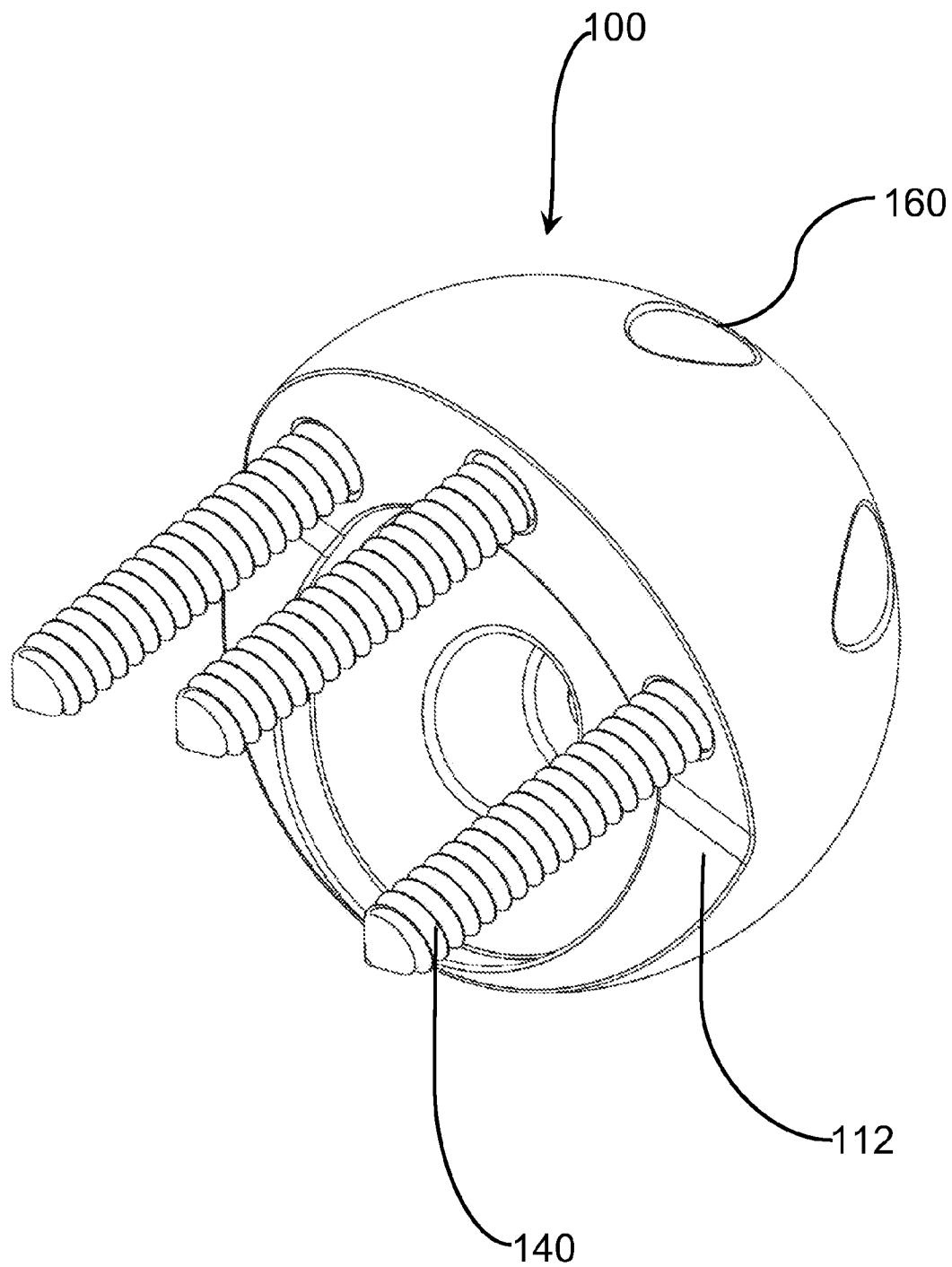


FIG. 8

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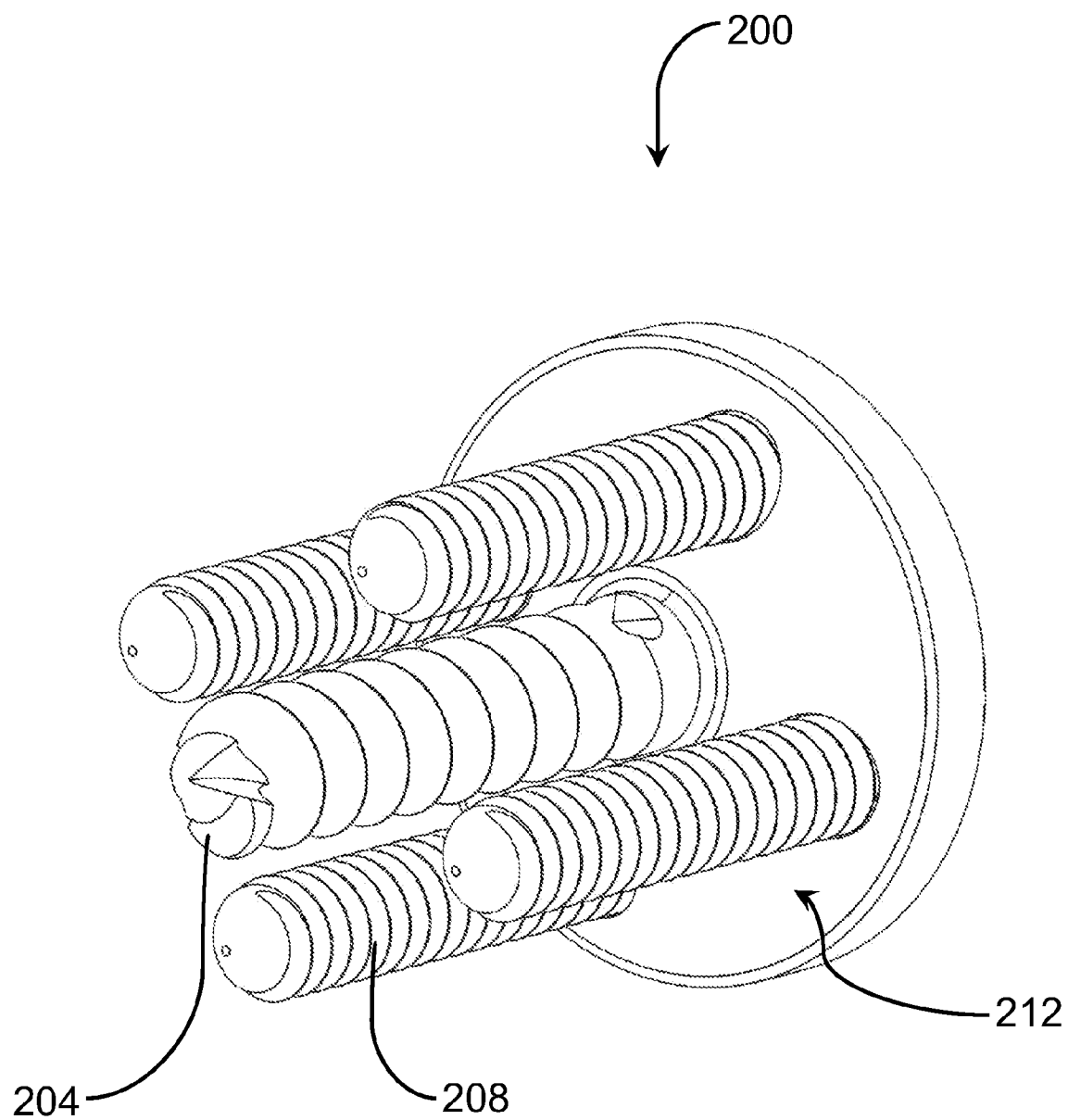


FIG. 9

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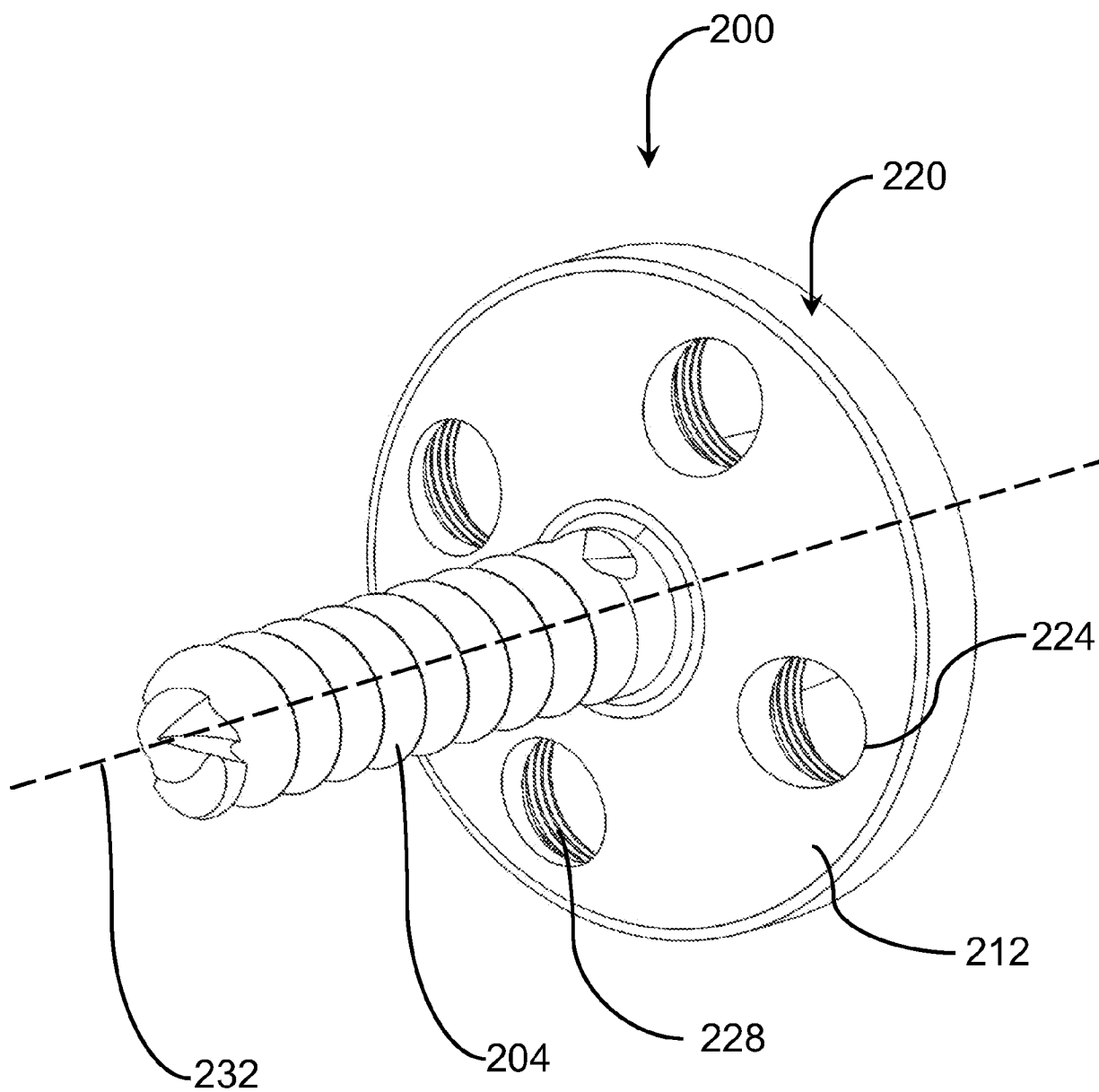


FIG. 10

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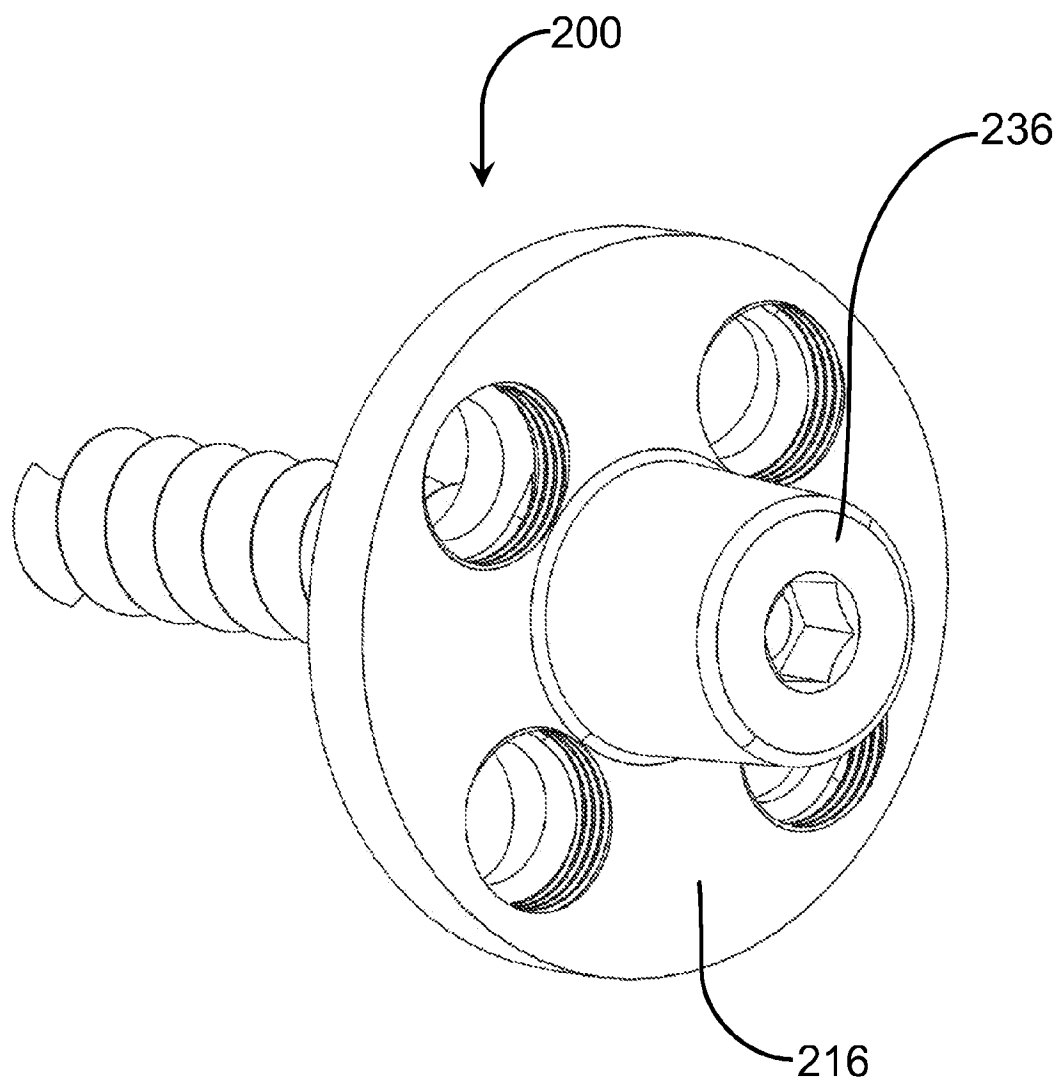


FIG. 11

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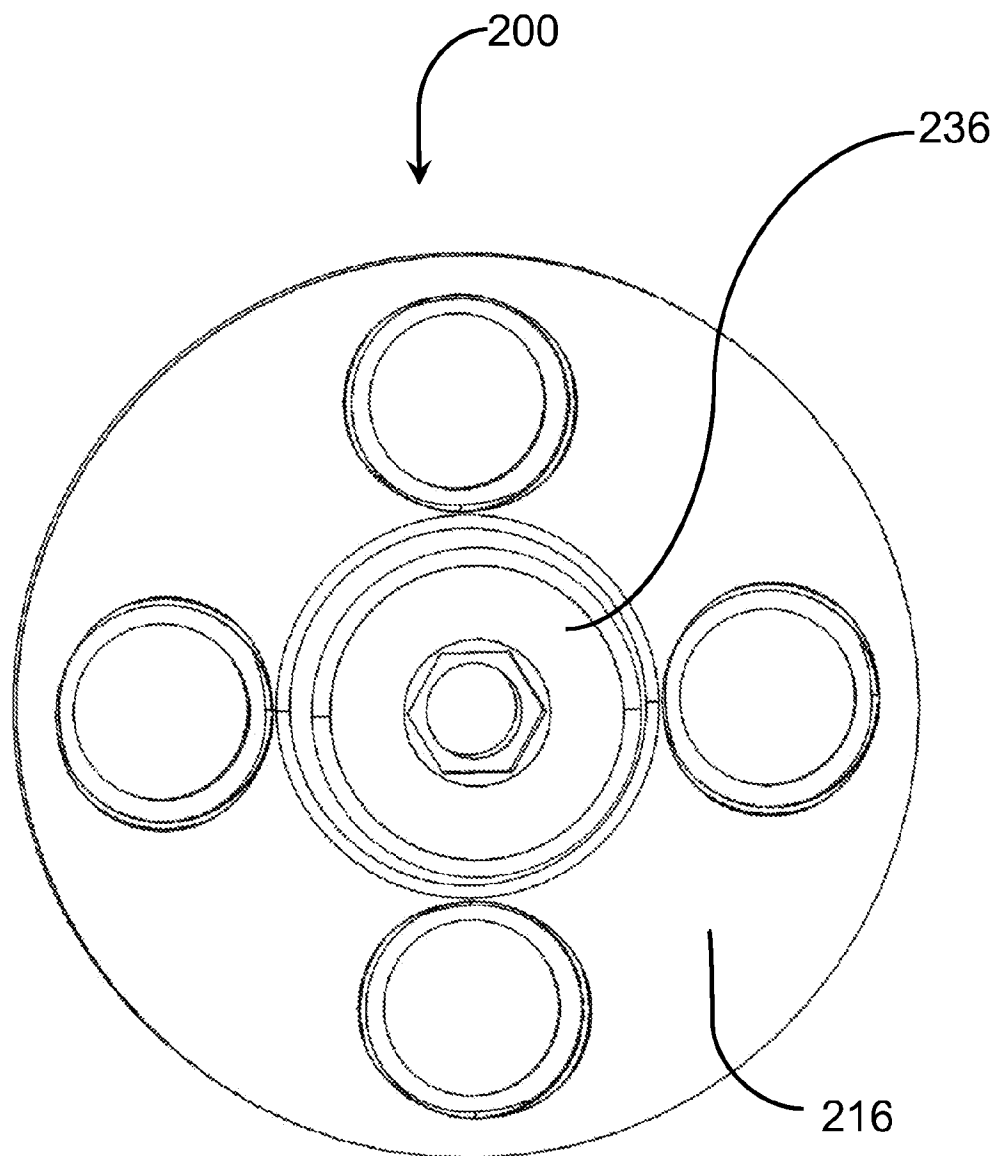


FIG. 12

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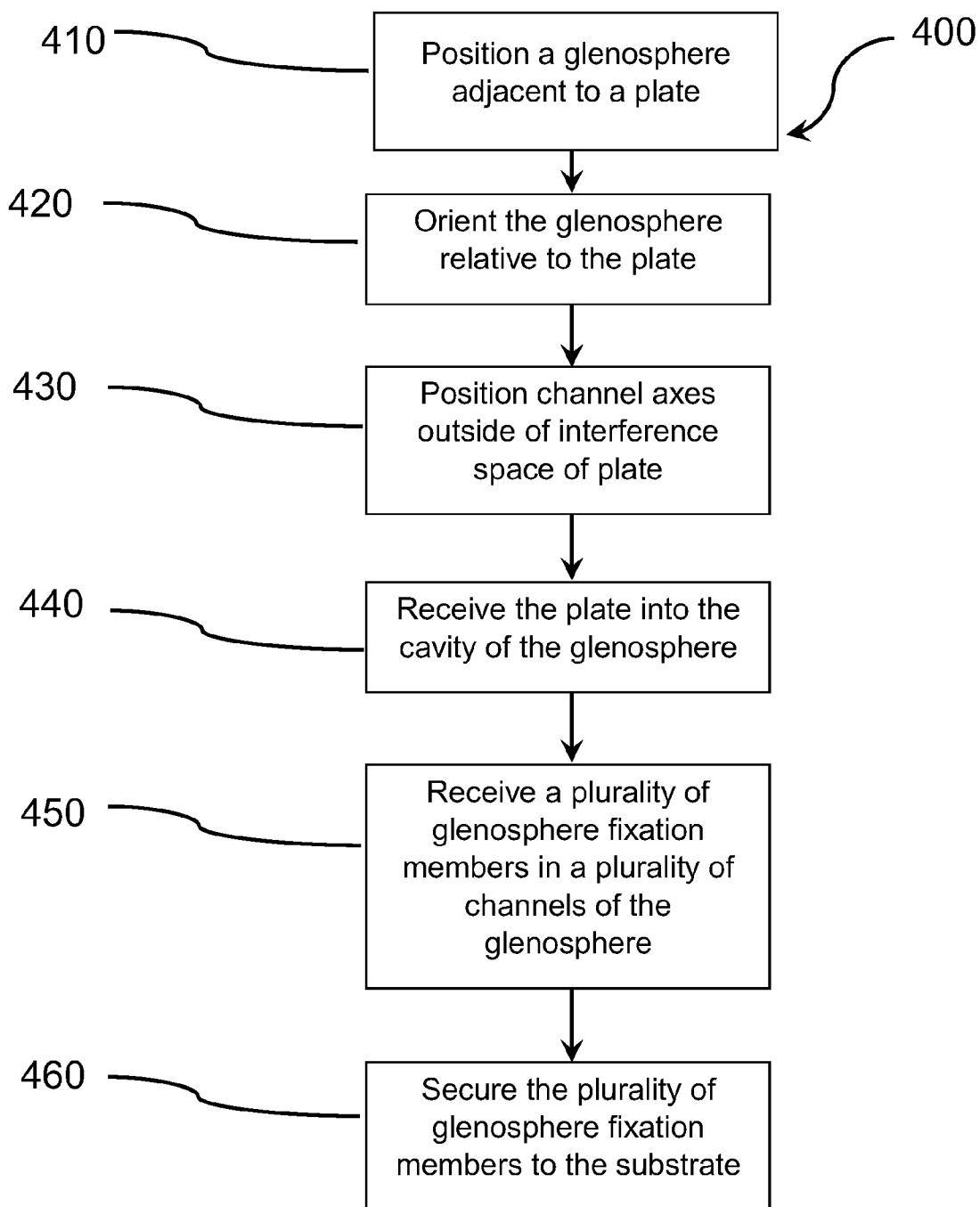


FIG. 13

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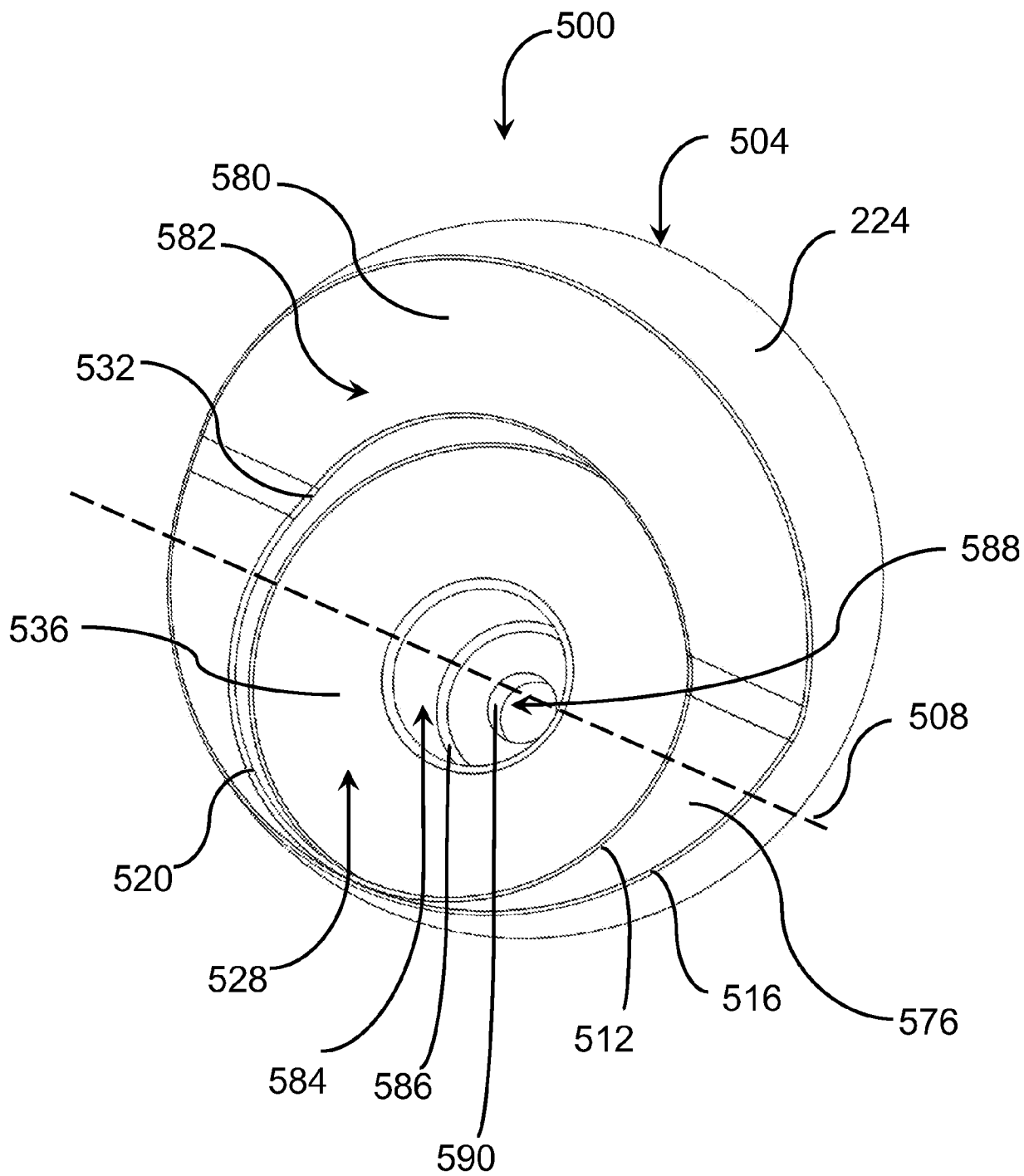


FIG. 14



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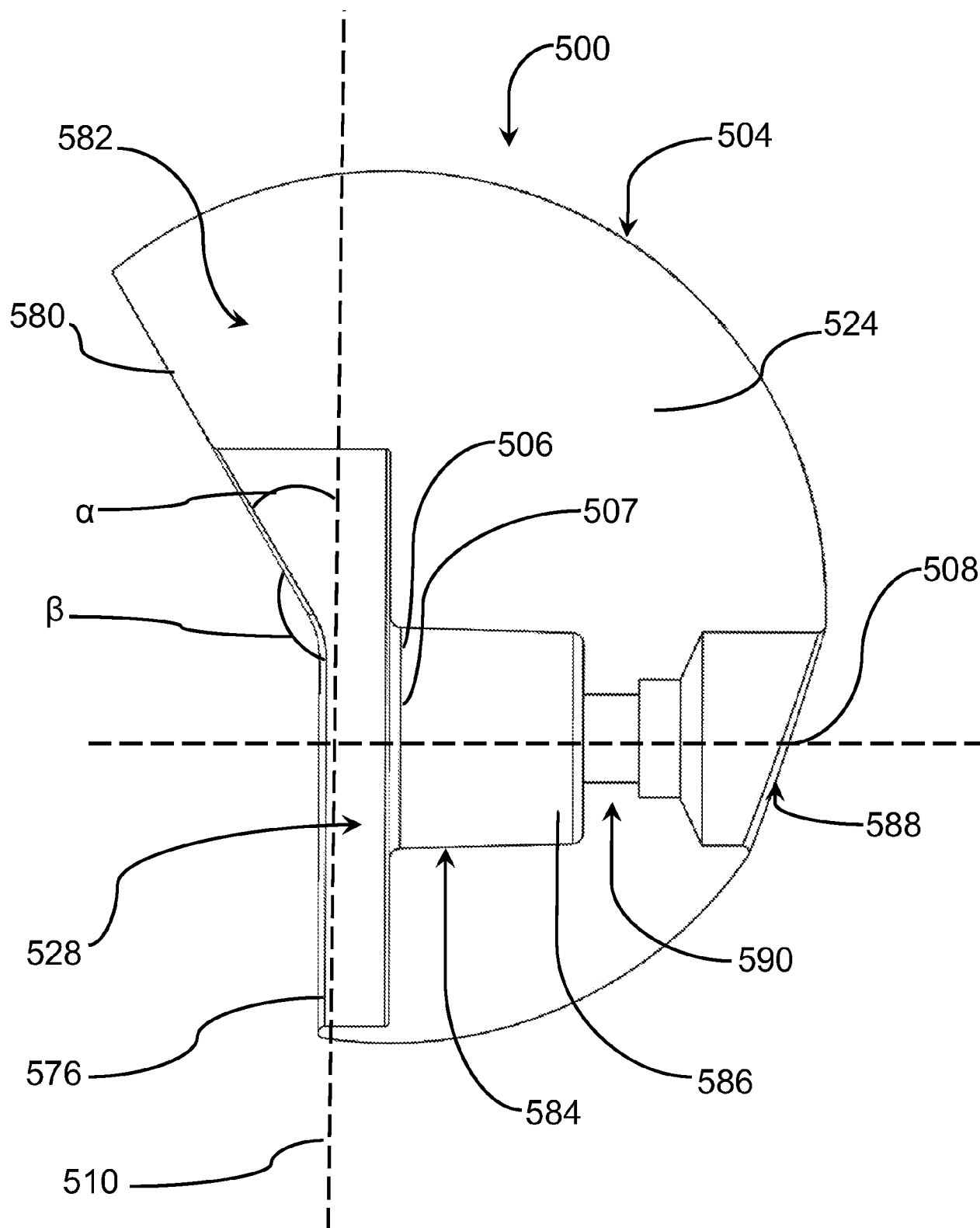


FIG. 15

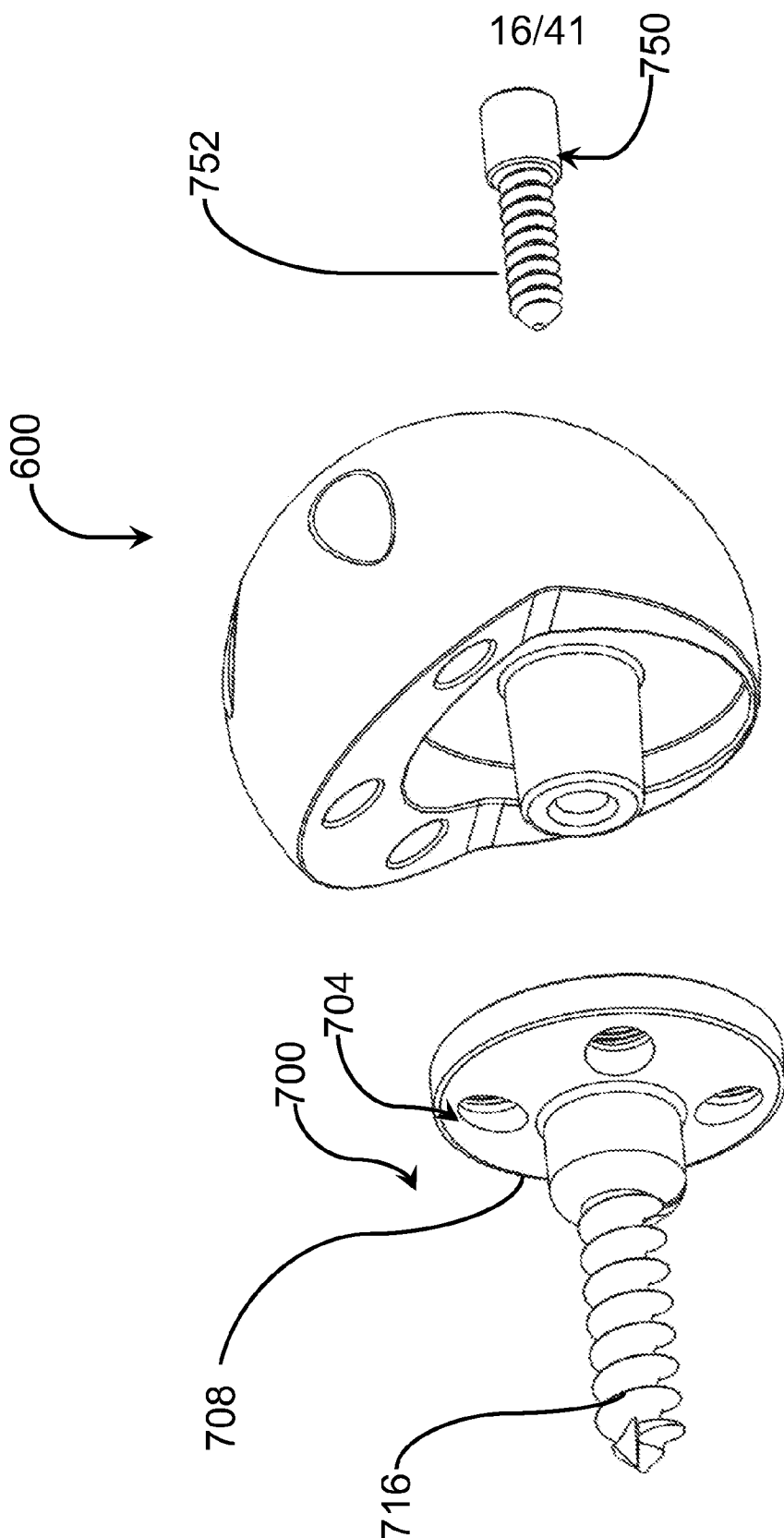


FIG. 16

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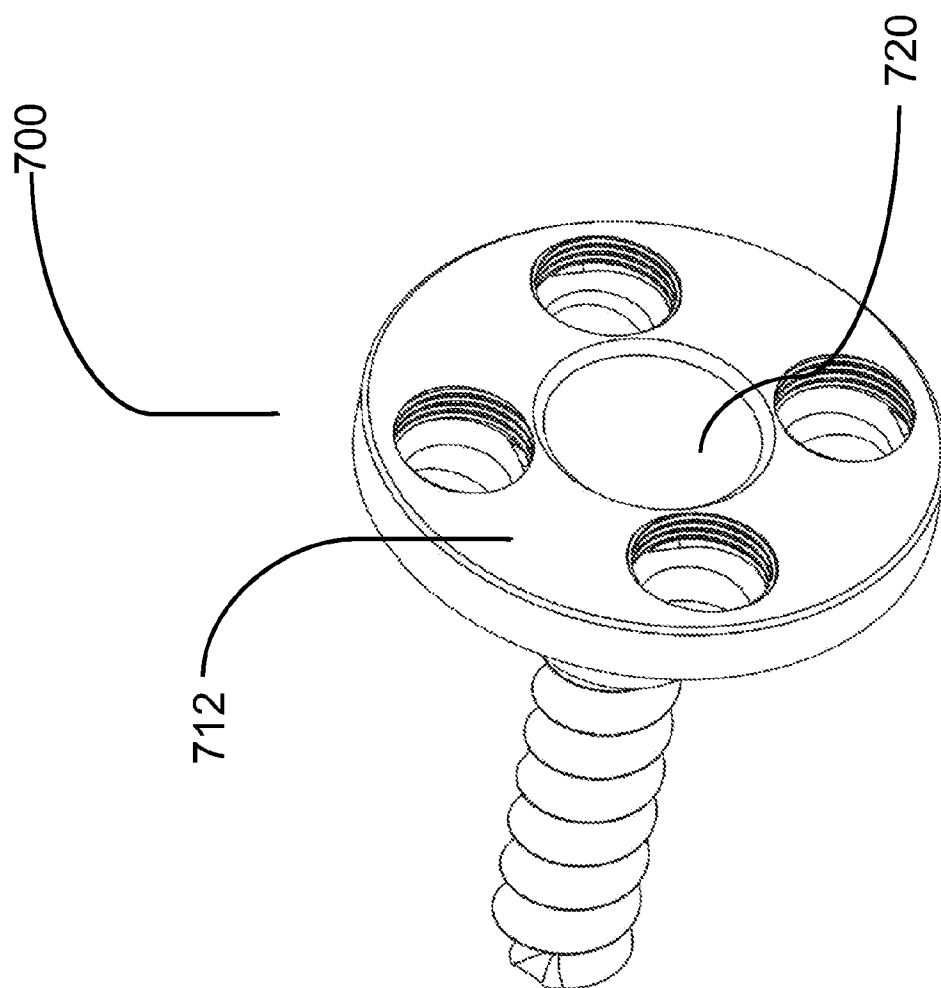


FIG. 17

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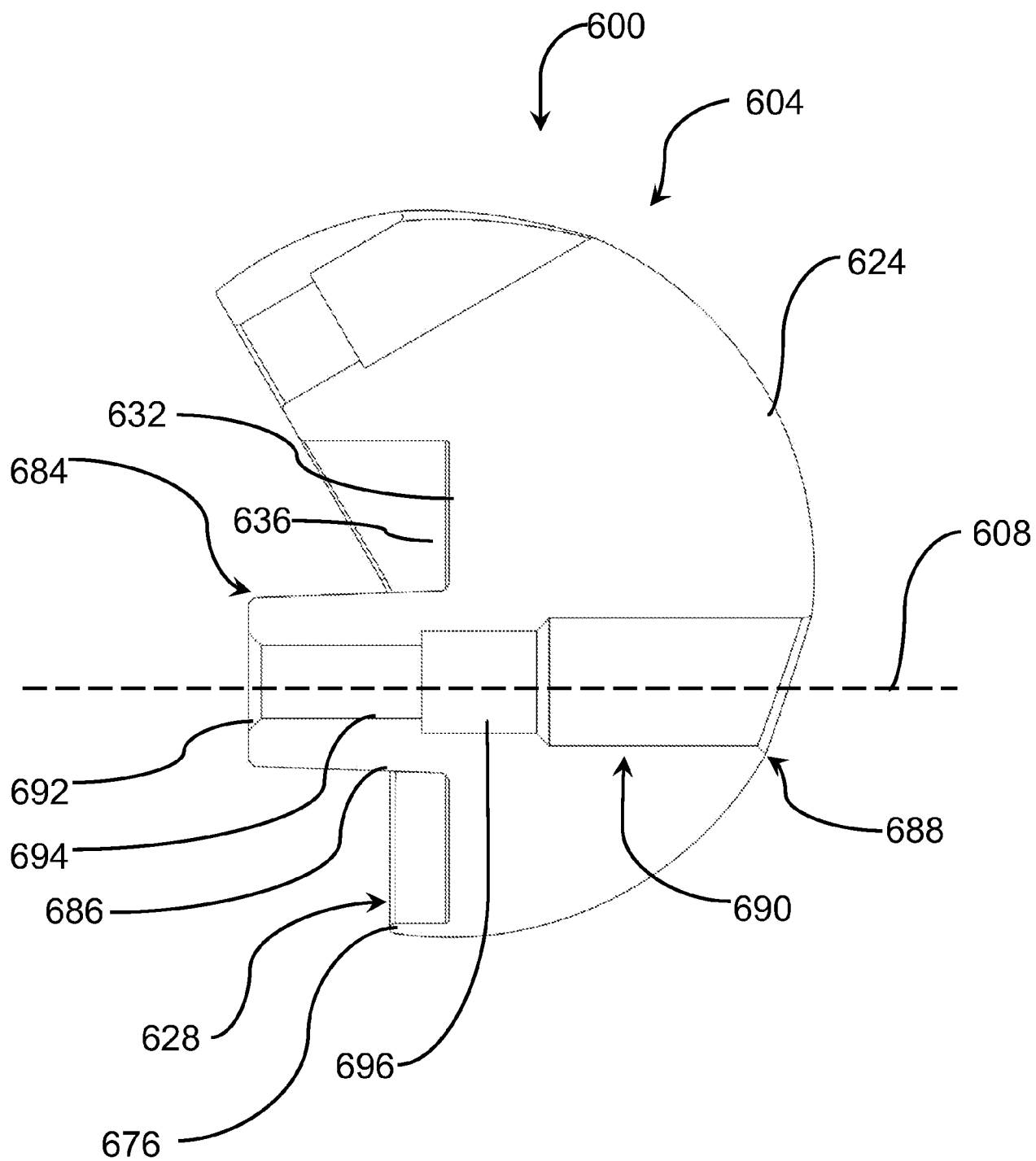


FIG. 18

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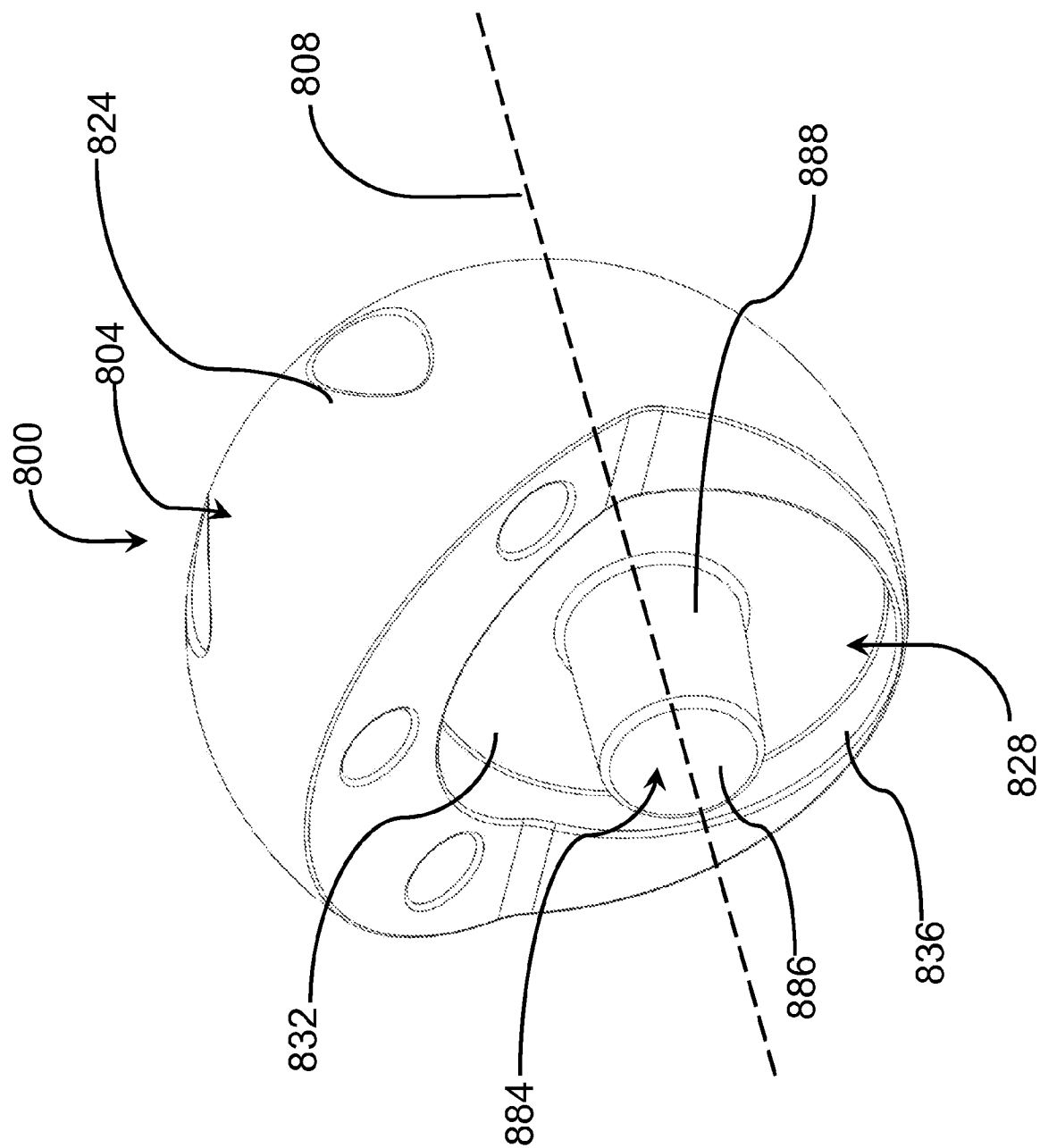


FIG. 19

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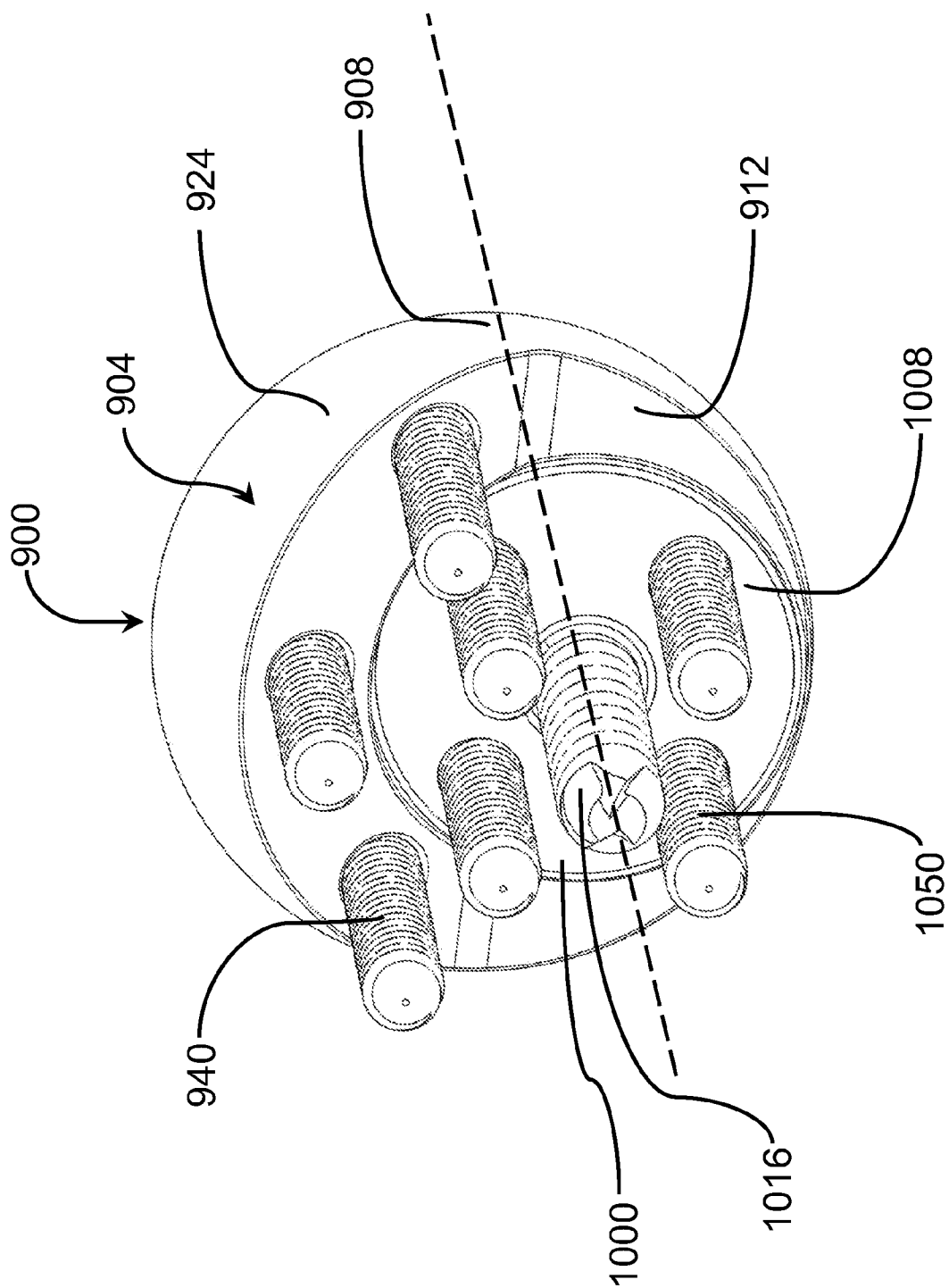


FIG. 20

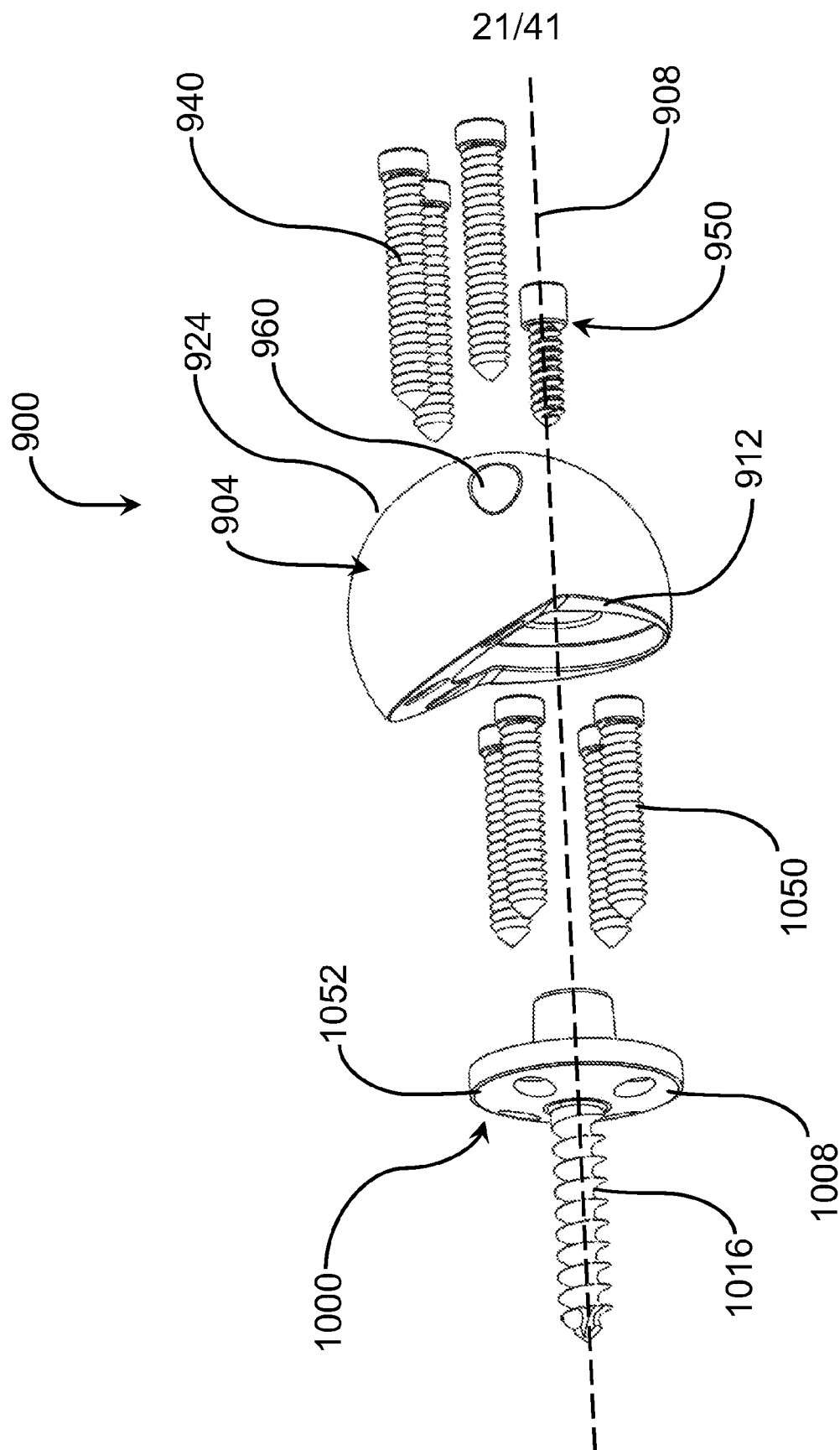


FIG. 21





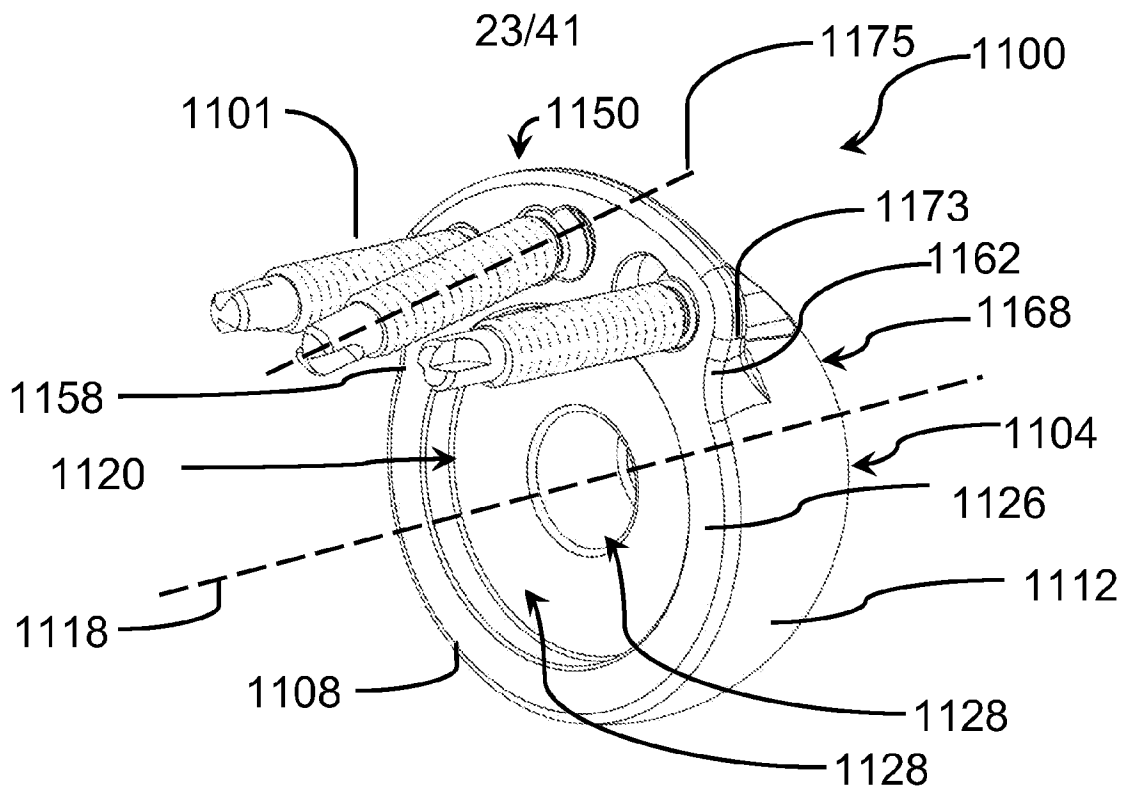


FIG. 23A

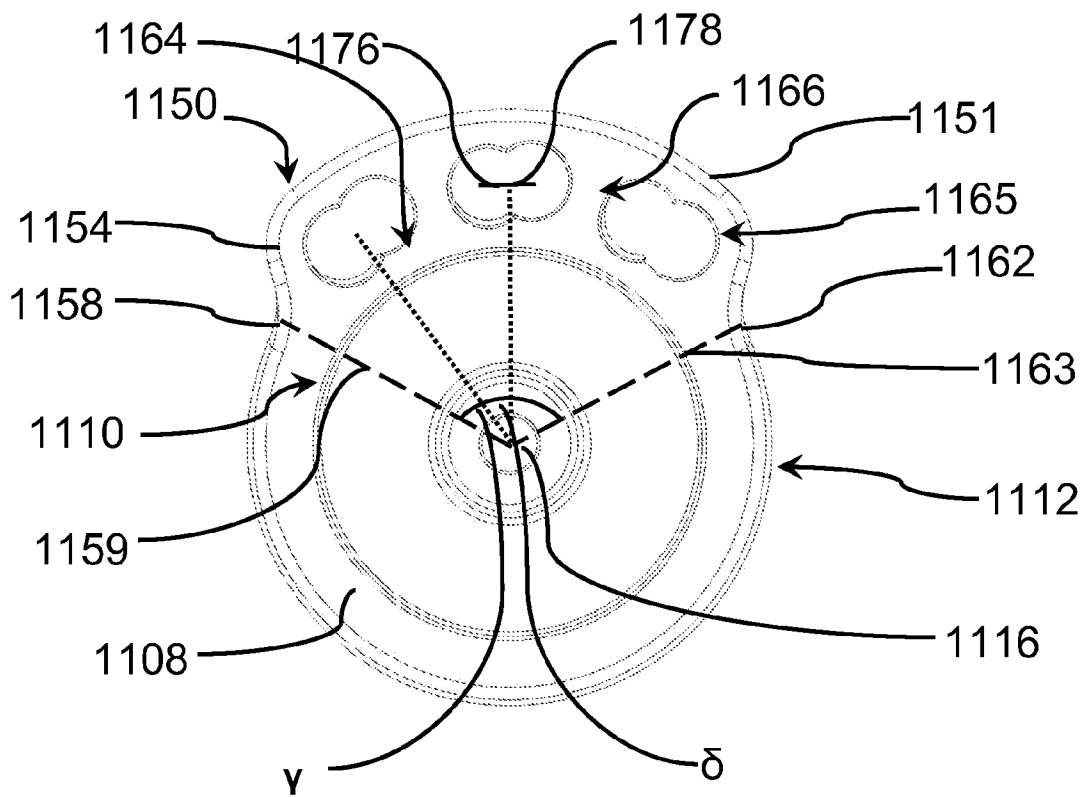


FIG. 23B

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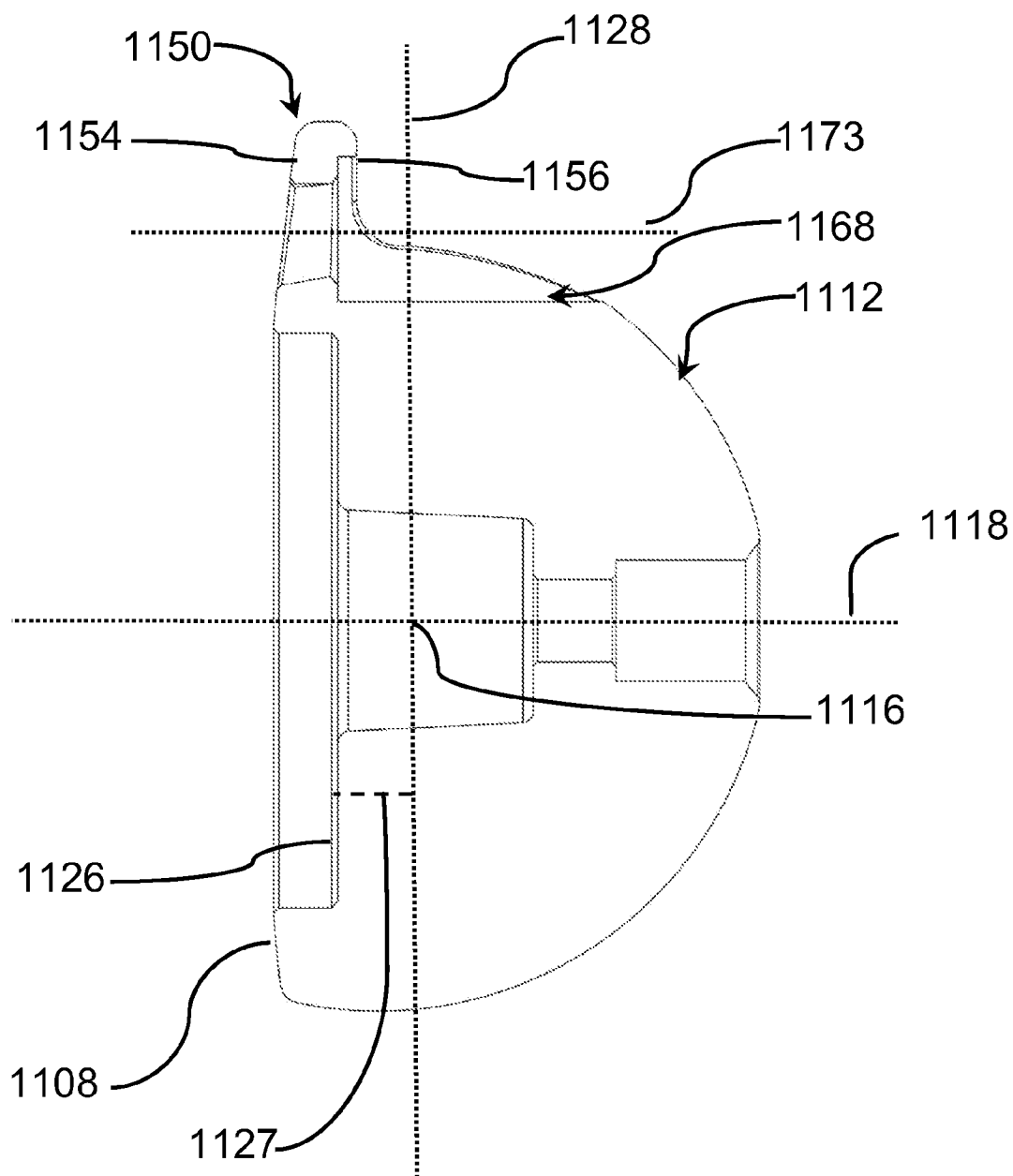


FIG. 23C

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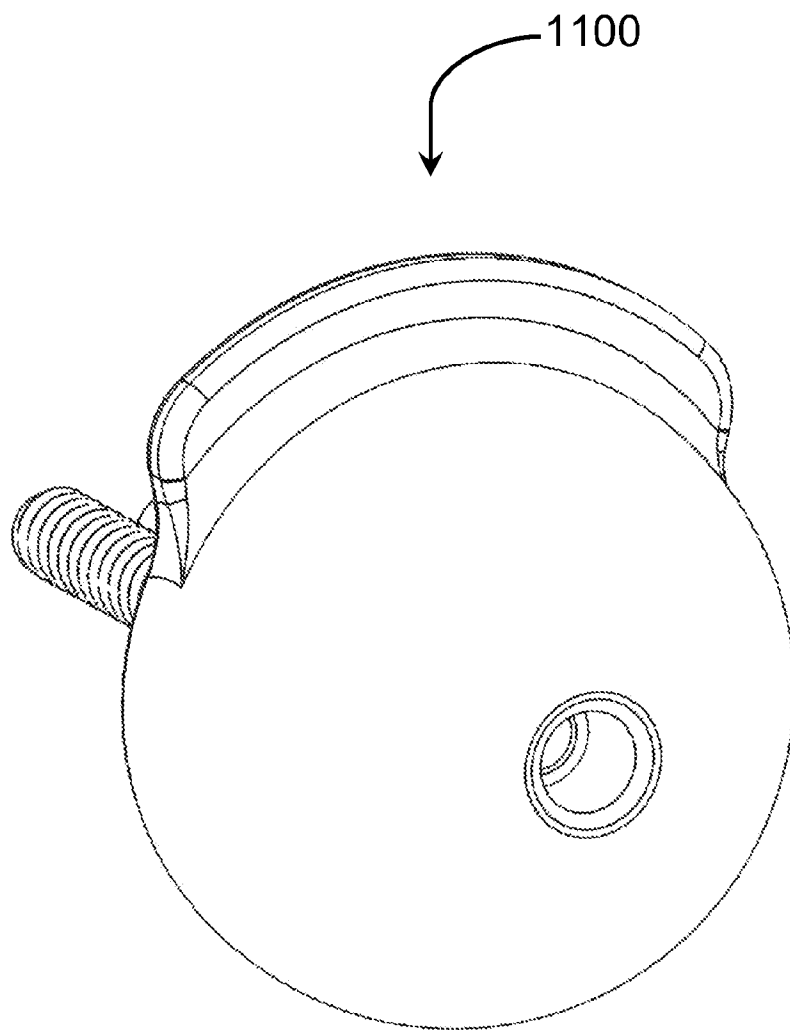


FIG. 24

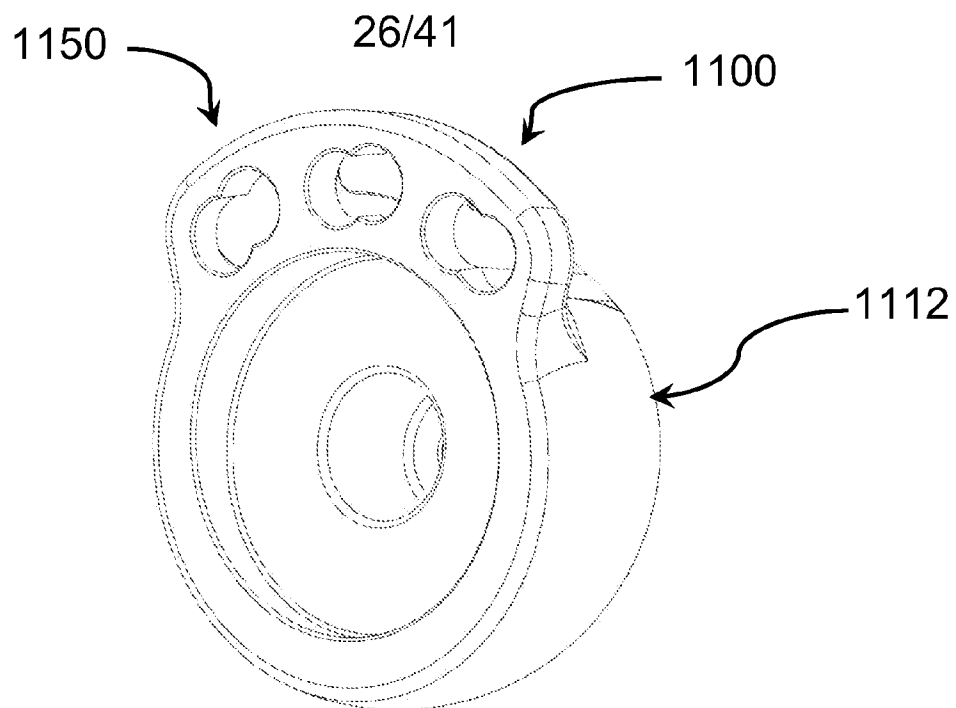
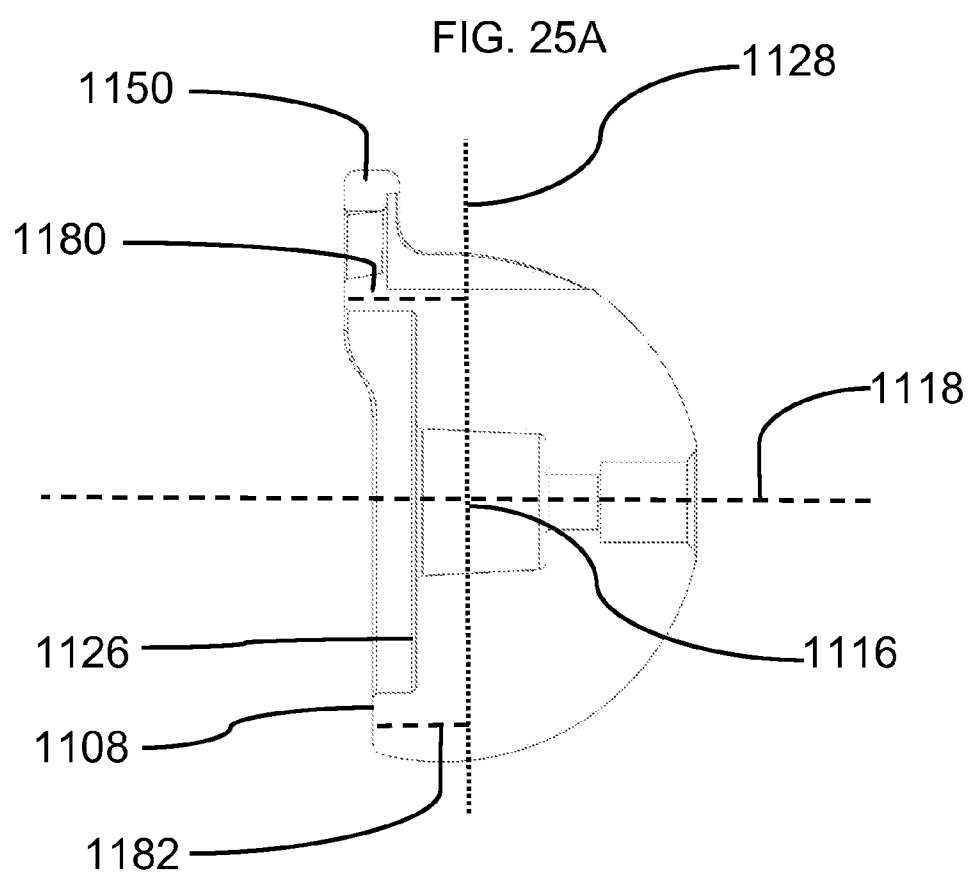


FIG. 25B

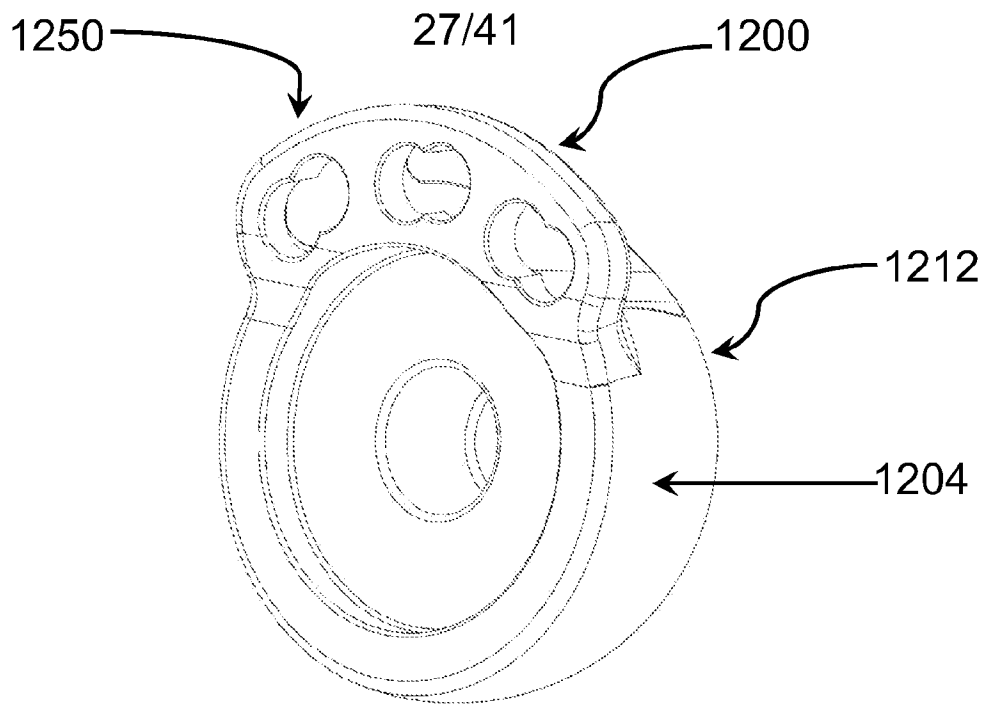
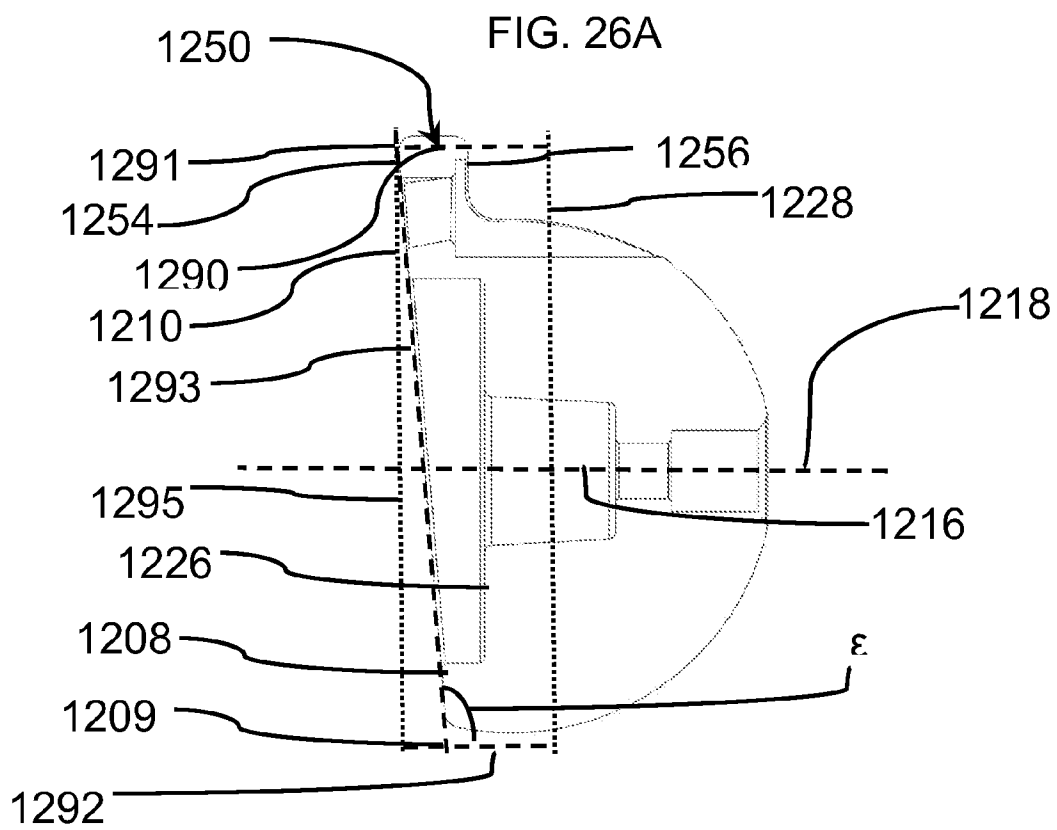
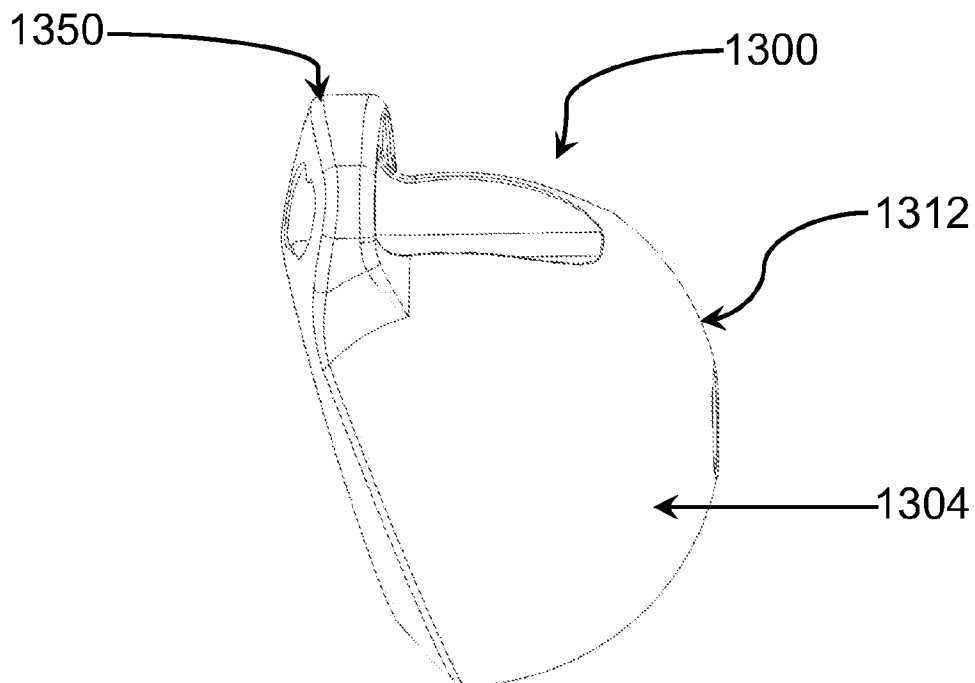
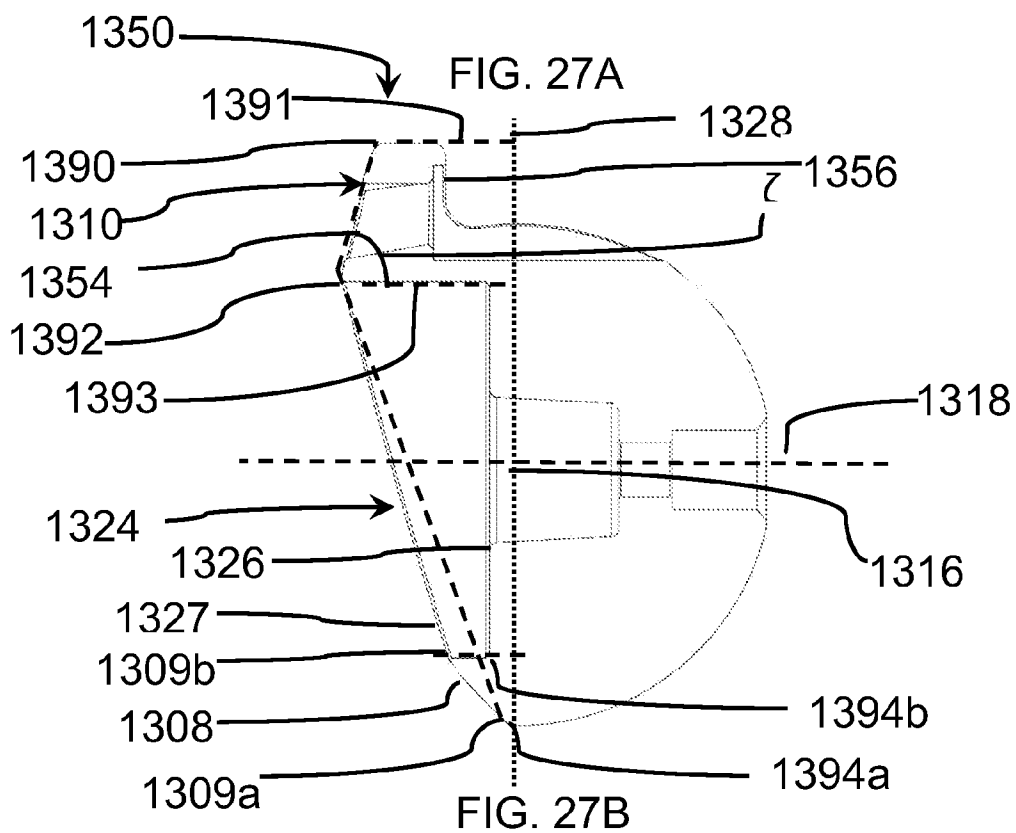


FIG. 26B

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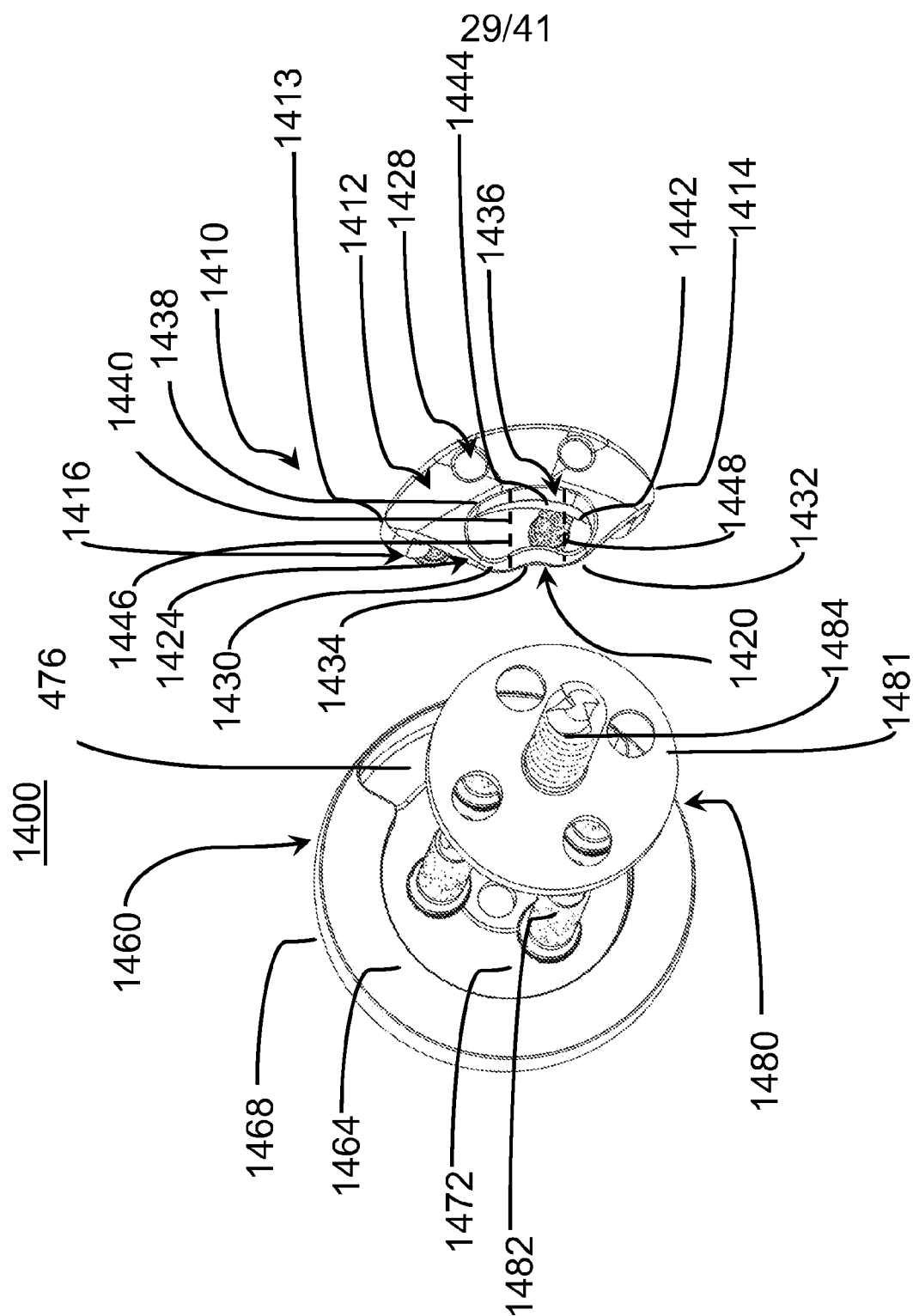


FIG. 28A

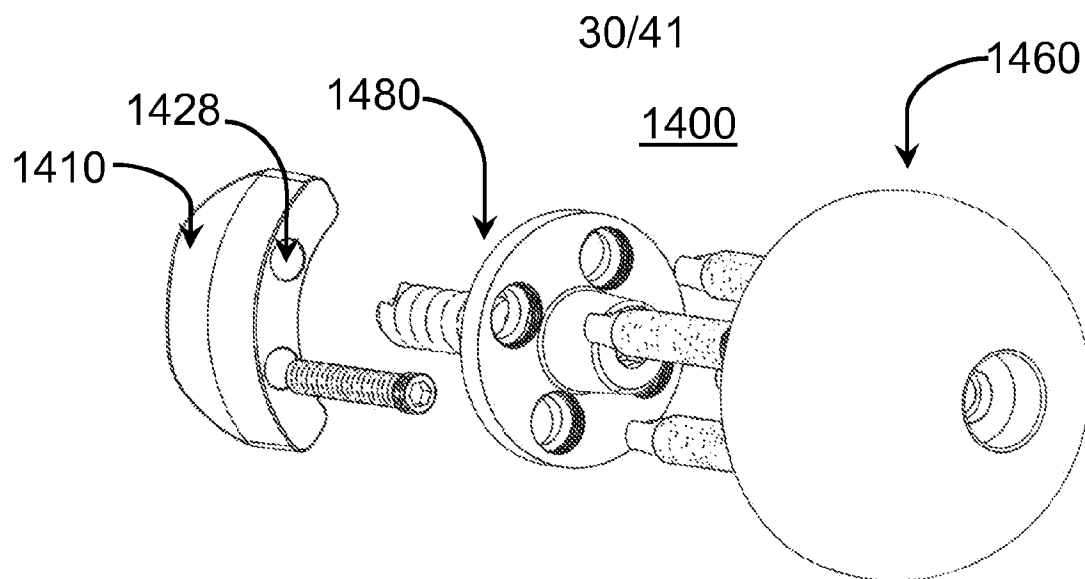


FIG. 28B

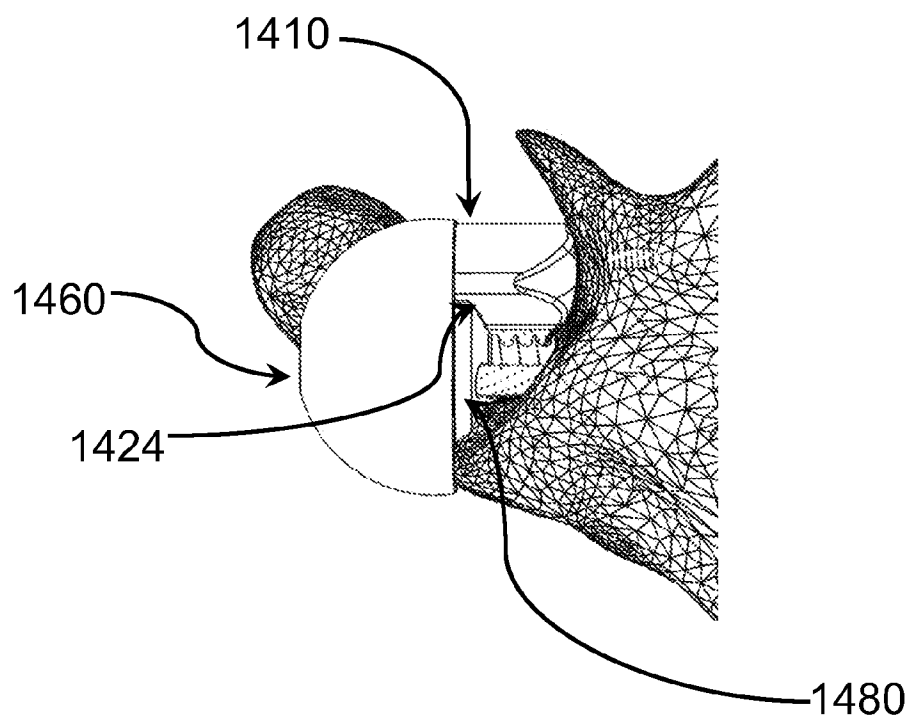


FIG. 28C



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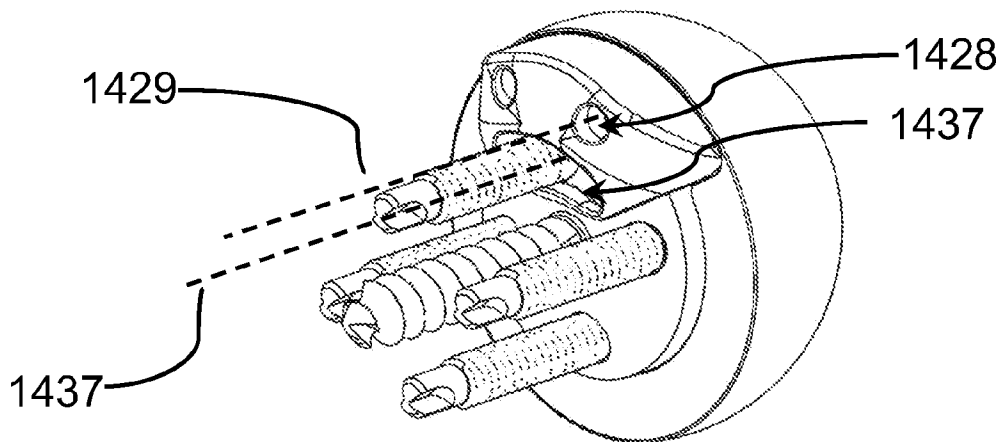


FIG. 28D

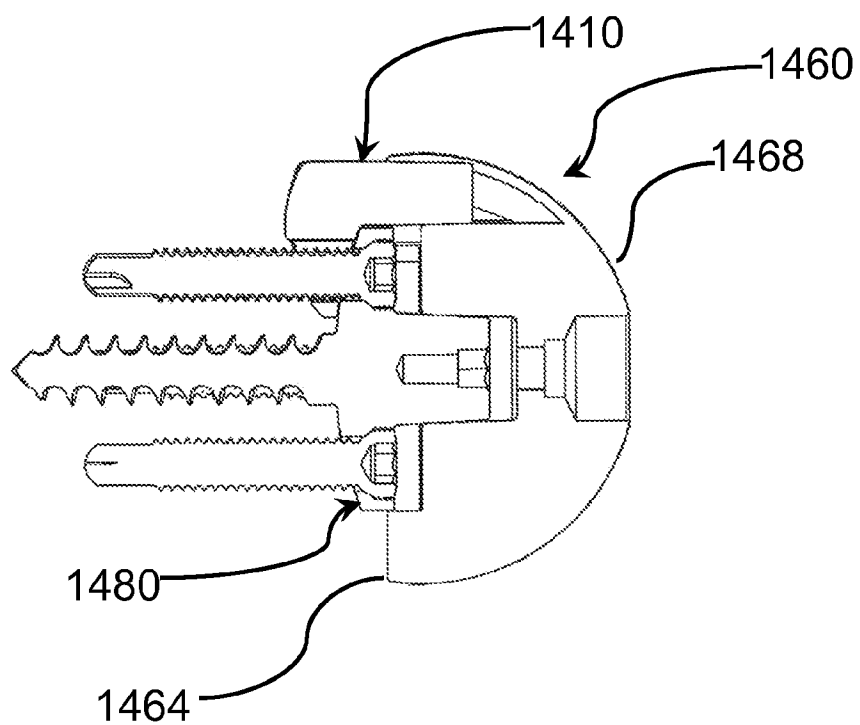


FIG. 28E

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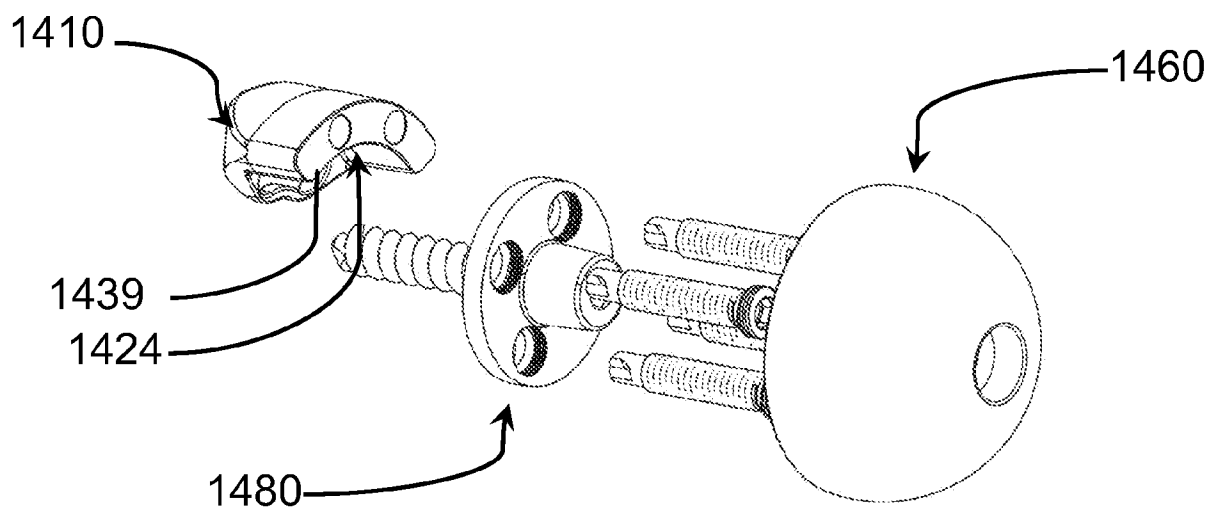


FIG. 28F

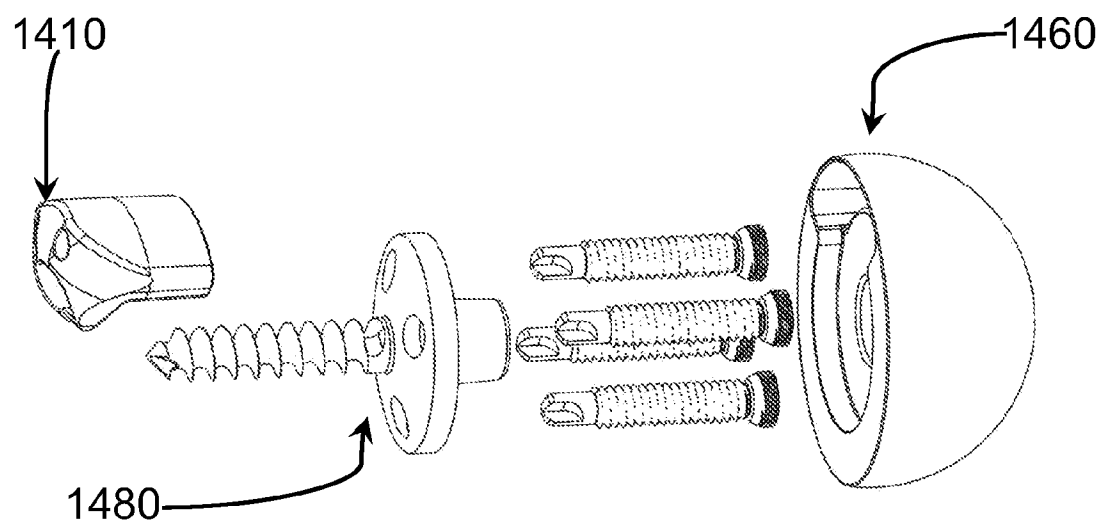


FIG. 28G

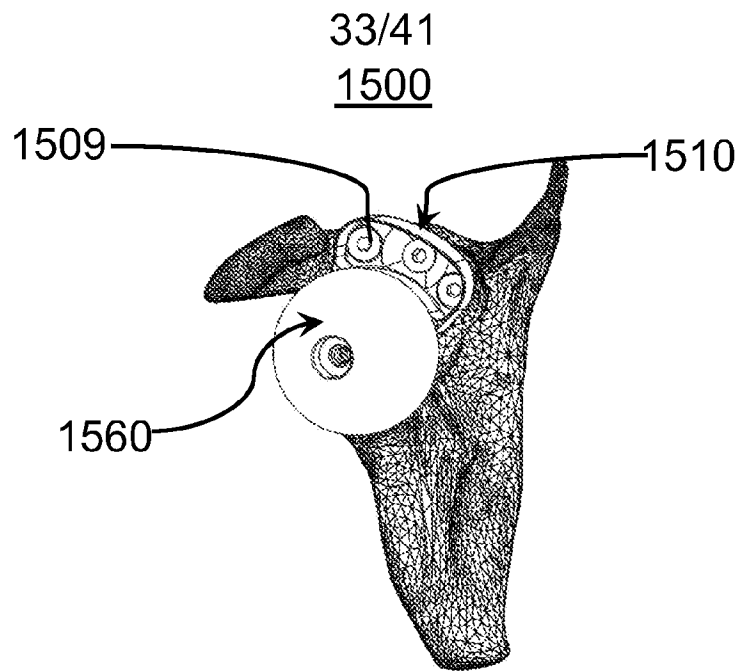


FIG. 29A

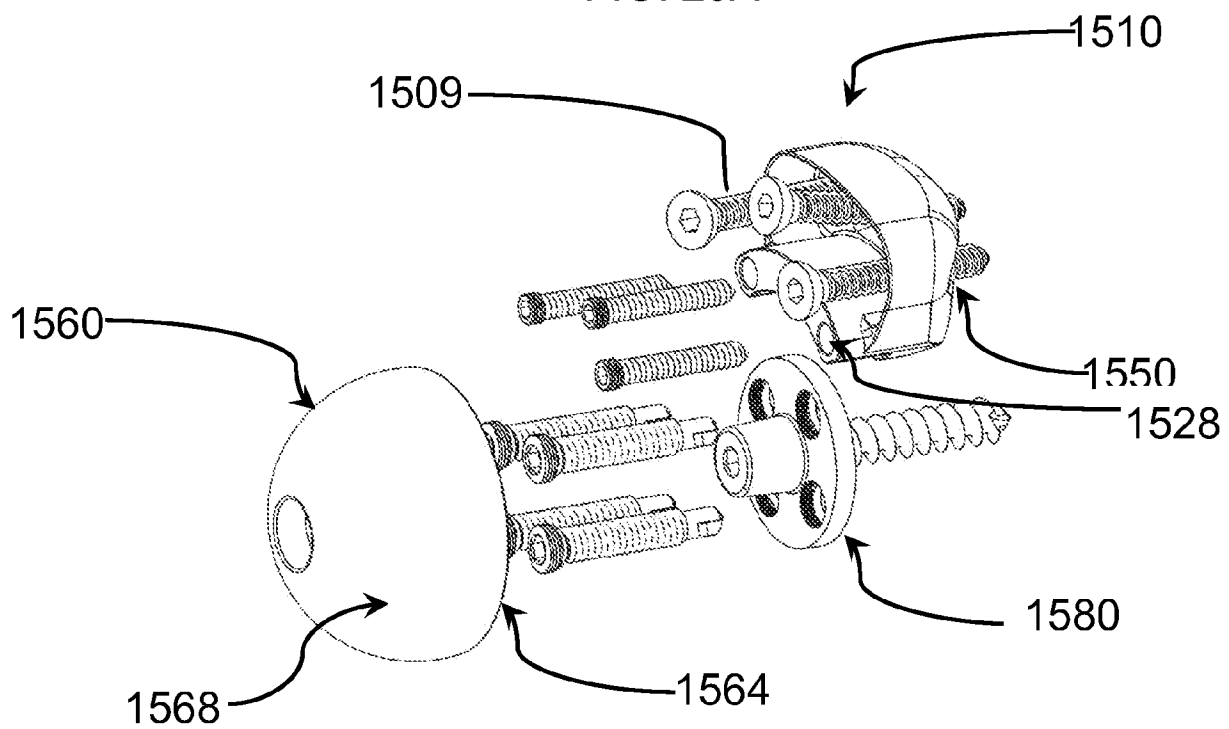


FIG. 29B

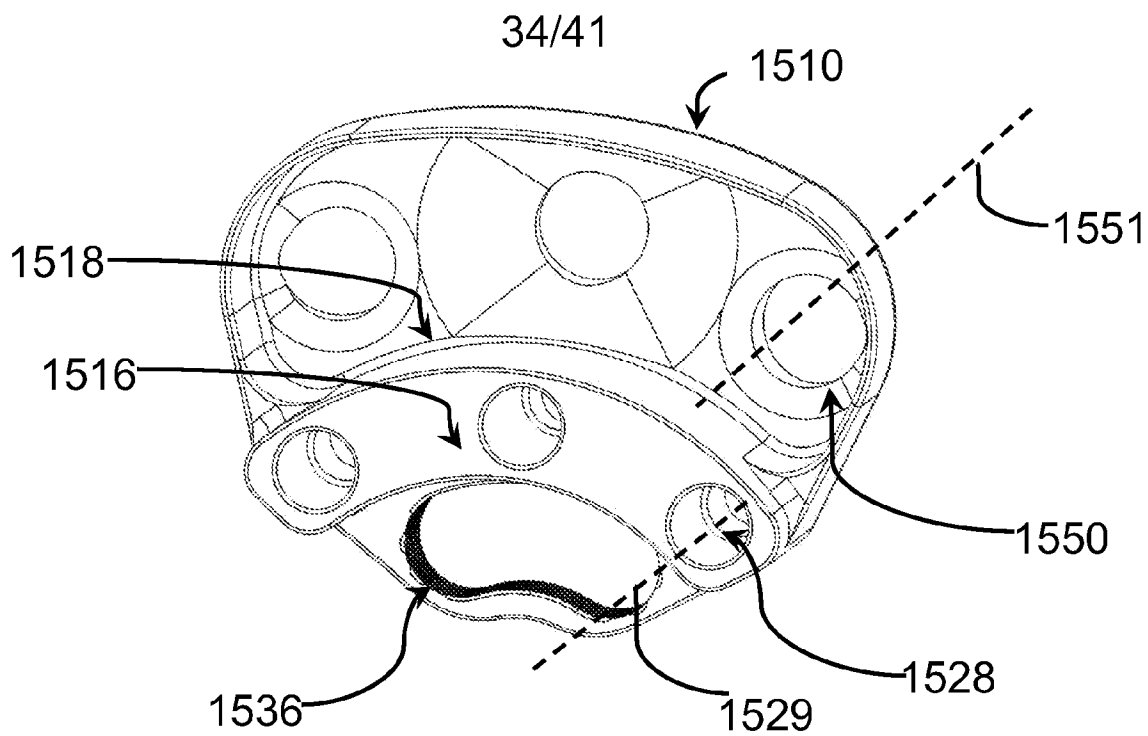


FIG. 29C

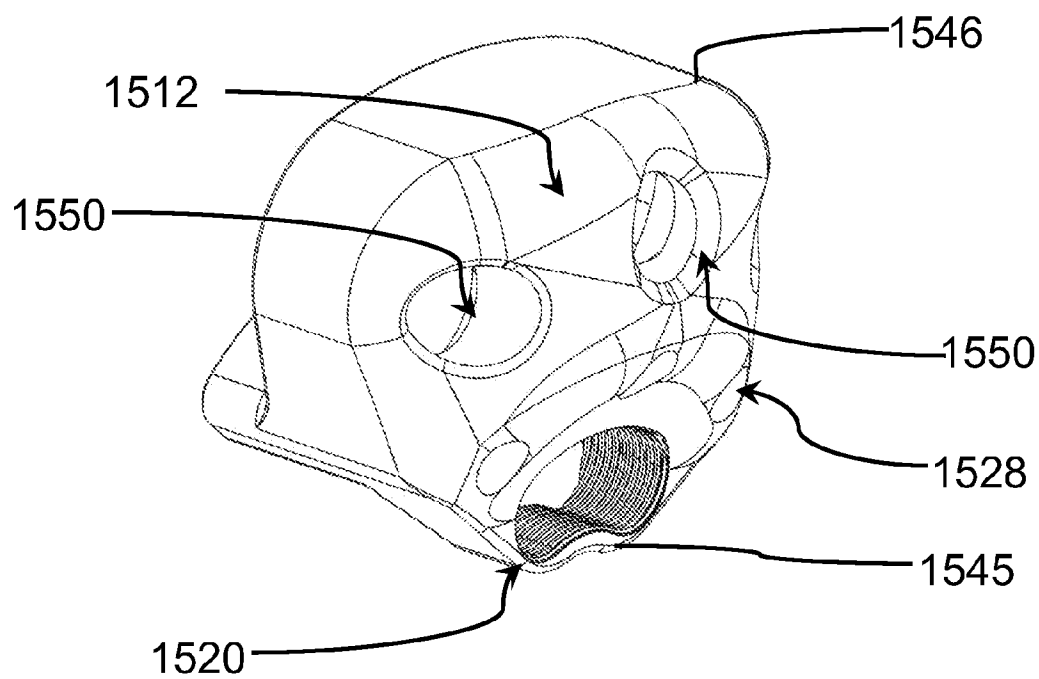


FIG. 29D

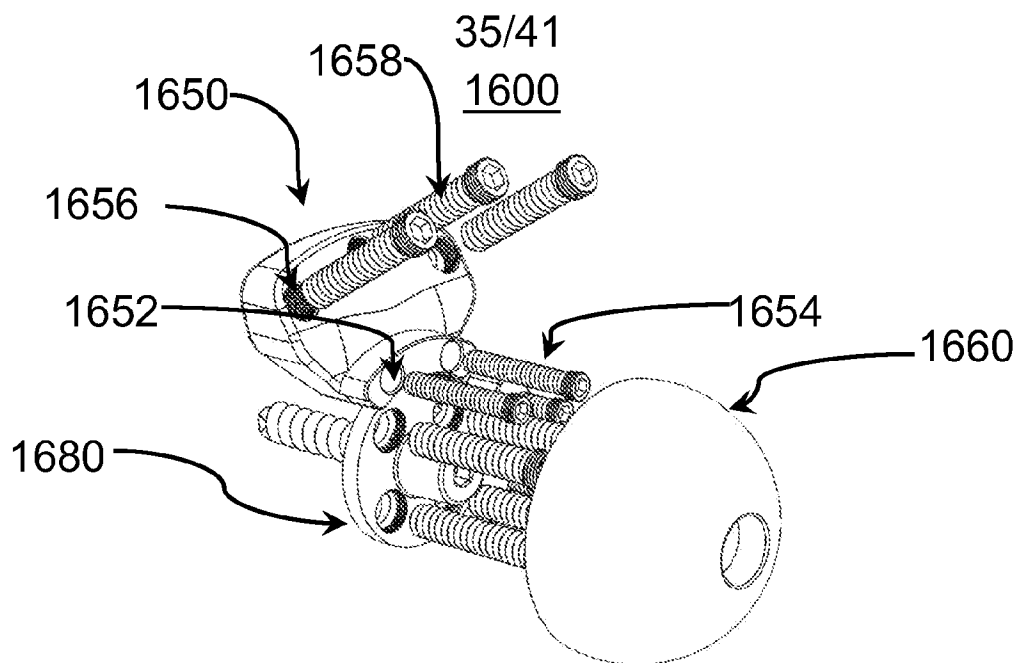


FIG. 30A

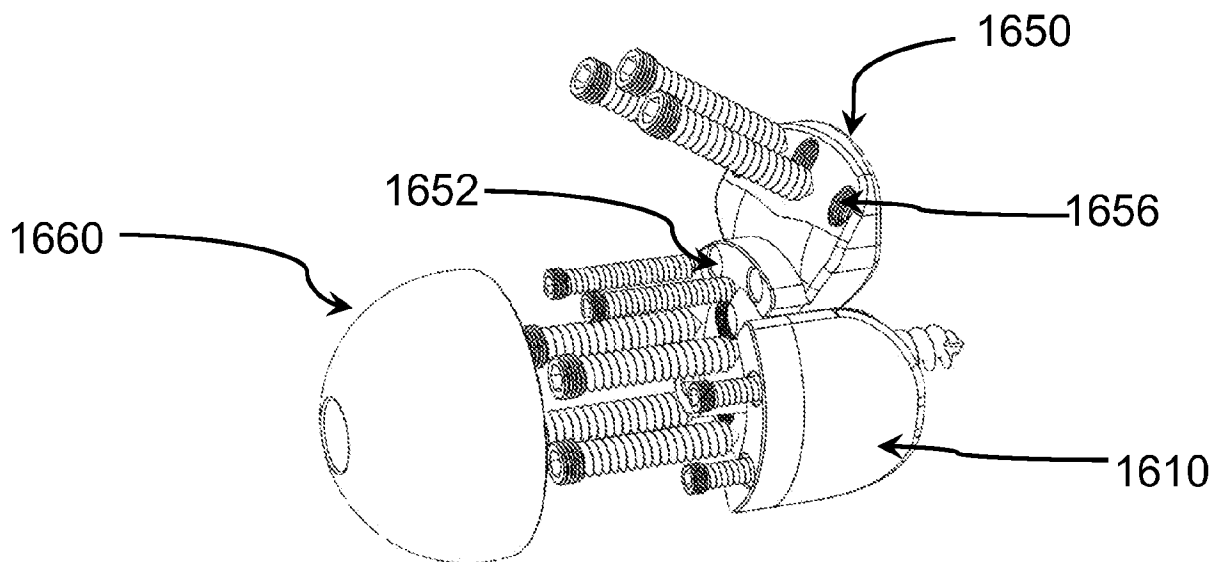


FIG. 30B

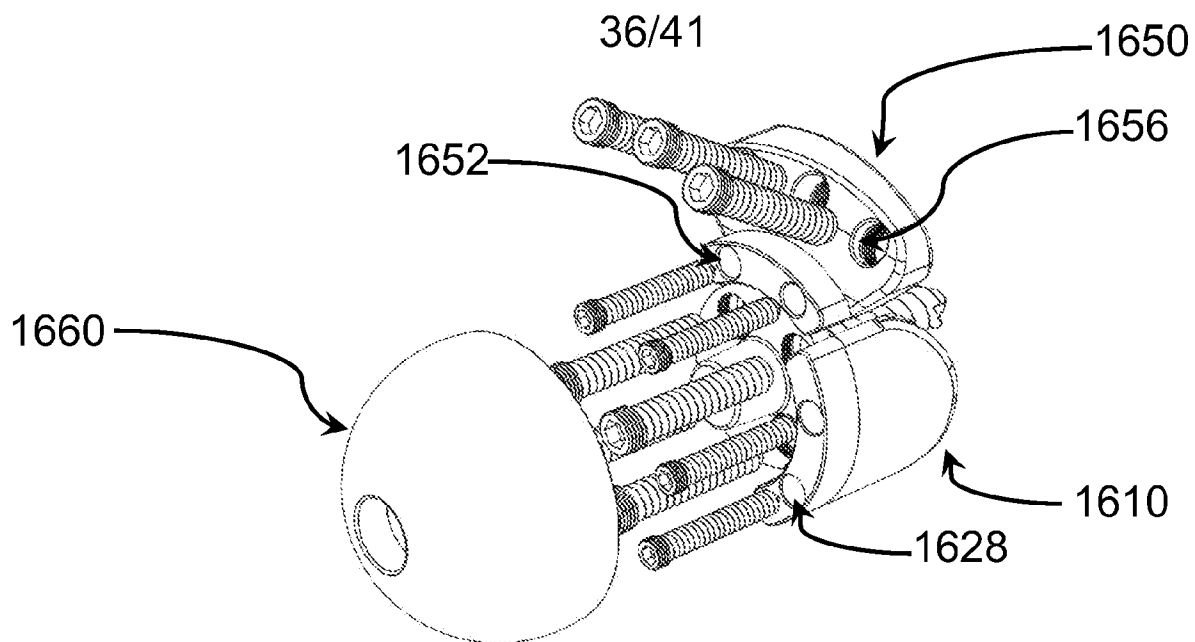


FIG. 30C

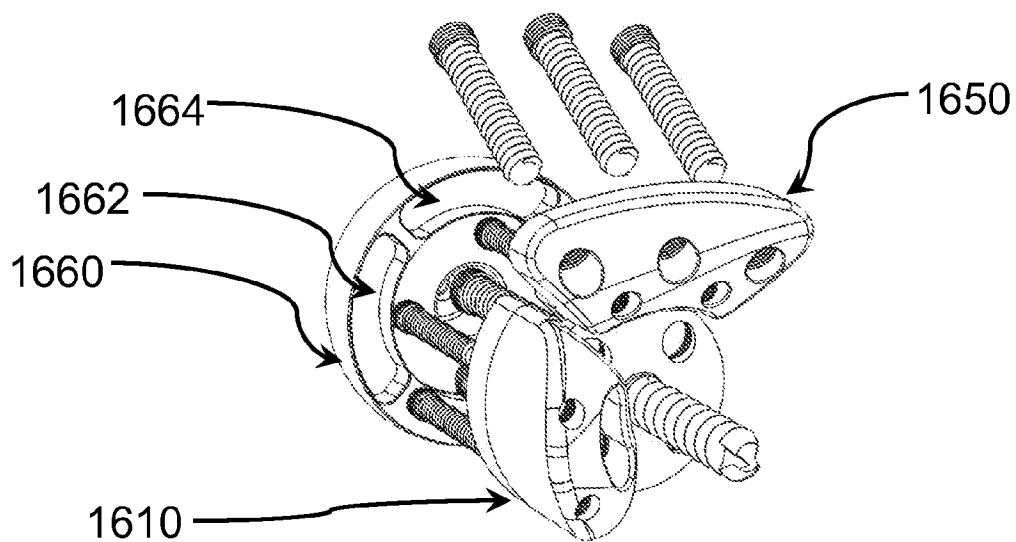


FIG. 30D

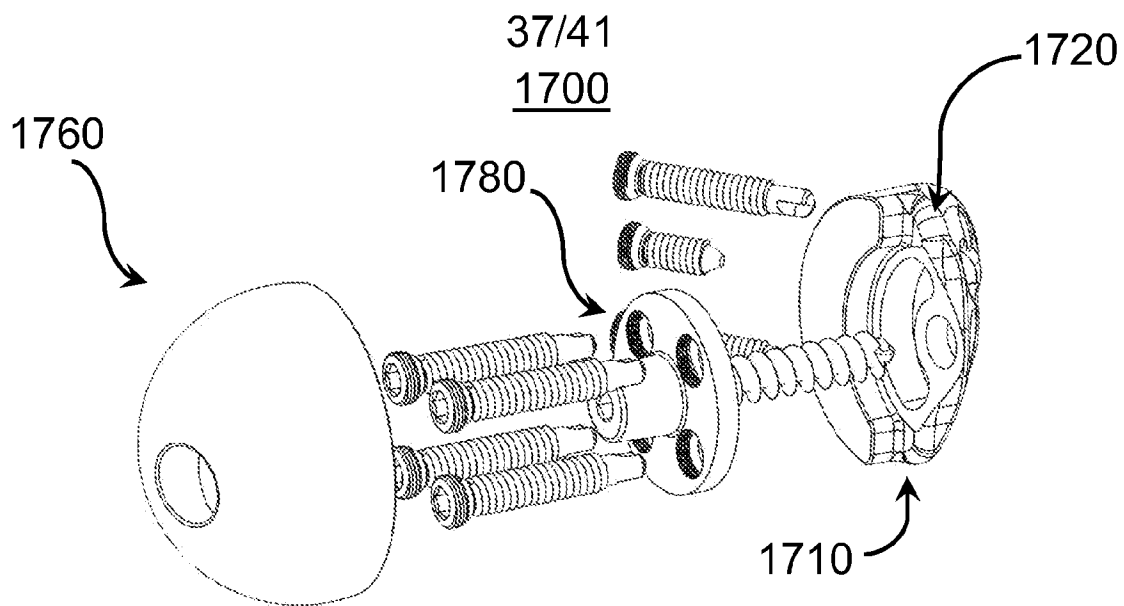


FIG. 31A

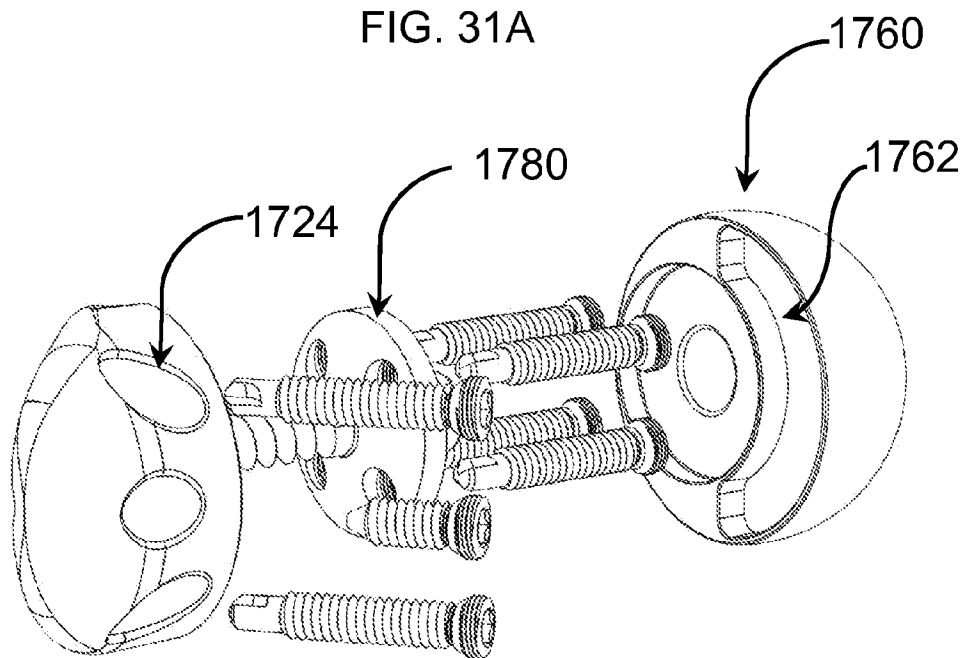


FIG. 31B

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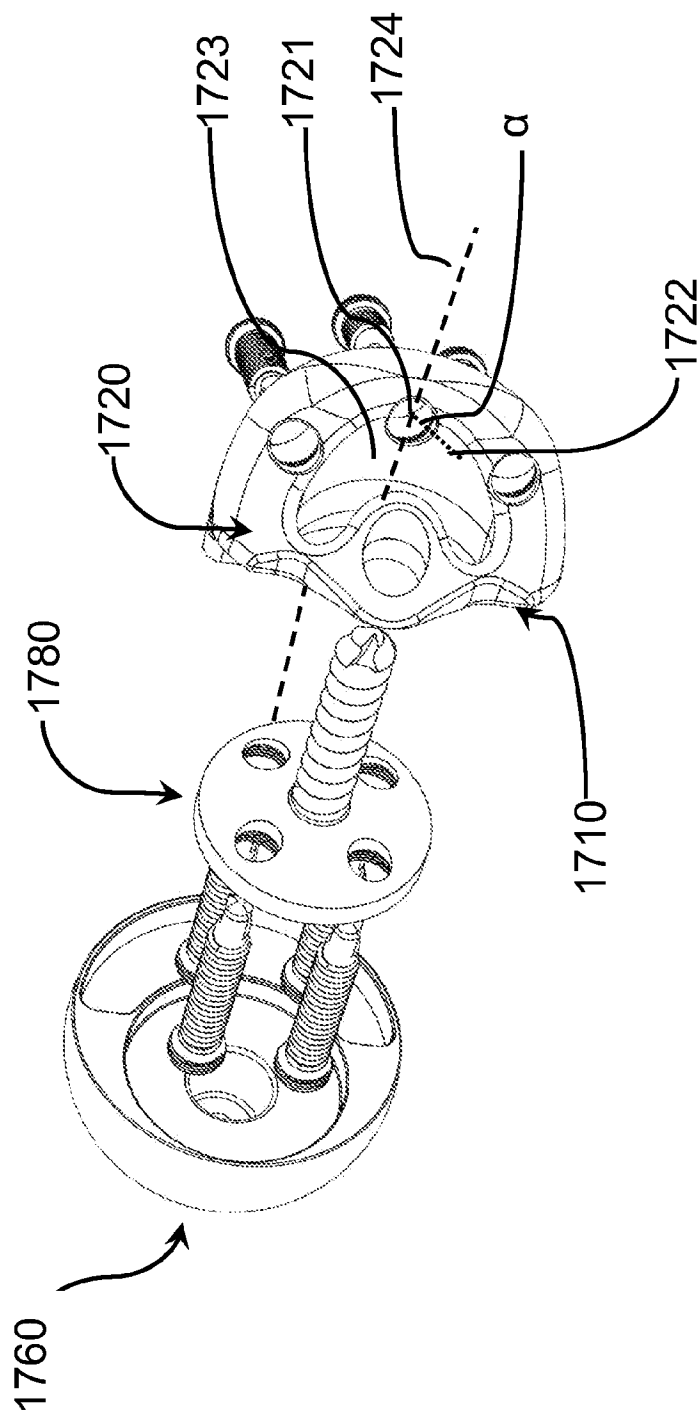


FIG. 31C



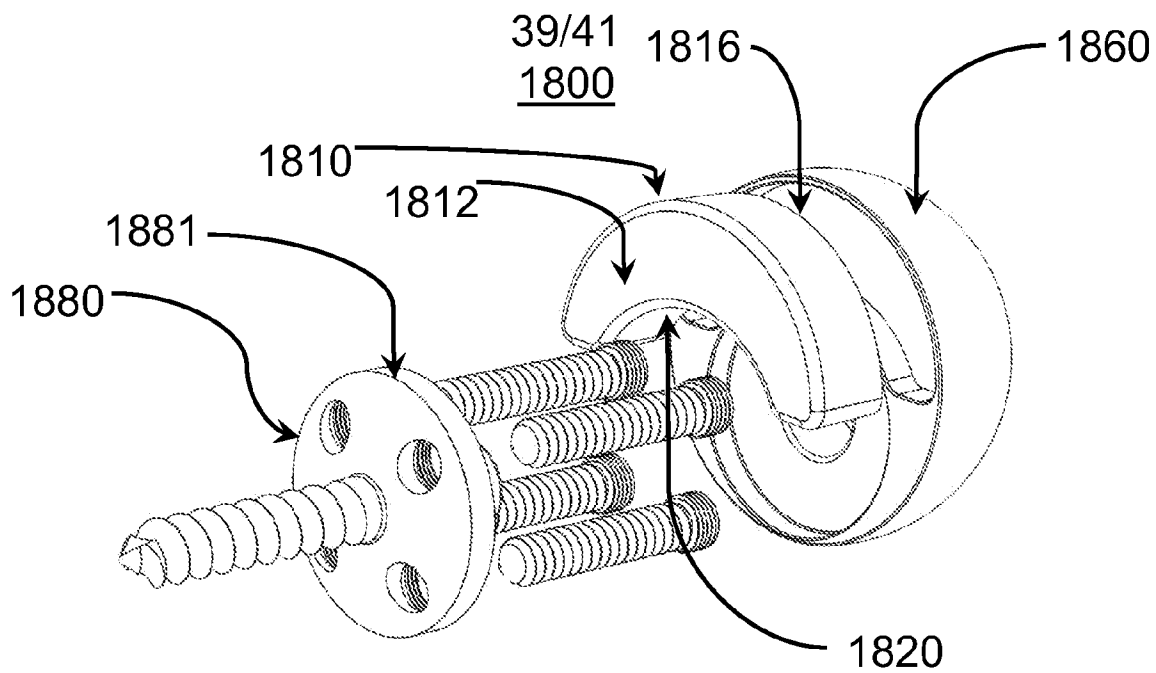


FIG. 32

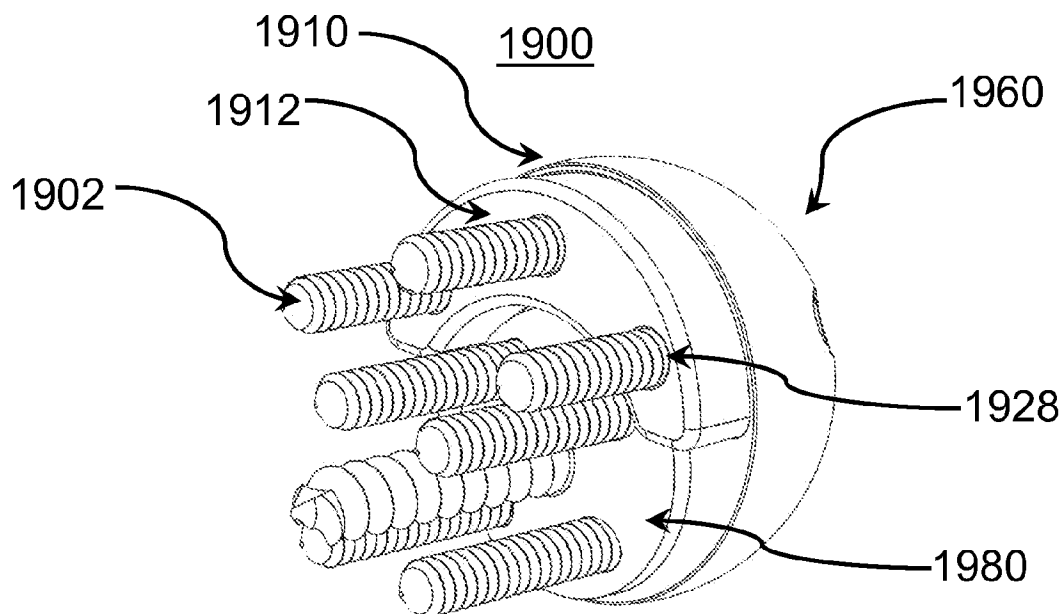


FIG. 33

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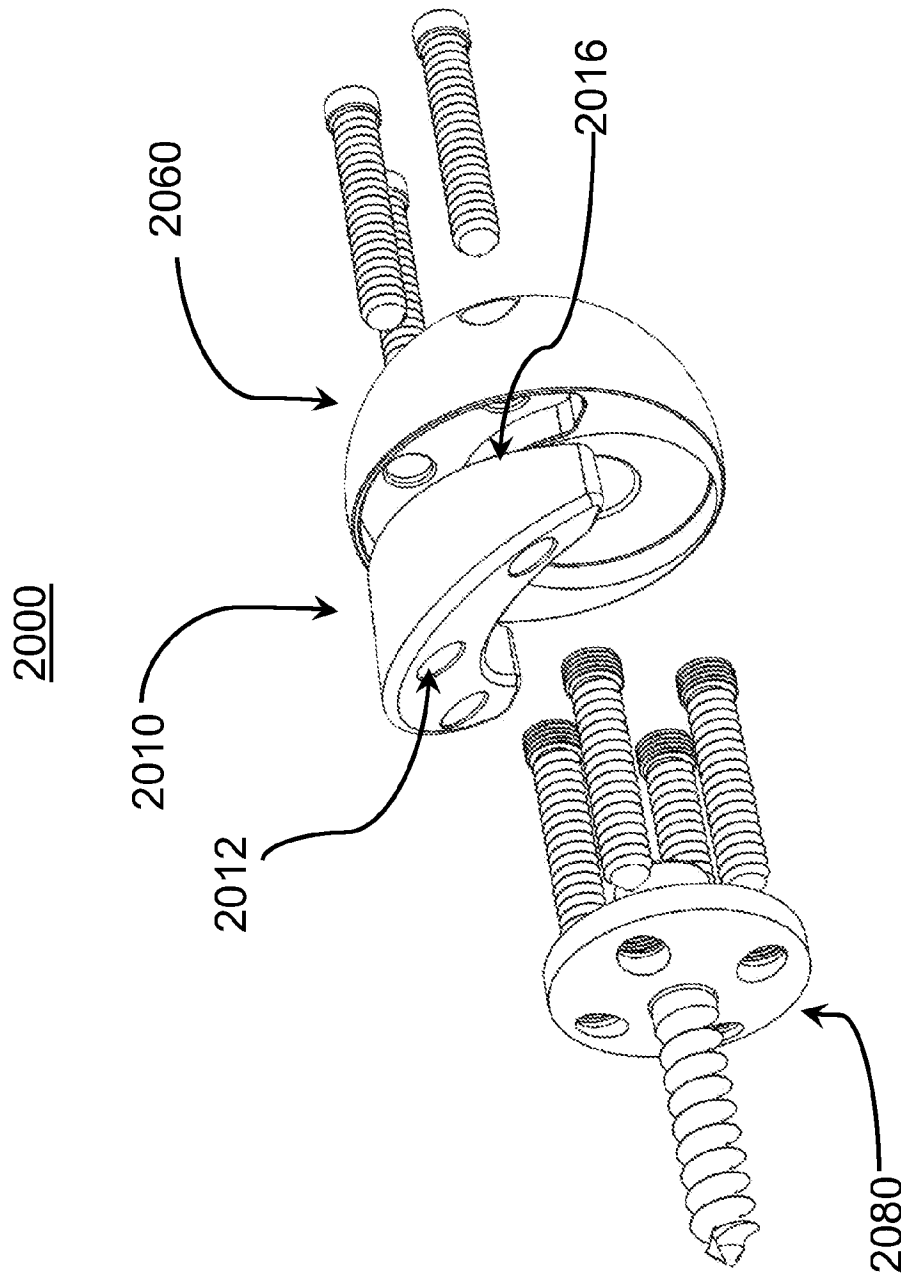


FIG. 34

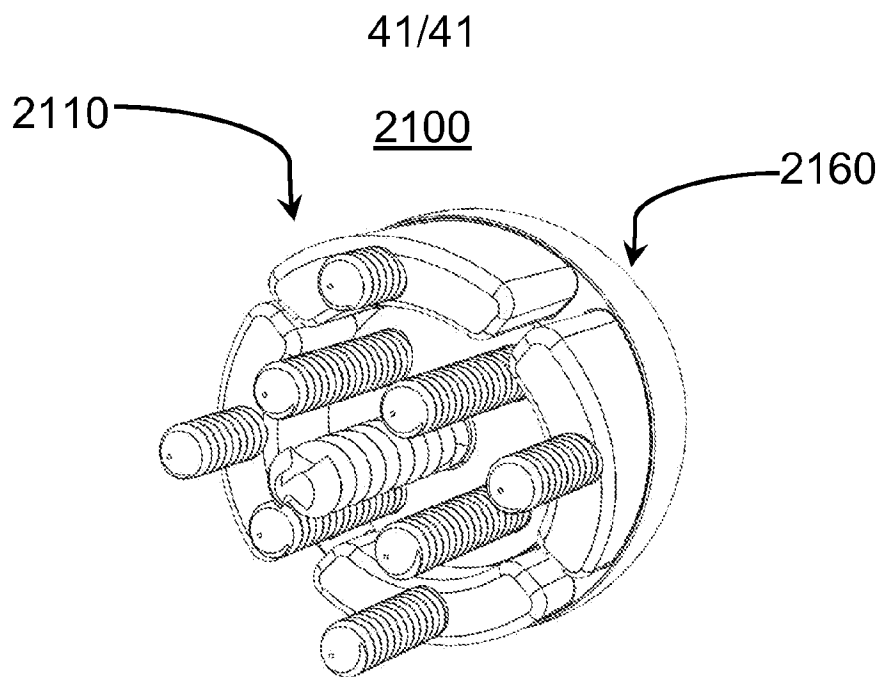


FIG. 35A

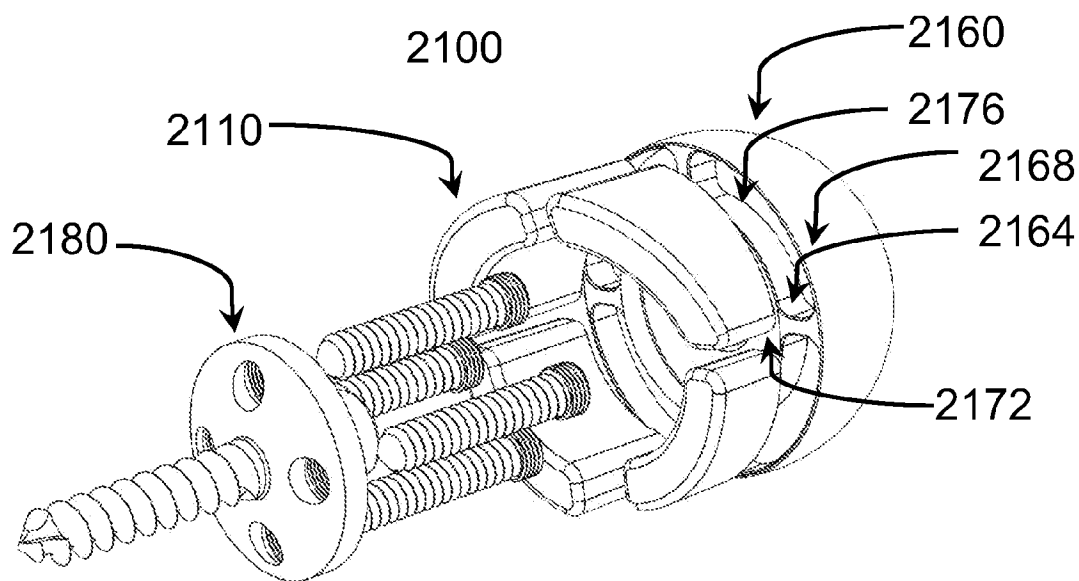


FIG. 35B

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2018/040141

## A. CLASSIFICATION OF SUBJECT MATTER

INV. A61F2/30 A61F2/40  
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)

A61F

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)

EP0-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 2014/257499 A1 (WINSLOW NATHAN A [US] ET AL) 11 September 2014 (2014-09-11)                                                                                           | 1-9                   |
| A         | paragraph [0046] - paragraph [0047]<br>paragraph [0054] - paragraph [0065]<br>figures 1-9                                                                                | 10-22                 |
| A         | -----<br>US 2016/045323 A1 (KOVACS MICHAEL FRANCIS [US] ET AL) 18 February 2016 (2016-02-18)<br>paragraph [0053]<br>paragraph [0081] - paragraph [0090]<br>figures 11-13 | 1,10                  |
| A         | -----<br>US 2007/179624 A1 (STONE KEVIN T [US] ET AL) 2 August 2007 (2007-08-02)<br>paragraph [0054] - paragraph [0056]<br>figures 15,16<br>-----<br>-/-                 | 1,10                  |



Further documents are listed in the continuation of Box C.



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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

14 September 2018

Date of mailing of the international search report

25/09/2018

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# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2018/040141

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                              | Relevant to claim No. |
|-----------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | <p>US 2014/277518 A1 (IANNOTTI JOSEPH P [US])<br/> 18 September 2014 (2014-09-18)<br/> abstract<br/> figure 22</p> <p>-----</p> | 1,10                  |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2018/040141

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| US 2014257499 A1                          | 11-09-2014          | AU 2014225636 A1           | 29-10-2015          |
|                                           |                     | CA 2904029 A1              | 12-09-2014          |
|                                           |                     | EP 2964157 A1              | 13-01-2016          |
|                                           |                     | JP 2016513498 A            | 16-05-2016          |
|                                           |                     | US 2014257499 A1           | 11-09-2014          |
|                                           |                     | US 2017224492 A1           | 10-08-2017          |
|                                           |                     | WO 2014138424 A1           | 12-09-2014          |
| -----                                     |                     |                            |                     |
| US 2016045323 A1                          | 18-02-2016          | AU 2015302017 A1           | 30-03-2017          |
|                                           |                     | CA 2957682 A1              | 18-02-2016          |
|                                           |                     | CN 107072791 A             | 18-08-2017          |
|                                           |                     | EP 3179962 A1              | 21-06-2017          |
|                                           |                     | JP 2017523872 A            | 24-08-2017          |
|                                           |                     | US 2016045323 A1           | 18-02-2016          |
|                                           |                     | US 2018071104 A1           | 15-03-2018          |
|                                           |                     | WO 2016025378 A1           | 18-02-2016          |
| -----                                     |                     |                            |                     |
| US 2007179624 A1                          | 02-08-2007          | EP 1815825 A1              | 08-08-2007          |
|                                           |                     | US 2007179624 A1           | 02-08-2007          |
| -----                                     |                     |                            |                     |
| US 2014277518 A1                          | 18-09-2014          | AU 2014235490 A1           | 05-11-2015          |
|                                           |                     | CA 2905096 A1              | 25-09-2014          |
|                                           |                     | EP 2967893 A1              | 20-01-2016          |
|                                           |                     | JP 6101857 B2              | 22-03-2017          |
|                                           |                     | JP 2016512092 A            | 25-04-2016          |
|                                           |                     | US 2014277518 A1           | 18-09-2014          |
|                                           |                     | US 2016120650 A1           | 05-05-2016          |
|                                           |                     | WO 2014150953 A1           | 25-09-2014          |
| -----                                     |                     |                            |                     |



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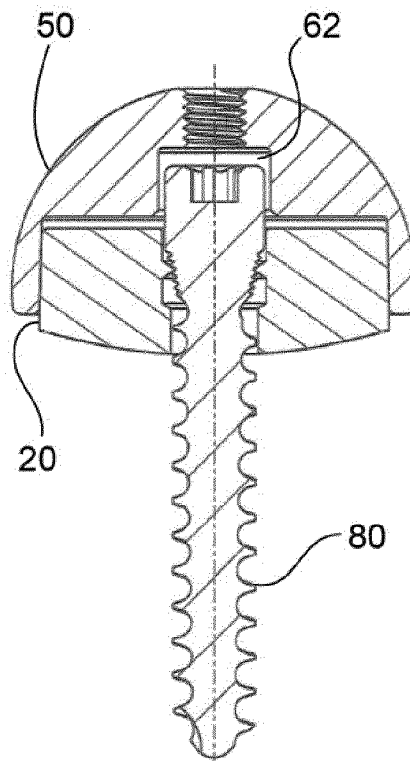
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(54) **Reverse shoulder baseplate with alignment guide for glenosphere**

(57) Disclosed herein is an implant assembly including an alignment guide for aligning the engagement between a glenosphere and baseplate via a central screw engaged to the baseplate. The glenosphere includes first and second recess portions. The first recess portion of the glenosphere is configured to engage a tapered side surface of the baseplate and the second recess portion of the glenosphere is configured to engage a portion of a head of the central screw projecting outwardly from a top surface of the baseplate when engaged thereto. The portion of the head of the central screw projecting outwardly from the baseplate is slip-fit into the second recess of the glenosphere. This engagement aids the alignment of the glenosphere and the baseplate and helps to ensure the accurate alignment of the tapered engagement of the side surface of the baseplate and the first recess of the glenosphere.



**SECTION E-E**  
**FIG. 7D**

## Description

### FIELD OF THE TECHNOLOGY

[0001] The present invention relates to an alignment guide for reverse shoulder arthroplasty (RSA), and in particular it relates to such a guide for aligning the engagement between a glenosphere and baseplate via a central screw engaged to the baseplate.

### BACKGROUND OF THE INVENTION

[0002] Many existing reverse shoulder systems (RSA) require a baseplate and a glenosphere. These systems generally differ from one another in how the baseplate is fastened to the glenoid cavity and how the glenosphere becomes engaged to the baseplate. In some systems, the baseplate may be fastened to the glenoid cavity of the scapula by a plurality of screws and a glenosphere having a convex joint surface may be screwed into the baseplate using an axial threaded feature and/or taper locked to a periphery of the baseplate. In other systems, the glenosphere may engage the baseplate solely via a taper connection. Generally, a compression fit is not preferable between the glenosphere and baseplate due to the potential need for separating the two components once engaged to one another.

[0003] In cases where the glenosphere becomes engaged to the baseplate through either a threaded or taper connection, the glenosphere and baseplate may become separated after a certain length of time. This may cause the glenosphere to tilt with respect to the baseplate or in some cases even completely separate therefrom. In either situation, the baseplate and glenosphere become misaligned.

[0004] Some systems include first fastening a central screw to a glenosphere and then guiding the connection between the baseplate and glenosphere via the central screw. Guiding the connection between the baseplate and glenosphere is generally an important consideration due to minimal access and visibility that the surgeon may have during a RSA procedure. Access to the baseplate is generally narrow making it relatively difficult for the surgeon to have the visibility needed to correctly align the engagement between a baseplate and glenosphere.

### BRIEF SUMMARY OF THE INVENTION

[0005] One embodiment in accordance with a first aspect of the present invention is an implant assembly including first, second and third components. The first component is preferably a baseplate, the second component is preferably a glenosphere, and the third component is preferably a central screw. First component of the implant assembly preferably includes a top surface, a bottom surface, a side surface connecting the top and bottom surfaces, and at least one borehole extending through the top and bottom surfaces. Second component of the im-

plant assembly preferably includes first and second circumferential recesses, the first circumferential recess defining a tapered wall having a minimum diameter at a base of the tapered wall, the second circumferential recess defining a circumferential wall having a constant diameter, the constant diameter of the circumferential wall being less than the minimum diameter of the tapered wall, the first and second circumferential recesses being in communication with one another. Third component of the implant assembly preferably includes a head portion and a body portion, the third component configured to be received at least partially within the at least one borehole of the first component. At least a portion of the head portion of the third component extends outwardly from the top surface of the first component when the third component is engaged to the at least one borehole of the first component such that the head portion can be slip-fit into the second circumferential recess of the second component and into engagement with the circumferential wall thereof, thereby guiding the engagement of the side surface of the first component into the first circumferential recess and into engagement with the tapered wall of the second component.

[0006] In another embodiment of the first aspect of the present invention the top surface of the second component is substantially flat and the bottom surface is convex. The side surface of the first component is preferably tapered and forms a circumferential perimeter of the first component, the side surface having a central longitudinal axis. In some embodiments, the implant assembly includes a plurality of baseplates having variable thicknesses connecting the top and bottom surfaces thereof.

[0007] In yet another embodiment of the first aspect of the present invention the at least one borehole of the first component has a central axis that is coaxial with the central longitudinal axis of the side surface of the first component.

[0008] In yet still another embodiment of the first aspect of the present invention the implant assembly further comprises a plurality of boreholes extending through the top and bottom surfaces of the first component that are equally spaced around a perimeter of the top and bottom surfaces, the boreholes adapted to receive screws for fixing the first component to a glenoid cavity of a patient. Each of the plurality of boreholes preferably includes a ramp portion adapted to receive and engage a head of a fixation screw. Each of the plurality of boreholes can either be straight or angled from the top surface of the baseplate.

[0009] In still yet another embodiment of the first aspect of the present invention the third component further includes a neck portion that is tapered and at least partially threaded, and the at least one borehole includes a threaded portion adapted to engage the at least partially threaded portion of the third component. Preferably, the head portion of the third component has a circumferential side surface and at least a portion of the body portion of the third component is threaded.



**[0010]** In still yet another embodiment of the first aspect of the present invention the second component has a semispherical convex outer surface and the second component has a bore hole through an apex portion thereof. The borehole through the apex portion of the second component is preferably at least partially threaded.

**[0011]** In still yet another embodiment of the first aspect of the present invention the tapered wall and the circumferential wall of the second component each have a longitudinal axis therethrough, the longitudinal axes being coaxial. Preferably, when the first component is engaged to the second component, the central axis of the at least one borehole is coaxial with the longitudinal axes of the tapered wall and the circumferential wall.

**[0012]** One embodiment in accordance with a second aspect of the present invention is an implant assembly including first, second and third components. The first component preferably has a top surface, a bottom surface, a side surface connecting the top and bottom surfaces, and at least one borehole extending through the top and bottom surfaces, the distance between the top surface and bottom surface defining a first height. The second component preferably has first and second circumferential recesses, the first circumferential recess defining a tapered wall having a second height substantially equal to the first height, the second circumferential recess defining a circumferential wall having a third height greater than the second height of the tapered wall, the first and second circumferential recesses being in communication with one another. The third component has a head portion and a body portion, the third component configured to be received at least partially within the at least one borehole of the first component. The third component when engaged to the at least one borehole of the first component the head portion thereof extends outwardly from the top surface of the first component in an amount substantially equal to the third height, and at least a portion of the head portion of the third component is located within the second circumferential recess of the second component and is in engagement with the circumferential wall when at least a portion of the side surface of the first component is located within the first circumferential recess and is in engagement with the tapered wall of the second component.

**[0013]** In another embodiment of the second aspect of the present invention the top surface of the second component is substantially flat and the bottom surface is convex. The side surface of the first component is preferably tapered and forms a circumferential perimeter of the first component, the side surface having a central longitudinal axis. In some embodiments, the implant assembly includes a plurality of baseplates having variable thicknesses connecting the top and bottom surfaces thereof.

**[0014]** In yet another embodiment of the second aspect of the present invention the at least one borehole of the first component has a central axis that is coaxial with the central longitudinal axis of the side surface of the first component.

**[0015]** In yet still another embodiment of the second aspect of the present invention the implant assembly further comprises a plurality of boreholes extending through the top and bottom surfaces of the first component that are equally spaced around a perimeter of the top and bottom surfaces, the boreholes adapted to receive screws for fixing the first component to a glenoid cavity of a patient. Each of the plurality of boreholes preferably includes a ramp portion adapted to receive and engage a head of a fixation screw. Each of the plurality of boreholes can either be straight or angled from the top surface of the baseplate.

**[0016]** In still yet another embodiment of the second aspect of the present invention the third component further includes a neck portion that is tapered and at least partially threaded, and the at least one borehole includes a threaded portion adapted to engage the at least partially threaded portion of the third component. Preferably, the head portion of the third component has a circumferential side surface and at least a portion of the body portion of the third component is threaded.

**[0017]** In still yet another embodiment of the second aspect of the present invention the second component has a semispherical convex outer surface and the second component has a bore hole through an apex portion thereof. The borehole through the apex portion of the second component is preferably at least partially threaded.

**[0018]** In still yet another embodiment of the second aspect of the present invention the tapered wall and the circumferential wall of the second component each have a longitudinal axis therethrough, the longitudinal axes being coaxial. Preferably, when the first component is engaged to the second component, the central axis of the at least one borehole is coaxial with the longitudinal axes of the tapered wall and the circumferential wall.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0019]** A more complete appreciation of the subject matter of the present invention and the various advantages thereof can be realized by reference to the following detailed description in which reference is made to the accompanying drawings in which:

**[0020]** FIG. 1 is an exploded view of an implant system showing a two-piece construct prior to assembly with a glenosphere.

**[0021]** FIG. 2A is a front view of one embodiment of a baseplate of the present invention.

**[0022]** FIG. 2B is a cross-sectional side view taken along line A-A of the baseplate shown in FIG. 2A.

**[0023]** FIG. 2C is an alternate side view of the baseplate shown in FIG. 2A.

**[0024]** FIG. 3A is a back view of one embodiment of a glenosphere of the present invention.

**[0025]** FIG. 3B is a cross-sectional side view taken along line B-B of the glenosphere shown in FIG. 3A.

**[0026]** FIG. 3C is an alternate side view of the gleno-

sphere shown in FIG. 3A.

[0027] FIG. 4A is a perspective view of an alternate embodiment of a glenosphere of the present invention.

[0028] FIG. 4B is a front view of the glenosphere shown in FIG. 4A.

[0029] FIG. 4C is a cross-sectional side view taken along line C-C of the glenosphere shown in FIG. 4B.

[0030] FIG. 5A is a perspective view of one embodiment of a central screw of the present invention.

[0031] FIG. 5B is a side plan view of the central screw shown in FIG. 5A.

[0032] FIG. 5C is a cross-sectional side view taken along line D-D of the central screw shown in FIG. 5B.

[0033] FIG. 6A is a perspective view of one embodiment of a two-piece construct of the present invention including an assembled baseplate and central screw.

[0034] FIG. 6B is a top view of the two-piece construct shown in FIG. 6A.

[0035] FIG. 6C is a side view of the two-piece construct shown in FIG. 6A.

[0036] FIG. 7A is a perspective view of one embodiment of an implant assembly of the present invention showing a two-piece construct assembled to a glenosphere.

[0037] FIG. 7B is a bottom view of the implant assembly shown in FIG. 7A.

[0038] FIG. 7C is a side view of the implant assembly shown in FIG. 7A.

[0039] FIG. 7D is a cross-sectional view taken along line E-E of the implant assembly shown in FIG. 7C.

[0040] FIG. 8A is a cross-sectional view of a two-piece construct being assembled to a glenosphere.

[0041] FIG. 8B is a cross-sectional view of the two-piece construct and glenosphere shown in FIG. 8A in an almost fully assembled position.

#### DETAILED DESCRIPTION

[0042] As used herein, when referring to bones or other parts of the body, the term "proximal" means closer to the heart and the term "distal" means more distant from the heart. The term "inferior" means lower or bottom and the term "superior" means upper or top. The term "anterior" means towards the front part of the body or the face and the term "posterior" means toward the back of the body. The term "medial" means toward the midline of the body and the term "lateral" means away from the midline of the body.

[0043] Referring to FIG. 1, there is shown an exploded view of an embodiment of an implant assembly of the present invention designated generally by reference numeral 10. As shown in this figure, implant assembly 10 includes a first component or baseplate 20, a second component or glenosphere 50, and a third component or central screw 80.

[0044] Referring to FIGS. 2A-2C, there is shown one embodiment of baseplate 20 of the present invention. Baseplate 20 includes a bottom surface 22, a top surface

24, and a tapered side surface 26 connecting the bottom and top surfaces, the side surface 26 defining a height H1 and a having a minimum diameter D1 defined by a perimeter of top surface 24. A central bore hole 28 extends through bottom and top surfaces 22, 24, the central bore hole 28 having a longitudinal axis 30.

[0045] As shown in FIG. 2B, bore hole 28 preferably includes a first diameter 32 and a second diameter 34 with the first diameter being larger than the second diameter. An intermediate portion 36 preferably separates first and second diameters 32, 34, the intermediate portion formed preferably as a singular thread projecting outwardly from a wall 38 of first diameter 32 of central bore hole 28.

[0046] Bottom surface 22 of baseplate 20 is generally convex, while top surface 24 is generally flat. Disposed around and adjacent a perimeter or circumference 40 formed by side surface 26 of baseplate 20 are a plurality of screw receiving apertures 42. While baseplate 20 as shown in FIG. 2A, includes four screw receiving apertures 42, baseplate 20 may include less or more than four screw receiving apertures 42. As shown in FIG. 2A, apertures 42 moving in a clockwise direction include a longitudinal axis 41, 43, 45, or 47, respectively. Longitudinal axes 41, 43, 45 and 47 are preferably angled from longitudinal axis 30 between 15° and 75° as shown in FIG. 2C, for example. Longitudinal axes 41, 43, 45 and 47 may each be angled from longitudinal axis 30 that same amount of degrees or each may be angled from longitudinal axis 30 a different amount of degrees. In some embodiments, longitudinal axes 41, 43, 45 and 47 may be parallel to longitudinal axis 30 of bore hole 28.

[0047] Referring to FIGS. 3A-3C, there is shown one embodiment of a second component or glenosphere 50 of the present invention. Glenosphere 50 includes a hemispherical or semispherical outer surface 52 having a perimeter 54 forming an outer diameter of a bottom surface 56. Starting at bottom surface 56 and projecting inwardly therefrom is a first circumferential recess 58 having a depth DP1 slightly larger than height H1 of baseplate 20. In one embodiment, depth DP1 may be substantially equivalent to height H1. First circumferential recess 58 defines a tapered wall 59 having a maximum diameter defining an outer perimeter 57 and a minimum diameter defining a first base portion 60 of the tapered wall. First circumferential recess 58 terminates at first base portion 60 of tapered wall 59.

[0048] Starting at first base portion 60 and projecting inwardly therefrom is a second circumferential recess 62 having a depth DP2. Second circumferential recess 62 defines a circumferential wall 61 having a constant diameter. Second circumferential recess 62 terminates at a base portion of circumferential wall 61 at a second base portion 64. The constant diameter of the circumferential wall 61 is preferably less than the minimum diameter of tapered wall 59. The first and second circumferential recesses 58 and 62 are in communication with one another. First circumferential recess includes a longitudinal axis

63 and second circumferential recess includes a longitudinal axis 65, the longitudinal axes 63, 65 of first and second circumferential recesses are coaxial. In other embodiments, longitudinal axes 63 and 65 may be offset from one another.

**[0049]** As shown in FIGS. 3A-3C, located at a polar or apex portion of glenosphere 50 is a threaded bore 70. Threaded bore 70 is in communication with first and second circumferential recesses 58 and 62. In other embodiments, threaded bore 70 is a recess formed in outer surface 52 and is not in communication with either first or second circumferential recess 58 and 62. In other embodiments, bore 70 is only partially threaded about a length thereof.

**[0050]** Referring to FIGS. 4A-4C, there is shown another embodiment of glenosphere 50 of the present invention denoted as 50'. Glenosphere 50' includes all of the same features as glenosphere 50 except that the first and second circumferential recesses 58', 62' are offset from threaded bore 70' of glenosphere 50'. First circumferential recess 58' includes a longitudinal axis 63' and second circumferential recess 62' includes a longitudinal axis 65', the longitudinal axes 63', 65' of first and second circumferential recesses are coaxial. Glenosphere 50' includes a hemispherical or semispherical outer surface 52' having a perimeter 54' forming an outer diameter of a bottom surface 56'. Perimeter 54' includes a longitudinal axis 67' that is offset from longitudinal axes 63', 65' of first and second circumferential recesses 58', 62'.

**[0051]** Referring to FIGS. 5A-5C, there is shown one embodiment of a third component or central screw 80 of the present invention. Central screw 80 includes a head portion 82, a body portion 84, a neck portion 86 and a longitudinal axis 90. Head portion 82 includes a circumferential side surface 83 defining a perimeter with a diameter D4. Body portion 84 of central screw 80 is preferably threaded. Neck portion 86 is preferably tapered and threaded. Central screw 80 further includes an engagement portion 88 for receiving an adjustment tool such as a screwdriver, for example.

**[0052]** In reference to FIGS. 6A-6C there is shown one embodiment of a two-piece construct 100 including an assembled baseplate 20 and central screw 80. When assembled, a portion of head portion 82 of central screw 80 projects outwardly from outer surface 24 of baseplate 20 a height H2. Depending on the configuration of first and second circumferential recesses 58 and 62 of glenosphere 50, namely depths DP1 and DP2, respectively, the height H2 may vary.

**[0053]** In reference to FIGS. 7A-7D there is shown implant assembly 10 with baseplate 20, glenosphere 50, and central screw 80 all being assembled together. The alignment guide of implant assembly 10 serves to enable a more efficient and reproducible alignment between glenosphere 50 and baseplate 20 during RSA. In one method of the invention, after baseplate 20 is secured to a patient's scapula by fixation screws, glenosphere 50 may be coupled thereto. It is important for the alignment

of glenosphere 50 to be accurate on the baseplate 20. In other words longitudinal axis 30 of baseplate 20 and longitudinal axis 63 of glenosphere should be coaxial when implant assembly 10 is in an assembled position.

**[0054]** The diameter D4 of head portion 82 of central screw 80 is preferably 8mm, but may be as little as 2mm and as much as 14mm, for example. When central screw 80 is assembled to baseplate 20, head portion 82 of central screw 80 preferably protrudes from top surface 24 of baseplate 20 approximately 5mm. Second circumferential recess 62 of glenosphere 50 has a diameter of approximately 9mm (just slightly more than the diameter of head portion 82 of central screw 80) and a depth of 5.4mm (just slightly more than the amount head portion 82 of central screw 80 protrudes from top surface 24 of baseplate 20).

**[0055]** Implant assembly 10 provides a surgeon or other operating room personnel with improved tactile feel and axial alignment when introducing glenosphere 50 onto baseplate 20 during final implantation. Reduction of surgery time is preferably a benefit attributable to implant assembly 10, which also has the potential to reduce the amount of time a surgeon needs to implant this device with a one-step procedure strategy.

**[0056]** One aspect of the present invention is the assembly of glenosphere 50 with a two-piece construct 100, namely assembled central screw 80 and baseplate 20. A holding instrument (not shown) can be secured to bore 70 in order to aid the assembly of glenosphere 50 with two-piece construct 100. Alignment between baseplate 20 of two-piece construct 100 and glenosphere 50 is first introduced by the peripheral external taper of perimeter 26 of baseplate 20 and first internal bore 58 of glenosphere 50 as shown in FIG. 8A. At least a portion of head portion 82 of central screw 80 is located within pilot bore 62 prior to engagement between external taper 26 of baseplate 20 and tapered wall 59 of glenosphere 50 as shown in FIG. 8B. Pilot diameter D4 of head 82 of central screw 80 is configured to be accepted by pilot bore 62 with diameter D3 of glenosphere 50 in a slip-fit manner. The dimensions of head portion 82 of central screw and pilot bore 62 of glenosphere 50 aids in preventing glenosphere 50 from cantilevering out of its intended assembled position when external taper 26 of baseplate 20 is engaged to tapered wall 59 of glenosphere 50.

**[0057]** 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 be 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.

**Claims****1.** An implant assembly comprising:

a first component having a top surface, a bottom surface, a side surface connecting the top and bottom surfaces, and at least one borehole extending through the top and bottom surfaces; a second component having first and second circumferential recesses, the first circumferential recess defining a tapered wall having a minimum diameter at a base of the tapered wall, the second circumferential recess defining a circumferential wall having a constant diameter, the constant diameter of the circumferential wall being less than the minimum diameter of the tapered wall, the first and second circumferential recesses being in communication with one another; and a third component having a head portion and a body portion, the third component configured to be received at least partially within the at least one borehole of the first component, wherein at least a portion of the head portion of the third component extends outwardly from the top surface of the first component when the third component is engaged to the at least one borehole of the first component such that the head portion can be slip-fit into the second circumferential recess of the second component and into engagement with the circumferential wall thereof, thereby guiding the engagement of the side surface of the first component into the first circumferential recess and into engagement with the tapered wall of the second component.

**2.** The implant assembly of claim 1, wherein the top surface is substantially flat and the bottom surface is convex.

**3.** The implant assembly of claim 1 or claim 2, wherein the side surface of the first component is tapered and forms a circumferential perimeter of the first component, the side surface having a central longitudinal axis.

**4.** The implant assembly of claim 3, wherein the at least one borehole of the first component has a central axis that is coaxial with the central longitudinal axis of the side surface.

**5.** The implant assembly of any one of claims 1-4, wherein the first component is a baseplate, the second component is a glenosphere, and the third component is a central screw.

**6.** The implant assembly of any one of claims 1-5, further comprising a plurality of boreholes extending

through the top and bottom surfaces and equally spaced around a perimeter of the top and bottom surfaces, the boreholes adapted to receive screws for fixing the first component to a glenoid cavity of a patient.

**7.** The implant assembly of claim 6, wherein each of the plurality of boreholes includes a ramp portion adapted to receive and engage a head of a fixation screw.

**8.** The implant assembly of any one of claims 1-7, wherein the third component further includes a neck portion that is tapered and at least partially threaded.

**9.** The implant assembly of claim 8, wherein the at least one borehole includes a threaded portion adapted to engage the at least partially threaded portion of the third component.

**10.** The implant assembly of any one of claims 1-9, wherein the tapered wall and the circumferential wall of the second component each have a longitudinal axis therethrough, the longitudinal axes being coaxial.

**11.** The implant assembly of claim 10, wherein when the first component is engaged to the second component, the central axis of the at least one borehole is coaxial with the longitudinal axes of the tapered wall and the circumferential wall.

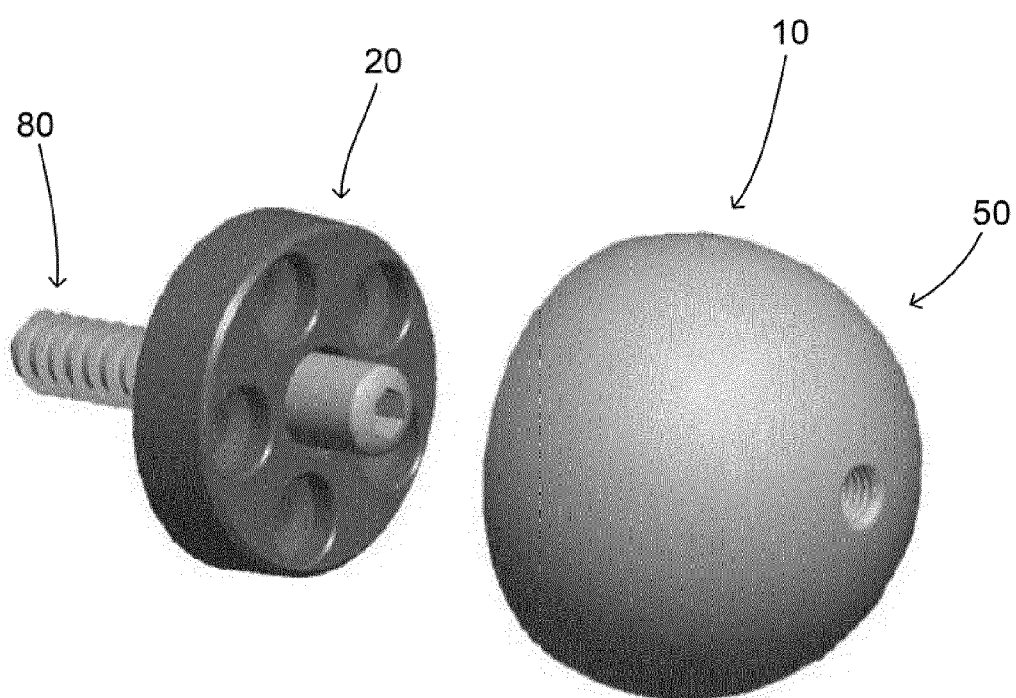


FIG. 1

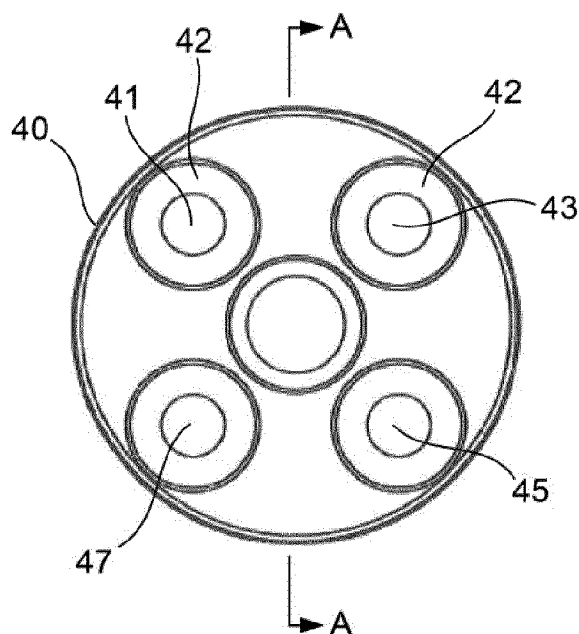


FIG. 2A

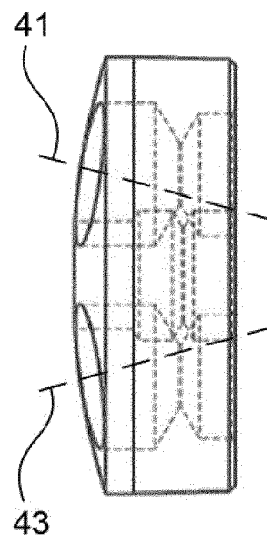
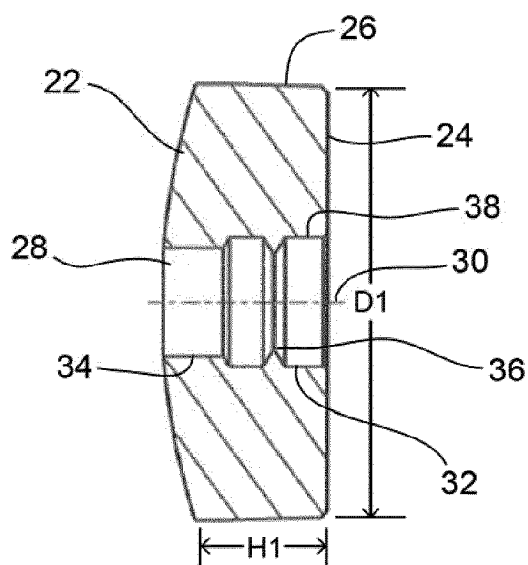


FIG. 2C



SECTION A-A

FIG. 2B

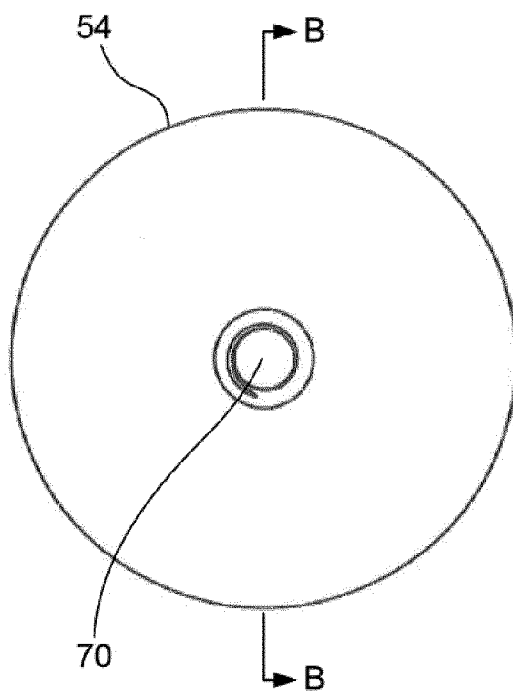


FIG. 3A

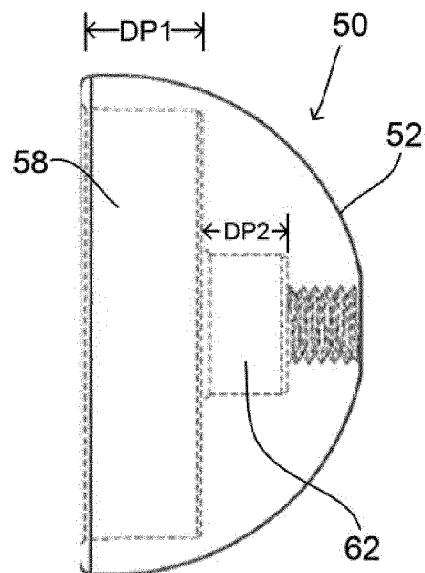
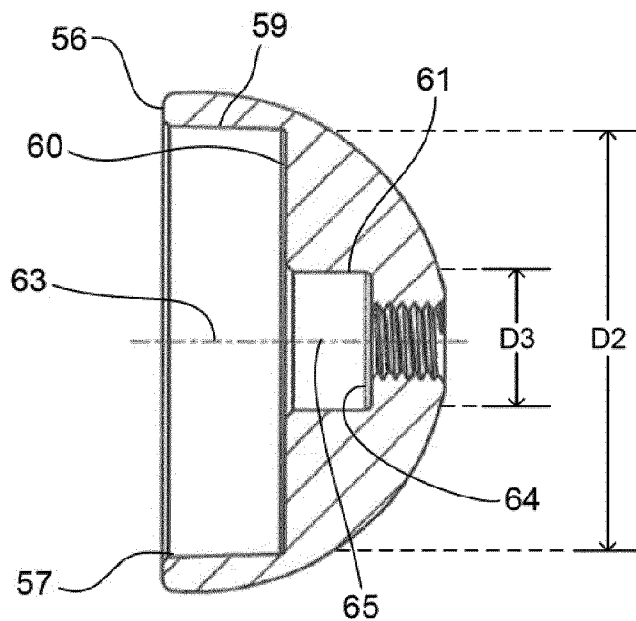


FIG. 3C



SECTION B-B

FIG. 3B

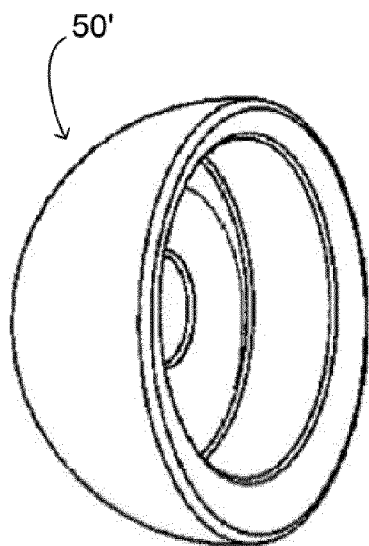


FIG. 4A

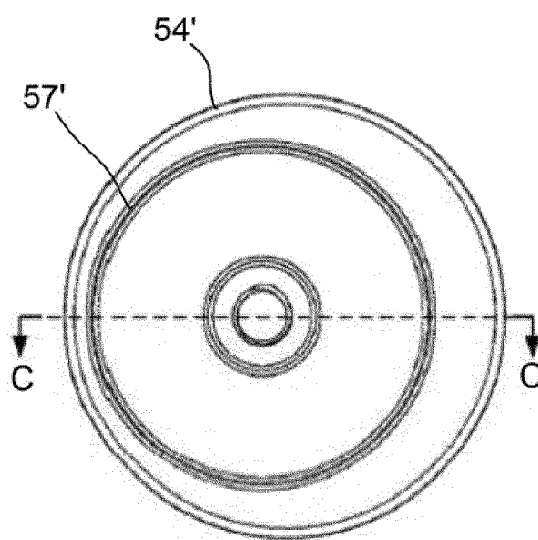
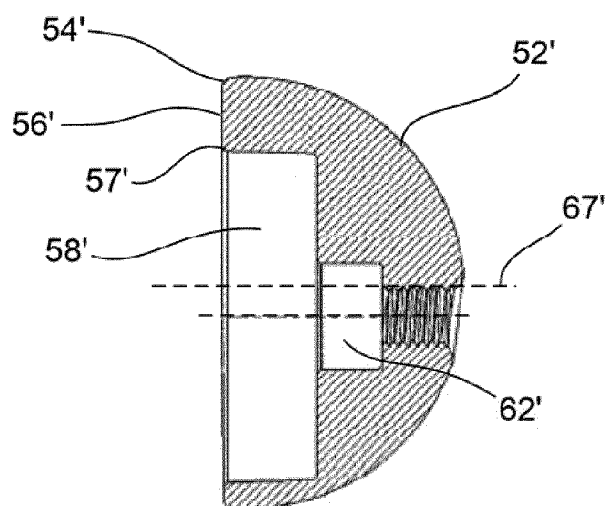


FIG. 4B



C-C  
FIG. 4C



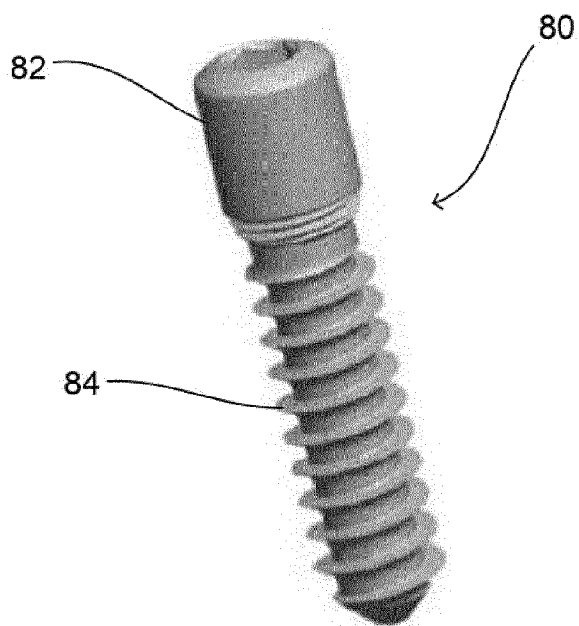


FIG. 5A

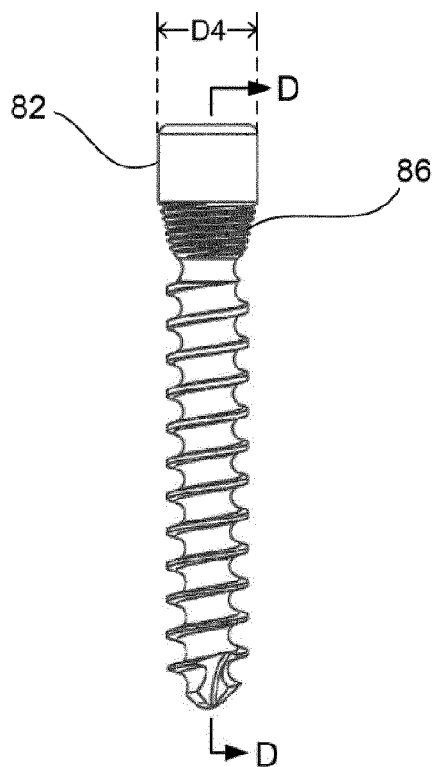
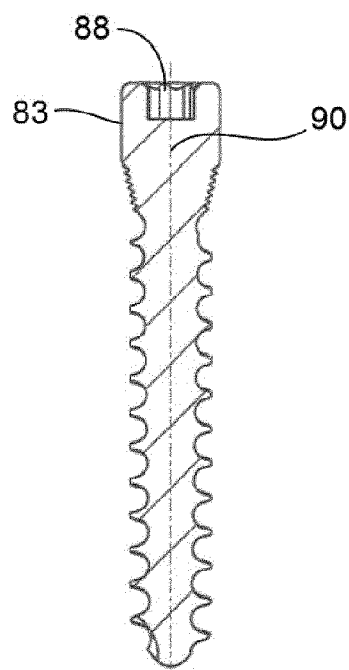


FIG. 5B



SECTION D-D  
FIG. 5C

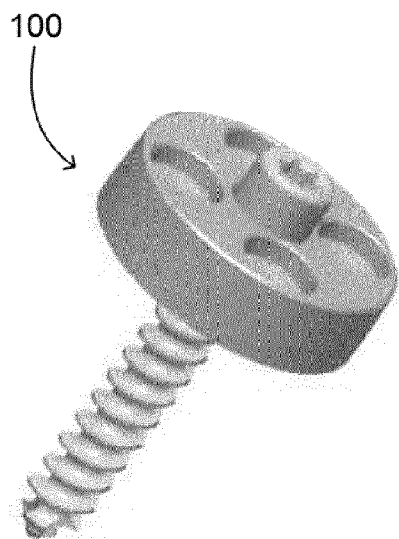


FIG. 6A

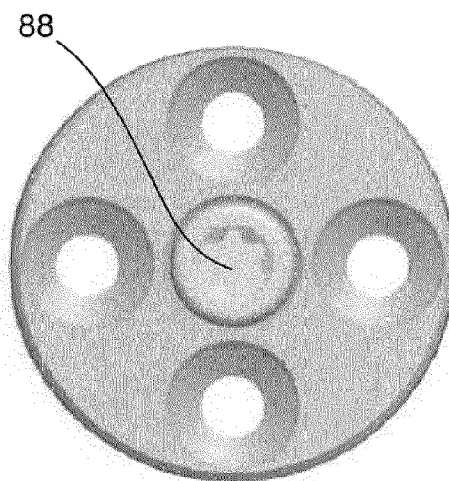


FIG. 6B

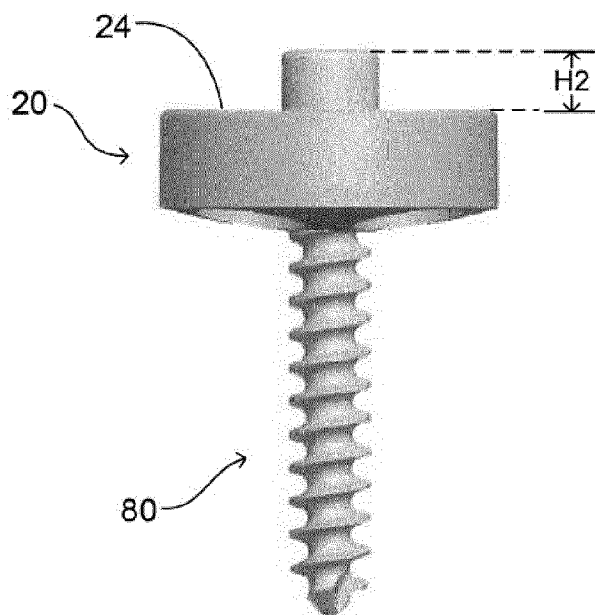


FIG. 6C

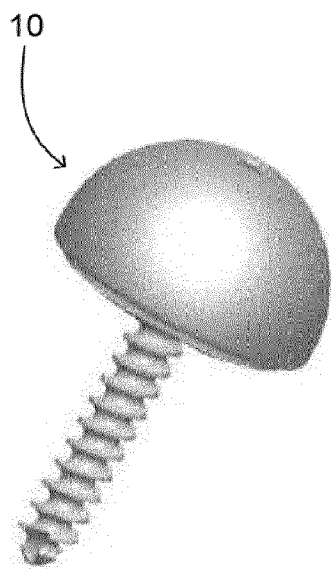


FIG. 7A

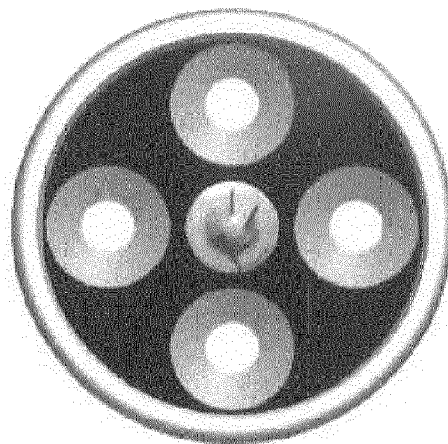


FIG. 7B

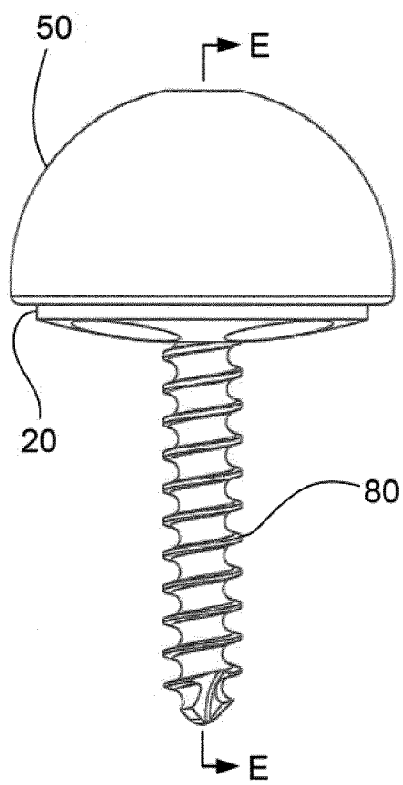
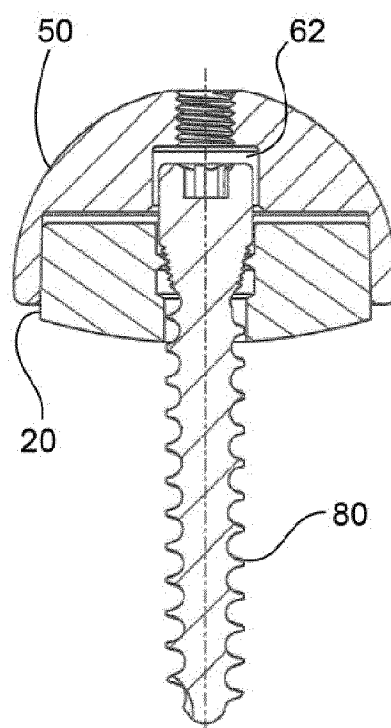


FIG. 7C



SECTION E-E

FIG. 7D

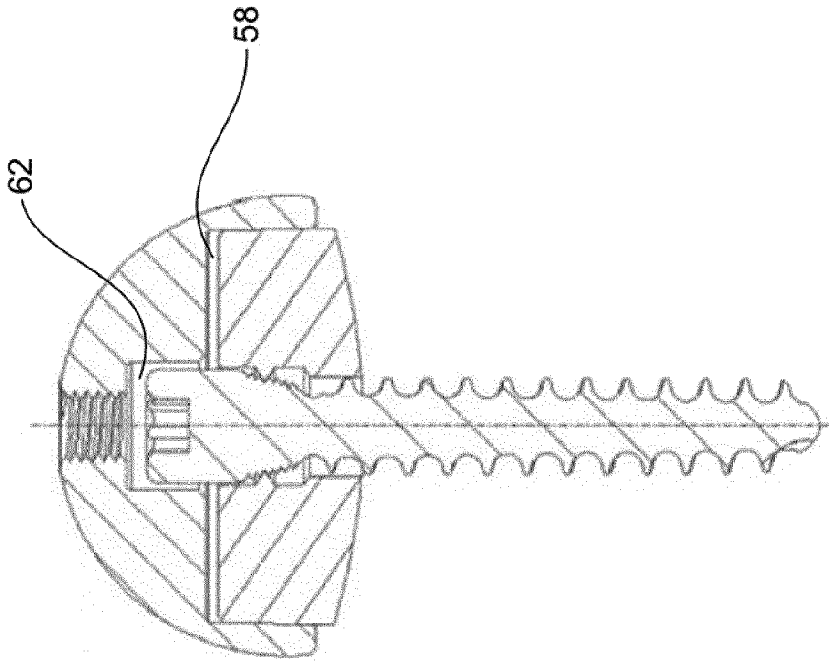


FIG. 8B

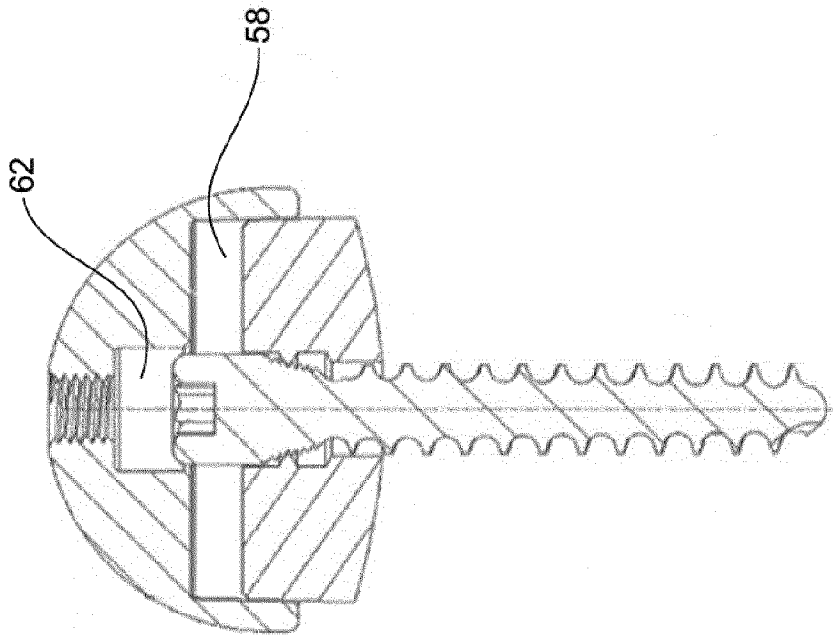


FIG. 8A



## EUROPEAN SEARCH REPORT

Application Number  
EP 12 19 5588

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                    |                                                                                                                                                                               |                                                                                                                                                                                                                                                                              |                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Category                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                                                                 | Relevant to claim                                                                                                                                                                                                                                                            | CLASSIFICATION OF THE APPLICATION (IPC)  |
| X                                                                                                                                                                                                                                                      | WO 01/47442 A1 (DEPUY FRANCE [FR];<br>BOUTTENS DENIS [FR]; BUTTET MICHEL DE<br>[FR]; CAPON D) 5 July 2001 (2001-07-05)<br>* page 5, line 25 - line 33; figures<br>2,3,4,5,6 * | 1-7,9-11                                                                                                                                                                                                                                                                     | INV.<br>A61F2/40<br><br>ADD.<br>A61F2/30 |
| X                                                                                                                                                                                                                                                      | EP 2 201 912 A1 (DEPUY PRODUCTS INC [US])<br>30 June 2010 (2010-06-30)<br>* figures 2-5 *                                                                                     | 1-7,10,<br>11                                                                                                                                                                                                                                                                |                                          |
| A                                                                                                                                                                                                                                                      | WO 2008/000928 A2 (TROIS S ORTHO [FR];<br>EVOLUTIS [FR]; DELINCE PHILIPPE [BE];<br>LESUR ETIENN) 3 January 2008 (2008-01-03)<br>* the whole document *                        | 1-11                                                                                                                                                                                                                                                                         |                                          |
| A                                                                                                                                                                                                                                                      | EP 1 656 910 A1 (LIMA LTO SPA [IT])<br>17 May 2006 (2006-05-17)<br>* the whole document *                                                                                     | 1-11                                                                                                                                                                                                                                                                         |                                          |
|                                                                                                                                                                                                                                                        |                                                                                                                                                                               |                                                                                                                                                                                                                                                                              | TECHNICAL FIELDS<br>SEARCHED (IPC)       |
|                                                                                                                                                                                                                                                        |                                                                                                                                                                               |                                                                                                                                                                                                                                                                              | A61F                                     |
| The present search report has been drawn up for all claims                                                                                                                                                                                             |                                                                                                                                                                               |                                                                                                                                                                                                                                                                              |                                          |
| Place of search<br><b>Munich</b>                                                                                                                                                                                                                       |                                                                                                                                                                               | Date of completion of the search<br><b>21 February 2013</b>                                                                                                                                                                                                                  | Examiner<br><b>Cuiper, Ralf</b>          |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                                                                               | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                          |

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EPC FORM 1503 (3.82) (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 19 5588

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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21-02-2013

| Patent document<br>cited in search report |    | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|----|---------------------|----------------------------|---------------------|
| WO 0147442                                | A1 | 05-07-2001          | AU 780176 B2               | 03-03-2005          |
|                                           |    |                     | AU 2526201 A               | 09-07-2001          |
|                                           |    |                     | FR 2802799 A1              | 29-06-2001          |
|                                           |    |                     | GB 2375052 A               | 06-11-2002          |
|                                           |    |                     | JP 4464026 B2              | 19-05-2010          |
|                                           |    |                     | JP 2003518408 A            | 10-06-2003          |
|                                           |    |                     | NO 20023063 A              | 24-06-2002          |
|                                           |    |                     | SE 526618 C2               | 18-10-2005          |
|                                           |    |                     | SE 0201836 A               | 17-06-2002          |
|                                           |    |                     | US 2003114933 A1           | 19-06-2003          |
|                                           |    |                     | US 2005256583 A1           | 17-11-2005          |
|                                           |    |                     | US 2010023068 A1           | 28-01-2010          |
|                                           |    |                     | WO 0147442 A1              | 05-07-2001          |
|                                           |    |                     | ZA 200205014 A             | 18-03-2003          |
| EP 2201912                                | A1 | 30-06-2010          | EP 2201912 A1              | 30-06-2010          |
|                                           |    |                     | US 2010161066 A1           | 24-06-2010          |
| WO 2008000928                             | A2 | 03-01-2008          | AT 551027 T                | 15-04-2012          |
|                                           |    |                     | DK 2032082 T3              | 18-06-2012          |
|                                           |    |                     | EP 2032082 A2              | 11-03-2009          |
|                                           |    |                     | ES 2384650 T3              | 10-07-2012          |
|                                           |    |                     | FR 2902993 A1              | 04-01-2008          |
|                                           |    |                     | US 2009281630 A1           | 12-11-2009          |
|                                           |    |                     | WO 2008000928 A2           | 03-01-2008          |
| EP 1656910                                | A1 | 17-05-2006          | AT 406854 T                | 15-09-2008          |
|                                           |    |                     | EP 1656910 A1              | 17-05-2006          |
|                                           |    |                     | EP 1980221 A1              | 15-10-2008          |
|                                           |    |                     | ES 2315804 T3              | 01-04-2009          |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82



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, KM, ML, MR, NE, SN, TD, TG).

**Published:**

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



## IMPLANTS, SYSTEMS AND METHODS OF USING THE SAME

## CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority benefit under 35 U.S.C. §119(e) of U.S. provisional application No. 62/711,449 filed July 27, 2018, which is incorporated herein by reference in its entirety.

## FIELD OF THE INVENTION

[0002] The present invention relates generally to general surgery, orthopedic implants used for replacing an articulation surface in a joint, such as shoulder prostheses. More specifically, but not exclusively, the present invention relates to glenoid implants for reverse shoulder arthroplasties, as well as methods for using the same.

## BACKGROUND OF THE INVENTION

[0003] Shoulder replacement is a surgical procedure in which all or part of the glenohumeral joint is replaced by a prosthetic implant. Such joint replacement surgery generally is conducted to relieve arthritis pain or fix severe physical joint damage.

[0004] Shoulder replacement surgery is an option for treatment of severe arthritis of the shoulder joint. Arthritis is a condition that affects the cartilage of the joints. As the cartilage lining wears away, the protective lining between the bones is lost. When this happens, painful bone-on-bone arthritis develops. Severe shoulder arthritis is quite painful, and it can cause restriction of motion. While this may be tolerated with some medications and lifestyle adjustments, there may come a time when surgical treatment is necessary.

[0005] There are a few major approaches to access the shoulder joint. The first is the deltopectoral approach, which saves the deltoid, but requires the subscapularis to be cut. The second is the trans deltoid approach, which provides a straight on approach at the glenoid. However, during this approach the deltoid is put at risk for potential damage.

[0006] Shoulder replacement, also known as shoulder arthroplasty or glenohumeral arthroplasty, was pioneered by the French surgeon Jules Emile Pean in 1893. His procedure consisted of physically smoothing the shoulder joint and implanting platinum and rubber materials. The next notable case in the evolution of shoulder replacement procedures was in 1955 when Charles Neer conducted the first hemiarthroplasty, essentially replacing only the humeral head, leaving the natural shoulder socket, or glenoid, intact. This procedure grew exponentially in popularity as time progressed; however, patients often developed cartilage loss on their glenoid surface as well, leading to pain and glenoid erosion. This

prompted the development of a procedure to replace not only the humeral component, but the glenoid component as well.

[0007] Throughout the development of the procedures, it became well accepted that the rotator cuff muscles were essential to producing the best outcomes in terms of strength, range of motion, and a decrease in pain. In addition to this finding, physical constraints of the normal ball-and-socket anatomy of the shoulder limited most developments in one way or another. For example, a heavily constrained system limited range of motion and the inherent anatomy of the glenoid proved difficult to cement prosthetics and fixate components without fracturing it. These challenges and high rates of failure led to the development of the reverse total shoulder arthroplasty to overcome the limitations imposed by the natural shoulder anatomy.

[0008] The 1970s saw an exponential increase in surgical approaches using this methodology, and the number and variation of surgical techniques are many. However, in 1985 Paul Grammont emerged with a superior technique that is the basis for most reverse shoulder replacement procedures today.

[0009] In traditional total shoulder arthroplasty, the approach begins with separating the deltoid muscle from the pectoral muscles, facilitating access to the shoulder (glenohumeral) joint through a relatively nerve free passageway. The shoulder joint is initially covered by the rotator cuff muscles (subscapularis, supraspinatus, infraspinatus & teres minor) and the joint capsule (glenohumeral ligaments). Typically, a single rotator cuff muscle is identified and cut to allow direct access to the shoulder joint. As this point, the surgeon can remove the arthritic portions of the joint and then secure the ball and socket prostheses within the joint.

[0010] The development of safer, more effective techniques has led to increased use of reverse total shoulder arthroplasty. Reverse total shoulder arthroplasties are typically indicated when the rotator cuff muscles are severely damaged.

[0011] Many existing reverse shoulder systems require a baseplate and a glenosphere. These systems generally differ from one another in how the baseplate is fastened to the glenoid cavity and how the glenosphere becomes engaged to the baseplate. In some systems, the baseplate may be fastened to the glenoid cavity of the scapula by a plurality of screws and a glenosphere having a convex joint surface may be screwed into the baseplate using an axial threaded feature and/or taper that is a part of the baseplate. In other systems, the glenosphere may engage the baseplate solely via a taper connection.

[0012] In cases where the glenosphere becomes engaged to the baseplate through either a threaded or taper connection, the glenosphere and baseplate may become separated after a certain length of time. This may cause the glenosphere to tilt with respect to the

baseplate or in some cases even separate therefrom. In either situation, the baseplate and glenosphere become misaligned.

[0013] Some systems include first fastening a central screw to a glenosphere and then guiding the connection between the baseplate and glenosphere via the central screw. Guiding the connection between the baseplate and glenosphere is generally an important consideration due to minimal access and visibility that the surgeon may have during a reverse shoulder procedure. Access to the baseplate is generally narrow making it relatively difficult for the surgeon to have the visibility needed to correctly align the engagement between a baseplate and glenosphere.

[0014] What is needed in the art is a shoulder implant that improves upon prior art devices by providing design advantages that result in less bone loss, improved bone graft retention, and greater initial and long-term implant fixation.

#### SUMMARY OF THE INVENTION

[0015] Aspects of the present disclosure provide glenoid implants for anatomic shoulder arthroplasties. The present invention also provides for methods for using the glenoid implants.

[0016] In one aspect, provided herein is an implant that includes a baseplate, a central screw extending through a central bore in the baseplate, and a coupling member engaging a portion of the central bore of the baseplate.

[0017] In another aspect, provided herein is are surgical methods for inserting the implants.

[0018] These, and other objects, features and advantages of this invention will become apparent from the following detailed description of the various aspects of the invention taken in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF DRAWINGS

[0019] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and together with the detailed description herein, serve to explain the principles of the invention. The drawings are only for purposes of illustrating preferred embodiments and are not to be construed as limiting the invention. It is emphasized that, in accordance with the standard practice in the industry, various features are not drawn to scale. In fact, the dimensions of the various features may be arbitrarily increased or reduced for clarity of discussion. The foregoing and other objects, features and advantages of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

[0020] **FIG. 1** is a first perspective view of an embodiment of a glenoid implant, in accordance with an aspect of the present disclosure;

- [0021] **FIG. 2** is a second perspective view of the glenoid implant of FIG. 1, in accordance with an aspect of the present disclosure;
- [0022] **FIG. 3** is a first side view of the glenoid implant of FIG. 1, in accordance with an aspect of the present disclosure;
- [0023] **FIG. 4** is a second side view of the glenoid implant of FIG. 1, in accordance with an aspect of the present disclosure;
- [0024] **FIG. 5** is a top view of the glenoid implant of FIG. 1, in accordance with an aspect of the present disclosure;
- [0025] **FIG. 6** is a bottom view of the glenoid implant of FIG. 1, in accordance with an aspect of the present disclosure;
- [0026] **FIG. 7** is a first cross-sectional view of the glenoid implant of FIG. 1 taken along line 7--7 in FIG. 5, in accordance with an aspect of the present disclosure;
- [0027] **FIG. 8** is a second cross-sectional view of the glenoid implant of FIG. 1 taken along line 8--8 in FIG. 5, in accordance with an aspect of the present disclosure;
- [0028] **FIG. 9** is an exploded, first perspective view of the glenoid implant of FIG. 1, in accordance with an aspect of the present disclosure;
- [0029] **FIG. 10** is an exploded, second perspective view of the glenoid implant of FIG. 1, in accordance with an aspect of the present disclosure;
- [0030] **FIG. 11** is an exploded, first side view of the glenoid implant of FIG. 1, in accordance with the present disclosure;
- [0031] **FIG. 12** is an exploded, second side view of the glenoid implant of FIG. 1, in accordance with an aspect of the present disclosure;
- [0032] **FIG. 13** is a lateral view of the glenoid implant of FIG. 1, in accordance with an aspect of the present disclosure;
- [0033] **FIG. 14** is a medial view of the glenoid implant of FIG. 1, in accordance with an aspect of the present disclosure;
- [0034] **FIG. 15** is an exploded, cross-sectional side view of the components of the glenoid implant of FIG. 1, in accordance with an aspect of the present disclosure;
- [0035] **FIG. 16** is a side assembly view of another glenoid implant, in accordance with an aspect of the present disclosure;
- [0036] **FIG. 17** is another side view of the glenoid implant of FIG. 16, in accordance with an aspect of the present disclosure;
- [0037] **FIG. 18** is yet another side view of the glenoid implant of FIG. 16, in accordance with an aspect of the present disclosure;

- [0038] **FIG. 19** is a top perspective view of the glenoid implant of FIG. 16, in accordance with an aspect of the present disclosure;
- [0039] **FIG. 20** is a bottom perspective view of the glenoid implant of FIG. 16, in accordance with an aspect of the present disclosure;
- [0040] **FIG. 21** is a side cross-sectional view of the glenoid implant of FIG. 16, in accordance with an aspect of the present disclosure;
- [0041] **FIG. 22** is an exploded, side view of the glenoid implant of FIG. 16, in accordance with an aspect of the present disclosure;
- [0042] **FIG. 23** is a top perspective view of a baseplate of the glenoid implant of FIG. 16, in accordance with an aspect of the present disclosure;
- [0043] **FIG. 24** is a bottom view of the baseplate of FIG. 23, in accordance with an aspect of the present disclosure;
- [0044] **FIG. 25** is a side view of the baseplate of FIG. 23, in accordance with an aspect of the present disclosure;
- [0045] **FIG. 26** is another side view of the baseplate of FIG. 23, in accordance with an aspect of the present disclosure;
- [0046] **FIG. 27** is another side view of the baseplate of FIG. 23, in accordance with an aspect of the present disclosure;
- [0047] **FIG. 28** is a cross-sectional side view of the baseplate of FIG. 23, in accordance with an aspect of the present disclosure;
- [0048] **FIG. 29** is a top perspective view of a central screw for use with the glenoid implant of FIG. 16, in accordance with an aspect of the present disclosure;
- [0049] **FIG. 30** is a side view of the central screw of FIG. 29, in accordance with an aspect of the present disclosure;
- [0050] **FIG. 31** is a cross-sectional side view of the central screw of FIG. 29, in accordance with an aspect of the present invention;
- [0051] **FIG. 32** is a top perspective view of a peripheral compression screw for use with the glenoid implant of FIG. 16, in accordance with an aspect of the present disclosure;
- [0052] **FIG. 33** is a side view of the peripheral compression screw of FIG. 32, in accordance with an aspect of the present disclosure;
- [0053] **FIG. 34** is a cross-sectional side view of the peripheral compression screw of FIG. 32, in accordance with an aspect of the present disclosure;
- [0054] **FIG. 35** is a top perspective view of a modular locking taper for use with the glenoid implant of FIG. 16 of FIG. 32, in accordance with an aspect of the present disclosure;

- [0055] **FIG. 36** is a side view of the modular locking taper of FIG. 35, in accordance with an aspect of the present disclosure;
- [0056] **FIG. 37** is a cross-sectional side view of the modular locking taper of FIG. 35, in accordance with an aspect of the present disclosure;
- [0057] **FIG. 38** is a top perspective view of a glenosphere of the glenoid implant of FIG. 16, in accordance with an aspect of the present disclosure;
- [0058] **FIG. 39** is a bottom perspective view of the glenosphere of FIG. 38, in accordance with an aspect of the present disclosure;
- [0059] **FIG. 40** is a top view of the glenosphere of FIG. 38, in accordance with an aspect of the present disclosure;
- [0060] **FIG. 41** is a side view of the glenosphere of FIG. 38, in accordance with an aspect of the present disclosure;
- [0061] **FIG. 42** is a cross-sectional side view of the glenosphere of FIG. 38, in accordance with an aspect of the present disclosure;
- [0062] **FIG. 43** is a top perspective view of a post for use with the glenoid implant of FIG. 16, in accordance with an aspect of the present disclosure;
- [0063] **FIG. 44** is a side view of the post of FIG. 43, in accordance with an aspect of the present disclosure; and
- [0064] **FIG. 45** is a cross-sectional side view of the post of FIG. 43, in accordance with an aspect of the present disclosure.

#### DETAILED DESCRIPTION FOR CARRYING OUT THE INVENTION

- [0065] Generally stated, disclosed herein are glenoid implants for shoulder prostheses. Further, surgical methods for using the glenoid implants are discussed.
- [0066] In this detailed description and the following claims, the words proximal, distal, anterior, posterior, medial, lateral, superior and inferior are defined by their standard usage for indicating a particular part of a bone or implant according to the relative disposition of the natural bone or directional terms of reference. For example, “proximal” means the portion of a device or implant nearest the torso, while “distal” indicates the portion of the device or implant farthest from the torso. As for directional terms, “anterior” is a direction towards the front side of the body, “posterior” means a direction towards the back side of the body, “medial” means towards the midline of the body, “lateral” is a direction towards the sides or away from the midline of the body, “superior” means a direction above and “inferior” means a direction below another object or structure.

[0067] As used herein, the word “exemplary” or “illustrative” means “serving as an example, instance, or illustration.” Any implementation described herein as “exemplary” or “illustrative” is not necessarily to be construed as preferred or advantageous over other implementations. Moreover, in the present description, the terms “upper”, “lower”, “left”, “rear”, “right”, “front”, “vertical”, “horizontal”, and derivatives thereof shall relate to the invention as oriented in the first figure of each embodiment.

[0068] Similarly, positions or directions may be used herein with reference to anatomical structures or surfaces. For example, as the current implants, devices, systems and methods are described herein with reference to use with the bones of the shoulder, the bones of the shoulder and upper arm may be used to describe the surfaces, positions, directions or orientations of the implants, devices, systems and methods. Further, the implants, devices, systems and methods, and the aspects, components, features and the like thereof, disclosed herein are described with respect to one side of the body for brevity purposes. However, as the human body is relatively symmetrical or mirrored about a line of symmetry (midline), it is hereby expressly contemplated that the implants, devices, systems and methods, and the aspects, components, features and the like thereof, described and/or illustrated herein may be changed, varied, modified, reconfigured or otherwise altered for use or association with another side of the body for a same or similar purpose without departing from the spirit and scope of the invention. For example, the implants, devices, systems and methods, and the aspects, components, features and the like thereof, described herein with respect to the right shoulder may be mirrored so that they likewise function with the left shoulder and vice versa. Further, the implants, devices, systems and methods, and the aspects, components, features and the like thereof, disclosed herein are described with respect to the shoulder for brevity purposes, but it should be understood that the implants, devices, systems and methods may be used with other bones of the body having similar structures, for example the lower extremity, and more specifically, with the bones of the ankle, foot, and leg.

[0069] Referring to the drawings, wherein like reference numerals are used to indicate like or analogous components throughout the several views, and with particular reference to FIGS. 1-15, there is illustrated an embodiment of a glenoid implant or reverse glenoid implant 100. The glenoid implant 100 includes a first end or lateral end 102 and a second end or medial end 104. The first end 102 is positioned opposite the second end 104. The glenoid implant 100 also includes a baseplate 110, a central screw 130, at least one peripheral screw 150, a coupling member 160, a glenosphere 180, and a post 200. The central screw 130 is inserted through a bore 116 of the baseplate 110. Next, the coupling member 160 engages the baseplate 110 on a first end to secure the central screw 130 within the bore 116. The second end of the coupling

member 160 is received within the glenosphere 180. Then, a post 200 may extend through the glenosphere 180 and the coupling member 160 and into the recess 136 of the central screw 130. The at least one peripheral screw 150 may be inserted through at least one peripheral bore 122 before securing the glenosphere 180 to the coupling member 160 with the post 200.

[0070] With continued reference to FIGS. 7-15, the baseplate 110 includes an upper surface 112 with a cylindrical shape and a lower surface or bottom surface 114. The baseplate 110 may include, for example, a constant or continuous exterior ring surrounding the boards 122 and keels 124. The baseplate 110 may also include a central bore 116 extending through the baseplate 110 from the upper surface 112 to the lower surface 114. As shown in FIGS. 7, 8 and 15, the central bore 116 may include, for example, a first section or proximal interior threaded section 118 extending into the baseplate 110 from the upper surface 112. In addition, the central bore 116 may include, for example, a second section or distal non-threaded section 120 extending from the first section 118 to the lower surface 114 of the baseplate 110. The baseplate 110 may also include a plurality of peripheral bores 122 extending through the baseplate 110 from the upper surface 112 to the lower surface 114. The bores 122 may be positioned, for example, equally spaced around the circumference of the baseplate 110 or alternatively, not equally spaced around the circumference of the base plate 110. In the depicted embodiment, the plurality of peripheral bores 122 includes three peripheral bores 122. The bottom surface 114 of the baseplate 110 may be, for example, curved or arced. The base plate 110 may also include a plurality of discrete arcuate keels, ridges, or protrusions 124. The protrusions 124 may extend away from the bottom surface 114 of the baseplate 110. The baseplate 110 may also include a plurality of through openings 126 extending through the base plate 110 from the upper surface 112 to the lower surface 114. The through openings 126 may, for example, be positioned between the plurality of peripheral boards 122 and positioned adjacent to the plurality of protrusions 124 on the lower surface 114 of the baseplate 110.

[0071] The central screw 130 as shown in FIGS. 7-15 may include a proximal non-threaded section 132 and a distal threaded section 142. The distal threaded section 142 may extend away from a bottom of the proximal non-threaded section 132. The proximal section 132 may include a head portion 134 positioned at a first end of the central screw 130. The head portion 134 may have, for example, a diameter larger than the diameter of the main portion of the proximal section 132 of the central screw 130. The proximal section 132 may also include a recess 136 extending into the proximal section 132 from the first end of the central screw 130. The recess 136 may include a first section or proximal female section 138 and a second section or threaded portion 140. The first section 138 may extend from the first end of the central screw 130 toward the second end and the second section 140 may extend from a bottom of the first section 138 to a



bottom of the recess 136. The first section 138 may be, for example, a drive feature for engaging a tool for inserting or removing the central screw 130. The second section 140 may be, for example, threaded for receiving a corresponding threads 210 of the post 200. The proximal section 132 may have, for example, a texture or coating to provide for porous fixation. The proximal section 132 may be, for example, configured or sized and shaped to conserve bone. The distal threaded section 142 may be, for example, threaded to engage a patient's bone to secure the baseplate 110 to the patient's bone, such as, the glenoid.

[0072] With continued reference to FIGS. 7-15, the at least one peripheral screw 150 is shown. The at least one peripheral screw 150 may include a head portion 152 with a drive opening 154 recessed into the head portion 152 from a first end of the peripheral screw 150. The at least one peripheral screw 150 may also include a threaded portion 156 extending away from a bottom surface of the head portion 152 to a second end of the peripheral screw 150. The at least one peripheral screw 150 may be, for example, three peripheral screws 150 as shown in the depicted embodiment. Although alternative numbers of peripheral screws 150 are also contemplated to correspond to the number of peripheral bores 122 in the baseplate 110. The peripheral screws 150 may be inserted through the peripheral bores 122 in the baseplate 110 to engage a patient's bone, such as, the glenoid, to assist with securing the baseplate 110 to the patient's bone.

[0073] The coupling member or modular taper 160 is shown in FIGS. 7-15. The coupling member 160 may include an exterior threaded portion 162 on the distal or second end of the coupling member 160. The coupling member 160 may also include a proximal recess 164 extending into the coupling member 160 from the first end. The coupling member 160 may also include a central bore 166 extending through the coupling member 160 from the first end to the second end. The proximal recess 164 may, for example, overlap with the central bore 166 at the first end of the coupling member 160.

[0074] With continued reference to FIGS. 7-15, the glenosphere 180 may include a central bore 182 extending through the glenosphere 180 from a first end to a second end. The central bore 182 may include a distal tapered portion 184, a central threaded portion 186, and a proximal cylindrical portion 188. The distal tapered portion 184 may extend from the second end of the glenosphere 180 toward the first end. The central threaded portion 186 may be positioned between the distal tapered portion 184 and the proximal cylindrical portion 188. The proximal cylindrical portion 188 may extend from the central threaded portion 186 to the first end of the glenosphere 180. As shown in FIGS. 7, 8 and 15, the diameter of the distal tapered portion 184 may be, for example, larger than the diameter of the proximal cylindrical portion 188. In addition, the diameter of the central threaded portion 186 may be smaller than the

diameter of both the proximal cylindrical portion 188 and the distal tapered portion 184. The distal tapered portion 184 may include sidewalls that taper as they extend from the second end of the glenosphere 180 to the central threaded portion 186. The second end of the glenosphere 180 may include a recessed region 190 positioned between a first lip or exterior lip 192 and a protrusion 194. The first lip 192 may surround the circumference of the second end of the glenosphere 180. The first lip 192 may be, for example, a constant or continuous ring surrounding the recessed region 190. The protrusion 194 may surround the central bore 182 on the second end of the glenosphere 180.

[0075] The post 200 is shown in FIGS. 7-15. The post 200 may include a cylindrical proximal head 202 positioned at a first end of the post 200. The cylindrical proximal head 202 may include, for example, a proximal recess 204 extending into the proximal head 202 from the first end of the post 200. The post 200 may also include a central portion 206 extending away from a second end of the proximal head 202. Further, the post 200 may include a distal portion 208 positioned at a second end of the post 200. The post 200 may also include an exterior threaded portion 210 positioned between the central portion 206 and a distal portion 208. The threaded portion 210 may be, for example, configured or sized and shaped to engage the second threaded section 140 of the central screw 130.

[0076] As shown in FIGS. 1-6, the implant 100 may be assembled by, for example, inserting the central screw 130 through the central bore 116 of the base plate 110. The threaded portion 162 of the coupling member 160 may then be threaded into the proximal interior threaded section 118 of the baseplate 110 to secure the central screw 130 to the base plate 110. After the baseplate 110, central screw 130, and the coupling member 160 are secured together they may be, for example, inserted into a patient coupled together. The at least one peripheral screw 150 may then be inserted through the plurality of peripheral bores 122 of the baseplate 110. Next, the distal tapered portion 184 of the glenosphere 180 may be coupled to the proximal end of the coupling member 160. The coupling member 160 may, for example, allow for angulation of the peripheral screws 150 before the coupling member 160 is attached to assist in preventing the central screw 130 from coming out when the glenosphere 180 is attached. A post 200 may then be inserted through the central bore 182 of the glenosphere 180, the central bore 166 of the coupling member 160 and into the recess 136 of the central screw 130 such that the threaded portion 210 of the post 200 engages the threaded portion 140 of the central screw 130.

[0077] A surgical method for implanting the glenoid implants 100, 300, may include preparing the patient's joint by performing sizing and alignment steps. Next, the bone may be reamed to form a channel and recess to receive the glenoid implant 100, 300. Next the selected

glenoid implant 100, 300 may be inserted and coupled to the bones. Finally, the surgical procedure may be completed and the patient's incision may be closed.

[0078] Referring now to FIGS. 16-45, another embodiment of a glenoid implant or reverse glenoid implant 300. As shown in FIGS. 21-22, the glenoid implant 300 includes a baseplate 310, a central screw 330, a peripheral compression screw 350, a modular taper 260, a glenosphere 380, and a post 390.

[0079] Referring now to FIGS. 23-28, the baseplate 310 includes a cylindrical shape, an upper surface 312 and a lower or bottom surface 314. The baseplate 310 also includes a central bore 316 extending between the upper surface 312 and the lower surface 314. The baseplate 310 also includes a plurality of peripheral bores 322 disposed around the central bore 316. In addition, the baseplate includes a plurality of discrete arcuated keels 324 extending away from the bottom surface 314 of the baseplate 310. As illustrated in FIG. 28, the central bore 316 of the baseplate 310 includes a proximal interior threaded section 318 and a distal non-threaded section 320.

[0080] Referring now to FIGS. 29-31, the central screw 330. The central screw 330 includes a central axis, a proximal non-threaded section 332 having a cylindrical shape, and a distal threaded section 344. The central screw 330 may include any desired length or width as can the proximal non-threaded section 332 and/or the distal threaded section 344. Advantageously, a reverse glenoid system may include a plurality of central screws 330 having varying overall lengths and varying section lengths. The non-threaded section 342 of the central screw 330 may further include a bone ingrowth surface including texturing, pores, holes, and/or a sprayed on mechanical or biological bone ingrowth promoting material. The central screw 330 also includes a proximal head portion 334. The head portion 334 has a surface area that increases in a direction opposite threaded portion 342. The head portion 334 of the central screw 330 includes a recess 336 that includes a proximal female section 338 for engaging a torque device (such as a screw driver). The recess 336 includes a central threaded portion 340, and a distal non-threaded portion 342. The recess 336 is disposed through proximal head 334. As illustrated in FIGS. 21 and 22, the central screw 330 is slidably disposed through the central bore 316 of the baseplate 310. The diameter of the head 334 is greater than a diameter of non-threaded section 332 of the central bore 316 of the baseplate 310 such that the central screw 330 is captured by the baseplate central bore 316. The central screw 330 is, for example, suitable for threading into a bone.

[0081] Referring now to FIGS. 32-34, a peripheral screw 350 is shown. The screw 350 may be, for example, a standard compression screw of the type known in the orthopedic implant arts. The peripheral screw 350 may include a head portion 352, a drive opening 354

inset into the head portion 352 at a first end of the screw 350, and a threaded portion 356 extending away from the head portion 352. Each screw 350 is insertable through at least one of the peripheral bores 322 of the baseplate 310 and into a desired bone to compress the implant 300 onto the bone.

[0082] Referring now to FIGS. 35-37, a coupling member or modular taper 360. The modular taper 360 includes an exterior tapered cylindrical shape. The modular taper 360 further includes a distal exterior threaded portion 362 and a proximal recess 364 for engaging a torque device, such as, a screwdriver. The modular taper 360 also includes a central bore 366 disposed through the modular taper 360. As shown in FIGS. 21 and 22, the modular taper 360 threadedly connects within the central bore 316 of the baseplate 310.

[0083] Referring now to FIGS. 38-42, of the glenosphere 380 is shown. The glenosphere 380 includes a hemispherical shape and a central bore 382 having a distal tapered portion 384, a central threaded portion 386, and a proximal cylindrical portion 388. As illustrated in FIGS. 21 and 22, the glenosphere 380 is disposed atop the modular taper 360 such that the exterior of the modular taper 360 and the distal tapered portion 384 of the glenosphere bore 382 form a mechanical taper connection.

[0084] Referring now collectively to FIGS. 28-30, a post 390 is shown. The post 390 includes a cylindrical proximal head 392 having a diameter and a proximal recess 394 for engaging a torque device. The post 390 further includes a central portion 396 having a diameter smaller than the diameter of the post proximal head 392 and a distal portion 398 having a diameter smaller than the diameter of the post proximal head 392. The post 390 also includes an exterior thread portion 300 disposed along a portion of the post 390 between the central post portion 396 and the distal post portion 398. When assembled, as illustrated in FIGS. 21 and 22, the post 390 is disposed through the central bore 382 of the glenosphere 380, through the central bore 366 of the modular taper 360, and threadedly connected to the recess 336 of the central screw 330.

[0085] An implant 300 in accordance with the present disclosure offers several advantages over other known reverse glenoid devices. The baseplate 310 can accept a central locking screw 330 to provide compression, then is locked in place to rigidify the construct via a taper cap 360 that will accept the glenosphere 380. This construct can be pre-assembled to allow the surgeon to insert the entire locked construct 300 as one piece to streamline the process or simplify revision surgeries. The taper that can be added later and/or have built-in offset to allow eccentricity or have a longer taper option to build in lateralization.

[0086] The screw 330 has a post portion that essentially replaces the distal post of the baseplate, and transfers that geometry to the screw, allowing the post to be much smaller in

diameter since a screw does not need to pass through it and ultimately conserves bone.

Additionally, the screw 330 passes through the baseplate and provides compression via the screw portion as well as long term fixation via the proximal portion.

[0087] An exemplary method of using an orthopedic implant assembly 300 includes placing a baseplate 310 into the bone, inserting a central screw 330 through the baseplate 310 into the bone, inserting a peripheral compression screw 350 through a peripheral bore 322 of the baseplate 310 into the bone, and screwing a modular taper 360 into the central bore 316 of the baseplate 310. These steps may be performed during an open surgical procedure or pre-assembled prior to surgery.

[0088] Next, an exemplary method of using the implant 300 of the present disclosure includes placing a glenosphere 380 onto the modular taper 360 and inserting the post 390 through the glenosphere 380 and the taper 360 then threading the same into the central screw 330.

[0089] As may be recognized by those of ordinary skill in the art based on the teachings herein, numerous changes and modifications may be made to the above-described and other embodiments of the present disclosure without departing from the scope of the disclosure. The components of the implants, devices, and/or systems as disclosed in the specification, including the accompanying abstract and drawings, may be replaced by alternative component(s) or feature(s), such as those disclosed in another embodiment, which serve the same, equivalent or similar purpose as known by those skilled in the art to achieve the same, equivalent or similar results by such alternative component(s) or feature(s) to provide a similar function for the intended purpose. In addition, the implants, devices, and/or systems may include more or fewer components or features than the embodiments as described and illustrated herein. For example, the components and features of implants 100, 300 may be used interchangeably and in alternative combinations as would be modified or altered by one of skill in the art. Further, the steps of the surgical methods associated with the implants 100, 300 may be used interchangeably and in alternative combinations as would be modified or altered by one of skill in the art. Accordingly, this detailed description of the currently-preferred embodiments is to be taken in an illustrative, as opposed to limiting of the disclosure.

[0090] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprise” (and any form of comprise, such as “comprises” and “comprising”), “have” (and any form of have, such as “has”, and “having”), “include” (and any form of include, such as “includes” and “including”), and

“contain” (and any form of contain, such as “contains” and “containing”) are open-ended linking verbs. As a result, a method or device that “comprises,” “has,” “includes,” or “contains” one or more steps or elements possesses those one or more steps or elements, but is not limited to possessing only those one or more steps or elements. Likewise, a step of a method or an element of a device that “comprises,” “has,” “includes,” or “contains” one or more features possesses those one or more features, but is not limited to possessing only those one or more features. Furthermore, a device or structure that is configured in a certain way is configured in at least that way, but may also be configured in ways that are not listed.

[0091] The invention has been described with reference to the preferred embodiments. It will be understood that the operational embodiments described herein are exemplary of a plurality of possible arrangements to provide the same general features, characteristics, and general system operation. Modifications and alterations will occur to others upon a reading and understanding of the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations.

## CLAIMS

Having thus described the preferred embodiments, the invention is now claimed to be:

1. An implant, comprising:
  - a baseplate;
  - a central screw extending through a central bore in the baseplate; and
  - a coupling member engaging a portion of the central bore of the baseplate.
2. The implant of claim 1, further comprising:
  - a glenosphere coupled to the coupling member; and
  - a post extending through the glenosphere, the coupling member and into the central screw.
3. The implant of claim 2, further comprising:
  - at least one peripheral screw received within a plurality of peripheral bores of the baseplate.
4. The implant of claim 3, wherein the central bore of the baseplate further comprises:
  - a proximal interior threaded section extending from a first end of the baseplate toward the second end; and
  - a distal non-threaded section extending from the proximal interior threaded section to the second end of the baseplate.
5. The implant of claim 4, wherein the baseplate further comprises:
  - a plurality of protrusions extending away from a bottom surface of the base plate.
6. The implant of claim 5, wherein each protrusion of the plurality of protrusions is positioned adjacent to each peripheral bore of the plurality of peripheral bores.
7. The implant of claim 6, wherein the baseplate further comprises:
  - a plurality of through openings extending through the baseplate from the first end to the second end; and
  - wherein the plurality of through opening our positioned adjacent to at least one of the protrusions of the plurality of protrusions.

8. The implant of claim 4, wherein the central screw further comprises:
  - a head portion;
  - a proximal non-threaded section extending away from a second end of the head portion; and
  - a distal threaded section extending away from a second end of the proximal non-threaded section.
9. The implant of claim 8, wherein the central screw further comprises:
  - a recess extending into the central screw from the first end through the head portion and into the proximal non-threaded section.
10. The implant of claim 9, wherein the recess comprises:
  - a first section extending from the first end of the central screw towards the second end; and
  - a second portion extending from a second end of the first section to a bottom of the recess.
11. The implant of claim 10, wherein the second portion is threaded.
12. The implant of claim 10, wherein the coupling member comprises:
  - a distal exterior threaded portion;
  - a central bore extending through the coupling member from a first end to a second end; and
  - a proximal recess extending into the first end of the coupling member can engaging the central bore.
13. The implant of claim 12, wherein the coupling member further comprises:
  - a plurality of protrusions extending away from the first end of the coupling member.
14. The implant of claim 12, wherein the glenosphere comprises:
  - a central bore extending through the glenosphere from a first end to a second end;
  - a recessed region extending into the glenosphere from the second end;
  - a first lip extending away from the second end of the glenosphere and surrounding the recessed region; and



a protrusion extending away from the second end of the glenosphere and surrounding the central bore.

15. The implant of claim 14, wherein the central bore comprises:
- a proximal cylindrical portion extending from the first end of the glenosphere toward the second end;
  - a distal tapered portion extending from the second end of the glenosphere toward the first end; and
  - a central threaded portion positioned between the proximal cylindrical portion and a distal tapered portion.
16. The implant of claim 15, wherein the post comprises:
- a head portion; and
  - a stem extending away from the head portion;
- wherein the head portion include an engagement recess extending into the head portion from a first end of the post.
17. The implant of claim 16, wherein the stem comprises:
- a central portion extending away from a bottom surface of the head portion toward the second end;
  - a distal portion extending from the second end toward the central portion; and
  - an exterior threaded portion positioned between the central portion and a distal portion.
18. An orthopedic implant assembly, comprising:
- a baseplate comprising:
    - a cylindrical shape;
    - an upper surface;
    - a lower surface;
    - a central bore disposed from the upper surface to the lower surface;
    - a plurality of peripheral bores disposed around the central bore;
    - a plurality of discrete arcuated keels extending from the bottom surface of the baseplate, the central bore having a proximal interior threaded section and a distal non-threaded section;

a central screw, said central screw having a central axis, a proximal non-threaded section having a cylindrical shape, and a distal threaded section, said central screw further comprising a proximal head portion, said head portion having a surface area that increases in a direction opposite said threaded portion, said central screw further comprising a recess having a proximal section for engaging a torque device, a central threaded portion, and a distal non-threaded portion, said recess disposed through said proximal head, said central screw slidably disposed through said central bore of said baseplate, where a diameter of said head is greater than a diameter of said non-threaded section of said central bore of said baseplate such that said central screw is captured by said baseplate central bore, said central screw suitable for threading into a bone;

a peripheral compression screw, said peripheral screw, said peripheral compression screw disposed through one of said peripheral bores, said peripheral screw suitable for threading into a bone;

a modular taper, said modular taper having a tapered cylindrical shape, a distal threaded portion and a proximal recess for engaging a torque device, and a central bore, said modular taper threadedly connected to said central bore of said baseplate, modular taper locks the central screw to the baseplate;

a glenosphere, said glenosphere having a hemispherical shape and a central bore having a distal tapered portion, a central threaded portion, and a proximal cylindrical portion, said glenosphere disposed atop said modular taper such that the exterior of said modular taper and the distal tapered portion of said glenosphere bore form a mechanical taper connection; and

a post, said post having a cylindrical proximal head having a diameter and a proximal recess for engaging a torque device, said post further comprised a central portion having a diameter smaller than the diameter of said post proximal head, said post further having a distal portion having a diameter smaller than the diameter of said post proximal head, said post further comprising an exterior thread portion, said exterior threaded portion disposed along a portion of said post between said central post portion and said distal post portion, said post disposed through said central bore of said glenosphere, said post further disposed through said central bore of said modular taper, said post further disposed into and threadedly connected to said recess of said central screw.

19. The orthopedic implant assembly of claim 18, wherein said proximal non-threaded section comprises a surface connected from the group consisting of porous, textured, indented, and sprayed.

20. An orthopedic implant assembly, comprising:

a baseplate, said baseplate having a cylindrical shape, an upper surface, and a lower surface, said baseplate further comprising a central bore disposed from said upper surface to said lower surface, said baseplate further comprising a plurality of discrete arcuated keels extending from said bottom surface of said baseplate, said central bore having a proximal interior threaded section and a distal non-threaded section;

a central screw, said central screw having a central axis, a proximal non-threaded section having a cylindrical shape, and a distal threaded section, said central screw further comprising a proximal head portion, said head portion having a surface area that increases in a direction opposite said threaded portion, said central screw further comprising a recess having a proximal section for engaging a torque device, a central threaded portion, and a distal non-threaded portion, said recess disposed through said proximal head, said central screw slidably disposed through said central bore of said baseplate, where a diameter of said head is greater than a diameter of said non-threaded section of said central bore of said baseplate such that said central screw is captured by said baseplate central bore, said central screw suitable for threading into a bone;

a modular taper, said modular taper having a tapered cylindrical shape, a distal threaded portion and a proximal recess for engaging a torque device, and a central bore, said modular taper threadedly connected to said central bore of said baseplate;

a glenosphere, said glenosphere having a hemispherical shape and a central bore having a distal tapered portion, a central threaded portion, and a proximal cylindrical portion, said glenosphere disposed atop said modular taper such that the exterior of said modular taper and the distal tapered portion of said glenosphere bore form a mechanical taper connection; and

a post, said post having a cylindrical proximal head having a diameter and a proximal recess for engaging a torque device, said post further comprising a central portion having a diameter smaller than the diameter of said post proximal head, said post further having a distal portion having a diameter smaller than the diameter of said post proximal head, said post further comprising an exterior thread portion, said exterior threaded portion disposed along a portion of said post

between said central post portion and said distal post portion, said post disposed through said central bore of said glenosphere, said post further disposed through said central bore of said modular taper, said post further disposed into and threadedly connected to said recess of said central screw.

21. The orthopedic implant assembly of claim 20, wherein said proximal non-threaded section of each screw of said plurality of central screws comprises a surface connected from the group consisting of porous, textured, indented, and sprayed.

22. An orthopedic implant assembly system, said implant assembly system comprising:

at least one baseplate, said baseplate having a cylindrical shape, an upper surface, and a lower surface, said baseplate further comprising a central bore disposed from said upper surface to said lower surface, and a plurality of peripheral bores disposed around said central bore; said baseplate further comprising a plurality of discrete arcuated keels extending from said bottom surface of said baseplate, said central bore having a proximal interior threaded section and a distal non-threaded section;

a plurality of central screws, each screw of said plurality of central screws having a central axis, a proximal non-threaded section having a cylindrical shape, and a distal threaded section, said central screw further comprising a proximal head portion, said head portion having a surface area that increases in a direction opposite said threaded portion, said central screw further comprising a recess having a proximal section for engaging a torque device, a central threaded portion, and a distal non-threaded portion, said recess disposed through said proximal head, said central screw slidingly disposed through said central bore of said baseplate, where a diameter of said head is greater than a diameter of said non-threaded section of said central bore of said baseplate such that said central screw is captured by said baseplate central bore, said central screw suitable for threading into a bone;

at least one peripheral compression screw, said peripheral screw, said peripheral compression screw disposed through one of said peripheral bores, said peripheral screw suitable for threading into a bone;

at least one modular taper, said modular taper having a tapered cylindrical shape, a distal threaded portion and a proximal recess for engaging a

torque device, and a central bore, said modular taper threadedly connected to said central bore of said baseplate;

a plurality of glenospheres, each glenosphere of said plurality of glenospheres having a hemispherical shape and a central bore having a distal tapered portion, a central threaded portion, and a proximal cylindrical portion, said glenosphere disposed atop said modular taper such that the exterior of said modular taper and the distal tapered portion of said glenosphere bore form a mechanical taper connection; and

at least one post, said post having a cylindrical proximal head having a diameter and a proximal recess for engaging a torque device, said post further comprised a central portion having a diameter smaller than the diameter of said post proximal head, said post further having a distal portion having a diameter smaller than the diameter of said post proximal head, said post further comprising an exterior thread portion, said exterior threaded portion disposed along a portion of said post between said central post portion and said distal post portion, said post disposed through said central bore of said glenosphere, said post further disposed through said central bore of said modular taper, said post further disposed into and threadedly connected to said recess of said central screw.

23. The orthopedic implant assembly system of claim 22, wherein each said screw of said plurality of central screws comprises a unique threaded portion length.

24. The orthopedic implant assembly system of claim 22, wherein each said screw of said plurality of central screws comprises a unique non-threaded portion length.

25. The orthopedic implant assembly system of claim 22, wherein said proximal non-threaded section of each screw of said plurality of central screws comprises a surface connected from the group consisting of porous, textured, indented, and sprayed.

26. The orthopedic implant assembly system of claim 25, wherein each said screw of said plurality of central screws comprises a unique threaded portion length.

27. The orthopedic implant assembly system of claim 25, wherein each said screw of said plurality of central screws comprises a unique non-threaded portion length.

28. A method of using an orthopedic implant assembly, said method comprising the steps of: surgically exposing and resecting a desired bone;

inserting a baseplate into said bone, said baseplate having a cylindrical shape, an upper surface, and a lower surface, said baseplate further comprising a central bore disposed from said upper surface to said lower surface, and a plurality of peripheral bores disposed around said central bore; said baseplate further comprising a plurality of discrete arcuated keels extending from said bottom surface of said baseplate, said central bore having a proximal interior threaded section and a distal non-threaded section;

inserting a central screw through said baseplate into said bone, said central screw having a central axis, a proximal non-threaded section having a cylindrical shape, and a distal threaded section, said central screw further comprising a proximal head portion, said head portion having a surface area that increases in a direction opposite said threaded portion, said central screw further comprising a recess having a proximal section for engaging a torque device, a central threaded portion, and a distal non-threaded portion, said recess disposed through said proximal head, said central screw slidably disposed through said central bore of said baseplate, where a diameter of said head is greater than a diameter of said non-threaded section of said central bore of said baseplate such that said central screw is captured by said baseplate central bore, said central screw suitable for threading into a bone;

inserting a peripheral screw through said peripheral bore into said bone, said peripheral screw, said peripheral screw disposed through one of said peripheral bores, said peripheral screw suitable for threading into a bone;

screwing a modular taper into said central bore of said baseplate, said modular taper having a tapered cylindrical shape, a distal threaded portion and a proximal recess for engaging a torque device, and a central bore, said modular taper threadedly connected to said central bore of said baseplate;

placing a glenosphere onto said modular taper, said glenosphere having a hemispherical shape and a central bore having a distal tapered portion, a central threaded portion, and a proximal cylindrical portion, said glenosphere disposed atop said modular taper such that the exterior of said modular taper and the distal tapered portion of said glenosphere bore form a mechanical taper connection; and

inserting a post through said glenosphere and taper and threading the same into said central screw recess, said post having a cylindrical proximal head

having a diameter and a proximal recess for engaging a torque device, said post further comprised a central portion having a diameter smaller than the diameter of said post proximal head, said post further having a distal portion having a diameter smaller than the diameter of said post proximal head, said post further comprising an exterior thread portion, said exterior threaded portion disposed along a portion of said post between said central post portion and said distal post portion, said post disposed through said central bore of said glenosphere, said post further disposed through said central bore of said modular taper, said post further disposed into and threadedly connected to said recess of said central screw.

29. A method of using an orthopedic implant assembly system, said method comprising the steps of: surgically exposing and resecting a desired bone;

selecting a baseplate and inserting said baseplate into said bone, said baseplate having a cylindrical shape, an upper surface, and a lower surface, said baseplate further comprising a central bore disposed from said upper surface to said lower surface, and a plurality of peripheral bores disposed around said central bore; said baseplate further comprising a plurality of discrete arcuated keels extending from said bottom surface of said baseplate, said central bore having a proximal interior threaded section and a distal non-threaded section;

selecting a central screw and inserting said central screw through said baseplate into said bone, said central screw having a central axis, a proximal non-threaded section having a cylindrical shape, and a distal threaded section, said central screw further comprising a proximal head portion, said head portion having a surface area that increases in a direction opposite said threaded portion, said central screw further comprising a recess having a proximal section for engaging a torque device, a central threaded portion, and a distal non-threaded portion, said recess disposed through said proximal head, said central screw slidably disposed through said central bore of said baseplate, where a diameter of said head is greater than a diameter of said non-threaded section of said central bore of said baseplate such that said central screw is captured by said baseplate central bore, said central screw suitable for threading into a bone;

selecting a peripheral screw and inserting said peripheral screw through said peripheral bore into said bone, said peripheral screw, said peripheral screw disposed through one of said peripheral bores, said peripheral screw suitable for threading into a bone;

selecting a modular taper and screwing said modular taper into said central bore of said baseplate, said modular taper having a tapered cylindrical shape, a distal threaded portion and a proximal recess for engaging a torque device, and a central bore, said modular taper threadedly connected to said central bore of said baseplate;

selecting a glenosphere and placing said glenosphere onto said modular taper, said glenosphere having a hemispherical shape and a central bore having a distal tapered portion, a central threaded portion, and a proximal cylindrical portion, said glenosphere disposed atop said modular taper such that the exterior of said modular taper and the distal tapered portion of said glenosphere bore form a mechanical taper connection; and

selecting a post and inserting said post through said glenosphere and taper and threading the same into said central screw recess, said post having a cylindrical proximal head having a diameter and a proximal recess for engaging a torque device, said post further comprised a central portion having a diameter smaller than the diameter of said post proximal head, said post further having a distal portion having a diameter smaller than the diameter of said post proximal head, said post further comprising an exterior thread portion, said exterior threaded portion disposed along a portion of said post between said central post portion and said distal post portion, said post disposed through said central bore of said glenosphere, said post further disposed through said central bore of said modular taper, said post further disposed into and threadedly connected to said recess of said central screw.

30. The method of claim 29, wherein said baseplate, said central screw and said modular taper are pre-assembled as a single unit and inserted into an implant as a single unit.

31. An implant, comprising:

a baseplate;

a central screw extending through a central bore in the baseplate; and

a coupling member engaging a portion of the central bore of the baseplate.

32. The implant of claim 31, further comprising:

a glenosphere coupled to the coupling member; and

a post extending through the glenosphere, the coupling member and into the central screw.



33. The implant of any of the preceding claims, further comprising:  
at least one peripheral screw received within a plurality of peripheral bores of the baseplate.
34. The implant of any of the preceding claims, wherein the central bore of the baseplate further comprises:  
a proximal interior threaded section extending from a first end of the baseplate toward the second end; and  
a distal non-threaded section extending from the proximal interior threaded section to the second end of the baseplate.
35. The implant of any of the preceding claims, wherein the baseplate further comprises:  
a plurality of protrusions extending away from a bottom surface of the base plate.
36. The implant of any of the preceding claims, wherein each protrusion of the plurality of protrusions is positioned adjacent to each peripheral bore of the plurality of peripheral bores.
37. The implant of any of the preceding claims, wherein the baseplate further comprises:  
a plurality of through openings extending through the baseplate from the first end to the second end; and  
wherein the plurality of through opening our positioned adjacent to at least one of the protrusions of the plurality of protrusions.
38. The implant of any of the preceding claims, wherein the central screw further comprises:  
a head portion;  
a proximal non-threaded section extending away from a second end of the head portion; and  
a distal threaded section extending away from a second end of the proximal non-threaded section.

39. The implant of any of the preceding claims, wherein the central screw further comprises:

a recess extending into the central screw from the first end through the head portion and into the proximal non-threaded section.

40. The implant of any of the preceding claims, wherein the recess comprises:

a first section extending from the first end of the central screw towards the second end; and

a second portion extending from a second end of the first section to a bottom of the recess.

41. The implant of any of the preceding claims, wherein the second portion is threaded.

42. The implant of any of the preceding claims, wherein the coupling member comprises:

a distal exterior threaded portion;

a central bore extending through the coupling member from a first end to a second end; and

a proximal recess extending into the first end of the coupling member can engaging the central bore.

43. The implant of any of the preceding claims, wherein the coupling member further comprises:

a plurality of protrusions extending away from the first end of the coupling member.

44. The implant of any of the preceding claims, wherein the glenosphere comprises:

a central bore extending through the glenosphere from a first end to a second end;

a recessed region extending into the glenosphere from the second end;

a first lip extending away from the second end of the glenosphere and surrounding the recessed region; and

a protrusion extending away from the second end of the glenosphere and surrounding the central bore.

45. The implant of any of the preceding claims, wherein the central bore comprises:  
a proximal cylindrical portion extending from the first end of the glenosphere toward the second end;  
a distal tapered portion extending from the second end of the glenosphere toward the first end; and  
a central threaded portion positioned between the proximal cylindrical portion and a distal tapered portion.
46. The implant of any of the preceding claims, wherein the post comprises:  
a head portion; and  
a stem extending away from the head portion;  
wherein the head portion include an engagement recess extending into the head portion from a first end of the post.
47. The implant of any of the preceding claims, wherein the stem comprises:  
a central portion extending away from a bottom surface of the head portion toward the second end;  
a distal portion extending from the second end toward the central portion; and  
an exterior threaded portion positioned between the central portion and a distal portion.

1/25

100

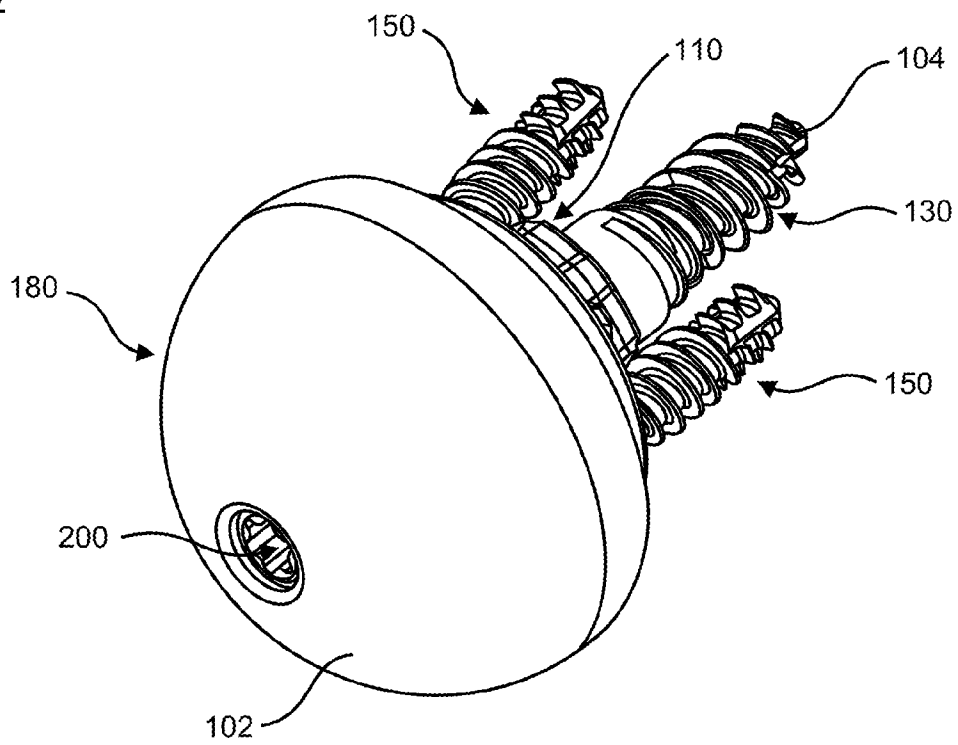


FIG. 1

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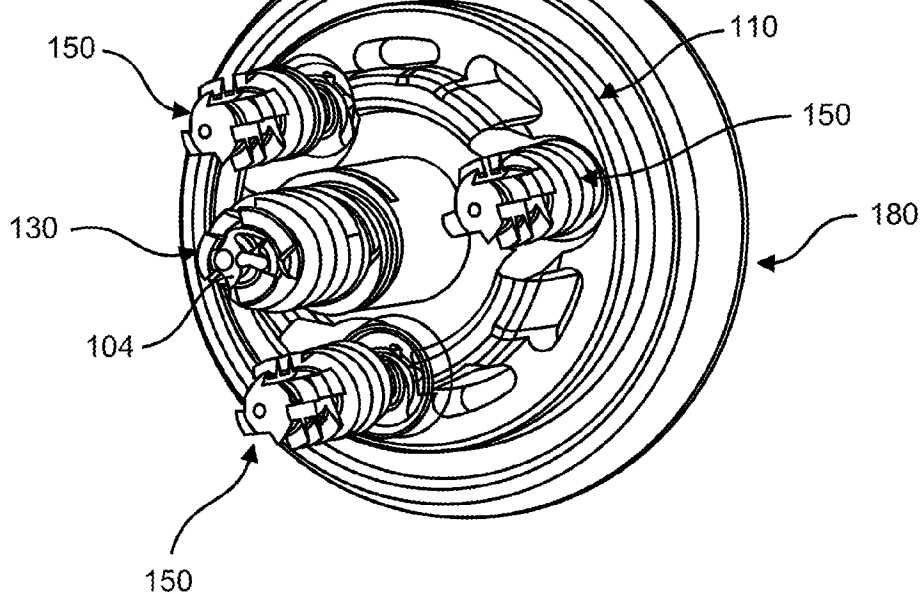


FIG. 2

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300

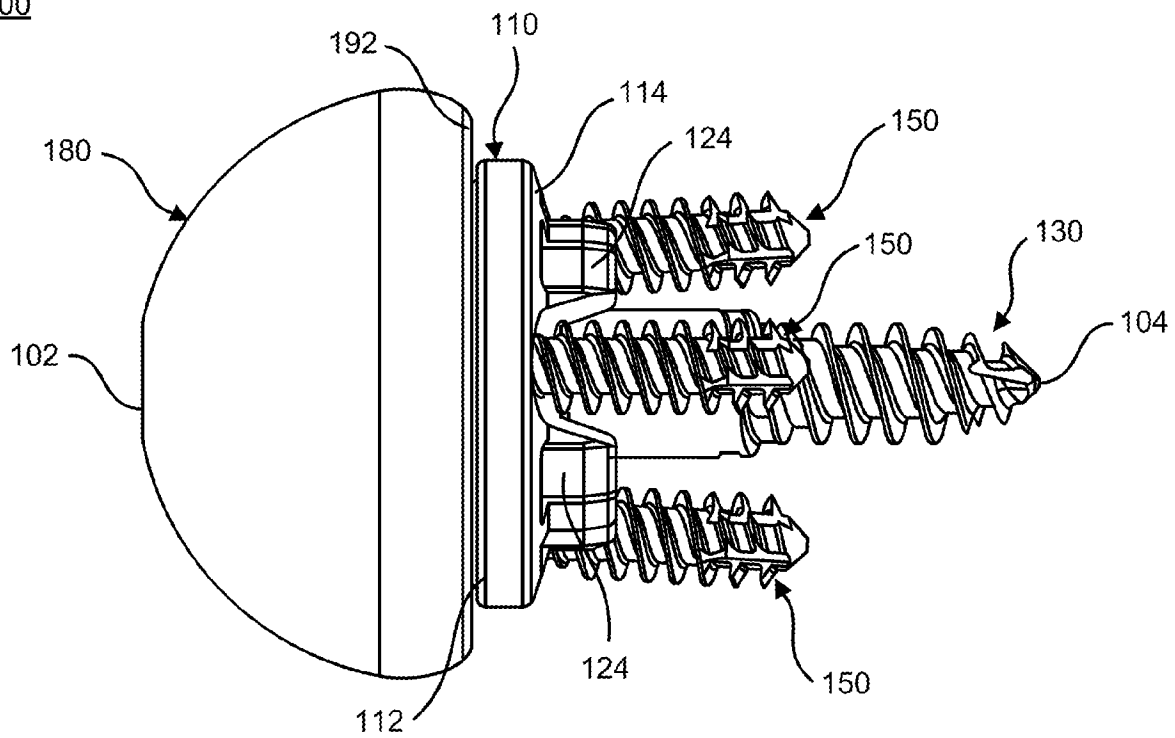


**FIG. 3**

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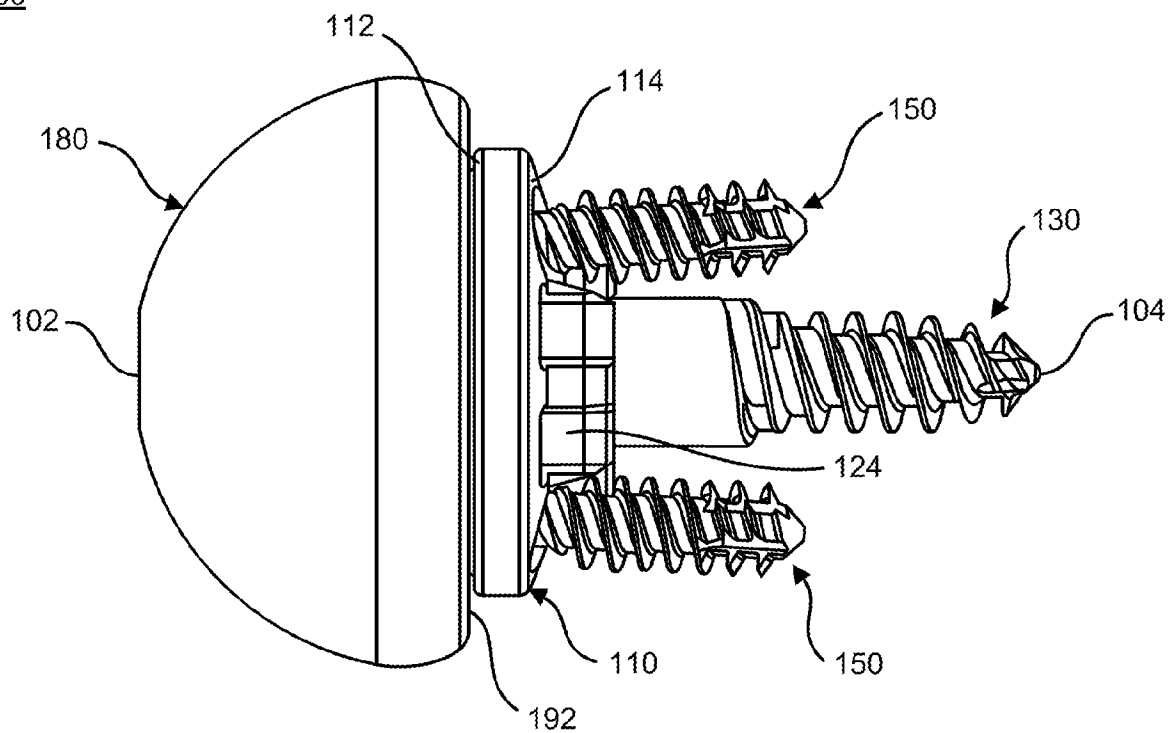


**FIG. 4**

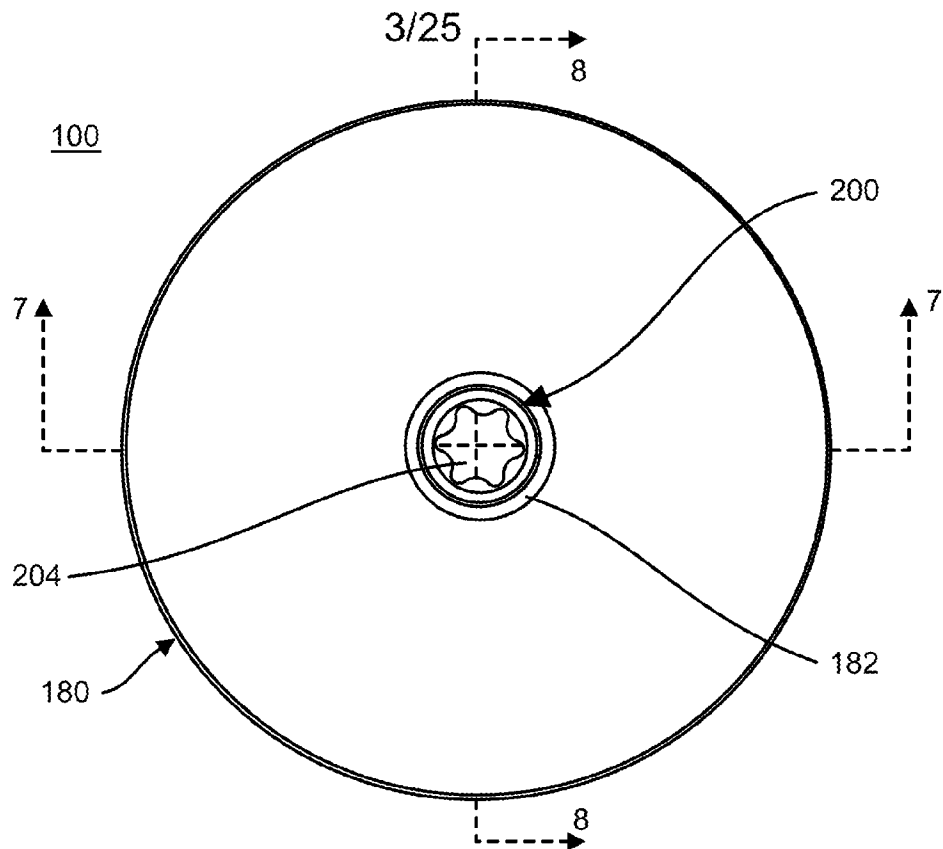


FIG. 5

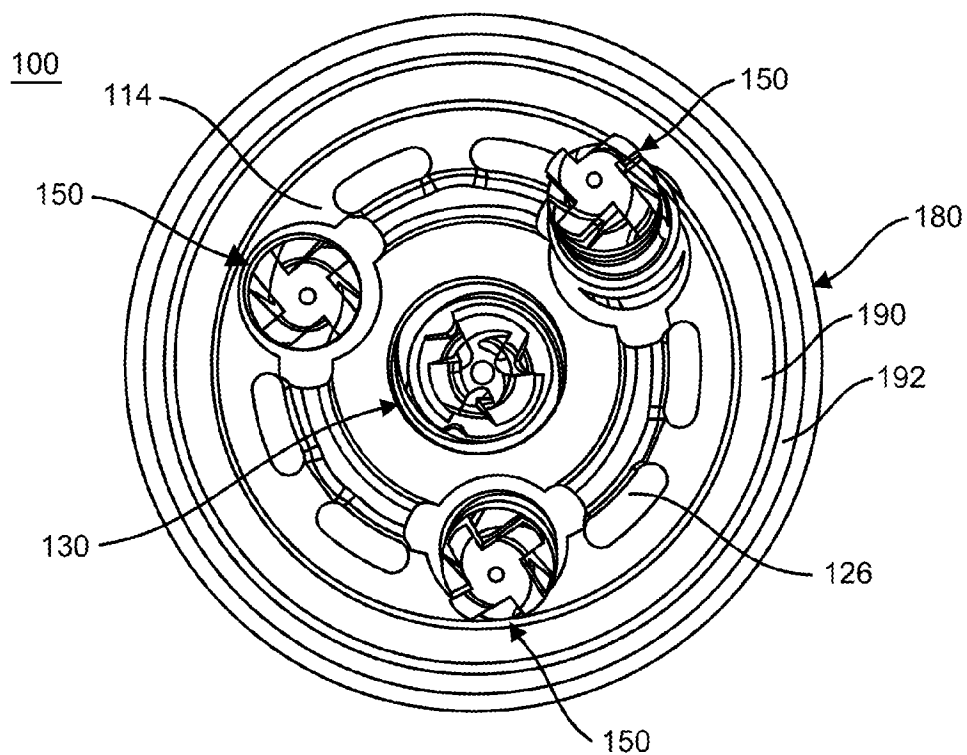


FIG. 6

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100

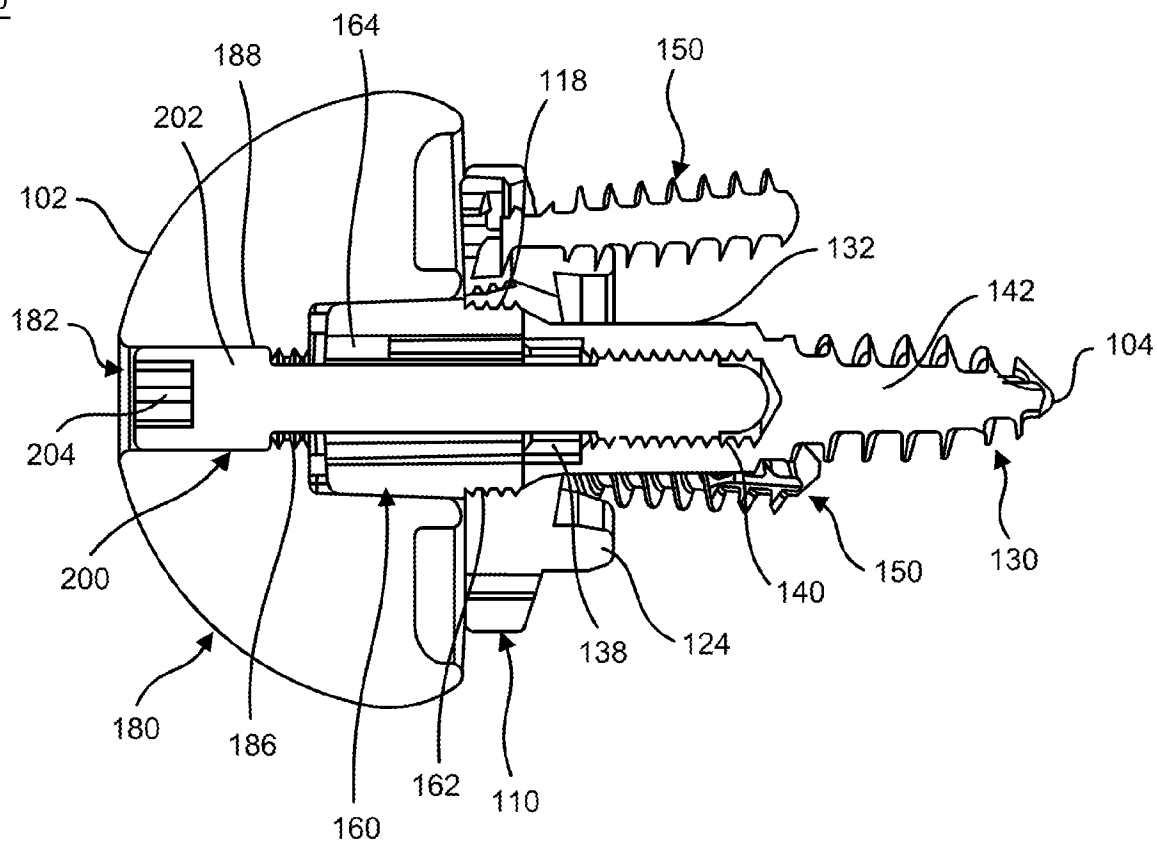


FIG. 7

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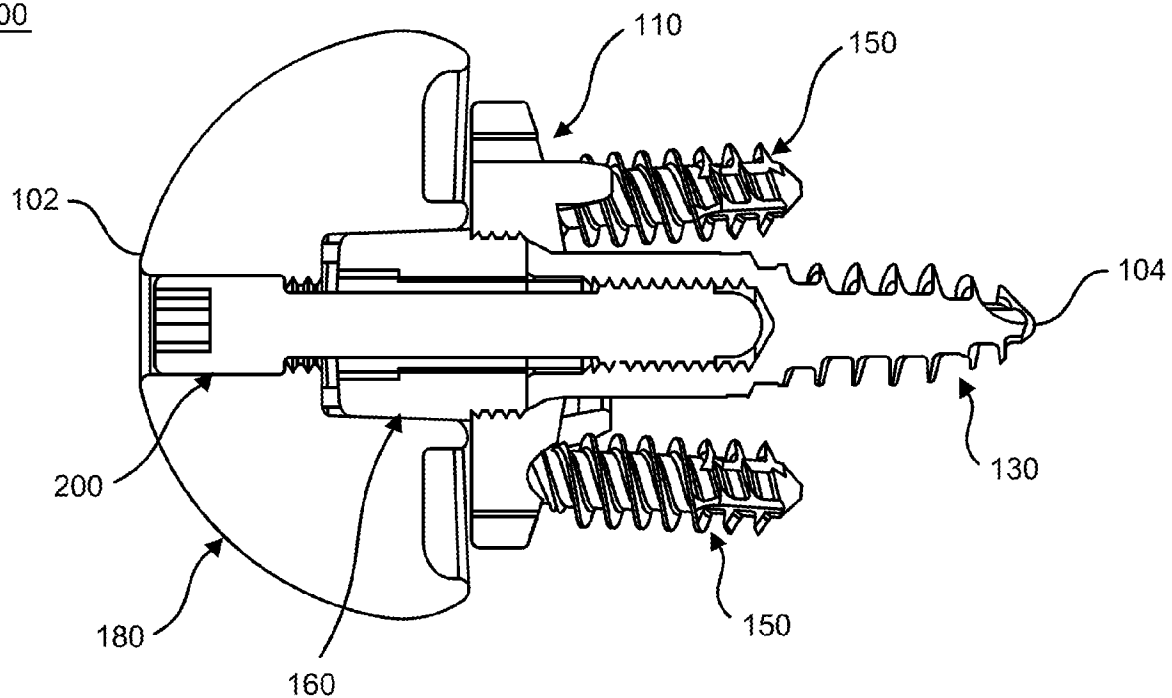


FIG. 8

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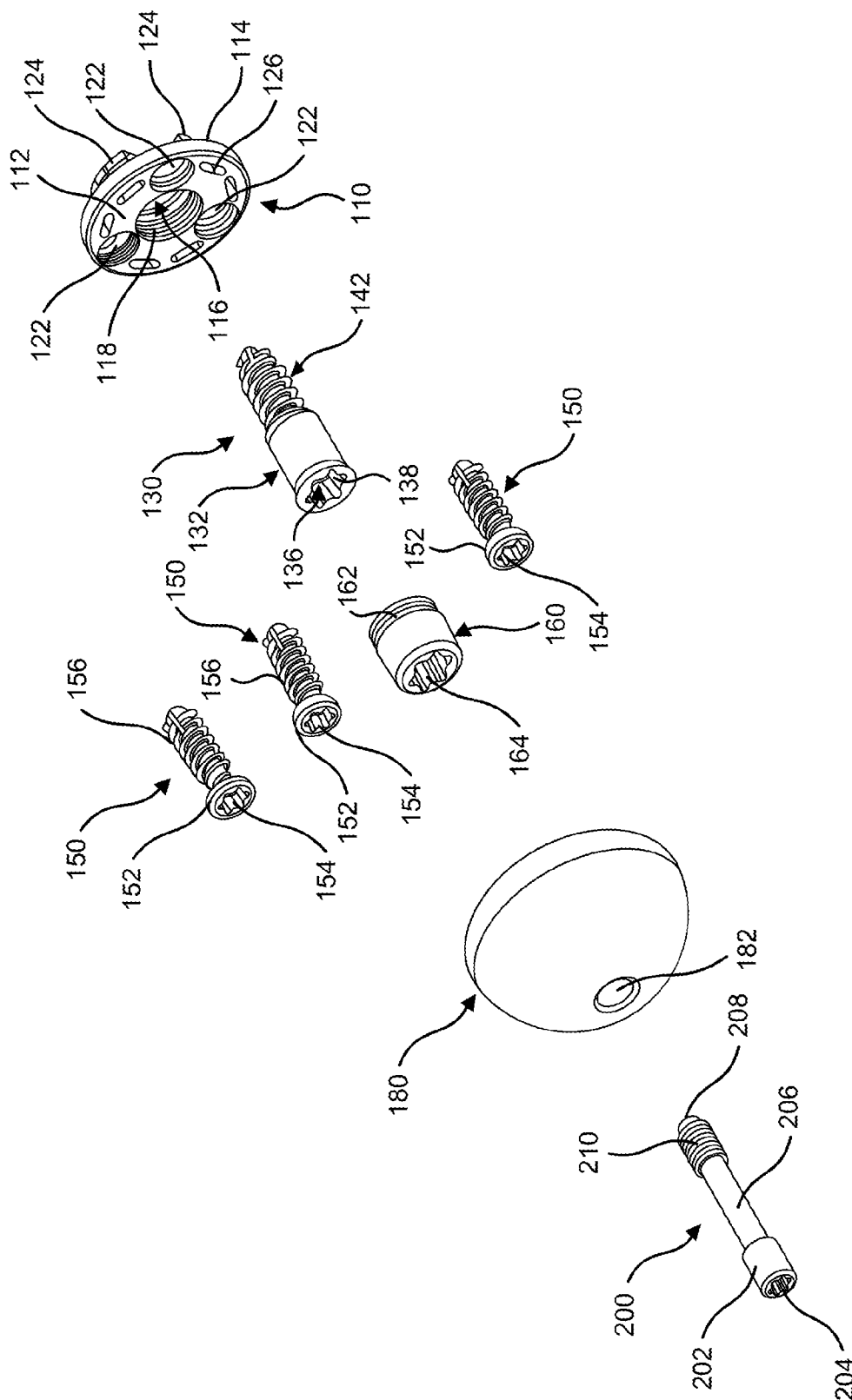


FIG. 9

100



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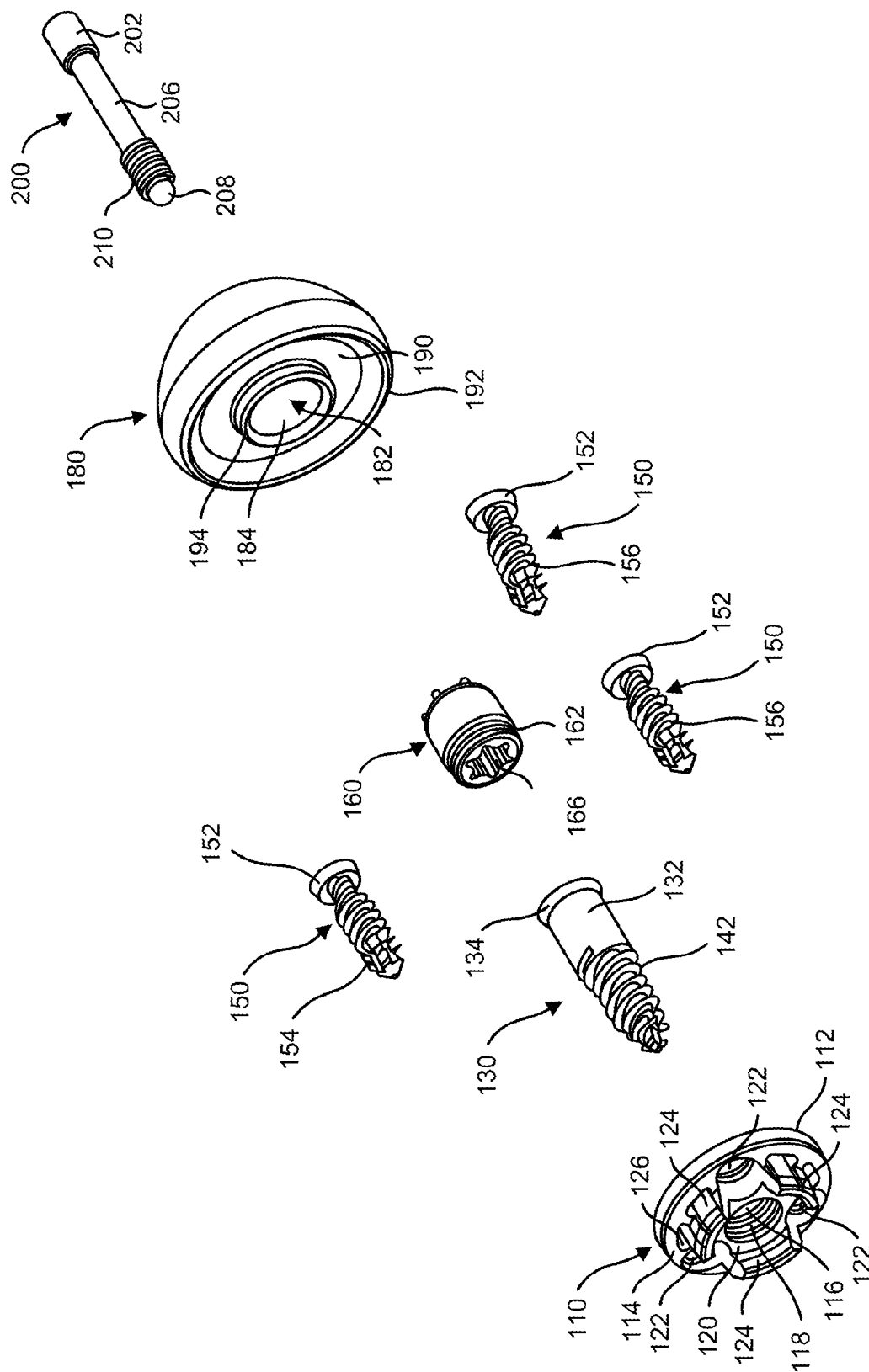


FIG. 10

100

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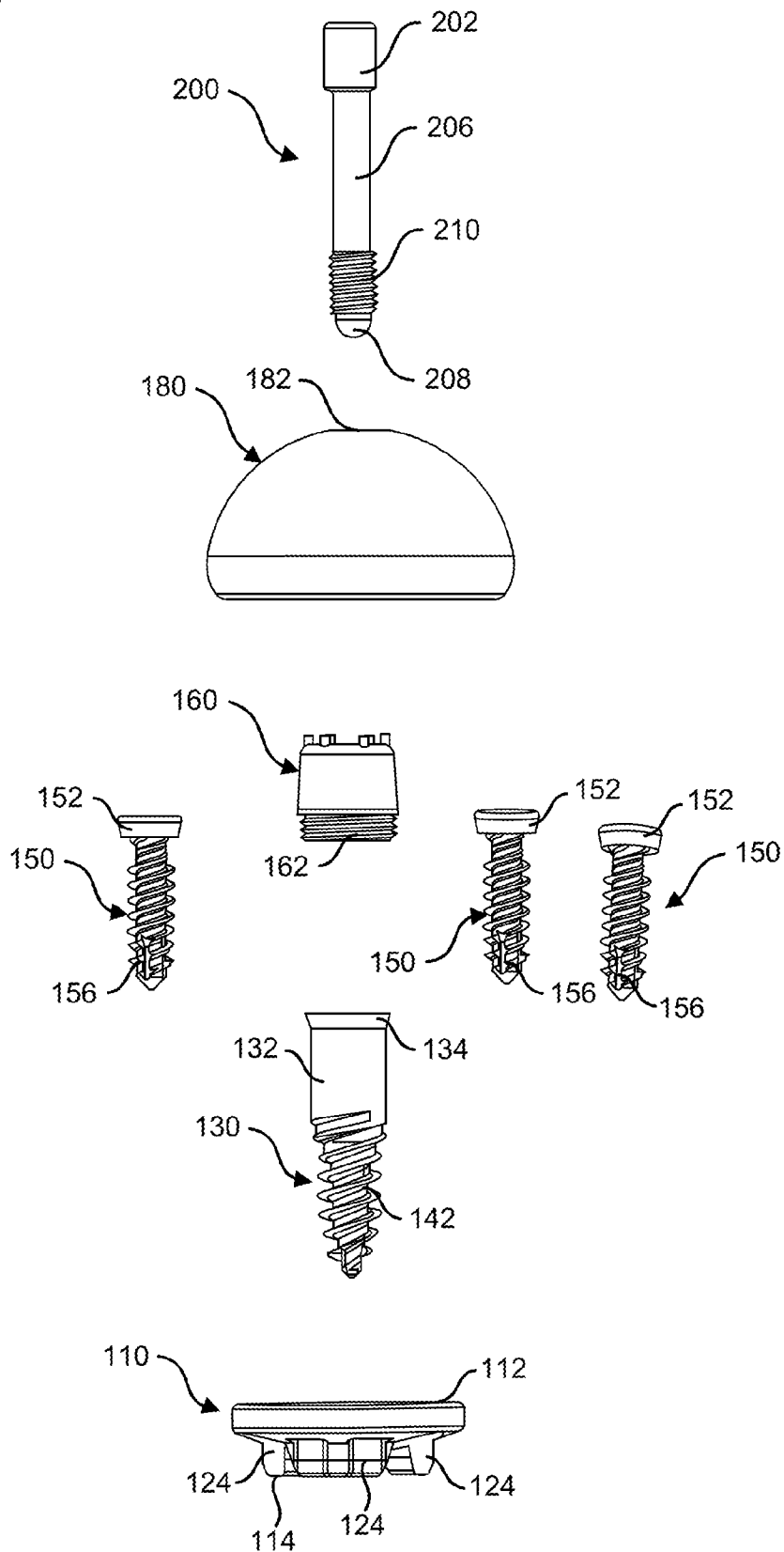


**FIG. 11**  
SUBSTITUTE SHEET (RULE 26)

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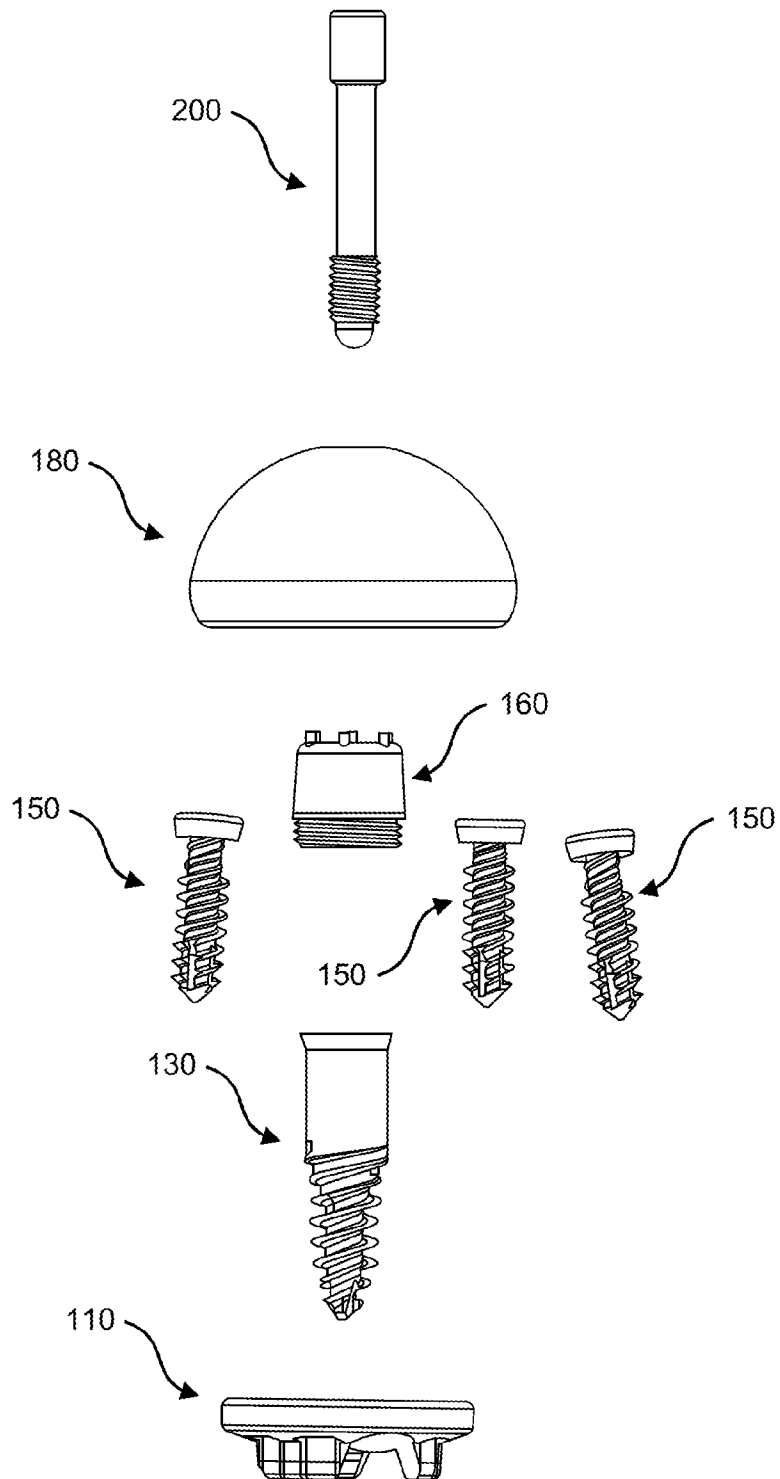


**FIG. 12**  
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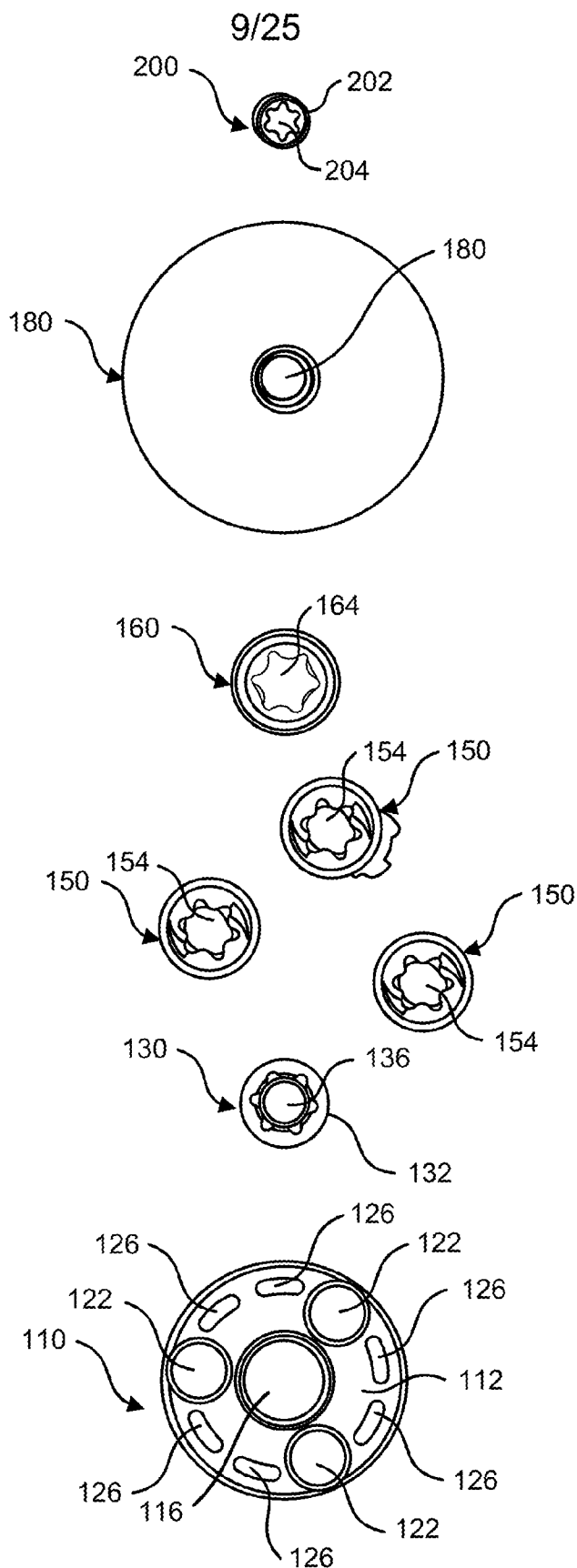


**FIG. 13**  
SUBSTITUTE SHEET (RULE 26)

10/25

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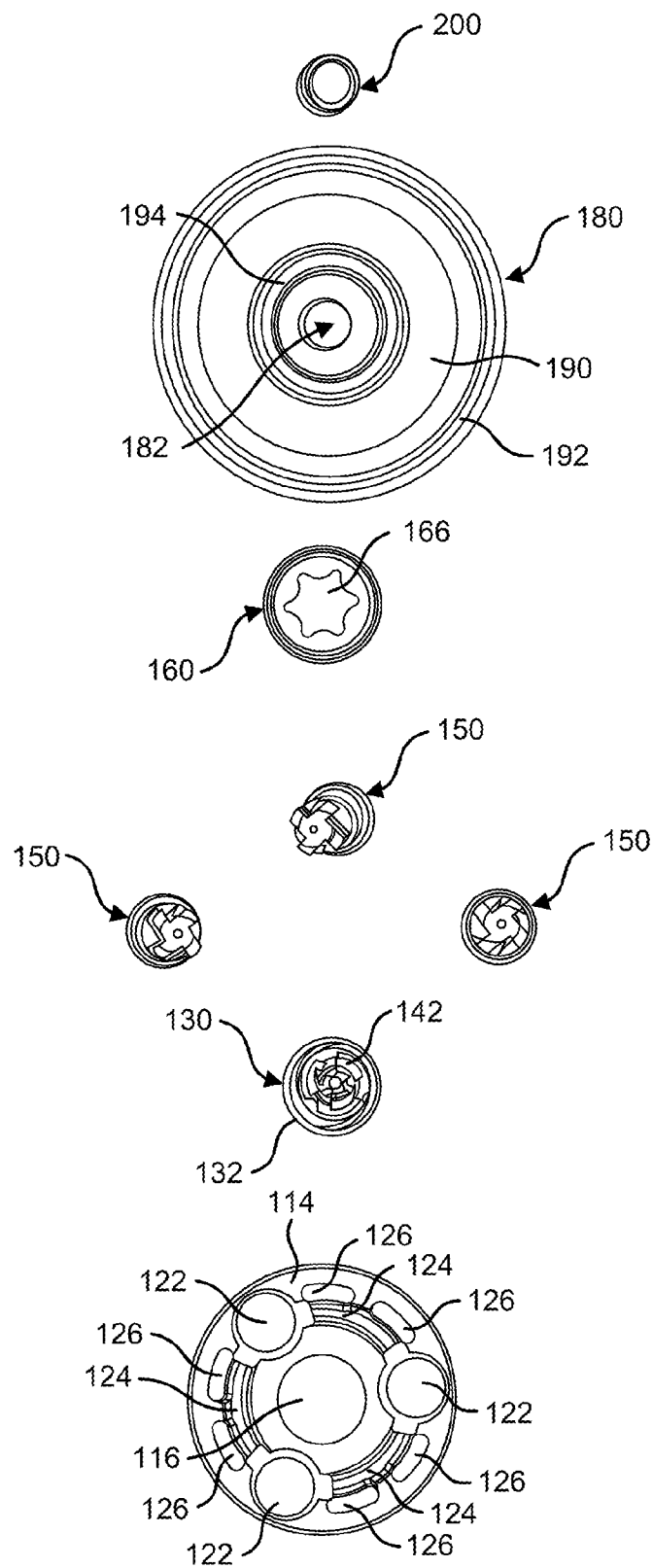


**FIG. 14**  
SUBSTITUTE SHEET (RULE 26)

11/25

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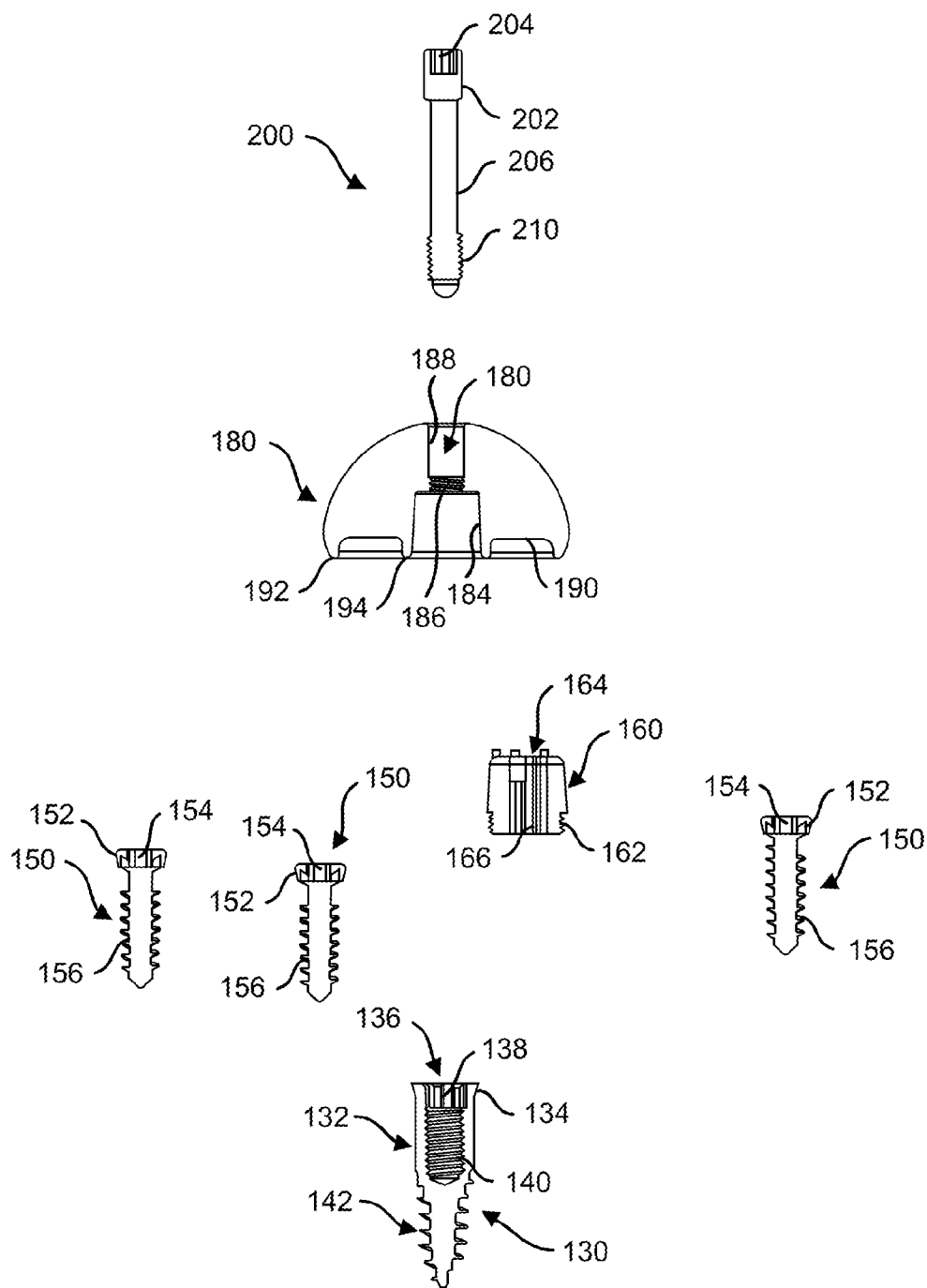


FIG. 15

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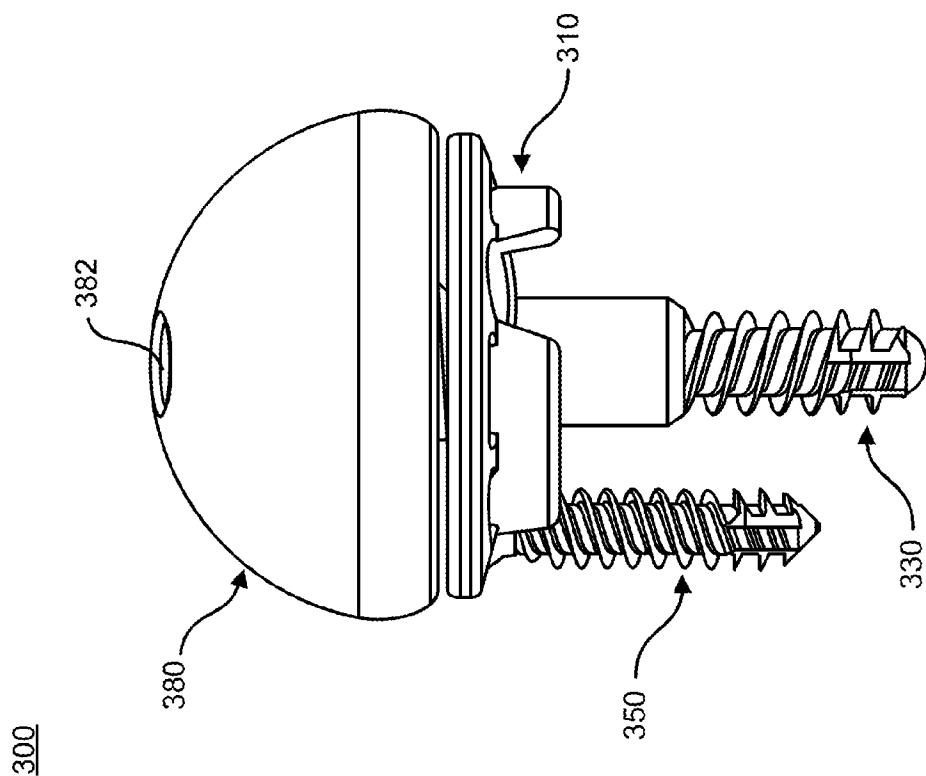


FIG. 17

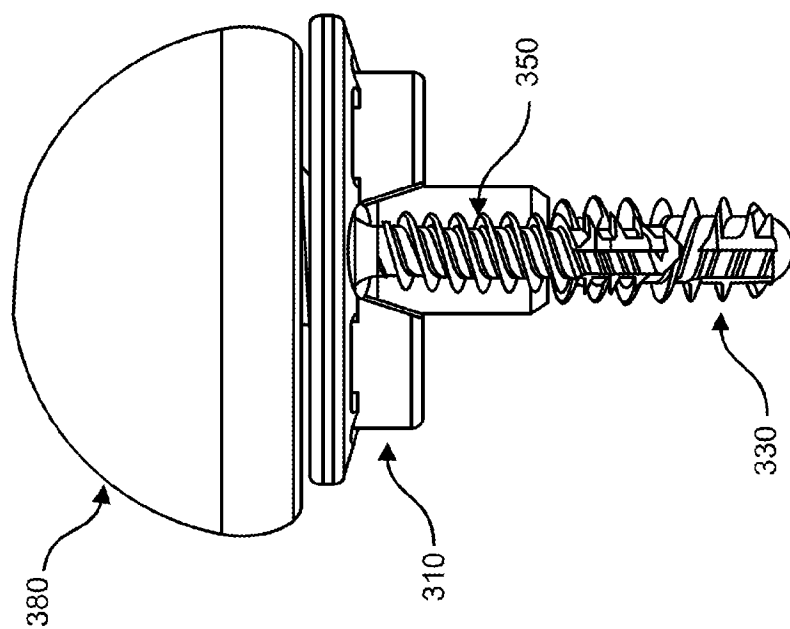


FIG. 16

300

13/25

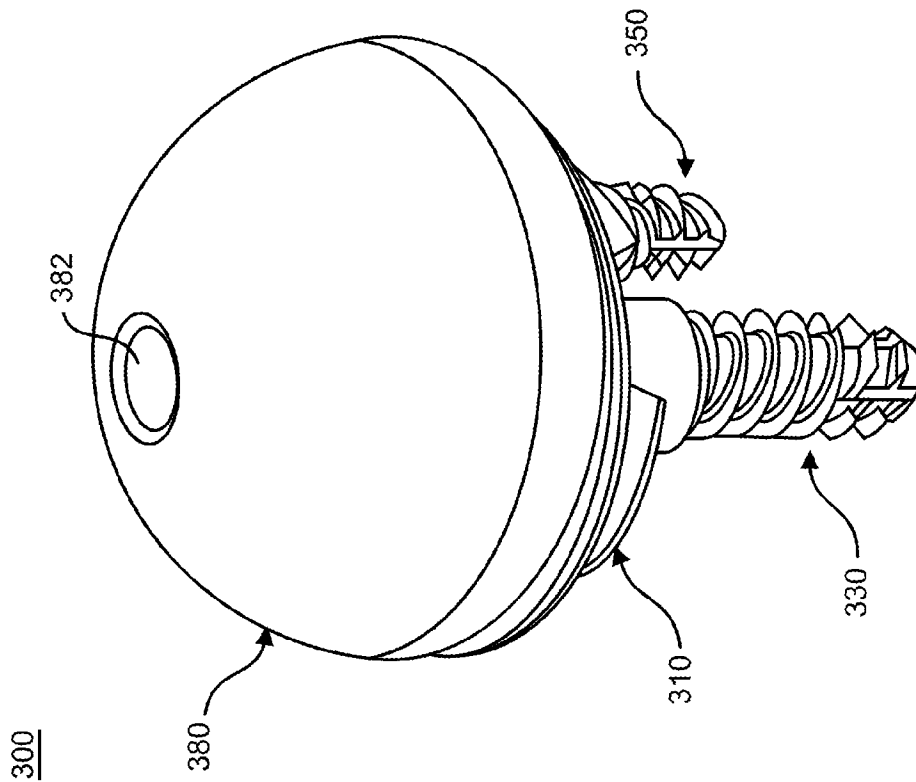


FIG. 19

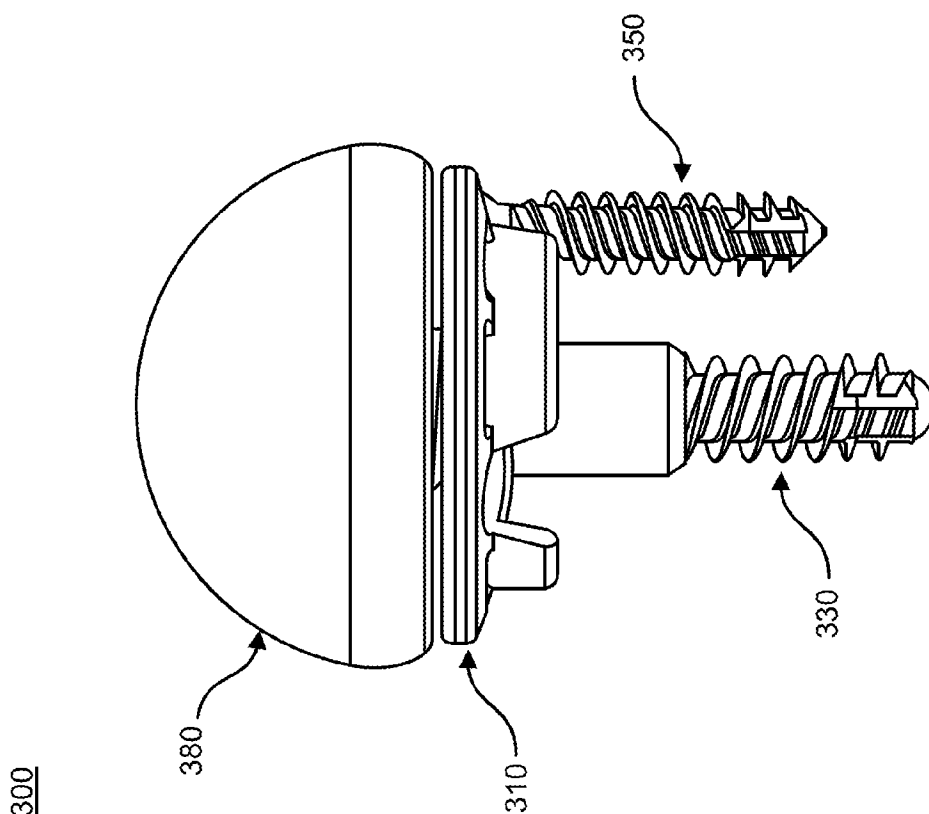


FIG. 18



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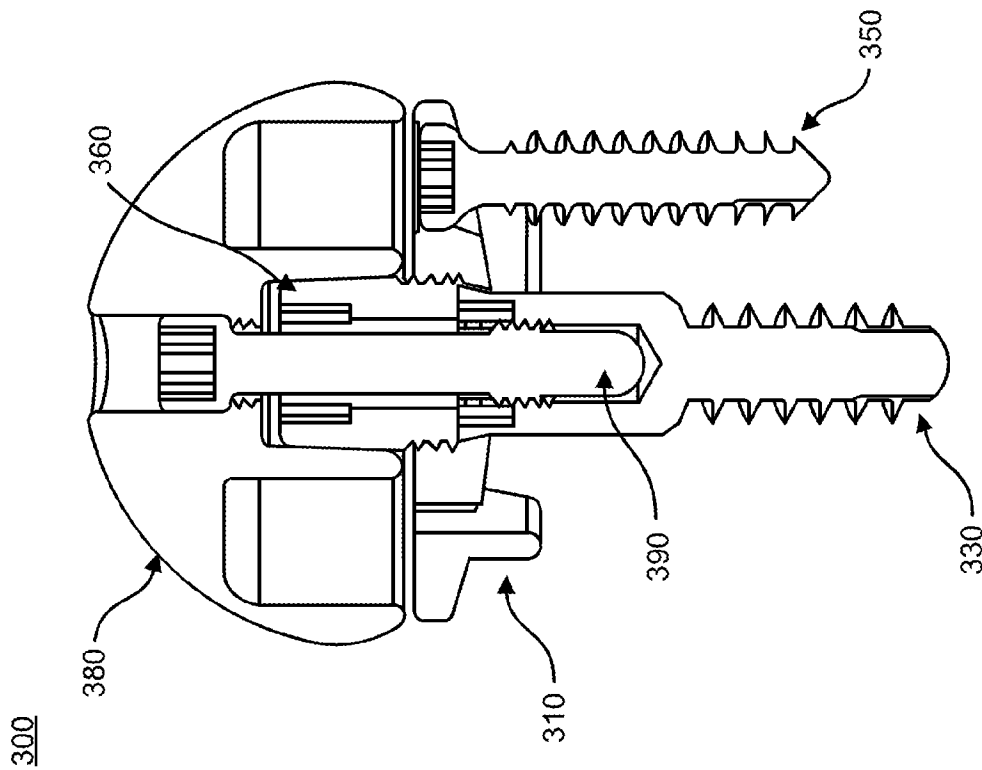


FIG. 21

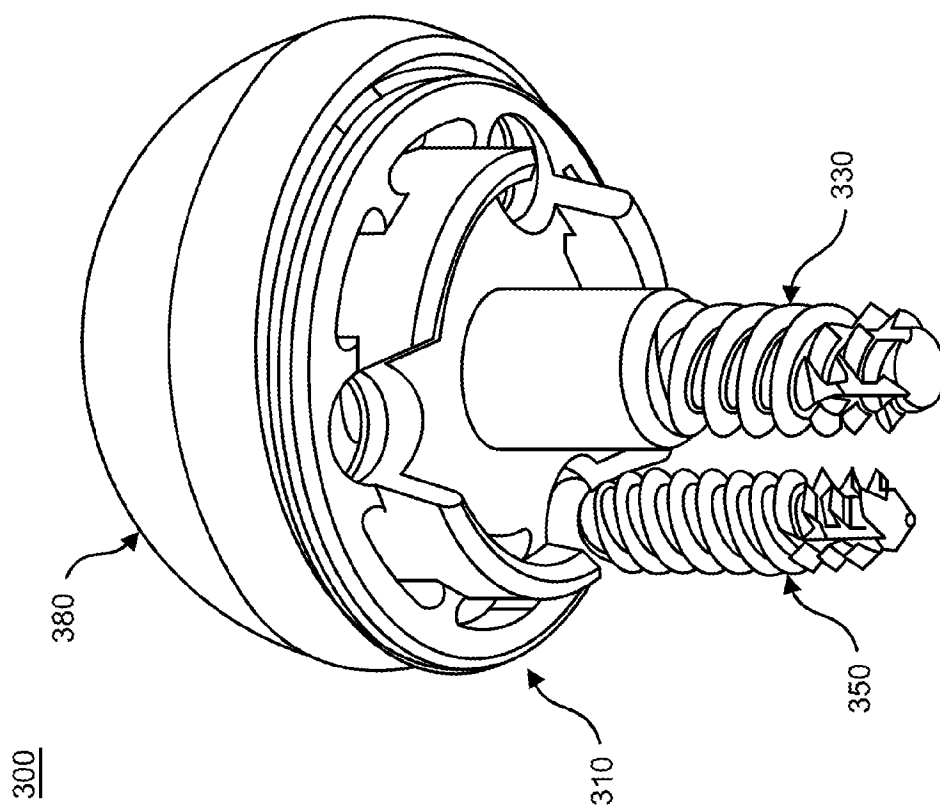
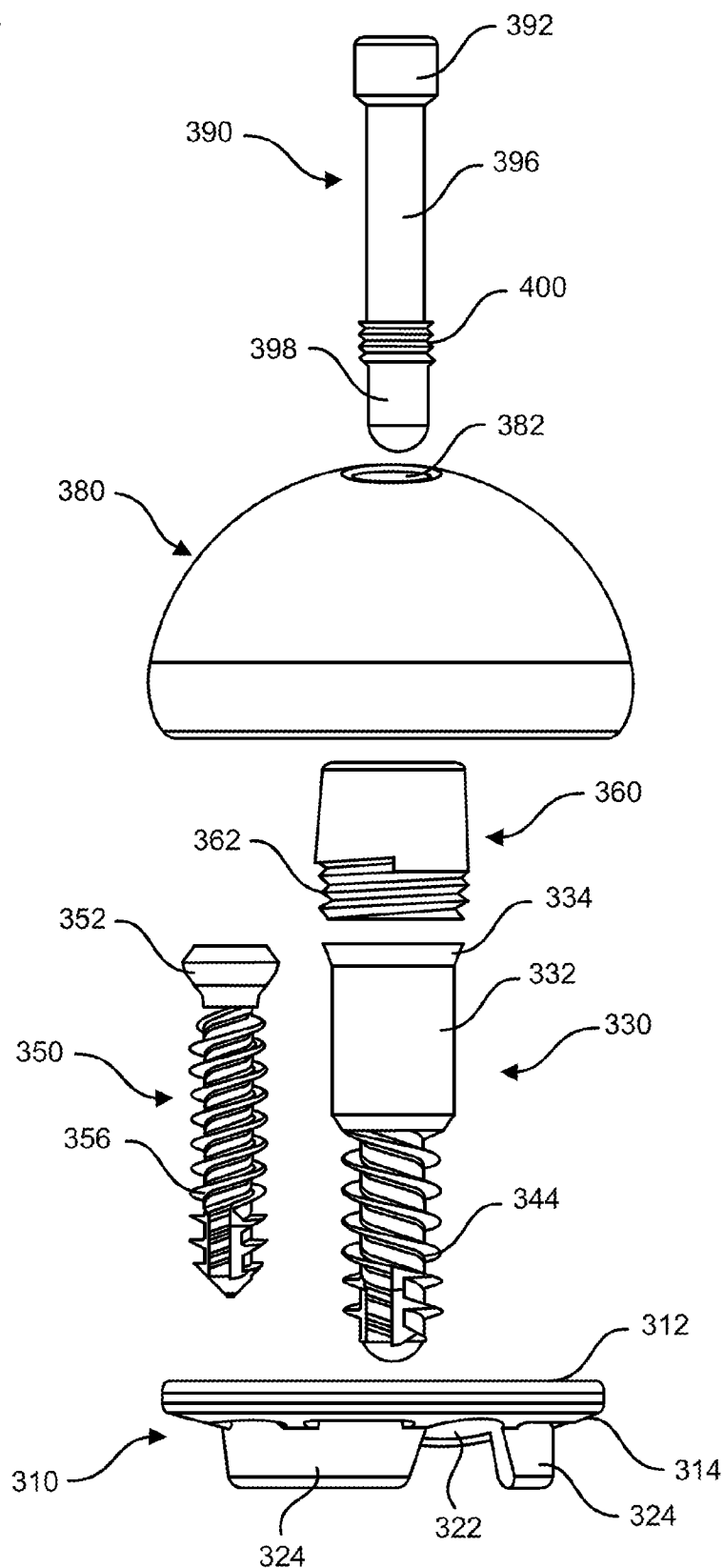


FIG. 20

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**FIG. 22**

SUBSTITUTE SHEET (RULE 26)

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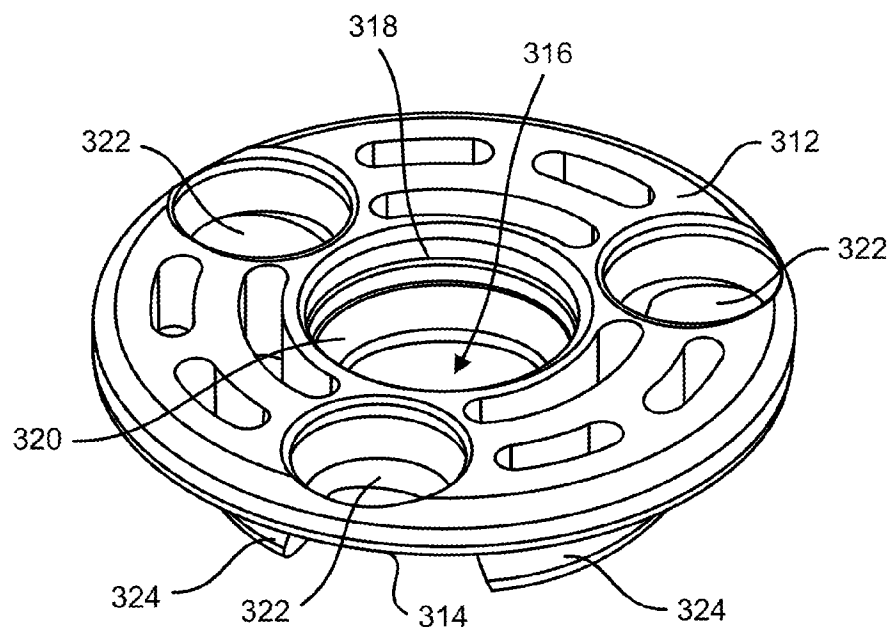


FIG. 23

310

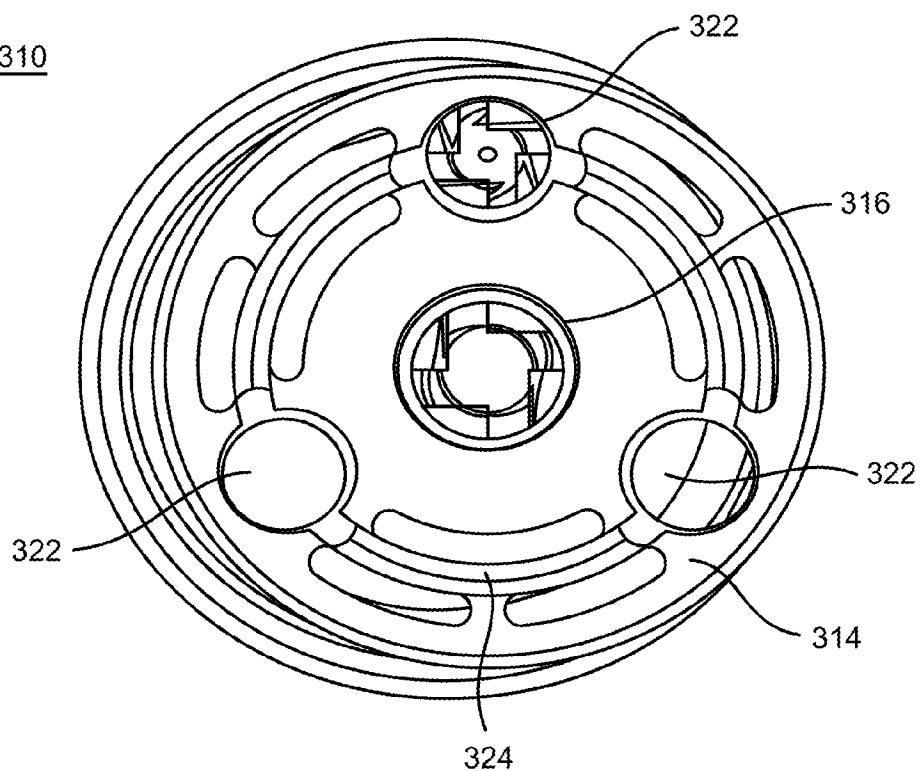


FIG. 24

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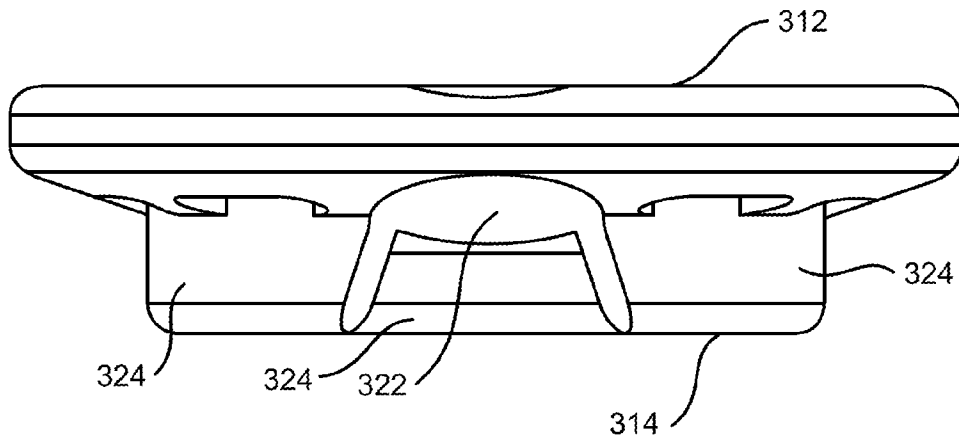


FIG. 25

310

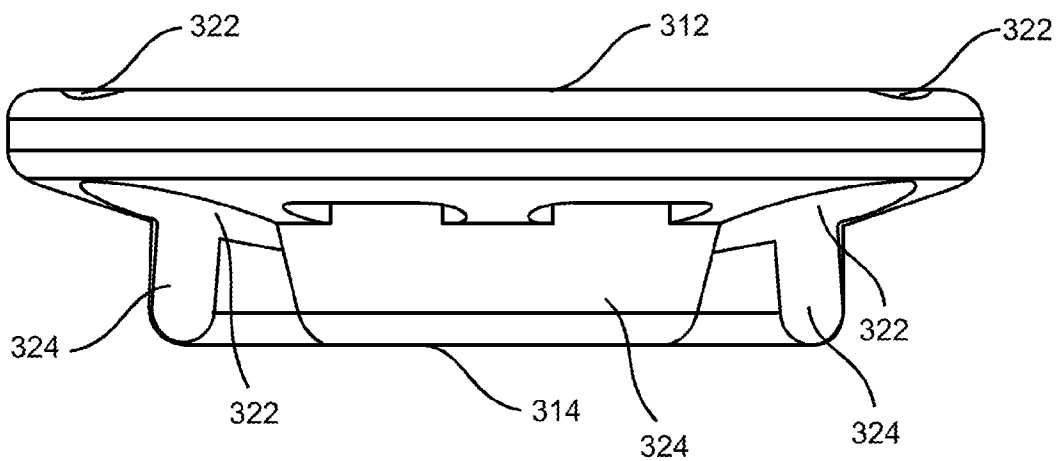


FIG. 26

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310

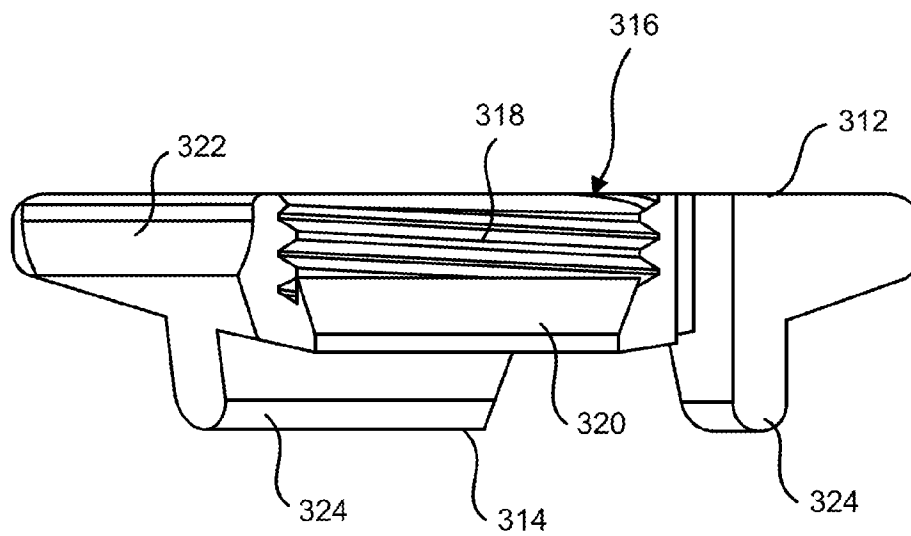


FIG. 27

310

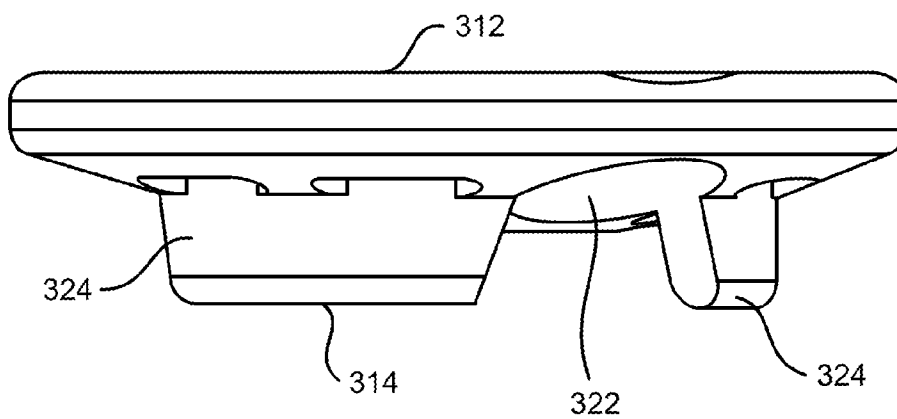


FIG. 28

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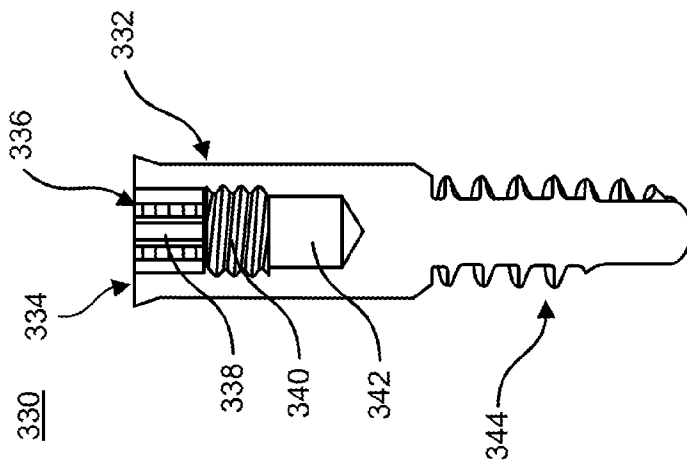


FIG. 31

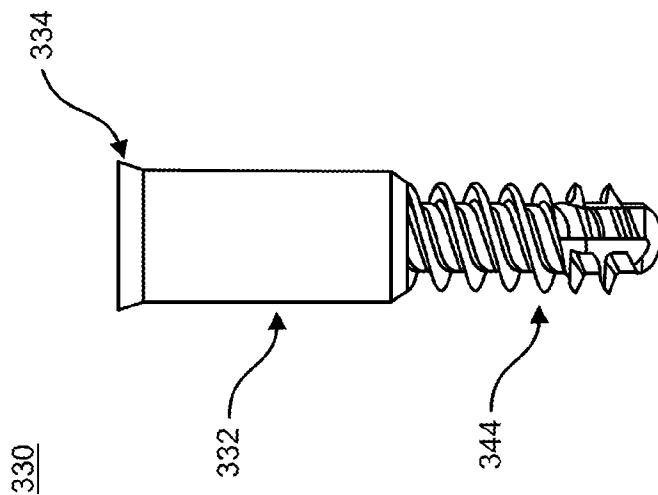


FIG. 30

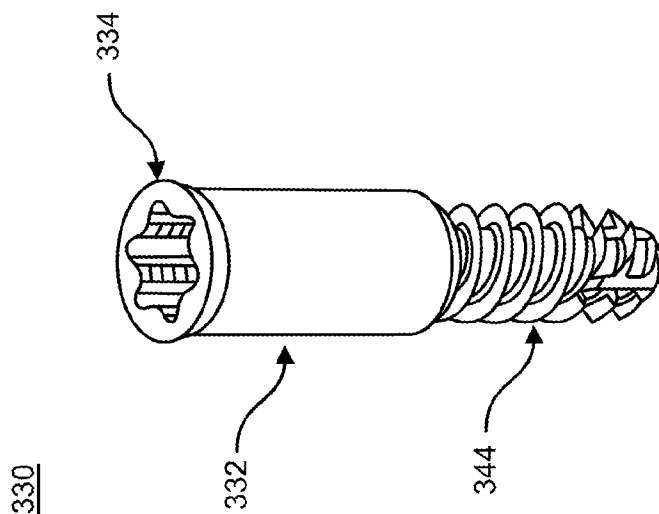


FIG. 29

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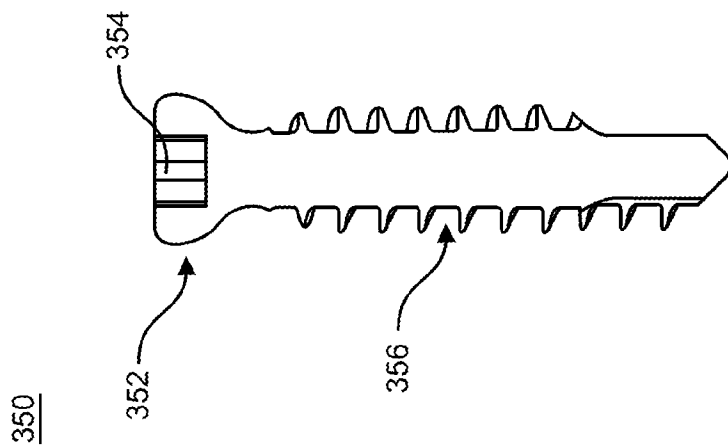


FIG. 34

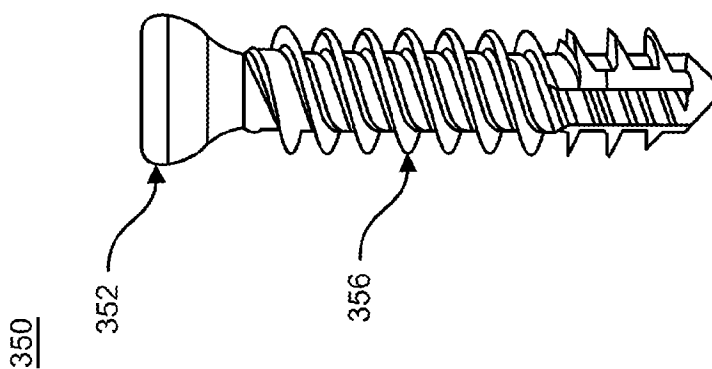


FIG. 33

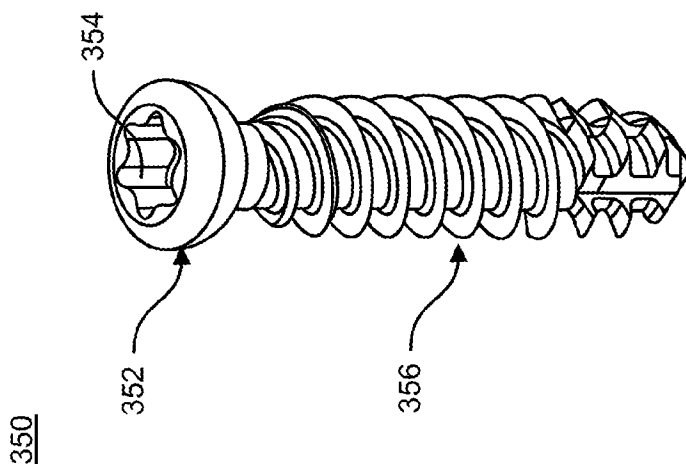


FIG. 32

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360

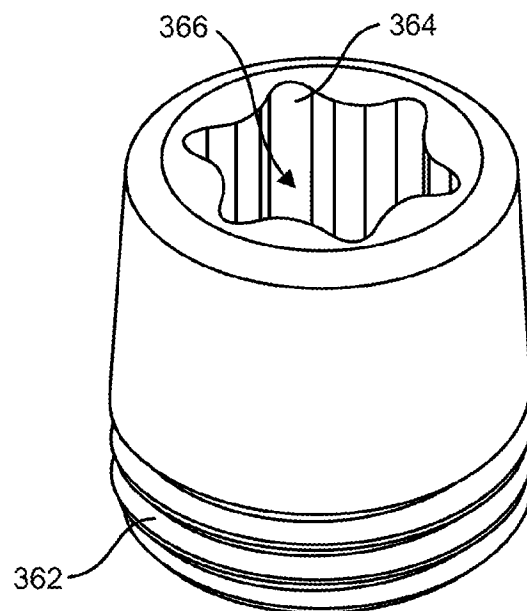


FIG. 35

360

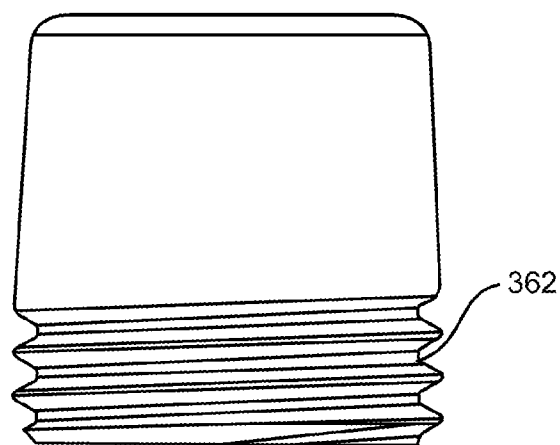


FIG. 36



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360

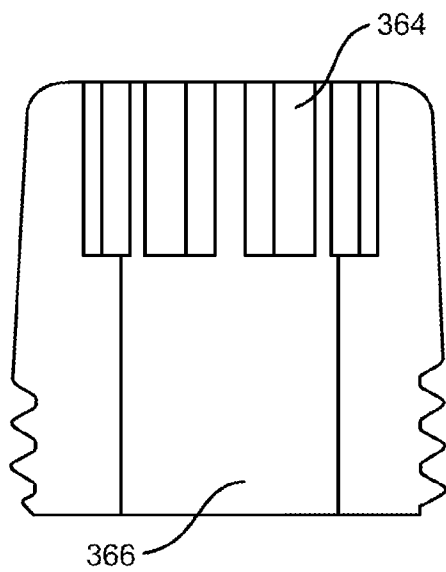


FIG. 37

380

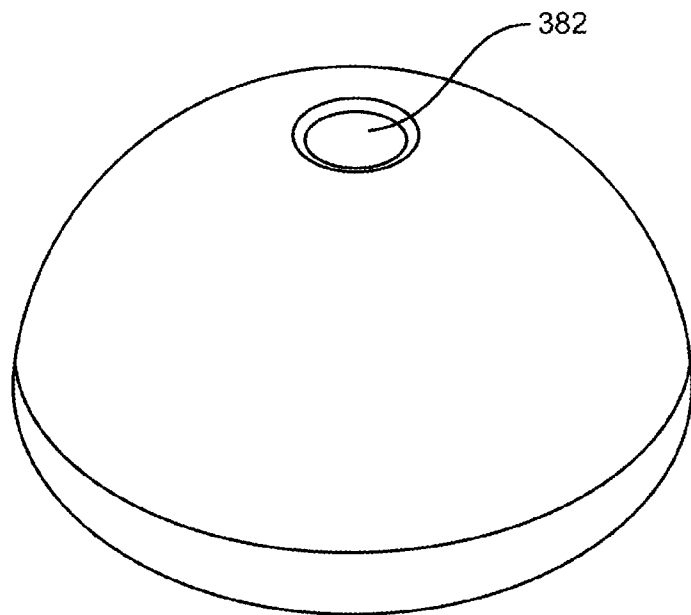


FIG. 38

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380

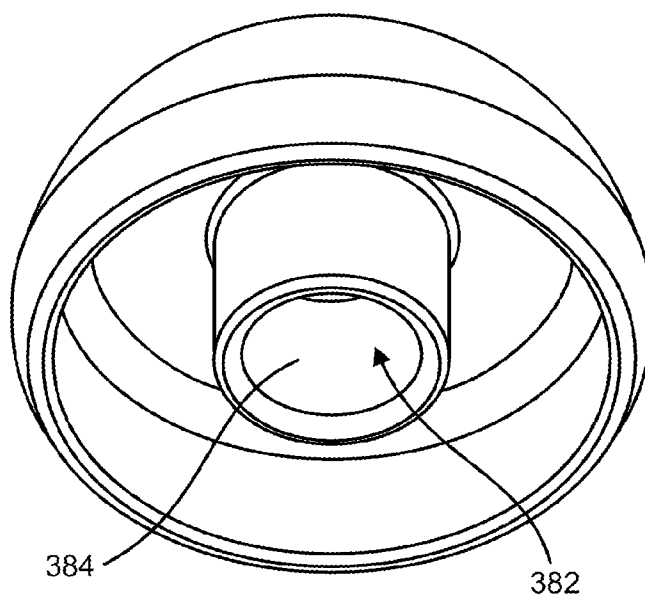


**FIG. 39**

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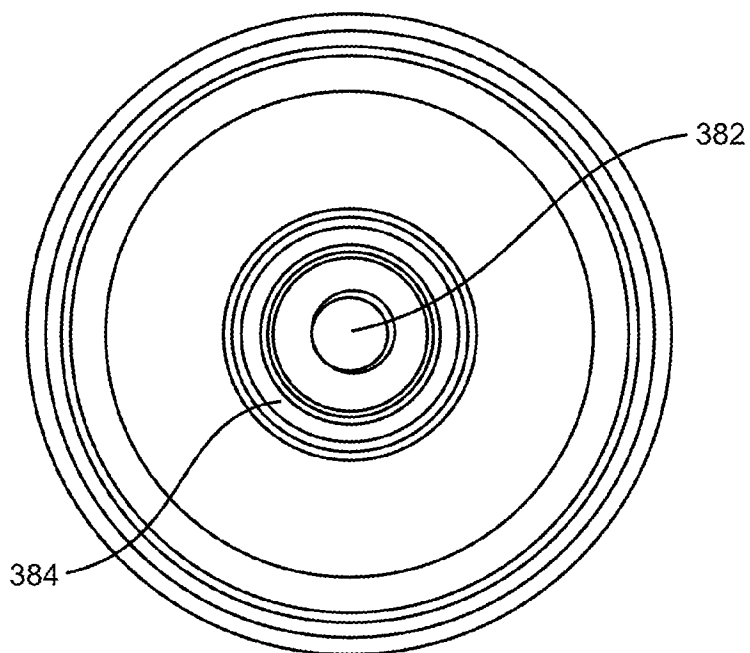


**FIG. 40**

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380

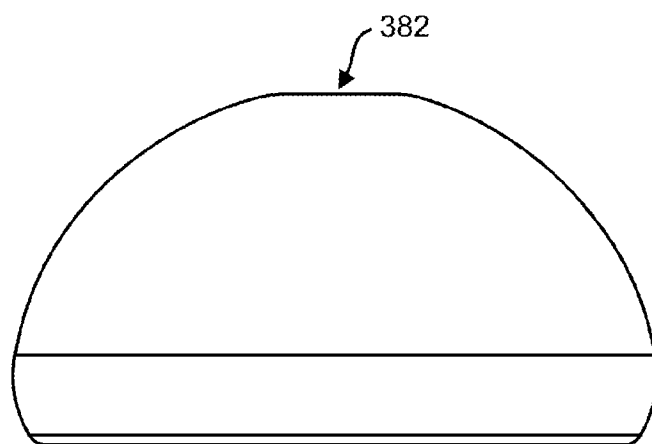


FIG. 41

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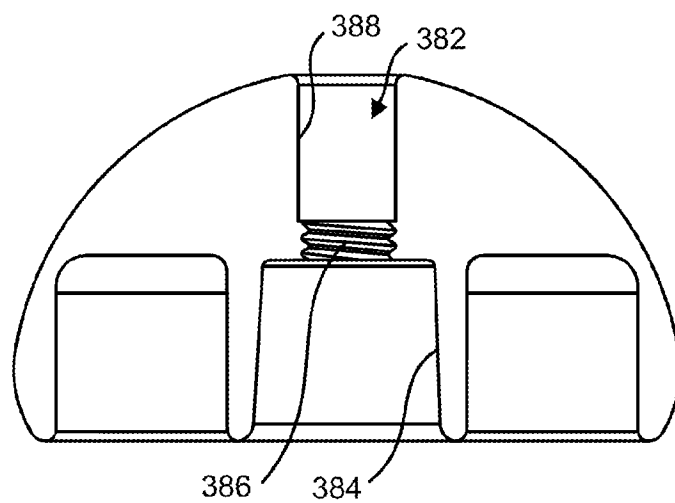


FIG. 42

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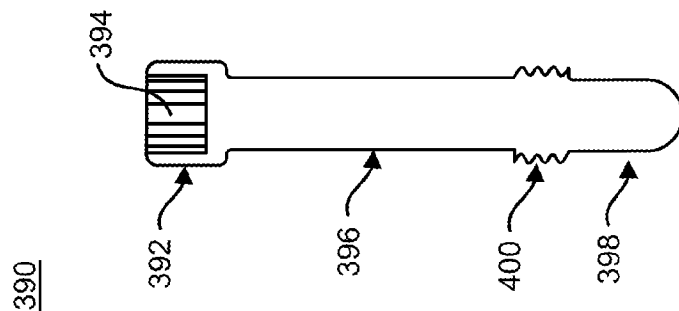


FIG. 45

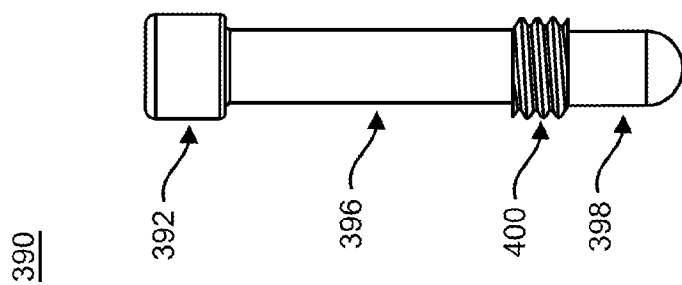


FIG. 44

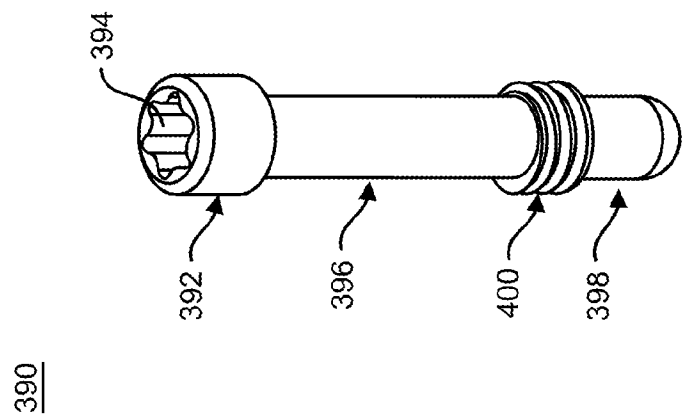


FIG. 43

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US19/43990

## A. CLASSIFICATION OF SUBJECT MATTER

IPC - A61F 2/46, A61F 2/40 (2019.01)

CPC - A61F 2/4081, A61F 2/02, A61F 2/40, A61F 2/4612, A61F 2/4603, A61F 2/30, A61B 17/8052

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)

See Search History document

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

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------|-----------------------|
| X         | US 2015/0305877 A1 (TORNIER, INC.) 29 October 2015; paragraphs [0047], [0057]      | 1-4, 31-33            |
| ----      |                                                                                    | -----                 |
| A         |                                                                                    | 5-30                  |
| A         | US 2010/0023068 A1 (BOUTTENS, D et al.) 28 January 2010; paragraph [0041]          | 5-30                  |
| A         | US 2017/0273806 A1 (TORNIER) 28 September 2017; paragraph [0052]                   | 5-30                  |

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

"D" document cited by the applicant in the international application

"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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

07 October 2019 (07.10.2019)

Date of mailing of the international search report

28 OCT 2019

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents  
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Shane Thomas

Telephone No. PCT Helpdesk: 571-272-4300

Form PCT/ISA/210 (second sheet) (July 2019)

CATALYST, EX-1005

PAGE 592

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US19/43990

## 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.: 34-47  
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:

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 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.:

### 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.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2019)

# PE2E SEARCH - Search History (Prior Art)

| Ref # | Hits | Search Query  | DBs                                                                                                                                                                                                                                                                                                                  | Default Operator | Plurals | British Equivalents | Time Stamp          |
|-------|------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------|---------------------|---------------------|
| L1    | 11   | "20180078377" | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR               | ON      | ON                  | 2023/04/06 10:20 AM |
| L2    | 31   | "2018022227"  | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR               | ON      | ON                  | 2023/04/06 10:21 AM |
| L3    | 12   | "20180071104" | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR               | ON      | ON                  | 2023/04/06 10:22 AM |
| L4    | 7    | "20180161169" | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,                                                                                                                                                                                                                                        | OR               | ON      | ON                  | 2023/04/06 10:22 AM |

|    |     |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |    |    |    |                     |
|----|-----|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L5 | 2   | ("9283083").pn. | CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)<br>(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 10:23 AM |
| L6 | 2   | ("9545312").pn. | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                                                                                                                                                                                                           | OR | ON | ON | 2023/04/06 10:23 AM |
| L7 | 116 | running.in      | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                                                                                                                                                                                                           | OR | ON | ON | 2023/04/06 10:23 AM |



|     |       |                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|-------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L8  | 607   | running.in.                                                                          | VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>10:23 AM |
| L9  | 2     | L8 AND (shoulder AND<br>screw AND glenoid<br>AND (implant OR<br>prosthesis)).clm.    | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                 | OR | ON | ON | 2023/04/06<br>10:24 AM |
| L10 | 25103 | ball.in.                                                                             | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                 | OR | ON | ON | 2023/04/06<br>10:25 AM |
| L11 | 13    | L10 AND ((shoulder<br>AND screw AND<br>glenoid AND (implant<br>OR prosthesis)).clm.) | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,                                                                                                                                                                                                                                                                          | OR | ON | ON | 2023/04/06<br>10:25 AM |

|     |      |                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |    |    |                        |
|-----|------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L12 | 11   | L11 NOT L9                                                                           | HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>10:25 AM |
| L13 | 2031 | slone.in.                                                                            | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                                                          | OR | ON | ON | 2023/04/06<br>10:29 AM |
| L14 | 1    | L13 AND ((shoulder<br>AND screw AND<br>glenoid AND (implant<br>OR prosthesis)).clm.) | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                                                          | OR | ON | ON | 2023/04/06<br>10:29 AM |

|     |      |                                                                                 |                                                                                                                                                                                                                                                                                                                                                                               |    |    |    |                        |
|-----|------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L15 | 100  | (shoulder ADJ innovations).as,aanm.                                             | IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>10:29 AM |
| L16 | 40   | L15 AND ((shoulder<br>AND screw AND<br>glenoid AND (implant<br>OR prosthesis))) | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)             | OR | ON | ON | 2023/04/06<br>10:30 AM |
| L17 | 468  | ((shoulder AND screw<br>AND glenoid AND<br>(implant OR<br>prosthesis)).clm.)    | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)             | OR | ON | ON | 2023/04/06<br>10:36 AM |
| L18 | 6814 | ((shoulder AND screw<br>AND glenoid AND<br>(implant OR<br>prosthesis)))         | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,                                                                                                                                                                                | OR | ON | ON | 2023/04/06<br>10:36 AM |

|     |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                            |    |    |    |                     |
|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L19 | 3762 | L18 AND ((A61F2/4081 OR A61F2/30749 OR A61F2002/30616 OR A61F2002/4085 OR A61F2/4612 OR A61F2002/30011 OR A61F2002/30433 OR A61F2002/30507 OR A61F2002/30604 OR A61F2002/30774 OR A61F2002/30827 OR A61F2002/30901 OR A61F2002/3092 OR A61F2002/3093 OR A61F2002/4659 OR A61F2002/4662 OR A61F2002/4668 OR A61F2002/4681).cpc.)                                                                                                                                                                                                                                                                                                                                                                                                                                         | MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 10:39 AM |
| L20 | 108  | ("3815157"   "3842442"   "3916451"   "3978528"   "3979778"   "4003095"   "4030143"   "4040131"   "4135517"   "4179758"   "4206517"   "4693723"   "4822370"   "4865605"   "4865609"   "4919670"   "4957510"   "4963155"   "4964865"   "5080673"   "5080685"   "5135529"   "5181928"   "5201882"   "5222984"   "5314479"   "5358526"   "5462563"   "5507817"   "5507818"   "5507824"   "5549682"   "5580352"   "5702457"   "5702486"   "5723018"   "5728161"   "5902340"   "5910171"   "5961555"   "6033439"   "6045582"   "6102953"   "6129764"   "6171341"   "6197062"   "6197063"   "6206925"   "6228120"   "6364910"   "6368352"   "6620197"   "6626946"   "6719799"   "6761740"   "6790234"   "6890358"   "6942699"   "6974483"   "6986790"   "7022141"   "7097663") | (US-PGPUB; USPAT; USOCR)                                                                                                                   | OR | ON | ON | 2023/04/06 10:40 AM |

|     |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|-----|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
|     |     | "7135044"   "7175663"<br>  "7189261"   "7238207"<br>  "7621961"   "7819923"<br>  "8062376"   "8070820"<br>  "20010049561"  <br>"20010053935"  <br>"20020120339"  <br>"20020138148"  <br>"20020156534"  <br>"20030028253"  <br>"20030097183"  <br>"20030114933"  <br>"20030158605"  <br>"20040064189"  <br>"20040064190"  <br>"20040220673"  <br>"20040220674"  <br>"20050197708"  <br>"20060020344"  <br>"20070142918"  <br>"20070179624"  <br>"20070198094"  <br>"20090192621"  <br>"20090210065"  <br>"20090270993"  <br>"20110035013"  <br>"20110035015"  <br>"20110054624"  <br>"20110118846").pn. OR<br>("9283083").urpn. AND<br>(PGPB   USPT  <br>USOC).dbnm. |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
| L21 | 580 | ((shoulder AND screw AND glenoid AND (implant OR prosthesis)) AND nut)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | (US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 10:40 AM |
| L22 | 17  | L20 AND nut AND screw                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,                                                                                                                        | OR | ON | ON | 2023/04/06 10:40 AM |

|     |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L23 | 1322 | L18 AND<br>((A61B17/1778 OR<br>A61B17/8605).cpc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                  | MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br><br>(US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>10:57 AM |
| L24 | 81   | L21 AND<br>((A61B17/1778 OR<br>A61B17/8605).cpc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                  | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                 | OR | ON | ON | 2023/04/06<br>10:57 AM |
| L25 | 172  | ("4986833"   "5033036"<br>  "5080673"   "5458637"<br>  "5489309"   "5489311"<br>  "5531973"   "5800551"<br>  "5954722"   "6102954"<br>  "6171342"   "6228119"<br>  "6406495"   "6508841"<br>  "6514287"   "6673115"<br>  "6679916"   "6699289"<br>  "6761740"   "6790234"<br>  "6860903"   "6953478"<br>  "7169184"   "7175663"<br>  "7175665"   "7204854"<br>  "7316715"   "7462197"<br>  "7462199"   "7604665"<br>  "7608109"   "7621961"<br>  "7637928"   "7648530"<br>  "7666522"   "7753959") | (US-PGPUB; USPAT;<br>USOCR)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | OR | ON | ON | 2023/04/06<br>10:58 AM |

|  |  |                       |  |  |  |  |  |
|--|--|-----------------------|--|--|--|--|--|
|  |  | "7766969"   "7854768" |  |  |  |  |  |
|  |  | "7892287"   "7922769" |  |  |  |  |  |
|  |  | "7927335"   "7993408" |  |  |  |  |  |
|  |  | "8007523"   "8048161" |  |  |  |  |  |
|  |  | "8062376"   "8070820" |  |  |  |  |  |
|  |  | "8092545"   "8206453" |  |  |  |  |  |
|  |  | "8231683"   "8241365" |  |  |  |  |  |
|  |  | "8287600"   "8308807" |  |  |  |  |  |
|  |  | "8357201"   "8361157" |  |  |  |  |  |
|  |  | "8425614"   "8444680" |  |  |  |  |  |
|  |  | "8449617"   "8454702" |  |  |  |  |  |
|  |  | "8465548"   "8480750" |  |  |  |  |  |
|  |  | "8532806"   "8556902" |  |  |  |  |  |
|  |  | "8556980"   "8556981" |  |  |  |  |  |
|  |  | "8591591"   "8597334" |  |  |  |  |  |
|  |  | "8632597"   "8690951" |  |  |  |  |  |
|  |  | "8753402"   "8790402" |  |  |  |  |  |
|  |  | "8840676"   "8864834" |  |  |  |  |  |
|  |  | "8961611"   "9114017" |  |  |  |  |  |
|  |  | "9498345"   "9629725" |  |  |  |  |  |
|  |  | "10064734"            |  |  |  |  |  |
|  |  | "20020095214"         |  |  |  |  |  |
|  |  | "20030149485"         |  |  |  |  |  |
|  |  | "20040106928"         |  |  |  |  |  |
|  |  | "20040220673"         |  |  |  |  |  |
|  |  | "20040220674"         |  |  |  |  |  |
|  |  | "20050049709"         |  |  |  |  |  |
|  |  | "20050143831"         |  |  |  |  |  |
|  |  | "20050149044"         |  |  |  |  |  |
|  |  | "20050261775"         |  |  |  |  |  |
|  |  | "20050278030"         |  |  |  |  |  |
|  |  | "20060074353"         |  |  |  |  |  |
|  |  | "20060100714"         |  |  |  |  |  |
|  |  | "20060122705"         |  |  |  |  |  |
|  |  | "20060142865"         |  |  |  |  |  |
|  |  | "20060200248"         |  |  |  |  |  |
|  |  | "20060200249"         |  |  |  |  |  |
|  |  | "20070016304"         |  |  |  |  |  |
|  |  | "20070055380"         |  |  |  |  |  |
|  |  | "20070100458"         |  |  |  |  |  |
|  |  | "20070142921"         |  |  |  |  |  |
|  |  | "20070156246"         |  |  |  |  |  |
|  |  | "20070179624"         |  |  |  |  |  |
|  |  | "20070219638"         |  |  |  |  |  |
|  |  | "20070244563"         |  |  |  |  |  |
|  |  | "20080269906"         |  |  |  |  |  |
|  |  | "20080294268"         |  |  |  |  |  |
|  |  | "20080306601"         |  |  |  |  |  |
|  |  | "20090149961"         |  |  |  |  |  |
|  |  | "20090204225"         |  |  |  |  |  |
|  |  | "20090216332"         |  |  |  |  |  |
|  |  | "20090281630"         |  |  |  |  |  |
|  |  | "20100016975"         |  |  |  |  |  |
|  |  | "20100023068"         |  |  |  |  |  |
|  |  | "20100049327"         |  |  |  |  |  |
|  |  | "20100087927"         |  |  |  |  |  |
|  |  | "20100161066"         |  |  |  |  |  |
|  |  | "20100217399"         |  |  |  |  |  |

|     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                 |    |    |    |                        |
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| L26 | 16 | "20100234959"<br>"20100274359"<br>"20100291401"<br>"20100331990"<br>"20110035013"<br>"20110118846"<br>"20110144760"<br>"20110190899"<br>"20110282393"<br>"20120004733"<br>"20120029647"<br>"20120165954"<br>"20120191201"<br>"20120209392"<br>"20120221111"<br>"20120221112"<br>"20120232670"<br>"20120239156"<br>"20120253467"<br>"20120277880"<br>"20130018483"<br>"20130053968"<br>"20130096631"<br>"20130110470"<br>"20130150972"<br>"20130150973"<br>"20130150975"<br>"20130226309"<br>"20130231754"<br>"20130253656"<br>"20130261751"<br>"20130261752"<br>"20130264749"<br>"20130282135"<br>"20140025173"<br>"20140142711"<br>"20140194995"<br>"20140257499"<br>"20140277180"<br>"20140371863"<br>"20150094819"<br>"20150142122"<br>"20150150688"<br>"20150272741"<br>"20150305877"<br>"20160270922"<br>"20160287401"<br>"20160310285"<br>"20160324649"<br>"20170042690"<br>"20170172764"<br>"20180243102").pn. OR<br>("10357373").urpn.<br>AND (PGPB   USPT  <br>USOC).dbnm.<br>L25 AND nut AND<br>(fastener OR screw) | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY, | OR | ON | ON | 2023/04/06<br>10:58 AM |
|-----|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|----|----|----|------------------------|



|     |    |                  |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|-----|----|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L27 | 20 | "2020023975"     | CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                           | OR | ON | ON | 2023/04/06 11:14 AM |
| L28 | 5  | "20200188121"    | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:15 AM |
| L29 | 4  | ("11166733").pn. | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:16 AM |

|     |    |                  |                                                                                                                                                                                                                                                                                                                                                                                    |    |    |    |                     |
|-----|----|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L30 | 54 | "3777777"        | TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)<br>(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:16 AM |
| L31 | 24 | "3598957"        | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                               | OR | ON | ON | 2023/04/06 11:17 AM |
| L32 | 57 | "2601912"        | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                               | OR | ON | ON | 2023/04/06 11:18 AM |
| L33 | 4  | ("10034757").pn. | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA,                                                                                                                                                                                                                                                                                  | OR | ON | ON | 2023/04/06 11:21 AM |

|     |    |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |    |    |    |                        |
|-----|----|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L34 | 2  | "20210236292" | EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>11:22 AM |
| L35 | 17 | "2012109245"  | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                                                                                     | OR | ON | ON | 2023/04/06<br>11:22 AM |
| L36 | 21 | "2019006205"  | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                                                                                     | OR | ON | ON | 2023/04/06<br>11:26 AM |

|     |    |                  |                                                                                                                                                                                                                                                                                                                                                                                                |    |    |    |                        |
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| L37 | 7  | ("9615839").pn.  | JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>11:27 AM |
| L38 | 8  | "2019173139"     | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                              | OR | ON | ON | 2023/04/06<br>11:28 AM |
| L39 | 2  | ("11564802").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                              | OR | ON | ON | 2023/04/06<br>11:29 AM |
| L40 | 16 | "2013148437"     | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,                                                                                                                                                                                                                            | OR | ON | ON | 2023/04/06<br>11:29 AM |

|     |    |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |    |    |                     |
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| L41 | 4  | "20210137693" | IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)<br>(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:30 AM |
| L42 | 62 | "2013085552"  | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                                                                                                                                       | OR | ON | ON | 2023/04/06 11:30 AM |
| L43 | 34 | "3090705"     | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                                                                                                                                       | OR | ON | ON | 2023/04/06 11:31 AM |

|     |    |                  |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
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| L44 | 21 | "2014138424"     | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:32 AM |
| L45 | 6  | "20210077264"    | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:33 AM |
| L46 | 2  | ("11464645").pn. | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:34 AM |
| L47 | 24 | "3332750"        | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,                                                                                                                        | OR | ON | ON | 2023/04/06 11:34 AM |

|     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                          |    |    |    |                        |
|-----|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L48 | 42 | ((US-20180078377-A1<br>OR US-20180071104-A1 OR US-<br>20180161169-A1 OR<br>US-20170202674-A1<br>OR US-20040064189-A1 OR US-<br>20070179624-A1 OR<br>US-20040030400-A1<br>OR US-20030060890-A1 OR US-<br>20040199260-A1 OR<br>US-20080294268-A1<br>OR US-20080009952-A1 OR US-<br>20130090737-A1 OR<br>US-20150025641-A1<br>OR US-20130150972-A1 OR US-<br>20140142711-A1 OR<br>US-20200188121-A1<br>OR US-20210236292-A1 OR US-<br>20210137693-A1).did.<br>AND PGPB.dbnm.) OR<br>((US-10357373-B2 OR<br>US-10258478-B2 OR<br>US-10925745-B2 OR<br>US-9283083-B2 OR<br>US-9545312-B2 OR<br>US-5702447-A OR US-<br>11166733-B2 OR US-<br>10034757-B2 OR US-<br>9615839-B2 OR US-<br>11564802-B2 OR US-<br>9668873-B2 OR US-<br>11464645-B2).did. AND<br>USPT.dbnm.) OR<br>((WO-2018022227-A1<br>OR WO-2012096965-A1 OR WO-<br>2018191420-A1 OR<br>WO-2020023975-A1<br>OR EP-3777777-A2 OR<br>EP-3598957-A1 OR<br>EP-2601912-A1 OR<br>WO-2012109245-A2<br>OR WO-2019006205-A1 OR WO-<br>2013148437-A1 OR<br>EP-3090705-A1 OR | MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>11:36 AM |
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| L49 | 12 | EP-3332750-A1).did.<br>AND FTDB.dbnm.)<br>L48 AND (screw OR<br>fastener) AND nut | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>11:36 AM |
| L50 | 12 | L48 AND nut                                                                      | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>12:08 PM |
| L51 | 5  | L48 AND washer                                                                   | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>12:12 PM |
| L52 | 4  | L51 NOT L50                                                                      | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,                                                                                                                                                                                               | OR | ON | ON | 2023/04/06<br>12:12 PM |



|     |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                               |    |    |    |                        |
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| L53 | 221 | ("4725280"   "4986833"<br> "5032132"   "5033036"<br> "5080673"   "5108446"<br> "5458637"   "5489309"<br> "5489311"   "5531973"<br> "5662657"   "5702447"<br> "5800551"   "5954722"<br> "6102954"   "6139550"<br> "6171342"   "6228119"<br> "6228120"   "6379386"<br> "6406495"   "6508841"<br> "6514287"   "6673115"<br> "6679916"   "6699289"<br> "6761740"   "6783549"<br> "6790234"   "6860903"<br> "6911047"   "6942699"<br> "6953478"   "6969406"<br> "7160328"   "7169184"<br> "7175663"   "7175665"<br> "7204854"   "7316715"<br> "7431736"   "7462197"<br> "7462199"   "7527631"<br> "7604665"   "7608109"<br> "7611539"   "7621961"<br> "7637928"   "7648530"<br> "7666522"   "7753959"<br> "7766969"   "7854768"<br> "7883653"   "7892287"<br> "7922769"   "7927335"<br> "7993408"   "8007523"<br> "8048161"   "8062376"<br> "8070820"   "8092545"<br> "8206453"   "8231683"<br> "8241365"   "8287600"<br> "8308807"   "8357201"<br> "8361157"   "8425614"<br> "8444680"   "8449617"<br> "8454702"   "8454705"<br> "8465548"   "8480750"<br> "8532806"   "8556902"<br> "8556980"   "8556981"<br> "8591591"   "8597334"<br> "8632597"   "8690951"<br> "8690952"   "8753402"<br> "8790402"   "8840676"<br> "8864834"   "8870886"<br> "8961611"   "9114017"<br> "9233003"   "9498345"<br> "9512445"   "9629725" | IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br><br>(US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2023/04/06<br>12:18 PM |
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|  |  | "10034757"  <br>"10064734"  <br>"10251755"  <br>"10357373"  <br>"10779952"  <br>"20010011192"  <br>"20010037153"  <br>"20020095214"  <br>"20030055507"  <br>"20030149485"  <br>"20040030394"  <br>"20040059424"  <br>"20040106928"  <br>"20040220673"  <br>"20040220674"  <br>"20050049709"  <br>"20050060039"  <br>"20050143831"  <br>"20050149044"  <br>"20050192673"  <br>"20050261775"  <br>"20050278030"  <br>"20060074353"  <br>"20060100714"  <br>"20060122705"  <br>"20060142865"  <br>"20060200248"  <br>"20060200249"  <br>"20070016304"  <br>"20070055380"  <br>"20070100458"  <br>"20070142921"  <br>"20070156246"  <br>"20070179624"  <br>"20070219638"  <br>"20070244563"  <br>"20070244564"  <br>"20080140130"  <br>"20080183297"  <br>"20080269906"  <br>"20080294268"  <br>"20080306601"  <br>"20090125113"  <br>"20090149961"  <br>"20090204225"  <br>"20090216332"  <br>"20090281630"  <br>"20090292364"  <br>"20100016975"  <br>"20100023068"  <br>"20100049327"  <br>"20100087927"  <br>"20100161066"  <br>"20100217399"  <br>"20100234959"  <br>"20100249938"  <br>"20100274359"  <br>"20100291401" |  |  |  |  |  |
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|  |  | "20100331990" |  |  |  |  |  |
|  |  | "20110035013" |  |  |  |  |  |
|  |  | "20110118846" |  |  |  |  |  |
|  |  | "20110144760" |  |  |  |  |  |
|  |  | "20110190899" |  |  |  |  |  |
|  |  | "20110282393" |  |  |  |  |  |
|  |  | "20120004733" |  |  |  |  |  |
|  |  | "20120029647" |  |  |  |  |  |
|  |  | "20120059383" |  |  |  |  |  |
|  |  | "20120165954" |  |  |  |  |  |
|  |  | "20120191201" |  |  |  |  |  |
|  |  | "20120209392" |  |  |  |  |  |
|  |  | "20120221112" |  |  |  |  |  |
|  |  | "20120232670" |  |  |  |  |  |
|  |  | "20120239156" |  |  |  |  |  |
|  |  | "20120253467" |  |  |  |  |  |
|  |  | "20120277880" |  |  |  |  |  |
|  |  | "20130018483" |  |  |  |  |  |
|  |  | "20130053968" |  |  |  |  |  |
|  |  | "20130066433" |  |  |  |  |  |
|  |  | "20130096631" |  |  |  |  |  |
|  |  | "20130110470" |  |  |  |  |  |
|  |  | "20130144393" |  |  |  |  |  |
|  |  | "20130150972" |  |  |  |  |  |
|  |  | "20130150973" |  |  |  |  |  |
|  |  | "20130150975" |  |  |  |  |  |
|  |  | "20130226309" |  |  |  |  |  |
|  |  | "20130231754" |  |  |  |  |  |
|  |  | "20130253656" |  |  |  |  |  |
|  |  | "20130261751" |  |  |  |  |  |
|  |  | "20130261752" |  |  |  |  |  |
|  |  | "20130264749" |  |  |  |  |  |
|  |  | "20130282135" |  |  |  |  |  |
|  |  | "20140025173" |  |  |  |  |  |
|  |  | "20140142711" |  |  |  |  |  |
|  |  | "20140194995" |  |  |  |  |  |
|  |  | "20140257499" |  |  |  |  |  |
|  |  | "20140277180" |  |  |  |  |  |
|  |  | "20140371863" |  |  |  |  |  |
|  |  | "20150073424" |  |  |  |  |  |
|  |  | "20150094819" |  |  |  |  |  |
|  |  | "20150142122" |  |  |  |  |  |
|  |  | "20150150688" |  |  |  |  |  |
|  |  | "20150272741" |  |  |  |  |  |
|  |  | "20150305877" |  |  |  |  |  |
|  |  | "20160166392" |  |  |  |  |  |
|  |  | "20160228262" |  |  |  |  |  |
|  |  | "20160270922" |  |  |  |  |  |
|  |  | "20160287401" |  |  |  |  |  |
|  |  | "20160310285" |  |  |  |  |  |
|  |  | "20160324649" |  |  |  |  |  |
|  |  | "20170027709" |  |  |  |  |  |
|  |  | "20170042687" |  |  |  |  |  |
|  |  | "20170049574" |  |  |  |  |  |
|  |  | "20170172764" |  |  |  |  |  |
|  |  | "20170273795" |  |  |  |  |  |
|  |  | "20170273801" |  |  |  |  |  |
|  |  | "20180078377" |  |  |  |  |  |

|     |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L54 | 45  | "20180243102"  <br>"20180368982"  <br>"20190029833"  <br>"20190076261"  <br>"20190336293"  <br>"20200188121"  <br>"20220175543").pn. OR<br>("11564802").urpn.<br>AND (PGPB   USPT  <br>USOC).dbnm.<br><br>L53 AND (nut OR<br>washer)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>12:19 PM |
| L55 | 172 | ("4986833"   "5033036"<br>  "5080673"   "5458637"<br>  "5489309"   "5489311"<br>  "5531973"   "5800551"<br>  "5954722"   "6102954"<br>  "6171342"   "6228119"<br>  "6406495"   "6508841"<br>  "6514287"   "6673115"<br>  "6679916"   "6699289"<br>  "6761740"   "6790234"<br>  "6860903"   "6953478"<br>  "7169184"   "7175663"<br>  "7175665"   "7204854"<br>  "7316715"   "7462197"<br>  "7462199"   "7604665"<br>  "7608109"   "7621961"<br>  "7637928"   "7648530"<br>  "7666522"   "7753959"<br>  "7766969"   "7854768"<br>  "7892287"   "7922769"<br>  "7927335"   "7993408"<br>  "8007523"   "8048161"<br>  "8062376"   "8070820"<br>  "8092545"   "8206453"<br>  "8231683"   "8241365"<br>  "8287600"   "8308807"<br>  "8357201"   "8361157"<br>  "8425614"   "8444680"<br>  "8449617"   "8454702"<br>  "8465548"   "8480750"<br>  "8532806"   "8556902") | (US-PGPUB; USPAT;<br>USOCR)                                                                                                                                                                                                                                                                                                                                       | OR | ON | ON | 2023/04/06<br>12:24 PM |

|  |  |                       |  |  |  |  |  |
|--|--|-----------------------|--|--|--|--|--|
|  |  | "8556980"   "8556981" |  |  |  |  |  |
|  |  | "8591591"   "8597334" |  |  |  |  |  |
|  |  | "8632597"   "8690951" |  |  |  |  |  |
|  |  | "8753402"   "8790402" |  |  |  |  |  |
|  |  | "8840676"   "8864834" |  |  |  |  |  |
|  |  | "8961611"   "9114017" |  |  |  |  |  |
|  |  | "9498345"   "9629725" |  |  |  |  |  |
|  |  | "10064734"            |  |  |  |  |  |
|  |  | "20020095214"         |  |  |  |  |  |
|  |  | "20030149485"         |  |  |  |  |  |
|  |  | "20040106928"         |  |  |  |  |  |
|  |  | "20040220673"         |  |  |  |  |  |
|  |  | "20040220674"         |  |  |  |  |  |
|  |  | "20050049709"         |  |  |  |  |  |
|  |  | "20050143831"         |  |  |  |  |  |
|  |  | "20050149044"         |  |  |  |  |  |
|  |  | "20050261775"         |  |  |  |  |  |
|  |  | "20050278030"         |  |  |  |  |  |
|  |  | "20060074353"         |  |  |  |  |  |
|  |  | "20060100714"         |  |  |  |  |  |
|  |  | "20060122705"         |  |  |  |  |  |
|  |  | "20060142865"         |  |  |  |  |  |
|  |  | "20060200248"         |  |  |  |  |  |
|  |  | "20060200249"         |  |  |  |  |  |
|  |  | "20070016304"         |  |  |  |  |  |
|  |  | "20070055380"         |  |  |  |  |  |
|  |  | "20070100458"         |  |  |  |  |  |
|  |  | "20070142921"         |  |  |  |  |  |
|  |  | "20070156246"         |  |  |  |  |  |
|  |  | "20070179624"         |  |  |  |  |  |
|  |  | "20070219638"         |  |  |  |  |  |
|  |  | "20070244563"         |  |  |  |  |  |
|  |  | "20080269906"         |  |  |  |  |  |
|  |  | "20080294268"         |  |  |  |  |  |
|  |  | "20080306601"         |  |  |  |  |  |
|  |  | "20090149961"         |  |  |  |  |  |
|  |  | "20090204225"         |  |  |  |  |  |
|  |  | "20090216332"         |  |  |  |  |  |
|  |  | "20090281630"         |  |  |  |  |  |
|  |  | "20100016975"         |  |  |  |  |  |
|  |  | "20100023068"         |  |  |  |  |  |
|  |  | "20100049327"         |  |  |  |  |  |
|  |  | "20100087927"         |  |  |  |  |  |
|  |  | "20100161066"         |  |  |  |  |  |
|  |  | "20100217399"         |  |  |  |  |  |
|  |  | "20100234959"         |  |  |  |  |  |
|  |  | "20100274359"         |  |  |  |  |  |
|  |  | "20100291401"         |  |  |  |  |  |
|  |  | "20100331990"         |  |  |  |  |  |
|  |  | "20110035013"         |  |  |  |  |  |
|  |  | "20110118846"         |  |  |  |  |  |
|  |  | "20110144760"         |  |  |  |  |  |
|  |  | "20110190899"         |  |  |  |  |  |
|  |  | "20110282393"         |  |  |  |  |  |
|  |  | "20120004733"         |  |  |  |  |  |
|  |  | "20120029647"         |  |  |  |  |  |
|  |  | "20120165954"         |  |  |  |  |  |
|  |  | "20120191201"         |  |  |  |  |  |

|     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|-----|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
|     |    | "20120209392"<br>"20120221111"<br>"20120221112"<br>"20120232670"<br>"20120239156"<br>"20120253467"<br>"20120277880"<br>"20130018483"<br>"20130053968"<br>"20130096631"<br>"20130110470"<br>"20130150972"<br>"20130150973"<br>"20130150975"<br>"20130226309"<br>"20130231754"<br>"20130253656"<br>"20130261751"<br>"20130261752"<br>"20130264749"<br>"20130282135"<br>"20140025173"<br>"20140142711"<br>"20140194995"<br>"20140257499"<br>"20140277180"<br>"20140371863"<br>"20150094819"<br>"20150142122"<br>"20150150688"<br>"20150272741"<br>"20150305877"<br>"20160270922"<br>"20160287401"<br>"20160310285"<br>"20160324649"<br>"20170042690"<br>"20170172764"<br>"20180243102").pn. OR<br>("10357373").urpn.<br>AND (PGPB   USPT  <br>USOC).dbnm. |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
| L56 | 37 | L55 AND (nut OR washer)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | (US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 12:24 PM |

|     |      |                                                               |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L57 | 3354 | (reverse SAME<br>shoulder SAME<br>(implant OR<br>prosthesis)) | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>12:24 PM |
| L58 | 292  | L57 AND (nut OR<br>washer)                                    | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>12:25 PM |
| L59 | 0    | "200400220674"                                                | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>01:57 PM |
| L60 | 8    | "20040220674"                                                 | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,                                                                                                                                             | OR | ON | ON | 2023/04/07<br>01:57 PM |

|     |   |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |    |    |    |                        |
|-----|---|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L61 | 5 | ("5383937").pn. | MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>01:58 PM |
| L62 | 2 | ("7294149").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                             | OR | ON | ON | 2023/04/07<br>01:58 PM |
| L63 | 5 | ("4865605").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                             | OR | ON | ON | 2023/04/07<br>02:04 PM |
| L64 | 5 | ("5282865").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | OR | ON | ON | 2023/04/07<br>02:04 PM |



|     |    |               |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|----|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L65 | 12 | "20050043805" | AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                             | OR | ON | ON | 2023/04/07<br>02:04 PM |
| L66 | 17 | "2019178104"  | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>02:10 PM |
| L67 | 17 | "20090105837" | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>02:11 PM |

|     |    |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |    |    |    |                        |
|-----|----|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L68 | 16 | "20170056187"   | RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>02:12 PM |
| L69 | 3  | ("8940054").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                               | OR | ON | ON | 2023/04/07<br>02:12 PM |
| L70 | 64 | "2015002394"    | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                               | OR | ON | ON | 2023/04/07<br>02:13 PM |
| L71 | 11 | "20150022394"   | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,                                                                                                                                                                                                                                                                                                                                                                          | OR | ON | ON | 2023/04/07<br>02:13 PM |



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| L75 | 30  | "2008011078"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br><br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>02:21 PM |
| L76 | 358 | (US-0000617-\$   US-<br>0002766-\$   US-<br>0011192-\$   US-<br>0029089-\$   US-<br>0036328-\$   US-<br>0037153-\$   US-<br>0038302-\$   US-<br>0038401-\$   US-<br>0039449-\$   US-<br>0039451-\$   US-<br>0043805-\$   US-<br>0045323-\$   US-<br>0047210-\$   US-<br>0049709-\$   US-<br>0050042-\$   US-<br>0055380-\$   US-<br>0055783-\$   US-<br>0056187-\$   US-<br>0059424-\$   US-<br>0060346-\$   US-<br>0064187-\$   US-<br>0064189-\$   US-<br>0064190-\$   US-<br>0065612-\$   US-<br>0069443-\$   US-<br>0069444-\$   US-<br>0069445-\$   US-<br>0071104-\$   US-<br>0071749-\$   US-<br>0078024-\$   US-<br>0078377-\$   US-<br>0080207-\$   US-<br>0081505-\$   US-<br>0082175-\$   US-<br>0082702-\$   US-<br>0087213-\$   US-<br>0090736-\$   US-<br>0095214-\$   US- | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                     | OR | ON | ON | 2023/04/07<br>02:23 PM |

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|  |  | 0100952-\$ | US- |  |  |  |  |  |
|  |  | 0105837-\$ | US- |  |  |  |  |  |
|  |  | 0105861-\$ | US- |  |  |  |  |  |
|  |  | 0106266-\$ | US- |  |  |  |  |  |
|  |  | 0107002-\$ | US- |  |  |  |  |  |
|  |  | 0107794-\$ | US- |  |  |  |  |  |
|  |  | 0107882-\$ | US- |  |  |  |  |  |
|  |  | 0111689-\$ | US- |  |  |  |  |  |
|  |  | 0112433-\$ | US- |  |  |  |  |  |
|  |  | 0112648-\$ | US- |  |  |  |  |  |
|  |  | 0114326-\$ | US- |  |  |  |  |  |
|  |  | 0114933-\$ | US- |  |  |  |  |  |
|  |  | 0119531-\$ | US- |  |  |  |  |  |
|  |  | 0122519-\$ | US- |  |  |  |  |  |
|  |  | 0122520-\$ | US- |  |  |  |  |  |
|  |  | 0125113-\$ | US- |  |  |  |  |  |
|  |  | 0125809-\$ | US- |  |  |  |  |  |
|  |  | 0137424-\$ | US- |  |  |  |  |  |
|  |  | 0137692-\$ | US- |  |  |  |  |  |
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|  |  | 0138148-\$ | US- |  |  |  |  |  |
|  |  | 0144738-\$ | US- |  |  |  |  |  |
|  |  | 0144758-\$ | US- |  |  |  |  |  |
|  |  | 0151795-\$ | US- |  |  |  |  |  |
|  |  | 0158605-\$ | US- |  |  |  |  |  |
|  |  | 0161066-\$ | US- |  |  |  |  |  |
|  |  | 0161169-\$ | US- |  |  |  |  |  |
|  |  | 0163202-\$ | US- |  |  |  |  |  |
|  |  | 0166033-\$ | US- |  |  |  |  |  |
|  |  | 0167629-\$ | US- |  |  |  |  |  |
|  |  | 0167630-\$ | US- |  |  |  |  |  |
|  |  | 0172996-\$ | US- |  |  |  |  |  |
|  |  | 0175543-\$ | US- |  |  |  |  |  |
|  |  | 0175544-\$ | US- |  |  |  |  |  |
|  |  | 0177241-\$ | US- |  |  |  |  |  |
|  |  | 0177327-\$ | US- |  |  |  |  |  |
|  |  | 0193150-\$ | US- |  |  |  |  |  |
|  |  | 0193168-\$ | US- |  |  |  |  |  |
|  |  | 0193275-\$ | US- |  |  |  |  |  |
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|  |  | 0193277-\$ | US- |  |  |  |  |  |
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|  |  | 0195909-\$ | US- |  |  |  |  |  |
|  |  | 0197651-\$ | US- |  |  |  |  |  |
|  |  | 0200067-\$ | US- |  |  |  |  |  |
|  |  | 0200249-\$ | US- |  |  |  |  |  |
|  |  | 0202674-\$ | US- |  |  |  |  |  |
|  |  | 0209392-\$ | US- |  |  |  |  |  |
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|  |  | 0220674-\$ | US- |  |  |  |  |  |
|  |  | 0223941-\$ | US- |  |  |  |  |  |
|  |  | 0225817-\$ | US- |  |  |  |  |  |
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|  |  | 0230311-\$ | US- |  |  |  |  |  |
|  |  | 0234820-\$ | US- |  |  |  |  |  |
|  |  | 0236572-\$ | US- |  |  |  |  |  |
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|  |  | 0244547-\$   US-     |  |  |  |  |  |
|  |  | 0249938-\$   US-     |  |  |  |  |  |
|  |  | 0251640-\$   US-     |  |  |  |  |  |
|  |  | 0253641-\$   US-     |  |  |  |  |  |
|  |  | 0257499-\$   US-     |  |  |  |  |  |
|  |  | 0260398-\$   US-     |  |  |  |  |  |
|  |  | 0261775-\$   US-     |  |  |  |  |  |
|  |  | 0265411-\$   US-     |  |  |  |  |  |
|  |  | 0273806-\$   US-     |  |  |  |  |  |
|  |  | 0274360-\$   US-     |  |  |  |  |  |
|  |  | 0276144-\$   US-     |  |  |  |  |  |
|  |  | 0278030-\$   US-     |  |  |  |  |  |
|  |  | 0287309-\$   US-     |  |  |  |  |  |
|  |  | 0304063-\$   US-     |  |  |  |  |  |
|  |  | 0313533-\$   US-     |  |  |  |  |  |
|  |  | 0336293-\$   US-     |  |  |  |  |  |
|  |  | 0338446-\$   US-     |  |  |  |  |  |
|  |  | 0360456-\$   US-     |  |  |  |  |  |
|  |  | 0368982-\$   US-     |  |  |  |  |  |
|  |  | 1234567-\$   US-     |  |  |  |  |  |
|  |  | 10143559-\$   US-    |  |  |  |  |  |
|  |  | 10492926-\$   US-    |  |  |  |  |  |
|  |  | 10702390-\$   US-    |  |  |  |  |  |
|  |  | 10779952-\$   US-    |  |  |  |  |  |
|  |  | 10786265-\$   US-    |  |  |  |  |  |
|  |  | 11065125-\$   US-    |  |  |  |  |  |
|  |  | 2781758-\$   US-     |  |  |  |  |  |
|  |  | 20010011192-\$   US- |  |  |  |  |  |
|  |  | 20010037153-\$   US- |  |  |  |  |  |
|  |  | 20010047210-\$   US- |  |  |  |  |  |
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|  |  | 20020087213-\$   US- |  |  |  |  |  |
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|  |  | 20020111689-\$   US- |  |  |  |  |  |
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|  |  | 20030100952-\$   US- |  |  |  |  |  |
|  |  | 20030114933-\$   US- |  |  |  |  |  |
|  |  | 20030125809-\$   US- |  |  |  |  |  |
|  |  | 20030144738-\$   US- |  |  |  |  |  |
|  |  | 20030158605-\$   US- |  |  |  |  |  |
|  |  | 20030163202-\$   US- |  |  |  |  |  |
|  |  | 20030236572-\$   US- |  |  |  |  |  |
|  |  | 20040002766-\$   US- |  |  |  |  |  |
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|  |  | 20040167629-\$   US- |  |  |  |  |  |
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|  |  | 20040193168-\$   US- |  |  |  |  |  |
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| L77 | 22  | 20040193277-\$   US-<br>20040193278-\$   US-<br>20040220674-\$   US-<br>20040230311-\$   US-<br>20040260398-\$   US-<br>20050043805-\$   US-<br>20050049709-\$   US-<br>20050065612-\$   US-<br>20050107882-\$   US-<br>20050119531-\$   US-<br>20050177241-\$   US-<br>20050261775-\$   US-<br>20050278030-\$   US-<br>20060036328-\$   US-<br>20060069443-\$   US-<br>20060069444-\$   US-<br>20060069445-\$   US-<br>20060200249-\$   US-<br>20070038302-\$   US-<br>20070050042-\$   US-<br>20070055380-\$   US-<br>20070112433-\$   US-<br>20070225817-\$   US-<br>20070225818-\$   US-<br>20080082175-\$   US-<br>20080177327-\$).DID.<br><br>L76 AND (washer OR nut) | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/07 02:23 PM |
| L78 | 270 | (US-20080234820-\$  <br>US-20090105837-\$  <br>US-20090125113-\$  <br>US-20090228112-\$  <br>US-20090287309-\$  <br>US-20100114326-\$  <br>US-20100161066-\$  <br>US-20100217399-\$  <br>US-20100249938-\$  <br>US-20100274360-\$  <br>US-20110029089-\$  <br>US-20110106266-\$  <br>US-20110112648-\$  <br>US-20110137424-\$  <br>US-20110144758-\$                                                                                                                                                                                                                                                                                                                        | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT;          | OR | ON | ON | 2023/04/07 02:27 PM |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |  |  |  |  |
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|  |  | US-20110276144-\$  <br>US-20110313533-\$  <br>US-20120172996-\$  <br>US-20120209392-\$  <br>US-20120239156-\$  <br>US-20130060346-\$  <br>US-20130090736-\$  <br>US-20130166033-\$  <br>US-20130197651-\$  <br>US-20140107794-\$  <br>US-20140253641-\$  <br>US-20140257499-\$  <br>US-20150105861-\$  <br>US-20150223941-\$  <br>US-20150265411-\$  <br>US-20160045323-\$  <br>US-20170000617-\$  <br>US-20170056187-\$  <br>US-20170071749-\$  <br>US-20170202674-\$  <br>US-20170273806-\$  <br>US-20170304063-\$  <br>US-20170360456-\$  <br>US-20180071104-\$  <br>US-20180078377-\$  <br>US-20180161169-\$  <br>US-20180193150-\$  <br>US-20180200067-\$  <br>US-20180368982-\$  <br>US-20190336293-\$  <br>US-20210038401-\$  <br>US-20210137692-\$  <br>US-20210137693-\$  <br>US-20210244547-\$  <br>US-20210251640-\$  <br>US-20210338446-\$  <br>US-20220151795-\$  <br>US-20220175543-\$  <br>US-20220175544-\$  <br>US-20230078024-\$  <br>US-20230080207-\$  <br>US-20230081505-\$  <br>US-3979778-\$   US-<br>4003095-\$   US-<br>4045826-\$   US-<br>4206517-\$   US-<br>4261062-\$   US-<br>4404693-\$   US-<br>4550450-\$   US-<br>4865605-\$   US-<br>4964865-\$   US-<br>4986833-\$   US-<br>4990161-\$   US-<br>5030219-\$   US-<br>5032132-\$   US-<br>5080673-\$   US-<br>5108440-\$   US-<br>5282865-\$   US- | IBM_TDB) |  |  |  |  |
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|  |  | 5314479-\$  | US- |  |  |  |  |  |
|  |  | 5314489-\$  | US- |  |  |  |  |  |
|  |  | 5344458-\$  | US- |  |  |  |  |  |
|  |  | 5358525-\$  | US- |  |  |  |  |  |
|  |  | 5370694-\$  | US- |  |  |  |  |  |
|  |  | 5462563-\$  | US- |  |  |  |  |  |
|  |  | 5487677-\$  | US- |  |  |  |  |  |
|  |  | 5489309-\$  | US- |  |  |  |  |  |
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|  |  | 5507819-\$  | US- |  |  |  |  |  |
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|  |  | 5549683-\$  | US- |  |  |  |  |  |
|  |  | 5593448-\$  | US- |  |  |  |  |  |
|  |  | 5702486-\$  | US- |  |  |  |  |  |
|  |  | 5755811-\$  | US- |  |  |  |  |  |
|  |  | 5769856-\$  | US- |  |  |  |  |  |
|  |  | 5800551-\$  | US- |  |  |  |  |  |
|  |  | 5928285-\$  | US- |  |  |  |  |  |
|  |  | 57419657-\$ | US- |  |  |  |  |  |
|  |  | 6037724-\$  | US- |  |  |  |  |  |
|  |  | 6228119-\$  | US- |  |  |  |  |  |
|  |  | 6231913-\$  | US- |  |  |  |  |  |
|  |  | 6290726-\$  | US- |  |  |  |  |  |
|  |  | 6334874-\$  | US- |  |  |  |  |  |
|  |  | 6364910-\$  | US- |  |  |  |  |  |
|  |  | 6368353-\$  | US- |  |  |  |  |  |
|  |  | 6379386-\$  | US- |  |  |  |  |  |
|  |  | 6458136-\$  | US- |  |  |  |  |  |
|  |  | 6514287-\$  | US- |  |  |  |  |  |
|  |  | 6520964-\$  | US- |  |  |  |  |  |
|  |  | 6589281-\$  | US- |  |  |  |  |  |
|  |  | 6610067-\$  | US- |  |  |  |  |  |
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|  |  | 6673115-\$  | US- |  |  |  |  |  |
|  |  | 6679916-\$  | US- |  |  |  |  |  |
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|  |  | 6699289-\$  | US- |  |  |  |  |  |
|  |  | 6709463-\$  | US- |  |  |  |  |  |
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|  |  | 6783549-\$  | US- |  |  |  |  |  |
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|  |  | 7011686-\$  | US- |  |  |  |  |  |
|  |  | 7044973-\$  | US- |  |  |  |  |  |
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|  |  | 7238208-\$  | US- |  |  |  |  |  |
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|  |  | 7320709-\$  | US- |  |  |  |  |  |
|  |  | 7329284-\$  | US- |  |  |  |  |  |
|  |  | 7465319-\$  | US- |  |  |  |  |  |
|  |  | 7517364-\$  | US- |  |  |  |  |  |
|  |  | 7618462-\$  | US- |  |  |  |  |  |
|  |  | 7678151-\$  | US- |  |  |  |  |  |
|  |  | 7749278-\$  | US- |  |  |  |  |  |
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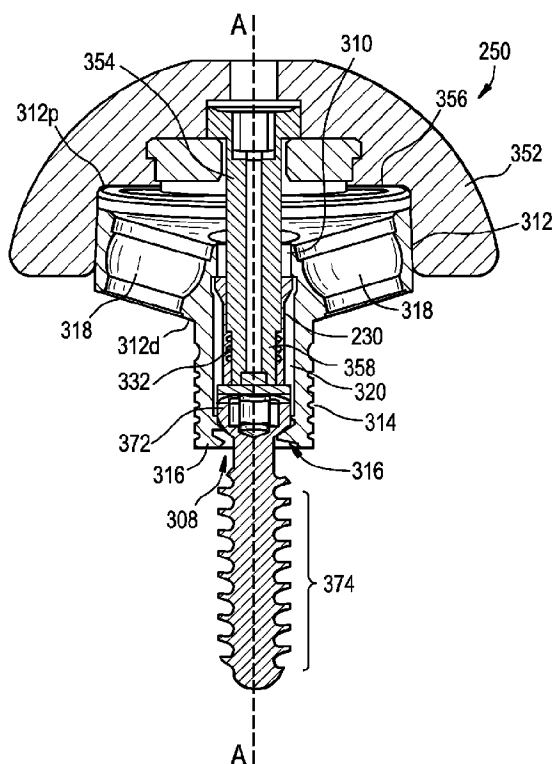
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(54) **BASEPLATE OF A MODULAR SHOULDER JOINT PROSTHESIS AND RELATED METHODS FOR IMPLANTING THE SAME**

(57) Shoulder joint implants (200) are disclosed herein for use in shoulder reconstruction that are configured to facilitate the inclusion a central bone screw for augmented bone fixation. The implant can include a baseplate (312) (or metaglene) configured to secure a glenosphere (250) or other prosthetic component to the glenoid. To facilitate lateral or proximal insertion of a central bone screw (270) through the implant, a throughbore (310) defined along the central axis of the metaglene can be widened to accommodate the maximum diameter of the screw. To enable fixation of the glenosphere to the metaglene, a collet (230) can be configured to engage the smaller diameter of a glenosphere coupling element (354) and inserted into the central throughbore. The collet and the bone screw can be separate parts, thereby making insertion of the bone screw optional. Alternatively, the collet and bone screw can be integrated together to form a unitary construct.

**FIG. 3**

## Description

### FIELD

**[0001]** The present disclosure relates generally to orthopedic implants, and more particularly to a baseplate of a modular shoulder joint prosthesis and related methods of implanting the baseplate into a patient's scapula.

### BACKGROUND

**[0002]** During the lifetime of a patient, it may be necessary to perform a total shoulder replacement procedure on the patient as a result of disease or trauma, for example. In a total shoulder replacement procedure, a humeral prosthesis is used to replace the natural head of the patient's humerus. The humeral prosthesis typically includes an elongated post component that is implanted into the intramedullary canal of the patient's humerus and a hemispherically-shaped prosthetic head component that is secured to the post component. In such a total shoulder replacement procedure, the natural glenoid surface of the scapula is resurfaced or otherwise replaced with a glenoid component that provides a bearing surface upon which the prosthetic head component of the humeral prosthesis articulates.

**[0003]** However, in some cases the patient's natural shoulder, including its soft tissue, has degenerated to a severe degree of joint instability and pain. In many such cases, it can be necessary to change the mechanics of the shoulder. Reverse shoulder implants can be used to do so. As its name suggests, a reverse shoulder implant reverses the anatomy, or structure, of the healthy shoulder. In particular, a reverse shoulder implant is designed such that the prosthetic head (*i.e.*, the "ball" in the ball-and-socket joint), known as a glenosphere component, is secured to the patient's scapula, with the corresponding concave bearing (*i.e.*, the "socket" in the ball-and-socket joint), known as a humeral cup, being secured to the patient's humerus. Such a reverse configuration allows the patient's deltoid muscle, which is one of the larger and stronger shoulder muscles, to raise the arm.

**[0004]** To secure the glenosphere component to the patient's scapula, a baseplate, sometimes referred to as a metaglene component, can be implanted onto the glenoid of the patient's scapula. For example, as shown in FIGS. 1A and 1B, a shoulder joint implant includes a metaglene component 60 that includes a platform 62 having a post 64 extending outwardly from its distal surface 66. The post 64 has a bore 68 formed about a central axis A-A of the metaglene component 60 and is configured to engage a locking screw or other coupling element protruding from a distal surface of a glenosphere component (not shown). The bore 68 extends through the entire length of the post 64. The post 64 of the metaglene component 60 is designed to be implanted into a void formed in a glenoid surface 28. Bone screws 80 can be positioned in some or all of the screw holes or apertures 74

and driven into, or otherwise secured to, the bone tissue of a patient's scapula 30, thereby fixing the metaglene component 60 in place.

**[0005]** In some challenging clinical situations, such as poor bone quality or anatomic limitations, it can be useful to drive a bone screw into the glenoid through the central bore 68 of the metaglene component 60. However, when the proximal width or diameter of the bore 68 is smaller than the width or diameter of the head of the screw, the surgeon may be prevented from inserting the screw through the bore using a top-down or lateral approach (*i.e.*, distally inserting the screw from the proximal end of the metaglene component), thereby increasing the complexity of the surgical procedure. Although the proximal diameter of the bore 68 can be widened to accommodate the screw diameter, such widening can cause backward incompatibility with glenoid/glenosphere components having coupling elements with narrower widths.

**[0006]** Accordingly, there is a need for improved metaglene components that, for example, facilitate use of a central screw, and related methods for implanting the various embodiments of a metaglene component provided for herein, or otherwise derivable from the present disclosures, in a scapula of a patient with (or without) a central screw in a manner that maintains backward compatibility with standard glenoid/glenosphere components.

### SUMMARY

**[0007]** The present disclosure is generally related to shoulder joint implants, and represents improvements over existing designs of such implants. These implants are often used in reverse shoulder procedures. Typically the shoulder joint implant includes a baseplate, sometimes referred to herein as a metaglene component (or metaglene). The base plate that is configured to secure a glenosphere component (or glenosphere) to the bony anatomy of the glenoid to complete the repair. As discussed in greater detail below, other components that can engage with the baseplate and/or the glenosphere component can include a collet and/or a bone screw, and in some such instances the collet and bone screw can form a singular component of the implant. The provided for embodiments can allow for backwards compatibility amongst the components of the implant, and also allow for surgeons to select a variety of different configuration types for the implant based, at least in part, on the needs and anatomy of the patient and the preferences of the particular surgeon. For example, some configurations that include a collet can allow a bone screw to be omitted from the implant, while some other configurations that include a collet and bone screw coupled together in a single, unitary component can reduce the number of steps performed during a procedure, thereby simplifying the procedure.

**[0008]** In one exemplary embodiment of a shoulder joint implant, the implant includes a first prosthetic com-

ponent, a baseplate, and a removable collet. The first prosthetic component includes a coupling element that protrudes from a distal bearing surface of the prosthetic component. The baseplate is configured to secure the first prosthetic component to bone, and includes a post that protrudes from a distal bearing surface of the baseplate. The post defines a throughbore that extends along a proximal-distal axis of the post. The removable collet is disposed within the throughbore, and is configured to engage the coupling element of the first prosthetic component such that the first prosthetic component is fixedly coupled to the baseplate.

**[0009]** In some embodiments, the first prosthetic component is a glenosphere component having an integrated locking screw protruding from a distal bearing surface of the glenosphere component. The collet can be dimensioned to engage the coupling element, with the coupling element having a diameter that is less than a diameter of the throughbore of the baseplate. Additionally, or alternatively, the collet can include a plurality of proximally-extending arms that are radially compressible to facilitate at least one of insertion and removal of the collet in the throughbore of the baseplate. One or more of the proximally-extending arms can include a lateral protrusion that is configured to engage an annular recessed portion of an inner sidewall of the throughbore when the arms are not compressed, which in turn can fix the removable collet in place with respect to the first prosthetic component and/or with respect to the baseplate itself at a predetermined depth in the throughbore of the baseplate. Further, one or more of the proximally-extending arms can have a proximal ramped bearing surface that is configured to bear against a counterpart bearing surface of a prosthetic implant tool. The arm(s) can be radially compressed in response to the counterpart bearing surface of the prosthetic implant tool bearing against the proximal ramped bearing surface, thus disengaging the lateral protrusion of the arm(s) from the recessed portion of the inner sidewall of the throughbore. This radial compression feature can be used to facilitate insertion and/or removal of the collet within the throughbore of the baseplate.

**[0010]** In some embodiments, the collet can include one or more keys protruding from one or more of the arms of the collet. The keys of the collet can be configured to engage with one or more keyways defined longitudinally along an inner sidewall of the throughbore of the baseplate to align and guide the collet into the baseplate. The keys of the collet can be configured to engage with the keyways defined along the inner sidewall of the throughbore to resist rotation of the collet while disposed within the throughbore of the baseplate. The keys of the collet can be configured to engage with the keyways along the inner sidewall of the throughbore to form a locking mechanism that provides a torsional resistive force that counteracts a torque imparted by the coupling element of the first prosthetic component while screwing the coupling element into the collet to form a taper lock between the first prosthetic component and the baseplate

or while unscrewing the coupling element out of the collet to break the taper lock between the first prosthetic component and the baseplate. The length of the keyways can define a distal most depth at which the removable collet can be seated in the throughbore of the baseplate. In some embodiments, the distance between the annular recessed portion and the distal most depth of the keyways can be a predefined distance that is greater than the height of the collet such that the collet bottoms out at the distal end of the one or more keyways while the coupling element of the glenosphere component is unscrewed from the collet.

**[0011]** In some embodiments, the implant can include a bone screw that has a proximal head and a distal threaded portion. In such embodiments, the throughbore of the baseplate can be dimensioned to facilitate insertion of the bone screw that has a diameter that is greater than a diameter of the coupling element of the first prosthetic component. Further, in some such embodiments, the collet can be dimensioned to engage the coupling element, with the coupling element having a diameter that is less than a diameter of the central bone screw. In some instances, the collet and the central bone screw can be separate components. This can result, for example, in a configuration in which the collet is disposed within the throughbore of the baseplate, proximal to the proximal head of the central bone screw. In some such embodiments, the collet can be disposed within the throughbore of the baseplate after the central bone screw is laterally inserted into the throughbore. In some embodiments, the implant can be devoid of a central bone screw.

**[0012]** In instances in which the implant includes a central bone screw that has a proximal head and a distal threaded portion, the collet can be coupled to the proximal head of the central bone screw. Alternatively, or additionally, the proximal head of the central bone screw can include a shoulder portion that is of a spherical and/or conical shape, and an inner sidewall of the throughbore at the distal end of the post can include a threaded sidewall portion that is configured to support the shoulder portion of the central bone screw. In some embodiments that include a central bone screw that has a proximal head and a distal threaded portion, the distal threaded portion of the central bone screw can extend through an opening at the distal end of the post, being configured to secure the baseplate to bone.

**[0013]** One exemplary method of implanting a shoulder prosthetic implant in a scapula of a patient includes reaming a glenoid of a scapula such that a surface of the glenoid is complementary to a distal bearing surface of a baseplate of a prosthetic shoulder implant, drilling a hole into the glenoid to receive a post that protrudes from the distal bearing surface of the baseplate, and disposing the post of the baseplate into the glenoid through the drilled hole. The method further includes securing a plurality of peripheral bone screws into the glenoid through one or more screw holes defined in the baseplate, and laterally inserting a removable collet into a throughbore

defined in the baseplate. The throughbore extends along a proximal-distal axis of the baseplate of the post. Still further, the method includes securing a first prosthetic component of the prosthetic shoulder implant onto a proximal bearing surface of the baseplate such that a coupling element protruding from a distal bearing surface of the first prosthetic component is secured to the collet within the throughbore of the baseplate.

**[0014]** The method can further include laterally inserting a central bone screw through the throughbore of the baseplate prior to inserting the removable collet, and securing a distal threaded portion of the central bone screw into the glenoid through an opening at the distal end of the post of the baseplate. The collet can be coupled to a proximal head of a central bone screw and the method can further include laterally inserting the collet and the central bone screw together into the throughbore of the baseplate, and securing a distal threaded portion of the central bone screw into the glenoid through an opening at the distal end of the post of the baseplate.

**[0015]** The throughbore of the baseplate can be dimensioned to facilitate insertion of a central bone screw having a diameter that is greater than a diameter of the coupling element of the first prosthetic component. Further, the collet can be dimensioned to engage the coupling element of the first prosthetic component having a diameter that is less than a diameter of the central bone screw. In some embodiments, the first prosthetic component is a glenosphere component having an integrated locking screw protruding from a distal bearing surface of the glenosphere component.

**[0016]** The removable collet can include a plurality of compressible arms. In some such embodiments, the method can include removing the collet from within the throughbore of the baseplate using a tool by laterally inserting the tool into the throughbore of the baseplate, and rotating a distal end of the tool to engage the threaded portion of the plurality of arms. The method can further include continuing to rotate the distal head until the distal head radially compresses the plurality of arms away from a recessed sidewall portion of the throughbore, and proximally pulling the collet out of the throughbore.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0017]** The accompanying drawings, which are incorporated herein and constitute part of this specification, illustrate exemplary embodiments, and together with the general description given above and the detailed description given below, serve to explain the features of the various embodiments:

FIG. 1A is a side, partial cross-sectional view of one example of a shoulder joint implant of the prior art;

FIG. 1B is a schematic side view of the shoulder joint implant of FIG. 1A coupled to a scapula;

FIG. 2A is a perspective view of one exemplary embodiment of a shoulder joint implant;

FIG. 2B is a perspective exploded view of components of the shoulder joint implant of FIG. 2A, the components including a metaglene component, a collet, a glenosphere component, and a bone screw;

FIG. 3 is a side, partially transparent view of the shoulder joint implant of FIG. 2B;

FIG. 4A is a bottom perspective view of the metaglene component of FIG. 2B;

FIG. 4B is a detailed top view of the metaglene component of FIG. 4A;

FIG. 4C is a detailed side, cross-sectional view of the metaglene component of FIG. 4B;

FIG. 5 is a perspective view of the collet of FIG. 2B;

FIG. 6A is a side perspective view of the bone screw of FIG. 2B;

FIG. 6B is a detailed perspective view of a distal end of the bone screw of FIG. 6A;

FIG. 6C is a detailed side, cross-sectional view of the metaglene component of FIG. 4C and a proximal end of the bone screw of FIG. 6A;

FIG. 7 is a detailed side, cross-sectional view of the metaglene component and the proximal end of the bone screw of FIG. 6A and the collet of FIG. 5;

FIG. 8 is a side, cross-sectional view of the metaglene component, proximal end of the bone screw, and the collet of FIG. 7, and the glenosphere component of FIG. 2B that includes a locking screw;

FIG. 9 is a schematic illustration of one exemplary embodiment of a method of implanting a shoulder implant like the shoulder implant of FIGS. 2A-8;

FIG. 10A is a perspective exploded view of another exemplary embodiment of a shoulder joint implant, the implant having components that include a metaglene component, a glenosphere component, and an integrated collet and bone screw;

FIG. 10B is a side, partially transparent view of the shoulder joint implant of FIG. 10A;

FIG. 10C is a detailed perspective view of the integrated collet and bone screw of FIG. 10A;

FIG. 11 is a schematic illustration of one exemplary

embodiment of a method of implanting a shoulder implant like the shoulder implant of FIGS. 10A-10C;

FIG. 12A is a perspective view of one exemplary embodiment of a collet removal tool;

FIG. 12B is a side perspective, cross-sectional view of one exemplary embodiment of the collet removal tool of FIG. 12A being associated with a shoulder joint implant that includes a collet;

FIG. 12C is a detailed side, partially transparent view of the collet removal tool and collet of FIG. 12B;

FIG. 13A is a perspective view of yet another exemplary embodiment of a shoulder joint implant;

FIG. 13B is a perspective exploded view of components of the shoulder joint implant of FIG. 13A, the components including a metaglene component having an integrated bone screw and a glenosphere component;

FIG. 14 is a side, partially transparent view of the shoulder joint implant of FIG. 13B; and

FIG. 15 is a schematic illustration of one exemplary embodiment of a method of implanting a shoulder joint implant like the shoulder implant of FIGS. 13A and 13B.

#### DETAILED DESCRIPTION

**[0018]** Certain exemplary embodiments will now be described to provide an overall understanding of the principles of the structure, function, manufacture, and use of the devices and methods disclosed herein. One or more examples of these embodiments are illustrated in the accompanying drawings. Those skilled in the art will understand that the devices and methods specifically described herein and illustrated in the accompanying drawings are non-limiting exemplary embodiments and that the scope of the present disclosure is defined solely by the claims. The features illustrated or described in connection with one exemplary embodiment may be combined with the features of other embodiments. Such modifications and variations are intended to be included within the scope of the present disclosure. Sizes and shapes of the devices, and the components thereof, can depend on a variety of factors, including but not limited to an anatomy and tendencies of the subject (*i.e.*, patient) in which the devices will be used, the size and shape of components with which the devices will be used, the methods and procedures in which the devices will be used, and the preferences of the surgeon operating the devices and/or otherwise performing the related procedure(s).

**[0019]** In the present disclosure, like-named compo-

nents of the embodiments generally have similar features and/or purposes, unless stated otherwise. Additionally, a number of terms may be used throughout the disclosure interchangeably but will be understood by a person skilled in the art. Additionally, to the extent that linear or circular dimensions are used in the description of the disclosed devices and methods, such dimensions are not intended to limit the types of shapes that can be used in conjunction with such devices and methods. A person skilled in the art will recognize that an equivalent to such linear and circular dimensions can be easily determined for any geometric shape (*e.g.*, references to widths and diameters being easily adaptable for circular and linear dimensions, respectively, by a person skilled in the art). Additionally, to the extent that terms are used in the disclosure to describe a direction, orientation, and/or relative position of the disclosed prosthetic devices and components thereof and/or for performing a disclosed method of assembly and/or implantation of such devices, such terms are not intended to be limiting. For example, a person skilled in the art will recognize that terms of direction, orientation, and/or relative position (*e.g.*, proximal, distal, medial, lateral, etc.) can be used interchangeably depending, at least in part, on the perspective view of the surgeon or other operator.

**[0020]** The present disclosure is generally related to shoulder joint implants, and represents improvements over existing designs of such implants. These implants are often used in reverse shoulder procedures. Typically the shoulder joint implant includes a baseplate, sometimes referred to herein as a metaglene component (or metaglene). The baseplate is configured to secure a glenosphere component (or glenosphere) to the bony anatomy of the glenoid to complete the repair. As discussed in greater detail below, other components that can engage with the metaglene component and/or the glenosphere component can include a collet and/or a bone screw, and in some such instances the collet and bone screw can form a singular component of the implant. The provided for embodiments can allow for backwards compatibility amongst the components of the implant, and also allow for surgeons to select a variety of different configuration types for the implant based, at least in part, on the needs and anatomy of the patient and the preferences of the particular surgeon. For example, some configurations that include a collet can allow a bone screw to be omitted from the implant, while some other configurations that include a collet and bone screw coupled together in a single, unitary component can reduce the number of steps performed during a procedure, thereby simplifying the procedure.

**[0021]** Although the various embodiments disclosed herein disclose fixing a glenosphere component to the metaglene component, one of skill in the art will recognize the other prosthetic components can be coupled to the metaglene component, such as but not limited to a glenoid component configured to replace or augment the glenoid surface of the scapula. A person skilled in the art



will also understand how the disclosures provided for herein can be adapted for use with devices and procedures associated with other joints without departing from the spirit of the present disclosure.

**[0022]** FIG. 2A, 2B, and 3 provide for one exemplary embodiment of a shoulder joint implant 200. As shown, the shoulder joint implant 200 can include a metaglene (or metaglene component) 210, a collet 230, a glenosphere (or glenosphere component) 250, and a central bone screw 270, which, as explained below, can be optional. More particularly, the collet 230 and the bone screw 270 can be disposed in a central throughbore of the metaglene 210 such that the bone screw can be driven into the glenoid and the collet can secure the glenosphere 250 to the metaglene 210. Each of these components is described in greater detail below.

**[0023]** The metaglene 210 is one component of the shoulder joint implant 200, and is illustrated in more detail in FIGS. 4A-4C. In the illustrated embodiment, the metaglene 210 includes a platform 312 having a post 314 extending outwardly from a bottom or distal-facing surface 312d. The platform 312 can be generally configured such that its bottom or distal-facing surface 312d engages in a complementary manner with a surface of the glenoid when implanted and a top or proximal-facing surface 312p engages in a complementary manner with the glenosphere 250 or other prosthetic component when coupled together. More specifically, the distal-facing surface 312d of the platform 312 can have a convex shape configured to conform to a concave surface of the glenoid. Further, the proximal-facing surface 312p of the platform 312 can have a concave shape configured to be complementary with a surface it engages with of the glenosphere 250.

**[0024]** The platform 312 can include a central throughbore 310 extending through a thickness of the platform 312. Its configuration is described in greater detail below with respect to its relationship with the post 314 and the collet 230. Although illustrated in a central configuration, a person skilled in the art will recognize the throughbore 310 can be located in a non-central manner without departing from the spirit of the present disclosure. The platform 312 can also include one or more screw holes or apertures 318 that likewise extend through a thickness of the platform 312. The apertures 318 can be positioned in any variety of configurations, and in the illustrated embodiment there are four that are positioned radially outward from the central throughbore 310 such that they are approximately equidistant from each other. The apertures 318 can be used to receive peripheral bone screws (not shown, but operate in a similar manner as screws 80 of FIGS. 1A and 1B) to be driven into the bony anatomy of the glenoid to help fix the metaglene 210 in place. Any number and configuration of apertures 318 can be used without departing from the spirit of the disclosure, including using no apertures.

**[0025]** The post 314 can generally extend distally from the distal-facing surface 312d of the platform 312, and

can be configured to be press fit into a void or hole drilled into the glenoid of the patient's scapula, thereby providing a first form of bone fixation. In some embodiments, to further augment bone fixation, the post 314 can have a throughbore 320 extending therethrough. In the illustrated embodiment the throughbore 320 is centrally disposed such that it is formed and centered around a central axis A-A of the metaglene 210, although other locations with respect to the metaglene 210 are possible. This location also places the throughbore 320 in-line with the throughbore 310 of the platform 312. The throughbore 320 can have an inner diameter sized to accommodate a maximum diameter of a bone screw 270 (e.g., the diameter of a screw head 372). For example, as shown in the illustrated embodiment, the bone screw 270 can be inserted laterally or proximally through the throughbore 320 of the metaglene 210 such that the screw head 372 is seated on a threaded distal portion 316 of the post 314. The threaded distal portion 374 of the screw 270 exits the metaglene 210 through a distal opening 308 of the post 314. As described in more detail below with respect to FIG. 7, the threaded distal portion 316 of the post 314 can be configured to facilitate the use of smaller screws and thus avoid the need to increase the size of the post 314. A distal opening 308 of the post 314 can be used to allow a central bone screw (not shown) to exit the metaglene 210 into bone.

**[0026]** As shown in FIGS. 4B and 4C, the central throughbore 310 of the metaglene 210 can be configured to facilitate insertion of the collet 230 and optionally a bone screw 270. For example, in some embodiments, one or more slots or recesses, sometimes referred to herein as keyway(s) 322, can be defined longitudinally along an inner sidewall 310s of the throughbore 310. The keyways can be configured to slidably mate with keys 512 protruding from the collet 230, described in greater detail below, to help orient and guide insertion of the collet 230 within the throughbore 310 of the metaglene 210. The keyways 322 can extend partially along the length of the throughbore 310 and terminate at a distal stop 322d at which to seat the collet 230.

**[0027]** In some embodiments, the mating of the keys 512 and keyways 322 can provide resistance to torsional rotation, e.g., while the glenosphere 250 is screwed into or otherwise coupled to the collet 230. For example, in some embodiments, the keys 512 of the collet 230 can be configured to engage with the keyways 322 along the inner sidewall 310s of the throughbore 310 to form a locking mechanism that provides a torsional resistive force that counteracts a torque imparted by the locking screw of the glenosphere 250 while screwing the locking screw into the collet 230 to form a taper lock (e.g., a Morse taper lock) between the distal facing surface of the glenosphere 250 and the proximal facing surface of the baseplate 210. Likewise, the mating of the keys 512 and the keyways 322 form a locking mechanism that provides a torsional resistive force that counteracts a torque imparted by the locking screw in an opposite direction while unscrewing

the coupling element out of the collet to break the taper lock between the first prosthetic component and the baseplate. As shown in the illustrated embodiment, the keyways 322 can be shaped to form rectangular or other suitably shaped slots. Although two keyways are shown in the illustrated embodiment, more or less than two keyways (e.g., four) can be defined within the throughbore 310 of the metaglene 210.

**[0028]** Alternatively, or additionally, in some embodiments the central throughbore 310 of the metaglene 210 can be configured to define an annular groove or recess, sometimes referred to herein as a catch 324, in the inner sidewall 310s of the central throughbore 310. As described in more detail with respect to FIG. 7, the annular catch 324 can be configured to engage the lip 514 of the collet, thereby securing the collet 230 in place at a predetermined depth.

**[0029]** Alternatively, or additionally, in some embodiments a threaded distal portion 316 can be defined along the inner sidewall 310s of the central throughbore 310 at the distal end of the post 314. In some embodiments, the threaded distal portion 316 of the central throughbore 310 can include two or more threads 316t configured to coarsely match the threads of a central bone screw (e.g., 270). As shown in FIG. 4C, the threads 316t of the distal threaded portion 316 can be configured at an oblique angle or otherwise radially contoured to serve as a spherical or conical bearing surface for the head of the central bone screw. As described in more detail with respect to FIG. 6A-6C, the distal threaded portion 316 of the throughbore 310 can allow the use of a central bone screw having a maximum thread size without having a large screw head, and thereby avoiding the need to increase the size of the post.

**[0030]** The platform 312 and post 314 can come in a variety of configurations, shapes, and sizes. As shown, the base plate 312 can be substantially cylindrical with a substantially circular cross-section. As discussed above, a top surface 312p of the platform 312 can have a concave configuration, and a bottom surface 312d of the platform can have a convex configuration. The post 314 can also be substantially cylindrical with a substantially circular cross-section, with a diameter of the post 314 being less than a diameter of the platform 312. In the illustrated configuration, the diameter of the post 314 is approximately half the size of the diameter of the platform 312, although other proportions are certainly possible, such as the diameter of the post 314 being approximately one-quarters or three-quarters the size of the diameter of the platform 312.

**[0031]** While the sizes of the components can certainly vary, in some exemplary embodiments a diameter of the platform 312 can be approximately in the range of about 15 millimeters to about 30 millimeters, a thickness of the platform 312 (as viewed, proximal-to-distal) can be approximately in the range of about 3.5 millimeters to about 14 millimeters, and a radius of curvature of the concavity of either or both the proximal-facing and distal-facing sur-

faces 312p, 312d of the platform 312 being approximately in the range of about 0.5 millimeters to about 2.0 millimeters. A person skilled in the art will recognize that a thickness of the platform 312 may change over its surface area of the radius of curvature of the concavity of the platform for its proximal-facing surface 312p is not the same as the radius of curvature of the concavity of the platform for its distal-facing surface 312d. A diameter of the post 314 can be approximately in the range of about 5 millimeters to about 20 millimeters, and a thickness of the post 314 (as viewed, proximal-to-distal) can be approximately in the range of about 5 millimeters to about 30 millimeters. In some exemplary embodiments, a diameter of the platform 312 is approximately 22 millimeters or approximately 27 millimeters, a thickness of the platform 312 is approximately 7 millimeters, approximately 8 millimeters, or approximately 10 millimeters, a radius of curvature of the concavity of each of the proximal-facing surface 312p and the distal-facing surface 312d of the platform 312 is approximately 1.0 millimeters, a diameter of the post 314 is approximately 10 millimeters, and a thickness of the post can be approximately 13 millimeters, approximately 23 millimeters, or approximately 28 millimeters.

**[0032]** The glenosphere 250 is illustrated in FIGS. 2A, 2B, and 3. In some embodiments, the glenosphere 250 can include a hemispherical body 352 having a locking screw 354 or other coupling element that extends outward from a distal surface 356 of the hemispherical body 352. The distal surface 356 can be complementary in size and shape to the proximal-facing surface 312p of the metaglene 210 so that they can form a secure fit when coupled together. In the illustrated embodiment, the fit is a thread fit, but in other embodiments it could be a snap fit or any other coupling technique known to those skilled in the art for coupling two mechanical components. While many different sizes, shapes, and configurations of the glenosphere 250 are possible, in some exemplary embodiments a diameter of the hemispherical body 352 is approximately in the range of about 20 millimeters to about 80 millimeters, such as 40 millimeters, and a height of the hemispherical body 352 (as viewed, proximal-to-distal) can be approximately in the range of about 10 millimeters to about 40 millimeters, such as 20 millimeters. Likewise, in some exemplary embodiments, a diameter of the locking screw 354 can be approximately in the range of about 2.5 millimeters to about 10 millimeters, such as 5 millimeters, and a height of the locking screw 354 (as viewed, proximal-to-distal) can be approximately in the range of about 12.5 millimeters to about 50 millimeters, such as 25 millimeters.

**[0033]** In previous iterations of shoulder joint implants, a glenosphere locking screw was screwed directly into a central throughbore of a metaglene to secure the glenosphere to the metaglene. However, when the diameter of the central throughbore of the metaglene is widened to accommodate the diameter of the head of a bone screw, the diameter of the central throughbore can ex-

ceed the diameter or width of a glenosphere locking screw such that the locking screw cannot be screwed directly to the metaglene.

**[0034]** To address this problem, the present disclosure provides for the collet 230, which is illustrated in FIG. 5 and sometimes referred to as an adaptor or a reducing bushing. As shown in the illustrated embodiment, the collet 230 can include a substantially hollow cylindrical body 502. The collet can also include open-ended slots 504 spaced about the circumference of the cylindrical body 502 to form radially compressible arms 506 that extend proximally from an annular base portion 508. As described in more detail below with respect to FIG. 7, the radially compressible arms of the collet 230 can be configured to facilitate insertion and/or removal of the collet by flexing in response to changes in the diameter of the throughbore 310 of the metaglene 210. In some embodiments, each of the proximally-extending arms 506 can have an inner threaded portion 510 configured to at least partially surround and threadably engage the locking screw 354 of the glenosphere 250 or other prosthetic component.

**[0035]** In some embodiments, the collet 230 can include one or more lateral protrusions that are configured to orient and guide the collet into the throughbore of the metaglene, sometimes referred to herein as key(s) 512. For example, as shown in the illustrated embodiment, the keys 512 can have a rectangular or other suitable shaped profile and protrude radially outward from one or more of the arms 506 and the annular base portion 508 of the collet 230. As described in more detail below with respect to FIG. 7, the keys 512 can be configured to slide along the keyways 322 formed along an inner sidewall of the throughbore 310 of the metaglene 210. When mated to the inner sidewall of the throughbore, the keys 512 can provide resistance to torsional rotation, e.g., while the glenosphere 250 is screwed into or otherwise coupled to the collet 230.

**[0036]** In some embodiments, the collet 230 can include an annular protrusion, sometimes referred to herein as a ridge or lip 514. As described in more detail below with respect to FIG. 7, the lip can be disposed or segmented across one or more of the arms 506 and configured to engage a catch 324 (e.g., an annular groove or recess) defined within the throughbore of the metaglene, thereby securing the collet 230 in place at a predetermined depth.

**[0037]** In some embodiments, the collet 230 can include a tapered or conical proximal bearing surface 516 at the proximal end of each arm 506. As described in more detail below with respect to FIGS 12A-12C, the conical or tapered bearing surface 516 can be used to facilitate removal of the collet from within the central throughbore of the metaglene.

**[0038]** The collet 230 can be disposed within the central throughbore 310 to effectively reduce the inner diameter of the throughbore and threadably engage or otherwise capture the locking screw 354 of the glenosphere

250. In some embodiments, the collet 230 can have an inner threaded portion 332 that enables the glenosphere locking screw 354 to be screwed directly into the collet and thereby draw the glenosphere 250 onto the proximal-facing bearing surface 312p of the metaglene 210.

**[0039]** The collet 230 can be laterally or proximally inserted into the throughbore 310 of metaglene 210 until the collet 230 reaches a predetermined depth within the throughbore 310. In other words, the collet 230 is advanced distally towards and into the throughbore 310. As previously described, in some embodiments, the keyways 322 and/or the catch 324 defined in the sidewall 310s of the central throughbore 310 can be used to engage the keys 514 and/or the lip 514 of the collet 230 and thereby position the collet at a predetermined depth. Alternatively, or additionally, the collet 230 can be inserted into the throughbore of the metaglene component after the central bone screw 270 is laterally or proximally inserted into the throughbore, such the collet 230 can be disposed proximal to a head of the central bone screw 270. In some embodiments the collet 230 can be inserted into the throughbore of the metaglene component with no central bone screw 270 disposed therein.

**[0040]** Like the other components, the collet 230 can have a variety of sizes, shapes, and configurations. In some exemplary embodiments, the collet has a diameter approximately in the range of about 3 millimeters to about 15 millimeters, such as about 6.4 millimeters, and a height (as viewed, proximal-to-distal) approximately in the range of about 5 millimeters to about 20 millimeters, such as about 10 millimeters. Although shown as a cylindrical shape, other shapes are possible provided that the shape is complementary to the shape of the throughbore 310 of the metaglene 210 into which it is inserted.

**[0041]** FIGS. 6A, 6B, and 6C illustrate a central bone screw 270 that is configured for use with the shoulder joint implant of FIG. 2A. As shown in the illustrated embodiment, the central screw 270 can have a screw head 602, a shoulder portion 604, an unthreaded neck portion 606, a distal threaded portion 608 and a distal tip 610. In some embodiments, the shoulder portion 604 can be shaped to form a spherical or conical bearing surface 604d for the screw head 602. Notably, the central bone screw 270 is an optional component that can be omitted while still allowing the rest of the shoulder joint implant 200 to be successfully used for a repair procedure.

**[0042]** Typical screw heads are generally much larger in diameter than the thread diameter in order to provide a sufficient bearing surface. However, in some embodiments, in view of the present disclosures, the screw head 602 can have an outer diameter that is the same or approximately the same as the maximum outer diameter of the distal threaded portion 608. In such embodiments, the spherical or conical shoulder portion 604 can serve as the bearing surface for the screw head. For example, the shoulder portion 605 of the screw can provide a spherical or conical bearing surface 604d that extends inward at an oblique angle between the head portion 602

and the neck portion 606.

**[0043]** Thus, as shown in the illustrated embodiment of FIG. 6C, when the screw 270 is inserted through the central throughbore 310 and seated at the distal opening 308 of the metaglene post 314, the spherical or conical bearing surface 604d of the screw can bear against the distal threaded portion 316 of the throughbore 310. For example, as shown, the threads 316t of the distal threaded portion 316 can be angled or otherwise radially contoured to match or approximately match the spherical or conical bearing surface 604d of the screw 270. Thus, the distal threaded portion 316 can serve as a proximal-facing bearing surface that substantially conforms to shaped profile of the shoulder portion 604 to support the screw head 602 within the post 314. As shown in the illustrated embodiment, the spherical or conical shoulder portion 604 can be unthreaded to prevent it from passing through the distal threaded portion 316 of the baseplate, such that the shoulder portion can serve as the bearing surface of the screw 604 to the baseplate 210. Accordingly, in some embodiments the distal threaded portion 316 of the central throughbore 310 can allow the use of a central bone screw in which the screw head and threaded portion are very close in size (e.g., diameter) and still provide a bearing surface to provide optimal compression. Additionally, the use of central bone screws having reduced diameter heads can provide an advantage in that increases in the size (e.g., outer diameter) of the metaglene post can be avoided and thus requiring removal of less bone in the glenoid.

**[0044]** In some embodiments, the unthreaded neck portion 606 of the bone screw 270 can be cylindrical or substantially cylindrical in shape. The unthreaded neck portion 606 can be configured to provide a clearance between the spherical or conical shoulder portion 604 to the threaded portion 608. The amount of such clearance provided by the neck portion 606 can be configured so that the distal threaded portion 608 of the screw 270 does not mate directly to the metaglene 210 when the screw head 602 is seated within the post 314.

**[0045]** In some embodiments, the unthreaded neck portion 606 of the screw 606 can allow a "free spinning screw" design in which the screw is disposed within the baseplate, as shown in FIG. 3. The unthreaded neck portion 606 can help prevent the distal threaded portion 608 from binding up within the post 314 of the baseplate 210. Accordingly, the unthreaded neck portion 606 allows the screw 600 to turn within the bone and thereby drag the baseplate 210 further into the bone to provide additional compression between the bone and the distal facing surface 312d of the platform 312. This feature allows the screw to act like any other socket head cap screw that is assembled into a counter-bored hole to provide compression.

**[0046]** In some embodiments, the unthreaded neck portion 606 can provide an additional bearing surface or contact surface area between the screw 600 and baseplate 210. Additionally, the unthreaded neck portion 606

can be spherical which allows the screw 600 to pivot off axis from the baseplate 210 and thus not influence the baseplate 210 to glenoid bone interface. In some embodiments, the unthreaded neck portion 606 can be omitted such that the screw 606 could still function as intended with less contact area.

**[0047]** In some embodiments, the diameter and length of the screw 270 can be varied to accommodate user needs. For example, in some embodiments, the length of the screw 270 can be approximately in the range of about 15 millimeters to about 80 millimeters, and in some embodiments it is approximately 40 millimeters. However, in some embodiments, the surgeon can be provided with a number of central bone screws having different screw lengths from which to choose depending, at least in part, on the depth of the glenoid vault in which the screw is to be secured. In some embodiments, the maximum outer diameter of the distal threaded portion 608 of the screw 270 can be approximately in the range of about 6.0 millimeters to about 6.5 millimeters. In some embodiments, the distal threaded portion 640 of the screw 270 can be configured for optimized purchase or grip within the glenoid vault and allow for single or multiple leads to aid in insertion speed. In some embodiments, the distal tip 610 of the screw 270 can include an optimized bone cutting self-tapping feature 612. The self-tapping feature 612 as shown is a channel formed in an outer surface of the distal threaded portion 640, which makes it easier to insert the screw 270 into bone.

**[0048]** In view of the present design, and the fact that in at least some instances a bone screw may not be needed, the surgeon can choose to not use the bone screw 270 in the assembly of the shoulder joint implant 200. If the central bone screw 270 is not used, the collet 230 can be inserted in the metaglene 210 without the bone screw. In some embodiments, the shoulder joint implant 200 can be fixedly attached to the bony anatomy of the glenoid as part of a reverse shoulder reconstruction procedure, described in more detail with respect to FIG. 9.

**[0049]** FIG. 7 illustrates the collet 230 and bone screw 270 disposed within the central throughbore 310 of the metaglene 210. In the illustrated embodiment, the collet 230 and the bone screw 270 are separate components. Thus, the surgeon can choose whether or not to include the central bone screw 270 in the assembly of the shoulder joint implant 200. For example, in some embodiments, if the surgeon chooses to include the central bone screw in the assembly, the screw 270 can be laterally or proximally inserted through the central throughbore 310 (i.e., advanced distally towards and into the metaglene 210). Thereafter, the collet 230 can be laterally or proximally inserted into the central throughbore 310 such the collet 230 is disposed proximal to the head 602 of the screw 270. Alternatively, if the surgeon chooses not to include the central bone screw 270, the collet 230 can be laterally or proximally inserted into the central throughbore 310 without no bone screw.

**[0050]** A detailed description of the structure and pro-

cedure for laterally or proximally inserting and seating a central bone screw 270 within the central throughbore 310 is described above with respect to FIGS. 6A-6C and thus is omitted here for the sake of brevity.

**[0051]** In some embodiments, the collet 230 can be laterally or proximally inserted into the central throughbore 310 of the metaglene 210 by aligning the keys 512 of collet 230 with the keyways 322 of the throughbore 310. For example, as previously discussed with respect to FIGS. 4A-4C and 5, the collet 230 can include one or more lateral protrusions or keys 512 that are configured to slidably mate with corresponding slots or keyways 322 defined in the throughbore 310. Once the collet 230 is oriented by aligning the keys 512 with the keyways 322, the collet 230 can be pushed laterally or proximally into the central throughbore 310 such that it is guided by the keys 512 sliding laterally or proximally along the respectively keyways 322.

**[0052]** In some embodiments, as the collet 230 enters the throughbore 310, the inner sidewall 310s of throughbore 310 bears against the ridge or lip 514 of collet 230 and thereby causes the radially compressible arms 506 of the collet to flex inward while remaining in contact with the wall. As previously discussed with respect to FIGS. 4A-4C and 5, the lip 514 of the collet 230 can be an annular protrusion disposed across one or more of the arms 506 and configured to engage an annular groove or catch 324 defined horizontally along the inner sidewall 310s of the throughbore 310.

**[0053]** In some embodiments, when the lip 514 of the collet 230 reaches the location of the catch 324, the radial compression force applied by the inner sidewall 310s can release and cause the collet arms 506 to flex outward such that the lip snaps into or otherwise mates within the catch. In some embodiments, the engagement of the lip 514 of the collet 230 and the catch 324 can create an audible and/or tactile cue (e.g., a "click") to notify the surgeon that the collet has reached the desired depth. In some embodiments, the engagement of the lip 514 of the collet 230 with the catch 324 can coincide with the keys 512 at the annular base portion 508 of the collet 230 hitting a mechanical stop 322d at the bottom of the keyways 322. With the collet 230 secured at the predetermined depth, a glenosphere (e.g., the glenosphere 250) or other prosthetic component can be attached to the metaglene 210 using techniques described herein or otherwise known to those skilled in the art.

**[0054]** In some embodiments, the location of the mechanical stop 322d at the distal end of the keyways 322 can define a distal most depth, or the key depth, at which the distal end of the collet 230 is capable of bottoming out within the throughbore 310 of the baseplate 210. The distance D between the distal most depth of the keyways 322 and the annular recessed portion defined in the inner sidewall 310s of the throughbore 310, or catch 324, can be a predefined distance that is slightly greater than the height of the collet 230. For example, in some embodiments, the distance D between the distal most depth of

the keyways and the catch 324 can be greater than the height of the collet by an amount in the range between approximately 0.5 millimeters and approximately 2.0 millimeters, such as about 1.0 millimeters. In some embodiments, where the height of the collet 230 is in the range between approximately 5 millimeters and 20 millimeters, the distance D can be in the range between approximately 4.0 millimeters and 22 millimeters. For example, in some embodiments, where the height of the collet 230 is approximately 10 millimeters, the distance D can be in the range between 9 and 12 millimeters, such as about 11 millimeters. Thus, the additional tolerance provided by the predefined distance D between the catch 324 and the distal end 322d of the keyways 322 can allow the collet 230 to be properly secured between the catch 324 and the distal end 322d of the keyways 322.

**[0055]** The additional tolerance provided by the predefined distance D can be useful during removal of the glenosphere (e.g., 250). For example, in some embodiments, the glenosphere and thus the glenosphere locking screw (e.g., 354) can be unscrewed (e.g., rotated counterclockwise) to remove the glenosphere from the baseplate 210. As the locking screw is unscrewed, the ridge or lip 514 of the collet 230 releases from the catch 324 in the sidewall 310s of the throughbore 310, thereby causing the collet to be pushed towards the mechanical stop 322d of the keyways 322 until the distal end of the collet 230 bottoms out against the stop. Once the collet 230 bottoms out against the mechanical stop 322d, the continuing turning of the locking screw 354 to unscrew the glenosphere (e.g. 250) causes the load to be transferred through glenosphere such that the taper lock connection between the glenosphere and the baseplate 210 is pulled apart. In some embodiments, the taper lock connection can be a Morse taper lock between the distal facing surface of the glenosphere and the proximal facing surface of the baseplate 210. This is essentially a "Jacking Screw" function for removal of the glenosphere from the baseplate.

**[0056]** FIG. 8 illustrates the shoulder joint implant 200 with the glenosphere 250 secured to the collet 230. As shown in the illustrated embodiment, the collet 230 can be disposed within the central throughbore 310 to effectively reduce the inner diameter of the throughbore 310 and threadably engage or otherwise capture the locking screw 354 of the glenosphere 250. For example, as shown, each of the proximally-extending collet arms 506 can have an inner threaded portion 510 configured to at least partially surround the locking screw 354 such that a threaded portion 358 of the locking screw 354 can be screwed into the collet 230 and thereby draw and secure the hemispherical body 352 of the glenosphere 250 onto the proximal-facing surface 312 of the metaglene 210. When the collet 230 is secured to the inner sidewall 310s of the throughbore 310, the engagement of the keys 512 and the keyways 322 can provide resistance to torsional rotation, e.g., while the glenosphere 250 is screwed into or otherwise coupled to the collet 230. Alternatively or in

addition, engagement of the lip 514 of the collet 230 and the catch 324 can prevent or otherwise limit vertical displacement of the collet 230 within the throughbore 310.

**[0057]** In exemplary embodiments any and all of the metaglene 210, the collet 230, the glenosphere 250, and the screw 270 can be made from any number of implantable metallic materials or other biocompatible materials to form the implant. Some non-limiting examples of materials suitable for forming the various components implant can include titanium, cobalt-chrome, stainless steel, and other metals known to those skilled in the art, and some plastic materials, such as but not limited to, polyetheretherketone (PEEK) and Ultra High Molecular Weight Polyethylene (UHMWPE). In some instances, the various components (e.g., the metaglene 210, the collet 230, the glenosphere 250, and the screw 270) can be made from the same material, while in other embodiments one or more components can be made from different materials. For example, in some instances it may be beneficial to have the metaglene 210, the collet 230, and the glenosphere 250 formed from surgical grade titanium, while the screw 270 is formed from surgical grade titanium coated with a porous biocompatible material (e.g., a hydroxyapatite (HA) coating). Additionally, a person skilled in the art will recognize that a number of different material blends can be used to form any component of the implants provided for herein or otherwise derivable from the present disclosures.

**[0058]** FIG. 9 illustrates an exemplary embodiment of a method 900 of implanting the shoulder joint implant 200 in a patient's scapula. In the illustrated embodiment, the shoulder joint implant 200 can be implanted as part of a reverse shoulder reconstruction surgery in which the glenosphere (i.e., the "ball" in the ball-and-socket joint) is secured to the patient's scapula. A humeral cup (i.e., the "socket" in the ball-and-socket joint) can be secured to the patient's humerus to provide a corresponding concave bearing for the glenosphere. Such a reverse configuration allows the patient's deltoid muscle, which is one of the larger and stronger shoulder muscles, to raise the arm. Although the illustrated configuration uses the implant 200 described above, at least some of the components associated with or otherwise used in conjunction with the implant 200 may not be easily visible in the various blocks 910, 920, 930, 940, 950, 960, and 970. In view of the disclosures provided for herein, and their related illustrations, a person skilled in the art will understand how the various components of the implant 200 engage the various portions of the patient's anatomy, and/or the components of the implant 200 and related tools used in conjunction with the procedures disclosed with respect to FIG. 9.

**[0059]** At block 910, a glenoid 912 of the patient's scapula 914 can be reamed such that a bony surface of the glenoid 912 conforms to the distal bearing surface (e.g., 312d) of the metaglene (e.g., 210). In some embodiments, a glenoid resurfacing reamer 710 can be used to prepare the glenoid 912 to have an approximately

smooth, curved surface having the same or substantially the same radius of curvature as the distal-facing surface 312d of the metaglene 210. The diameters may also be complementary, whether that means the same or substantially equal, or the glenoid 912 being a little larger with the labrum (not visible in block 910) being adjacent to help keep the metaglene 210 in the desired location.

**[0060]** At block 920, a hole can be drilled into the glenoid 912 to receive the metaglene post (e.g., 314) of the metaglene (e.g., 210). In some embodiments, a cannulated stop drill 720 aligned with a central guide pin (not shown) can be used to drill the central hole.

**[0061]** At block 930, the metaglene post 314 (not visible) can be disposed into the glenoid 912 through the drilled hole. In some embodiments, a metaglene delivery instrument 730 can be secured to the metaglene 210 and used to insert the metaglene post 314 into the hole drilled into the glenoid 912. The metaglene post 314 can be slightly oversized relative to the diameter of the drilled hole to enable a press fit. Once the post 314 and the distal-facing surface 312d (not visible) of the metaglene 210 is seated on the bone 912, the metaglene delivery instrument 730 can be removed.

**[0062]** At block 940, one or more peripheral bone screws (not shown) can be driven into the glenoid through one or more screw apertures 318 of the metaglene 210 to secure the metaglene 210 to bone. In some embodiments, a screw driver 740 can be used to screw the peripheral bone screws at superior and/or inferior locations in the glenoid 912. In some embodiments, peripheral bone screws can be placed at lateral and/or medial locations of the glenoid.

**[0063]** At optional block 950, a bone screw 270 (not visible) can be laterally or proximally inserted through the central throughbore 310 (not visible) of the metaglene 210 prior to inserting the collet 230. In some embodiments, a screw driver 750 can be used to screw a distal threaded portion 608 (not visible) of the bone screw 270 into the glenoid through an opening 308 (not visible) at the distal end of the post 314 (not visible) of the metaglene 210. In some embodiments, the bone screw can be laterally or proximally inserted as previously described with respect to FIGS. 6A-6C.

**[0064]** At block 960, the collet 230 (not visible) can be laterally or proximally inserted into the central throughbore 310 (not visible) defined in the metaglene 210 into the post 314 (not visible). In some embodiments, a collet delivery instrument 760 can be coupled to the collet 230 (not visible) and used to push the collet 230 into the central throughbore 310 (not visible) as previously described with respect to FIG. 7.

**[0065]** At block 970, the glenosphere 250 of the shoulder joint implant 200 can be secured onto the proximal bearing surface 312p of the metaglene 210. For example, in some embodiments, a locking screw 354 (not visible) or other coupling element protruding from a distal bearing surface of the glenosphere 250 can be secured to the collet 230 (not visible) within the throughbore of the me-

taglene 210. In some embodiments, the glenosphere 250 can be screwed into or otherwise coupled the collet 230 as previously described with respect to FIG. 8.

**[0066]** FIG. 10A and 10B provide for another exemplary embodiment of a shoulder joint implant 1000. As shown, the shoulder joint implant 1000 can include a metaglene 1010, a glenosphere 1030, and an integrated collet and central bone screw 1050. Accordingly, the integrated collet and central bone screw 1050 can allow surgeons to add a bone screw down the center axis of the metaglene component as a single unitary component in one step, while maintaining backwards compatibility with existing glenosphere components.

**[0067]** Except as described below or as will be readily appreciated by one having ordinary skill in the art, the metaglene 1010 and the glenosphere 1030 are substantially similar to the metaglene 210 and the glenosphere 250 described above with respect to FIGS. 2A-9. A detailed description of the structure and function thereof is omitted here for the sake of brevity. The shoulder joint implant 1000 can include any one or more of the features of the shoulder joint implant 200.

**[0068]** As shown in the illustrated embodiment, the integrated collet and bone screw 1050 can include a collet portion 1052, a proximal screw head 1054, a spherical or conical shoulder portion 1056, an unthreaded neck portion 1058, a distal threaded portion 1060, and a distal tip 1062. Except as described below or as will be readily appreciated by one having ordinary skill in the art, the shoulder portion 1056, an unthreaded neck portion 1058, a distal threaded portion 1060, and a distal tip 610 are substantially similar to the spherical or conical shoulder portion 604, the unthreaded neck portion 606, the distal threaded portion 608, and the distal tip 610 of the screw 270 described above with respect to FIGS. 6A-6C. A detailed description of the structure and function thereof is omitted here for the sake of brevity.

**[0069]** In some embodiments, the collet portion 1052 can be fixedly coupled to the proximal head 1054 of the screw to form the integrated collet and central bone screw 1050. For example, the collet portion 1052 can mechanically attached, welded, bonded, or attached in any other manner of ways to the proximal screw head 1054. Alternatively, the collet portion 1052 can be integrally formed on the proximal screw head 1054, e.g., using a three dimensional (3D) printing technique.

**[0070]** As shown in the illustrated embodiment of FIG. 10C, the collet portion 1052 can have a substantially hollow cylindrical body 1070. The collet portion 1052 can include open-ended slots 1072 spaced about the circumference of the cylindrical body 1070 to form radially compressible arms 1074 that extend proximally from an annular base portion 1076. The radially compressible arms 1074 of the collet portion 1052 can be configured to facilitate insertion and/or removal of the collet by flexing in response to changes in the diameter of the throughbore of the metaglene 1010.

**[0071]** In some embodiments, each of the proximally-

extending arms 1074 can have an inner threaded portion 1078 configured to at least partially surround and threadably engage a locking screw 1032 of the glenosphere 1030 or other prosthetic component. In some embodiments, the collet portion 1052 can include an annular protrusion, sometimes referred to herein as a lip 1080. As shown, the lip 1080 can be disposed or segmented across one or more of the arms 1074 and configured to engage an annular groove or recess defined within the throughbore of the metaglene (e.g., catch 324 of FIG. 4C), thereby securing the collet 230 in place at a predetermined depth. In some embodiments, the collet portion 1052 can include a tapered or conical proximal bearing surface 1082 at the proximal end of each arm 1074. As described in more detail below with respect to FIG. 12A and 12B, the conical or tapered bearing surface 1082 can be used to facilitate removal of the collet.

**[0072]** In some embodiments, the integrated collet/central bone screw 1050 can be laterally or proximally inserted into the central throughbore of the metaglene 1010 and driven into the bony anatomy of the glenoid in as single unitary component. For example, in some embodiments, the integrated collet and central bone screw 1050 can be advanced into the central throughbore of the metaglene (e.g., 310 of FIG. 4C) until the distal tip 1062 of the screw 1050 reaches the threaded distal portion (e.g., 316 of FIG. 4C) of the central throughbore. Once the integrated collet/central bone screw 1050 reaches the threaded distal portion 316, the integrated collet/central bone screw can be screwed loosely through the threaded distal portion to advance the unitary component into bony anatomy of the glenoid.

**[0073]** In some embodiments, as the collet portion 1052 of the unitary component enters the throughbore, the inner sidewall of the throughbore (e.g., 310s of FIG. 4C) bears against the lip 1080 of collet portion 1052 and thereby causes the radially compressible arms 1074 of the collet to flex inward while remaining in contact with the wall. The lip 1080 of the collet portion 1052 can be an annular protrusion disposed across one or more of the arms 1074 and configured to engage an annular groove or catch (e.g., 324 of FIG. 4C) defined horizontally along the inner sidewall 310s of the throughbore 310.

**[0074]** In some embodiments, when the lip 1080 of the collet portion 1052 reaches the location of the catch 324, the radial compression force applied by the inner sidewall 310s can release and cause the collet arms 1074 to flex outward such that the lip snaps into or otherwise mates within the catch. In some embodiments, the engagement of the lip 1080 of the collet portion 1052 and the catch 324 can create an audible and/or tactile cue (e.g., a "click") to notify the surgeon that the collet has reached the desired depth. With the collet portion 1052 secured at the predetermined depth, a glenosphere 1030 or other prosthetic component can be screw or otherwise attached to the metaglene 1010.

**[0075]** FIG. 11 illustrates an exemplary embodiment of a method 1100 of implanting the shoulder joint implant

1100 in a patient's scapula. In the illustrated embodiment, the shoulder joint implant 1000 can be implanted as part of a reverse shoulder reconstruction surgery. The method 1100 may include operations in blocks 910, 920, 930, 940, and 970 that are described above with reference to FIG. 9. Accordingly, a detailed description of these operations is omitted here for the sake of brevity.

**[0076]** At block 1110, the integrated collet and central bone screw 1050 (not visible) can be laterally or proximally inserted into the central throughbore defined in the metaglene 1010 through the post and driven into the glenoid through an opening at the distal end of the post of the metaglene 1010. In some embodiments, the integrated collet-bone screw 1050 can be coupled to the distal head of a delivery tool 770. The tool 770 can be operated by the surgeon to push the integrated collet-bone screw 1050 into the central throughbore (e.g., 310, not visible) and then to rotate integrated collet-bone screw 1050 until the bone screw portion 1060 (not visible) is secured to the glenoid 912 as previously described with respect to FIGS. 10A-10C.

**[0077]** FIGS. 12A, 12B, and 12C provide for an exemplary embodiment of a collet removal tool 1200. As shown the collet removal tool 1200 can include a handle portion 1210 and a distal head 1220. For example, in some embodiments, the collet removal tool 1200 can be inserted laterally or proximally into the central throughbore 310 of the metaglene 210. An operator can rotate or otherwise actuate the handle portion 1210 such that the distal head 1220 engages the inner threaded portion 510 of the proximally extending arms 506 of the collet 230.

**[0078]** In some embodiments, the distal head 1220 can include a first engagement mechanism 1232 having a threaded external surface configured to engage the thread portion 510 of the collet 230 as the head is rotated. In some embodiments, the first engagement mechanism 1232 can be a threaded cylindrical body disposed at a distal most end of the head 1220.

**[0079]** As previously discussed with respect to FIG. 4C, a lip 514 of the collet 230 can be secured within a catch 324 or other recessed sidewall portion defined in the throughbore 310. To disengage the lip 514 from the catch 324, the distal head 1220 can include a second engagement mechanism 1234 proximal to the first engagement mechanism 1232. As the head of the tool 1220 is rotated and advanced laterally or proximally, the second engagement mechanism 1234 can be configured to radially compress the arms 506 of the collet 230 radially inward away from the catch 324 in the throughbore.

**[0080]** For example, in some embodiments, the second engagement mechanism 1234 can have a distal-facing bearing surface that conforms to the shape or profile at the proximal end of the collet 230. As previously described with respect to FIG. 5, the collet 230 can have a conical or tapered bearing surface 516 at the proximal end of each arm 506 to facilitate removal. Thus, in some embodiments, the second engagement mechanism 1234 can be configured to have a distal-facing bearing

surface of the distal head 1220 that complements the collet's conical or tapered bearing surface 516.

**[0081]** As shown in the illustrated embodiment of FIG. 12C, as the operator continues to rotate the handle portion 1210, the head of the tool 1220 can advance laterally or proximally until the distal facing feature surface of the second engagement mechanism 1234 engages the conical or tapered bearing surface 516 of the collet. As the head 1220 further advances, the second engagement mechanism 1234 can radially compress the arms of the collet away from the catch 324 or other recessed sidewall portion and thereby release the lip 514 of collet 230 from the catch. Once the lip 514 of the collet 230 is released from the catch 324, the distal head 1220 can be pulled proximally out of the central throughbore 310 along with the collet which is threadably attached to the first engagement mechanism 1232.

**[0082]** Although the collet removal tool 1200 is described above for removing a collet 230 which is separate from the bone screw 270, one of ordinary skill in the art will recognize that the collet remove tool 1200 can be used to remove an integrated collet/bone screw 1050 from with the central throughbore of a metaglene in a substantially similar manner.

**[0083]** FIGS. 13A and 13B are schematic illustrations of an exemplary embodiment of a shoulder joint implant 1300 having a central bone screw integrated into the metaglene. In the illustrated embodiment, the shoulder joint implant 1300 can include a metaglene 1310 and a glenosphere 1350. The metaglene 1310, sometimes referred to herein as a monoblock construct, can include platform 1312 having a proximal-facing surface 1314 and a distal-facing surface 1316. Peripheral bone screws (not shown) can be positioned in some or all of the peripheral screw holes 1318 defined in the platform 1312 and driven into the glenoid to fix the metaglene 1310 in place. In some embodiments, a bone screw portion 1320 can extend outwardly from the distal-facing surface 1316 of the platform 1312 along a central longitudinal axis of the metaglene 1310. As described in more detail with respect to FIG. 15, the bone screw portion 1320 can be screwed into the bony anatomy of the glenoid at the same time that the metaglene 1310 is seated onto the glenoid, and thereby reducing the number of steps needed to install the shoulder joint implant.

**[0084]** In some embodiments, the glenosphere 1350 can include a hemispherical body 1352 having a locking screw 1354 or other coupling element that extends outward from the distal surface 1356 of the hemispherical body 1352. Although the illustrated embodiment disclose fixing a glenosphere 1350 to the metaglene 1310, one of ordinary skill in the art will recognize the other prosthetic components can be coupled to the metaglene, such as but not limited to a glenoid component configured to replace or augment the glenoid surface of the scapula.

**[0085]** FIG. 14 is a schematic illustration of a cross section of the metaglene 1310 of FIGS. 13A and 13B having an integrated central bone screw portion 1320. In



the illustrated embodiment, the metaglene 1310 includes a central throughbore 1322 configured to extend from the proximal-facing surface 1314 of the platform 1312 and partially into the bone screw portion 1320. The locking screw 1354 of the glenosphere 1350 can be screwed directly into the central throughbore 1322 to draw the distal-facing surface 1356 of the glenosphere body 1352 onto the proximal-facing surface 1314 of the metaglene platform 1312. In some embodiments, a proximal end of the central throughbore 1322p can be configured to threadably engage central locking screw 1354 of the glenosphere 1350. As shown in the illustrated embodiment, the outer thread diameter of the bone screw portion 1320 can be greater at a proximal end portion 1320p than the outer thread diameter at a distal end portion 1320d in order to accommodate to the diameter of the locking screw 1354.

**[0086]** FIG. 15 illustrates an exemplary embodiment of a method 1500 for implanting the shoulder joint implant 1300 of FIGS. 13A and 13B into a patient's scapula. In the illustrated embodiment, the shoulder joint implant 1300 can be implanted as part of a reverse shoulder reconstruction surgery.

**[0087]** At block 1510, the metaglene 1310 having an integrated central bone screw portion, or monoblock construct, can be attached to a distal end of a monoblock delivery instrument 800. In some embodiments, the monoblock delivery instrument 800 can have a handle portion 810, a distal head 820, and a locking mechanism 830. The distal head 820 can be specifically adapted to engage one or more of the screw holes 1318 or other locking feature defined on the proximal face 1314 of the platform 1312.

**[0088]** At block 1520, the monoblock construct 1310 can be locked to the monoblock delivery instrument 800 using the locking mechanism 830. In some embodiments, the locking mechanism 830 can include a handle portion 832 and an elongated shaft 834 having a distal threaded head 834. The locking mechanism 830 can be laterally or proximally inserted through a cannula defined along a central axis of the handle portion 810 and the distal head 820 and received within the central throughbore 1322 (not visible) of the monoblock construct 1310. The handle portion 832 of the locking mechanism 830 can be rotated in a direction (e.g., clockwise) such that the threaded head 836 of the locking mechanism 830 threadably engages the central throughbore and thereby locks the monoblock construct 1310 to the distal head 820 of the monoblock delivery instrument 800.

**[0089]** At block 1530, the monoblock construct 1310 can be inserted into a hole drilled into the glenoid 912 of a patient's scapula 914. For example, as shown in the illustrated embodiment, the monoblock delivery instrument 800 can push the bone screw portion 1320 extending from the monoblock construct 1310 into the hole.

**[0090]** At block 1540, the monoblock construct 1310 can be seated onto the glenoid 912, such that the bone screw portion 1320 (not visible) is screwed into the gle-

noid vault (not visible) and the distal-facing surface 1316 (not visible) of the metaglene platform 1312 is seated on the bony surface of the glenoid 912. As shown in the illustrated embodiment, the monoblock delivery instrument 800 can be rotated in a tightening direction (e.g., clockwise) to screw the bone screw portion 1320 until a distal-facing surface 1316 (not visible) of the monoblock construct 1310 is seated onto the glenoid.

**[0091]** At block 1550, the peripheral screw holes 1318 of the platform 1312 of the monoblock construct 1310 can be aligned. In some embodiments, the handle portion 810 of the monoblock delivery instrument 800 can be rotated as needed in a clockwise and/or a counter clockwise direction to align the peripheral screw holes 1318 such that peripheral screws (not shown) can be inserted and driven through the screw holes in one or more of a superior, inferior, medial and/or lateral position with respect to the surface of the glenoid bone.

**[0092]** At block 1560, the handle portion 832 of the locking mechanism 830 can be rotated in a direction to unlock the monoblock construct 1310 from the distal head 820 of the monoblock delivery instrument 800. For example, as shown in the illustrated embodiment, the handle portion 832 of the locking mechanism 830 can be rotated counter-clockwise to disengage the threaded head 836 (not visible) of the locking mechanism 830 from the central throughbore (e.g., 1322, not visible) of the monoblock construct 1310 and thereby unlock the monoblock construct 1310 from the distal head 820 of the monoblock delivery instrument 800.

**[0093]** At block 1570, the monoblock delivery instrument 800 can be removed from the monoblock construct 1310 by proximally pulling the instrument away from the construct. After the monoblock inserter instrument is removed, peripheral screws can be inserted and driven through the peripheral screw holes 1318 in the platform 1312 of the monoblock construct 1310. Alternatively or additionally, the glenosphere 1350 (not shown) can be secured to the platform 1312 of the monoblock construct 1310 by screwing the locking screw 1354 (not shown) into the threaded portion of the central throughbore 1322 (not shown).

**[0094]** The preceding description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the claims. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the scope of the claims. Thus, the present disclosure is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the following claims and the principles and novel features disclosed herein. All publications and references cited herein are expressly incorporated herein by reference in their entirety.

**Claims****1.** A shoulder joint implant, comprising:

a first prosthetic component that includes a coupling element protruding from a distal bearing surface thereof;

a baseplate configured to secure the first prosthetic component to bone, the baseplate including a post protruding from a distal bearing surface thereof and defining a throughbore that extends along a proximal-distal axis of the post; and

a removable collet disposed within the throughbore and configured to engage the coupling element of the first prosthetic component such that the first prosthetic component is fixedly coupled to the baseplate.

**2.** The implant of claim 1, wherein the collet is dimensioned to engage the coupling element, the coupling element having a diameter that is less than a diameter of the throughbore of the baseplate.**3.** The implant of claim 1, further comprising:

a central bone screw comprising a proximal head and a distal threaded portion, and wherein the throughbore of the baseplate is dimensioned to facilitate insertion of the central bone screw having a diameter that is greater than a diameter of the coupling element of the first prosthetic component.

**4.** The implant of claim 3, wherein the collet is dimensioned to engage the coupling element, the coupling element having a diameter that is less than a diameter of the central bone screw.**5.** The implant of claim 3, wherein the collet and the central bone screw are separate components, the collet being disposed within the throughbore of the baseplate proximal to the proximal head of the bone screw.**6.** The implant of claim 5, wherein the collet is disposed within the throughbore of the baseplate after the central bone screw is laterally inserted into the throughbore.**7.** The implant of claim 1, wherein the implant is devoid of a central bone screw.**8.** The implant of claim 3, wherein the collet is coupled to the proximal head of the central bone screw.**9.** The implant of claim 3, wherein the proximal head of the central bone screw includes a shoulder portion

that has at least one of a spherical shape and conical shape, and wherein an inner sidewall of the throughbore at the distal end of the post comprises a threaded sidewall portion configured to support the shoulder portion of the central bone screw.

**10.** The implant of claim 3 wherein the distal threaded portion of the central bone screw extends through a threaded opening at the distal end of the post and is configured to secure the baseplate to bone.**11.** The implant of claim 1, wherein a plurality of screw holes are defined in the baseplate adjacent the throughbore and the implant further comprises a plurality of peripheral bone screws disposed through the plurality of screw holes and configured to secure the baseplate implant to bone.**12.** The implant of claim 1, wherein the collet comprises a plurality of proximally-extending arms that are radially compressible to facilitate at least one of insertion and removal of the collet in the throughbore of the baseplate.**13.** The implant of claim 12, wherein one or more of the plurality of arms comprise a lateral protrusion configured to engage an annular recessed portion of an inner sidewall of the throughbore when the arms are not compressed, thereby fixing the removable collet at a predetermined depth in the throughbore of the baseplate.**14.** The implant of claim 12, wherein the collet includes one or more keys protruding from one or more of the arms of the collet, the one or more keys being configured to engage with one or more keyways defined longitudinally along an inner sidewall of the throughbore of the baseplate to align and guide the collet into the baseplate.**15.** The implant of claim 14, wherein the one or more keys are configured to engage with the one or more keyways defined along the inner sidewall of the throughbore to resist rotation of the collet while disposed within the throughbore of the baseplate.**16.** The implant of claim 14, wherein the one or more keys of the collet are configured to engage with the one or more keyways along the inner sidewall of the throughbore to form a locking mechanism that provides a torsional resistive force that counteracts a torque imparted by the coupling element of the first prosthetic component while screwing the coupling element of the first prosthetic component into the collet to form a taper lock between the first prosthetic component and the baseplate or while unscrewing the coupling element out of the collet to break the taper lock between the first prosthetic component

and the baseplate.

17. The implant of claim 14, wherein the length of the one or more keyways define a distal most depth at which the removable collet is seated in the through-  
bore of the baseplate. 5
18. The implant of claim 17, wherein an annular recessed portion is defined in the inner sidewall of the throughbore and configured to capture a lateral protrusion from one or more of the plurality of arms of the collet when inserted into the throughbore, wherein the distance between the annular recessed portion and the distal most depth of the one or more keyways is a predefined distance that is greater than the height of the collet such that the collet bottoms out at the distal end of the one or more keyways when the coupling element of the glenosphere component is unscrewed from the collet. 10 15 20
19. The implant of claim 12, wherein the one or more compressible arms of the removable collet have a proximal ramped bearing surface configured to bear against a counterpart bearing surface of a prosthetic implant tool, the one or more compressive arms being radially compressed in response to the counterpart bearing surface of the prosthetic implant tool bearing against the proximal ramped bearing surface, thereby disengaging the lateral protrusion of the one or more compressible arms from the recessed portion of the inner sidewall of the through-  
bore. 25 30
20. The implant of claim 1, wherein the first prosthetic component is a glenosphere component having an integrated locking screw protruding from a distal bearing surface thereof. 35

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**FIG. 1A**  
PRIOR ART

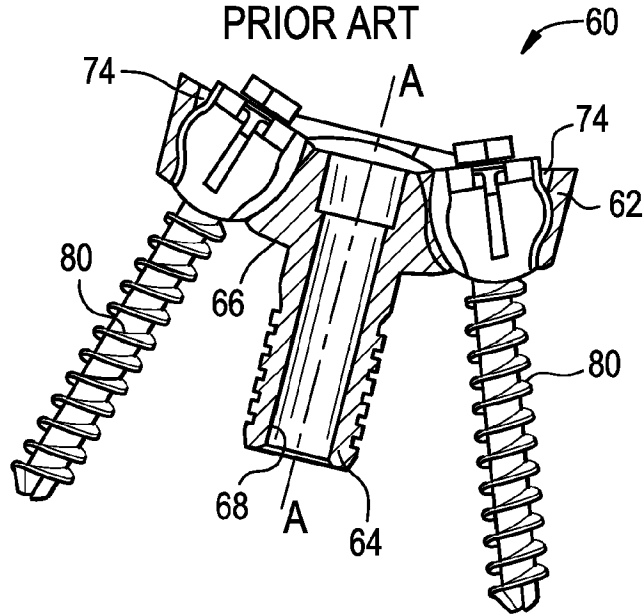


**FIG. 1B**  
PRIOR ART

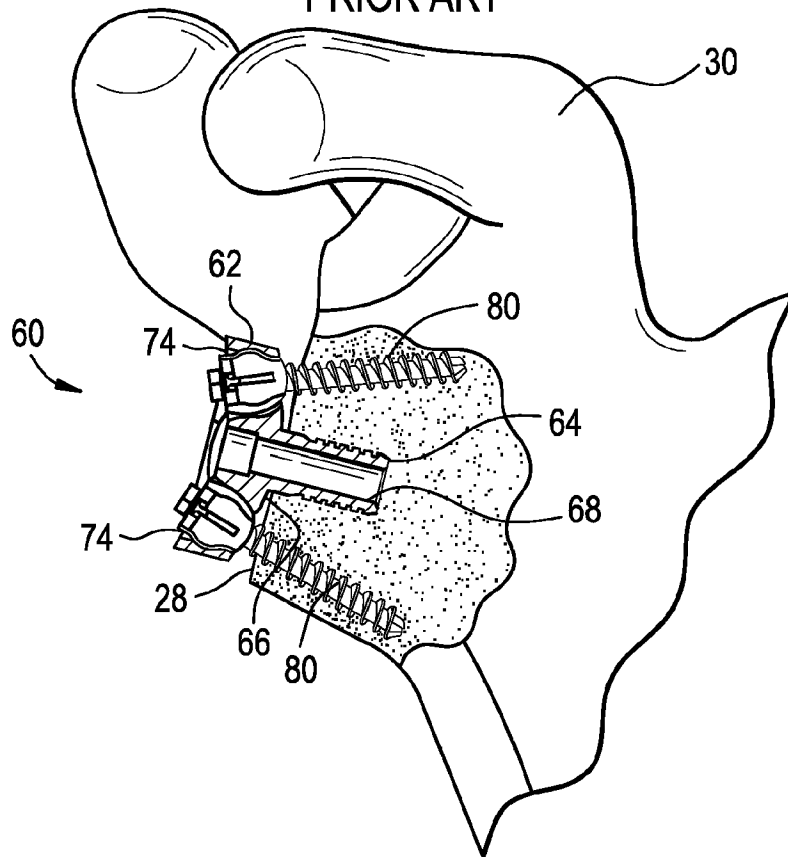


FIG. 2A

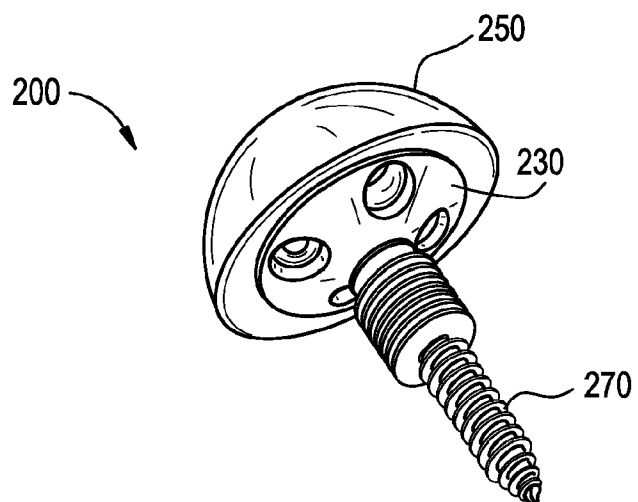


FIG. 2B

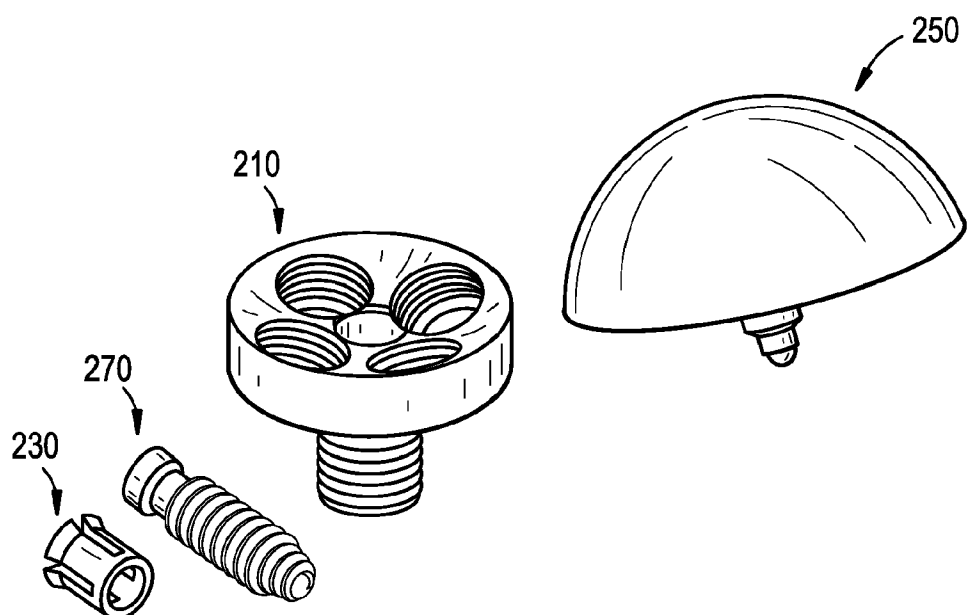


**FIG. 3**

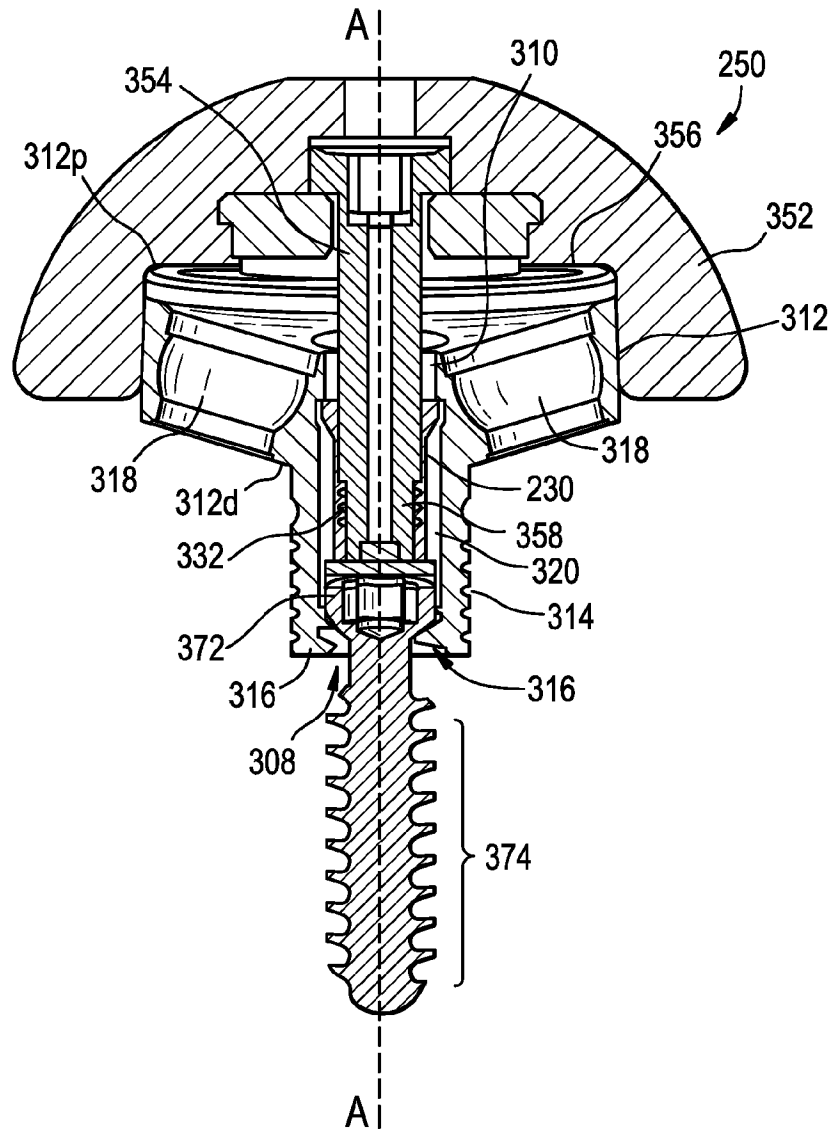


FIG. 4A

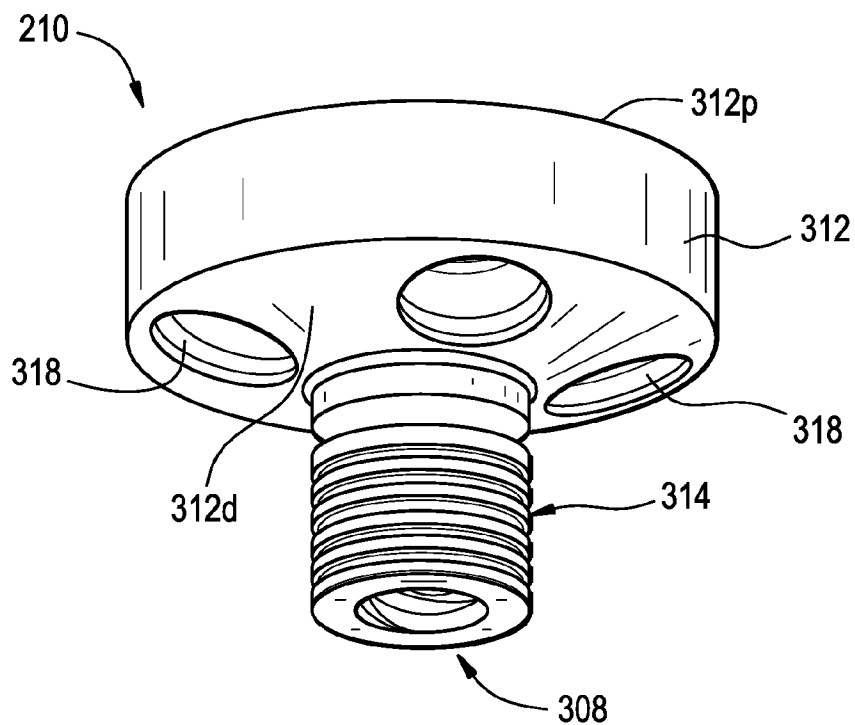


FIG. 4B

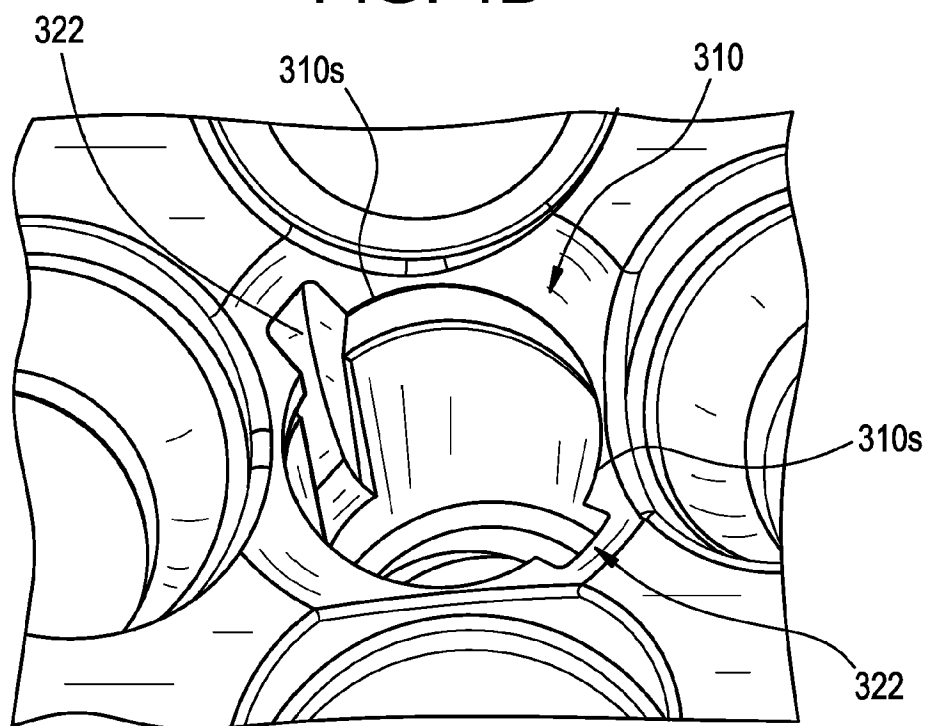


FIG. 4C

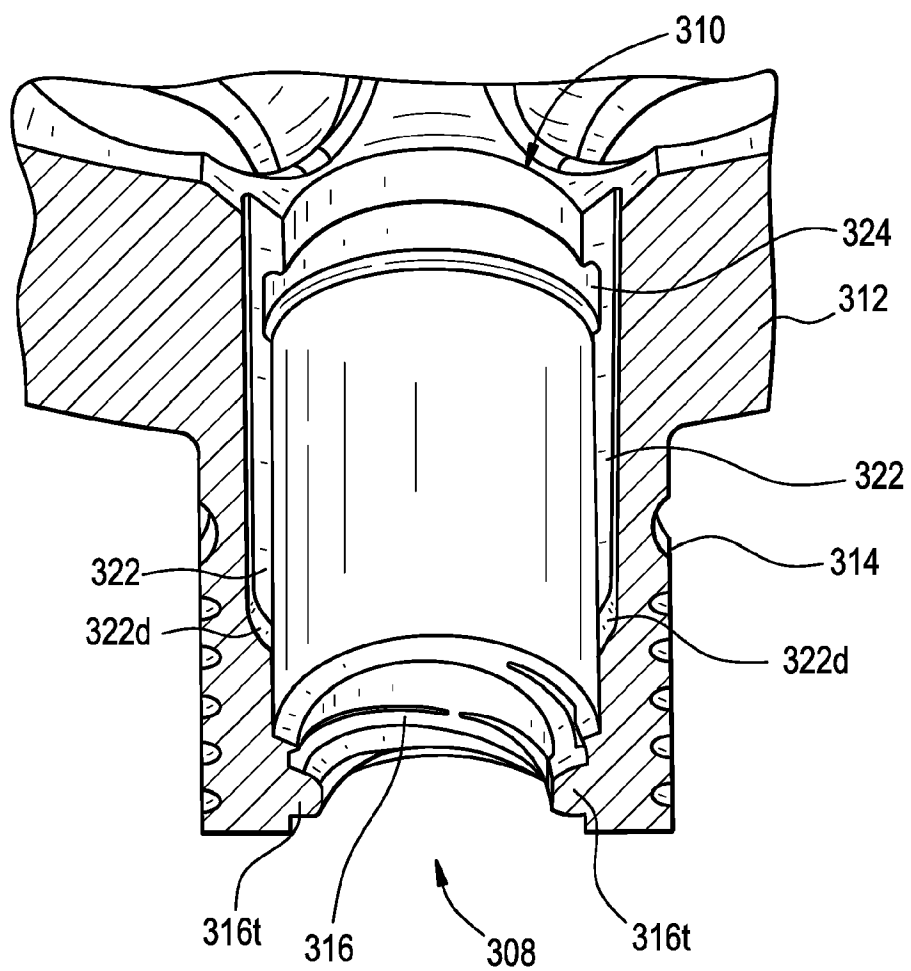




FIG. 5

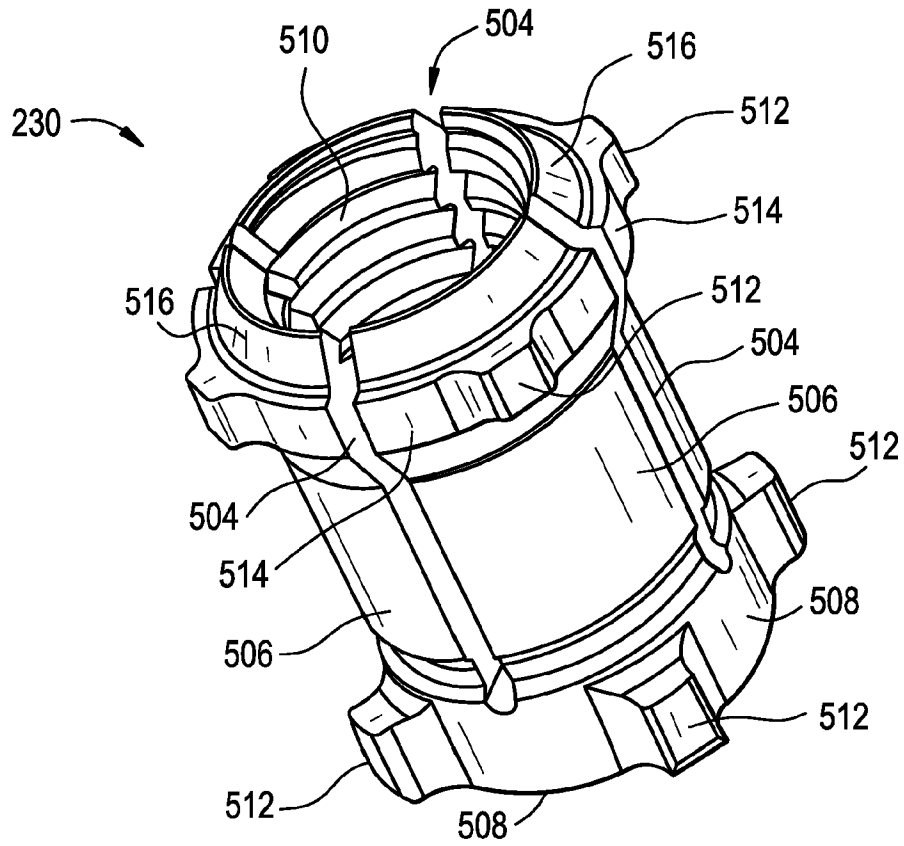


FIG. 6A

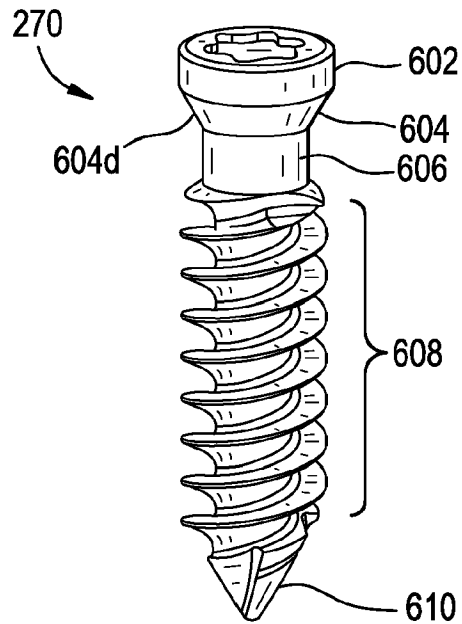


FIG. 6B

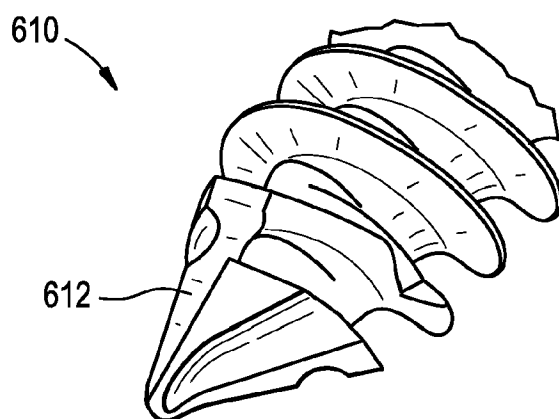


FIG. 6C

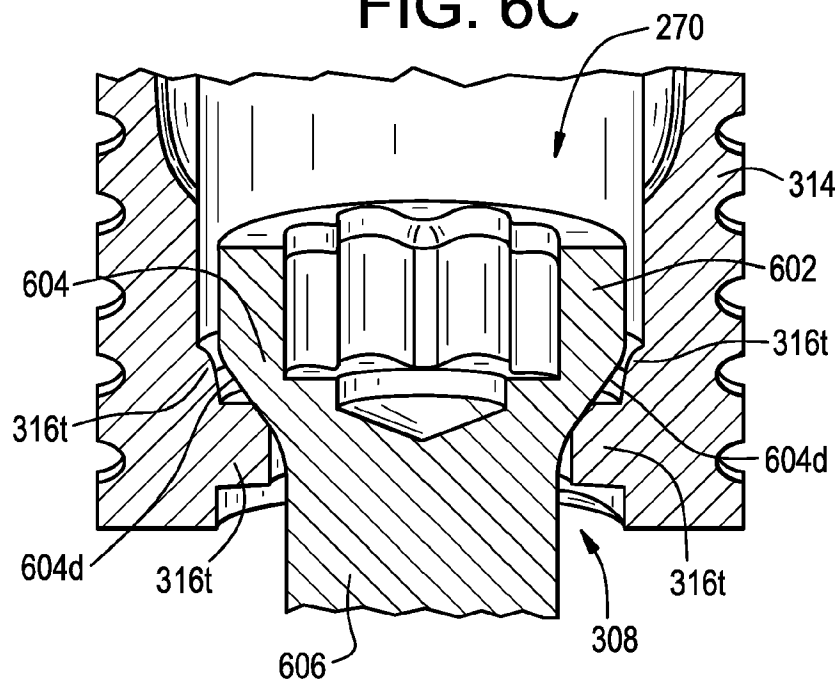


FIG. 7

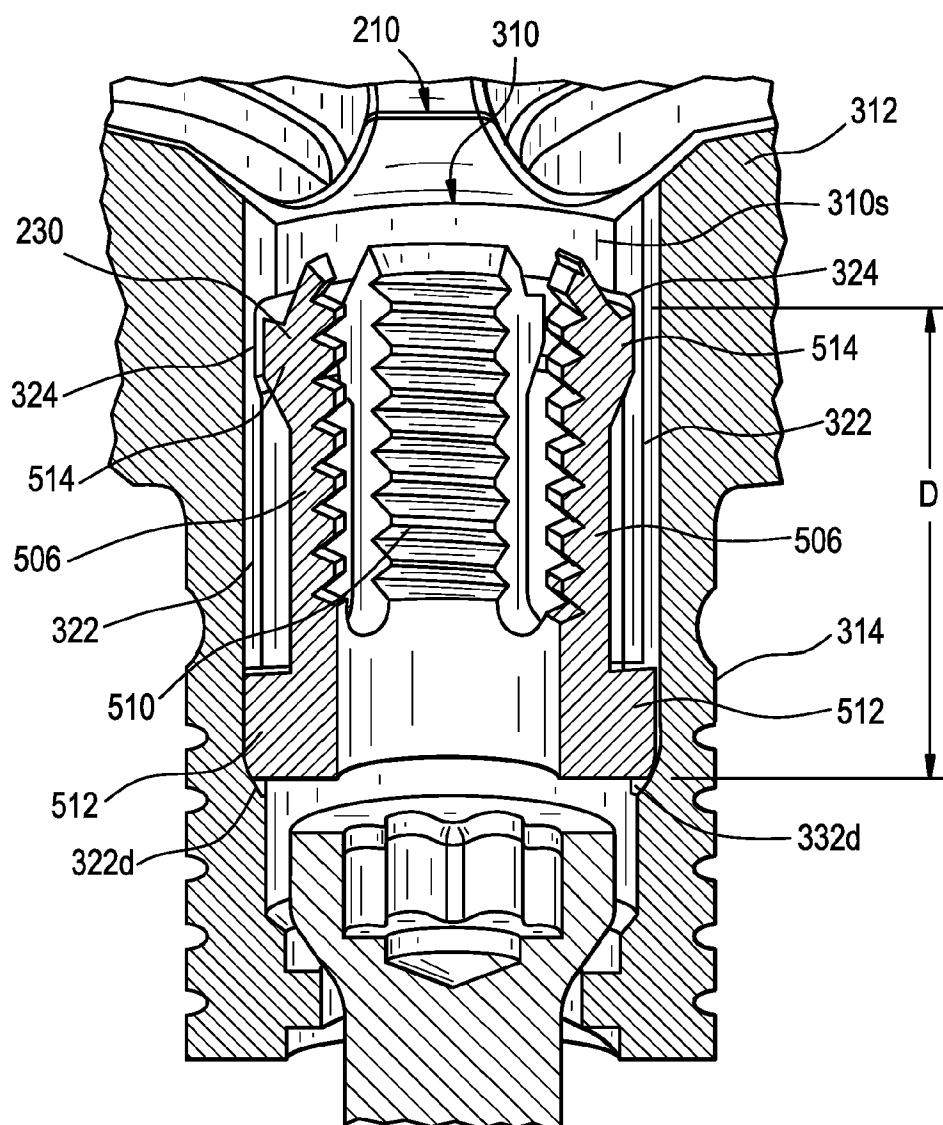


FIG. 8

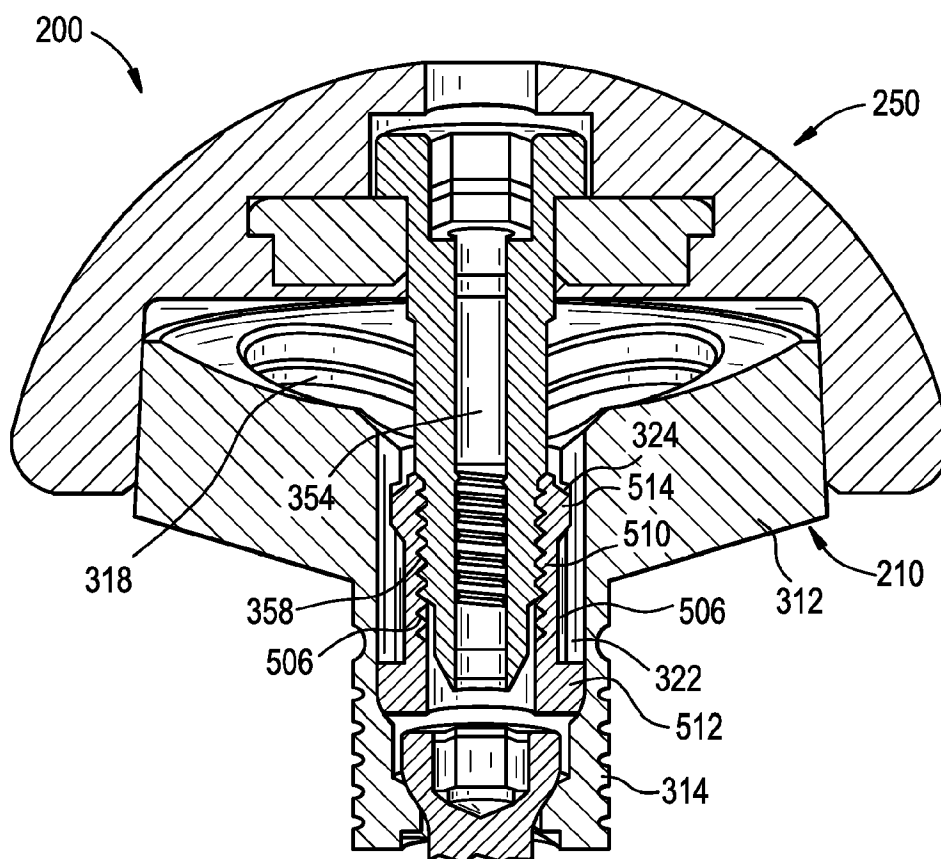


FIG. 9

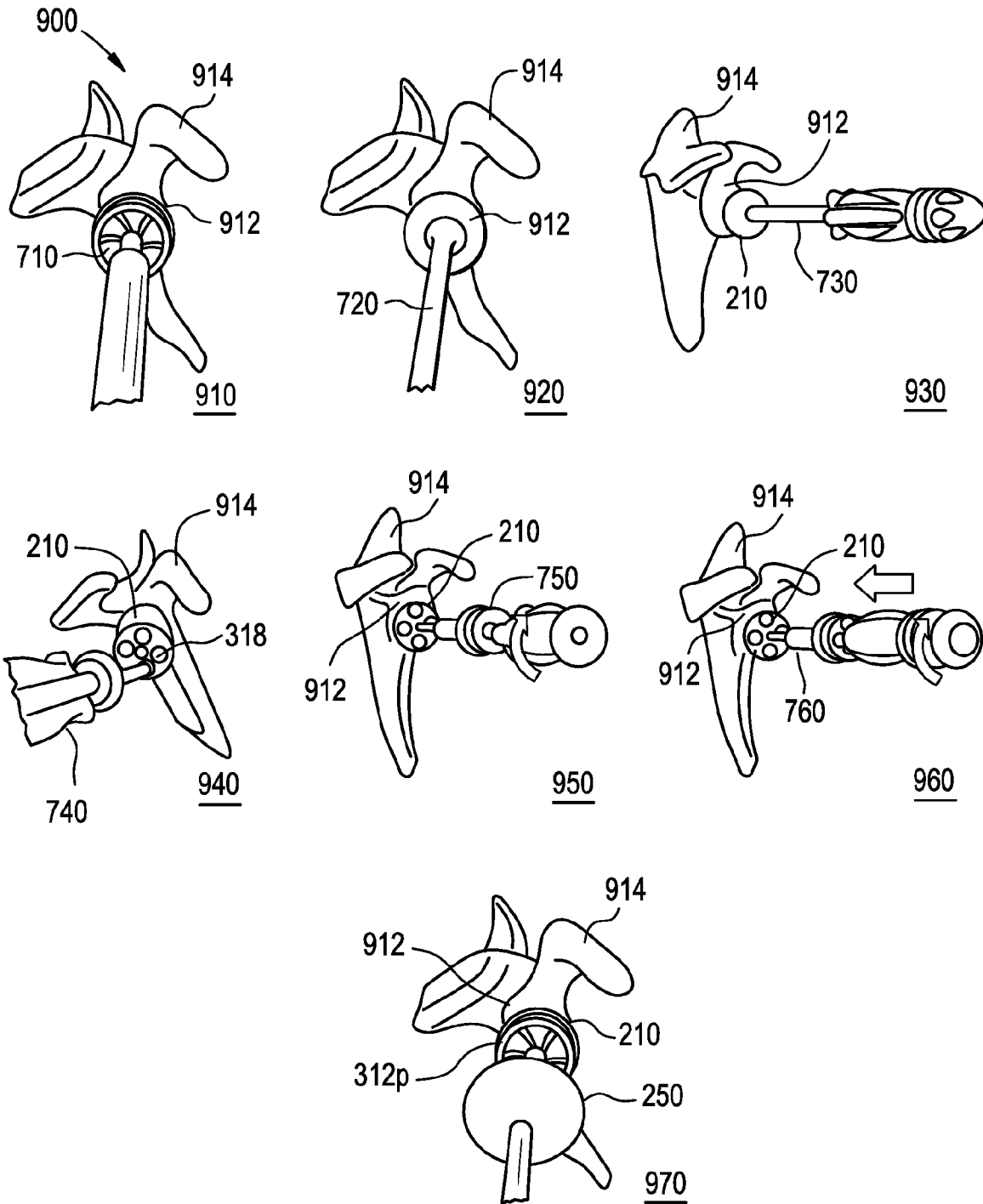


FIG. 10A

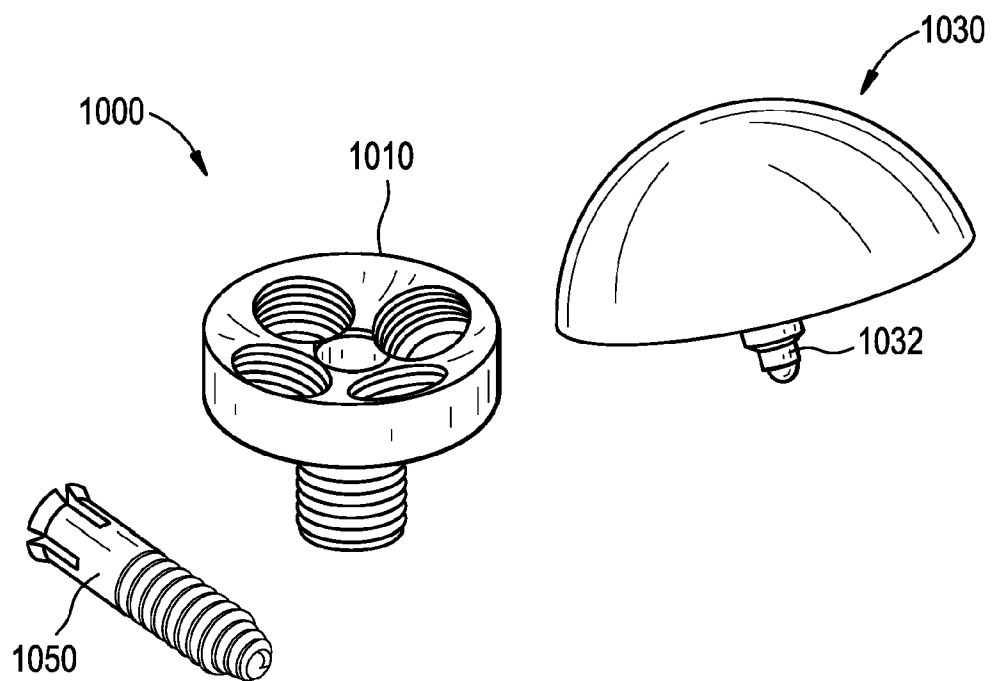


FIG. 10B

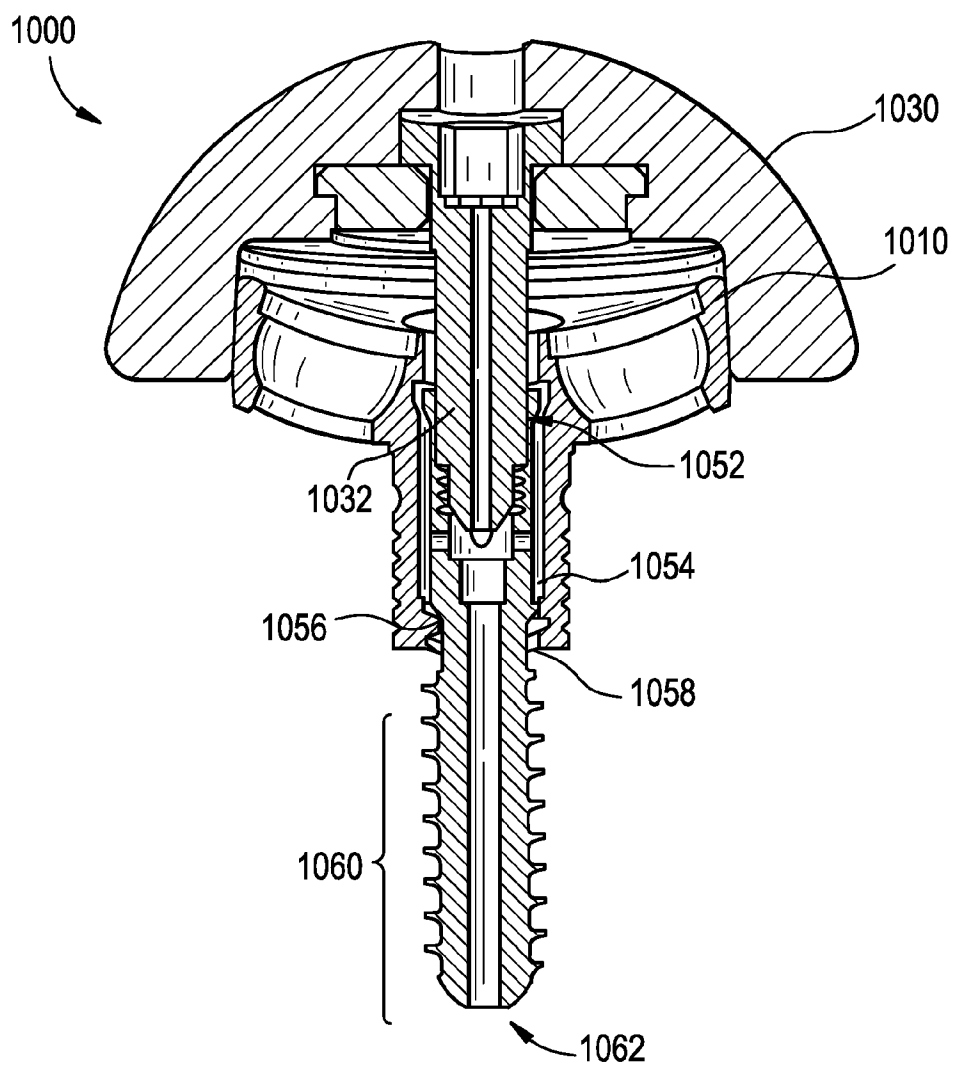


FIG. 10C

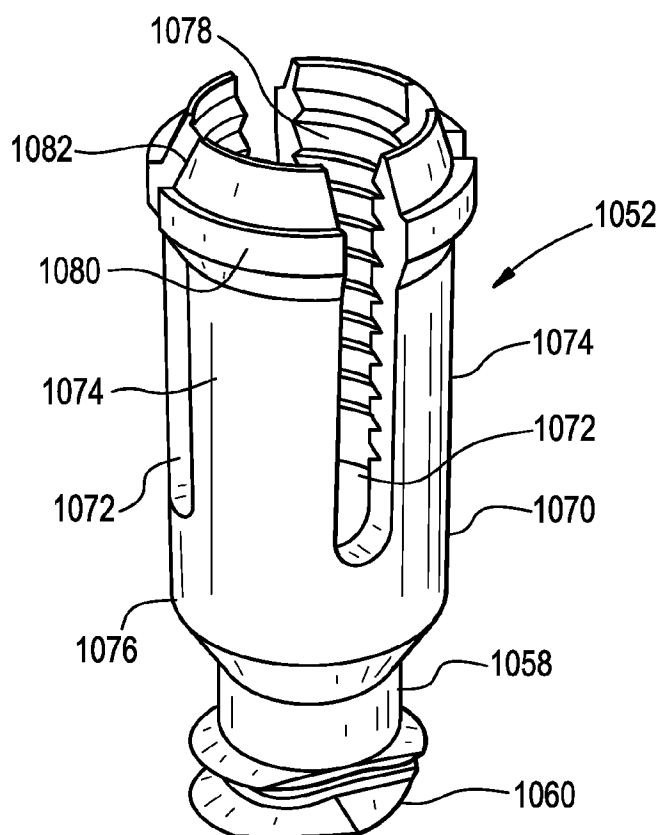




FIG. 11

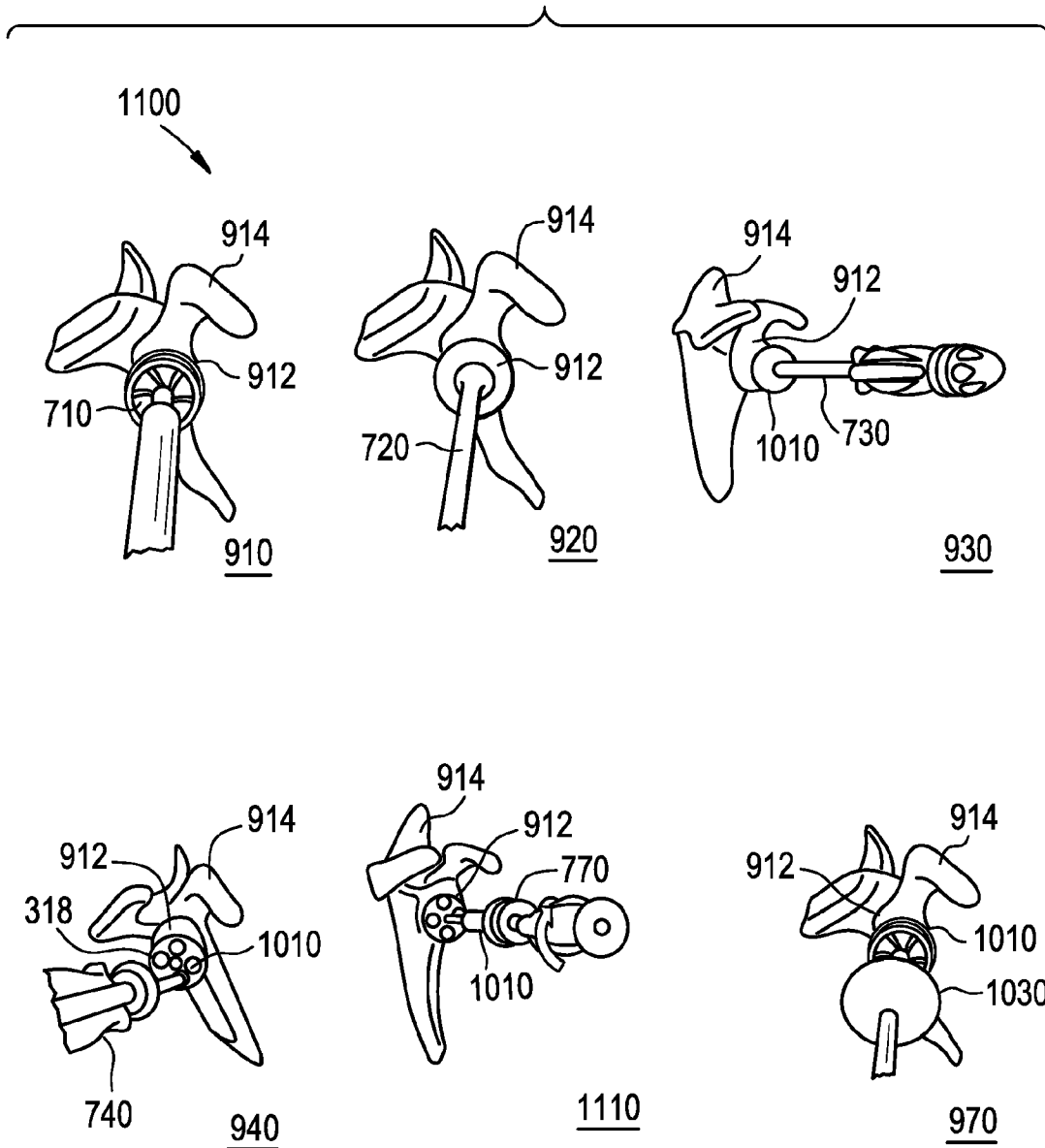


FIG. 12A

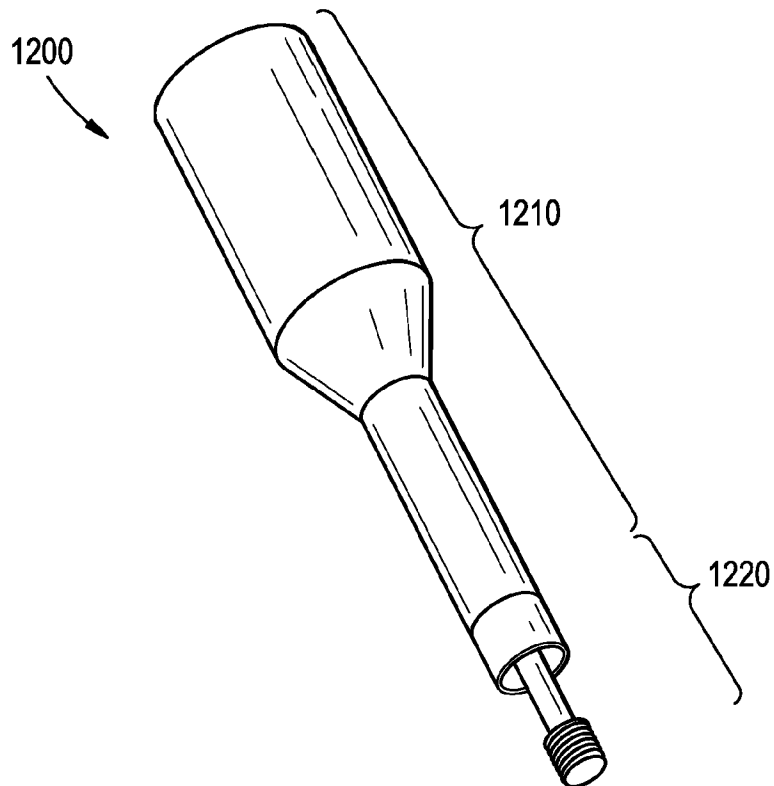


FIG. 12B

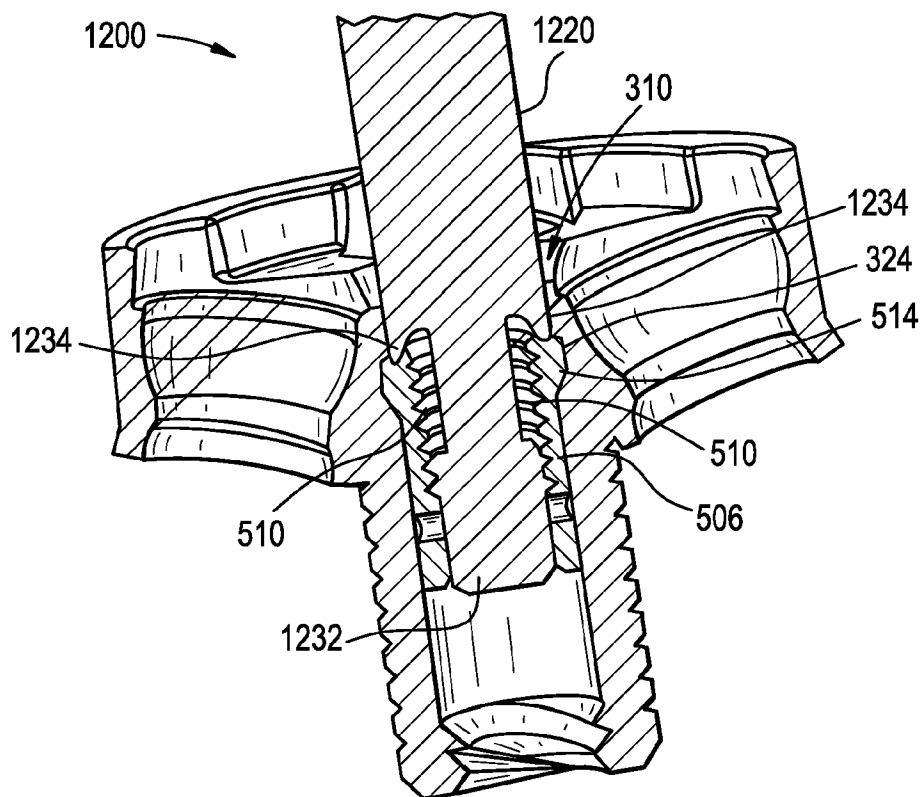


FIG. 12C

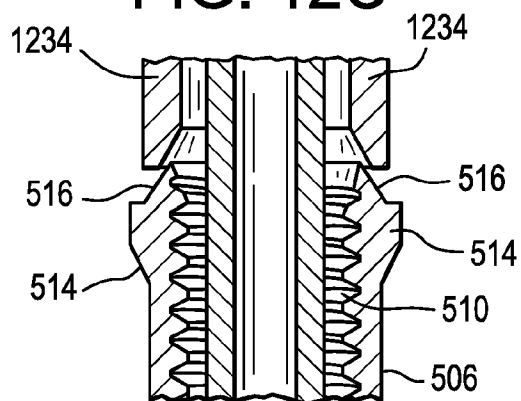


FIG. 13A

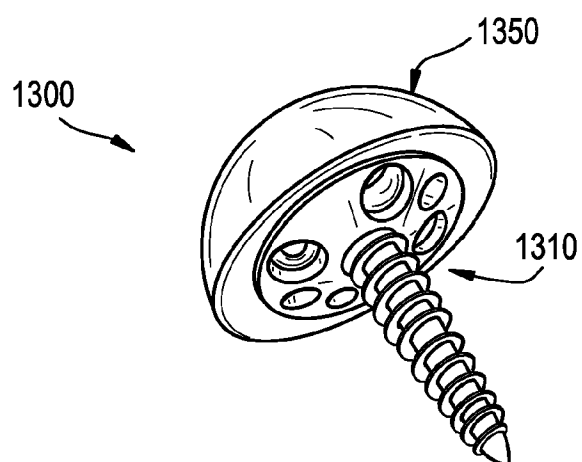


FIG. 13B

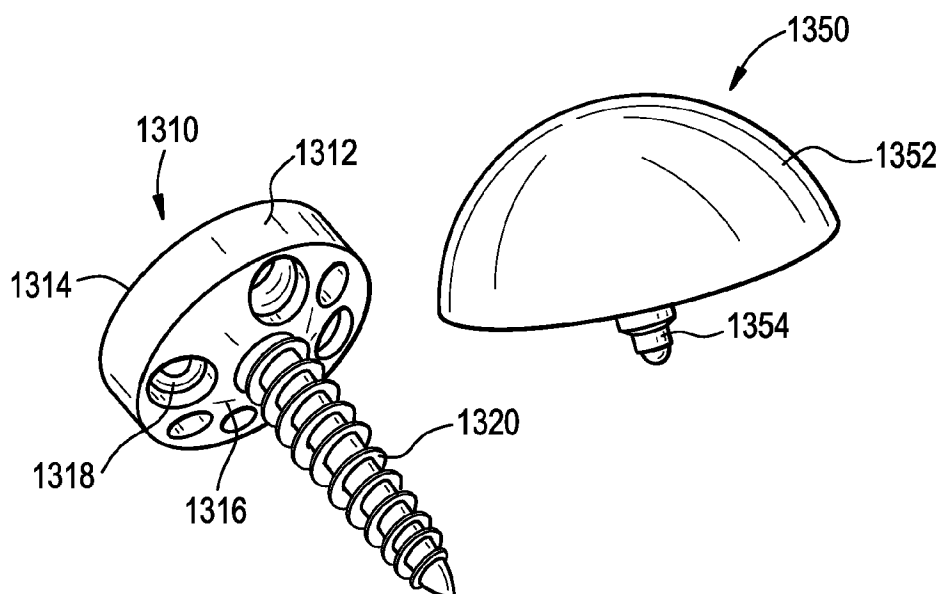


FIG. 14

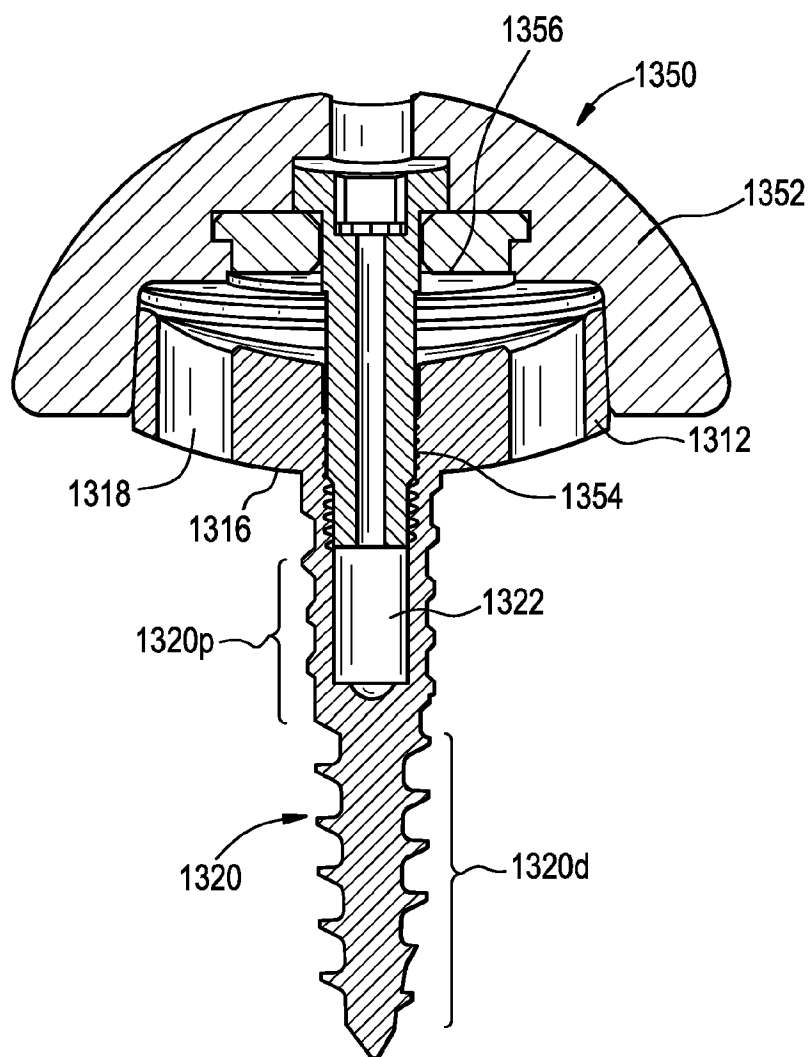
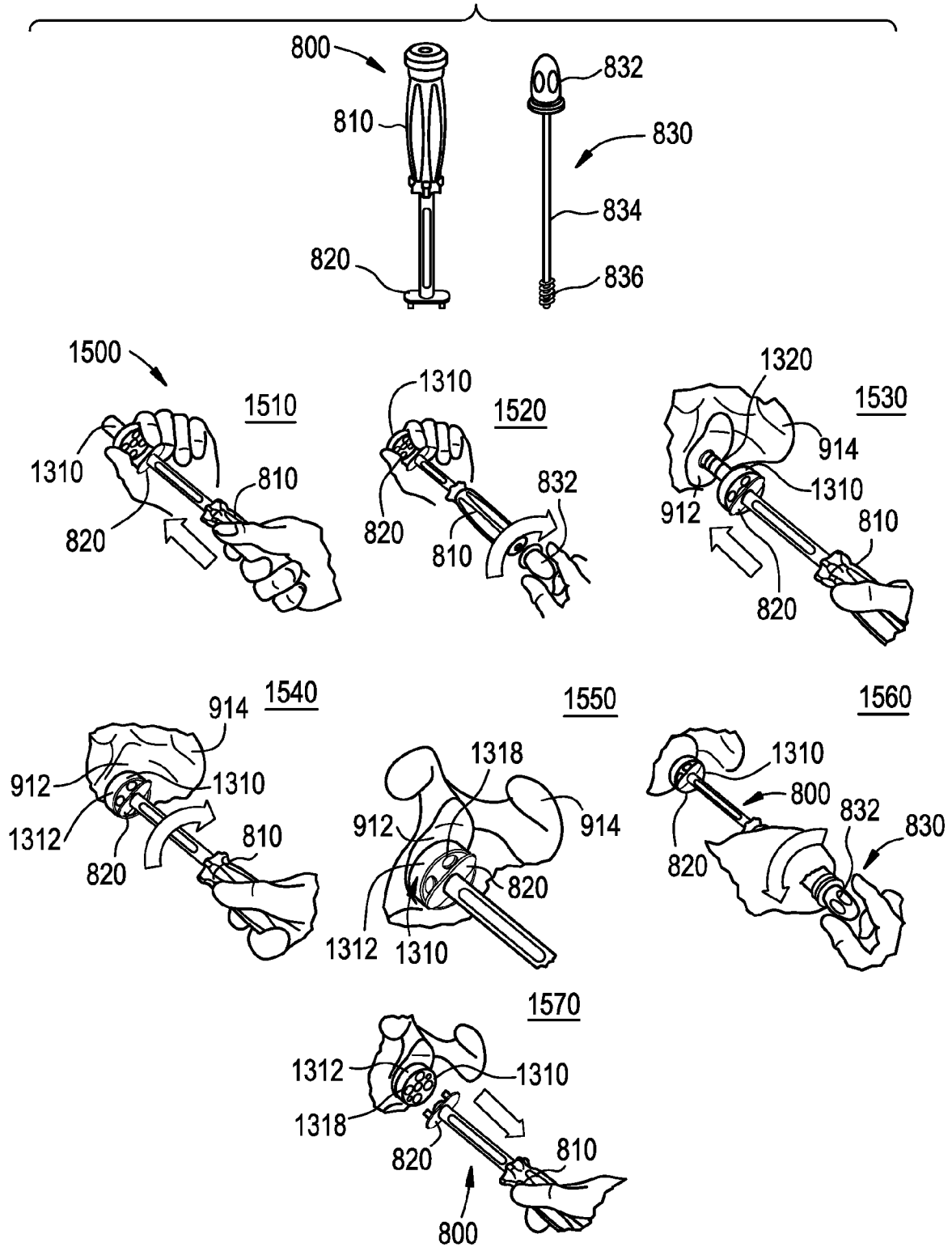


FIG. 15





## EUROPEAN SEARCH REPORT

Application Number  
EP 19 18 8150

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                               |                                                     |                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                                                 | Relevant to claim                                   | CLASSIFICATION OF THE APPLICATION (IPC) |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | WO 2013/086440 A1 (CLEVELAND CLINIC FOUNDATION [US]; IMDS CORP [US])<br>13 June 2013 (2013-06-13)                                                             | 1-7,<br>9-13,20                                     | INV.<br>A61F2/40                        |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | * paragraph [0160] - paragraph [0167] *<br>* paragraph [0312] - paragraph [0318] *<br>* paragraph [0324] - paragraph [0325] *<br>* figures 1A-3,91-93,97,98 * | 8,14-19                                             |                                         |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 2008/294268 A1 (BAUM INES [DE] ET AL)<br>27 November 2008 (2008-11-27)<br>* paragraph [0087] - paragraph [0092] *<br>* figures 7,8 *                       | 1,2,7                                               |                                         |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 2012/253467 A1 (FRANKLE MARK [US])<br>4 October 2012 (2012-10-04)<br>* paragraph [0144] *<br>* figures 51-53,59 *                                          | 1,2,7,20                                            |                                         |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 2010/161066 A1 (IANNOTTI JOSEPH P [US] ET AL)<br>24 June 2010 (2010-06-24)<br>* abstract *<br>* figures 2-4 *                                              | 1                                                   |                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                               |                                                     | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                               |                                                     | A61F                                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                               |                                                     |                                         |
| Place of search<br>Munich                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                               | Date of completion of the search<br>10 October 2019 | Examiner<br>Storer, John                |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                                               |                                                     |                                         |

EPO FORM 1503 03.02 (P04C01)

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 18 8150

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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10-10-2019

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| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| WO 2013086440 A1                          | 13-06-2013          | AU 2012321093 A1           | 27-06-2013          |
|                                           |                     | EP 2787932 A1              | 15-10-2014          |
|                                           |                     | WO 2013086440 A1           | 13-06-2013          |
| -----                                     |                     |                            |                     |
| US 2008294268 A1                          | 27-11-2008          | AU 2006314835 A1           | 24-05-2007          |
|                                           |                     | CA 2629959 A1              | 24-05-2007          |
|                                           |                     | EP 1787603 A1              | 23-05-2007          |
|                                           |                     | EP 1951161 A1              | 06-08-2008          |
|                                           |                     | ES 2476044 T3              | 11-07-2014          |
|                                           |                     | US 2008294268 A1           | 27-11-2008          |
|                                           |                     | WO 2007057054 A1           | 24-05-2007          |
| -----                                     |                     |                            |                     |
| US 2012253467 A1                          | 04-10-2012          | US 2012253467 A1           | 04-10-2012          |
|                                           |                     | US 2014243986 A1           | 28-08-2014          |
|                                           |                     | US 2017095339 A1           | 06-04-2017          |
|                                           |                     | US 2019151103 A1           | 23-05-2019          |
| -----                                     |                     |                            |                     |
| US 2010161066 A1                          | 24-06-2010          | EP 2201912 A1              | 30-06-2010          |
|                                           |                     | US 2010161066 A1           | 24-06-2010          |
| -----                                     |                     |                            |                     |

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82



## Bibliographic Data

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Foreign Priority claimed: ☐ Yes ☒ No

35 USC 119 (a-d) conditions met: ☐ Yes ☒ No ☐ Met After Allowance

Verified and Acknowledged: /ANN SCHILLINGER/

Examiner's Signature

Initials

Title: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

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| FILING or 371(c) DATE | CLASS | GROUP ART UNIT | ATTORNEY DOCKET NO. |
|-----------------------|-------|----------------|---------------------|
| 11/22/2022            | 623   | 3774           | SHOLD.013C1         |
| RULE                  |       |                |                     |

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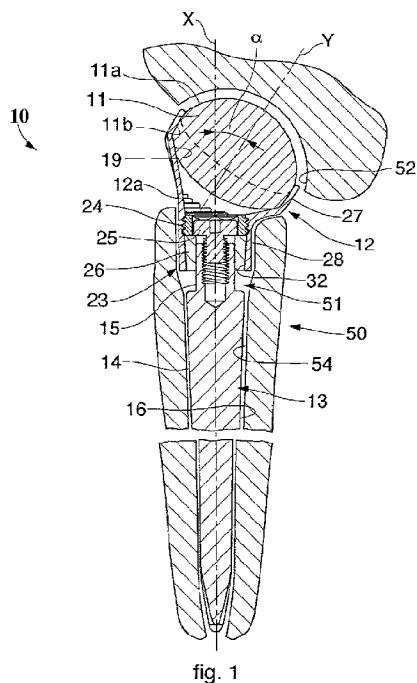
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(57) Abstract: A modular humeral prosthesis suitable for implant in a humeral seating (51) of a humerus (50) comprises an articulation component (11, 111), a distal joint element (13, 113) able to be inserted into said humeral seating (51) along an insertion axis (X), and an adapter body (12) provided with a support (12a) positionable in the humeral seating (51) and that has a coupling seating (19) to connect said articulation component (11, 111) and provided with a connection unit (23) inserted into said support (12a) to connect said distal joint element (13, 113) to said adapter body (12) in a releasable manner. The connection unit (23) comprises an anchoring element (24), an attachment element (25) and a clamping element (26) associated in a selectively releasable manner to the distal joint element (13, 113) and the support (12a) has a through coupling seating (32) configured to receive and position said clamping element (26) inside it, and also configured to allow the insertion and extraction of said distal joint element (13, 113) through said support (12a) without removing said support (12a) from the humeral seating (51).

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**"MODULAR HUMERAL PROSTHESIS"**

\* \* \* \* \*

**FIELD OF THE INVENTION**

The present invention concerns a humeral prosthesis, able to be configured anatomically or inversely for the reconstruction of the humerus in the articulation of the shoulder. In particular the humeral prosthesis of the present invention is the modular type and comprises an articulation component, a distal joint element and an adapter body which acts as a metaphyseal module.

**BACKGROUND OF THE INVENTION**

It is known that arthroprostheses used to reconstruct the shoulder joint can be the anatomical or inverse type. Anatomical humeral prostheses are provided with a hemispherical head that artificially reconstructs the human anatomy and are suitable to articulate in the glenoid cavity of the shoulder blade or possibly in a mating artificial seating attached to the glenoid cavity. On the contrary, inverse prostheses provide a concave articular insert able to allow the rotation of an artificial spherical body attached to the glenoid seating, commonly called glenosphere.

It is known that humeral prostheses, whether anatomical or inverse, generally include a distal joint element, also called rod or pin, inserted inside the humerus along the diaphyseal axis, to support the humeral head in anatomical humeral prostheses or the concave articular insert in inverse prostheses.

Distal joint elements of various types are known, for example with an elongated tubular shape, to define an elongated rod, or a small-sized pin, typically used for mini-invasive humeral prostheses. The shape and size of the distal joint element can also depend on the type and size of the humeral prosthesis, for example inverse humeral prostheses can need a distal joint element that is bigger than anatomical ones.

It is possible, for example due to degeneration of the tissues of the shoulder, that operations may have to be carried out to revise the prosthesis, for example to replace the prosthesis, or operations to convert an anatomical prosthesis into a inverse prosthesis or vice versa.

It is known, for example from the patent application EP-A-1.472.999, to make a modular humeral prosthesis, comprising an adapter body, which functions as a

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metaphyseal module, to be positioned in a seating made under the head of the humerus and connectable on one side to a rod inserted in the humerus and on the other side to the semi-spherical humeral head, in the case of anatomical prostheses, or to the concave articular insert in the case of inverse prostheses. Indeed, by varying the adapter body, the known modular humeral prosthesis can be made as anatomical or inverse. Moreover, in the field of the same type of prosthesis, anatomical or inverse, it may be possible to change the shape or size of the adapter body, releasing it from the rod and keeping the latter inserted in the humerus, whenever its sizes or characteristics are suitable for the humeral prosthesis to be grafted.

However, one possible disadvantage of this known modular humeral prosthesis is that it cannot be converted from anatomical to inverse without having to replace the adapter body. This latter operation, which entails extracting the adapter body from the bone seating, can be invasive and destructive.

Another possible disadvantage of the known humeral prosthesis is that it does not allow to completely replace the rod with another element inserted in the humerus, such as a rod with a different conformation or size, or a nail for osteosynthesis, preserving the adapter body already inserted, that is, without extracting the adapter body from the humerus which, as we said above, can be difficult and invasive.

It is known for example that, in the event of fractures of the humerus, for the purposes of osteosynthesis, it may be necessary to introduce inside the humerus a humeral nail that reproduces the correct alignment of the bone fragments to allow reciprocal welding thereof. The humeral nail can be introduced in antegrade fashion, with a passage through the proximal part of the humerus (antegrade nail), or retrograde, through an aperture in the olecranon fossa (retrograde nail). The antegrade solution is generally preferable, since it is less invasive and less complex.

However, in the state of the art and with the humeral prostheses available, if there is a fracture of the humerus and there is a humeral prosthesis present, it may be necessary to completely remove the prosthetic implant, or alternatively to use external synthesis means, such as osteosynthesis plates which in any case do not always guarantee a successful synthesis.

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One disadvantage of known solutions is therefore that it is not possible to act in an antegrade manner to remove the rod or pin and insert the nail without removing the adapter body, in the event of fractures of the humerus where there is a humeral prosthesis present.

Document US-A-2005/0 125067 describes a modular prosthesis of the known type, provided with a head and a rod coupled to the head. The rod has a proximal portion coupled with the head and a distal portion configured to extend in a long bone of the patient. The distal portion can be removed from the rod after the prosthesis has been implanted, without removing the proximal portion.

Document WO-A-99/47081 also describes a modular orthopedic prosthesis having a body that has a through hole that receives a connection bushing that in turn receives a rod having a proximal neck and a distal shaft. The connection bushing can be expanded radially in order to clamp the rod and the body together.

Purpose of the present invention is to obtain a modular humeral prosthesis that allows revisions or conversions of the prosthesis, keeping the adapter body of the humeral prosthesis in the humeral seating and allowing to replace the distal joint element, either rod or pin.

#### SUMMARY OF THE INVENTION

The present invention is set forth and characterized in the independent claim, while the dependent claims describe other characteristics of the invention or variants to the main inventive idea.

In accordance with the above purpose, a modular humeral prosthesis according to the present invention, which overcomes the limits of the state of the art and eliminates the defects therein, is suitable to be implanted in a humeral seating of a humerus and comprises an articulation component and a distal joint element insertable in the humeral seating along an insertion axis. The humeral prosthesis also comprises an adapter body, which acts as a metaphyseal module, provided with a support that can be positioned in the humeral seating and that has a coupling seating to connect the articulation component and provided with a connection unit inserted into the adapter body support to connect the distal joint element to the adapter body in a releasable manner.

According to the present invention, the connection unit comprises a clamping element associated in a selectively releasable manner to the distal joint element.

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Moreover, the adapter body support has a through coupling seating configured to receive and position the clamping element inside it. The through coupling seating is also configured to allow the insertion and extraction of the distal joint element through the adapter body support, without removing the support from the humeral seating.

In this way, allowing the complete passage, or crossing, of the distal joint element along the through coupling seating, it is possible, once the clamping element is removed, to position and remove the distal joint element as well, operating advantageously from above, without needing to extract the adapter body support from the humeral seating.

Therefore, with the present invention, it is possible to carry out revision or conversion operations of the prosthesis maintaining the adapter body support of the humeral prosthesis in the humeral seating. In particular, with the present invention, it is possible to change the articulation component, for the conversion for example from anatomical prosthesis to inverse prosthesis or vice versa, without extracting the adapter body support. Moreover, with the present invention it is also possible to replace the distal joint element, rod or pin, also maintaining in this case the adapter body support of the humeral prosthesis in the seating on the head of the humerus. For example, in the case of conversion of the prosthesis, it might be necessary to change the type or size of the distal joint element, while in the case of a fracture of the humerus for example, in the presence of a modular prosthesis which has already been implanted, it could be necessary to insert an osteosynthesis nail in its place, and in any case the present invention allows to intervene to remove and/or replace the distal joint element operating from above in an antegrade manner, without removing the adapter body support.

In variant forms of embodiment, the clamping element is configured to clamp a movement of axial extraction of the distal joint element toward the outside of the humeral seating.

In variant forms of embodiment, the clamping element is configured to achieve a same-shape coupling with a one-directional constraint toward the inside of the humeral seating with the through coupling seating of the support.

In variant forms of embodiment, the clamping element is configured to

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achieve a same-shape coupling with a one-directional constraint toward the outside of the humeral seating with the distal joint element.

In variant forms of embodiment, the clamping element is coupled externally to the distal joint element.

In variant forms of embodiment, the clamping element has a truncated cone configuration, both internally and externally. The truncated cone configuration can be inverted between outside and inside. For example, the clamping element can be shaped internally like a truncated cone, while externally it can be shaped like a truncated cone inverse with respect to the inside.

In possible implementations, the clamping element comprises a hollow truncated cone element that has an external clamping surface shaped like a truncated cone with a section that reduces toward the inside of the humeral seating, an internal clamping cavity delimited by internal lateral walls shaped like a truncated cone inverse with respect to the external clamping surface, to receive a mating connection portion of the distal joint element.

In other variant forms of embodiment, internally the clamping element has a truncated cone configuration and externally a cylindrical configuration.

In yet other variant forms of embodiment, internally the clamping element has a cylindrical configuration and externally a truncated cone configuration.

In implementations where the clamping element is at least internally configured as a truncated cone, the distal joint element has a similar truncated cone connection portion to be inserted into the clamping element.

In other variant forms of embodiment, the clamping element has a cylindrical configuration, both internally and externally.

In a possible implementation, internally the clamping element has threaded connection means to cooperate with the distal joint element. This implementation can be used, for example, in the case where the clamping element internally has a cylindrical configuration and the distal joint element has a similar cylindrical connection portion to be inserted in the clamping element.

Depending whether the clamping element is externally configured as a truncated cone or as a cylinder, the through coupling seating will consequently be configured as a truncated cone or a cylinder.

Moreover, according to some forms of embodiment of the present invention,

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the connection unit comprises an anchoring element configured to clamp a movement of axial extraction of the clamping element toward the outside of the humeral seating.

The anchoring element can be configured to be constrained bi-directionally to the adapter body support.

In possible variation forms of embodiment, the anchoring element comprises an externally threaded annular body that has an external threaded anchoring surface and a shaped central aperture.

In other variants, the anchoring element comprises an elastically deformable ring, in particular a Seeger ring.

In some forms of embodiment, the clamping element is inserted between the distal joint element and the anchoring element.

In some forms of embodiment of the present invention, the connection unit also comprises an attachment element associated with the clamping element and the distal joint element to clamp the axial movement thereof toward the inside of the humeral seating with respect to the clamping element.

In possible variants, the attachment element is mounted on the clamping element and is attached to the distal joint element.

In some forms of embodiment, the attachment element comprises a screw, provided with a shaped head, configured to abut against the clamping element, from which a threaded rod extends, configured to be inserted into the clamping element and able to be screwed into an attachment cavity of the distal joint element to define overall a one-directional constraint of the distal joint element toward the inside of the humeral seating.

Moreover, in possible variants, the clamping element is configured to define an axial stopping abutment for the attachment element.

These and other aspects, characteristics and advantages of the present disclosure will be better understood with reference to the following description, drawings and attached claims. The drawings, which are integrated and form part of the present description, show some forms of embodiment of the present invention, and together with the description, are intended to describe the principles of the disclosure.

The various aspects and characteristics described in the present description can



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be applied individually where possible. These individual aspects, for example aspects and characteristics described in the attached dependent claims, can be the object of divisional applications.

It is understood that any aspect or characteristic that is discovered, during the patenting process, to be already known, shall not be claimed and shall be the object of a disclaimer.

#### BRIEF DESCRIPTION OF THE DRAWINGS

These and other characteristics of the present invention will become apparent from the following description of some forms of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a section of a modular humeral prosthesis, in its anatomical configuration, according to forms of embodiment of the present invention;
- fig. 2 is a section of a modular humeral prosthesis, in its inverse configuration, according to forms of embodiment of the present invention;
- fig. 3 is a section in separate parts of a modular humeral prosthesis according to forms of embodiment of the present invention;
- fig. 4 is a perspective view in separate parts of a modular humeral prosthesis according to other forms of embodiment of the present invention;
- fig. 5 is a perspective view of a part of a modular humeral prosthesis according to forms of embodiment of the present invention;
- fig. 6 is a section of a part of a modular humeral prosthesis according to forms of embodiment of the present invention;
- fig. 7 is a section of a modular humeral prosthesis according to a form of embodiment of the present invention;
- fig. 8 is a perspective view in separate parts of a part of fig. 7.

To facilitate comprehension, the same reference numbers have been used, where possible, to identify identical common elements in the drawings. It is understood that elements and characteristics of one form of embodiment can conveniently be incorporated into other forms of embodiment without further clarifications.

#### DETAILED DESCRIPTION OF FORMS OF EMBODIMENT

We shall now refer in detail to the various forms of embodiment of the present invention, of which one or more examples are shown in the attached drawing.

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Each example is supplied by way of illustration of the invention and shall not be understood as a limitation thereof. For example, the characteristics shown or described inasmuch as they are part of one form of embodiment can be adopted on, or in association with, other forms of embodiment to produce another form of embodiment. It is understood that the present invention shall include all such modifications and variants.

Figs. 1 and 2 are used to describe forms of embodiment of a modular humeral prosthesis 10 suitable to be implanted in a humeral seating 51 of a humerus 50.

The modular humeral prosthesis 10 can comprise, or be associated with, an articulation component that can be a humeral head 11 for example, or a concave articular insert 111, depending on whether the modular humeral prosthesis 10 is anatomical or inverse, a distal joint element 13, 113 and an adapter body 12.

According to some forms of embodiment of the present invention, the distal joint element 13, 113 can have an axial symmetry with respect to an insertion axis X. The axis X can generally coincide with the diaphyseal axis along which the distal joint element 13, 113 is located in the humerus 50, even if situations can be hypothesized wherein the insertion axis X does not coincide with the diaphyseal axis.

In some forms of embodiment, the modular humeral prosthesis 10 is generally inserted in the direction defined by the axis X, toward the inside of the humerus 50, and also extracted in the direction defined by the axis X, however in the opposite direction, that is toward the outside of the humerus 50 and the humeral seating 51.

In some forms of embodiment, the adapter body 12 is intended to be positioned in the humeral seating 51, typically along the axis X, and can be connected on one side to the distal joint element 13, 113, insertable in its turn in the humerus 50, and on the other side, opposite to the articulation component, to the humeral head 11, or concave articular insert 111. The adapter body 12 can also be configured to allow the bone integration with the internal surface of the humeral seating 51.

In some forms of embodiment, the adapter body 12 is the modular type, comprising components, including for example the following, indicated by the reference numbers 12a and 23, that can be coupled to each other in a selectively

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releasable manner, according to requirements.

In particular, in possible implementations the adapter body 12 can comprise a support 12a to support the articulation component, humeral head 11, or concave articular insert 111. The support 12a of the adapter body 12 can typically be inserted in a stable manner into the humeral seating 51.

In some forms of embodiment, the adapter body 12 can also comprise a connection unit 23 for the releasable connection of the distal joint element 13, 113 to the support 12a. In possible implementations, the connection unit 23 can be axial-symmetric with respect to the axis of symmetry X, or diaphyseal axis. The connection unit 23 can be inserted into the support 12a, advantageously releasably, and coupled with the distal joint element 13, 113 subsequently to the positioning of the support 12a in the humeral seating 51.

In some forms of embodiment, the adapter body 12 can also comprise coupling means to associate the articulation component to the support 12a, that is, to stably connect it for the purposes of articulation. In possible implementations, the coupling means of the adapter body 12 can comprise a concave shaped coupling seating 19, provided in the support 12a, to which the articulation component is coupled, whether it is the humeral head 11 or the concave articular insert 111.

Moreover, the support 12a of the adapter body 12 can comprise a through coupling seating 32 for the connection of the connection unit 23, opposite to the coupling means, to constrain the articulation component. In possible implementations, the through coupling seating 32 can be shaped, for example, for the insertion and the geometric coupling of the connection unit 23.

In possible implementations, the through coupling seating 32 can be internally shaped as a truncated cone, typically with a section that reduces toward the inside of the humeral seating 51.

In some forms of embodiment, the through coupling seating 32 can be configured to allow the insertion and extraction of the distal joint element 13, 113 through the support 12a, without removing the support 12a itself from the humeral seating 51.

Typically, moreover, the through coupling seating 32 can be provided with a diameter greater than the maximum diameter, or maximum equivalent diameter,

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of the cross section of the distal joint element 13, 113. In this way, the distal joint element 13, 113 can be inserted and can pass completely through the through coupling seating 32.

In possible forms of embodiment, the adapter body 12 can be made completely of metal material, such as alloys of titanium or cobalt.

In other forms of embodiment, the components of the adapter body 12 can be made of different materials, preferably biocompatible with mechanical and chemical properties suitable for the functions provided. Some examples of such materials are, apart from metal materials such as alloys of titanium or cobalt, ceramic materials for medical use or plastic polymer materials, such as polyethylene with high or very high reticulation, or PEEK, possibly loaded with carbon.

According to some forms of embodiment of the present invention, the distal joint element 13, 113 can comprise an insertion portion 14, 114, typically inserted in the humerus 50, and a connection portion 15, for connection to the connection unit 23 of the adapter body 12.

According to some forms of embodiment of the present invention, as described by way of example using figs. 1 and 2, the insertion portion 14, 114 and the connection portion 15 can be made as a single body. Typically the distal joint element 13, 113 can be made entirely of metal material suitable for biomedical use, such as for example alloys of titanium or alloys with a cobalt base.

According to other forms of embodiment, the connection portion 15 can be made as a distinct element from the insertion portion 14, 114 and can for example be made with other materials than the insertion portion 14, 114.

According to some forms of embodiment described here, the connection unit 23 can be the modular type, or formed by components, including for example those indicated hereafter by the reference numbers 24, 25, 26, selectively associable with respect to each other.

For example, the connection unit 23 can comprise a clamping element 26, such as for example a bushing, associated, typically in a selectively releasable manner, to the distal joint element 13, 113. In particular, the clamping element 26, can be coupled externally to the distal joint element 13, 113 to clamp a

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movement of axial extraction thereof toward the outside of the humeral seating 51 with respect to the support 12a. The support 12a in its turn has the through coupling seating 32 configured to clamp an axial movement of the clamping element 26 toward the inside of the humeral seating 51. In particular, the through coupling seating 32 is configured to receive and position the clamping element 26 inside it. For example, the through coupling seating 32 can be mating with the clamping element 26, which therefore can be stably inserted inside it. Moreover, as said above, the through coupling seating 32 is configured to allow the complete passage, for example during the steps of insertion or extraction of the distal joint element 13, 113 into/from the humeral seating 51, advantageously without removing or extracting the support 12a from the humeral seating 51.

According to some forms of embodiment described here, the connection unit 23 can also comprise an anchoring element 24, which can be configured to clamp a movement of axial extraction of the clamping element 26 toward the outside of the humeral seating 51. The anchoring element 24 is for example configured to be constrained, advantageously in a releasable manner, to the support 12a bi-directionally along the axis X. For example, the anchoring element 24 can be provided above the clamping element 26.

In possible implementations (see fig. 3 for example), the anchoring element 24 can be an externally threaded annular body, which in particular has an external threaded anchoring surface 33 and a shaped central aperture 24a, delimited by an internal drive surface 34, for example polygonal, typically hexagonal, to be driven by a mating key or similar polygonal tool. An advantage of the solution in which the anchoring element 24 is threaded can be that, by means of screwing, it is possible to take the connection unit 23 completely in abutment, that is, packed, preventing unwanted movements of its components, even minimal, which could cause wear.

In other possible implementations, the anchoring element 24 can be an elastically deformable ring, such as an interrupted ring, for example a Seeger ring. For example, in this case the deformable ring can be selectively inserted in a suitable recess made in the through coupling seating 32, such as for example one or more hollows, or an annular groove, typically made above the clamping element 26.

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In other possible implementations, the anchoring element 24 can be a deformable portion of the clamping element 26 itself. For example, the clamping element 26 can be suitably coupled to the through coupling seating 32 and in so doing a deformation of the material can be achieved, such as a protruding lip or fin, of the clamping element 26, for example an upper portion thereof, which is selectively constrained in a suitable recess made in the through coupling seating 32 as described above for example.

According to some forms of embodiment described here, the connection unit 23 can also comprise an attachment element 25 associated to the clamping element 26, assembled on the latter for example and which can be attached for example, advantageously in a releasable manner to the distal joint element 13, 113, in particular to the connection portion 15, in order to clamp the axial movement thereof toward the inside of the humeral seating 51 with respect to the clamping element 26. For its connection to the attachment element 25, the connection portion 15 can have an attachment cavity 20.

For example, in possible implementations, the attachment element 25 can be a screw, typically provided with a shaped head 35, circular or polygonal for example. The shaped head 35 can be provided with a blind coupling seating 38, drivable for example by means of a key, typically with a hexagonal head. A threaded rod 36 extends from the shaped head 35, destined to be screwed to the connection portion 15. The attachment cavity 20 of the latter, for example, can be a coordinated threaded seating, to receive the threaded rod 36 of the attachment element 25. In this way, the attachment element 25 can define overall a one-directional constraint of the distal joint element 13, 113 toward the inside of the humeral seating 51.

For example, the attachment element 25 can be inserted through the anchoring element 24, in particular having the shaped head 35 for example housed in the central shaped aperture 24a and the threaded rod 36 protruding from the latter toward the distal joint element 13, 113.

According to other forms of embodiment, the attachment element 25 can provide different configurations, for example with a fixed-joint mechanism. In other possible implementations, the attachment element 25 can be an internally threaded surface of the clamping element 26 configured to cooperate screwing

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with a mating external threaded surface present on the distal joint element 13, 113, in particular on the connection portion 15.

In possible forms of embodiment, the clamping element 26 can be configured to define an axial stopping abutment for the attachment element 25, in practice preventing movements thereof toward the inside of the humeral seating 51.

In possible forms of embodiment, the clamping element 26 can be inserted between the distal joint element 13, 113 and the anchoring element 24. In particular, the clamping element 26 can be configured to receive the distal joint element 13, 113 inside it through coupling, in particular the connection portion 15 and also part of the attachment element 25 attached to the distal joint element 13, 113, the threaded rod 36 for example.

As we said, the clamping element 26 can also be configured to achieve a same-shape coupling with one-directional constraint toward the inside of the humeral seating 51 with the through coupling seating 32 of the support 12a.

Moreover, the clamping element 26 can be configured to achieve a same-shape coupling with one-directional constraint toward the inside of the humeral seating 51 with the distal joint element 13, 113.

In possible implementations, the clamping element 26 can comprise an internally hollow body to receive the distal joint element 13, 113, in particular the connection portion 15. For example, the clamping element 26 can be shaped as a truncated cone both externally and internally.

For example, the clamping element 26 can comprise a hollow truncated cone element, which has an external clamping surface 41 shaped like a truncated cone with a section that reduces toward the inside of the humeral seating 51. The external clamping surface 41 can define the same-shape coupling with the through coupling seating 32. Moreover, the clamping element 26 shaped like a hollow truncated cone can provide an internal clamping cavity 40, delimited for example by internal lateral walls 43 shaped like a truncated cone inverse with respect to the external clamping surface 41, that is, with a section that widens toward the inside of the humeral seating 51. The internal clamping cavity 40 can define the same-shape coupling with the connection portion 15 of the distal joint element 13, 113. The internal clamping cavity 40 can be sized so that the connection portion 15 does not protrude toward the outside from the clamping

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element 26. The clamping element 26 can also have an upper clamping surface 42, to define the stopping abutment for the attachment element 25.

In other variants, the clamping element 26 can be shaped externally like a cylinder and internally like a truncated cone, or vice versa. Or again, the clamping element 26 can be shaped like a cylinder both externally and internally. In the case where the clamping element 26 is configured at least internally like a cylinder, a coupling by screwing with the distal joint element 13, 113 can be provided, in particular the connection portion 15, shaped like a cylinder in a coordinated manner, providing one or more suitable threaded surfaces inside the clamping element 26 and outside the distal joint element 13, 113. Moreover, in possible variant forms of embodiment, the clamping element 26 can also have one or more threaded surfaces outside, for coupling with the through coupling seating 32 by screwing.

Therefore, in some forms of embodiment, the clamping element 26 can be coupled to the distal joint element 13, 113 and also the clamping element 26 itself can be coupled to the through coupling seating 32 of the adapter body 12 and can axially clamp the attachment element 25. Furthermore, the clamping element 25 is stably positioned thanks to the attachment element 25 which, being attached to the distal joint element 13, 113, also clamps the clamping element 26 in an intermediate position. Finally, the clamping element 26 is also constrained in its axial movement toward the outside by the anchoring element 24.

Consequently, with the present invention it is possible to position and extract the connection unit 23 and the distal joint element 13, 113 in/from the humeral seating 51, without extracting and removing the support 12a of the adapter body 12.

Indeed, to position the modular humeral prosthesis 10, typically the support 12a of the adapter body 12 can be inserted in the humeral seating 51 suitably prepared.

Moreover, it is possible for example to insert the distal joint element 13, 113 in the clamping element 26 and attach the distal joint element 13, 113 to the attachment element 25, thus obtaining a single insertion body 44. In this condition, the attachment element 25 abuts against the clamping element 26 at the upper part, typically against the upper clamping surface 42.



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The single insertion body 44 can be inserted from above into the humeral seating 51, passing through the through coupling seating 32. In this way, the clamping element 26 geometrically couples with the through coupling seating 32 as well.

Then, the anchoring element 24 is positioned from above, which anchors inside the adapter body 12, thus clamping possible movements of the single insertion body 44 toward the outside of the humeral seating 51.

Possible movements of the distal joint element 13, 113 toward the inside of the humeral seating 51 are instead prevented by the upper abutment of the attachment element 25 against the clamping element 26 inserted on the connection portion 15 and interposed between insertion portion 14, 114 and anchoring element 24.

In this way, since the connection unit 23 and the distal joint element 13, 113 can be installed with positioning in sequence from above, that is in antegrade fashion, with the support 12a already positioned in the humeral seating 51, it is also possible to extract, in inverse order, the connection unit 23 and the distal joint element 13, 113, always keeping the support 12a in position.

Similarly, the present invention easily allows operations to remove and/or replace the distal joint element 13, 113 without needing to remove the support 12a disposed in the humeral seating 51, advantageously operating in antegrade fashion. Indeed, it is sufficient to remove the components of the connection unit 23 in sequence, for example first the anchoring element 24 and then the single insertion body 44, formed by the attachment element 25, the clamping element 26 and the distal joint element 13, 113, which is removed through the through coupling seating 32.

With reference for example to forms of embodiment described using figs. 1, 2 or 3, the distal joint element 13, 113 can be an oblong shape and the insertion portion 14 of the distal joint element 13 can therefore be an elongated rod. The insertion portion 14 can be provided with an external insertion surface 16 suitable to be coupled to the internal surface 54 of the humeral seating 51 of the humerus 50.

The coupling of the external insertion surface 16 and the internal surface 54 can generally occur by percussion or by screwing, so as to allow the distal joint

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element 13 to remain attached to the humerus 50.

According to some variant forms of embodiment, the external insertion surface 16 can comprise a plurality of longitudinal fins, possibly present in only one of its portions, which can allow to increase the interference and the gripping capacity of the contact surfaces. According to another variant the fins are integrated with, or replaced by screw threads.

In the case where the insertion portion 14 has an elongated rod, in a variant solution provided for example to increase the stability and longevity of the graft, the external insertion surface 16 can have a triple or double conical development. According to other solutions, the conicity can be single or with a different multiple value, quadruple for example. The sequence of the conicity is such as to shape the insertion portion 14 overall as a tapered body along the axis X in the insertion direction.

With reference for example to forms of embodiment described using fig. 4, the insertion portion 114 of the distal joint element 113 can be a simple protuberance or reduced protrusion, that is, it can have a reduced size, in particular in length, and for example be suitable for use in mini-invasive humeral prostheses. In particular, in possible implementations, described for example with reference to fig. 4, the insertion portion 114 can have a front surface shaped like a spherical cap 114a. In other forms of embodiment a different shape of the front end of the insertion portion 114 can be provided, for example conical, truncated cone or cylindrical.

In other possible implementations, the distal joint element 113 can be an antegrade nail which has the insertion portion elongated, insertable in a suitable channel in the humerus 50 for the function of osteosynthesis, and the connection portion 15, for connection to the adapter body 12.

With reference for example to fig. 3, the connection portion 15 of the distal joint element 13, 113 can comprise an external connection surface 17.

The external connection surface 17 of the connection portion 15 can have a shape complementary to that of the internal clamping cavity 40 of the clamping element 26. For example, the external connection surface 17 can be provided with a truncated cone shape tapered along the axis of symmetry X, toward the outside of the humeral seating 51, as for example described using fig. 3. In other

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forms of embodiment, the external connection surface 17 can be shaped as an only partly truncated cone.

The internal clamping cavity 40 of the clamping element 26 can therefore have a truncated cone shape complementary to that of the external connection surface 17 defining a conical coupling.

This conical coupling prevents the clamping element 26 from sliding along the distal joint element 13 toward the insertion portion 14, once they have reached their final positioning shown more clearly in fig. 1.

With reference for example to fig. 3, the connection portion 15 can also comprise an upper surface 18 with an annular shape that develops around the attachment cavity 20 inside the distal joint element 13. The attachment cavity 20 is delimited by an internal attachment surface 21 and, for example, by a bottom 22. The internal attachment surface 21 can be cylindrical in shape and have an inner threading.

According to possible forms of embodiment, the support 12a of the adapter body 12 can comprise a proximal portion 27 and a distal portion 28. According to possible forms of embodiment, the proximal portion 27 can be shaped, for example concave, in order to accommodate the humeral head 11 in an anatomical configuration, or a concave articular insert 111 in an inverse configuration. In particular, the proximal portion 27 can have the coupling seating 19. Typically, during normal use the proximal portion 27 can be protruding, that is, on the outside with respect to the humeral seating 51. On the contrary, the distal portion 28 can have the through coupling seating 32. During normal use, the distal portion 28 can be inserted inside the humeral seating 51.

The proximal portion 27 can comprise in its turn an upper portion 29 and a lower portion 30, which can define the coupling seating 19.

The upper portion 29 can be, for example, a seating with a cylindrical shape. The upper portion 29 can have an axial symmetry along an axis Y inclined by an angle  $\alpha$  with respect to the axis X, or diaphyseal axis, of the distal joint element 13, 113, to which the adapter body 12 will be connected.

According to some forms of embodiment, moreover, the lower portion 30 can be for example a truncated cone shaped seating.

In possible implementations, the lower portion 30 can provide a hollow

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truncated cone shape obtained by a cone having the axis Y for its axis of symmetry. Moreover the lower portion 30 can taper starting from the section of the upper portion 29 until it joins the distal portion 28. This form of embodiment, in particular, can define a truncated cone lower portion 30 obtained by sectioning a cone in two planes which are not parallel to each other.

In variant forms of embodiment, the proximal portion 27 of the support 12a is solid (see for example fig. 3). According to variant forms of embodiment, the proximal portion 27 of the support 12a, in particular the lower portion 30 for example, can provide a configuration such as to allow bone integration, for example with bone fragments of the humerus 50 in the case of reconstruction of a fracture. In possible implementations, described for example with reference to fig. 5, the proximal portion 27, for example the corresponding lower portion 30, can have through apertures or windows 31 for this purpose, for example defined by lateral support elements 30a which join the upper portion 29 with the distal portion 28. The through apertures or windows 31 can allow to position the bone fragments. In this way, the proximal portion 27 can have a cage configuration for example.

With reference to fig. 5, the upper portion 29 can have a hollow cylindrical shape and the support elements 30a can be a different length and shape from each other.

The support elements 30a can be configured to obtain a desired inclination of the upper portion 29.

For example, providing that the upper portion 29 has a symmetry along an axis Y different to the axis X of symmetry of the distal joint element, an angle  $\alpha$  is thus defined between the two axes.

For example, the distal portion 28 of the support 12a, able to connect the connection unit 23 to the support 12a, can be connected to the lower portion 30.

Typically the distal portion 28 can have an axial symmetry along the axis X of symmetry, or diaphyseal axis, of the distal joint element 13, 113. The distal portion 28, in this embodiment, also has an external shape of the cylindrical type, and hollow inside.

According to other forms of embodiment, the distal portion 28 can have other external shapes, keeping the inside hollow, for example parallelepiped or cubic.

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In some forms of embodiment, the distal portion 28 can connect to the lower portion 30 of the proximal portion 27, defining a cylinder sectioned in two planes which are not parallel with each other.

The distal portion 28 can provide the through coupling seating 32, able to cooperate with the connection unit 23. According to some forms of embodiment, the through coupling seating 32 can be delimited internally by an upper surface 31a configured to cooperate with the anchoring element 24 and by a lower surface 31b to cooperate with the clamping element 26, in sequence one after the other along the axis X. The upper surface 31a can provide a cylindrical shape for example and have a threading for screwing to the threaded external anchoring surface 33 of the anchoring element 24. The lower distal surface 31b on the contrary can have a truncated cone shape, tapered at the lower part. For example, the external clamping surface 41 of the clamping element 26 can be configured to be coupled with the lower surface 31b, and these surfaces can have complementary shapes. As described for example with reference to fig. 3, the upper surface 31a and the external clamping surface 41 can both be truncated cone shaped and have the same size, to achieve a conical coupling which prevents the movement of the clamping element 26 along the axis X, in the direction of insertion of the distal body 13, 113 into the adapter body 12, once the clamping element 26 has been inserted in the distal portion 28.

As discussed above, the connection unit 23 of the adapter body 12 is configured to allow the insertion of the distal joint element 13, 113 from the upper part of the adapter body 12, that is, on the side where the humeral head 11 or the concave articular insert 111 are inserted. The distal joint element 13, 113 can therefore be inserted passing first through the proximal portion 27 and then through the proximal portion 28 of the adapter body 12 to then be constrained to the adapter body 12 itself. In possible implementations, the connection unit 23 is provided in the distal portion 28 of the support 12a when the distal joint element 13, 113 is inserted in the adapter body 12.

Fig. 1 is used to describe possible implementations of the modular humeral prosthesis 10 in making an anatomical prosthesis, while fig. 2 is used to describe possible implementations of the modular humeral prosthesis 10 in making an inverse prosthesis.

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With reference for example to fig. 1, the modular humeral prosthesis 10 can be configured as an anatomical prosthesis to allow the articulation of the humerus 50 in a corresponding glenoid cavity 52, only partly shown, of a shoulder or possibly in a mating artificial seating attached to the glenoid cavity 52.

In the forms of embodiment described by way of example in fig. 1, the modular humeral prosthesis 10 is shown in an anatomical configuration and comprises a humeral head 11, a distal joint element 13 and an adapter body 12, provided with a connection unit 23, suitable to constrain the humeral head 11 to the distal joint element 13, and with a coupling seating 19.

With reference to forms of embodiment described using fig. 1 for example, a humeral head 11 which can be associated to the modular prosthesis 10 can be formed by a single body and have a convex articulation surface 11a configured to articulate in the glenoid cavity 52 and a coupling surface 11b to the adapter body 12.

With reference to forms of embodiment described using for example figs. 7 and 8, the humeral head 11 can be the modular type, formed by a connection element 45 and by a convex articulation element 46, which can be connected to each other by coupling means 47.

The connection element 45 can have the coupling surface 11b and is inserted for example in the upper portion 29 to support the convex articulation element 46, which, on the contrary, is the part nearest the glenoid cavity 52, and has the convex articulation surface 11a.

The coupling means 47 can comprise a coupling cavity 48, made in the convex articulation element 46, and a coupling pin 49 provided protruding from the connection element 45. For example, the coupling cavity 48 and the coupling pin 49 are configured to achieve a conical coupling.

Instead, with reference to fig. 2 for example, the modular humeral prosthesis 10 can be configured as an inverse prosthesis to allow the articulation of the humerus 50 with respect to an artificial convex portion, semi-spherical for example, also called glenosphere, positioned in the glenoid.

In the forms of embodiment described by way of example in fig. 2, a concave articular insert 111 is provided, able to be used in a modular humeral prosthesis 10 in an inverse configuration, constrained to the adapter body 12, as an

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alternative to the humeral head 11 in figs. 1, 7 and 8.

With reference to forms of embodiment described using fig. 2 for example, the concave articular insert 111 associable to the modular humeral prosthesis 10, in the inverse configuration, can have a concave articulation surface 111a, for example to allow the articulation of a glenosphere attached to the glenoid cavity 52, and a support surface 111b to be inserted and attached in the adapter body 12.

It is clear that modifications and/or additions of parts may be made to the modular humeral prosthesis 10 as described heretofore, without departing from the field and scope of the present invention.

It is also clear that, although the present invention has been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of humeral prosthesis, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

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## CLAIMS

1. Modular humeral prosthesis suitable for implant in a humeral seating (51) of a humerus (50), comprising an articulation component (11, 111), a distal joint element (13, 113) able to be inserted into said humeral seating (51) along an insertion axis (X), and an adapter body (12) provided with a support (12a) positionable in the humeral seating (51) and that has a coupling seating (19) to connect said articulation component (11, 111) and provided with a connection unit (23) inserted into said support (12a) to connect said distal joint element (13, 113) to said adapter body (12) in a releasable manner, **characterized in that** said connection unit (23) comprises:

a clamping element (26) associated in a selectively releasable manner to the distal joint element (13, 113),

an anchoring element (24) configured to clamp a movement of axial extraction of the clamping element (26) toward the outside of the humeral seating (51),

an attachment element (25) associated with the clamping element (26) and the distal joint element (13, 113) to clamp the axial movement of the distal joint element (13, 113) toward the inside of the humeral seating (51) with respect to the clamping element (26),

**and in that** said support (12a) has a through coupling seating (32) configured to receive and position said clamping element (26) inside it, and also configured to allow the insertion and extraction of said distal joint element (13, 113) through said support (12a) without removing said support (12a) from the humeral seating (51).

2. Humeral prosthesis as in claim 1, **characterized in that** the clamping element (26) is configured to clamp a movement of axial extraction of the distal joint element (13, 113) toward the outside of the humeral seating (51).

3. Humeral prosthesis as in claim 1 or 2, **characterized in that** the clamping element (26) is configured to achieve a same-shape coupling with a one-directional constraint toward the outside of the humeral seating (51) with the through coupling seating (32) of the support (12a).

4. Humeral prosthesis as in any claim hereinbefore, **characterized in that** the clamping element (26) is configured to achieve a same-shape coupling with a one-directional constraint toward the inside of the humeral seating (51) with the



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distal joint element (13, 113).

5. Humeral prosthesis as in any claim hereinbefore, **characterized in that** the clamping element (26) is coupled externally to the distal joint element (13, 113).

6. Humeral prosthesis as in any claim hereinbefore, **characterized in that** the clamping element (26) has a truncated cone configuration, both internally and externally.

7. Humeral prosthesis as in claim 6, **characterized in that** the clamping element (26) comprises a hollow truncated cone element that has an external clamping surface (41) shaped like a truncated cone with a section that reduces toward the inside of the humeral seating (51), an internal clamping cavity (40) delimited by internal lateral walls (43) shaped like a truncated cone inverse with respect to the external clamping surface (41), to receive a mating connection portion (15) of the distal joint element (13, 113).

8. Humeral prosthesis as in any claim from 1 to 5, **characterized in that** internally the clamping element (26) has a truncated cone configuration and externally a cylindrical configuration.

9. Humeral prosthesis as in any claim from 1 to 5, **characterized in that** internally the clamping element (26) has a cylindrical configuration and externally a truncated cone configuration.

10. Humeral prosthesis as in any claim from 1 to 5, **characterized in that** the clamping element (26) has a cylindrical configuration both internally and externally.

11. Humeral prosthesis as in claim 9 or 10, **characterized in that** at least internally the clamping element (26) has threaded connection means to cooperate with the distal joint element (13, 113).

12. Humeral prosthesis as in any claim hereinbefore, **characterized in that** said anchoring element (24) is configured to be constrained bi-directionally to said support (12a).

13. Humeral prosthesis as in any claim hereinbefore, **characterized in that** the anchoring element (24) comprises an externally threaded annular body that has a threaded external anchoring surface (33) and a shaped central aperture (24a).

14. Humeral prosthesis as in any claim from 1 to 12, **characterized in that** the anchoring element (24) comprises an elastically deformable ring, in particular a

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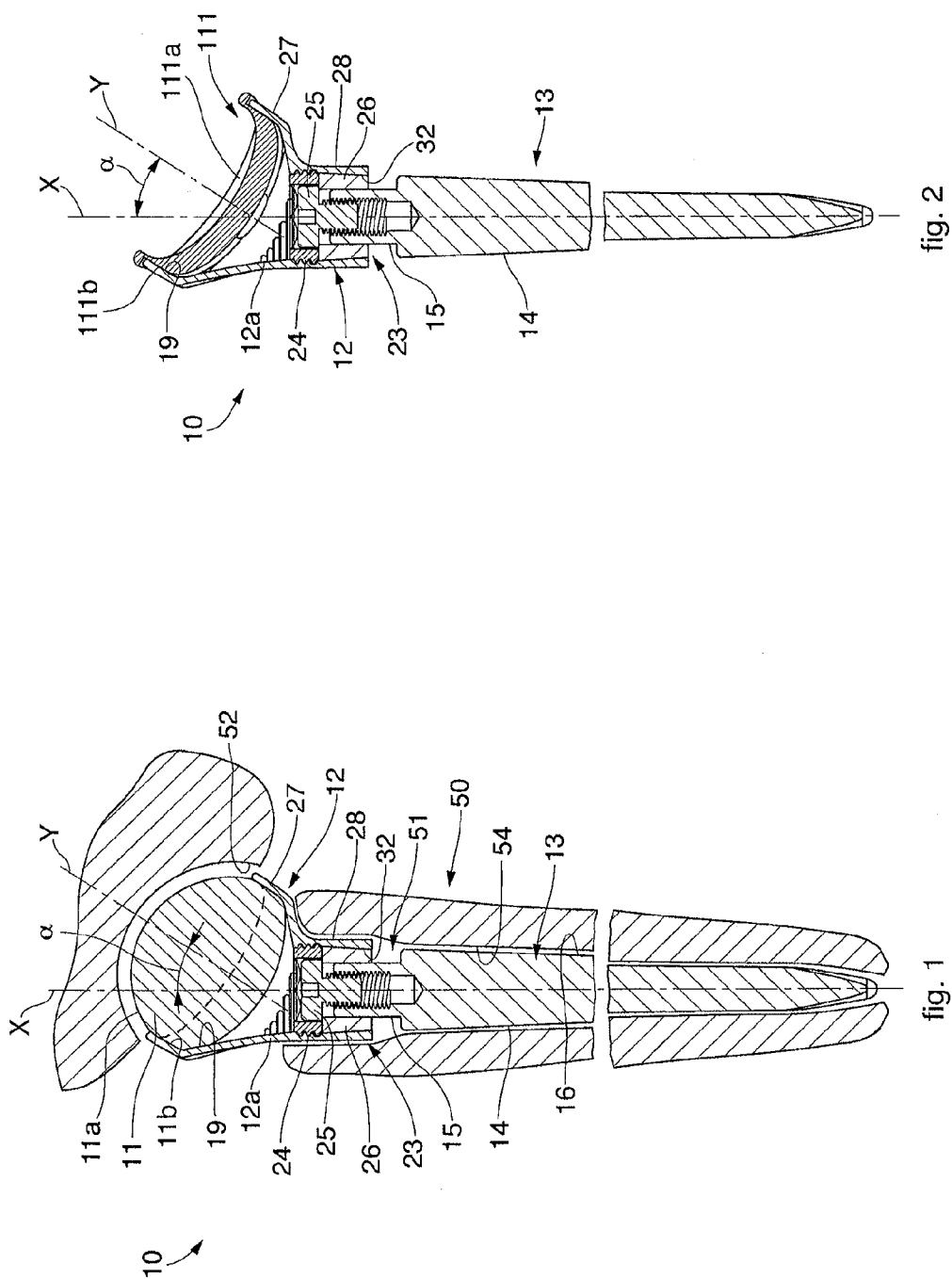
Seeger ring.

15. Humeral prosthesis as in any claim hereinbefore, **characterized in that** the clamping element (26) is inserted between the distal joint element (13, 113) and the anchoring element (24).

16. Humeral prosthesis as in any claim hereinbefore, **characterized in that** the attachment element (25) is mounted on the clamping element (26) and is attached to the distal joint element (13, 113).

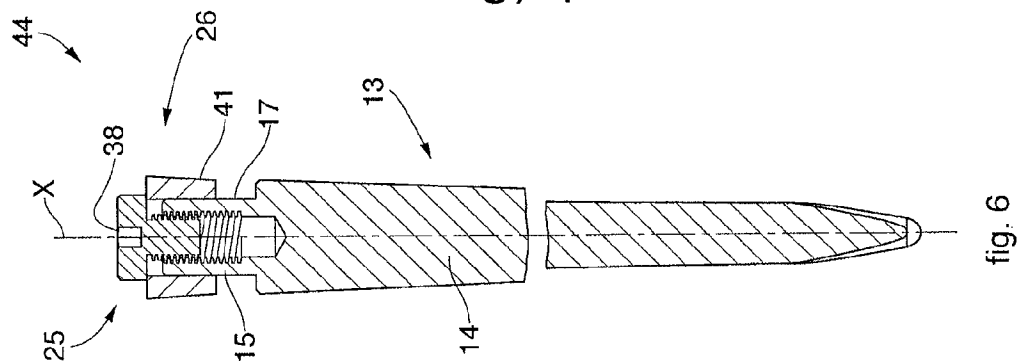
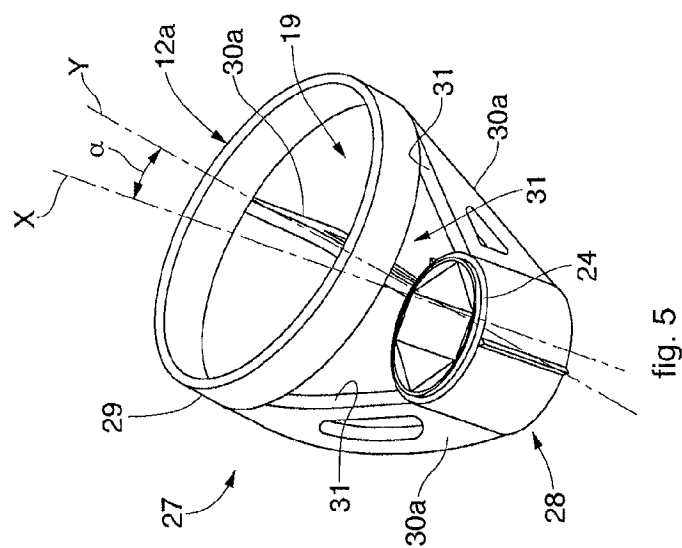
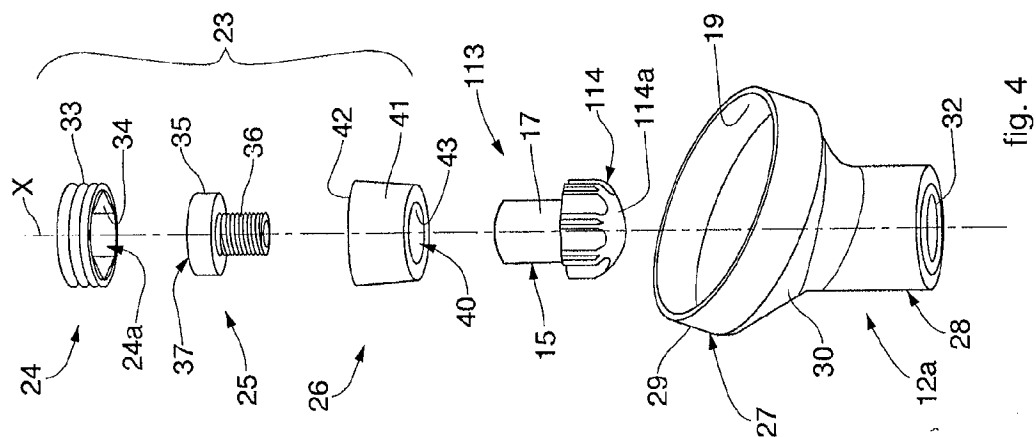
17. Humeral prosthesis as in any claim hereinbefore, **characterized in that** the attachment element (25) comprises a screw, provided with a shaped head (35), configured to abut against the clamping element (26), from which a threaded rod (36) extends, configured to be inserted into the clamping element (26) and able to be screwed into an attachment cavity (20) of the distal joint element (13, 113) to define overall a one-directional constraint of the distal joint element (13, 113) toward the inside of the humeral seating (51).

18. Humeral prosthesis as in any claim hereinbefore, **characterized in that** the clamping element (26) is configured to define an axial stopping abutment for the attachment element (25).

$1/4$ 



3/4



4/4

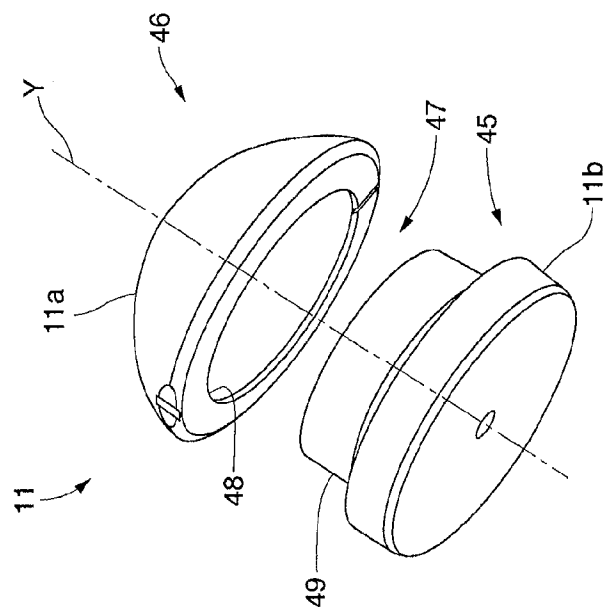


fig. 8

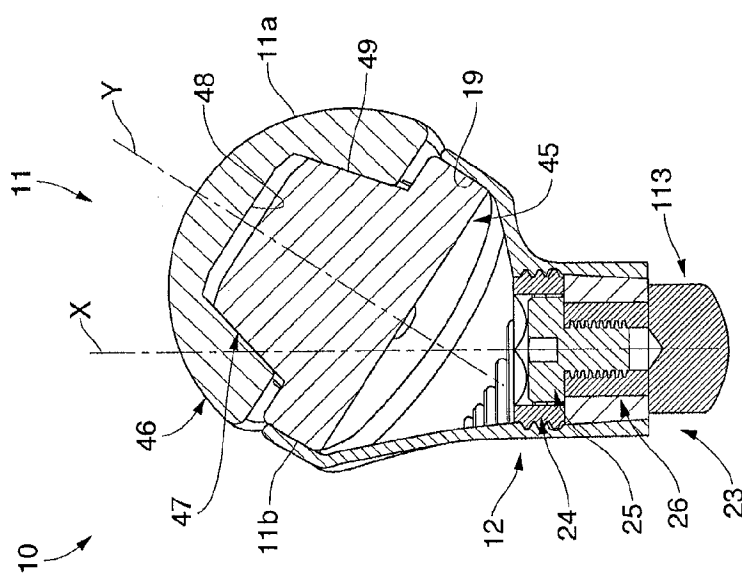


fig. 7

## INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2014/062002

## A. CLASSIFICATION OF SUBJECT MATTER

INV. A61F2/40 A61F2/30

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)

A61F

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. |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | US 2005/125067 A1 (SWEENEY PATRICK J [US])<br>9 June 2005 (2005-06-09)<br>figures 2-8<br>paragraphs [0008] , [0009] , [0030] ,<br>[0032]<br>----- | 1-18                  |
| A         | W0 99/47081 A1 (WHITE PATRICK MICHEL [US])<br>23 September 1999 (1999-09-23)<br>figures 1,4,8,14,16<br>abstract<br>-----                          | 1-18                  |
| A         | EP 1 472 999 A1 (LIMA LT0 SPA [IT])<br>3 November 2004 (2004-11-03)<br>cited in the application<br>figures 2,4<br>-----                           | 1                     |



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

19 August 2014

Date of mailing of the international search report

04/09/2014

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Authorized officer

Josten, Stefan

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2014/062002

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| US 2005125067 A1                          | 09-06-2005          | EP 1696836 A2              | 06-09-2006          |
|                                           |                     | US 2005125067 A1           | 09-06-2005          |
|                                           |                     | WO 2005060452 A2           | 07-07-2005          |
| -----                                     |                     |                            |                     |
| WO 9947081 A1                             | 23-09-1999          | AU 3099999 A               | 11-10-1999          |
|                                           |                     | CA 2324221 A1              | 23-09-1999          |
|                                           |                     | EP 1063947 A1              | 03-01-2001          |
|                                           |                     | US 2002004685 A1           | 10-01-2002          |
|                                           |                     | US 2002151984 A1           | 17-10-2002          |
|                                           |                     | WO 9947081 A1              | 23-09-1999          |
| -----                                     |                     |                            |                     |
| EP 1472999 A1                             | 03-11-2004          | EP 1472999 A1              | 03-11-2004          |
|                                           |                     | ES 2342384 T3              | 06-07-2010          |
|                                           |                     | US 2004220674 A1           | 04-11-2004          |
| -----                                     |                     |                            |                     |



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| 18058058    | NOA      | 04/18/2023    | SHOLD.013C1         |
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|----------------------------------------------------------|---------------------------------|
| <b>First Inventor:</b> Running, Donald E.                | <b>Conf. No.:</b> 5500          |
| <b>App. No.:</b> 18/058058                               | <b>Filed:</b> November 22, 2022 |
| <b>Examiner:</b> Schillinger, Ann M.                     | <b>Art Unit:</b> 3774           |
| <b>Title:</b> TOTAL REVERSE SHOULDER SYSTEMS AND METHODS |                                 |

Commissioner for Patents  
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Alexandria, VA 22313-1450

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The claims of the present application are different and possibly broader in scope than the claims pursued in the parent application(s). To the extent any prior amendments or characterizations of the scope of any claim or referenced art could be construed as a disclaimer of any subject matter supported by the present disclosure, Applicant hereby rescinds and retracts such disclaimer. Accordingly, the references previously considered in the parent application(s) may need to be re-visited.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

Knobbe, Martens, Olson & Bear, LLP

Dated: April 18, 2023

By:           /Andrew I. Kimmel/            
Andrew I. Kimmel  
Registration No. 58,855  
Registered Practitioner  
(949) 760-0404

57453262



## ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #  
**18/058,058**

RECEIPT DATE / TIME  
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ATTORNEY DOCKET #  
**SHOLD.013C1**

### Title of Invention

TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

### Application Information

APPLICATION TYPE Utility - Nonprovisional Application  
under 35 USC 111(a)

PATENT # -

CONFIRMATION # 5500

FILED BY Rio Competente

PATENT CENTER # 61941854

FILING DATE 11/22/2022

CUSTOMER # 20995

FIRST NAMED INVENTOR Donald E. Running

CORRESPONDENCE ADDRESS -

AUTHORIZED BY Andrew Kimmel

### Documents

**TOTAL DOCUMENTS: 1**

| DOCUMENT                   | PAGES | DESCRIPTION                   | SIZE (KB) |
|----------------------------|-------|-------------------------------|-----------|
| Rescission-SHOLD-013C1.pdf | 1     | Miscellaneous Incoming Letter | 16 KB     |

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|----------------------------------------------------------------------------------------------------------------|-------------|----------------------|--------------------------------|------------------|
| APPLICATION NO.                                                                                                | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.            | CONFIRMATION NO. |
| 18/058,058                                                                                                     | 11/22/2022  | Donald E. Running    | SHOLD.013C1                    | 5500             |
| 7590 04/21/2023<br>KNOBBE MARTENS OLSON & BEAR LLP<br>2040 MAIN STREET<br>FOURTEENTH FLOOR<br>IRVINE, CA 92614 |             |                      | EXAMINER<br>SCHILLINGER, ANN M |                  |
|                                                                                                                |             |                      | ART UNIT                       | PAPER NUMBER     |
|                                                                                                                |             |                      | 3774                           |                  |
|                                                                                                                |             |                      | NOTIFICATION DATE              | DELIVERY MODE    |
|                                                                                                                |             |                      | 04/21/2023                     | ELECTRONIC       |

## NOTICE REQUIRING INVENTOR'S OATH OR DECLARATION

☒ An inventor's oath or declaration in compliance with 37 CFR 1.63 or substitute statement in compliance with 37 CFR 1.64 executed by or with respect to each inventor has not yet been submitted.

The inventor's oath or declaration or substitute statement dated \_\_\_\_\_ is defective. The inventor's oath or declaration does not comply with 37 CFR 1.63 or the substitute statement does not comply with 37 CFR 1.64 because it:

- ☐ does not include a statement that the person executing the oath or declaration or substitute statement believes the named inventor or joint inventor to be the original inventor or an original joint inventor of a claimed invention in the application for which the oath or declaration is being submitted.
- ☐ does not state that the application was made or was authorized to be made by the person executing the oath or declaration or substitute statement.
- ☐ does not acknowledge that any willful false statement made in such oath or declaration or substitute statement is punishable under section 1001 of title 18 by fine or imprisonment of not more than 5 years, or both.
- ☐ does not identify the person executing the oath or declaration or substitute statement by his or her legal name.
- ☐ does not identify the application to which the oath or declaration or substitute statement is directed.
- ☐ Other: \_\_\_\_\_

The substitute statement dated \_\_\_\_\_ does not comply with 37 CFR 1.64 because it:

- ☐ does not identify the inventor with respect to whom the statement applies.
- ☐ does not identify the relationship to the non-signing inventor.
- ☐ does not identify the circumstances permitting execution of the statement.
- ☐ was signed by someone other than the applicant.
- ☐ Other: \_\_\_\_\_

An oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each inventor **MUST** be filed **no later than the date on which the issue fee is paid**. See 35 U.S.C. 115(f). Failure to timely comply will result in ABANDONMENT of this application. This period for reply is not extendable under 37 CFR 1.136(a).

Questions relating to this Notice should be directed to the Application Assistance Unit at 571-272-4200.

(571)-272-4200 or 1(888)-786-0101

Patent Publication Branch  
Office of Data Management

CATALYST, EX-1005

PAGE 704

**RESPONSE TO INFORMATIONAL NOTICE**

|                                                          |                                 |
|----------------------------------------------------------|---------------------------------|
| <b>First Inventor:</b> Running, Donald E.                | <b>Conf. No.:</b> 5500          |
| <b>App. No.:</b> 18/058058                               | <b>Filed:</b> November 22, 2022 |
| <b>Examiner:</b> Schillinger, Ann M.                     | <b>Art Unit:</b> 3774           |
| <b>Title:</b> TOTAL REVERSE SHOULDER SYSTEMS AND METHODS |                                 |

**Commissioner for Patents**  
**P.O. Box 1450**  
**Alexandria, VA 22313-1450**

Dear Sir:

The above-captioned application was filed without a Declaration and/or Substitute Statement. Enclosed in compliance with 37 CFR 1.53(f) are the following.

(X) Declaration(s) for:

Donald E. Running, Robert J. Ball, and Jason Slone

The Commissioner is hereby authorized to charge any additional fees which may be required, now or in the future, or credit any overpayment, to Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: April 20, 2023

By: /Andrew I. Kimmel/

Andrew I. Kimmel  
Registration No. 58,855  
Registered Practitioner  
(949) 760-0404

57492724

**COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))***Application Data Sheet filed previously or concurrently*

Docket No.: SHOLD.013NP

Page 1 of 4

Title: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

Inventors: Donald E. Running, Robert J. Ball, and Jason Slone

***Declaration***

This Declaration is directed to U.S. Application No. **17/435,333**, filed **August 31, 2021** and incorporating any amendments made thereto prior to the signature date of this Declaration.

As a named inventor, I declare that:

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 USC 1001 by fine or imprisonment of not more than five (5) years, or both.

I have reviewed and understand the contents of the above-identified application, including the claims, as amended by any amendment.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

***Assignment from Inventors***

WHEREAS, **above-identified Inventors** (individuals, hereinafter "ASSIGNOR") invented certain new and useful improvements, technology, inventions, developments, ideas, ornamental designs, or discoveries related to **TOTAL REVERSE SHOULDER SYSTEMS AND METHODS** (collectively hereinafter referred to as the "Work") for which an application for Letters Patent in the United States (identified above) has been filed or prepared for filing with the United States Patent and Trademark Office (hereinafter the "Application"), and ASSIGNOR desires to assign or confirm assignment of the Work and the Application to the below identified Assignee.

AND WHEREAS, **Shoulder Innovations, Inc.**, with its principal place of business at **13827 Port Sheldon St., Holland, MI 49424** (hereinafter the "ASSIGNEE"), desires to acquire or confirm ownership of the entire right, title, and interest in and to the Application and the Work.

NOW, THEREFORE, for good and valuable consideration of which receipt is hereby acknowledged, ASSIGNOR hereby acknowledges that ASSIGNOR has sold, assigned, transferred, and set over, and by these presents does hereby sell, assign, transfer, and set over, unto said ASSIGNEE, its successors, legal representatives, and assigns, the entire right, title, and interest throughout the world in and to the Application and the Work, including: all provisional and international applications relating to the Work and the Application (including but not limited to U.S. Provisional Application No. **62/816,708**, filed **March 11, 2019** and **International Application No. PCT/US2020/022094** filed **March 11, 2020**); all nonprovisional applications claiming priority to aforementioned provisional, international application and/or the Application, including, all divisions, continuations, continuations-in-part, and reissues, and all Letters Patent of the United States which may be granted thereon and all reissues and extensions thereof; and all rights of priority under International Conventions and any related Letters Patent which may hereafter be granted or filed in any country or countries foreign to the United States, all extensions, renewals, and reissues thereof.

ASSIGNOR hereby authorizes and requests the Commissioner for Patents of the United States, and any Official of any country or countries foreign to the United States, whose duty it is to issue patents on applications as aforesaid, to issue all related Letters Patent to the ASSIGNEE, its successors, legal representatives, and assigns.

**COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))***Application Data Sheet filed previously or concurrently*

Docket No.: SHOLD.013NP

Page 2 of 4

Title: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

Inventors: Donald E. Running, Robert J. Ball, and Jason Slone

AND ASSIGNOR DOES HEREBY acknowledge and agree that the assigned scope of the Application and the Work includes any currently recited claims, all embodiments, and all claims supported by the Application; Assignor agrees not to contest or disparage claim scope thus supported (including in any later-filed continuing patent applications) for any claims deemed patentable by any government patent office. Assignor also agrees not to challenge the validity, including as a defense to patent infringement, of any issued patent claims resulting from or based on the Work, regardless of the scope of any such claims.

AND ASSIGNOR DOES HEREBY sell, assign, transfer, and convey to ASSIGNEE, its successors, legal representatives, and assigns all claims for damages and all remedies arising out of any violation of the rights assigned hereby that may have accrued prior to the date of assignment to ASSIGNEE, or may accrue hereafter, including, but not limited to, the right to sue for, collect, and retain damages for past infringements of said Letters Patent before or after issuance.

AND ASSIGNOR DOES HEREBY covenant and agree that ASSIGNOR will: communicate to said ASSIGNEE, its successors, legal representatives, and assigns any facts known to ASSIGNOR respecting the Work; testify in any legal proceeding; assist in the preparation of any other Patent Property relating to the Application and the Work or any improvements made thereto; sign/execute all lawful papers; authorize the filing of, execute, and make all rightful oaths and/or declarations in connection with the Application and the Work including any improvements made thereto, any patent applications filed therefrom, and any continuing application filed from any of the aforementioned applications; and generally do everything possible to aid the ASSIGNEE, its successors, legal representatives, and assigns, to obtain and enforce proper patent protection for the Work in all countries.

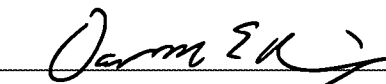
AND ASSIGNOR DOES HEREBY agree that if any term or provision of this agreement becomes invalid or unenforceable, the remainder shall survive unaffected.

---

Legal Name of Inventor: Donald E. Running

IN TESTIMONY WHEREOF, I hereunto set my hand and seal this 27th day of January, 2023.

Signature: \_\_\_\_\_



*Signature before a Notary is desirable but not required. When signed in presence of a Notary, please attach the appropriate notarial documentation.*



**COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))**

*Application Data Sheet filed previously or concurrently*

Docket No.: SHOLD.013NP

Page 3 of 4

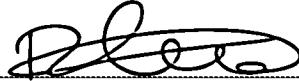
Title: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

Inventors: Donald E. Running, Robert J. Ball, and Jason Slone

Legal Name of Inventor: Robert J. Ball

IN TESTIMONY WHEREOF, I hereunto set my hand and seal this 17th day of Jan,  
20 23.

Signature: \_\_\_\_\_



*Signature before a Notary is desirable but not required. When signed in presence of a Notary, please attach the appropriate notarial documentation.*

**COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))**

*Application Data Sheet filed previously or concurrently*

Docket No.: SHOLD.013NP

Page 4 of 4

Title: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

Inventors: Donald E. Running, Robert J. Ball, and Jason Slone

Legal Name of Inventor: Jason Slone

IN TESTIMONY WHEREOF, I hereunto set my hand and seal this 17th day of January,  
2023.

Signature: William J. Slone

*Signature before a Notary is desirable but not required. When signed in presence of a Notary, please attach the appropriate notarial documentation.*



## ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #  
**18/058,058**

RECEIPT DATE / TIME  
**04/20/2023 06:36:13 PM ET**

ATTORNEY DOCKET #  
**SHOLD.013C1**

### Title of Invention

TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

### Application Information

APPLICATION TYPE Utility - Nonprovisional Application  
under 35 USC 111(a)

PATENT # -

CONFIRMATION # 5500

FILED BY Rio Competente

PATENT CENTER # 61958888

FILING DATE 11/22/2022

CUSTOMER # 20995

FIRST NAMED  
INVENTOR Donald E. Running

CORRESPONDENCE  
ADDRESS -

AUTHORIZED BY Andrew Kimmel

### Documents

**TOTAL DOCUMENTS: 4**

| DOCUMENT                                                            | PAGES | DESCRIPTION                                | SIZE (KB) |
|---------------------------------------------------------------------|-------|--------------------------------------------|-----------|
| 2023-04-20 Response to<br>Informational Notice -<br>SHOLD.013C1.pdf | 1     | Miscellaneous Incoming Letter              | 16 KB     |
| 2023-04-20 Comments<br>Reasons Allowance -<br>SHOLD.013C1.pdf       | 2     | Post Allowance Communication<br>- Incoming | 19 KB     |
| Signed Declaration<br>Assignment -<br>SHOLD.013C1.pdf               | 4     | Oath or Declaration filed                  | 168 KB    |
| 2023-04-20 Issue Fee<br>Transmittal -<br>SHOLD.013C1.PDF            | 1     | Issue Fee Payment (PTO-85B)                | 199 KB    |

## Digest

| DOCUMENT                                                            | MESSAGE DIGEST(SHA-512)                                                                                                                  |
|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 2023-04-20 Response to<br>Informational Notice -<br>SHOLD.013C1.pdf | 0248F07A8C31A30B05C68E8ED1658881FCC66D68FD65B7485<br>EE0A435368ADBE1DE5FEBDFDA4CA2557C3856CE1AB03D737<br>56F31752B9A3AD5F5C6CC978B299B38 |
| 2023-04-20 Comments<br>Reasons Allowance -<br>SHOLD.013C1.pdf       | D1241550FF8C5CB0F8E0151B453A9CA1FA2C67666E37493439<br>C3D97E522FA0D98F4F866D3ACE79D12FDF9E847C1794C4094<br>1F9A10F24BFD0BFB841AC1DADC331 |
| Signed Declaration Assignment<br>- SHOLD.013C1.pdf                  | 062B99582F946A7C57DAB5FD5A0FA36844636F9C670F8F4DA<br>638C4838BD600B7F716ED974BB1212E781A0B702D5CB2EF59<br>A17FCCC0D7153F05C2F1EB3D43D397 |
| 2023-04-20 Issue Fee<br>Transmittal -<br>SHOLD.013C1.PDF            | 5B2486343B2D3922732488D2F5903EC4214A4FACD42E280560<br>B8184CBEB6201ED12138BE20C5969D93F4F5A385EA9E54360<br>5CA213A327A168265B32DCF244E0E |

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

### **New Applications Under 35 U.S.C. 111**

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

### **National Stage of an International Application under 35 U.S.C. 371**

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

### **New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

## PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

**INSTRUCTIONS:** This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize dependency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

20995 7590 04/18/2023  
KNOBBE MARTENS OLSON & BEAR LLP  
2040 MAIN STREET  
FOURTEENTH FLOOR  
IRVINE, CA 92614

#### Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

|                         |
|-------------------------|
| (Typed or printed name) |
| (Signature)             |
| (Date)                  |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 18/058,058      | 11/22/2022  | Donald E. Running    | SHOLD.013C1         | 5500             |

TITLE OF INVENTION: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | SMALL         | \$480         | \$0.00              | \$0.00               | \$480            | 07/18/2023 |

| EXAMINER           | ART UNIT | CLASS-SUBCLASS |
|--------------------|----------|----------------|
| SCHILLINGER, ANN M | 3774     | 623-019130     |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Knobbé, Martens,

2 Olson & Bear, LLP

3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY AND STATE OR COUNTRY)

Shoulder Innovations, Inc.

Holland, Michigan

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

☒ Electronic Payment via Patent Center or EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 11-1410

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Andrew I. Kimmel/

Date April 20, 2023

Typed or printed name Andrew I. Kimmel

Registration No. 58,855



## ELECTRONIC PAYMENT RECEIPT

APPLICATION #  
18/058,058

RECEIPT DATE / TIME  
04/20/2023 06:36:13 PM ET

ATTORNEY DOCKET #  
SHOLD.013C1

### Title of Invention

TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

### Application Information

APPLICATION TYPE Utility - Nonprovisional Application  
under 35 USC 111(a)

PATENT # -

CONFIRMATION # 5500

FILED BY Rio Competente

PATENT CENTER # 61958888

AUTHORIZED BY Andrew Kimmel

CUSTOMER # 20995

FILING DATE 11/22/2022

CORRESPONDENCE  
ADDRESS -

FIRST NAMED  
INVENTOR Donald E. Running

### Payment Information

PAYMENT METHOD  
CARD / 3259

PAYMENT TRANSACTION ID  
E20234J138427335

PAYMENT AUTHORIZED BY  
Fabiola Esmerio

PRE-AUTHORIZED ACCOUNT  
111410

PRE-AUTHORIZED CATEGORY  
37 CFR 1.16 (National application filing, search, and examination fees); 37  
CFR 1.17 (Patent application and reexamination processing fees)

| FEE CODE      | DESCRIPTION       | ITEM PRICE(\$) | QUANTITY | ITEM TOTAL(\$) |
|---------------|-------------------|----------------|----------|----------------|
| 2501          | UTILITY ISSUE FEE | 480.00         | 1        | 480.00         |
| TOTAL AMOUNT: |                   |                |          | \$480.00       |

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

#### New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

**National Stage of an International Application under 35 U.S.C. 371**

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

**New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

---

**COMMENTS ON STATEMENT OF REASONS FOR ALLOWANCE**

|                                                          |                                 |
|----------------------------------------------------------|---------------------------------|
| <b>First Inventor:</b> Running, Donald E.                | <b>Conf. No.:</b> 5500          |
| <b>App. No.:</b> 18/058058                               | <b>Filed:</b> November 22, 2022 |
| <b>Examiner:</b> Schillinger, Ann M.                     | <b>Art Unit:</b> 3774           |
| <b>Title:</b> TOTAL REVERSE SHOULDER SYSTEMS AND METHODS |                                 |

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Commissioner:

Applicant thanks the Examiner for indicating that the pending claims are allowable. In response to the Examiner's Statement of Reasons for Allowance accompanying the Notice of Allowance dated April 18, 2023 ("Reasons"), Applicant respectfully submits the following comments:

To the extent that there is any implication that the patentability of these allowed claims rests on the recitation of a certain feature or features and not each claim as a whole, Applicant respectfully disagrees with the Reasons. Further, to the extent that the Reasons omit claim elements, group claims together, or identify purportedly distinguishing features of a claim or a group of claims, Applicant respectfully disagrees with the Reasons. Rather, Applicant submits that the allowed claims are allowable, because each claim, taken as a whole, recites a unique combination of features that is not anticipated or rendered obvious by the prior art.

Applicant further respectfully notes that the Reasons have characterized various teachings of some cited references. To the extent that there is any implication that the cited references are the closest prior art, Applicant does not necessarily agree. Additionally, Applicant does not concede that the characterizations of the cited references are accurate or complete. Further, Applicant does not concede the cited references teach or suggest other features of the claims that are not discussed in the Reasons.

In addition, Applicant assumes that, pursuant to M.P.E.P. § 1302.14, the Examiner has stated some, but not all, of the reasons for allowance of the claims. As a result, the Reasons do not necessarily relate to or completely set out the reasons for allowance of each and every claim. For example, Applicant submits that the claims depending from the independent claim recite additional features distinguishing the art of record.



Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: April 20, 2023

By:           /Andrew I. Kimmel/            
Andrew I. Kimmel  
Registration No. 58,855  
Registered Practitioner  
(949) 760-0404

57490638

---

**SUBMISSION OF REPLACEMENT DRAWINGS**

|                                                          |                                 |
|----------------------------------------------------------|---------------------------------|
| <b>First Inventor:</b> Running, Donald E.                | <b>Conf. No.:</b> 5500          |
| <b>App. No.:</b> 18/058058                               | <b>Filed:</b> November 22, 2022 |
| <b>Examiner:</b> Schillinger, Ann M.                     | <b>Art Unit:</b> 3774           |
| <b>Title:</b> TOTAL REVERSE SHOULDER SYSTEMS AND METHODS |                                 |

**Mail Stop Issue Fee**

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Dear Commissioner:

Enclosed for filing in the above-referenced application is the following:

(X) Replacement Drawings

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON &amp; BEAR, LLP

Dated: April 20, 2023By: /Andrew I. Kimmel/

Andrew I. Kimmel

Registration No. 58,855

Registered Practitioner

(949) 760-0404

57493926

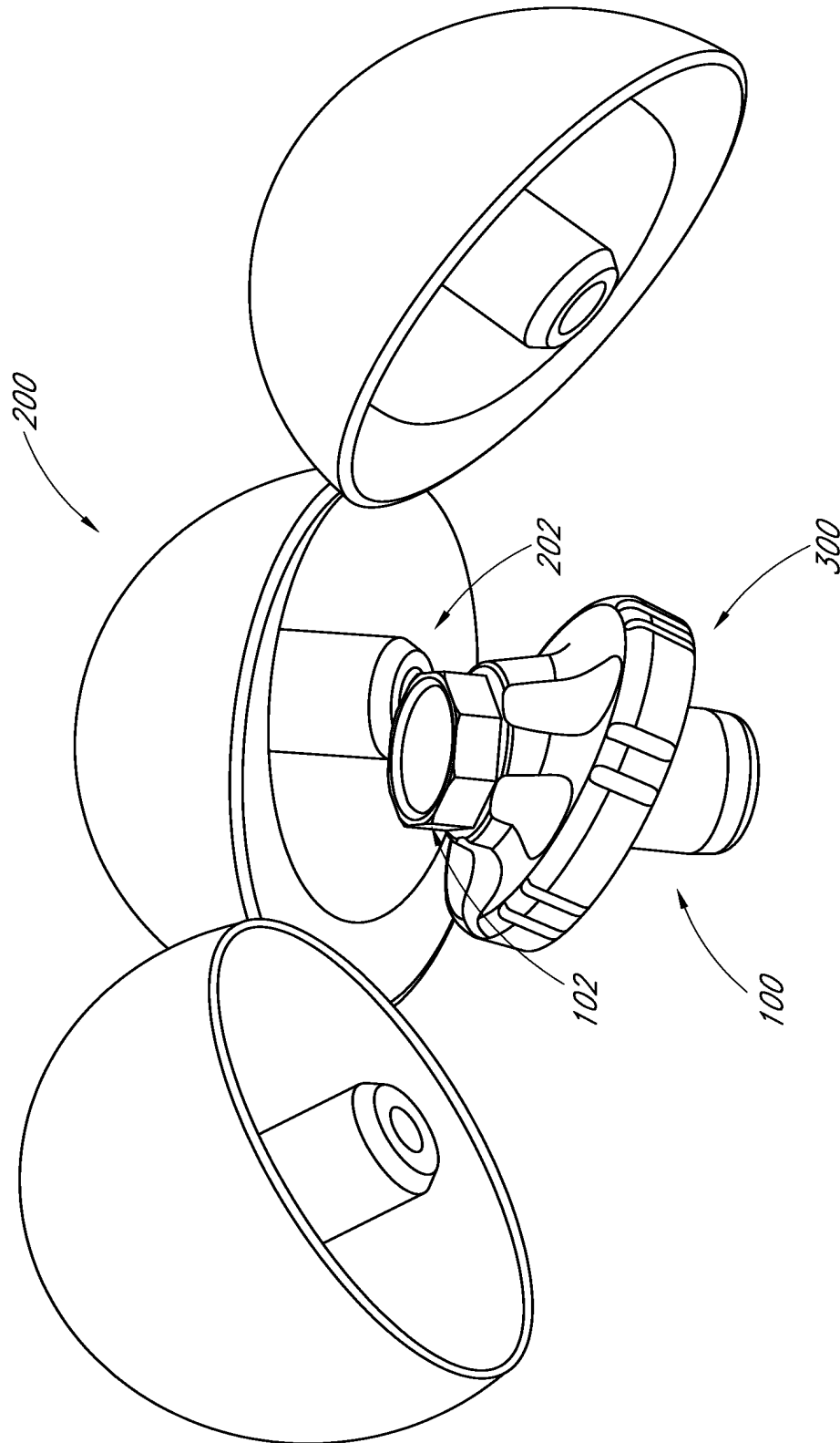


*FIG. 1*

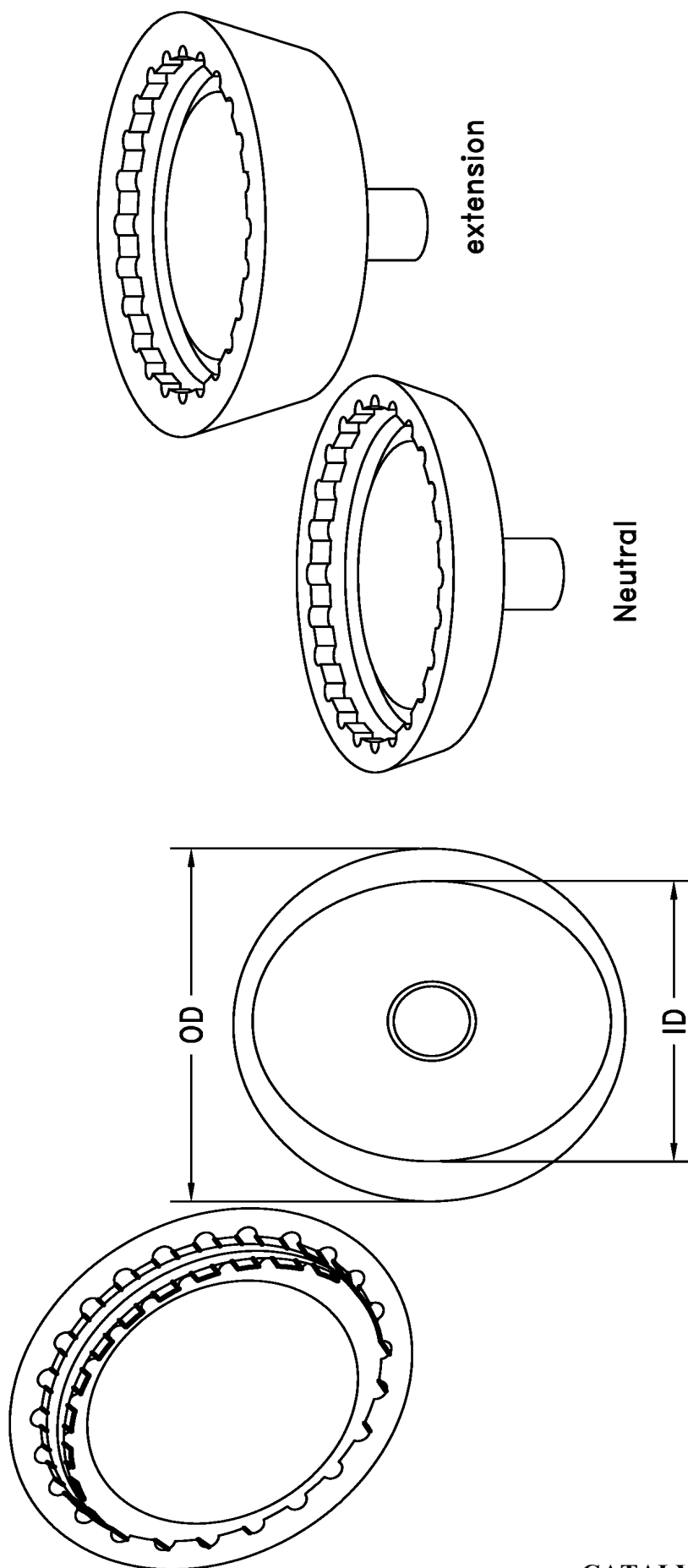


FIG. 2

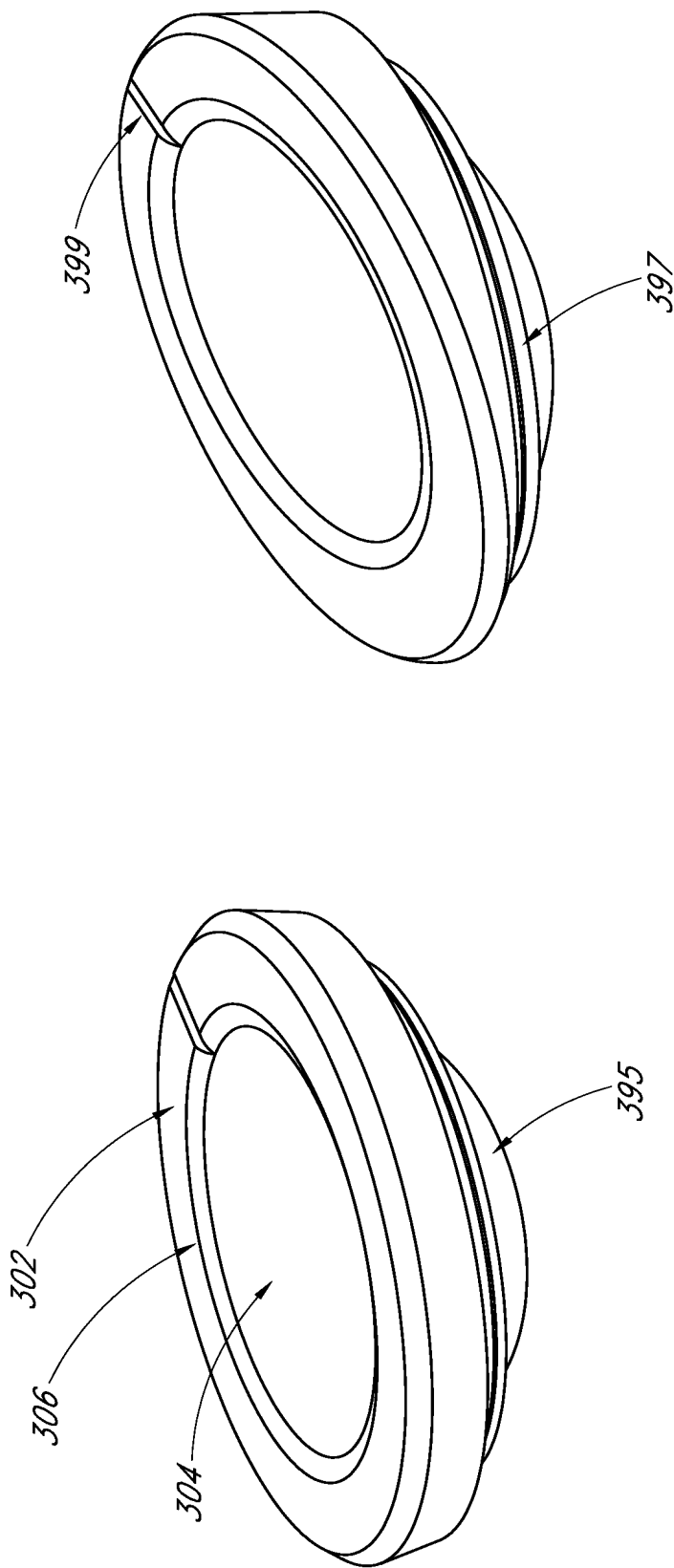


FIG. 3

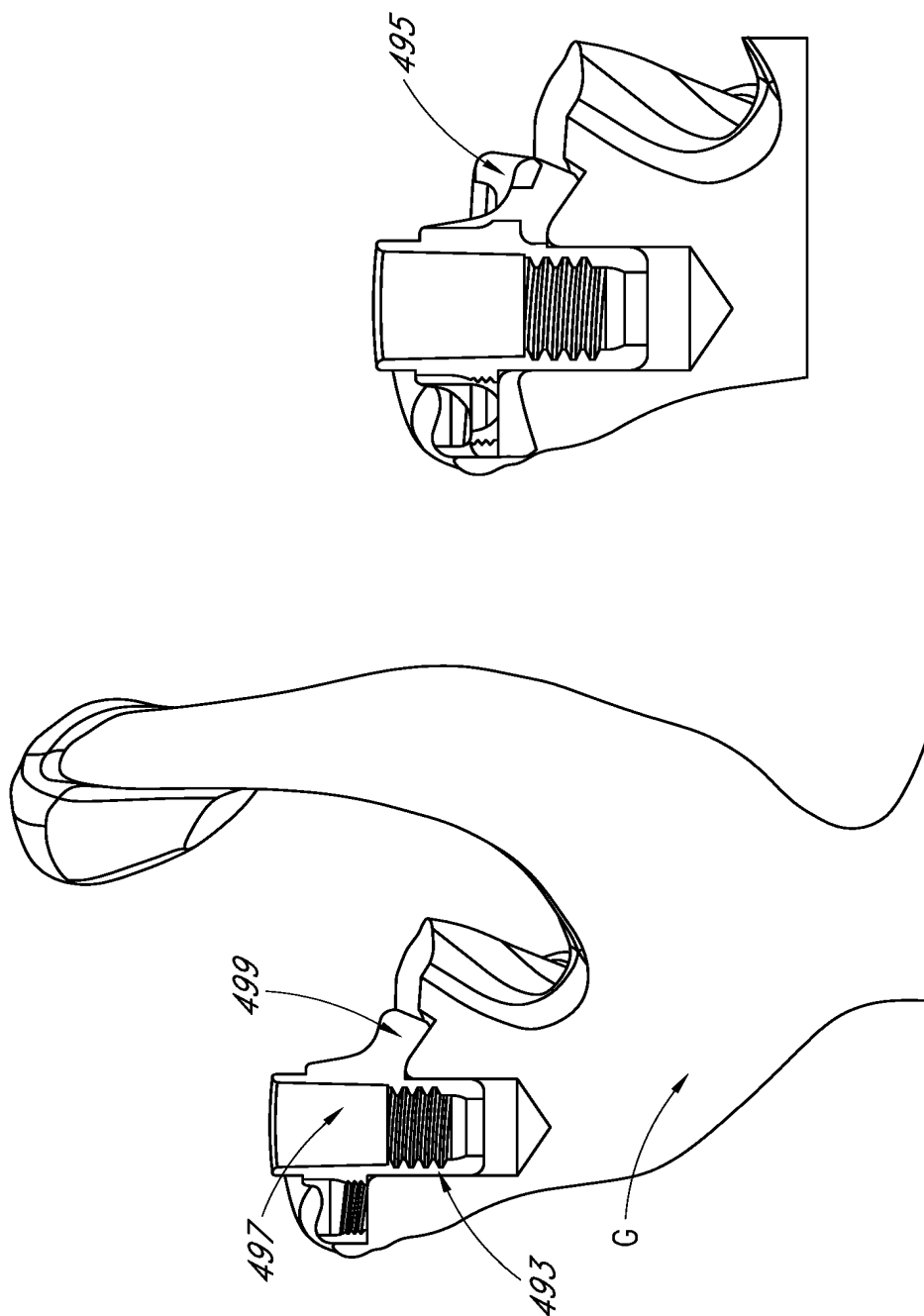


*FIG. 4*

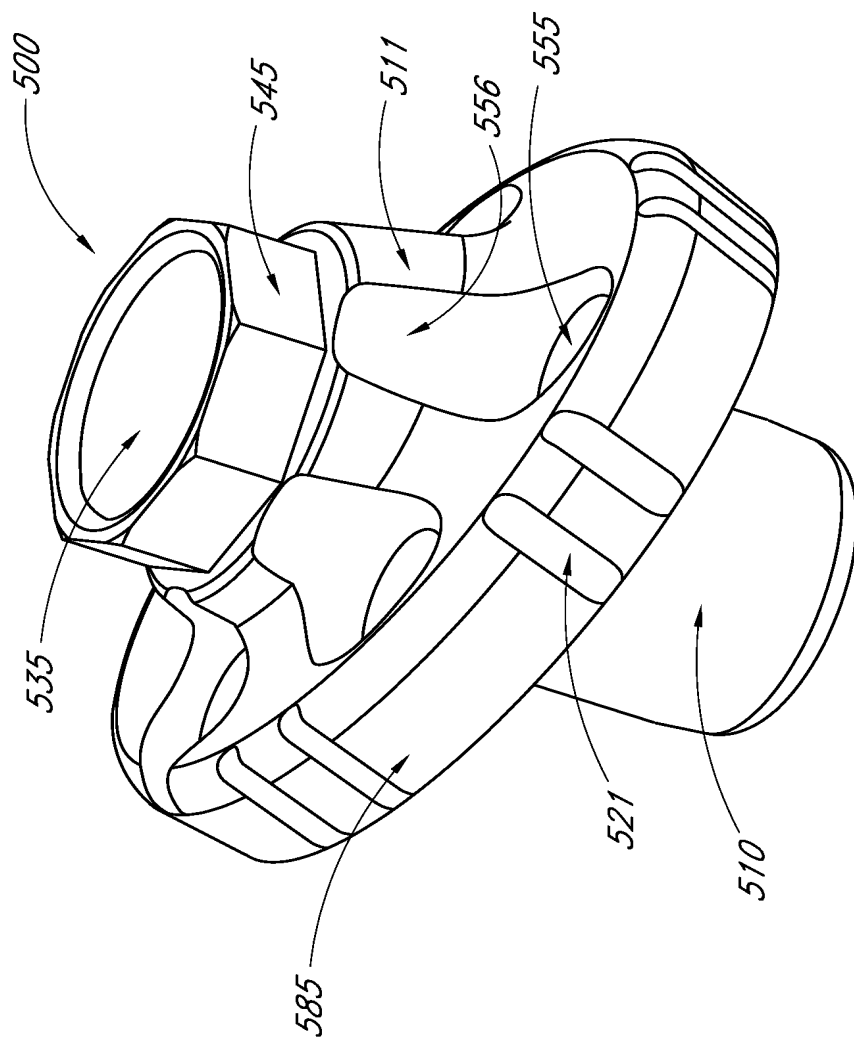


FIG. 5

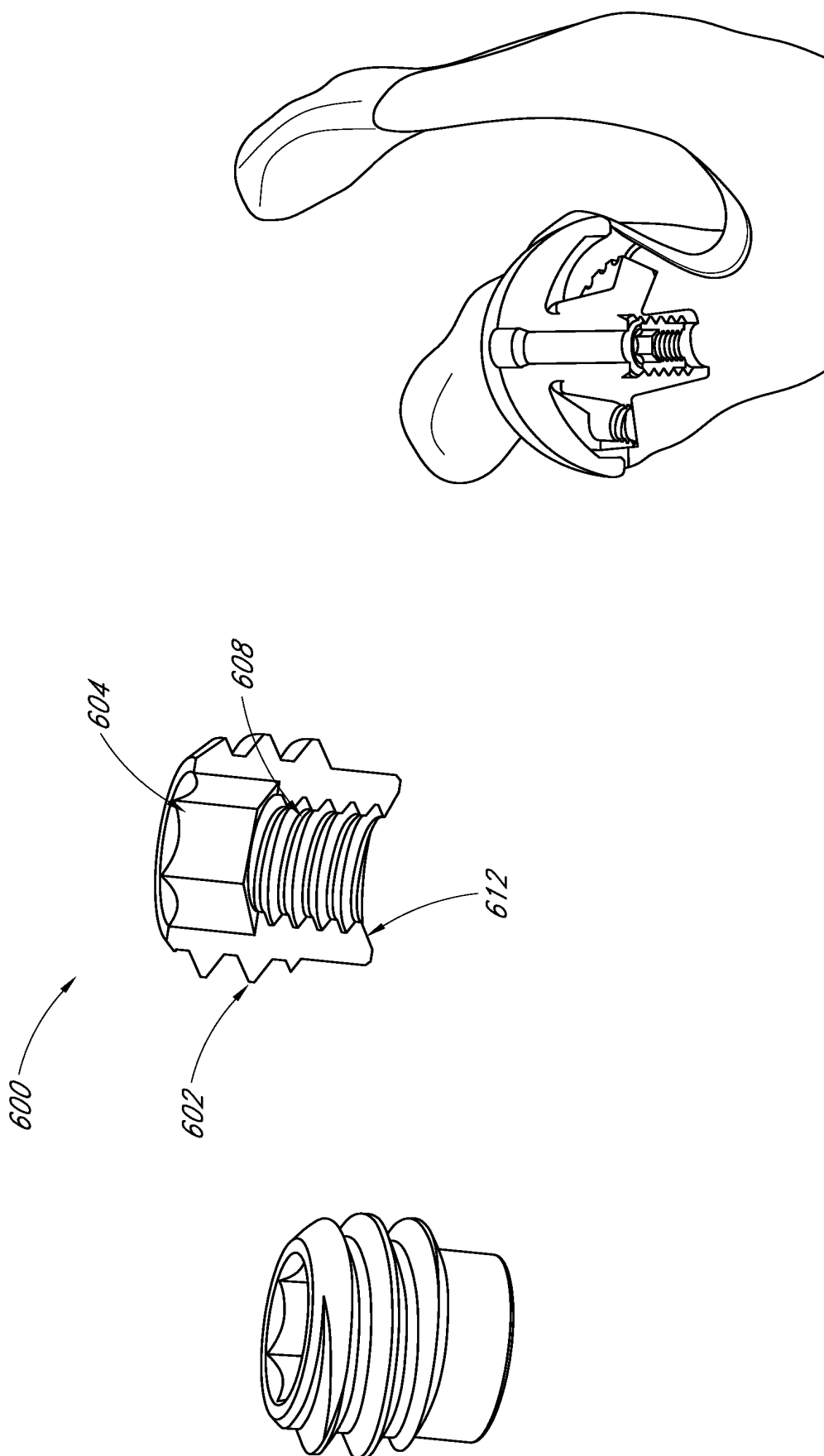


FIG. 6



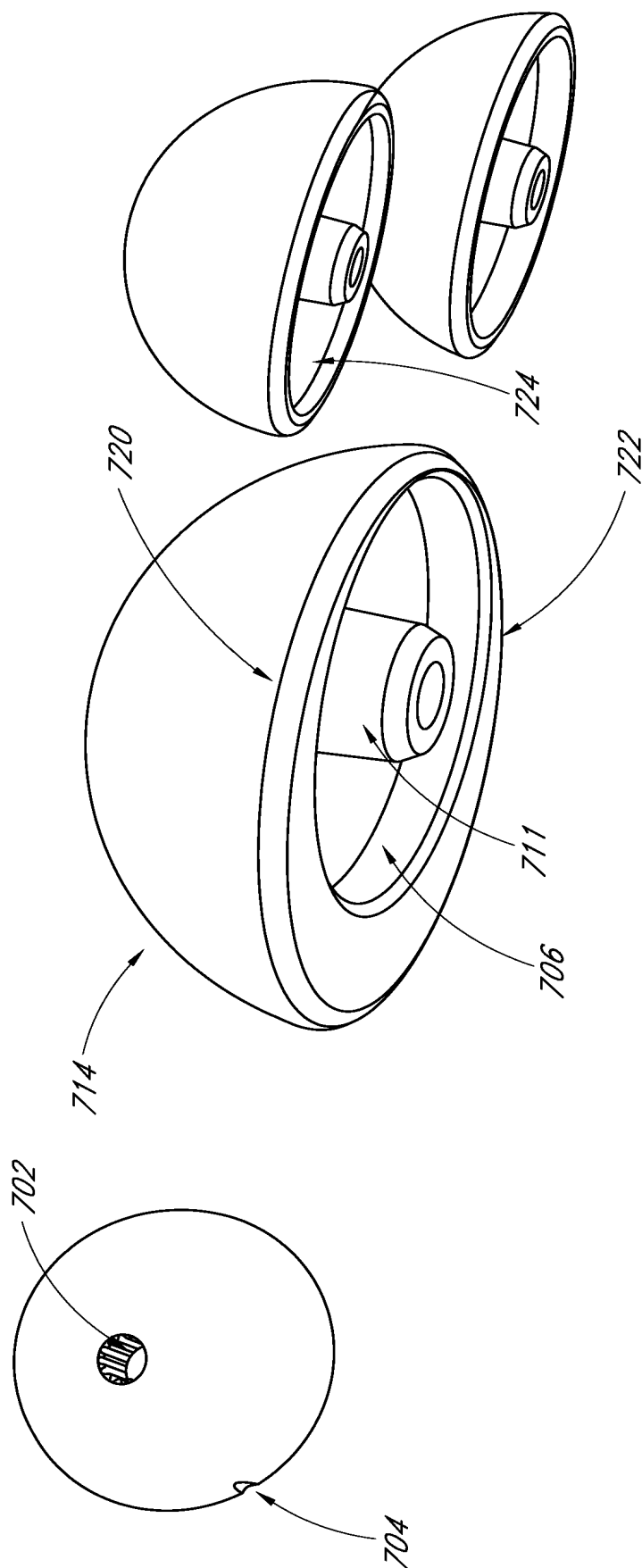


FIG. 7

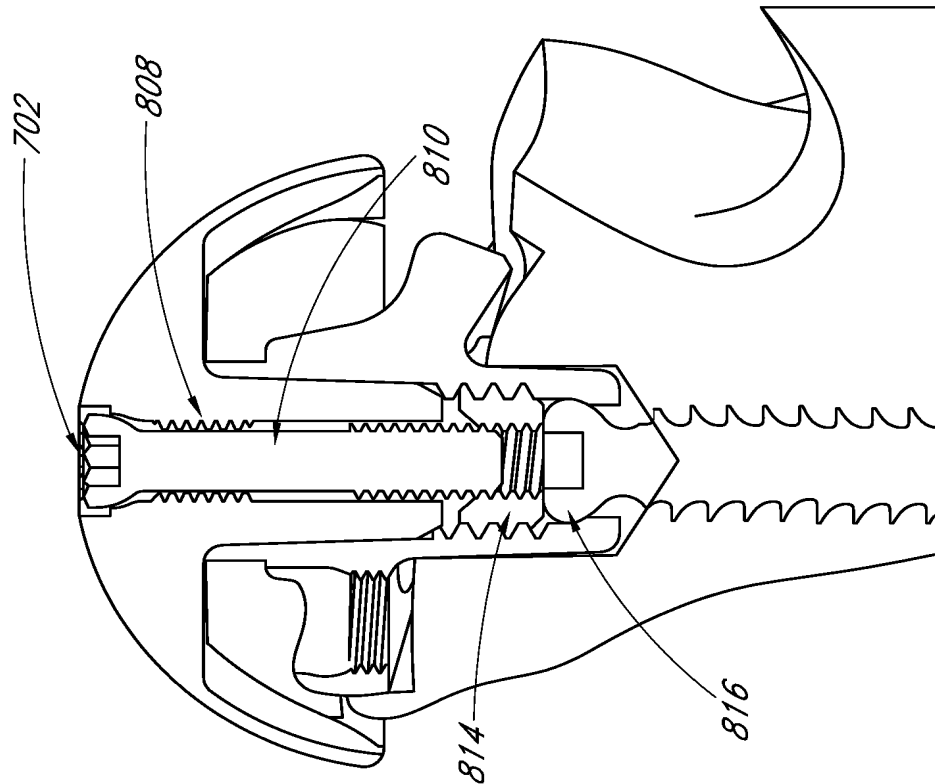


FIG. 8

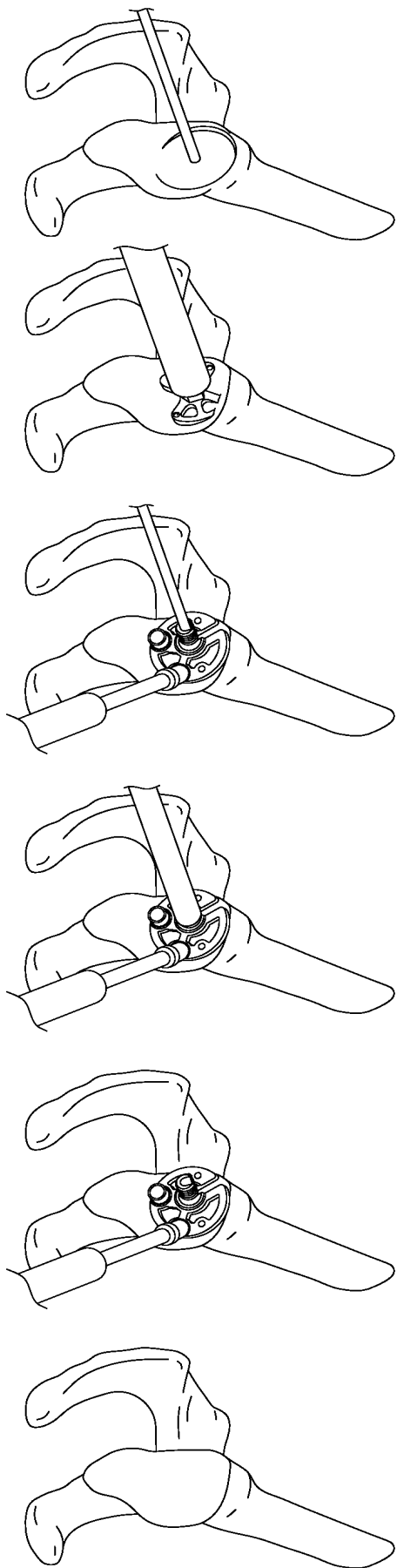


FIG. 8A FIG. 8B FIG. 8C FIG. 8D FIG. 8E FIG. 8F

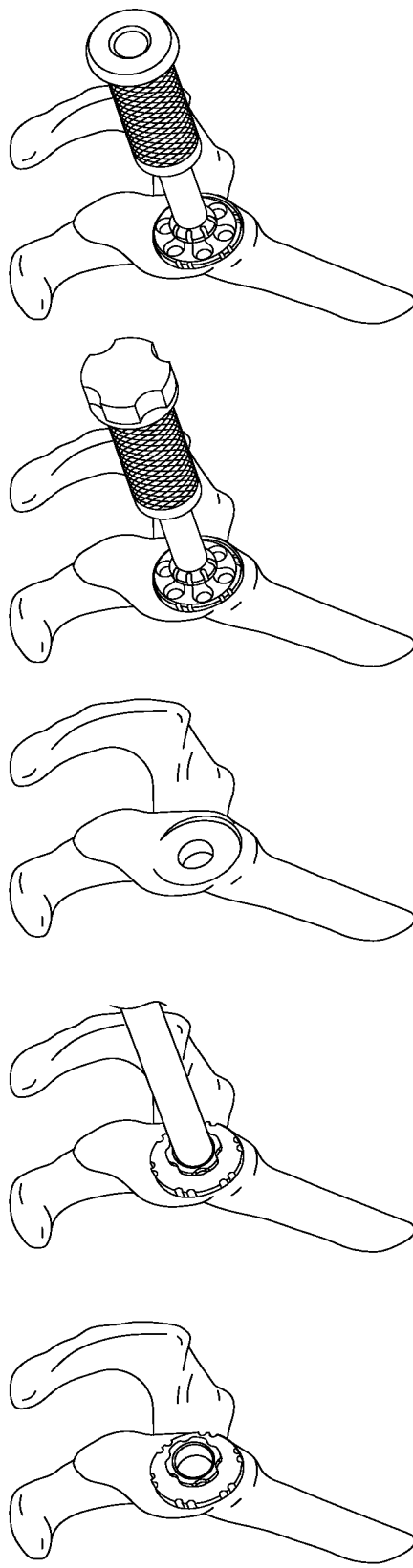


FIG. 8G FIG. 8H FIG. 8I FIG. 8J FIG. 8K

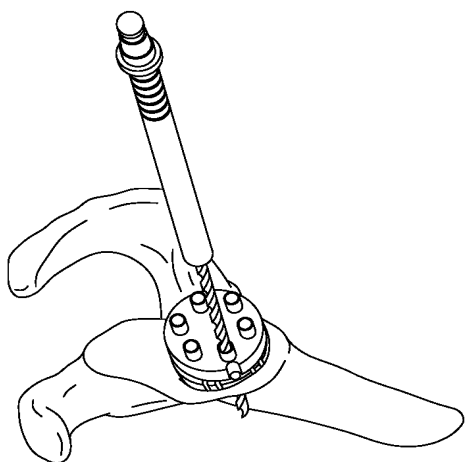


FIG. 8P

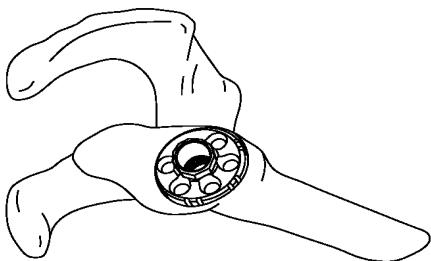


FIG. 8O

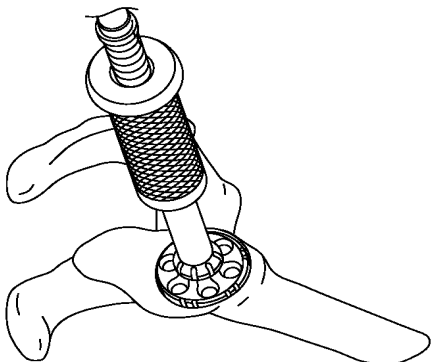


FIG. 8N

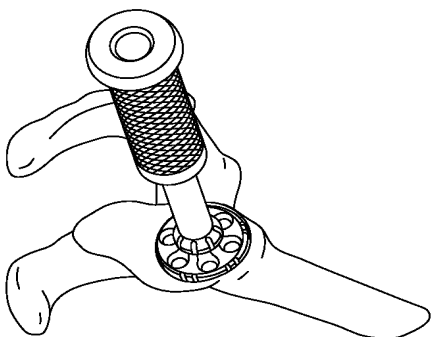


FIG. 8M

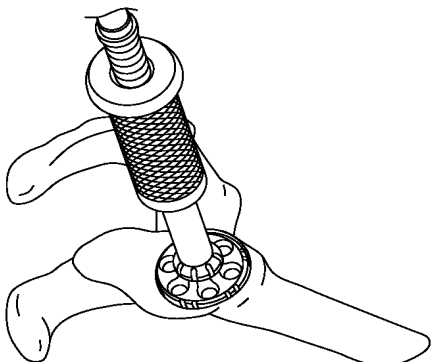


FIG. 8L

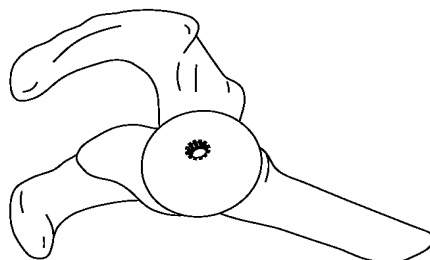


FIG. 8U

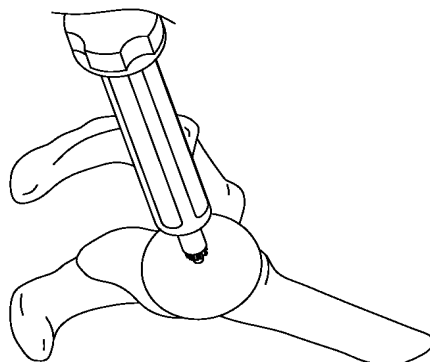


FIG. 8T

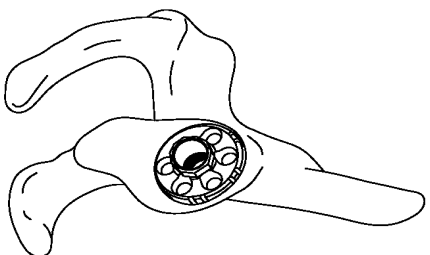


FIG. 8S

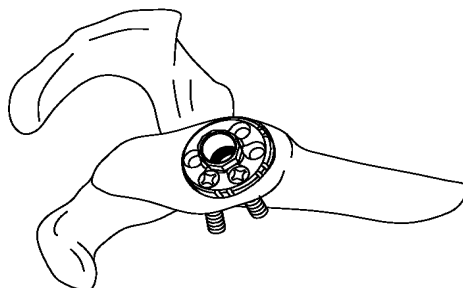


FIG. 8R

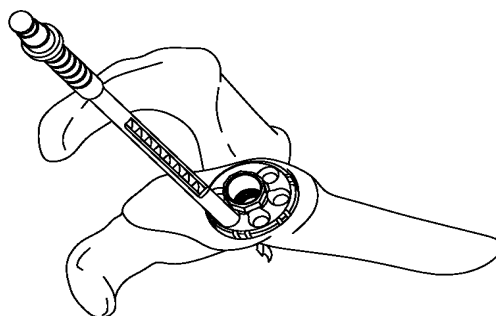


FIG. 8Q

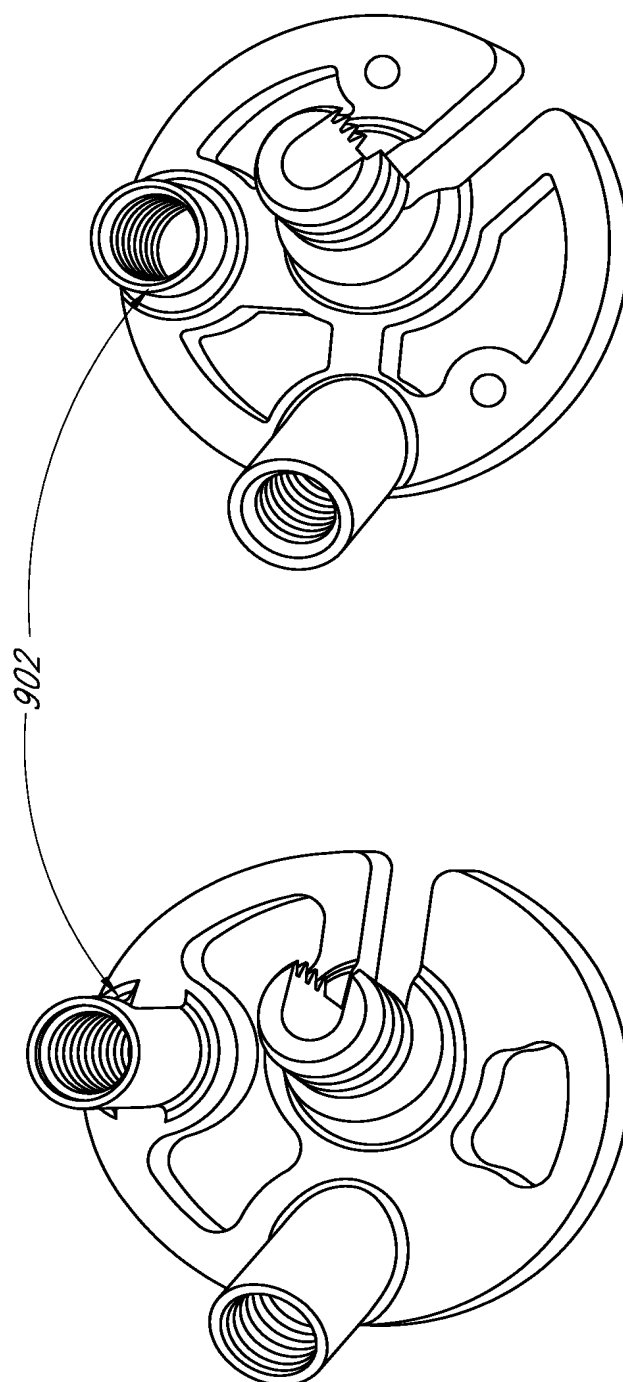


*FIG. 9*

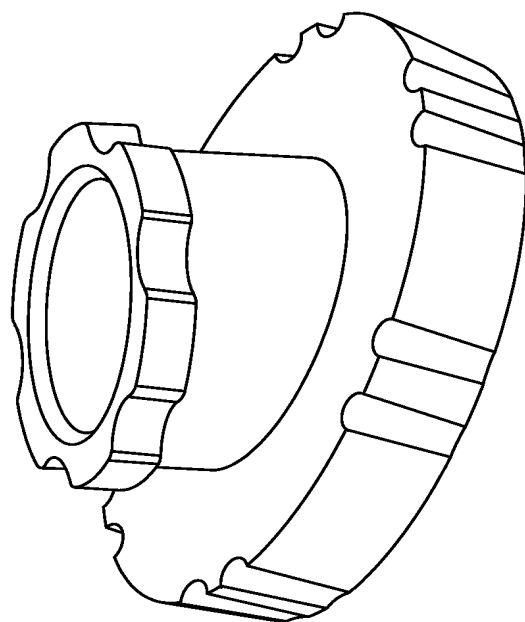


*FIG. 10*

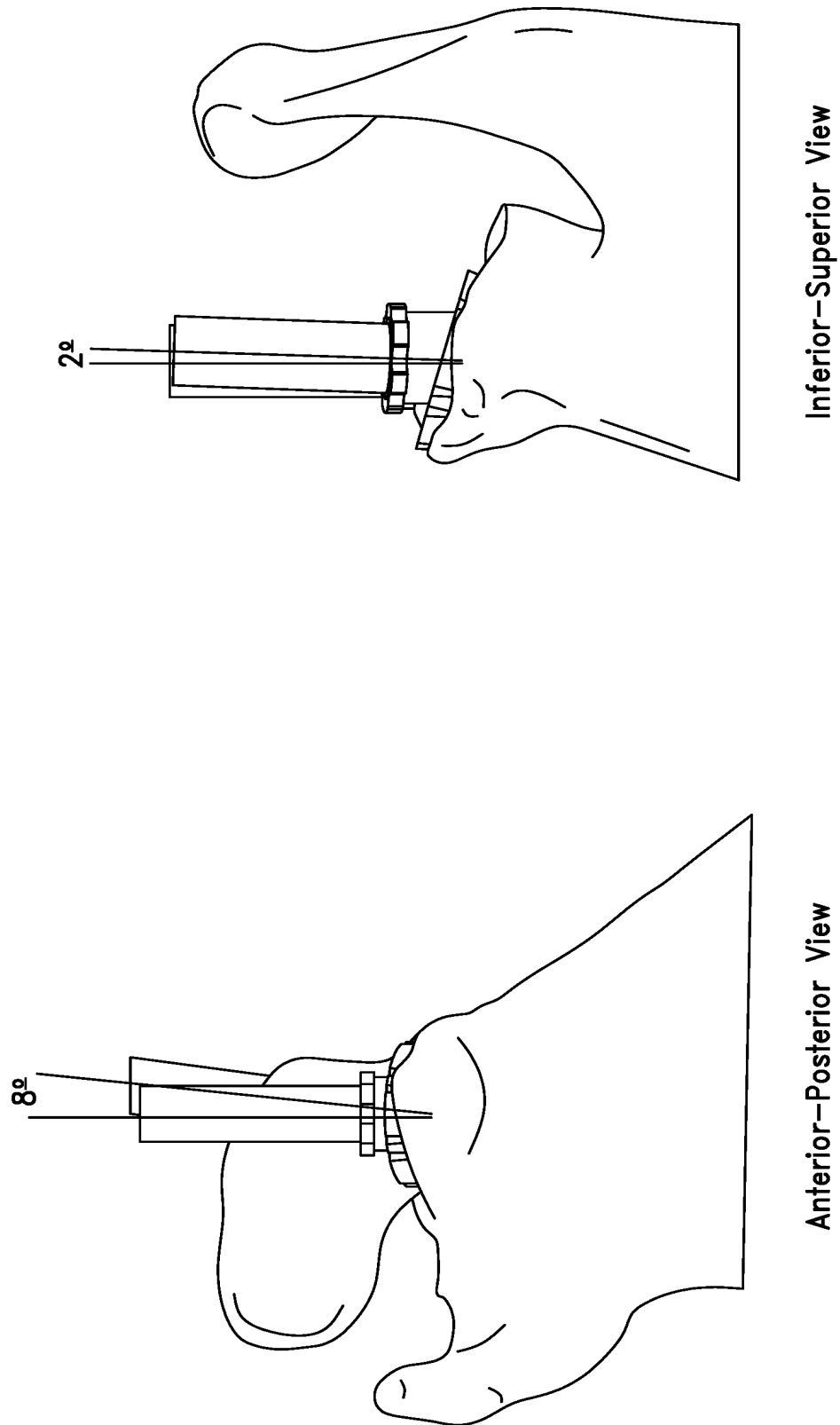


*FIG. 11*

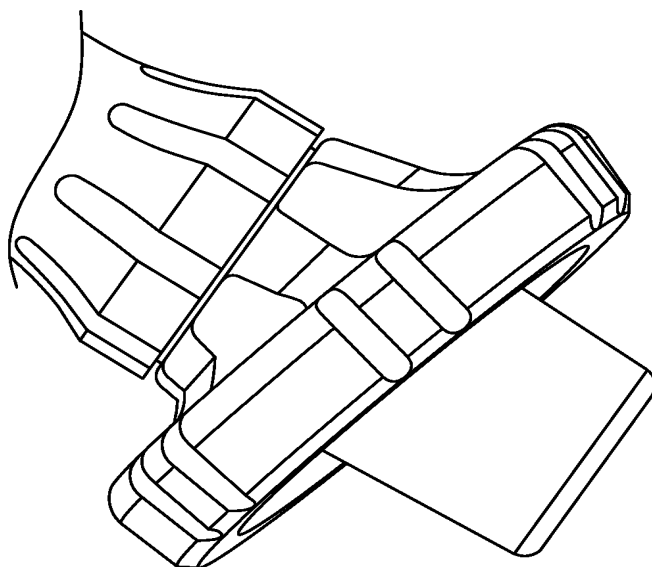
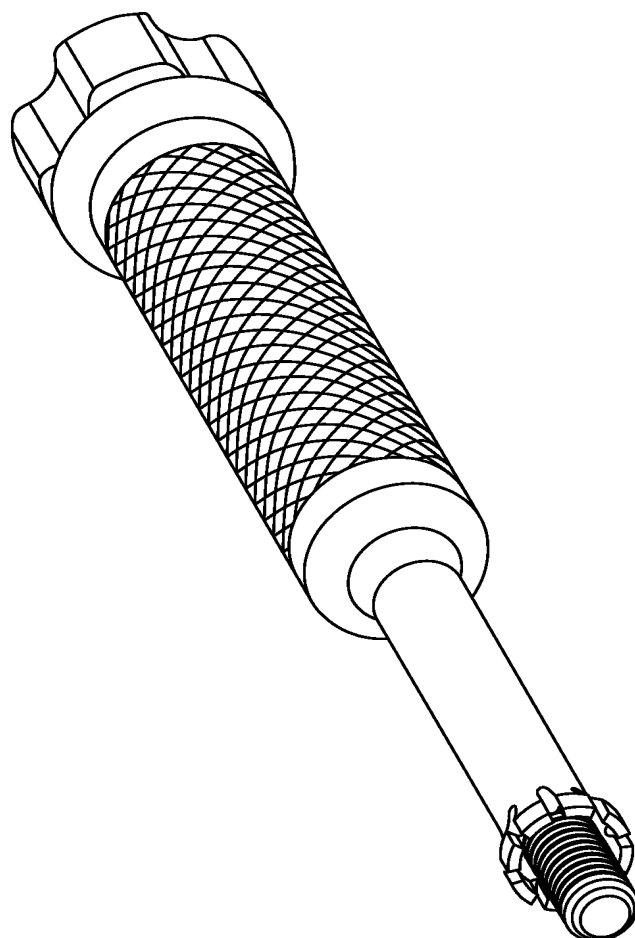


*FIG. 12*



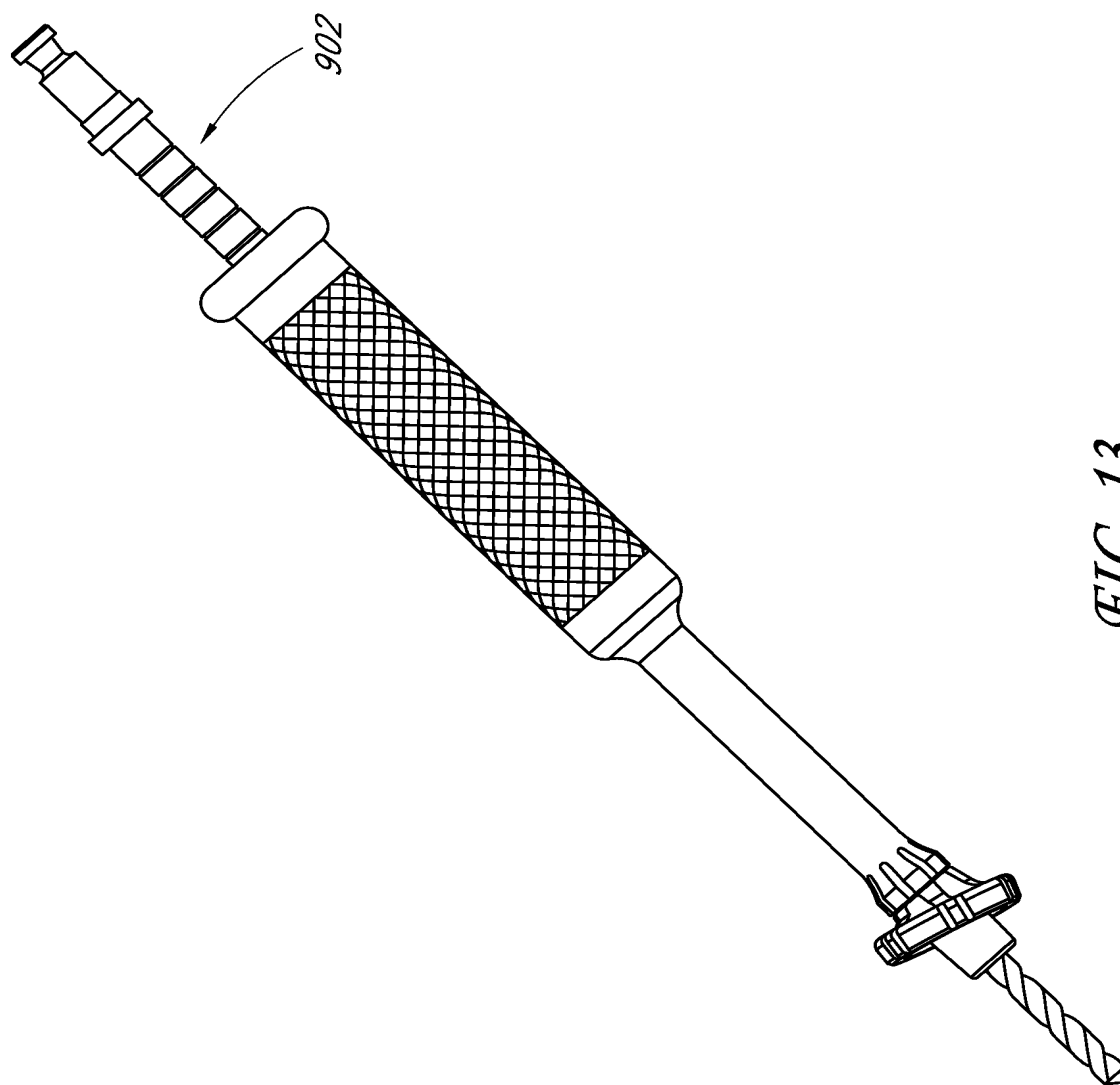


*FIG. 13*

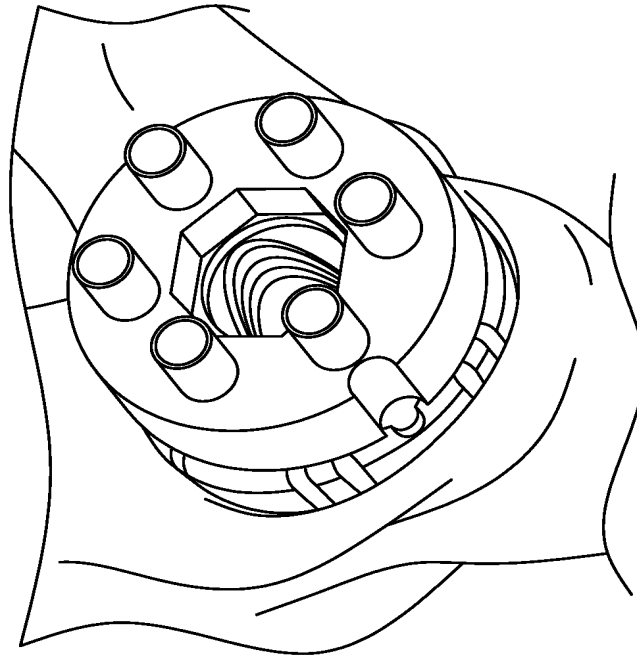
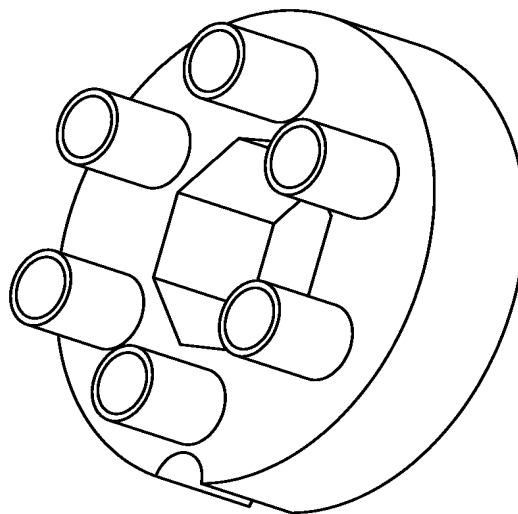


*FIG. 14*



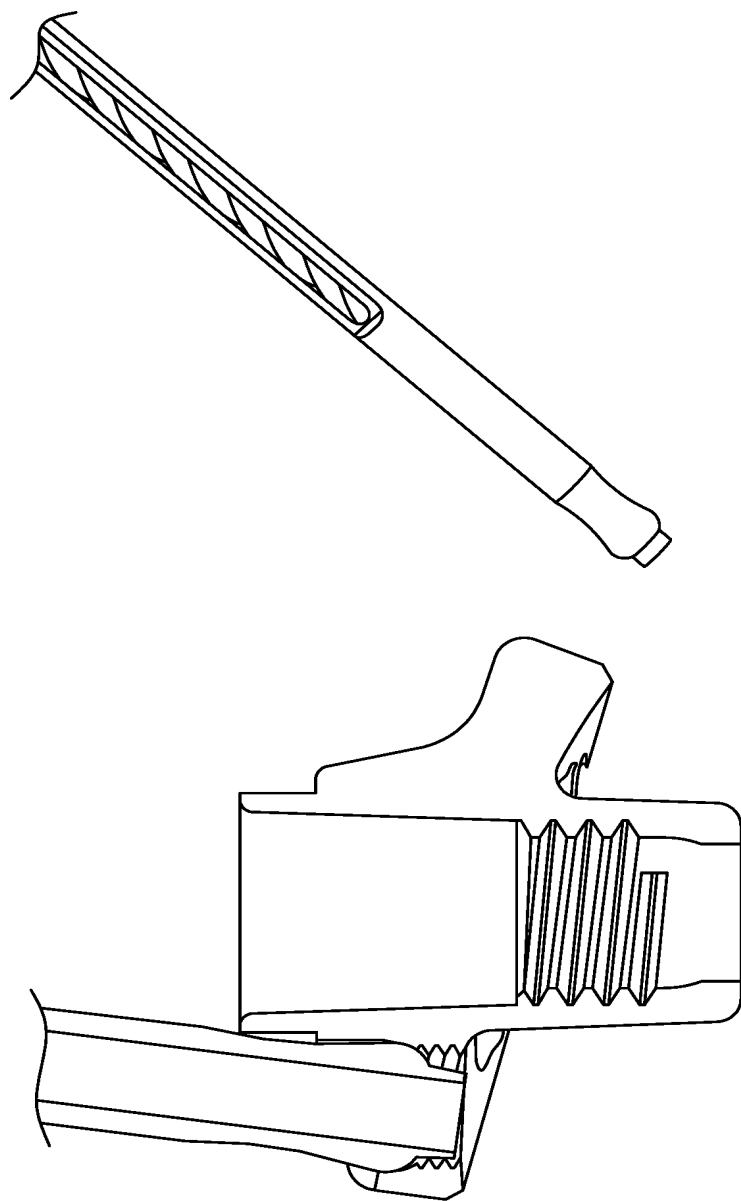
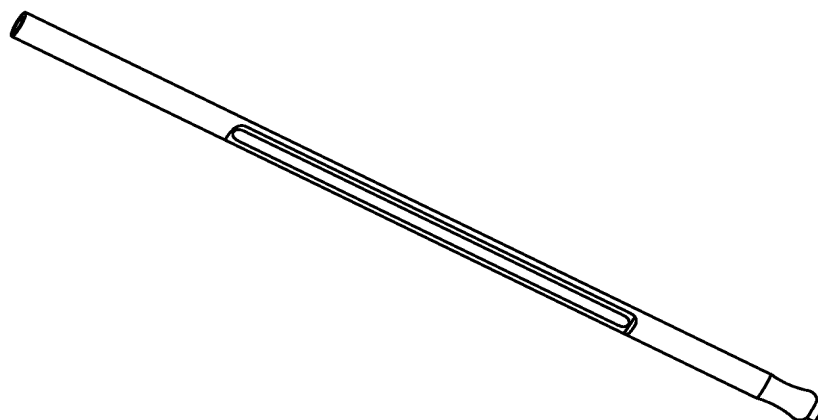


*FIG. 15*



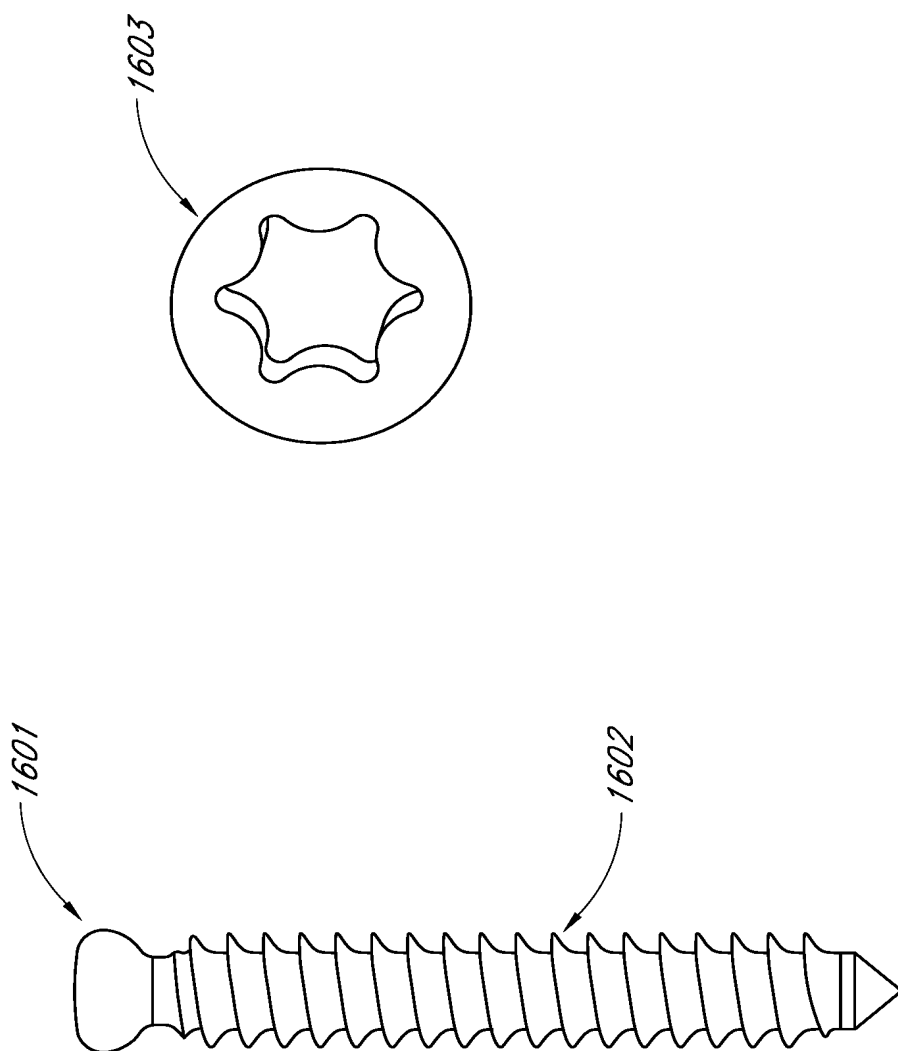


*FIG. 16*

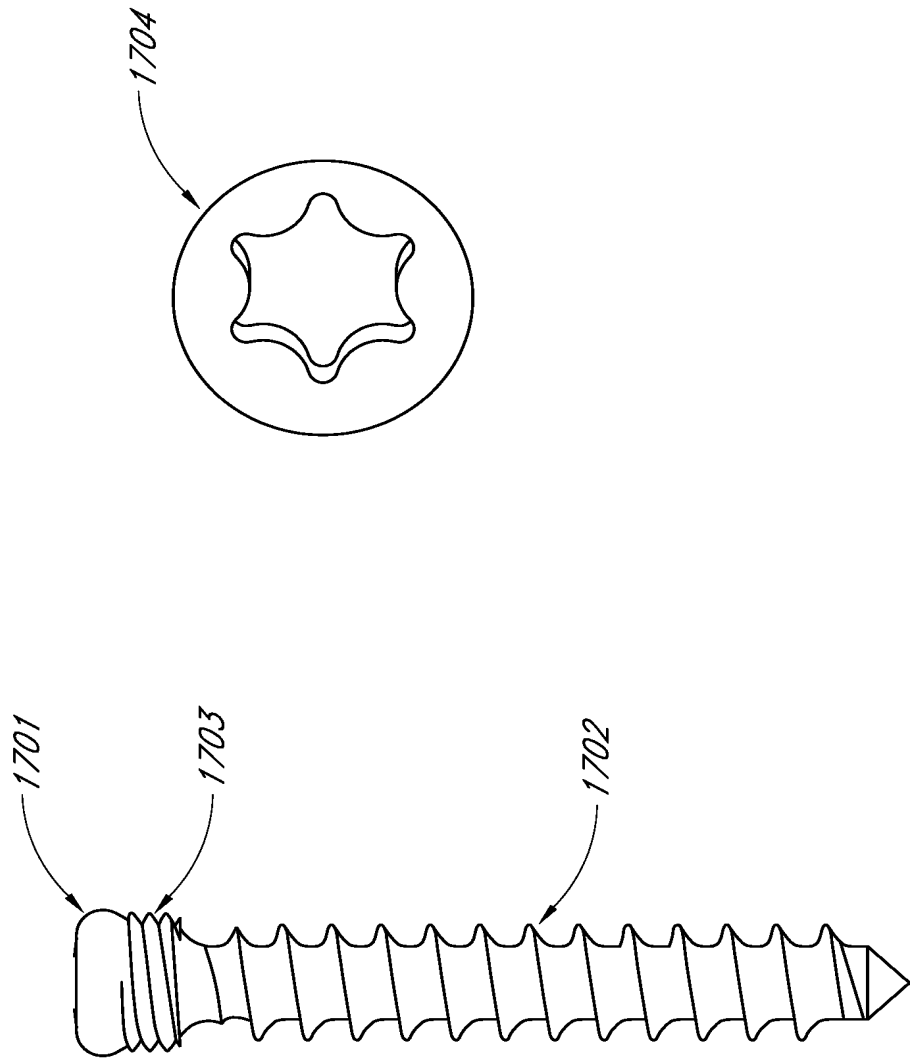


*FIG. 17*

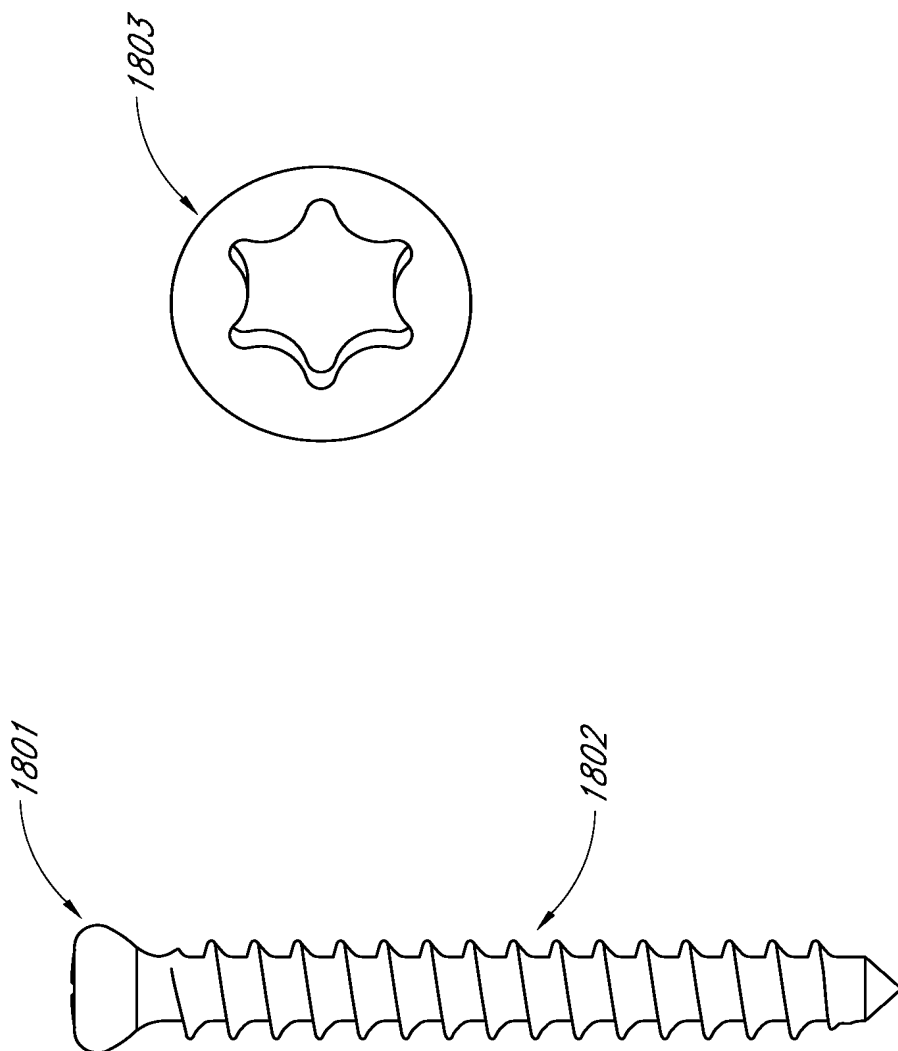


*FIG. 18*

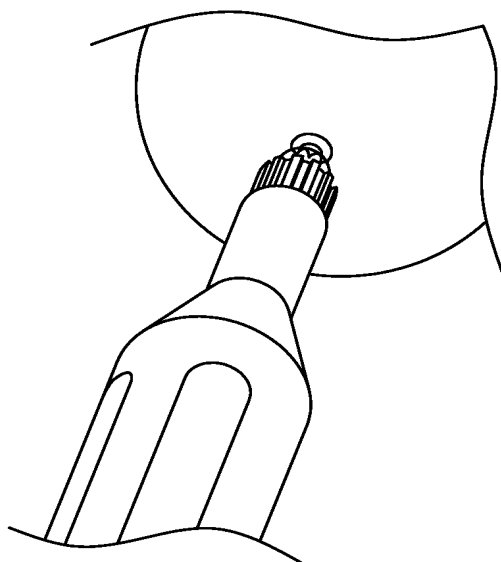
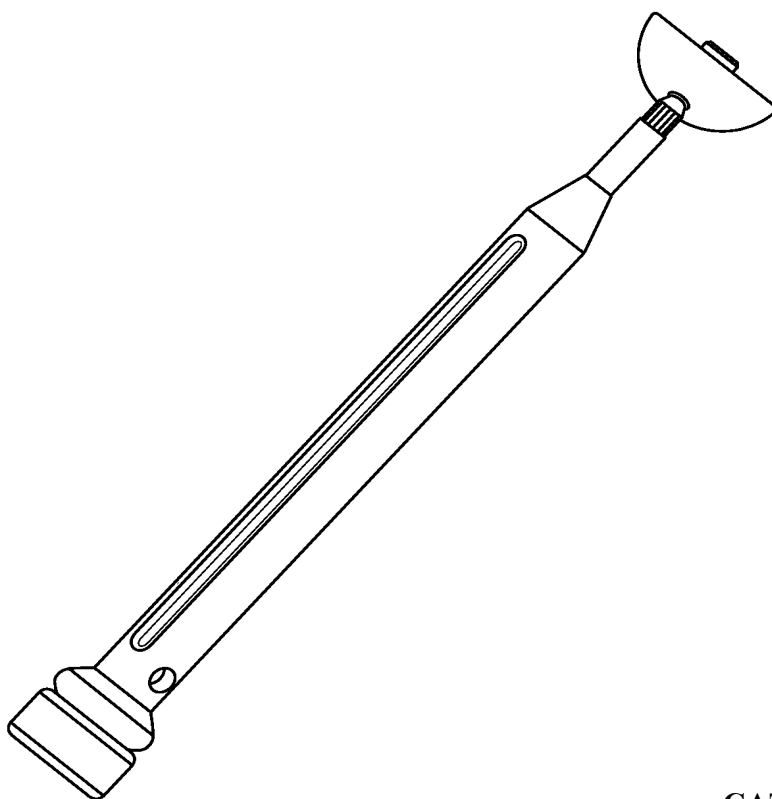


*FIG. 19*



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## ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #  
**18/058,058**

RECEIPT DATE / TIME  
**04/20/2023 07:20:33 PM ET**

ATTORNEY DOCKET #  
**SHOLD.013C1**

### Title of Invention

TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

### Application Information

APPLICATION TYPE Utility - Nonprovisional Application  
under 35 USC 111(a)

PATENT # -

CONFIRMATION # 5500

FILED BY Rio Competente

PATENT CENTER # 61959262

FILING DATE 11/22/2022

CUSTOMER # 20995

FIRST NAMED INVENTOR Donald E. Running

CORRESPONDENCE ADDRESS -

AUTHORIZED BY Andrew Kimmel

### Documents

**TOTAL DOCUMENTS: 2**

| DOCUMENT                             | PAGES | DESCRIPTION                                 | SIZE (KB) |
|--------------------------------------|-------|---------------------------------------------|-----------|
| Drawings_Transmittal-SHOLD-013C1.pdf | 1     | Transmittal Letter                          | 15 KB     |
| Replacement Drawings-SHOLD.013C1.pdf | 21    | Drawings-only black and white line drawings | 2119 KB   |

### Digest

| DOCUMENT                             | MESSAGE DIGEST(SHA-512)                                                                               |
|--------------------------------------|-------------------------------------------------------------------------------------------------------|
| Drawings_Transmittal-SHOLD-013C1.pdf | 145FCD9DEAD17381D8BD1345C7E857544D8BBCA7F11303AF<br>E3CA7026016632CC53CAF1D11A8554B86E0C65EDC55084608 |



01908868C83C1621B44FC8DF02CAB5C

Replacement Drawings-  
SHOLD.013C1.pdf

28A1B6D93906EBDAE9C1F5B66FDB637FB31EC082828DB7AF  
ECF589BF99115D8C8393B1B4CFBB1ECF54111660CA98A318C  
8CA74A0257A89030DF9FEF00786AA99

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If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

**National Stage of an International Application under 35 U.S.C. 371**

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

**New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

TO: cassie.wolf@knobbe.com,efiling@knobbe.com  
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SUBJECT: USPTO: Patent Electronic System - Correspondence Notification for Customer Number 20995

Fri Apr 21 05:05:40 EDT 2023

Dear Patent Center Customer:

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| Application | Document | Mailroom Date | Attorney Docket No. |
|-------------|----------|---------------|---------------------|
| 18058058    | M327     | 04/21/2023    | SHOLD.013C1         |

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Sincerely,

The Patent Center Team

## PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1  
Stylesheet Version v1.2

EPAS ID: PAT7912878

|                                                                                                                                                                                                 |                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| <b>SUBMISSION TYPE:</b>                                                                                                                                                                         | NEW ASSIGNMENT                     |
| <b>NATURE OF CONVEYANCE:</b>                                                                                                                                                                    | ASSIGNMENT                         |
| <b>CONVEYING PARTY DATA</b>                                                                                                                                                                     |                                    |
| <b>Name</b>                                                                                                                                                                                     | <b>Execution Date</b>              |
| DONALD E. RUNNING                                                                                                                                                                               | 01/27/2023                         |
| ROBERT J. BALL                                                                                                                                                                                  | 01/17/2023                         |
| JASON SLONE                                                                                                                                                                                     | 01/17/2023                         |
| <b>RECEIVING PARTY DATA</b>                                                                                                                                                                     |                                    |
| <b>Name:</b>                                                                                                                                                                                    | SHOULDER INNOVATIONS, INC.         |
| <b>Street Address:</b>                                                                                                                                                                          | 13827 PORT SHELDON ST.             |
| <b>City:</b>                                                                                                                                                                                    | HOLLAND                            |
| <b>State/Country:</b>                                                                                                                                                                           | MICHIGAN                           |
| <b>Postal Code:</b>                                                                                                                                                                             | 49424                              |
| <b>PROPERTY NUMBERS Total: 1</b>                                                                                                                                                                |                                    |
| <b>Property Type</b>                                                                                                                                                                            | <b>Number</b>                      |
| Application Number:                                                                                                                                                                             | 18058058                           |
| <b>CORRESPONDENCE DATA</b>                                                                                                                                                                      |                                    |
| <b>Fax Number:</b>                                                                                                                                                                              | (949)760-9502                      |
| <i>Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.</i> |                                    |
| <b>Phone:</b>                                                                                                                                                                                   | 9497600404                         |
| <b>Email:</b>                                                                                                                                                                                   | efiling@knobbe.com                 |
| <b>Correspondent Name:</b>                                                                                                                                                                      | KNOBBE, MARTENS, OLSON & BEAR, LLP |
| <b>Address Line 1:</b>                                                                                                                                                                          | 2040 MAIN STREET, 14TH FLOOR       |
| <b>Address Line 4:</b>                                                                                                                                                                          | IRVINE, CALIFORNIA 92614           |
| <b>ATTORNEY DOCKET NUMBER:</b>                                                                                                                                                                  | SHOLD.013C1                        |
| <b>NAME OF SUBMITTER:</b>                                                                                                                                                                       | ANDREW I. KIMMEL                   |
| <b>SIGNATURE:</b>                                                                                                                                                                               | /Andrew I. Kimmel/                 |
| <b>DATE SIGNED:</b>                                                                                                                                                                             | 04/20/2023                         |
| This document serves as an Oath/Declaration (37 CFR 1.63).                                                                                                                                      |                                    |
| <b>Total Attachments: 4</b>                                                                                                                                                                     |                                    |
| source=Signed Declaration Assignment - SHOLD.013C1#page1.tif                                                                                                                                    |                                    |
| source=Signed Declaration Assignment - SHOLD.013C1#page2.tif                                                                                                                                    |                                    |
| source=Signed Declaration Assignment - SHOLD.013C1#page3.tif                                                                                                                                    |                                    |



## COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))

*Application Data Sheet filed previously or concurrently*

Docket No.: SHOLD.013NP

Page 1 of 4

Title: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

Inventors: Donald E. Running, Robert J. Ball, and Jason Slone

### ***Declaration***

This Declaration is directed to U.S. Application No. **17/435,333**, filed **August 31, 2021** and incorporating any amendments made thereto prior to the signature date of this Declaration.

As a named inventor, I declare that:

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 USC 1001 by fine or imprisonment of not more than five (5) years, or both.

I have reviewed and understand the contents of the above-identified application, including the claims, as amended by any amendment.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

### ***Assignment from Inventors***

WHEREAS, **above-identified Inventors** (individuals, hereinafter "ASSIGNOR") invented certain new and useful improvements, technology, inventions, developments, ideas, ornamental designs, or discoveries related to **TOTAL REVERSE SHOULDER SYSTEMS AND METHODS** (collectively hereinafter referred to as the "Work") for which an application for Letters Patent in the United States (identified above) has been filed or prepared for filing with the United States Patent and Trademark Office (hereinafter the "Application"), and ASSIGNOR desires to assign or confirm assignment of the Work and the Application to the below identified Assignee.

AND WHEREAS, **Shoulder Innovations, Inc.**, with its principal place of business at **13827 Port Sheldon St., Holland, MI 49424** (hereinafter the "ASSIGNEE"), desires to acquire or confirm ownership of the entire right, title, and interest in and to the Application and the Work.

NOW, THEREFORE, for good and valuable consideration of which receipt is hereby acknowledged, ASSIGNOR hereby acknowledges that ASSIGNOR has sold, assigned, transferred, and set over, and by these presents does hereby sell, assign, transfer, and set over, unto said ASSIGNEE, **its** successors, legal representatives, and assigns, the entire right, title, and interest throughout the world in and to the Application and the Work, including: all provisional and international applications relating to the Work and the Application (including but not limited to U.S. Provisional Application No. **62/816,708**, filed **March 11, 2019** and **International Application No. PCT/US2020/022094** filed **March 11, 2020**); all nonprovisional applications claiming priority to aforementioned provisional, international application and/or the Application, including, all divisions, continuations, continuations-in-part, and reissues, and all Letters Patent of the United States which may be granted thereon and all reissues and extensions thereof; and all rights of priority under International Conventions and any related Letters Patent which may hereafter be granted or filed in any country or countries foreign to the United States, all extensions, renewals, and reissues thereof.

ASSIGNOR hereby authorizes and requests the Commissioner for Patents of the United States, and any Official of any country or countries foreign to the United States, whose duty it is to issue patents on applications as aforesaid, to issue all related Letters Patent to the ASSIGNEE, **its** successors, legal representatives, and assigns.

**COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))***Application Data Sheet filed previously or concurrently***Docket No.:** SHOLD.013NP

Page 2 of 4

**Title:** TOTAL REVERSE SHOULDER SYSTEMS AND METHODS**Inventors:** Donald E. Running, Robert J. Ball, and Jason Slone

AND ASSIGNOR DOES HEREBY acknowledge and agree that the assigned scope of the Application and the Work includes any currently recited claims, all embodiments, and all claims supported by the Application; Assignor agrees not to contest or disparage claim scope thus supported (including in any later-filed continuing patent applications) for any claims deemed patentable by any government patent office. Assignor also agrees not to challenge the validity, including as a defense to patent infringement, of any issued patent claims resulting from or based on the Work, regardless of the scope of any such claims.

AND ASSIGNOR DOES HEREBY sell, assign, transfer, and convey to ASSIGNEE, **its** successors, legal representatives, and assigns all claims for damages and all remedies arising out of any violation of the rights assigned hereby that may have accrued prior to the date of assignment to ASSIGNEE, or may accrue hereafter, including, but not limited to, the right to sue for, collect, and retain damages for past infringements of said Letters Patent before or after issuance.

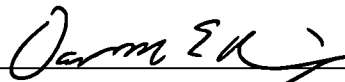
AND ASSIGNOR DOES HEREBY covenant and agree that ASSIGNOR will: communicate to said ASSIGNEE, **its** successors, legal representatives, and assigns any facts known to ASSIGNOR respecting the Work; testify in any legal proceeding; assist in the preparation of any other Patent Property relating to the Application and the Work or any improvements made thereto; sign/execute all lawful papers; authorize the filing of, execute, and make all rightful oaths and/or declarations in connection with the Application and the Work including any improvements made thereto, any patent applications filed therefrom, and any continuing application filed from any of the aforementioned applications; and generally do everything possible to aid the ASSIGNEE, **its** successors, legal representatives, and assigns, to obtain and enforce proper patent protection for the Work in all countries.

AND ASSIGNOR DOES HEREBY agree that if any term or provision of this agreement becomes invalid or unenforceable, the remainder shall survive unaffected.

---

**Legal Name of Inventor:** Donald E. Running

IN TESTIMONY WHEREOF, I hereunto set my hand and seal this 27th day of January, 2023.

Signature: 

*Signature before a Notary is desirable but not required. When signed in presence of a Notary, please attach the appropriate notarial documentation.*

**COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))**

*Application Data Sheet filed previously or concurrently*

**Docket No.:** SHOLD.013NP

Page 3 of 4

**Title:** TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

**Inventors:** Donald E. Running, Robert J. Ball, and Jason Slone

**Legal Name of Inventor:** Robert J. Ball

IN TESTIMONY WHEREOF, I hereunto set my hand and seal this 17<sup>th</sup> day of Jan,  
2023.

Signature: \_\_\_\_\_



*Signature before a Notary is desirable but not required. When signed in presence of a Notary, please attach the appropriate notarial documentation.*

**COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))**

*Application Data Sheet filed previously or concurrently*

**Docket No.:** SHOLD.013NP

Page 4 of 4

**Title:** TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

**Inventors:** Donald E. Running, Robert J. Ball, and Jason Slone

**Legal Name of Inventor:** Jason Slone

IN TESTIMONY WHEREOF, I hereunto set my hand and seal this 17th day of January,  
2023.

Signature: William J. Slone

***Signature before a Notary is desirable but not required. When signed in presence of a Notary, please attach the appropriate notarial documentation.***





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| APPLICATION NO. | ISSUE DATE | PATENT NO. | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|------------|------------|---------------------|------------------|
| 18/058,058      | 06/13/2023 | 11672669   | SHOLD.013C1         | 5500             |

20995 7590 05/24/2023

KNOBBE MARTENS OLSON & BEAR LLP  
2040 MAIN STREET  
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IRVINE, CA 92614

## ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at <https://patentcenter.uspto.gov/>. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

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### **Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)** (application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

**INVENTOR(s)** (Please see PAIR WEB site <http://pair.uspto.gov> for additional inventors):

Donald E. Running, Missoula, MT;  
Robert J. Ball, Holland, MI;  
Jason Slone, Silver Lake, IN;

**APPLICANT(s)** (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

SHOULDER INNOVATIONS, INC., Holland, MI;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit [SelectUSA.gov](http://SelectUSA.gov).

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CC: patentcenter\_eofficeaction@uspto.gov  
SUBJECT: USPTO: Patent Electronic System - Correspondence Notification for Customer Number 20995

Thu May 25 07:03:35 EDT 2023

Dear Patent Center Customer:

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| Application | Document  | Mailroom Date | Attorney Docket No. |
|-------------|-----------|---------------|---------------------|
| 18058058    | ISSUE.NTF | 05/24/2023    | SHOLD.013C1         |

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Sincerely,

The Patent Center Team

# **REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL** **(Submitted Only via EFS-Web)**

|                      |                    |             |            |                               |                     |          |      |
|----------------------|--------------------|-------------|------------|-------------------------------|---------------------|----------|------|
| Application Number   | 18058058           | Filing Date | 2022-11-22 | Docket Number (if applicable) | SHOLD.013C1         | Art Unit | 3774 |
| First Named Inventor | Running, Donald E. |             |            | Examiner Name                 | Schillinger, Ann M. |          |      |

**This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.**

Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

## **SUBMISSION REQUIRED UNDER 37 CFR 1.114**

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on \_\_\_\_\_

☐ Other \_\_\_\_\_

☒ Enclosed

☐ Amendment/Reply

☒ Information Disclosure Statement (IDS)

☐ Affidavit(s)/ Declaration(s)

☒ Other Certification and Request for Consideration of an Information Disclosure Statement Filed After Payment of the Issue Fee Under the QPIDS Program

## **MISCELLANEOUS**

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months \_\_\_\_\_  
 (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other \_\_\_\_\_

## **FEES**

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**  
 The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to  
 Deposit Account No 111410

## **SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED**

☒ Patent Practitioner Signature  
 Applicant Signature

| Signature of Registered U.S. Patent Practitioner |                    |                     |            |
|--------------------------------------------------|--------------------|---------------------|------------|
| Signature                                        | /Andrew I. Kimmel/ | Date (YYYY-MM-DD)   | 2023-05-24 |
| Name                                             | Andrew I. Kimmel   | Registration Number | 58855      |

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*

## Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

**INFORMATION DISCLOSURE STATEMENT**

|                                                          |                                 |
|----------------------------------------------------------|---------------------------------|
| <b>First Inventor:</b> Running, Donald E.                | <b>Conf. No.:</b> 5500          |
| <b>App. No.:</b> 18/058058                               | <b>Filed:</b> November 22, 2022 |
| <b>Examiner:</b> Schillinger, Ann M.                     | <b>Art Unit:</b> 3774           |
| <b>Title:</b> TOTAL REVERSE SHOULDER SYSTEMS AND METHODS |                                 |

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**References and Listing**

Pursuant to 37 CFR 1.56, an Information Disclosure Statement listing references is provided herewith. Copies of any listed foreign and non-patent literature references are being submitted.

**No Disclaimers**

To the extent that anything in the Information Disclosure Statement or the listed references could be construed as a disclaimer of any subject matter supported by the present application, Applicant hereby rescinds and retracts such disclaimer.

**Timing of Disclosure**

This Information Disclosure Statement is being submitted with a request to participate in the Quick Path Information Disclosure Statement (QPIDS) pilot. The Issue Fee has already been paid in this application and references are being submitted under the QPIDS pilot. Submitted herewith in accordance with the requirements of the pilot are:

1. Petition to withdraw application from issuance and fee under 1.17(h) (Group III);
2. PTO/SB/09 identifying this IDS submission as a request for participation in the QPIDS pilot and the IDS fee under 1.17(p); and
3. Request for Continued Examination (RCE) and fee under 1.17(e).

**CERTIFICATION UNDER 37 CFR 1.97(e)(2)**

I hereby certify that no item of information contained in this Statement was cited in a communication from a foreign Patent Office in a counterpart foreign application, and, to my knowledge after making reasonable inquiry, was known to any individual designated in 37

CFR 1.56(c) more than three (3) months prior to the filing of this Information Disclosure Statement.

This Statement is accompanied by the fee set forth in 37 CFR 1.17(p). The Commissioner is authorized to charge any additional fees which may be required or to credit any overpayment to Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: May 25, 2023

By:           /Andrew I. Kimmel/          

Andrew I. Kimmel  
Registration No. 58,855  
Registered Practitioner  
(949) 760-0404

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|                                                          |                      |                     |
|----------------------------------------------------------|----------------------|---------------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> | Application No.      | 18/058058           |
|                                                          | Filing Date          | November 22, 2022   |
|                                                          | First Named Inventor | Running, Donald E.  |
|                                                          | Art Unit             | 3774                |
| (Multiple sheets used when necessary)                    | Examiner             | Schillinger, Ann M. |
| SHEET 1 OF 1                                             | Attorney Docket No.  | SHOLD.013C1         |

| U.S. PATENT DOCUMENTS |          |                                                                                  |                                |                      |                                                                          |
|-----------------------|----------|----------------------------------------------------------------------------------|--------------------------------|----------------------|--------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br><i>Number - Kind Code (if known)</i><br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name                 | Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear |
|                       | 1        | 8,177,786                                                                        | 05-15-2012                     | Leyden et al.        |                                                                          |
|                       | 2        | 8,870,962                                                                        | 10-28-2014                     | Roche et al.         |                                                                          |
|                       | 3        | 11,259,931                                                                       | 03-01-2022                     | Pressacco et al.     |                                                                          |
|                       | 4        | 2014/0277520                                                                     | 09-18-2014                     | Chavarria et al.     |                                                                          |
|                       | 5        | 2018/0243102                                                                     | 08-30-2018                     | Burkhead, Jr. et al. |                                                                          |
|                       | 6        | 2014/0025173A1                                                                   | 01-23-2014                     | Cardon, et al.       |                                                                          |

| FOREIGN PATENT DOCUMENTS |          |                                                                                           |                                |                                  |                                                                          |                |
|--------------------------|----------|-------------------------------------------------------------------------------------------|--------------------------------|----------------------------------|--------------------------------------------------------------------------|----------------|
| Examiner Initials        | Cite No. | Foreign Patent Document<br><i>Country Code-Number-Kind Code</i><br>Example: JP 1234567 A1 | Publication Date<br>MM-DD-YYYY | Name                             | Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear | T <sup>1</sup> |
|                          | 7        | EP 1488764 B1                                                                             | 12-13-2006                     | LIMA LtoSpA                      |                                                                          |                |
|                          | 8        | EP 2689750 B1                                                                             | 08-24-2016                     | Tornier Orthopedics Ireland Ltd. |                                                                          | Abs            |

| NON PATENT LITERATURE DOCUMENTS |          |                                                                                                                                                                                                                                                                 |                |
|---------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Examiner Initials               | Cite No. | Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published. | T <sup>1</sup> |

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|                                                                                                                                                                                                                                                  |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Examiner Signature                                                                                                                                                                                                                               | Date Considered |
| <b>*Examiner:</b> Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. |                 |

T<sup>1</sup> - Place a check mark in this area when an English language Translation is attached. **CATALYST, EX-1005**

| <b>CERTIFICATION AND REQUEST FOR CONSIDERATION OF AN INFORMATION DISCLOSURE<br/>STATEMENT FILED AFTER PAYMENT OF THE ISSUE FEE UNDER THE QPIDS PROGRAM</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Non-Provisional Application Number: <b>18/058058</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Filing Date: <b>November 22, 2022</b>                                 |
| First Named Inventor: <b>Running, Donald E.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Title of Invention: <b>TOTAL REVERSE SHOULDER SYSTEMS AND METHODS</b> |
| <p><b>THE UNDERSIGNED HEREBY CERTIFIES AND REQUESTS THE FOLLOWING FOR THE ABOVE-IDENTIFIED APPLICATION.</b></p> <ol style="list-style-type: none"> <li>1. Consideration is requested of the information disclosure statement (IDS) submitted herewith, which is being filed after payment of the issue fee.</li> <li>2. Check the box next to the appropriate selection:               <div style="margin-left: 20px;"> <input type="checkbox"/> Each item of information contained in the IDS was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the IDS. See 37 CFR 1.97(e)(1).               </div> <p style="margin-left: 20px;"><b>OR</b></p> <div style="margin-left: 20px;"> <input checked="" type="checkbox"/> No item of information contained in the IDS was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the IDS was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the IDS. See 37 CFR 1.97(e)(2).               </div> <p style="margin-left: 20px;"><b>OR</b></p> <div style="margin-left: 20px;"> <input type="checkbox"/> See attached certification statement in compliance with 37 CFR 1.97(e).               </div> </li> <li>3. Please charge the IDS fee set forth in 37 CFR 1.17(p) to Deposit Account No. <u>11-1410</u>.</li> <li>4. A Petition to Withdraw from Issue After Payment of the Issue Fee (37 CFR 1.313(c)(2)), including the petition fee set forth in 37 CFR 1.17(h), is submitted herewith as a <b>Web-based ePetition</b>.<br/> <b>WARNING:</b> Do <u>not</u> submit the petition as a follow-on paper via EFS-Web. Submit the petition as a Web-based ePetition by signing on to EFS-Web as a registered user, selecting the radio button next to "Existing application/patent," and then selecting the radio button next to "ePetition (for automatic processing and immediate grant, if all petitions requirements are met)." Failure to use the Web-based ePetition interface will result in automatic entry of the RCE.             </li> <li>5. A request for continued examination (RCE) under 37 CFR 1.114 and the RCE fee under 37 CFR 1.17(e) are submitted herewith.</li> <li>6. The RCE will be treated as a "conditional" RCE. In the event the examiner determines that any item of information contained in the IDS necessitates the reopening of prosecution in the application, the undersigned understands that (i) the RCE will be processed and treated as an RCE under 37 CFR 1.114 and therefore (ii) the IDS fee under 37 CFR 1.17(p) will be returned in accordance with 37 CFR 1.97(b)(4). In the event that no item of information in the IDS necessitates reopening prosecution, the undersigned understands that the RCE will not be processed and the RCE fee under 37 CFR 1.17(e) will be returned.</li> <li>7. This certification and request is being filed as a <b>Web-based ePetition</b> and is not accompanied by an amendment to the application. Inclusion of an amendment will result in automatic entry of the RCE.</li> </ol> |                                                                       |
| Signature <b>/Andrew Kimmel/</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Date <b>May 24, 2023</b>                                              |
| Name (Print/Typed) <b>Andrew Kimmel</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Practitioner Registration Number (If applicable) <b>58855</b>         |
| <p><b>Note:</b> Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature. If necessary, submit multiple forms for more than one signature, see below.*</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                       |
| <input checked="" type="checkbox"/> *Total of <u>1</u> forms are submitted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                       |

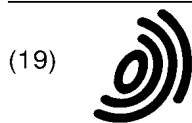
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

## Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11)

**EP 1 488 764 B1**

(12)

**EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:  
**13.12.2006 Bulletin 2006/50**

(51) Int Cl.:  
**A61F 2/40 (2006.01)**

(21) Application number: **04101736.9**

(22) Date of filing: **26.04.2004**

(54) **Inverse prosthesis for the shoulder joint**

Umgekehrte Prothese für das Schultergelenk

Prothèse inversée pour l'articulation de l'épaule

(84) Designated Contracting States:  
**DE ES FR IT**

(30) Priority: **30.04.2003 IT UD20030094**

(43) Date of publication of application:  
**22.12.2004 Bulletin 2004/52**

(73) Proprietor: **LIMA Lto SpA**  
**33030 Villanova di San Daniele del Friuli (UD) (IT)**

(72) Inventor: **Dalla Pria, Paolo**  
**33100, UDINE (IT)**

(74) Representative: **Petraz, Gilberto Luigi et al**  
**GLP S.r.l.**  
**Piazzale Cavedalis 6/2**  
**33100 Udine (IT)**

(56) References cited:

|                         |                         |
|-------------------------|-------------------------|
| <b>EP-A- 0 776 636</b>  | <b>EP-A- 1 064 890</b>  |
| <b>WO-A-00/41653</b>    | <b>WO-A-01/47442</b>    |
| <b>DE-U- 20 022 306</b> | <b>DE-U- 20 207 913</b> |
| <b>FR-A- 2 704 747</b>  | <b>FR-A- 2 737 107</b>  |

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

**EP 1 488 764 B1**

## Description

### FIELD OF THE INVENTION

**[0001]** The present invention concerns a prosthesis of the shoulder for the articulation of the head of a humerus with respect to the relative scapula. To be more exact, the prosthesis of the shoulder according to the invention is configured as an inverse prosthesis, wherein a convex shaped head is associated with the glenoid cavity and articulates in an artificial concave seating associated with the top of the humerus.

### BACKGROUND OF THE INVENTION

**[0002]** Inverse prostheses of the shoulder are known, for the articulation of a sphere attached to the scapula in a mating cavity obtained in the upper part of the humerus, which inversely reproduce the gleno-humeral anatomy. Normally, inverse prostheses are used in the event of serious muscular degeneration of the shoulder, particularly of the rotator cuff muscles. The degeneration of such muscles causes a prevalent action by the deltoid, which tends to draw the humerus upwards, consequently making the humeral bone head, or possible artificial head, move upwards, with the risk of making it knock against the protrusion which prolongs the spine of the scapula, known as acromion.

**[0003]** Starting from the idea of eliminating the humeral head, inverse prostheses comprise, as elements associated with the humerus, a concave shaped humeral seating including a relative attachment shaft implanted in the humerus.

**[0004]** The humeral seating defines the articulation for a spherical body attached to the glenoid cavity, which is provided in a single body with a pin for direct attachment in the glenoid cavity, or to a support previously attached to said glenoid cavity.

**[0005]** One shortcoming of known inverse prostheses is that the attachment pin of the aforementioned spherical body is difficult to insert into the glenoid cavity, or into the relative support element, previously applied, due to the extremely limited spaces available; this is an obstacle to precise positioning and a limit to the surgeon's operating possibilities.

**[0006]** In an inverse shoulder prosthesis according to WO-A-01 47442, means in the form of a pin are provided, which pin guides the glenoid sphere to a meta-glenoid element onto which the sphere must be fixed.

**[0007]** A further disadvantage of known inverse prostheses is that the position of the spherical body cannot be oriented or translated as desired with respect to the wall of the glenoid cavity where the relative pin is attached.

**[0008]** One purpose of the invention is to achieve a prosthesis for the articulation of the shoulder wherein the implantation of an inverse prosthesis will allow the spherical body to be assembled easily and precisely in the

glenoid cavity, facilitating the work of the surgeon.

**[0009]** Another purpose of the invention is to achieve a prosthesis of the shoulder in an inverse configuration wherein it is possible to select the orientation and position of the spherical body with respect to its axis of implantation in the glenoid cavity, in relation to the presence of non-regular spaces between the glenoid cavity and the head of the humerus.

**[0010]** The Applicant has devised, tested and embodied the present invention to achieve these purposes and other advantages, and to overcome the shortcomings of the state of the art.

### SUMMARY OF THE INVENTION

**[0011]** The present invention is set forth and characterized in the main claim, while the dependent claims describe other innovative characteristics of the invention.

**[0012]** An inverse prosthesis of the shoulder comprises an at least partly convex articulation element associated with relative implant means, normally a pin defining an implantation axis, for attachment to the glenoid cavity, and able to articulate with a mating articulation element, at least partly concave, associated with the top of the humerus. According to the invention, the articulation element associated with the glenoid cavity, and the relative pin-type implant means, are made as distinct elements and are reciprocally removable, so as to allow them to be assembled sequentially with respect to the glenoid cavity.

**[0013]** Thanks to this, according to a first feature, the articulation element and the pin-type implant means can also be made of different materials; the articulation element can be made for example of ceramic, or of metal such as for example a cobalt-based alloy, while the pin-type implant element can be made of a different metal such as for example a titanium-based alloy.

**[0014]** Using a ceramic material or a cobalt-based alloy improves the resistance to wear of the convex element, which functions as the articulation element, while using a titanium-based alloy ensures both good bone integration and also the due and necessary resistance of the anchorage.

**[0015]** Moreover, the size of the elements can also be selected on each occasion according to the space available in the glenoid cavity of the patient's scapula.

**[0016]** According to another feature, using a pin distinct from the relative convex articulation element allows the surgeon, during the implantation step, to orientate the pin as desired in the space with respect to its axis of insertion, without constraints created by the lack of space available.

**[0017]** In a subsequent step, after having anchored the pin to the bone seating of the glenoid or to a relative support element, the convex articulation element can be associated, with the desired orientation, with the relative pin-type implant element.

**[0018]** The coupling of the articulation element and the

relative pin-type implant means can be of any type, for example conical coupling, by means of screwing, with auxiliary elements such as rivets or pins or other.

**[0019]** According to another characteristic feature of the invention, the articulation element has a convex surface with at least an axis of symmetry, and the pin-type implant means are able to be positioned in an eccentric or angled position with respect to such axis of symmetry. The eccentricity or angulation of the implant means with respect to the articulation element allows to translate or orient the articulation element itself with respect to the glenoid cavity, especially when the bone tissue of the glenoid is not healthy and it is necessary to move the point of implantation.

**[0020]** According to a variant, if the prosthesis according to the invention comprises a support element previously attached to the glenoid cavity, the coupling of the pin-type implant means and the support element solid with the bone seating is of the conical type.

**[0021]** According to a variant, the pin-type implant means are able to be screwed at least partly into the glenoid support element.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0022]** These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a longitudinal section of an inverse type prosthesis according to the invention;
- fig. 2 shows an exploded detail of the prosthesis in fig. 1;
- fig. 3 shows a variant of fig. 2.

#### DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT OF THE INVENTION

**[0023]** With reference to the attached drawings, the reference number 10 denotes an inverse prosthesis according to the present invention, able to be implanted in a shoulder in order to allow the articulation of a humerus 12 in a relative glenoid cavity 15 of a scapula 54, only partly shown.

**[0024]** The prosthesis 10 comprises a support element 14, or glenoid element, which is first anchored to the glenoid 15, and is made of metal or, according to a variant, of plastic.

**[0025]** The support element 14 (fig. 2) comprises a shaft 22 and a plate 24, coaxial with the shaft 22 and having a substantially concave outer surface 25 or, according to a variant, substantially plane.

**[0026]** A convex or spherical articulation element, solid with the glenoid 15, is anchored to said support element 14, as will be described hereafter.

**[0027]** The support element 14 is also provided with a

central hole 26, in this case with a conical section, which is through and, with variations in diameter, passes through the plate 24 and the shaft 22; the element 14 also has a plurality of holes 28, arranged peripherally with respect to the central hole 26, for the insertion of attachment screws 30 to attach the support element 14 to the wall of the bone seating.

**[0028]** The support element 14 is implanted by forcing the shaft 22 through interference, by screwing or cementing it into a mating seating made in the glenoid 15, and the attachment screws 30 are subsequently screwed in.

**[0029]** According to a variant not shown in the drawings, the shaft 22 is sectioned longitudinally into two identical sub-portions for reasons of elasticity and stable attachment.

**[0030]** A spherical body, or glenoid head 19, is applied on the support element 14, which allows the articulation of a concave articulation element solid with the humerus 12.

**[0031]** To be more exact, the articulation element solid with the humerus 12 comprises an anchoring shaft 38, which can be inserted into the humerus 12 by percussion or by screwing, and may or may not be cemented to the bone.

**[0032]** In this case, a humeral cup 20 (fig. 1) is associated with the shaft 38.

**[0033]** To be more exact, a mating supporting humeral body 37 is provided to attach the humeral cup 20.

**[0034]** The glenoid head 19 (figs. 1 and 2) comprises in this case a hemi-spherical head 47, with an axis of symmetry Y, and a coupling pin 48, which is able to be inserted and coupled, in this case by means of conical coupling as will be described in more detail hereafter, into the central hole 26 of the glenoid support element 14.

**[0035]** According to a variant, not shown in the drawings, the pin 48 is completely threaded, and is able to be screwed into a central hole 26, suitably threaded inside.

**[0036]** According to a characteristic of the present invention, the pin 48 is a distinct component with respect to the hemi-spherical head 47. In this way, the pin 48 can be assembled separately, in a first operating step, onto the support element 14 and subsequently, in a second step, the hemi-spherical head 47 can easily be attached on the pin 48.

**[0037]** The fact that the pin 48 and the hemi-spherical head 47 are made in several parts, first of all, facilitates the insertion and positioning of the glenoid head 19 on the support element 14, since it allows, even when there are very limited spaces available to the surgeon, to orientate the pin 48 as desired in the space with respect to its axis of implantation.

**[0038]** Secondly, the pin 48 and the hemi-spherical head 47 can be made of different materials.

**[0039]** The pin 48 can be made of a titanium alloy to ensure the due resistance and a sufficient bone integration, while the hemi-spherical head 47 is made of an alloy based on cobalt-chrome-molybdenum, or of ceramic material, in order to improve the resistance to wear of the

prosthesis 10. To be more exact, the ceramic material is used for those cases where the patients are allergic to certain elements contained in cobalt-based alloys.

**[0040]** The hemi-spherical head 47 in this case is hollow inside, both for reasons of weight and also so as not to interfere with the head portions of the attachment screws 30.

**[0041]** The pin 48 (fig. 2) comprises a first conical portion 48a in which an internally threaded cavity 49 is made, and a second conical portion 48b, able to be inserted into the central hole 26 of the support element 14 and having an opposite taper with respect to the first portion 48a.

**[0042]** The pin 48 can have, in one embodiment, a length greater than the shaft 22 and also comprises, in the embodiment shown here, a threaded terminal portion 48c, able to be screwed into the terminal portion of the shaft 22 and into the bone wall of the scapula 54, in order to attach the pin 48 definitively when the latter is assembled and clamped into the hole 26 of the support element 14 (fig. 2).

**[0043]** On the inner side of the hemi-spherical head 47 a coupling cone 50 is made in one piece therewith, and extends towards the outside; inside it a through cavity 52 is made, open towards the outside.

**[0044]** The cone 50 serves to implant the head 47 onto the corresponding conical portion 48a of the pin 48, after the latter has been clamped onto the support element 14.

**[0045]** Alternatively, the pin 48 and the head 47 can be previously pre-assembled and attached to the support element 14 by screwing the portion 48c.

**[0046]** As a last step, the hemi-spherical head 47 is clamped to the pin 48 by means of a safety attachment screw 53, which is inserted through the open cavity 52 and screwed into the threaded cavity 49 of the first conical portion 48a.

**[0047]** In the embodiment shown in fig. 2, the main axis of symmetry Y of the hemi-spherical head 47 coincides with an axis X of the cone 50 by coupling with the pin 48.

**[0048]** According to the variant shown in fig. 3, a glenoid head 119 comprises a hemi-spherical head 147, having a convex surface symmetrical with respect to an axis Y, and which is coupled by means of a relative cone 150 with a pin 48 which has an axis X of implantation, eccentric with respect to the axis of symmetry Y.

**[0049]** The eccentricity of the coupling cone 150 allows to translate the hemi-spherical head 147 in a front-rear or lateral-medial direction with respect to the glenoid 15, or to modify its orientation with respect to the shaft 22. This allows to correct possible non-symmetrical spaces, especially in the event that the bone wall of the glenoid 15 is not healthy, and the shaft 22 has to be implanted in a slightly translated position with respect to the zone where the glenoid head 19 articulates with the humeral cup 20.

**[0050]** It is clear, however, that modifications and/or additions of parts may be made to the universal prosthesis 10 as described heretofore, without departing from the field and scope of the present invention.

**[0051]** For example, the axis X of the coupling cone 150 can be angled with respect to the axis of symmetry Y.

## Claims

1. Inverse prosthesis of the shoulder for the articulation of a humerus (12) in a scapula (54) of a shoulder having a glenoid cavity (15), comprising an at least partly convex articulation element (19), including means for support and attachment (14, 48) of the prosthesis to said glenoid cavity (15), and able to articulate with an at least partly concave mating articulation element (20), suited for being associated with the top of said humerus (12), said articulation element (19) comprising a substantially hemi-spherical element (47) and a pin-type implant element (48) made as distinct and reciprocally removable elements, so as to allow them to be assembled sequentially with respect to said glenoid cavity (15), **characterized in that** said pin-type implant element (48) includes a first conical portion (48a), for coupling with a mating conical seating (50) made in said hemi-spherical articulation element (47), and a second conical portion (48b), having a taper opposite with respect to said first conical portion (48a), and able to be attached in a conical hole (26) made in a support element (14) suited for being fixed to said glenoid cavity (15).
2. Prosthesis of the shoulder as in claim 1, **characterized in that** said conical seating (50) extends as far as a convex outer side of said substantially hemi-spherical element (47) defining a through cavity (52).
3. Prosthesis of the shoulder as in any claim hereinbefore, **characterized in that** in said pin-type implant element (48) a threaded cavity (49) is made for screwing in a safety screw (53) in order to attach the pin-type implant element (48) to said substantially hemi-spherical element (47).
4. Prosthesis of the shoulder as in any claim hereinbefore, **characterized in that** said pin-type implant element (48) has a threaded terminal portion (48c) able to be screwed into said glenoid cavity (15).
5. Prosthesis of the shoulder as in any claim hereinbefore, **characterized in that** said substantially hemi-spherical element (47) and said pin-type implant element (48) are made of different materials.
6. Prosthesis of the shoulder as in claim 5, **characterized in that** said substantially hemi-spherical element (47) is made of ceramic material, or of metal, and said pin-type implant element (48) is made of metal.

7. Prosthesis of the shoulder as in any claim hereinbefore, wherein the convex surface of said substantially hemi-spherical element (47) is symmetrical at least with respect to an axis (Y), **characterized in that** said pin-type implant element (48) is able to be positioned in an eccentric position with respect to said axis (Y) of symmetry of said substantially hemi-spherical element (47). 5
8. Prosthesis of the shoulder as in any claim hereinbefore, wherein the convex surface of said substantially hemi-spherical element (47) is symmetrical at least with respect to an axis (Y), **characterized in that** said pin-type implant element (48) is able to be positioned along an axis (X) inclined with respect to the axis (Y) of symmetry of said articulation element (47). 10 15
9. Prosthesis of the shoulder as in claim 1, **characterized in that** said conical seating (50) are offset and/or angled with respect to an axis (Y) of symmetry of said substantially hemi-spherical element (47). 20
10. Prosthesis of the shoulder as in claim 1, **characterized in that** at least a terminal portion (48c) of said pin-type implant element (48) is able to be attached to a mating portion of said conical hole (26) by means of screwing. 25

#### Patentansprüche

1. Umgekehrte Schulterprothese für das Gelenk eines Oberarmknochens (12) in einem Schulterblatt (54), das eine Schulterblattpfanne (15) hat, mit einem zumindest teilweise konvexen Gelenkelement (19), das Mittel zur Halterung und Befestigung (14, 48) der Prothese an der Schulterblattpfanne (15) einschließt und ein Gelenk mit einem zumindest teilweise konkaven eingreifenden Gelenkelement (20) bilden kann, das geeignet ist, oben an dem Oberarmknochen (12) verbunden zu werden, wobei das Gelenkelement (19) ein im Wesentlichen halbkugelförmiges Element (47) und ein Implantatelement (48) vom Stifftyp umfasst, die als verschiedene und gegenseitig entfernbare Elemente ausgebildet sind, um es ihnen zu ermöglichen, der Reihe nach mit Bezug auf die Schulterblattpfanne (15) zusammengesetzt zu werden, **dadurch gekennzeichnet, dass** das Implantatelement (48) vom Stifftyp ein erstes konisches Teil (48a), um mit einer eingreifenden konischen Auflagefläche (50) gekoppelt zu werden, die in dem halbkugelförmigen Gelenkelement (47) ausgebildet ist, und ein zweites konisches Teil (48b) einschließt, das gegenüber dem ersten konischen Teil (48a) eine Abschrägung hat und in einem konischen Loch (26) befestigt werden kann, das in einem Stützelement (14) ausgebildet ist, das geeignet ist, an der Schulterblattpfanne (15) befestigt zu werden. 30 35 40 45 50 55

2. Schulterprothese nach Anspruch 1, **dadurch gekennzeichnet, dass** die konische Auflagefläche (50) sich bis zu einer konvexen äußeren Seite des im Wesentlichen halbkugelförmigen Elements (47) erstreckt, das einen durchgehenden Hohlraum (52) definiert.
3. Schulterprothese nach einem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** in dem Implantatelement (48) vom Stifftyp ein mit einem Gewinde versehener Hohlraum zum Einschrauben von einer Sicherheitsschraube (53) ausgebildet ist, um das Implantatelement (48) vom Stifftyp an dem im Wesentlichen halbkugelförmigen Element (47) zu befestigen.
4. Schulterprothese nach einem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** das Implantatelement (48) vom Stifftyp ein mit einem Gewinde versehenes Endteil (48c) hat, das in die Schulterblattpfanne (15) eingeschraubt werden kann.
5. Schulterprothese nach einem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** das im Wesentlichen halbkugelförmige Element (47) und das Implantatelement (48) vom Stifftyp aus unterschiedlichen Werkstoffen bestehen.
6. Schulterprothese nach Anspruch 5, **dadurch gekennzeichnet, dass** das im Wesentlichen halbkugelförmige Element (47) aus einem Keramikwerkstoff oder Metall besteht, und das Implantatelement (48) vom Stifftyp aus Metall besteht. 30
7. Schulterprothese nach einem vorhergehenden Anspruch, wobei die konvexe Oberfläche des im Wesentlichen halbkugelförmigen Elements (47) zumindest mit Bezug auf eine Achse (Y) symmetrisch ist, **dadurch gekennzeichnet, dass** das Implantatelement (48) vom Stifftyp in einer exzentrischen Position mit Bezug auf die Symmetrieachse (Y) des im Wesentlichen halbkugelförmigen Elements (47) positioniert werden kann. 35 40
8. Schulterprothese nach einem vorhergehenden Anspruch, wobei die konvexe Oberfläche des im Wesentlichen halbkugelförmigen Elements (47) zumindest mit Bezug auf eine Achse (Y) symmetrisch ist, **dadurch gekennzeichnet, dass** das Implantatelement (48) vom Stifftyp entlang einer Achse (X) positioniert werden kann, die mit Bezug auf die Symmetrieachse (Y) des Gelenkelements (47) geneigt ist. 45 50
9. Schulterprothese nach Anspruch 1, **dadurch gekennzeichnet, dass** die konische Auflagefläche (50) mit Bezug auf eine Symmetrieachse (Y) des im wesentlichen halbkugelförmigen Elements (47) ver- 55



setzt und/oder gewinkelt ist.

10. Schulterprothese nach Anspruch 1, **dadurch gekennzeichnet, dass** zumindest ein Endteil (48c) des Implantatelements (48) vom Stifftyp an einem eingreifenden Teil des konischen Lochs (26) durch Verschrauben befestigt werden kann.

## Revendications

1. Prothèse inverse de l'épaule destinée à l'articulation de l'humérus (12) dans la scapula (54) d'une l'épaule ayant une cavité glénoïde (15), comportant un élément articulaire au moins partiellement convexe (19), comprenant des moyens de support et de fixation (14, 48) de la prothèse à ladite cavité glénoïde (15), et pouvant s'articuler avec un élément articulaire d'appui au moins partiellement concave (20), apte à être associé avec le haut dudit humérus (12), ledit élément articulaire (19) comportant un élément sensiblement hémisphérique (27) et un implant à broche (48), se présentant sous forme d'éléments distincts et réciproquement amovibles, de manière à permettre leur assemblage séquentiel par rapport à ladite cavité glénoïde (15), prothèse **caractérisée en ce que** ledit implant à broche (48) comprend une première partie conique (48a), destinée à s'accoupler avec un siège conique correspondant (50) ménagé dans ledit élément articulaire hémisphérique (47), et une seconde partie conique (48b), présentant une conicité opposée à ladite première partie conique (48a), et pouvant être fixée dans un trou conique (26) ménagé dans un élément de support (14) apte à être fixé à ladite cavité glénoïde (15).
2. Prothèse de l'épaule selon la revendication 1, **caractérisée en ce que** ledit siège conique (50) s'étire jusqu'à un côté externe convexe dudit élément sensiblement hémisphérique (47) en définissant une cavité traversante (52).
3. Prothèse de l'épaule selon l'une quelconque des revendications ci-dessus, **caractérisée en ce qu'**une cavité filetée (49) est ménagée dans ledit implant à broche (48) pour y visser une vis de sécurité (53) afin de fixer l'implant à broche (48) audit élément sensiblement hémisphérique (47).
4. Prothèse de l'épaule selon l'une quelconque des revendications ci-dessus, **caractérisée en ce que** ledit implant à broche (48) présente une partie terminale filetée (48c) pouvant être vissée dans ladite cavité glénoïde (15).
5. Prothèse de l'épaule selon l'une quelconque des revendications ci-dessus, **caractérisée en ce que** ledit élément sensiblement hémisphérique (47) et ledit

implant à broche (48) sont constitués de matériaux différents.

6. Prothèse de l'épaule selon la revendication 5, **caractérisée en ce que** ledit élément sensiblement hémisphérique (47) est en matériau céramique ou en métal, et ledit implant à broche (48) est en métal.
7. Prothèse de l'épaule selon l'une quelconque des revendications ci-dessus, dans laquelle la surface convexe dudit élément sensiblement hémisphérique (47) est symétrique au moins par rapport à un axe (Y), **caractérisée en ce que** ledit implant à broche (48) peut être placé en position excentrique par rapport audit axe (Y) de symétrie dudit élément sensiblement hémisphérique (47).
8. Prothèse de l'épaule selon l'une quelconque des revendications ci-dessus, dans laquelle la surface convexe dudit élément sensiblement hémisphérique (47) est symétrique au moins par rapport à un axe (Y), **caractérisée en ce que** ledit implant à broche (48) peut être positionné le long d'un axe (X) incliné par rapport à l'axe (Y) de symétrie dudit élément articulaire (47).
9. Prothèse de l'épaule selon la revendication 1, **caractérisée en ce que** ledit siège conique (50) est décalé et/ou forme un angle par rapport à l'axe (Y) de symétrie dudit élément sensiblement hémisphérique (47).
10. Prothèse de l'épaule selon la revendication 1, **caractérisée en ce qu'**au moins une partie terminale (48c) dudit implant à broche (48) peut être fixée à une partie correspondante dudit trou conique (26) au moyen de vis.

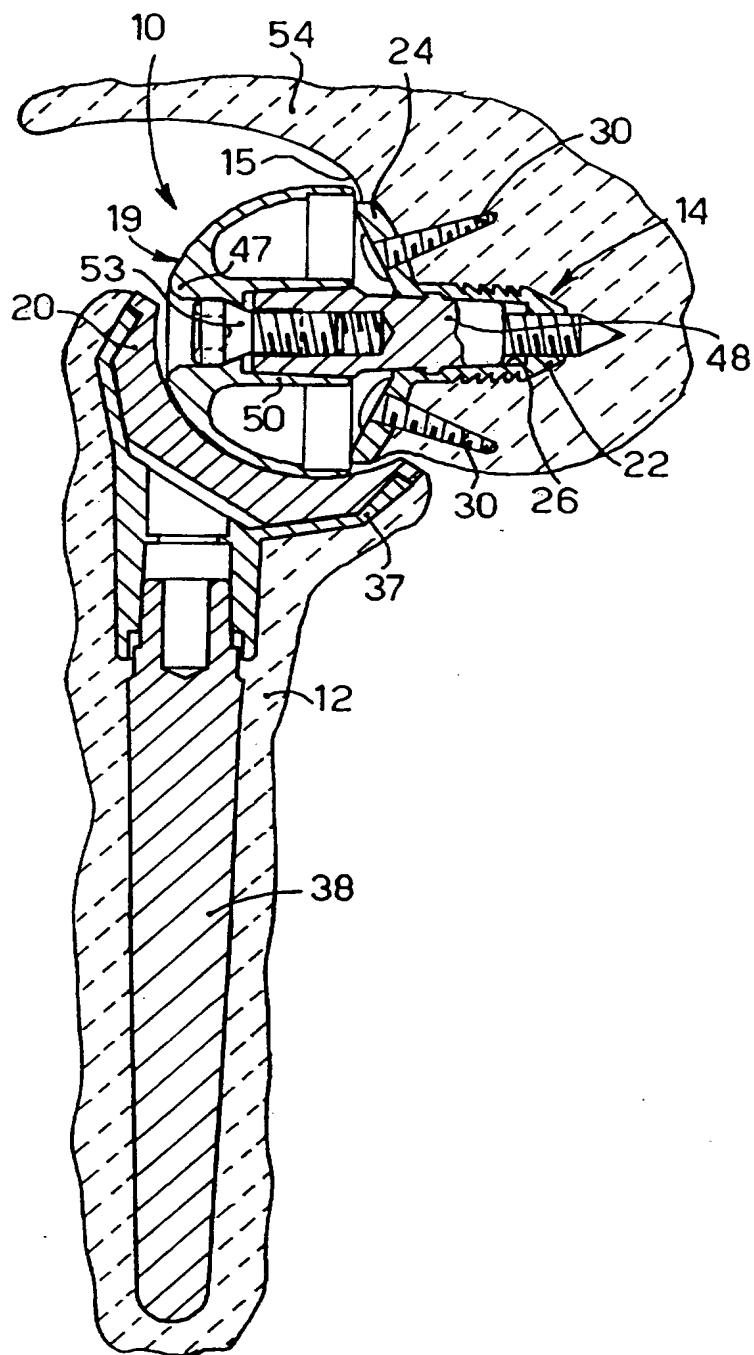
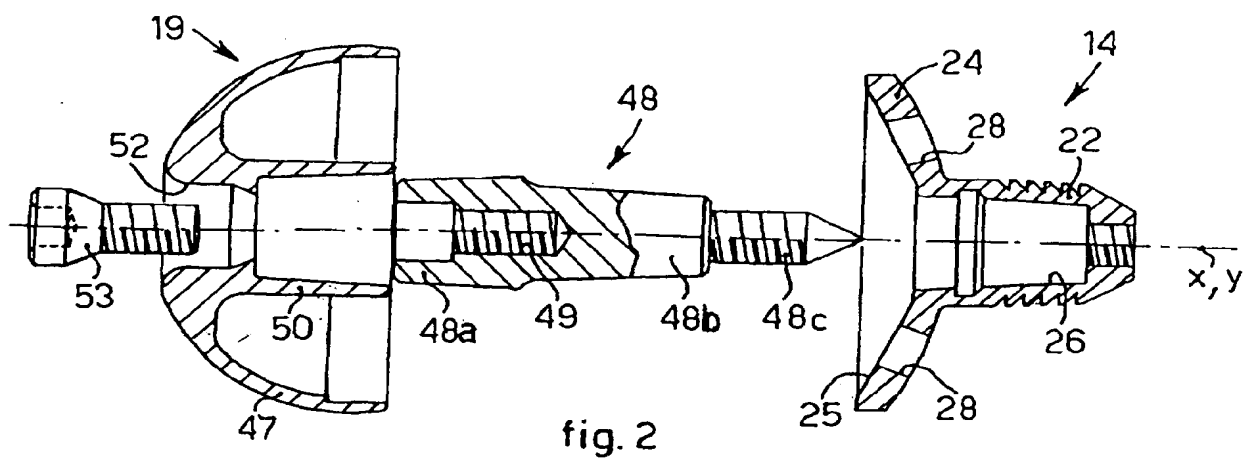
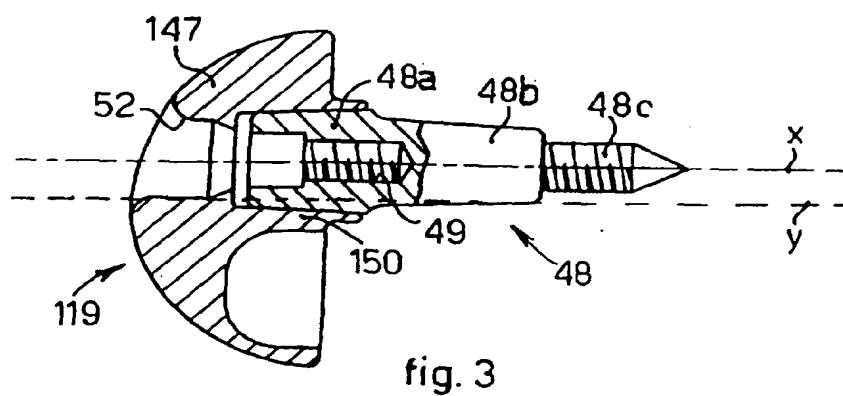


fig. 1





Espacenet

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Glenoidal implant for shoulder prosthesis and surgical kit

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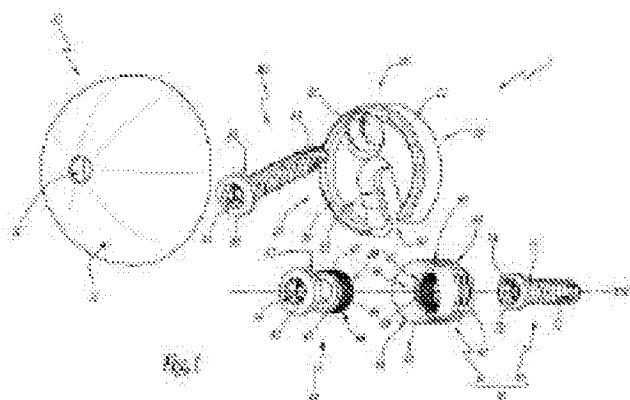
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**Abstract of EP2689750 (A1)**

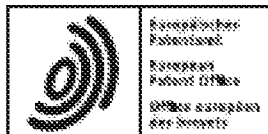
A glenoid implant for a shoulder prosthesis, where the glenoid implant is adapted to be implanted in the glenoid (B) of a patient comprises: an articular body for articulating the glenoid implant with a humeral component; plate (20) for supporting the articular body; an anchoring mechanism (50); and a securing mechanism for securing the plate in position relative to the anchoring mechanism and the glenoid; and

adjustment mechanism for selectively adjusting the position of the plate, before it is secured in position by the securing mechanism. A glenoid implant for a shoulder prosthesis, where the glenoid implant is adapted to be implanted in the glenoid (B) of a



patient comprises: an articular body for articulating the glenoid implant with a humeral component; plate (20) for supporting the articular body; an anchoring mechanism (50) for anchoring the glenoid implant along an anchoring axis and adapted to be secured to the glenoid; and a securing mechanism for securing the plate in position relative to the anchoring mechanism and the glenoid; and adjustment mechanism for selectively adjusting the position of the plate, before it is secured in position by the securing mechanism, in rotation about the anchoring axis and in translation transversely to the anchoring axis. The adjustment mechanism includes a ball-type connection for selectively titably adjusting the position of the plate, before it is secured in position by the securing mechanism, relative to the anchoring axis. The adjustment mechanism includes a groove (30) formed in the plate; and pin (40) that cooperates with the anchoring mechanism and the plate to adjust the position of the plate relative to the anchoring axis.

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(54) **Implant glénoïdien pour prothèse d'épaule et kit chirurgical**

Glenoidales Implantat für Schulterprothese und chirurgisches Kit

Glenoidal implant for shoulder prosthesis and surgical kit

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(56) Documents cités:  
EP-A1- 1 336 396 FR-A1- 2 652 498  
FR-A1- 2 737 107 FR-A1- 2 871 389  
US-A1- 2009 204 225

## Description

[0001] La présente invention concerne un implant glénoïdien pour prothèse d'épaule. L'invention concerne également un kit chirurgical adapté pour la mise en

[0002] De manière classique, un tel implant glénoïdien comprend un corps articulaire adapté pour l'articulation avec la tête de l'humérus, prothésée ou non. En pratique, l'implant glénoïdien peut être conformé selon une configuration anatomique, dans laquelle le corps articulaire comporte une cavité prévue pour remplacer la cavité glénoïdale, ou bien selon une configuration inversée, dans laquelle le corps articulaire comporte un dôme hémisphérique prévu pour coopérer avec une cavité complémentaire définie par un implant huméral. Le corps articulaire peut être métallique, par exemple en alliage de titane, en céramique, ou synthétique, par exemple en polyéthylène.

[0003] EP-A-2 481 376 décrit différents modes de réalisation d'un tel implant glénoïdien, présentant une grande polyvalence. L'implant comprend un insert de fixation du corps articulaire à la glène. L'insert est ancré à demeure dans la glène par le chirurgien, avant le positionnement du corps articulaire sur cet insert. L'implant comprend également des moyens de blocage de la rotation de l'insert et du corps articulaire par rapport à la glène.

[0004] FR-A-2 737 107 décrit différents modes de réalisation d'un autre implant glénoïdien, comprenant un corps articulaire; une platine de fixation à la glène, une rondelle et une vis. Lorsque l'implant est assemblé, ces différents éléments sont centrés par rapport à un axe d'ancrage. Le corps articulaire est centré sur une surface externe de la platine de fixation, la rondelle est centrée contre une surface interne du corps articulaire et la vis traversant la rondelle est centrée dans la platine de fixation. La vis forme des moyens de blocage de la rotation de la rondelle par rapport à la platine. La position de la rondelle peut être réglée en rotation autour de l'axe d'ancrage, mais pas en translation transversalement à l'axe d'ancrage.

[0005] Dans certains cas, le chirurgien peut être amené à réviser l'épaule avec une nouvelle prothèse, anatomique ou inversée. L'insert reste à demeure dans la glène, tandis que le corps articulaire est remplacé. Les implants existants permettent difficilement au chirurgien de mettre en oeuvre un nouveau corps articulaire d'un type différent du précédent, par exemple de convertir une configuration anatomique en configuration inversée. En outre, lorsque le chirurgien veut réviser la glène avec un implant inversé, le dôme glénoïdien doit généralement être décalé du côté inférieur de la glène par rapport à la position précédemment définie par l'insert. Autrement dit, le centre articulaire en configuration anatomique peut être différent du centre articulaire en configuration inver-

sée. A cet effet, il existe des gammes de corps articulaires présentant différentes excentrations de la surface articulaire. Cependant, les corps articulaires sont des éléments coûteux, cette solution n'est donc pas entièrement satisfaisante.

[0006] Le but de la présente invention est de proposer un implant glénoïdien amélioré, notamment en termes de polyvalence, simplicité et coût de mise en oeuvre.

[0007] A cet effet, l'invention a pour objet un implant glénoïdien pour prothèse d'épaule, destiné à être implanté dans la glène d'un patient et comprenant les caractéristiques de la revendication 1.

[0008] Ainsi, l'invention permet d'améliorer la polyvalence, la simplicité et le coût de mise en oeuvre de l'implant glénoïdien, qui peut présenter une configuration anatomique ou inversée en fonction des besoins du chirurgien. Les moyens d'ancrage peuvent rester à demeure dans l'implant, de sorte que la révision de la prothèse d'épaule est facilitée. Les moyens d'ajustement permettent un positionnement précis de la platine et donc du corps articulaire par rapport aux moyens d'ancrage et à la glène, quelle que soit la configuration choisie pour l'implant. En particulier, l'excentration du corps articulaire par rapport aux moyens d'ancrage est réglée au niveau de la platine et des moyens d'ajustement, ce qui évite de devoir prévoir une gamme importante de corps articulaires coûteux. La platine peut être positionnée au meilleur emplacement sur la glène, en fonction de la configuration différentes configurations anatomiques et osseuses à la fois grâce à un ajustement transversal, notamment suivant une direction supérieure-inférieure, et un ajustement en rotation, notamment en fonction de la configuration particulière de la glène du patient. En outre, un ajustement de la platine par basculement par rapport à l'axe d'ancrage peut être de préférence effectué dans le cas où la surface de la glène n'est pas perpendiculaire à l'axe d'ancrage. L'implant selon l'invention, avantageusement modulaire et convertible, peut se présenter sous forme d'un kit chirurgical, comme détaillé ci-après.

[0009] Selon d'autres caractéristiques avantageuses de l'implant glénoïdien selon l'invention, prises isolément ou en combinaison :

- Les moyens d'ajustement définissent de plus une liaison rotule pour ajuster en position la platine, préalablement à son blocage en position par les moyens de blocage, en basculement par rapport à l'axe d'ancrage.
- Les moyens d'ajustement comprennent une rainure ménagée dans la platine suivant une direction transversale à l'axe d'ancrage et adaptée pour ajuster en position la platine transversalement à l'axe d'ancrage indépendamment d'une rotation de cette platine autour de l'axe d'ancrage.
- La rainure comporte au moins deux empreintes délimitant chacune une position distincte de la platine transversalement à l'axe d'ancrage indépendamment d'une rotation de cette platine autour de l'axe

d'ancrage.

- Les moyens d'ajustement comprennent un pion coopérant avec les moyens d'ancrage et la platine pour ajuster en position cette platine par rapport à l'axe d'ancrage.
- Le pion coopère avec une rainure ménagée dans la platine pour ajuster en position cette platine par rapport à l'axe d'ancrage.
- Le pion reçu dans l'une des empreintes formées dans la rainure bloque en position la platine transversalement à l'axe d'ancrage indépendamment d'une rotation de cette platine autour de l'axe d'ancrage.
- Le corps articulaire présente sélectivement une configuration glénoïdienne anatomique ou inversée.

[0010] L'invention a également pour objet un kit chirurgical selon les caractéristiques de la revendication 9.

[0011] Selon d'autres caractéristiques avantageuses du kit chirurgical selon l'invention, prises isolément ou en combinaison :

- Les moyens d'ajustement comprennent une rainure ménagée dans la ou au moins l'une des platines suivant une direction transverse à l'axe d'ancrage et adaptée pour ajuster en position cette platine transversalement à l'axe d'ancrage indépendamment d'une rotation de cette platine autour de l'axe d'ancrage.
- Le kit comprend au moins deux platines ajustables sélectivement selon un ensemble de configurations en rotation autour de l'axe d'ancrage et transversalement à l'axe d'ancrage différent pour chacune de ces platines.

[0012] L'invention sera mieux comprise à la lecture de la description qui va suivre, donnée uniquement à titre d'exemple non limitatif et faite en référence aux dessins annexés sur lesquels :

- la figure 1 est une vue en perspective éclatée d'un implant glénoïdien conforme à l'invention, comprenant une platine également conforme à l'invention ;
- la figure 2 est une autre vue en perspective éclatée, selon un angle différent, de l'implant de la figure 1 ;
- la figure 3 est une section partielle de l'implant des figures 1 et 2, implanté dans la glène d'un patient également montrée en section ;
- la figure 4 est une vue en élévation de la platine des figures 1 à 3 ;
- la figure 5 est une vue de côté d'un pion appartenant à l'implant des figures 1 à 3 et permettant d'ajuster la platine en position ;
- la figure 6 est une vue en perspective partielle de l'implant des figures 1 à 3, dans une configuration assemblée ;
- la figure 7 est une vue selon la flèche VII à la figure 6 ;
- les figures 8, 9 et 10 sont des vues analogues à la

figure 4, montrant d'autres variantes de platines conforme à l'invention ;

- les figures 11 et 13 sont des vues analogues aux figures 4 et 8 à 10, montrant d'autres variantes de platines adaptées pour équiper un kit chirurgical, et qui ne représentent pas l'invention ; et
- les figures 12 et 14 sont des vues en perspective des platines, respectivement des figures 11 et 13.

[0013] Sur les figures 1 à 7 est représenté un implant glénoïdien 1 conforme à l'invention.

[0014] Cet implant 1 est destiné à être implanté dans la glène B de l'omoplate d'un patient. La glène B est montrée uniquement à la figure 3, tandis que l'humérus n'est pas représenté, dans un but de simplification. La glène B comprend une préparation osseuse qui remplace la cavité glénoïdale d'origine, incluant une surface d'appui B1 et une cavité d'ancrage B2. La surface B1 est sensiblement plane, par exemple réalisée par fraisage. La cavité B2 débouche de la glène B au niveau de cette surface B1.

[0015] Par la suite, afin de se repérer dans l'espace, on désigne par côté arrière de l'implant 1 les éléments tournés vers la glène B et par côté avant de l'implant 1 les éléments tournés à l'opposé de la glène B, lorsque l'implant 1 est implanté dans la glène B. En termes anatomiques, le côté arrière est donc orienté suivant la direction médiale, tandis que le côté avant est orienté suivant la direction latérale du corps du patient.

[0016] L'implant 1 comprend un corps articulaire 10 pour l'articulation de l'implant glénoïdien 1 avec l'humérus prothésé ou non-prothésé. L'implant 1 comprend également une platine 20 de support du corps articulaire 10, facilitant le positionnement précis de ce corps articulaire 10 par rapport à la glène B. L'implant 1 comprend également un pion d'ajustement 40, un système d'ancrage 50 incluant un insert 60 et une vis 70, ainsi qu'une vis de blocage 80. L'insert 60 et la vis 70 sont adaptés pour être fixés à demeure à la glène B, plus précisément dans la cavité d'ancrage B2 suivant un axe d'ancrage X50. Le pion 40 et la vis 80 forment des moyens de blocage en position de la platine 20 par rapport au système d'ancrage 50 et à la glène B. La platine 20 comporte une rainure 30 adaptée pour recevoir le pion 40. La rainure 30 et le pion 40 forment des moyens d'ajustement en position de la platine 20 préalablement à son blocage en position par les moyens de blocage 40 et 80, sélectivement en rotation autour de l'axe d'ancrage X50 et en translation transversalement à l'axe d'ancrage X50.

[0017] Les éléments 10, 20, 40, 60, 70 et 80 constitutifs de l'implant 1 peuvent être réalisés en métal, alliage métallique, céramique ou polymère biocompatible, par exemple en acier inoxydable, en titane ou alliage de titane, en alliage cobalt-chrome, en pyrocarbone, en PEEK ou tout autre matériau adapté à la présente application. En outre, chacune de ces éléments peut recevoir tout traitement ou revêtement adapté à la présente application, de manière localisée ou non.



[0018] Sur l'exemple des figures, l'implant 1 présente une configuration inversée. Ainsi, le corps articulaire 10 présente une forme de dôme hémisphérique. Le corps 10 comprend une surface articulaire externe 11 de forme sphérique convexe, munie d'un orifice au sommet 12. Le corps 10 comprend également une cavité interne 13, incluant en particulier une surface tronconique 14 de fixation à la platine 20. En alternative, la surface 14 peut avoir un profil cylindrique. L'orifice 12 relie la surface externe 11 et la cavité interne 13. Cet orifice 12 permet au chirurgien d'accéder au pion 40 et à la vis 60 lorsque le corps 10 est fixé sur la platine 20.

[0019] La platine de support 20 est distincte du corps articulaire 10, du pion 40 et de l'insert 60. La platine 20 comprend une surface externe tronconique 21 reliant un côté arrière 22 et un côté avant 23 de la platine 20. La surface 21 présente un diamètre plus important du côté arrière 22 que du côté avant 23. La surface 21 est prévue pour coopérer avec la surface 14 du corps articulaire 10, en vue de sa fixation selon un positionnement précis par rapport à la glène B. Du côté avant 23, la platine 20 comporte une bordure avant 24 délimitant un évidement avant 25. La platine 20 comporte un orifice 27 de réception de la vis 60, traversant la platine 20 entre l'évidement 25 du côté avant 23 et le côté arrière 22. La platine 20 comporte des trous 28 répartis du côté arrière 22, pour donner un aspect de surface irrégulier à ce côté arrière 22 et ainsi favoriser la repousse osseuse. Excepté les trous 28, la platine 20 présente une surface sensiblement plane du côté arrière 22, adaptée pour venir en appui contre la surface d'appui B1 de la glène B.

[0020] La rainure 30 ménagée dans la platine 20 s'étend suivant un axe de rainure A30, qui est sensiblement perpendiculaire à l'axe X50 lorsque la platine 20 est en position. La rainure 30 débouche à la fois au niveau de la surface 21, du côté arrière 22 et du côté avant 23 de la platine 20. La rainure 30 comporte des empreintes 31, 32 et 33, délimitant des positions distinctes d'ajustement de la platine 20. Une bordure 34 est formée autour des empreintes 31-33 du côté arrière 22 de la platine 20, de sorte que les empreintes 31-33 sont plus étroites du côté arrière 22 et plus larges du côté avant 23 de la rainure 30. La bordure 34 s'étend en arc de cercle autour du centre de chaque empreinte 31-33 et présente une concavité du côté avant 23, adaptée pour recevoir le pion 40. L'empreinte 31 est plus rapprochée du centre de la platine 20 et de l'évidement 25 relativement à la surface 21, l'empreinte 33 est formée au niveau de la surface 21 et de la bordure 24, tandis que l'empreinte 32 est formée entre les empreintes 31 et 33 dans l'évidement 25. Suivant l'axe A30, la rainure 30 est fermée au niveau de l'empreinte 31 et munie d'une ouverture transversale 35 délimitée au niveau de la surface 21 et de l'empreinte 33.

[0021] Le pion 40 permet d'ajuster la position de la platine 20 par rapport au système d'ancrage 50. Le pion 40 comprend une tige cylindrique 41, une tête 42 comportant une surface arrière bombée 43 et un orifice hexagonal 44, ainsi qu'un pied fileté 46 comportant une sur-

face plane annulaire avant 47, un filetage 48 et une surface plane arrière 49. La tige 41 s'étend entre la surface 43 de la tête 42 et la surface 47 du pied 46. L'orifice 44 est prévu pour recevoir un outil, tel qu'un tournevis chirurgical. Le pied 46 peut ainsi être vissé dans le système d'ancrage 50 suivant l'axe d'ancrage X50. Pour sa part, la tête 41 peut venir se loger dans les empreintes 31-33 et bloquer la position de la platine 20. Ainsi, comme détaillé ci-après, le pion 40 appartient à la fois aux moyens d'ajustement et aux moyens de blocage de la platine 20.

[0022] Le système 50 d'ancrage de l'implant 1 dans la glène B est formé par l'insert 60 et la vis 70 et s'étend suivant l'axe d'ancrage X50. Plus précisément, l'insert 60 et la vis 70 sont positionnées à demeure dans la cavité d'ancrage B2 prévue à cet effet. Selon une variante non représentée, l'insert 60 et la vis 70 peuvent constituer une pièce unique. De préférence, dans un cas idéal, l'axe X50 est sensiblement perpendiculaire à la surface d'appui B1. L'insert 60 est globalement en forme de cylindre creux à section circulaire, comportant une ouverture avant 61 et une ouverture arrière 62. L'insert 60 est conformé comme une cheville, pour réaliser une fonction de centrage de l'implant 1 dans la cavité B2 de la glène B. L'insert 60 comporte une surface externe bosselée 63, un filetage externe 64, une surface tronconique arrière 65, une surface interne 66, un épaulement interne 67, un filetage interne 68 et une surface interne 69. L'axe d'ancrage est défini principalement par l'insert 60 plutôt que par la vis 70, en particulier défini par le filetage 68 prévu pour recevoir le pion 40.

[0023] A l'extérieur de l'insert 60, la surface 63 est munie de bosselages lui procurant un aspect de surface rugueux, pour adhérer aux parois internes de la cavité d'ancrage B2. Le filetage 64 permet d'ancrer l'insert 60 à la glène B par vissage dans la cavité B2. La surface 65 peut venir en butée au fond de la cavité B2, en fonction de l'enfoncement de l'insert 60, mais ce n'est généralement pas le cas.

[0024] A l'intérieur de l'insert 60, la surface 66 est ovale et prévue pour recevoir un outil, qui peut venir en appui contre l'épaulement 67, afin de visser l'insert 60 dans la cavité B2. En alternative, la surface 66 peut être polygonale, par exemple hexagonale, ou cylindrique, et dans ce cas l'outil coopère directement avec le filetage 68. Une fois l'insert 60 en place dans la glène B, le filetage 66 est prévu pour recevoir le pied fileté 46 du pion 40, plus précisément le filetage 48. La surface 69 est tournée vers l'ouverture avant 61 et est prévue pour recevoir la vis 70 en appui.

[0025] La vis d'ancrage 70 comporte un corps fileté 71 et une tête de vis 72, munie d'une surface arrière bombée 73 et d'un orifice avant hexagonal 74. La surface 73 est prévue pour venir en appui contre la surface 69 de l'insert 60 lorsque le corps fileté 71 pénètre dans la masse osseuse de la glène B. L'orifice 74 est prévu pour recevoir un outil, tel qu'un tournevis chirurgical, pour visser la vis 70 dans la glène B. Idéalement, l'axe de la vis 70 peut être aligné avec l'axe d'ancrage X50 défini par l'insert

60. En pratique, lors du vissage de la vis 70 dans la glène B, l'axe de cette vis 70 peut être plus ou moins incliné par rapport à l'axe d'ancrage X50. Un tel cas correspond notamment à une vis 70 du type directionnel.

[0026] La vis de blocage 80 comporte un corps fileté 81 et une tête de vis 82, munie d'une surface arrière bombée 83 et d'un orifice avant hexagonal 84. L'orifice 84 est prévu pour recevoir un outil, tel qu'un tournevis chirurgical, pour visser le corps fileté 81 de la vis 80 dans la glène B. La surface 83 est prévue pour venir en appui contre les bords de l'orifice 27 formé dans la platine 20, lorsque le corps fileté 81 pénètre dans la masse osseuse de la glène B. Du fait de sa configuration, l'orifice 27 est adapté pour recevoir une vis 80 dite « multidirectionnelle », c'est à dire pouvant être positionnée par rapport à la platine 20 et à la glène B suivant différentes directions, au choix du chirurgien. Le vissage de la vis 80 dans l'orifice 27 de la platine 20 permet de bloquer la position de la platine 20, notamment en rotation par rapport à l'axe d'ancrage X50 du système 50 implanté dans la glène B.

[0027] En variante non représentée, la vis de blocage multidirectionnelle 80 peut être remplacée ou complétée par des moyens de blocage par expansion. Par exemple, de tels moyens de blocage peuvent comprendre une rondelle qui s'écarte radialement dans l'orifice 27 lors du vissage d'une vis d'expansion, similaire ou non à la vis 80, dans cette rondelle.

[0028] Le procédé de mise en oeuvre de l'implant 1 est détaillé ci-après.

[0029] Lors de la pose d'un premier implant 1 dans la glène B, le chirurgien prépare la surface d'appui B1 et la cavité d'ancrage B2. Dans ce cadre, le chirurgien peut réaliser la surface B1 avant ou après la cavité B2. Selon l'invention, le premier implant 1 peut comprendre soit directement un corps articulaire inversé 10, soit un corps articulaire anatomique auquel succède un corps articulaire inversé 10 lors d'une révision.

[0030] Lorsque le chirurgien perce la cavité B2, il fore un trou dont le diamètre est légèrement inférieur au diamètre externe de l'insert 60, notamment du filetage 64. Le chirurgien visse ensuite l'insert 60 dans la cavité 64, au moyen d'un outil, non représenté, équipé d'un embout coopérant avec la surface 66. Le filetage 64 est de préférence auto-taroudant, ce qui lui permet de pénétrer dans la cavité B2 en taroudant la masse osseuse de la glène B. Le chirurgien fait alors un nouveau trou dans la glène B, de diamètre légèrement inférieur au diamètre du corps fileté 71 de la vis 70, en passant une mèche, non représentée, à travers les ouvertures 61 et 62 de l'insert 60, perpendiculairement à la surface B1. La mèche peut être guidée par un outil additionnel, non représenté, agencé à l'intérieur de l'insert 60. Le chirurgien visse ensuite la vis d'ancrage 70 dans le trou qu'il vient de réaliser et dans l'insert 60, à l'aide d'un outil, non représenté, qu'il insère dans l'orifice 74 de la vis 70. En fin de course, la surface 73 de la vis 70 vient en appui contre la surface 69 de l'insert 60. Sur l'exemple des figures, le

filetage 64 de l'insert 60 est « à droite » et son vissage s'effectue dans le sens antihoraire, tandis que le filetage 71 de la vis 70 est « à gauche » et son vissage s'effectue dans le sens horaire. Ainsi, une fois l'insert 60 et la vis 70 en place dans la cavité B2, le système d'ancrage 50 est bloqué en rotation et son dévissage en service est évité. De préférence, l'insert 60 est positionné avec un jeu entre l'ouverture avant 61 et l'embouchure de la cavité B2, ce qui permet éventuellement le fraisage d'une nouvelle surface B1 sans fraiser l'insert 60.

[0031] Lorsque le chirurgien révisé la glène B, en particulier en mettant en oeuvre l'implant 1 selon l'invention, la cavité B2 est déjà formée et le système d'ancrage 50 reste avantageusement en place dans cette cavité B2. Pour sa part, la surface B1 est formée en remplacement de l'ancienne surface de la glène B. Dans ce cas, la surface B1 peut être inclinée par rapport à un plan perpendiculaire à l'axe d'ancrage X50 précédemment défini.

[0032] Ensuite, que ce soit une première implantation ou une révision, le chirurgien introduit le pion 40 dans l'insert 60 par l'ouverture 61, puis visse le pied fileté 46 dans le filetage 68 à l'aide d'un outil, non représenté, qu'il insère dans l'orifice 44 ménagé dans la tête 42 du pion 40. A ce stade, la tige 41 et la tête 42 du pion 40 dépassent de la cavité d'ancrage B2 au niveau de la surface d'appui B1. La platine 20 peut alors coopérer avec le pion 40, en se translatant contre la surface d'appui B1, de sorte que la rainure 30 reçoit la tige 41. De préférence, la bordure 34 de la rainure 30 est dimensionnée pour glisser de part et d'autre de la tige 41, contre la surface externe cylindrique de la tige 41. Grâce à la rainure 30, la platine 20 peut à la fois pivoter et se translater par rapport au pion 40 et à l'axe d'ancrage X50.

[0033] Ainsi, la rainure 30 et le pion 40 constituent des moyens d'ajustement en position de la platine 20, préalablement à son blocage en position par le pion 40 et la vis 80, sélectivement en rotation autour de l'axe d'ancrage X50 et en translation transversalement à l'axe d'ancrage X50. En particulier, la rainure 30 permet d'ajuster en position la platine 20 transversalement à l'axe X50, avec une excentration donnée de la platine 20 par rapport à l'axe X50, indépendamment d'une rotation de cette platine 20 autour de l'axe X50. Pour une orientation angulaire donnée de la platine 20 et de l'axe A30 autour de l'axe X50, une translation de la platine 20 est autorisée et dans ce cas, chaque empreinte 31-33 délimite une position distincte de la platine 20 transversalement à l'axe X50. Autrement dit, chaque empreinte 31-33 définit un excentrique donné de la platine 20.

[0034] De plus, la rainure 30 et le pion 40 constituent avantageusement des moyens d'ajustement en position de la platine 20 en basculement par rapport à l'axe d'ancrage X50. Ce basculement est réalisé selon une liaison du type rotule entre la tête 41 du pion 40 et l'empreinte 31, 32 ou 33 de la rainure 30 dans laquelle est logée cette tête 41. Ainsi, si la surface B1 n'est pas exactement perpendiculaire à l'axe X50, la platine 20 peut basculer par rapport à cet axe 50 pour venir en appui contre cette

surface B1.

[0035] Ensuite, le chirurgien bloque la position de la platine 20 par rapport au système d'ancrage 50, à l'axe d'ancrage X50 et à la glène B, grâce aux moyens de blocage constitués par le pion 40 et la vis 80. En l'espèce, la surface 43 de la tête 42 est complémentaire des empreintes 31-33 formées dans la rainure 30. Lorsque le chirurgien visse encore le pion 40 dans l'insert 60, la surface 43 vient appuyer contre la bordure 34 en se logeant dans l'une des empreintes 31-33, bloquant ainsi la position de la platine 20 par rapport à l'insert 30. Le chirurgien fait alors un nouveau trou dans la glène B, de diamètre légèrement inférieur au diamètre du corps fileté 81 de la vis 80, en passant une mèche, non représentée, à travers l'orifice 27 de la platine 20, selon une direction inclinée par rapport à la surface B1. Comme pour le trou de la vis 70, la mèche peut être guidée par un outil additionnel, non représenté, agencé à l'intérieur de l'orifice 27. Le chirurgien visse ensuite la vis de blocage 80 dans le trou qu'il vient de réaliser et dans l'orifice 27, à l'aide d'un outil, non représenté, qu'il insère dans l'orifice 64 de la vis 84. En pratique, le pion 40 est bien adapté pour bloquer la platine 20 essentiellement en translation par rapport au système 50, à l'axe 50 et à la glène B. Néanmoins, le chirurgien utilise la vis 80 pour bloquer de manière certaine la rotation de la platine 20. Autrement dit, les moyens de blocage de la platine 20 comprennent au moins le pion 40, de préférence le pion 40 et la vis 80.

[0036] Enfin, le chirurgien fixe le corps articulaire 10 sur la platine 20 par impact. En positionnant avec précision la platine 20 et notamment sa surface 21 de réception du corps 10, le chirurgien peut donc positionner la surface articulaire 11 du corps 10 avec précision par rapport à la glène B. A ce stade, l'implant 1 complet est implanté dans la glène B. Grâce à l'invention, l'opération chirurgicale est sûre et le risque de désassemblage des différentes parties de l'implant 1 est limité. Une fois l'opération terminée, le corps articulaire 10 s'articule avec l'humérus en vue de reproduire un comportement articulaire de type prothèse d'épaule inversée sur l'exemple de la figure 3, ou bien de type prothèse d'épaule anatomique lorsque le corps articulaire présente une configuration anatomique.

[0037] En outre, l'implant 1 peut se présenter sous forme d'un kit chirurgical. Dans ce cas, le kit chirurgical comprend au moins un corps articulaire et au moins une platine, tels que le corps 10 et la platine 20 représentés sur l'exemple des figures 1 à 7. De préférence, le kit chirurgical comprend plusieurs corps articulaires et/ou plusieurs platines, telles que les platines 20, 120, 220, 320, 420 et 520 décrites ci-dessus et ci-après.

[0038] Sur les figures 8, 9 et 10 sont représentées des platines 120, 220 et 320 conformes à d'autres variantes de réalisation de l'invention.

[0039] Certaines parties constitutives de ces platines 120, 220 et 320 sont similaires à celles de la platine 20, décrite plus haut, et portent les mêmes références numériques. Seules les différences avec la platine 20 sont

détailées ci-après.

[0040] Comme montré à la figure 8, la platine 120 comporte deux orifices traversants additionnels 129, ménagés de part et d'autre de la rainure 30. Ces orifices 129 sont adaptés pour recevoir des moyens de blocage additionnels, tels que des vis similaires à la vis 80 ou tous moyens de blocage adaptés à la présente application.

[0041] Comme montré aux figures 9 et 10, les platines 220 et 320 comportent chacune une rainure, respectivement 230 et 330, différente de la rainure 30. En l'espèce, chaque rainure 230 ou 330 comporte une unique empreinte, respectivement 231 ou 332, bordée par une bordure localisée, respectivement 234 ou 334. Les rainures 230 et 330 forment, avec le pion 40 décrit plus haut, des moyens d'ajustement en position de la platine 220 ou 320, préalablement à son blocage en position par les moyens de blocage, sélectivement en rotation autour de l'axe X50, en translation transversalement à l'axe X50 et en basculement par rapport à l'axe X50. Les empreintes 231 et 332 définissent des excentrations distinctes par rapport à leur surface 21 de réception du corps articulaire 10.

[0042] Lorsque les platines 220 et 320 équipent le kit chirurgical selon l'invention, le chirurgien peut choisir entre l'une ou l'autre en fonction de l'ajustement en translation désiré par rapport à l'axe d'ancrage X50. Les deux platines 220 et 320 sont ajustables sélectivement selon un ensemble de configurations en rotation autour de l'axe X50 et transversalement à l'axe X50 différent pour chacune de ces platines 220 et 320. Par conséquent, les platines 220 et 320 sont également ajustables sélectivement selon un ensemble de configurations en basculement différent pour chacune d'elles.

[0043] Sur les figures 11 à 14 sont représentées d'autres variantes de platines 420 et 520, adaptées pour équiper un kit chirurgical. Ces variantes ne sont pas conformes à l'invention.

[0044] Certaines parties constitutives de ces platines 420 et 520 sont similaires à celles de la platine 20, décrite plus haut, notamment la surface 21 de réception du corps articulaire 10. Seules les différences avec la platine 20 sont détaillées ci-après. En particulier, les platines 420 et 520 ne comportent pas de rainure d'ajustement en position. En revanche, les platines 420 et 520 comportent chacune un pion, respectivement 440 et 540, d'ajustement en position, directement intégré à la platine 420 ou 520 et adapté pour coopérer avec le système d'insert 60 de l'implant 1.

[0045] Comme montré aux figures 11 et 12, la platine 420 comprend une bordure 424 et une cavité 425 situées du côté avant, ainsi que deux orifices traversants 427 et deux orifices traversants 429. Les orifices 427 sont globalement similaires à l'orifice 27, tandis que les orifices 429 sont globalement similaires aux orifices 129. Sur l'exemple représenté, les orifices 427 et 429 chevauchent à la fois la bordure 424 et la cavité 425, et sont répartis en alternance à 90° autour du pion 440.

[0046] En l'espèce, le pion 440 présente un profil lu-

bulaire cylindrique, centré sur la platine 420 par rapport à la surface 21. Le pion 440 comporte une bordure annulaire avant 442 située dans l'évidement 425, ainsi qu'une bordure annulaire arrière 449. Le pion 440 comporte un alésage cylindrique 443 traversant la platine 420 entre les bordures 442 et 449. Du côté arrière de la platine 420, le pion 440 est plus allongé et comporte un filetage 448 adapté pour coopérer avec le système d'ancrage 50 de l'implant 1. Le pion 440 constitue des moyens d'ajustement en rotation de la platine 420 par rapport à l'axe d'ancrage X50, mais pas en translation. Lorsque l'orientation de la platine 420 par rapport à l'axe X50 varie, la position des orifices 427 et 429 varie, contrairement à la position de la surface 21 de cette platine 420.

[0047] Comme montré aux figures 13 et 14, le pion 540 est similaire au pion 440 et comporte les mêmes parties constitutives, portant des références numériques augmentées de 100. Il s'agit des bordures 542 et 549, de l'alésage 543 et du filetage 548, lequel est adapté pour coopérer avec le système d'ancrage de l'implant 1. La platine 520 comprend en outre une bordure 524 et une cavité 525 situées du côté avant, ainsi que deux orifices traversants identiques aux orifices 429.

[0048] En l'espèce, la principale différence entre le pion 440 et le pion 540 est que ce pion 540 n'est pas centré par rapport à la surface 21 de la platine 520. Le pion 540 constitue des moyens d'ajustement en rotation de la platine 520 par rapport à l'axe d'ancrage X50, mais pas en translation. Lorsque l'orientation de la platine 520 par rapport à l'axe X50 varie, la position des orifices de passage de vis de blocage varie, mais la position de la surface 21 de cette platine 520 varie également, contrairement à la platine 420. Les configurations possibles de la surface 21 par rapport à la glène B sont donc différentes pour la platine 420 et la platine 520.

[0049] En variante non représentée, les pions 420 ou 520 peuvent être configurés différemment en vue de coopérer avec le système d'ancrage 50, par exemple avec un dispositif de crémaillère, un élément expansif ou un clip.

[0050] Indépendamment l'une de l'autre, chacune des platines 420 ou 520 peut être ajustée en position, préalablement à son blocage en position par les moyens de blocage, en rotation autour de l'axe d'ancrage X50, mais pas en translation transversalement à l'axe d'ancrage X50, ni en basculement par rapport à l'axe d'ancrage X50. Lorsque les platines 420 et 520 équipent le kit chirurgical selon l'invention, le chirurgien peut choisir entre l'une ou l'autre en fonction de l'ajustement en translation désiré par rapport à l'axe X50, autrement dit l'excentration de la surface 21 par rapport à l'axe X50. Les deux platines 420 et 520 sont donc ajustables sélectivement selon un ensemble de configurations en rotation autour de l'axe X50 et transversalement à l'axe X50. Cet ensemble de configurations est différent pour chacune de ces platines 420 et 520.

[0051] Par ailleurs, l'implant 1 et/ou la platine équipant cet implant 1 peuvent être conformés différemment des

figures sans sortir du cadre de l'invention. En particulier, le corps articulaire, les moyens d'ancrage, les moyens de blocage et/ou les moyens d'ajustement peuvent être conformés différemment des figures.

[0052] En outre, les caractéristiques techniques des différents modes de réalisation peuvent être, en totalité ou pour certaines d'entre elles, combinées entre elles. Ainsi, l'implant 1 peut être adapté en termes de coût, de fonctionnalité et de performance.

## Revendications

1. Implant glénoïdien (1) pour prothèse d'épaule, destiné à être implanté dans la glène (B) d'un patient et comprenant :

- un corps articulaire (10) pour l'articulation de l'implant glénoïdien, (1) avec l'humérus prothésé ou non-prothésé ;
- une platine (20 ; 120 ; 220 ; 320) de support du corps articulaire (10), cette platine (20 ; 120 ; 220 ; 320) comprenant une surface externe tronconique (21) reliant un côté arrière (22) et un côté avant (23) de la platine et prévue pour coopérer avec une surface interne (14) du corps articulaire (10) ;
- des moyens (50) d'ancrage suivant un axe d'ancrage (X50), adaptés pour être fixés à demeure à la glène (B) ; et
- des moyens (40, 80) de blocage en position de la platine (20 ; 120 ; 220 ; 320) par rapport aux moyens d'ancrage (50) et à la glène (B) ;

caractérisé en ce que la platine (20 ; 120 ; 220 ; 320) comprend des moyens (30 ; 230 ; 330) d'ajustement en position de la platine (20 ; 120 ; 220 ; 320) par rapport aux moyens d'ancrage (50), préalablement à son blocage en position par les moyens de blocage (40, 80), sélectivement en rotation autour de l'axe d'ancrage (X50) et en translation transversalement à l'axe d'ancrage (X50).

2. Implant glénoïdien (1) selon la revendication 1, caractérisé en ce que les moyens d'ajustement (30 ; 230 ; 330) définissent de plus une liaison rotule pour ajuster en position la platine (20 ; 120 ; 220 ; 320), préalablement à son blocage en position par les moyens de blocage (40, 80), en basculement par rapport à l'axe d'ancrage (X50).

3. Implant glénoïdien (1) selon l'une des revendications 1 ou 2, caractérisé en ce que les moyens d'ajustement (30 ; 230 ; 330) comprennent une rainure (30 ; 230 ; 330) ménagée dans la platine (20 ; 120 ; 220 ; 320) suivant une direction (A30) transverse à l'axe d'ancrage (X50) et adaptée pour ajuster en position la platine (20 ; 120 ; 220 ; 320) transversalement à

l'axe d'ancrage (X50) indépendamment d'une rotation de cette platine (20 ; 120 ; 220 ; 320) autour de l'axe d'ancrage (X50).

4. Implant glénoïdien (1) selon la revendication 3, caractérisé en ce que la rainure (30) comporte au moins deux empreintes (31, 32, 33) délimitant chacune une position distincte de la platine (20 ; 120) transversalement à l'axe d'ancrage (X50) indépendamment d'une rotation de cette platine (20 ; 120) autour de l'axe d'ancrage (X50). 5
5. Implant glénoïdien (1) selon l'une des revendications précédentes, caractérisé en ce que les moyens de blocage (40, 80) comprennent un pion (40) qui coopère avec les moyens d'ancrage (50) et avec les moyens d'ajustement (30 ; 230 ; 330) de la platine (20 ; 120 ; 220 ; 320) pour ajuster en position cette platine (20 ; 120 ; 220 ; 320) par rapport à l'axe d'ancrage (X50). 10
6. Implant glénoïdien (1) selon les revendications 3 et 5, caractérisé en ce que le pion (40) coopère avec la rainure (30 ; 230 ; 330) ménagée dans la platine (20 ; 120 ; 220 ; 320) pour ajuster en position cette platine (20 ; 120 ; 220 ; 320) par rapport à l'axe d'ancrage (X50). 15
7. Implant glénoïdien (1) selon les revendications 4 et 6, caractérisé en ce que le pion (40) reçu dans l'une des empreintes (31, 32, 33) formées dans la rainure (30) bloque en position la platine (20 ; 120) transversalement à l'axe d'ancrage (X50) indépendamment d'une rotation de cette platine (20 ; 120) autour de l'axe d'ancrage (X50). 20
8. Implant glénoïdien (1) selon l'une des revendications précédentes, caractérisé en ce que le corps articulaire (10) présente sélectivement une configuration glénoïdienne anatomique ou inversée. 25
9. Kit chirurgical adapté pour la mise en oeuvre d'un implant glénoïdien (1) pour prothèse d'épaule selon l'une des revendications 1 à 8, l'implant glénoïdien (1) étant destiné à être implanté dans la glène (B) d'un patient, le kit comprenant :
  - au moins un corps articulaire (10) pour l'articulation de l'implant glénoïdien (1) avec l'humérus prothésé ou non-prothésé ; 30
  - au moins une platine (20 ; 120 ; 220, 320) de support du corps articulaire (10), cette platine (20 ; 120 ; 220 ; 320) comprenant une surface externe tronconique (21) reliant un côté arrière (22) et un côté avant (23) de la platine et prévue pour coopérer avec une surface inférieure (14) du corps articulaire (10) ; 35
  - des moyens (50) d'ancrage suivant un axe

d'ancrage (X50), adaptées pour être fixées à demeure à la glène (B) ; et  
- des moyens (40, 80) de blocage en position de la platine (20) par rapport aux moyens d'ancrage (50) et à la glène (B) ;

caractérisé en ce que la platine (20 ; 120 ; 220 ; 320) comprend des moyens (30 ; 230 ; 330) d'ajustement en position de l'au moins une platine (20 ; 120 ; 220 ; 320) par rapport aux moyens d'ancrage (50), préalablement à son blocage en position par les moyens de blocage (40, 80), sélectivement en rotation autour de l'axe d'ancrage (X50) et transversalement à l'axe d'ancrage (X50).

10. Kit chirurgical selon la revendication 9, caractérisé en ce que les moyens d'ajustement (30 ; 230 ; 330) comprennent une rainure (30 ; 230 ; 330) ménagée dans la ou au moins l'une des platines (20 ; 120 ; 220 ; 320) suivant une direction (A30) transverse à l'axe d'ancrage (X50) et adaptée pour ajuster en position cette platine (20 ; 120 ; 220 ; 320) transversalement à l'axe d'ancrage (X50) indépendamment d'une rotation de cette platine (20 ; 120 ; 220 ; 320) autour de l'axe d'ancrage (X50). 40

#### Patentansprüche

1. Gelenkimplantat (1) für eine Schulterprothese, welches bestimmt ist, in der Gelenkpfanne (B) eines Patienten implantiert zu sein und welches aufweist:
  - einen Gelenkkörper (10) zur Gelenkverbindung des Gelenkimplantats (1) zusammen mit einer Oberarmknochenprothese oder dem Oberarmknochen ohne Prothese,
  - eine Platte (20; 120; 220; 320) zum Stützen des Gelenkkörpers (10), wobei diese Platte (20; 120; 220; 320) eine kegelförmige Außenfläche (21) aufweist, die eine Hinterseite (22) und eine Vorderseite (23) der Platte verbindet und die vorgesehen ist, um mit einer Innenfläche (14) des Gelenkkörpers (10) zu kooperieren,
  - Mittel (50) zum Verankern entlang einer Verankerungsachse (X50), welche angepasst sind, um dauerhaft an der Gelenkpfanne (B) fixiert zu sein, und
  - Mittel (40, 80) zum Blockieren der Platte (20; 120; 220; 320) in Position bezüglich der Mittel (50) zum Verankern und der Gelenkpfanne (B);

dadurch gekennzeichnet, dass die Platte (20; 120; 220; 320) Mittel (30; 230; 330) aufweist zum Einstellen der Position der Platte (20; 120; 220; 320) bezüglich der Mittel zum Verankern (50), vor ihrem Blockieren in Position durch die Mittel zum Blockieren (40, 80), selektiv durch Rotation um die Verankerungsachse (X50).



rungsachse (X50) herum und durch Translation quer zur Verankerungsachse (X50).

2. Gelenkimplantat (1) gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Mittel zum Einstellen (30; 230; 330) ferner eine Kugelgelenkverbindung definieren zum Einstellen der Position der Platte (20; 120; 220; 320), vor ihrem Blockieren in Position durch die Mittel zum Blockieren (40, 80), durch Verschwenkung bezüglich der Verankerungsachse (X50).

3. Gelenkimplantat (1) gemäß einem der Ansprüche 1 oder 2, **dadurch gekennzeichnet, dass** die Mittel (30; 230; 330) zum Einstellen eine Nut (30; 230; 330) aufweisen, welche in der Platte (20; 120; 220; 320) entlang einer Richtung (A30) quer zur Verankerungsachse (X50) vorgesehen ist und angepasst ist, um die Position der Platte (20; 120; 220; 320) quer zur Verankerungsachse (X50) unabhängig von einer Drehung dieser Platte (20; 120; 220; 320) um die Verankerungsachse (X50) herum einzustellen.

4. Gelenkimplantat (1) gemäß Anspruch 3, **dadurch gekennzeichnet, dass** die Nut (30) zumindest zwei Vertiefungen (31, 32, 33) aufweist, welche jede eine individuelle Position der Platte (20; 120) quer zur Verankerungsachse (X50) unabhängig von einer Drehung dieser Platte (20; 120) um die Verankerungsachse (X50) herum begrenzt.

5. Gelenkimplantat (1) gemäß einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Mittel zum Blockieren (40, 80) einen Zapfen (40) aufweisen, welcher mit den Mitteln zum Verankern (50) und mit den Mitteln zum Einstellen (30; 230; 330) der Platte (20; 120; 220; 320) zum Einstellen der Position dieser Platte (20; 120; 220; 320) bezüglich der Verankerungsachse (X50) kooperiert.

6. Gelenkimplantat (1) gemäß den Ansprüchen 3 und 5, **dadurch gekennzeichnet, dass** der Zapfen (40) mit der Nut (30; 230; 330) kooperiert, die in der Platte (20; 120; 220; 320) zum Einstellen der Position dieser Platte (20; 120; 220; 320), bezüglich der Verankerungsachse (X50) vorgesehen ist.

7. Gelenkimplantat (1) gemäß den Ansprüchen 4 und 6, **dadurch gekennzeichnet, dass** der Zapfen (40), welcher in einer der Vertiefungen (31, 32, 33) aufgenommen ist, die in der Nut (30) geformt sind, die Platte (20; 120) in Position quer zur Verankerungsachse (X50) unabhängig von einer Drehung dieser Platte (20; 120) um die Verankerungsachse (X50) herum blockiert.

8. Gelenkimplantat (1) gemäß einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass**

der Gelenkkörper (10) selektiv eine anatomische Schultergelenkkonfiguration oder eine invers-anatomische Schultergelenkkonfiguration aufweist.

9. Chirurgisches Kit, welches zum Umsetzen eines Gelenkimplantats (1) für eine Schulterprothese gemäß einem der Ansprüche 1 bis 8 eingerichtet ist, wobei das Gelenkimplantat (1) bestimmt ist, in der Gelenkpfanne (B) eines Patienten implantiert zu sein, wobei das Kit aufweist:

- zumindest einen Gelenkkörper (10) zur Gelenkverbindung des Gelenkimplantats (1) mit einer Oberarmknochenprothese oder dem Oberarmknochen ohne Prothese,
- zumindest eine Platte (20; 120; 220; 320) zum Stützen des Gelenkkörpers (10), wobei diese Platte (20; 120; 220; 320) eine konische Außenfläche (21) aufweist, die eine Hinterseite (22) und eine Vorderseite (23) der Platte verbindet und die vorgesehen ist, um mit einer Innenfläche (14) des Gelenkkörpers (10) zu kooperieren,
- Mittel (50) zum Verankern entlang einer Verankerungsachse (X50), welche angepasst sind, um dauerhaft an der Gelenkpfanne (B) fixiert zu sein, und
- Mittel (40, 80) zum Blockieren der Platte (20) in Position bezüglich der Mittel zum Verankern (50) und der Gelenkpfanne (B);

**dadurch gekennzeichnet, dass** die Platte (20; 120; 220; 320) Mittel (30; 230; 330) aufweist zum Einstellen der zumindest einen Platte (20; 120; 220; 320) in Position bezüglich der Mittel zum Verankern (50), vor ihrem Blockieren in Position durch die Mittel zum Blockieren (40, 80), selektiv durch Drehung um die Verankerungsachse (X50) und quer zur Verankerungsachse (X50).

10. Chirurgisches Kit gemäß Anspruch 9, **dadurch gekennzeichnet, dass** die Mittel zum Einstellen (30; 230; 330) eine Nut (30; 230; 330) aufweisen, welche in der oder in zumindest einer der Platten (20; 120; 220; 320) entlang einer Richtung (A30) quer zur Verankerungsachse (X50) vorgesehen ist und angepasst ist, um die Position dieser Platte (20; 120; 220; 320) quer zur Verankerungsachse (X50) unabhängig von einer Drehung dieser Platte (20; 120; 220; 320) um die Verankerungsachse (X50) herum einzustellen.

#### Claims

1. A glenoidal implant (1) for a shoulder prosthesis, designed to be implanted in the glenoid (B) of a patient and comprising:

- an articular body (10) for articulating the glenoidal implant (1) with the humerus provided with or without a prosthesis;

- a plate (20; 120; 220; 320) for supporting the articular body (10), this plate (20; 120; 220; 320) comprising an outer frustoconical surface (21) that connects a rear side (22) and a front side (23) of the plate and that is provided for cooperating with an inner surface (14) of the articular body (10);

- means (50) for anchoring along an anchor axis (X50), suitable for being permanently fastened to the glenoid (B); and

- means (40, 80) for locking the plate (20; 120; 220; 320) in position relative to the anchoring means (50) and the glenoid (B);

**characterized in that** the plate comprises means (30; 230; 330) for adjusting the position of the plate (20; 120; 220; 320) relative to the anchoring means, before it is locked in position by the locking means (40, 80), selectively in rotation around the anchoring axis (X50) and in translation transverse to the anchoring axis (X50).

2. The glenoidal implant (1) according to claim 1, **characterized in that** the adjustment means (30; 230; 330) define a ball-type connection for adjusting the position of the plate (20; 120; 220; 320), before it is locked in position by the locking means (40, 80), in terms of tilt relative to the anchoring axis (X50).

3. The glenoidal implant (1) according to one of claims 1 or 2, **characterized in that** the adjustment means (30; 230; 330) comprise a groove (30; 230; 330) formed in the plate (20; 120; 220; 320) in a direction (A30) transverse to the anchoring axis (X50) and suitable for adjusting the position of the plate (20; 120; 220; 320) transverse to the anchoring axis (X50) independently of a rotation of that plate (20; 120; 220; 320) around the anchoring axis (X50).

4. The glenoidal implant (1) according to claim 3, **characterized in that** the groove (30) comprises at least two cavities (31, 32, 33) each delimiting a distinct position of the plate (20; 120) transverse to the anchoring axis (X50) independently of a rotation of that plate (20; 120) around the anchoring axis (X50).

5. The glenoidal implant (1) according to one of the preceding claims, **characterized in that** the locking means (40, 80) comprise a pin (40) that cooperates with the anchoring means (50) and with the adjustment means (30; 230; 330) of the plate (20; 120; 220; 320), to adjust the position of that plate (20; 120; 220; 320) relative to the anchoring axis (X50).

6. The glenoidal implant (1) according to claims 3 and

5, **characterized in that** the pin (40) cooperates with the groove (30; 230; 330) formed in the plate (20; 120; 220; 320), to adjust the position of that plate (20; 120; 220; 320) relative to the anchoring axis (X50).

7. The glenoidal implant (1) according to claims 4 and 6, **characterized in that** the pin (40) received in one of the cavities (31, 32, 33) formed in the groove (30) locks the position of the plate (20; 120) transversally to the anchoring axis (X50) independently of a rotation of that plate (20; 120) around the anchoring axis (X50).

8. The glenoidal implant (1) according to one of the preceding claims, **characterized in that** the articular body (10) selectively has an anatomical or reversed glenoidal configuration.

9. A surgical kit suitable for implementing a glenoidal implant (1) for a shoulder prosthesis according to one of claims 1 to 8, the glenoidal implant (1) being designed to be implanted in the glenoid (B) of a patient, the kit comprising:

- at least one articular body (10) for articulating the glenoidal implant (1) with the humerus provided with or without a prosthesis;

- at least one plate (20; 120; 220; 320) for supporting the articular body (10), this plate (20; 120; 220; 320) comprising an outer frustoconical surface (21) that connects a rear side (22) and a front side (23) of the plate and that is provided for cooperating with an inner surface (14) of the articular body (10);

- means (50) for anchoring along an anchor axis (X50), suitable for being permanently fastened to the glenoid (B); and

- means (40, 80) for locking the plate (20) in position relative to the anchoring means (50) and the glenoid (B);

**characterized in that** the plate comprises means (30; 230; 330) for adjusting the position of the at least one plate (20; 120; 220; 320) relative to the anchoring means, before it is locked in position by the locking means (40, 80), selectively in rotation around the anchoring axis (X50) and in translation transverse to the anchoring axis (X50).

10. The surgical kit according to claim 9, **characterized in that** the adjustment means (30; 230; 330) comprise a groove (30; 230; 330) formed in the or at least one of the plates (20; 120; 220; 320) in a direction (A30) transverse to the anchoring axis (X50) and suitable for adjusting the position of the plate (20; 120; 220; 320) transverse to the anchoring axis (X50) independently of a rotation of that plate (20; 120;

220; 320) around the anchoring axis (X50).

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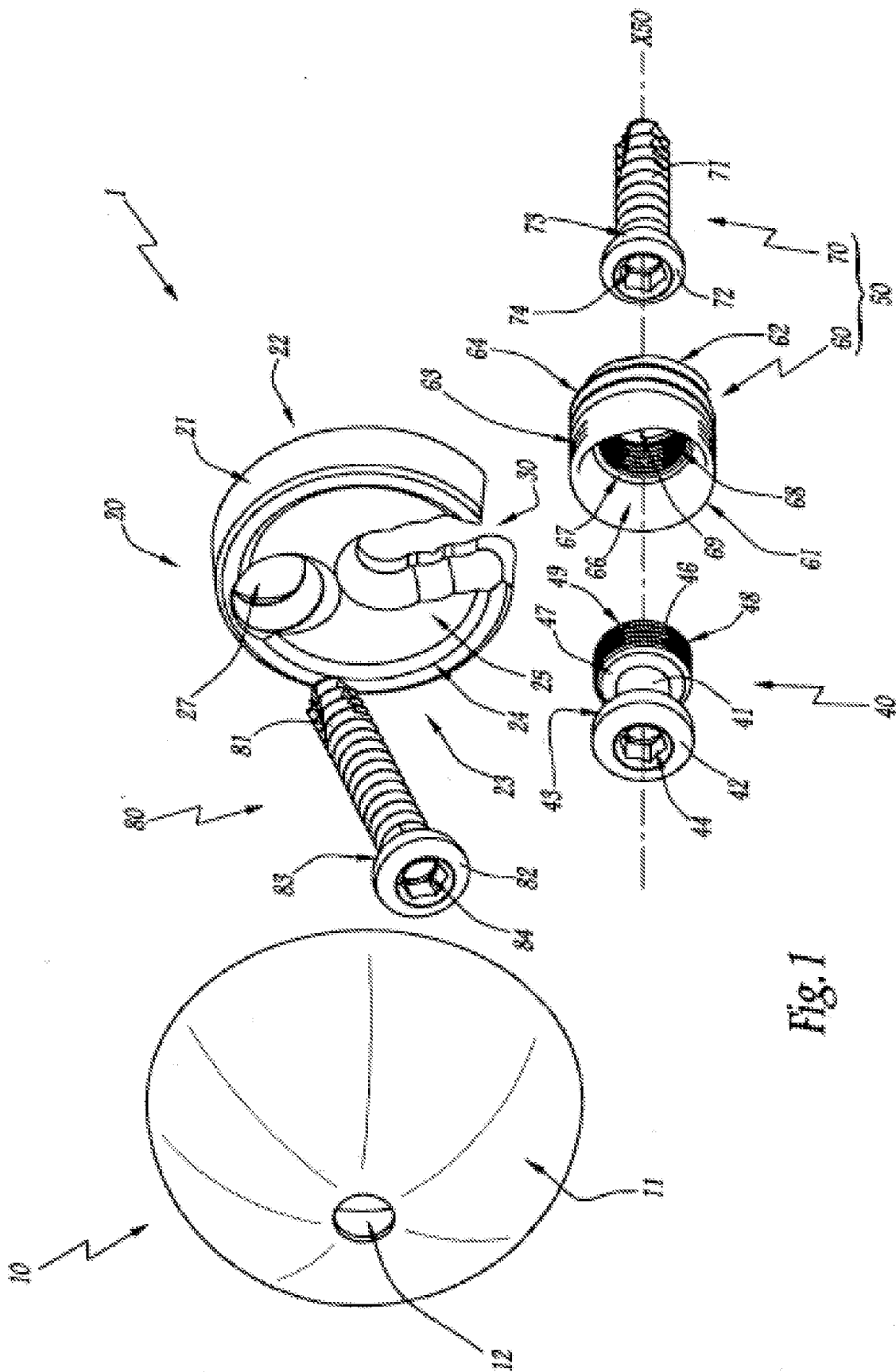


Fig. 1

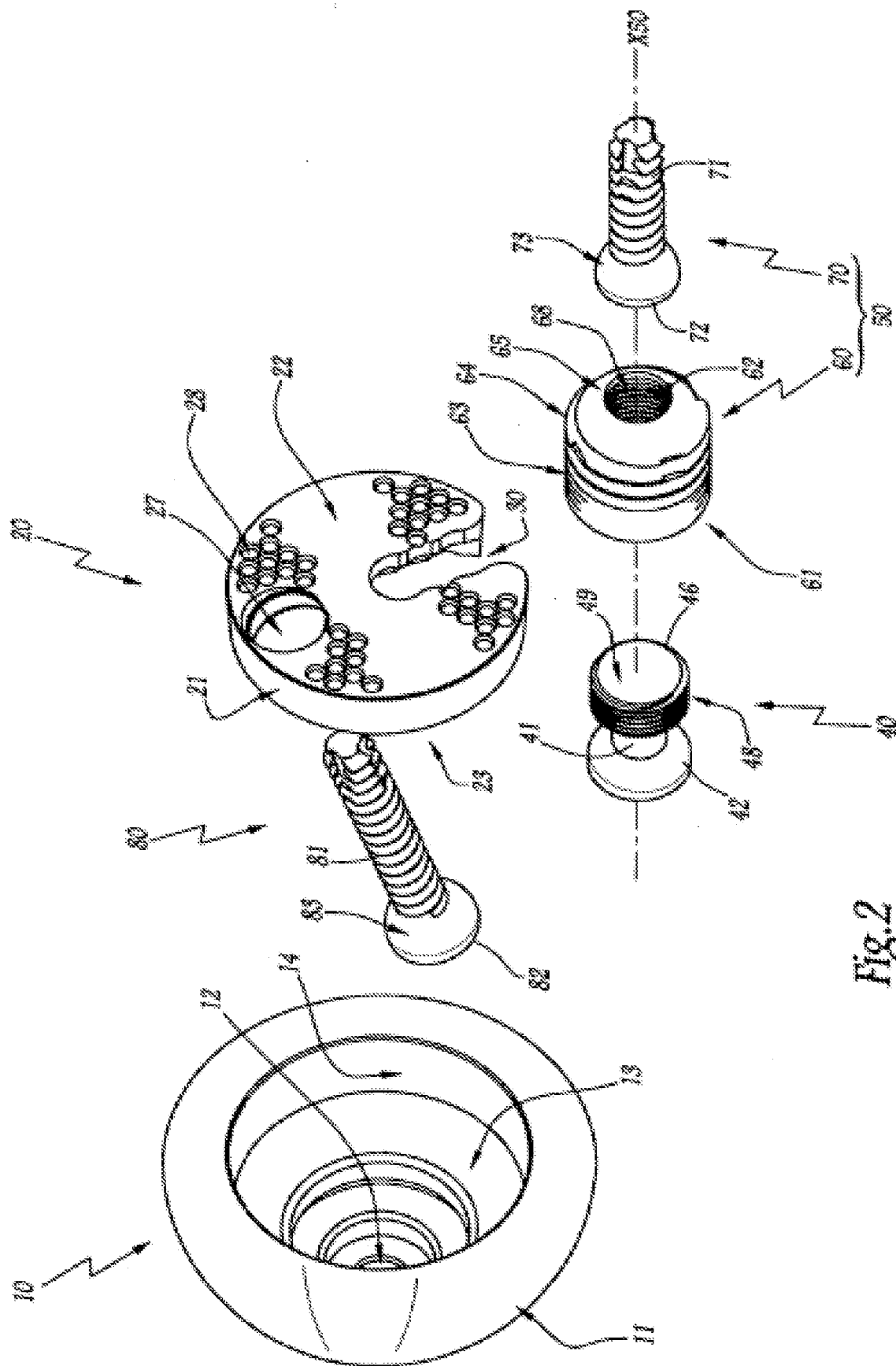


Fig. 2

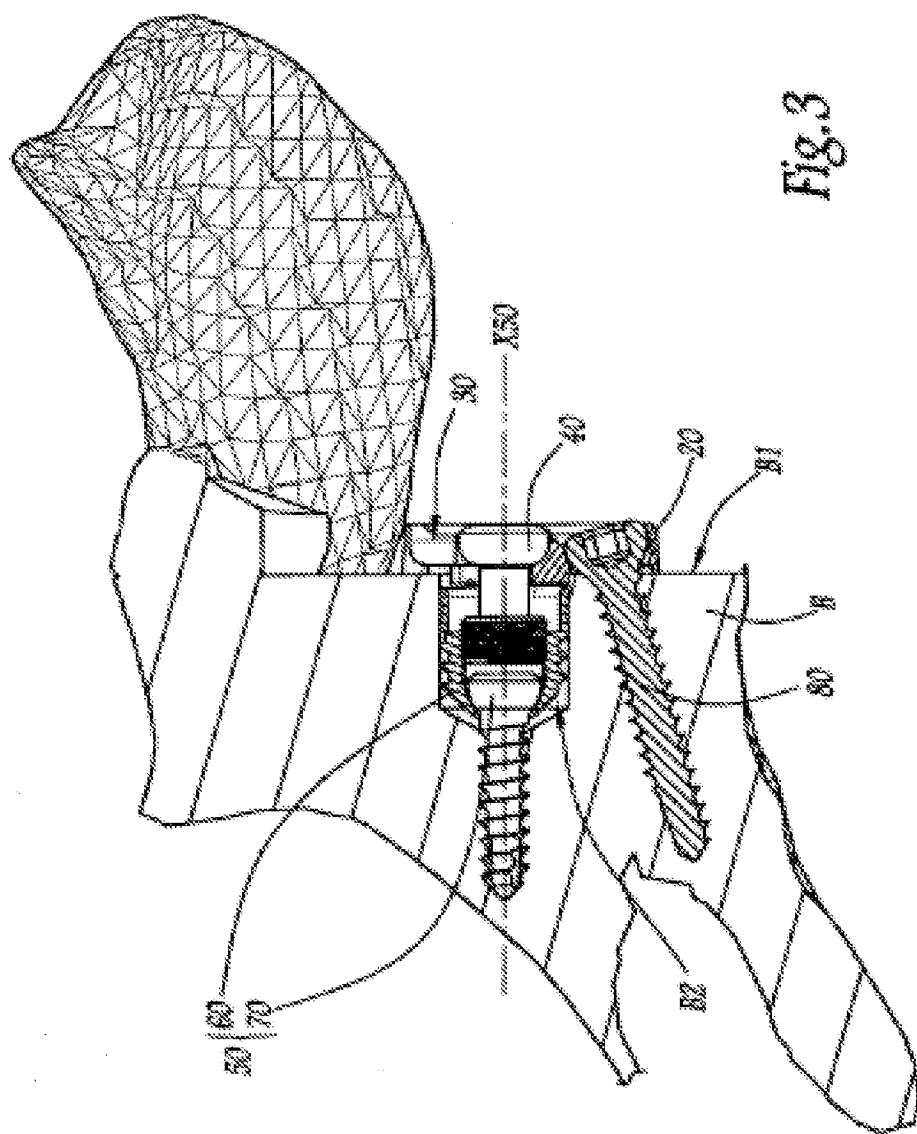


Fig. 3

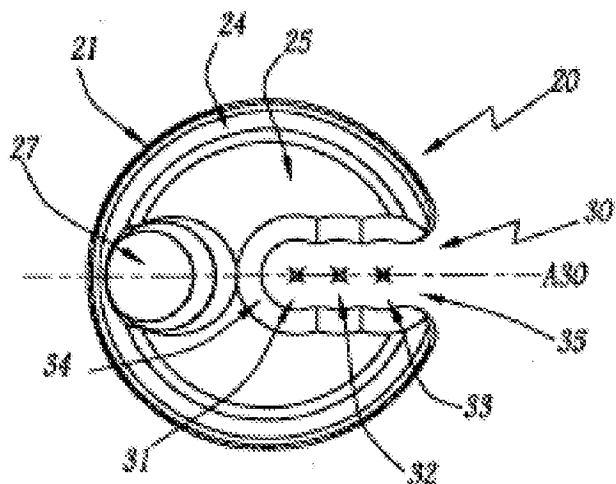


Fig. 4

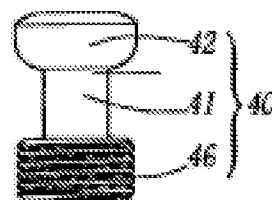


Fig. 5

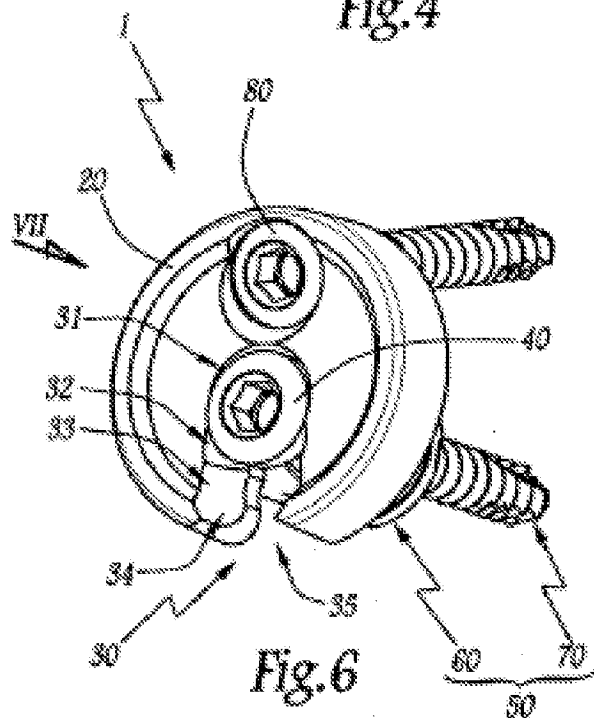


Fig. 6

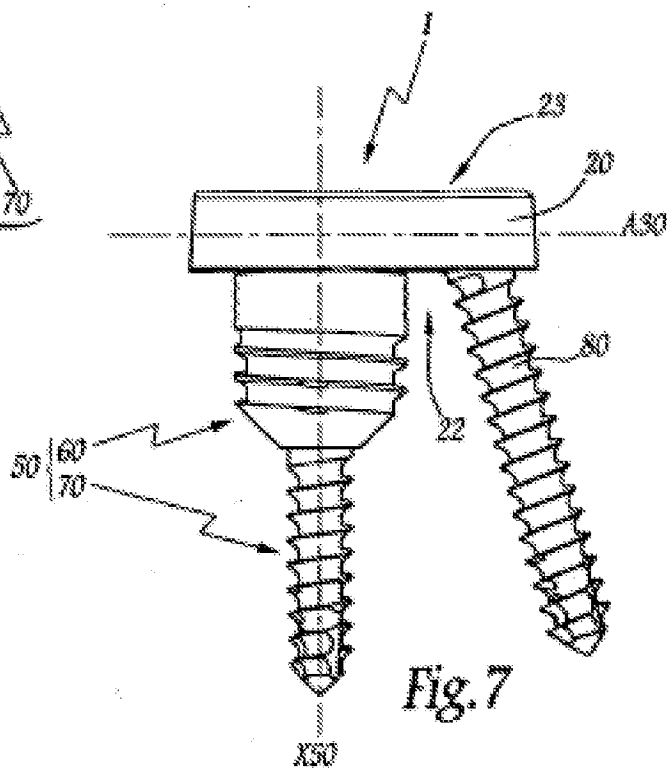
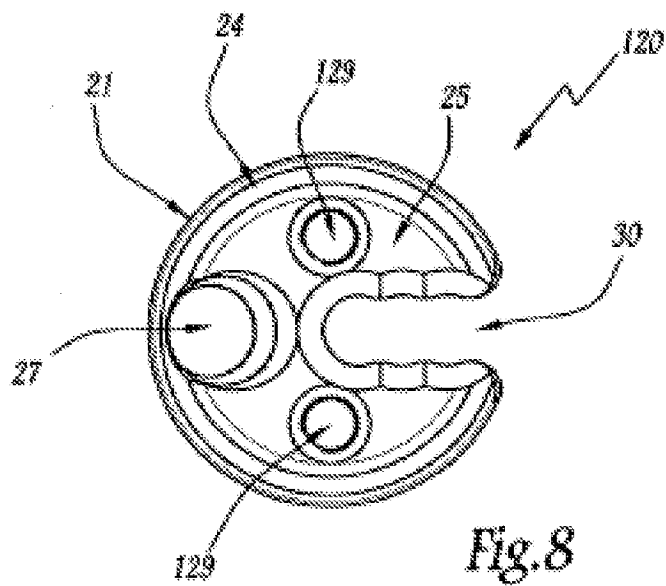
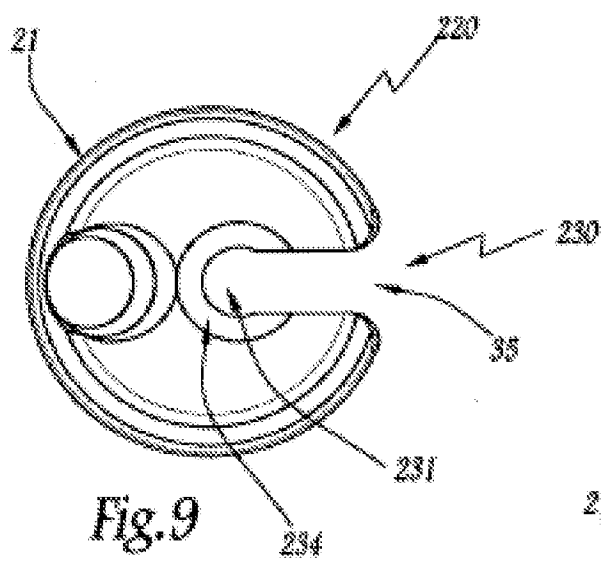
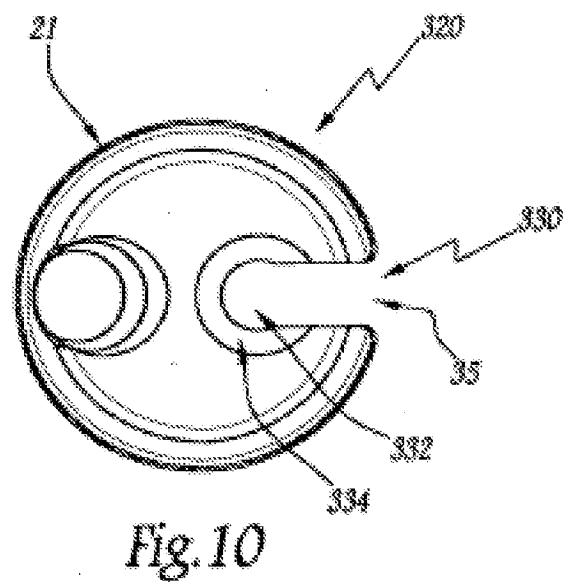


Fig. 7



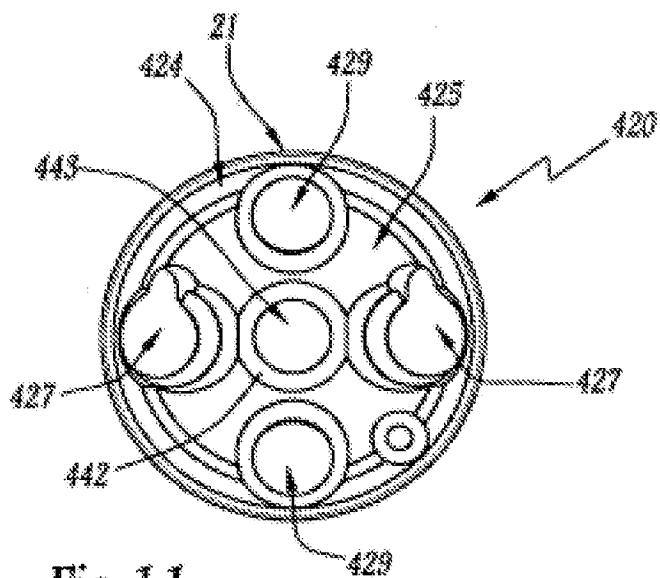


Fig. 11

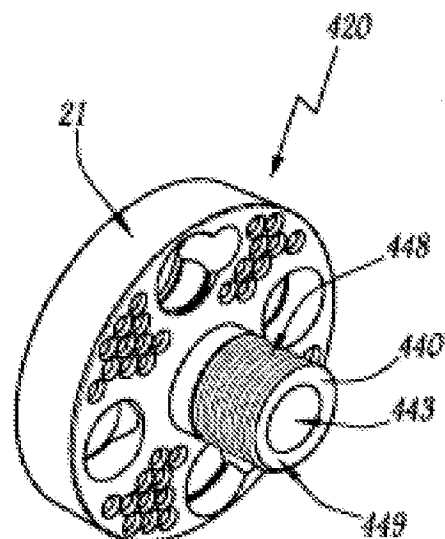


Fig. 12

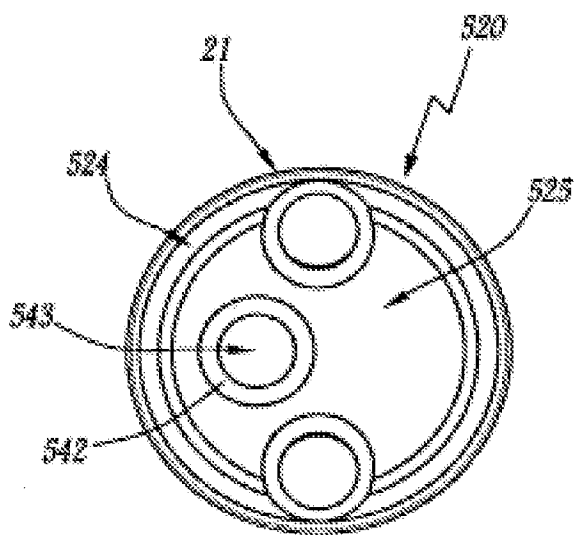


Fig. 13

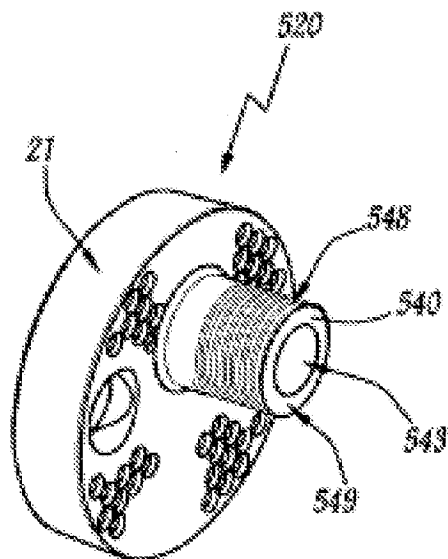


Fig. 14

**RÉFÉRENCES CITÉES DANS LA DESCRIPTION**

*Cette liste de références citées par le demandeur vise uniquement à aider le lecteur et ne fait pas partie du document de brevet européen. Même si le plus grand soin a été accordé à sa conception, des erreurs ou des omissions ne peuvent être exclues et l'OEB décline toute responsabilité à cet égard.*

**Documents brevets cités dans la description**

- EP 2481376 A [0003]
- FR 2737107 A [0004]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                            |                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Doc Code: PET.AUTO<br>Document Description: Petition automatically granted by EFS-Web                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                            | PTO/SB/140<br>U.S. Patent and Trademark Office<br>Department of Commerce |
| Electronic Petition Request                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>PETITION TO WITHDRAW AN APPLICATION FROM ISSUE AFTER PAYMENT OF THE ISSUE FEE UNDER 37 CFR 1.313(c)</b> |                                                                          |
| Application Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 18058058                                                                                                   |                                                                          |
| Filing Date                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 22-Nov-2022                                                                                                |                                                                          |
| First Named Inventor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Donald Running                                                                                             |                                                                          |
| Art Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 3774                                                                                                       |                                                                          |
| Examiner Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ANN SCHILLINGER                                                                                            |                                                                          |
| Attorney Docket Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | SHOLD.013C1                                                                                                |                                                                          |
| Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | TOTAL REVERSE SHOULDER SYSTEMS AND METHODS                                                                 |                                                                          |
| <p>An application may be withdrawn from issue for further action upon petition by the applicant. To request that the Office withdraw an application from issue, applicant must file a petition under this section including the fee set forth in § 1.17(h) and a showing of good and sufficient reasons why withdrawal of the application from issue is necessary.</p> <p>APPLICANT HEREBY PETITIONS TO WITHDRAW THIS APPLICATION FROM ISSUE UNDER 37 CFR 1.313(c).</p> <p>A grantable petition requires the following items:</p> <p>(1) Petition fee; and</p> <p>(2) One of the following reasons:</p> <p>(a) Unpatentability of one or more claims, which must be accompanied by an unequivocal statement that one or more claims are unpatentable, an amendment to such claim or claims, and an explanation as to how the amendment causes such claim or claims to be patentable;</p> <p>(b) Consideration of a request for continued examination in compliance with § 1.114 (for a utility or plant application only); or</p> <p>(c) Express abandonment of the application. Such express abandonment may be in favor of a continuing application, but not a CPA under 37 CFR 1.53(d).</p> |                                                                                                            |                                                                          |
| Petition Fee                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                            |                                                                          |
| <div style="border: 1px solid black; padding: 5px;"> <input checked="checked" type="radio"/> Small Entity         </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                            |                                                                          |
| <div style="border: 1px solid black; padding: 5px;"> <input type="radio"/> Micro Entity         </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                            |                                                                          |
| <div style="border: 1px solid black; padding: 5px;"> <input type="radio"/> Regular Undiscounted         </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                            |                                                                          |
| Reason for withdrawal from issue                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                            |                                                                          |



- ☐ One or more claims are unpatentable
- ☒ Consideration of a request for continued examination (RCE) (List of Required Documents and Fees)
- ☐ Applicant hereby expressly abandons the instant application (any attorney/agent signing for this reason must have power of attorney pursuant to 37 CFR 1.32(b)).

RCE request, submission, and fee.

- ☐ I certify, in accordance with 37 CFR 1.4(d)(4) that :
- ☐ The RCE request ,submission, and fee have already been filed in the above-identified application on
- ☒ Are attached.

THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES

I certify, in accordance with 37 CFR 1.4(d)(4) that I am:

- ☒ An attorney or agent registered to practice before the Patent and Trademark Office who has been given power of attorney in this application.
- ☐ An attorney or agent registered to practice before the Patent and Trademark Office, acting in a representative capacity.
- ☐ A sole inventor
- ☐ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application
- ☐ A joint inventor; all of whom are signing this e-petition

|                     |                    |
|---------------------|--------------------|
| Signature           | /Andrew I. Kimmel/ |
| Name                | Andrew I. Kimmel   |
| Registration Number | 58855              |

## Electronic Patent Application Fee Transmittal

|                                                       |                                            |                 |               |                             |
|-------------------------------------------------------|--------------------------------------------|-----------------|---------------|-----------------------------|
| <b>Application Number:</b>                            | 18058058                                   |                 |               |                             |
| <b>Filing Date:</b>                                   | 22-Nov-2022                                |                 |               |                             |
| <b>Title of Invention:</b>                            | TOTAL REVERSE SHOULDER SYSTEMS AND METHODS |                 |               |                             |
| <b>First Named Inventor/Applicant Name:</b>           | Donald E. Running                          |                 |               |                             |
| <b>Filer:</b>                                         | Andrew I. Kimmel/Christina Gaul            |                 |               |                             |
| <b>Attorney Docket Number:</b>                        | SHOLD.013C1                                |                 |               |                             |
| Filed as Small Entity                                 |                                            |                 |               |                             |
| <b>Filing Fees for    Utility under 35 USC 111(a)</b> |                                            |                 |               |                             |
| <b>Description</b>                                    | <b>Fee Code</b>                            | <b>Quantity</b> | <b>Amount</b> | <b>Sub-Total in USD(\$)</b> |
| <b>Basic Filing:</b>                                  |                                            |                 |               |                             |
| PETITION FEE-37CFR 1.17(H) (GROUP II)                 | 2464                                       | 1               | 56            | 56                          |
| RCE- 1ST REQUEST                                      | 2801                                       | 1               | 544           | 544                         |
| <b>Pages:</b>                                         |                                            |                 |               |                             |
| <b>Claims:</b>                                        |                                            |                 |               |                             |
| <b>Miscellaneous-Filing:</b>                          |                                            |                 |               |                             |
| <b>Petition:</b>                                      |                                            |                 |               |                             |
| <b>Patent-Appeals-and-Interference:</b>               |                                            |                 |               |                             |

| Description                       | Fee Code | Quantity | Amount | Sub-Total in USD(\$) |
|-----------------------------------|----------|----------|--------|----------------------|
| Post-Allowance-and-Post-Issuance: |          |          |        |                      |
| Extension-of-Time:                |          |          |        |                      |
| Miscellaneous:                    |          |          |        |                      |
| Total in USD (\$)                 |          |          |        | 600                  |



## UNITED STATES PATENT AND TRADEMARK OFFICE

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Commissioner for Patents  
United States Patent and Trademark Office  
P.O. Box 1450  
Alexandria, VA 22313-1450  
[www.uspto.gov](http://www.uspto.gov)

Decision Date : May 25, 2023

In re Application of :

Donald E. Running

DECISION ON PETITION

UNDER CFR 1.313(c)(2)

Application No : 18058058

Filed : 22-Nov-2022

Attorney Docket No : SHOLD.013C1

This is an electronic decision on the petition under 37 CFR 1.313(c)(2), filed May 25, 2023 , to withdraw the above-identified application from issue after payment of the issue fee.

The petition is **GRANTED**.

The above-identified application is withdrawn from issue for consideration of a submission under 37 CFR 1.114 (request for continued examination). See 37 CFR 1.313(c)(2).

**Petitioner is advised that the issue fee paid in this application cannot be refunded. If, however, this application is again allowed, petitioner may request that it be applied towards the issue fee required by the new Notice of Allowance.**

Telephone inquiries concerning this decision should be directed to the Patent Electronic Business Center (EBC) at 866-217-9197.

This application file is being referred to Technology Center AU 3774 for processing of the request for continuing examination under 37 CFR 1.114 .

Office of Petitions

## Electronic Acknowledgement Receipt

|                                             |                                            |
|---------------------------------------------|--------------------------------------------|
| <b>EFS ID:</b>                              | 48058764                                   |
| <b>Application Number:</b>                  | 18058058                                   |
| <b>International Application Number:</b>    |                                            |
| <b>Confirmation Number:</b>                 | 5500                                       |
| <b>Title of Invention:</b>                  | TOTAL REVERSE SHOULDER SYSTEMS AND METHODS |
| <b>First Named Inventor/Applicant Name:</b> | Donald E. Running                          |
| <b>Customer Number:</b>                     | 20995                                      |
| <b>Filer:</b>                               | Andrew I. Kimmel/Christina Gaul            |
| <b>Filer Authorized By:</b>                 | Andrew I. Kimmel                           |
| <b>Attorney Docket Number:</b>              | SHOLD.013C1                                |
| <b>Receipt Date:</b>                        | 25-MAY-2023                                |
| <b>Filing Date:</b>                         | 22-NOV-2022                                |
| <b>Time Stamp:</b>                          | 16:38:14                                   |
| <b>Application Type:</b>                    | Utility under 35 USC 111(a)                |

### Payment information:

|                                          |                  |
|------------------------------------------|------------------|
| Submitted with Payment                   | yes              |
| Payment Type                             | CARD             |
| Payment was successfully received in RAM | \$600            |
| RAM confirmation Number                  | E20235OG38095416 |
| Deposit Account                          | 111410           |
| Authorized User                          | Christina Gaul   |

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

**CATALYST, EX-1005**

|                                                 |                                                    |                                  |                                          |                  |                  |
|-------------------------------------------------|----------------------------------------------------|----------------------------------|------------------------------------------|------------------|------------------|
|                                                 |                                                    |                                  |                                          |                  |                  |
| File Listing:                                   |                                                    |                                  |                                          |                  |                  |
| Document Number                                 | Document Description                               | File Name                        | File Size(Bytes)/ Message Digest         | Multi Part /.zip | Pages (if appl.) |
| 1                                               | Request for Continued Examination (RCE)            | SHOLD-013C1_RCE.pdf              | 1350053                                  | no               | 3                |
|                                                 |                                                    |                                  | 0d3c540be72acd7d8022df4ccb40a4b10ee787f2 |                  |                  |
| Warnings:                                       |                                                    |                                  |                                          |                  |                  |
| Information:                                    |                                                    |                                  |                                          |                  |                  |
| 2                                               | Transmittal Letter                                 | SHOLD-013C1_IDSTRANSMITTAL.pdf   | 20091                                    | no               | 2                |
|                                                 |                                                    |                                  | f03b9cc8f7541a80d5e5bf30d84286ccb252747a |                  |                  |
| Warnings:                                       |                                                    |                                  |                                          |                  |                  |
| Information:                                    |                                                    |                                  |                                          |                  |                  |
| 3                                               | Information Disclosure Statement (IDS) Form (SB08) | SHOLD-013C1_IDSLIST.pdf          | 23984                                    | no               | 1                |
|                                                 |                                                    |                                  | 31a5a8c51a7c785be426bedd1d46394f676df591 |                  |                  |
| Warnings:                                       |                                                    |                                  |                                          |                  |                  |
| Information:                                    |                                                    |                                  |                                          |                  |                  |
| This is not an USPTO supplied IDS fillable form |                                                    |                                  |                                          |                  |                  |
| 4                                               | Quick Path Information Disclosure Statement        | SHOLD-013C1_QPIDSIDSTATEMENT.pdf | 178605                                   | no               | 2                |
|                                                 |                                                    |                                  | 8f9e8e7b1a11e7d87d6285698fb736aea10fb8b3 |                  |                  |
| Warnings:                                       |                                                    |                                  |                                          |                  |                  |
| Information:                                    |                                                    |                                  |                                          |                  |                  |
| 5                                               | Foreign Reference                                  | SHOLD-013C1_FOREP1488764B1.pdf   | 89201                                    | no               | 8                |
|                                                 |                                                    |                                  | 5451100187144e913e7165daa705e173bd49924a |                  |                  |
| Warnings:                                       |                                                    |                                  |                                          |                  |                  |
| Information:                                    |                                                    |                                  |                                          |                  |                  |
| 6                                               | Foreign Reference                                  | SHOLD-013C1_FOREP2689750B1.pdf   | 1999772                                  | no               | 20               |
|                                                 |                                                    |                                  | f51484152f2f598243bd3fa0d64c95e7575fe0   |                  |                  |
| Warnings:                                       |                                                    |                                  |                                          |                  |                  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                        |                      |                                          |    |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------------------|------------------------------------------|----|---|
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        |                      |                                          |    |   |
| 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ePetition Request Form | petition-request.pdf | 39666                                    | no | 2 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                        |                      | 7a107fd7f7ea1359d318005528c92ec640909607 |    |   |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                        |                      |                                          |    |   |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        |                      |                                          |    |   |
| 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Fee Worksheet (SB06)   | fee-info.pdf         | 40352                                    | no | 2 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                        |                      | da3a1301f89670618120662139bc573bce829c67 |    |   |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                        |                      |                                          |    |   |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        |                      |                                          |    |   |
| <b>Total Files Size (in bytes):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        |                      | 3741724                                  |    |   |
| <p><b>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</b></p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b><br/> <b>If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</b></p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b><br/> <b>If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</b></p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b><br/> <b>If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</b></p> |                        |                      |                                          |    |   |



# United States Patent and Trademark Office

*Office of the Chief Financial Officer*

Document Code:WFEE

User :Charmise Carter

Sale Accounting Date:05/26/2023

Sale Item Reference Number  
18058058

Effective Date  
05/25/2023

| Document Number  | Fee Code | Fee Code Description                       | Amount Paid | Payment Method  |
|------------------|----------|--------------------------------------------|-------------|-----------------|
| I20235PF21247400 | 2806     | SUBMISSION- INFORMATION<br>DISCLOSURE STMT | \$104.00    | Deposit Account |





# UNITED STATES PATENT AND TRADEMARK OFFICE

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**United States Patent and Trademark Office**  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO.                                                                                                      | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.            | CONFIRMATION NO. |
|----------------------------------------------------------------------------------------------------------------------|-------------|----------------------|--------------------------------|------------------|
| 18/058,058                                                                                                           | 11/22/2022  | Donald E. Running    | SHOLD.013C1                    | 5500             |
| 20995 7590 06/01/2023<br>KNOBBE MARTENS OLSON & BEAR LLP<br>2040 MAIN STREET<br>FOURTEENTH FLOOR<br>IRVINE, CA 92614 |             |                      | EXAMINER<br>SCHILLINGER, ANN M |                  |
|                                                                                                                      |             |                      | ART UNIT                       | PAPER NUMBER     |
|                                                                                                                      |             |                      | 3774                           |                  |
|                                                                                                                      |             |                      | NOTIFICATION DATE              | DELIVERY MODE    |
|                                                                                                                      |             |                      | 06/01/2023                     | ELECTRONIC       |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

cassie.wolf@knobbe.com  
efiling@knobbe.com

|                                                |                                      |                                       |                                 |
|------------------------------------------------|--------------------------------------|---------------------------------------|---------------------------------|
| <b>Supplemental<br/>Notice of Allowability</b> | <b>Application No.</b><br>18/058,058 | <b>Applicant(s)</b><br>Running et al. |                                 |
|                                                | <b>Examiner</b><br>ANN SCHILLINGER   | <b>Art Unit</b><br>3774               | <b>AIA (FITF) Status</b><br>Yes |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the Information Disclosure Statement filed on 5/25/2023.  
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 17-32. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

**Certified copies:**

a) ☐ All      b) ☐ Some\*      c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.  
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_.

**Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

|                                                                                                                   |                                                                           |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892)                                                  | 5. <input type="checkbox"/> Examiner's Amendment/Comment                  |
| 2. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO/SB/08),<br>Paper No./Mail Date ____ | 6. <input type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| 3. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br>of Biological Material ____   | 7. <input type="checkbox"/> Other ____                                    |
| 4. <input type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date ____                              |                                                                           |

|                                                      |  |
|------------------------------------------------------|--|
| /ANN SCHILLINGER/<br>Primary Examiner, Art Unit 3774 |  |
|------------------------------------------------------|--|

|                                                                                                                 |                                              |                                                                  |
|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------|
| <b><i>Search Notes</i></b><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |
|                                                                                                                 | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |

| CPC - Searched*                                                                                                                                                                                                                                                                                                               |            |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------|
| Symbol                                                                                                                                                                                                                                                                                                                        | Date       | Examiner |
| A61F2/4081 OR A61F2/30749 OR A61F2002/30616 OR A61F2002/4085 OR A61F2/4612 OR A61F2002/30011 OR A61F2002/30433 OR A61F2002/30507 OR A61F2002/30604 OR A61F2002/30774 OR A61F2002/30827 OR A61F2002/30901 OR A61F2002/3092 OR A61F2002/3093 OR A61F2002/4659 OR A61F2002/4662 OR A61F2002/4668 OR A61F2002/4681 (text limited) | 04/06/2023 | AS       |
| A61B17/1778 OR A61B17/8605 (text limited)                                                                                                                                                                                                                                                                                     | 04/06/2023 | AS       |

| CPC Combination Sets - Searched* |      |          |
|----------------------------------|------|----------|
| Symbol                           | Date | Examiner |
|                                  |      |          |

| US Classification - Searched* |          |      |          |
|-------------------------------|----------|------|----------|
| Class                         | Subclass | Date | Examiner |
|                               |          |      |          |

\* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

| Search Notes                                                               |            |          |
|----------------------------------------------------------------------------|------------|----------|
| Search Notes                                                               | Date       | Examiner |
| PE2E search, inventor name, and family search, IDS search, assignee search | 04/06/2023 | AS       |
| Ip.com text search                                                         | 04/06/2023 | AS       |
| Interference search PE2E, see printout                                     | 04/06/2023 | AS       |
| Updated IDS search                                                         | 05/30/2023 | AS       |

|                                           |  |
|-------------------------------------------|--|
| /A.S./<br>Primary Examiner, Art Unit 3774 |  |
|-------------------------------------------|--|

|                                                                                                                 |                                              |                                                                  |
|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------|
| <b><i>Search Notes</i></b><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |
|                                                                                                                 | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |

| Interference Search |                                                                                                                                                                                                                                                                                                                |            |          |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------|
| US Class/CPC Symbol | US Subclass/CPC Group                                                                                                                                                                                                                                                                                          | Date       | Examiner |
| A61F                | A61F2/4081 OR A61F2/30749 OR A61F2002/30616 OR A61F2002/4085 OR A61F2/4612 OR A61F2002/30011 OR A61F2002/30433 OR A61F2002/30507 OR A61F2002/30604 OR A61F2002/30774 OR A61F2002/30827 OR A61F2002/30901 OR A61F2002/3092 OR A61F2002/3093 OR A61F2002/4659 OR A61F2002/4662 OR A61F2002/4668 OR A61F2002/4681 | 04/06/2023 | AS       |
| A61B                | A61B17/1778 OR A61B17/8605                                                                                                                                                                                                                                                                                     | 04/06/2023 | AS       |

|                                           |  |
|-------------------------------------------|--|
| /A.S./<br>Primary Examiner, Art Unit 3774 |  |
|-------------------------------------------|--|

PTO/SB/08 Equivalent

|                                                          |                      |                     |
|----------------------------------------------------------|----------------------|---------------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> | Application No.      | 18/058058           |
|                                                          | Filing Date          | November 22, 2022   |
|                                                          | First Named Inventor | Running, Donald E.  |
|                                                          | Art Unit             | 3774                |
| (Multiple sheets used when necessary)                    | Examiner             | Schillinger, Ann M. |
| SHEET 1 OF 1                                             | Attorney Docket No.  | SHOLD.013C1         |

| U.S. PATENT DOCUMENTS |          |                                                                           |                                |                      |                                                                          |
|-----------------------|----------|---------------------------------------------------------------------------|--------------------------------|----------------------|--------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br>Number - Kind Code (if known)<br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name                 | Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear |
|                       | 1        | 8,177,786                                                                 | 05-15-2012                     | Leyden et al.        |                                                                          |
|                       | 2        | 8,870,962                                                                 | 10-28-2014                     | Roche et al.         |                                                                          |
|                       | 3        | 11,259,931                                                                | 03-01-2022                     | Pressacco et al.     |                                                                          |
|                       | 4        | 2014/0277520                                                              | 09-18-2014                     | Chavarria et al.     |                                                                          |
|                       | 5        | 2018/0243102                                                              | 08-30-2018                     | Burkhead, Jr. et al. |                                                                          |
|                       | 6        | 2014/0025173A1                                                            | 01-23-2014                     | Cardon, et al.       |                                                                          |

| FOREIGN PATENT DOCUMENTS |          |                                                                                       |                                |                                  |                                                                          |                |
|--------------------------|----------|---------------------------------------------------------------------------------------|--------------------------------|----------------------------------|--------------------------------------------------------------------------|----------------|
| Examiner Initials        | Cite No. | Foreign Patent Document<br>Country Code-Number-Kind<br>Code<br>Example: JP 1234567 A1 | Publication Date<br>MM-DD-YYYY | Name                             | Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear | T <sup>1</sup> |
|                          | 7        | EP 1488764 B1                                                                         | 12-13-2006                     | LIMA LtoSpA                      |                                                                          |                |
|                          | 8        | EP 2689750 B1                                                                         | 08-24-2016                     | Tornier Orthopedics Ireland Ltd. |                                                                          | Abs            |

| NON PATENT LITERATURE DOCUMENTS |          |                                                                                                                                                                                                                                                                 |                |
|---------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Examiner Initials               | Cite No. | Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published. | T <sup>1</sup> |

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|                                                                                                                                                                                                                                                  |                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Examiner Signature /ANN SCHILLINGER/                                                                                                                                                                                                             | Date Considered 05/30/2023 |
| <b>*Examiner:</b> Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. |                            |

T<sup>1</sup> - Place a check mark in this area when an English language Translation is attached. **CATALYST, EX-1005**ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A. **SPAGE 800**

TO: cassie.wolf@knobbe.com,efiling@knobbe.com  
FROM: noreply@uspto.gov  
CC: patentcenter\_eofficeaction@uspto.gov  
SUBJECT: USPTO: Patent Electronic System - Correspondence Notification for Customer Number 20995

Thu Jun 01 05:04:07 EDT 2023

Dear Patent Center Customer:

Correspondence Address:

KNOBBE MARTENS OLSON & BEAR LLP  
2040 MAIN STREET  
FOURTEENTH FLOOR  
IRVINE, CALIFORNIA, 92614  
UNITED STATES

This is a courtesy notification regarding the following USPTO patent application(s) associated with your Customer Number, 20995, that have new outgoing correspondence. This correspondence is now available for viewing in Patent Center.

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| Application | Document | Mailroom Date | Attorney Docket No. |
|-------------|----------|---------------|---------------------|
| 18058058    | NOA      | 06/01/2023    | SHOLD.013C1         |
| 18058058    | 1449     | 06/01/2023    | SHOLD.013C1         |

To view your correspondence online, please sign in to [Patent Center](#) and then select Workbench/View correspondence. To update your email address(es), select Manage/Manage customer numbers.

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Please do not reply to this email as it was sent from an unmonitored mailbox.

Sincerely,

The Patent Center Team



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
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www.uspto.gov

## NOTICE OF ALLOWANCE AND FEE(S) DUE

20995 7590 07/21/2023  
KNOBBE MARTENS OLSON & BEAR LLP  
2040 MAIN STREET  
FOURTEENTH FLOOR  
IRVINE, CA 92614

EXAMINER

SCHILLINGER, ANN M

ART UNIT

PAPER NUMBER

3774

DATE MAILED: 07/21/2023

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 18/058,058      | 11/22/2022  | Donald E. Running    | SHOLD.013C1         | 5500             |

TITLE OF INVENTION: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | SMALL         | \$480         | \$0.00              | \$480.00             | \$0              | 10/23/2023 |

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.**

**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.**

### HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at [www.uspto.gov/PatentMaintenanceFees](http://www.uspto.gov/PatentMaintenanceFees).**

# PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

**INSTRUCTIONS:** This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

20995 7590 07/21/2023  
KNOBBE MARTENS OLSON & BEAR LLP  
2040 MAIN STREET  
FOURTEENTH FLOOR  
IRVINE, CA 92614

## Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

|                         |
|-------------------------|
| (Typed or printed name) |
| (Signature)             |
| (Date)                  |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 18/058,058      | 11/22/2022  | Donald E. Running    | SHOLD.013C1         | 5500             |

TITLE OF INVENTION: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | SMALL         | \$480         | \$0.00              | \$480.00             | \$0              | 10/23/2023 |

| EXAMINER           | ART UNIT | CLASS-SUBCLASS |
|--------------------|----------|----------------|
| SCHILLINGER, ANN M | 3774     | 623-019130     |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

1 \_\_\_\_\_

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

2 \_\_\_\_\_

3 \_\_\_\_\_

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☐ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

☐ Electronic Payment via Patent Center or EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. \_\_\_\_\_

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature \_\_\_\_\_

Date \_\_\_\_\_

Typed or printed name \_\_\_\_\_

Registration No. \_\_\_\_\_





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Address: COMMISSIONER FOR PATENTS  
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www.uspto.gov

| APPLICATION NO.                 | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---------------------------------|-------------|----------------------|---------------------|------------------|
| 18/058,058                      | 11/22/2022  | Donald E. Running    | SHOLD.013C1         | 5500             |
| 20995                           | 7590        | 07/21/2023           | EXAMINER            |                  |
| KNOBBE MARTENS OLSON & BEAR LLP |             |                      | SCHILLINGER, ANN M  |                  |
| 2040 MAIN STREET                |             |                      | ART UNIT            |                  |
| FOURTEENTH FLOOR                |             |                      | PAPER NUMBER        |                  |
| IRVINE, CA 92614                |             |                      | 3774                |                  |
| DATE MAILED: 07/21/2023         |             |                      |                     |                  |

## Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

## OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

### Privacy Act Statement

**The Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law.

|                               |                                      |                                       |                                 |
|-------------------------------|--------------------------------------|---------------------------------------|---------------------------------|
| <b>Notice of Allowability</b> | <b>Application No.</b><br>18/058,058 | <b>Applicant(s)</b><br>Running et al. |                                 |
|                               | <b>Examiner</b><br>ANN SCHILLINGER   | <b>Art Unit</b><br>3774               | <b>AIA (FITF) Status</b><br>Yes |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the Request for Continued Examination filed on 5/25/2023.  
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 17-32. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

**Certified copies:**

a) ☐ All      b) ☐ Some\*      c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.  
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_.

**Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

|                                                                                                                    |                                                                                      |
|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892)                                                   | 5. <input type="checkbox"/> Examiner's Amendment/Comment                             |
| 2. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO/SB/08),<br>Paper No./Mail Date ____. | 6. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| 3. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br>of Biological Material ____.   | 7. <input type="checkbox"/> Other ____.                                              |
| 4. <input type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date. ____.                             |                                                                                      |

/ANN SCHILLINGER/  
Primary Examiner, Art Unit 3774

## **DETAILED ACTION**

### ***Notice of Pre-AIA or AIA Status***

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on 5/25/2023 has been entered.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ann Schillinger whose telephone number is (571)272-6652. The examiner can normally be reached on Monday-Friday (9am-5:30pm).

If attempts to reach the examiner by telephone are unsuccessful, please contact the examiner's supervisor, Jerrah Edwards, at (408)918-7557. The fax phone number for the organization where this application or proceeding is assigned is (571)273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ANN SCHILLINGER/  
Primary Examiner, Art Unit 3774

|                                                                                                                  |                                              |                                                                  |  |
|------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------|--|
| <b>Issue Classification</b><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |  |
|                                                                                                                  | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |  |

| CPC    |   |      |   |       |      |            |
|--------|---|------|---|-------|------|------------|
| Symbol |   |      |   |       | Type | Version    |
| A61F   | / | 2    | / | 4081  | F    | 2013-01-01 |
| A61B   | / | 17   | / | 1778  | I    | 2016-11-01 |
| A61F   | / | 2    | / | 30749 | I    | 2013-01-01 |
| A61F   | / | 2002 | / | 4085  | A    | 2013-01-01 |
| A61F   | / | 2002 | / | 30616 | A    | 2013-01-01 |

| CPC Combination Sets |   |  |   |      |     |
|----------------------|---|--|---|------|-----|
| Symbol               |   |  |   | Type | Set |
|                      | / |  | / |      |     |

|                                                      |              |                              |                   |
|------------------------------------------------------|--------------|------------------------------|-------------------|
| NONE                                                 |              | <b>Total Claims Allowed:</b> |                   |
| (Assistant Examiner)                                 | (Date)       | 16                           |                   |
| /ANN SCHILLINGER/<br>Primary Examiner, Art Unit 3774 | 29 June 2023 | O.G. Print Claim(s)          | O.G. Print Figure |
| (Primary Examiner)                                   | (Date)       | 1                            | 8                 |

|                                                                                                                  |                                              |                                                                  |  |
|------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------|--|
| <b>Issue Classification</b><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |  |
|                                                                                                                  | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |  |

|                                     |   |    |      |
|-------------------------------------|---|----|------|
| <b>INTERNATIONAL CLASSIFICATION</b> |   |    |      |
| <b>CLAIMED</b>                      |   |    |      |
| A61F                                | / | 2  | / 40 |
| A61F                                | / | 2  | / 30 |
| A61B                                | / | 17 | / 80 |
| A61B                                | / | 17 | / 86 |
| <b>NON-CLAIMED</b>                  |   |    |      |
|                                     | / |    | /    |

|                                   |                 |
|-----------------------------------|-----------------|
| <b>US ORIGINAL CLASSIFICATION</b> |                 |
| <b>CLASS</b>                      | <b>SUBCLASS</b> |
|                                   |                 |

|                            |                                          |  |  |  |  |  |
|----------------------------|------------------------------------------|--|--|--|--|--|
| <b>CROSS REFERENCES(S)</b> |                                          |  |  |  |  |  |
| <b>CLASS</b>               | <b>SUBCLASS (ONE SUBCLASS PER BLOCK)</b> |  |  |  |  |  |
|                            |                                          |  |  |  |  |  |

|                                                                            |                        |                              |                        |
|----------------------------------------------------------------------------|------------------------|------------------------------|------------------------|
| NONE                                                                       |                        | <b>Total Claims Allowed:</b> |                        |
| (Assistant Examiner)                                                       | (Date)                 | 16                           |                        |
| /ANN SCHILLINGER/<br>Primary Examiner, Art Unit 3774<br>(Primary Examiner) | 29 June 2023<br>(Date) | O.G. Print Claim(s)<br>1     | O.G. Print Figure<br>8 |

|                                                                                                                         |                                              |                                                                  |
|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------|
| <b><i>Issue Classification</i></b><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |
|                                                                                                                         | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |

|                                                                                                                                                                                   |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|
| <input type="checkbox"/> Claims renumbered in the same order as presented by applicant <input type="checkbox"/> CPA <input type="checkbox"/> T.D. <input type="checkbox"/> R.1.47 |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |
| <b>CLAIMS</b>                                                                                                                                                                     |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |              |                 |
| <b>Final</b>                                                                                                                                                                      | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> | <b>Final</b> | <b>Original</b> |
|                                                                                                                                                                                   | 1               |              | 10              | 3            | 19              | 12           | 28              |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 2               |              | 11              | 4            | 20              | 13           | 29              |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 3               |              | 12              | 5            | 21              | 14           | 30              |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 4               |              | 13              | 6            | 22              | 15           | 31              |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 5               |              | 14              | 7            | 23              | 16           | 32              |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 6               |              | 15              | 8            | 24              |              |                 |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 7               |              | 16              | 9            | 25              |              |                 |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 8               | 1            | 17              | 10           | 26              |              |                 |              |                 |              |                 |              |                 |              |                 |
|                                                                                                                                                                                   | 9               | 2            | 18              | 11           | 27              |              |                 |              |                 |              |                 |              |                 |              |                 |

|                                                                                                      |  |                                    |                        |
|------------------------------------------------------------------------------------------------------|--|------------------------------------|------------------------|
| NONE<br><br>(Assistant Examiner) _____ (Date) _____                                                  |  | <b>Total Claims Allowed:</b><br>16 |                        |
| /ANN SCHILLINGER/<br>Primary Examiner, Art Unit 3774<br>(Primary Examiner) _____ (Date) 29 June 2023 |  | O.G. Print Claim(s)<br>1           | O.G. Print Figure<br>8 |



|                                                                                                          |                                              |                                                                  |
|----------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------|
| <b>Search Notes</b><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |
|                                                                                                          | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |

| CPC - Searched*                                                                                                                                                                                                                                                                                                               |            |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------|
| Symbol                                                                                                                                                                                                                                                                                                                        | Date       | Examiner |
| A61F2/4081 OR A61F2/30749 OR A61F2002/30616 OR A61F2002/4085 OR A61F2/4612 OR A61F2002/30011 OR A61F2002/30433 OR A61F2002/30507 OR A61F2002/30604 OR A61F2002/30774 OR A61F2002/30827 OR A61F2002/30901 OR A61F2002/3092 OR A61F2002/3093 OR A61F2002/4659 OR A61F2002/4662 OR A61F2002/4668 OR A61F2002/4681 (text limited) | 04/06/2023 | AS       |
| A61B17/1778 OR A61B17/8605 (text limited)                                                                                                                                                                                                                                                                                     | 04/06/2023 | AS       |

| CPC Combination Sets - Searched* |      |          |
|----------------------------------|------|----------|
| Symbol                           | Date | Examiner |
|                                  |      |          |

| US Classification - Searched* |          |      |          |
|-------------------------------|----------|------|----------|
| Class                         | Subclass | Date | Examiner |
|                               |          |      |          |

\* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

| Search Notes                                                                        |            |          |
|-------------------------------------------------------------------------------------|------------|----------|
| Search Notes                                                                        | Date       | Examiner |
| PE2E search, inventor name, and family search, IDS search, assignee search          | 04/06/2023 | AS       |
| Ip.com text search                                                                  | 04/06/2023 | AS       |
| Interference search PE2E, see printout                                              | 04/06/2023 | AS       |
| Updated IDS search                                                                  | 05/30/2023 | AS       |
| Updated PE2E search, inventor name, and family search, IDS search , assignee search | 06/29/2023 | AS       |
| Interference search PE2E, see printout                                              | 06/29/2023 | AS       |

|                                           |  |
|-------------------------------------------|--|
| /A.S./<br>Primary Examiner, Art Unit 3774 |  |
|-------------------------------------------|--|

|                                                                                                                     |                                              |                                                                  |
|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------|
| <b><i>Search Notes</i></b><br><br> | <b>Application/Control No.</b><br>18/058,058 | <b>Applicant(s)/Patent Under Reexamination</b><br>Running et al. |
|                                                                                                                     | <b>Examiner</b><br>ANN SCHILLINGER           | <b>Art Unit</b><br>3774                                          |

| Interference Search |                                                                                                                                                                                                                                                                                                                |            |          |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------|
| US Class/CPC Symbol | US Subclass/CPC Group                                                                                                                                                                                                                                                                                          | Date       | Examiner |
| A61F                | A61F2/4081 OR A61F2/30749 OR A61F2002/30616 OR A61F2002/4085 OR A61F2/4612 OR A61F2002/30011 OR A61F2002/30433 OR A61F2002/30507 OR A61F2002/30604 OR A61F2002/30774 OR A61F2002/30827 OR A61F2002/30901 OR A61F2002/3092 OR A61F2002/3093 OR A61F2002/4659 OR A61F2002/4662 OR A61F2002/4668 OR A61F2002/4681 | 04/06/2023 | AS       |
| A61B                | A61B17/1778 OR A61B17/8605                                                                                                                                                                                                                                                                                     | 04/06/2023 | AS       |
| A61F                | A61F2/4081 OR A61F2/30749 OR A61F2002/30616 OR A61F2002/4085 OR A61F2/4612 OR A61F2002/30011 OR A61F2002/30433 OR A61F2002/30507 OR A61F2002/30604 OR A61F2002/30774 OR A61F2002/30827 OR A61F2002/30901 OR A61F2002/3092 OR A61F2002/3093 OR A61F2002/4659 OR A61F2002/4662 OR A61F2002/4668 OR A61F2002/4681 | 06/29/2023 | AS       |
| A61B                | A61B17/1778 OR A61B17/8605                                                                                                                                                                                                                                                                                     | 06/29/2023 | AS       |

|                                           |  |
|-------------------------------------------|--|
| /A.S./<br>Primary Examiner, Art Unit 3774 |  |
|-------------------------------------------|--|

PTO/SB/08 Equivalent

|                                                          |                      |                     |
|----------------------------------------------------------|----------------------|---------------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> | Application No.      | 18/058058           |
|                                                          | Filing Date          | November 22, 2022   |
|                                                          | First Named Inventor | Running, Donald E.  |
|                                                          | Art Unit             | 3774                |
| (Multiple sheets used when necessary)                    | Examiner             | Schillinger, Ann M. |
| SHEET 1 OF 1                                             | Attorney Docket No.  | SHOLD.013C1         |

| U.S. PATENT DOCUMENTS |          |                                                                           |                                |                      |                                                                          |
|-----------------------|----------|---------------------------------------------------------------------------|--------------------------------|----------------------|--------------------------------------------------------------------------|
| Examiner Initials     | Cite No. | Document Number<br>Number - Kind Code (if known)<br>Example: 1,234,567 B1 | Publication Date<br>MM-DD-YYYY | Name                 | Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear |
|                       | 1        | 8,177,786                                                                 | 05-15-2012                     | Leyden et al.        |                                                                          |
|                       | 2        | 8,870,962                                                                 | 10-28-2014                     | Roche et al.         |                                                                          |
|                       | 3        | 11,259,931                                                                | 03-01-2022                     | Pressacco et al.     |                                                                          |
|                       | 4        | 2014/0277520                                                              | 09-18-2014                     | Chavarria et al.     |                                                                          |
|                       | 5        | 2018/0243102                                                              | 08-30-2018                     | Burkhead, Jr. et al. |                                                                          |
|                       | 6        | 2014/0025173A1                                                            | 01-23-2014                     | Cardon, et al.       |                                                                          |

| FOREIGN PATENT DOCUMENTS |          |                                                                                       |                                |                                  |                                                                          |                |
|--------------------------|----------|---------------------------------------------------------------------------------------|--------------------------------|----------------------------------|--------------------------------------------------------------------------|----------------|
| Examiner Initials        | Cite No. | Foreign Patent Document<br>Country Code-Number-Kind<br>Code<br>Example: JP 1234567 A1 | Publication Date<br>MM-DD-YYYY | Name                             | Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear | T <sup>1</sup> |
|                          | 7        | EP 1488764 B1                                                                         | 12-13-2006                     | LIMA LtoSpA                      |                                                                          |                |
|                          | 8        | EP 2689750 B1                                                                         | 08-24-2016                     | Tornier Orthopedics Ireland Ltd. |                                                                          | Abs            |

| NON PATENT LITERATURE DOCUMENTS |          |                                                                                                                                                                                                                                                                 |                |
|---------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Examiner Initials               | Cite No. | Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published. | T <sup>1</sup> |

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|                                                                                                                                                                                                                                                  |                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Examiner Signature /ANN SCHILLINGER/                                                                                                                                                                                                             | Date Considered 06/29/2023 |
| <b>*Examiner:</b> Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. |                            |

T<sup>1</sup> - Place a check mark in this area when an English language Translation is attached. **CATALYST, EX-1005**ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A. **PAGE 814**

# PE2E SEARCH - Search History (Prior Art)

| Ref # | Hits | Search Query  | DBs                                                                                                                                                                                                                                                                                                                  | Default Operator | Plurals | British Equivalents | Time Stamp          |
|-------|------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------|---------------------|---------------------|
| L1    | 11   | "20180078377" | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR               | ON      | ON                  | 2023/04/06 10:20 AM |
| L2    | 31   | "2018022227"  | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR               | ON      | ON                  | 2023/04/06 10:21 AM |
| L3    | 12   | "20180071104" | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR               | ON      | ON                  | 2023/04/06 10:22 AM |
| L4    | 7    | "20180161169" | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,                                                                                                                                                                                                                                        | OR               | ON      | ON                  | 2023/04/06 10:22 AM |

|    |     |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |    |    |    |                     |
|----|-----|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L5 | 2   | ("9283083").pn. | CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)<br>(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 10:23 AM |
| L6 | 2   | ("9545312").pn. | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                                                                                                                                                                                                           | OR | ON | ON | 2023/04/06 10:23 AM |
| L7 | 116 | running.in      | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                                                                                                                                                                                                           | OR | ON | ON | 2023/04/06 10:23 AM |

|     |       |                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|-------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L8  | 607   | running.in.                                                                          | VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>10:23 AM |
| L9  | 2     | L8 AND (shoulder AND<br>screw AND glenoid<br>AND (implant OR<br>prosthesis)).clm.    | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                 | OR | ON | ON | 2023/04/06<br>10:24 AM |
| L10 | 25103 | ball.in.                                                                             | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                 | OR | ON | ON | 2023/04/06<br>10:25 AM |
| L11 | 13    | L10 AND ((shoulder<br>AND screw AND<br>glenoid AND (implant<br>OR prosthesis)).clm.) | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,                                                                                                                                                                                                                                                                          | OR | ON | ON | 2023/04/06<br>10:25 AM |

|     |      |                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |    |    |                        |
|-----|------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L12 | 11   | L11 NOT L9                                                                           | HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>10:25 AM |
| L13 | 2031 | slone.in.                                                                            | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                                                          | OR | ON | ON | 2023/04/06<br>10:29 AM |
| L14 | 1    | L13 AND ((shoulder<br>AND screw AND<br>glenoid AND (implant<br>OR prosthesis)).clm.) | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                                                          | OR | ON | ON | 2023/04/06<br>10:29 AM |

|     |      |                                                                        |                                                                                                                                                                                                                                                                                                                                                                               |    |    |    |                        |
|-----|------|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L15 | 100  | (shoulder ADJ innovations).as,aanm.                                    | IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>10:29 AM |
| L16 | 40   | L15 AND ((shoulder AND screw AND glenoid AND (implant OR prosthesis))) | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)             | OR | ON | ON | 2023/04/06<br>10:30 AM |
| L17 | 468  | ((shoulder AND screw AND glenoid AND (implant OR prosthesis)).clm.)    | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)             | OR | ON | ON | 2023/04/06<br>10:36 AM |
| L18 | 6814 | ((shoulder AND screw AND glenoid AND (implant OR prosthesis)))         | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,                                                                                                                                                                                | OR | ON | ON | 2023/04/06<br>10:36 AM |



|     |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                            |    |    |    |                     |
|-----|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L19 | 3762 | L18 AND ((A61F2/4081 OR A61F2/30749 OR A61F2002/30616 OR A61F2002/4085 OR A61F2/4612 OR A61F2002/30011 OR A61F2002/30433 OR A61F2002/30507 OR A61F2002/30604 OR A61F2002/30774 OR A61F2002/30827 OR A61F2002/30901 OR A61F2002/3092 OR A61F2002/3093 OR A61F2002/4659 OR A61F2002/4662 OR A61F2002/4668 OR A61F2002/4681).cpc.)                                                                                                                                                                                                                                                                                                                                                                                                                                         | MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 10:39 AM |
| L20 | 108  | ("3815157"   "3842442"   "3916451"   "3978528"   "3979778"   "4003095"   "4030143"   "4040131"   "4135517"   "4179758"   "4206517"   "4693723"   "4822370"   "4865605"   "4865609"   "4919670"   "4957510"   "4963155"   "4964865"   "5080673"   "5080685"   "5135529"   "5181928"   "5201882"   "5222984"   "5314479"   "5358526"   "5462563"   "5507817"   "5507818"   "5507824"   "5549682"   "5580352"   "5702457"   "5702486"   "5723018"   "5728161"   "5902340"   "5910171"   "5961555"   "6033439"   "6045582"   "6102953"   "6129764"   "6171341"   "6197062"   "6197063"   "6206925"   "6228120"   "6364910"   "6368352"   "6620197"   "6626946"   "6719799"   "6761740"   "6790234"   "6890358"   "6942699"   "6974483"   "6986790"   "7022141"   "7097663") | (US-PGPUB; USPAT; USOCR)                                                                                                                   | OR | ON | ON | 2023/04/06 10:40 AM |

|     |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|-----|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
|     |     | "7135044"   "7175663"<br>  "7189261"   "7238207"<br>  "7621961"   "7819923"<br>  "8062376"   "8070820"<br>  "20010049561"  <br>"20010053935"  <br>"20020120339"  <br>"20020138148"  <br>"20020156534"  <br>"20030028253"  <br>"20030097183"  <br>"20030114933"  <br>"20030158605"  <br>"20040064189"  <br>"20040064190"  <br>"20040220673"  <br>"20040220674"  <br>"20050197708"  <br>"20060020344"  <br>"20070142918"  <br>"20070179624"  <br>"20070198094"  <br>"20090192621"  <br>"20090210065"  <br>"20090270993"  <br>"20110035013"  <br>"20110035015"  <br>"20110054624"  <br>"20110118846").pn. OR<br>("9283083").urpn. AND<br>(PGPB   USPT  <br>USOC).dbnm. |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
| L21 | 580 | ((shoulder AND screw AND glenoid AND (implant OR prosthesis)) AND nut)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | (US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 10:40 AM |
| L22 | 17  | L20 AND nut AND screw                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,                                                                                                                        | OR | ON | ON | 2023/04/06 10:40 AM |

|     |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L23 | 1322 | L18 AND<br>((A61B17/1778 OR<br>A61B17/8605).cpc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                  | MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br><br>(US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>10:57 AM |
| L24 | 81   | L21 AND<br>((A61B17/1778 OR<br>A61B17/8605).cpc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                  | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                 | OR | ON | ON | 2023/04/06<br>10:57 AM |
| L25 | 172  | ("4986833"   "5033036"<br>  "5080673"   "5458637"<br>  "5489309"   "5489311"<br>  "5531973"   "5800551"<br>  "5954722"   "6102954"<br>  "6171342"   "6228119"<br>  "6406495"   "6508841"<br>  "6514287"   "6673115"<br>  "6679916"   "6699289"<br>  "6761740"   "6790234"<br>  "6860903"   "6953478"<br>  "7169184"   "7175663"<br>  "7175665"   "7204854"<br>  "7316715"   "7462197"<br>  "7462199"   "7604665"<br>  "7608109"   "7621961"<br>  "7637928"   "7648530"<br>  "7666522"   "7753959") | (US-PGPUB; USPAT;<br>USOCR)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | OR | ON | ON | 2023/04/06<br>10:58 AM |

|  |  |                       |  |  |  |  |  |
|--|--|-----------------------|--|--|--|--|--|
|  |  | "7766969"   "7854768" |  |  |  |  |  |
|  |  | "7892287"   "7922769" |  |  |  |  |  |
|  |  | "7927335"   "7993408" |  |  |  |  |  |
|  |  | "8007523"   "8048161" |  |  |  |  |  |
|  |  | "8062376"   "8070820" |  |  |  |  |  |
|  |  | "8092545"   "8206453" |  |  |  |  |  |
|  |  | "8231683"   "8241365" |  |  |  |  |  |
|  |  | "8287600"   "8308807" |  |  |  |  |  |
|  |  | "8357201"   "8361157" |  |  |  |  |  |
|  |  | "8425614"   "8444680" |  |  |  |  |  |
|  |  | "8449617"   "8454702" |  |  |  |  |  |
|  |  | "8465548"   "8480750" |  |  |  |  |  |
|  |  | "8532806"   "8556902" |  |  |  |  |  |
|  |  | "8556980"   "8556981" |  |  |  |  |  |
|  |  | "8591591"   "8597334" |  |  |  |  |  |
|  |  | "8632597"   "8690951" |  |  |  |  |  |
|  |  | "8753402"   "8790402" |  |  |  |  |  |
|  |  | "8840676"   "8864834" |  |  |  |  |  |
|  |  | "8961611"   "9114017" |  |  |  |  |  |
|  |  | "9498345"   "9629725" |  |  |  |  |  |
|  |  | "10064734"            |  |  |  |  |  |
|  |  | "20020095214"         |  |  |  |  |  |
|  |  | "20030149485"         |  |  |  |  |  |
|  |  | "20040106928"         |  |  |  |  |  |
|  |  | "20040220673"         |  |  |  |  |  |
|  |  | "20040220674"         |  |  |  |  |  |
|  |  | "20050049709"         |  |  |  |  |  |
|  |  | "20050143831"         |  |  |  |  |  |
|  |  | "20050149044"         |  |  |  |  |  |
|  |  | "20050261775"         |  |  |  |  |  |
|  |  | "20050278030"         |  |  |  |  |  |
|  |  | "20060074353"         |  |  |  |  |  |
|  |  | "20060100714"         |  |  |  |  |  |
|  |  | "20060122705"         |  |  |  |  |  |
|  |  | "20060142865"         |  |  |  |  |  |
|  |  | "20060200248"         |  |  |  |  |  |
|  |  | "20060200249"         |  |  |  |  |  |
|  |  | "20070016304"         |  |  |  |  |  |
|  |  | "20070055380"         |  |  |  |  |  |
|  |  | "20070100458"         |  |  |  |  |  |
|  |  | "20070142921"         |  |  |  |  |  |
|  |  | "20070156246"         |  |  |  |  |  |
|  |  | "20070179624"         |  |  |  |  |  |
|  |  | "20070219638"         |  |  |  |  |  |
|  |  | "20070244563"         |  |  |  |  |  |
|  |  | "20080269906"         |  |  |  |  |  |
|  |  | "20080294268"         |  |  |  |  |  |
|  |  | "20080306601"         |  |  |  |  |  |
|  |  | "20090149961"         |  |  |  |  |  |
|  |  | "20090204225"         |  |  |  |  |  |
|  |  | "20090216332"         |  |  |  |  |  |
|  |  | "20090281630"         |  |  |  |  |  |
|  |  | "20100016975"         |  |  |  |  |  |
|  |  | "20100023068"         |  |  |  |  |  |
|  |  | "20100049327"         |  |  |  |  |  |
|  |  | "20100087927"         |  |  |  |  |  |
|  |  | "20100161066"         |  |  |  |  |  |
|  |  | "20100217399"         |  |  |  |  |  |

|     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                 |    |    |    |                        |
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| L26 | 16 | "20100234959"<br>"20100274359"<br>"20100291401"<br>"20100331990"<br>"20110035013"<br>"20110118846"<br>"20110144760"<br>"20110190899"<br>"20110282393"<br>"20120004733"<br>"20120029647"<br>"20120165954"<br>"20120191201"<br>"20120209392"<br>"20120221111"<br>"20120221112"<br>"20120232670"<br>"20120239156"<br>"20120253467"<br>"20120277880"<br>"20130018483"<br>"20130053968"<br>"20130096631"<br>"20130110470"<br>"20130150972"<br>"20130150973"<br>"20130150975"<br>"20130226309"<br>"20130231754"<br>"20130253656"<br>"20130261751"<br>"20130261752"<br>"20130264749"<br>"20130282135"<br>"20140025173"<br>"20140142711"<br>"20140194995"<br>"20140257499"<br>"20140277180"<br>"20140371863"<br>"20150094819"<br>"20150142122"<br>"20150150688"<br>"20150272741"<br>"20150305877"<br>"20160270922"<br>"20160287401"<br>"20160310285"<br>"20160324649"<br>"20170042690"<br>"20170172764"<br>"20180243102").pn. OR<br>("10357373").urpn.<br>AND (PGPB   USPT  <br>USOC).dbnm.<br>L25 AND nut AND<br>(fastener OR screw) | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY, | OR | ON | ON | 2023/04/06<br>10:58 AM |
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|     |    |                  |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
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| L27 | 20 | "2020023975"     | CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                           | OR | ON | ON | 2023/04/06 11:14 AM |
| L28 | 5  | "20200188121"    | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:15 AM |
| L29 | 4  | ("11166733").pn. | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:16 AM |

|     |    |                  |                                                                                                                                                                                                                                                                                                                                                                                    |    |    |    |                     |
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| L30 | 54 | "3777777"        | TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)<br>(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:16 AM |
| L31 | 24 | "3598957"        | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                               | OR | ON | ON | 2023/04/06 11:17 AM |
| L32 | 57 | "2601912"        | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                               | OR | ON | ON | 2023/04/06 11:18 AM |
| L33 | 4  | ("10034757").pn. | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA,                                                                                                                                                                                                                                                                                  | OR | ON | ON | 2023/04/06 11:21 AM |

|     |    |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |    |    |    |                        |
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| L34 | 2  | "20210236292" | EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>11:22 AM |
| L35 | 17 | "2012109245"  | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                                                                                     | OR | ON | ON | 2023/04/06<br>11:22 AM |
| L36 | 21 | "2019006205"  | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                                                                                     | OR | ON | ON | 2023/04/06<br>11:26 AM |



|     |    |                  |                                                                                                                                                                                                                                                                                                                                                                                                |    |    |    |                        |
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| L37 | 7  | ("9615839").pn.  | JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>11:27 AM |
| L38 | 8  | "2019173139"     | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                              | OR | ON | ON | 2023/04/06<br>11:28 AM |
| L39 | 2  | ("11564802").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                              | OR | ON | ON | 2023/04/06<br>11:29 AM |
| L40 | 16 | "2013148437"     | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,                                                                                                                                                                                                                            | OR | ON | ON | 2023/04/06<br>11:29 AM |

|     |    |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |    |    |                     |
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| L41 | 4  | "20210137693" | IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)<br>(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:30 AM |
| L42 | 62 | "2013085552"  | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                                                                                                                                       | OR | ON | ON | 2023/04/06 11:30 AM |
| L43 | 34 | "3090705"     | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                                                                                                                                       | OR | ON | ON | 2023/04/06 11:31 AM |

|     |    |                  |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
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| L44 | 21 | "2014138424"     | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:32 AM |
| L45 | 6  | "20210077264"    | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:33 AM |
| L46 | 2  | ("11464645").pn. | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 11:34 AM |
| L47 | 24 | "3332750"        | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,                                                                                                                        | OR | ON | ON | 2023/04/06 11:34 AM |

|     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                          |    |    |    |                        |
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| L48 | 42 | ((US-20180078377-A1<br>OR US-20180071104-A1 OR US-<br>20180161169-A1 OR<br>US-20170202674-A1<br>OR US-20040064189-A1 OR US-<br>20070179624-A1 OR<br>US-20040030400-A1<br>OR US-20030060890-A1 OR US-<br>20040199260-A1 OR<br>US-20080294268-A1<br>OR US-20080009952-A1 OR US-<br>20130090737-A1 OR<br>US-20150025641-A1<br>OR US-20130150972-A1 OR US-<br>20140142711-A1 OR<br>US-20200188121-A1<br>OR US-20210236292-A1 OR US-<br>20210137693-A1).did.<br>AND PGPB.dbnm.) OR<br>((US-10357373-B2 OR<br>US-10258478-B2 OR<br>US-10925745-B2 OR<br>US-9283083-B2 OR<br>US-9545312-B2 OR<br>US-5702447-A OR US-<br>11166733-B2 OR US-<br>10034757-B2 OR US-<br>9615839-B2 OR US-<br>11564802-B2 OR US-<br>9668873-B2 OR US-<br>11464645-B2).did. AND<br>USPT.dbnm.) OR<br>((WO-2018022227-A1<br>OR WO-2012096965-A1 OR WO-<br>2018191420-A1 OR<br>WO-2020023975-A1<br>OR EP-3777777-A2 OR<br>EP-3598957-A1 OR<br>EP-2601912-A1 OR<br>WO-2012109245-A2<br>OR WO-2019006205-A1 OR WO-<br>2013148437-A1 OR<br>EP-3090705-A1 OR | MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>11:36 AM |
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| L49 | 12 | EP-3332750-A1).did.<br>AND FTDB.dbnm.)<br>L48 AND (screw OR<br>fastener) AND nut | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>11:36 AM |
| L50 | 12 | L48 AND nut                                                                      | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>12:08 PM |
| L51 | 5  | L48 AND washer                                                                   | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>12:12 PM |
| L52 | 4  | L51 NOT L50                                                                      | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,                                                                                                                                                                                               | OR | ON | ON | 2023/04/06<br>12:12 PM |

|     |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                               |    |    |    |                        |
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| L53 | 221 | ("4725280"   "4986833"<br>  "5032132"   "5033036"<br>  "5080673"   "5108446"<br>  "5458637"   "5489309"<br>  "5489311"   "5531973"<br>  "5662657"   "5702447"<br>  "5800551"   "5954722"<br>  "6102954"   "6139550"<br>  "6171342"   "6228119"<br>  "6228120"   "6379386"<br>  "6406495"   "6508841"<br>  "6514287"   "6673115"<br>  "6679916"   "6699289"<br>  "6761740"   "6783549"<br>  "6790234"   "6860903"<br>  "6911047"   "6942699"<br>  "6953478"   "6969406"<br>  "7160328"   "7169184"<br>  "7175663"   "7175665"<br>  "7204854"   "7316715"<br>  "7431736"   "7462197"<br>  "7462199"   "7527631"<br>  "7604665"   "7608109"<br>  "7611539"   "7621961"<br>  "7637928"   "7648530"<br>  "7666522"   "7753959"<br>  "7766969"   "7854768"<br>  "7883653"   "7892287"<br>  "7922769"   "7927335"<br>  "7993408"   "8007523"<br>  "8048161"   "8062376"<br>  "8070820"   "8092545"<br>  "8206453"   "8231683"<br>  "8241365"   "8287600"<br>  "8308807"   "8357201"<br>  "8361157"   "8425614"<br>  "8444680"   "8449617"<br>  "8454702"   "8454705"<br>  "8465548"   "8480750"<br>  "8532806"   "8556902"<br>  "8556980"   "8556981"<br>  "8591591"   "8597334"<br>  "8632597"   "8690951"<br>  "8690952"   "8753402"<br>  "8790402"   "8840676"<br>  "8864834"   "8870886"<br>  "8961611"   "9114017"<br>  "9233003"   "9498345"<br>  "9512445"   "9629725" | IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br><br>(US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2023/04/06<br>12:18 PM |
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|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |  |  |  |  |
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|  |  | "10034757"  <br>"10064734"  <br>"10251755"  <br>"10357373"  <br>"10779952"  <br>"20010011192"  <br>"20010037153"  <br>"20020095214"  <br>"20030055507"  <br>"20030149485"  <br>"20040030394"  <br>"20040059424"  <br>"20040106928"  <br>"20040220673"  <br>"20040220674"  <br>"20050049709"  <br>"20050060039"  <br>"20050143831"  <br>"20050149044"  <br>"20050192673"  <br>"20050261775"  <br>"20050278030"  <br>"20060074353"  <br>"20060100714"  <br>"20060122705"  <br>"20060142865"  <br>"20060200248"  <br>"20060200249"  <br>"20070016304"  <br>"20070055380"  <br>"20070100458"  <br>"20070142921"  <br>"20070156246"  <br>"20070179624"  <br>"20070219638"  <br>"20070244563"  <br>"20070244564"  <br>"20080140130"  <br>"20080183297"  <br>"20080269906"  <br>"20080294268"  <br>"20080306601"  <br>"20090125113"  <br>"20090149961"  <br>"20090204225"  <br>"20090216332"  <br>"20090281630"  <br>"20090292364"  <br>"20100016975"  <br>"20100023068"  <br>"20100049327"  <br>"20100087927"  <br>"20100161066"  <br>"20100217399"  <br>"20100234959"  <br>"20100249938"  <br>"20100274359"  <br>"20100291401" |  |  |  |  |  |
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|  |  | "20100331990" |  |  |  |  |  |
|  |  | "20110035013" |  |  |  |  |  |
|  |  | "20110118846" |  |  |  |  |  |
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|  |  | "20120059383" |  |  |  |  |  |
|  |  | "20120165954" |  |  |  |  |  |
|  |  | "20120191201" |  |  |  |  |  |
|  |  | "20120209392" |  |  |  |  |  |
|  |  | "20120221112" |  |  |  |  |  |
|  |  | "20120232670" |  |  |  |  |  |
|  |  | "20120239156" |  |  |  |  |  |
|  |  | "20120253467" |  |  |  |  |  |
|  |  | "20120277880" |  |  |  |  |  |
|  |  | "20130018483" |  |  |  |  |  |
|  |  | "20130053968" |  |  |  |  |  |
|  |  | "20130066433" |  |  |  |  |  |
|  |  | "20130096631" |  |  |  |  |  |
|  |  | "20130110470" |  |  |  |  |  |
|  |  | "20130144393" |  |  |  |  |  |
|  |  | "20130150972" |  |  |  |  |  |
|  |  | "20130150973" |  |  |  |  |  |
|  |  | "20130150975" |  |  |  |  |  |
|  |  | "20130226309" |  |  |  |  |  |
|  |  | "20130231754" |  |  |  |  |  |
|  |  | "20130253656" |  |  |  |  |  |
|  |  | "20130261751" |  |  |  |  |  |
|  |  | "20130261752" |  |  |  |  |  |
|  |  | "20130264749" |  |  |  |  |  |
|  |  | "20130282135" |  |  |  |  |  |
|  |  | "20140025173" |  |  |  |  |  |
|  |  | "20140142711" |  |  |  |  |  |
|  |  | "20140194995" |  |  |  |  |  |
|  |  | "20140257499" |  |  |  |  |  |
|  |  | "20140277180" |  |  |  |  |  |
|  |  | "20140371863" |  |  |  |  |  |
|  |  | "20150073424" |  |  |  |  |  |
|  |  | "20150094819" |  |  |  |  |  |
|  |  | "20150142122" |  |  |  |  |  |
|  |  | "20150150688" |  |  |  |  |  |
|  |  | "20150272741" |  |  |  |  |  |
|  |  | "20150305877" |  |  |  |  |  |
|  |  | "20160166392" |  |  |  |  |  |
|  |  | "20160228262" |  |  |  |  |  |
|  |  | "20160270922" |  |  |  |  |  |
|  |  | "20160287401" |  |  |  |  |  |
|  |  | "20160310285" |  |  |  |  |  |
|  |  | "20160324649" |  |  |  |  |  |
|  |  | "20170027709" |  |  |  |  |  |
|  |  | "20170042687" |  |  |  |  |  |
|  |  | "20170049574" |  |  |  |  |  |
|  |  | "20170172764" |  |  |  |  |  |
|  |  | "20170273795" |  |  |  |  |  |
|  |  | "20170273801" |  |  |  |  |  |
|  |  | "20180078377" |  |  |  |  |  |



|     |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L54 | 45  | "20180243102"  <br>"20180368982"  <br>"20190029833"  <br>"20190076261"  <br>"20190336293"  <br>"20200188121"  <br>"20220175543").pn. OR<br>("11564802").urpn.<br>AND (PGPB   USPT  <br>USOC).dbnm.<br><br>L53 AND (nut OR<br>washer)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>12:19 PM |
| L55 | 172 | ("4986833"   "5033036"<br>  "5080673"   "5458637"<br>  "5489309"   "5489311"<br>  "5531973"   "5800551"<br>  "5954722"   "6102954"<br>  "6171342"   "6228119"<br>  "6406495"   "6508841"<br>  "6514287"   "6673115"<br>  "6679916"   "6699289"<br>  "6761740"   "6790234"<br>  "6860903"   "6953478"<br>  "7169184"   "7175663"<br>  "7175665"   "7204854"<br>  "7316715"   "7462197"<br>  "7462199"   "7604665"<br>  "7608109"   "7621961"<br>  "7637928"   "7648530"<br>  "7666522"   "7753959"<br>  "7766969"   "7854768"<br>  "7892287"   "7922769"<br>  "7927335"   "7993408"<br>  "8007523"   "8048161"<br>  "8062376"   "8070820"<br>  "8092545"   "8206453"<br>  "8231683"   "8241365"<br>  "8287600"   "8308807"<br>  "8357201"   "8361157"<br>  "8425614"   "8444680"<br>  "8449617"   "8454702"<br>  "8465548"   "8480750"<br>  "8532806"   "8556902" | (US-PGPUB; USPAT;<br>USOCR)                                                                                                                                                                                                                                                                                                                                       | OR | ON | ON | 2023/04/06<br>12:24 PM |

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|--|--|-----------------------|--|--|--|--|--|
|  |  | "8556980"   "8556981" |  |  |  |  |  |
|  |  | "8591591"   "8597334" |  |  |  |  |  |
|  |  | "8632597"   "8690951" |  |  |  |  |  |
|  |  | "8753402"   "8790402" |  |  |  |  |  |
|  |  | "8840676"   "8864834" |  |  |  |  |  |
|  |  | "8961611"   "9114017" |  |  |  |  |  |
|  |  | "9498345"   "9629725" |  |  |  |  |  |
|  |  | "10064734"            |  |  |  |  |  |
|  |  | "20020095214"         |  |  |  |  |  |
|  |  | "20030149485"         |  |  |  |  |  |
|  |  | "20040106928"         |  |  |  |  |  |
|  |  | "20040220673"         |  |  |  |  |  |
|  |  | "20040220674"         |  |  |  |  |  |
|  |  | "20050049709"         |  |  |  |  |  |
|  |  | "20050143831"         |  |  |  |  |  |
|  |  | "20050149044"         |  |  |  |  |  |
|  |  | "20050261775"         |  |  |  |  |  |
|  |  | "20050278030"         |  |  |  |  |  |
|  |  | "20060074353"         |  |  |  |  |  |
|  |  | "20060100714"         |  |  |  |  |  |
|  |  | "20060122705"         |  |  |  |  |  |
|  |  | "20060142865"         |  |  |  |  |  |
|  |  | "20060200248"         |  |  |  |  |  |
|  |  | "20060200249"         |  |  |  |  |  |
|  |  | "20070016304"         |  |  |  |  |  |
|  |  | "20070055380"         |  |  |  |  |  |
|  |  | "20070100458"         |  |  |  |  |  |
|  |  | "20070142921"         |  |  |  |  |  |
|  |  | "20070156246"         |  |  |  |  |  |
|  |  | "20070179624"         |  |  |  |  |  |
|  |  | "20070219638"         |  |  |  |  |  |
|  |  | "20070244563"         |  |  |  |  |  |
|  |  | "20080269906"         |  |  |  |  |  |
|  |  | "20080294268"         |  |  |  |  |  |
|  |  | "20080306601"         |  |  |  |  |  |
|  |  | "20090149961"         |  |  |  |  |  |
|  |  | "20090204225"         |  |  |  |  |  |
|  |  | "20090216332"         |  |  |  |  |  |
|  |  | "20090281630"         |  |  |  |  |  |
|  |  | "20100016975"         |  |  |  |  |  |
|  |  | "20100023068"         |  |  |  |  |  |
|  |  | "20100049327"         |  |  |  |  |  |
|  |  | "20100087927"         |  |  |  |  |  |
|  |  | "20100161066"         |  |  |  |  |  |
|  |  | "20100217399"         |  |  |  |  |  |
|  |  | "20100234959"         |  |  |  |  |  |
|  |  | "20100274359"         |  |  |  |  |  |
|  |  | "20100291401"         |  |  |  |  |  |
|  |  | "20100331990"         |  |  |  |  |  |
|  |  | "20110035013"         |  |  |  |  |  |
|  |  | "20110118846"         |  |  |  |  |  |
|  |  | "20110144760"         |  |  |  |  |  |
|  |  | "20110190899"         |  |  |  |  |  |
|  |  | "20110282393"         |  |  |  |  |  |
|  |  | "20120004733"         |  |  |  |  |  |
|  |  | "20120029647"         |  |  |  |  |  |
|  |  | "20120165954"         |  |  |  |  |  |
|  |  | "20120191201"         |  |  |  |  |  |

|     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|-----|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
|     |    | "20120209392"<br>"20120221111"<br>"20120221112"<br>"20120232670"<br>"20120239156"<br>"20120253467"<br>"20120277880"<br>"20130018483"<br>"20130053968"<br>"20130096631"<br>"20130110470"<br>"20130150972"<br>"20130150973"<br>"20130150975"<br>"20130226309"<br>"20130231754"<br>"20130253656"<br>"20130261751"<br>"20130261752"<br>"20130264749"<br>"20130282135"<br>"20140025173"<br>"20140142711"<br>"20140194995"<br>"20140257499"<br>"20140277180"<br>"20140371863"<br>"20150094819"<br>"20150142122"<br>"20150150688"<br>"20150272741"<br>"20150305877"<br>"20160270922"<br>"20160287401"<br>"20160310285"<br>"20160324649"<br>"20170042690"<br>"20170172764"<br>"20180243102").pn. OR<br>("10357373").urpn.<br>AND (PGPB   USPT  <br>USOC).dbnm. |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
| L56 | 37 | L55 AND (nut OR washer)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | (US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/06 12:24 PM |

|     |      |                                                               |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L57 | 3354 | (reverse SAME<br>shoulder SAME<br>(implant OR<br>prosthesis)) | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>12:24 PM |
| L58 | 292  | L57 AND (nut OR<br>washer)                                    | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/06<br>12:25 PM |
| L59 | 0    | "200400220674"                                                | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>01:57 PM |
| L60 | 8    | "20040220674"                                                 | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,                                                                                                                                             | OR | ON | ON | 2023/04/07<br>01:57 PM |

|     |   |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |    |    |    |                        |
|-----|---|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L61 | 5 | ("5383937").pn. | MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>01:58 PM |
| L62 | 2 | ("7294149").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                             | OR | ON | ON | 2023/04/07<br>01:58 PM |
| L63 | 5 | ("4865605").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                             | OR | ON | ON | 2023/04/07<br>02:04 PM |
| L64 | 5 | ("5282865").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | OR | ON | ON | 2023/04/07<br>02:04 PM |

|     |    |               |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|----|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L65 | 12 | "20050043805" | AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                             | OR | ON | ON | 2023/04/07<br>02:04 PM |
| L66 | 17 | "2019178104"  | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>02:10 PM |
| L67 | 17 | "20090105837" | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>02:11 PM |

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|-----|----|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L68 | 16 | "20170056187"   | RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>02:12 PM |
| L69 | 3  | ("8940054").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                               | OR | ON | ON | 2023/04/07<br>02:12 PM |
| L70 | 64 | "2015002394"    | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                               | OR | ON | ON | 2023/04/07<br>02:13 PM |
| L71 | 11 | "20150022394"   | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,                                                                                                                                                                                                                                                                                                                                                                          | OR | ON | ON | 2023/04/07<br>02:13 PM |





|     |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                       |    |    |    |                        |
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| L75 | 30  | "2008011078"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br><br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>02:21 PM |
| L76 | 358 | (US-0000617-\$   US-<br>0002766-\$   US-<br>0011192-\$   US-<br>0029089-\$   US-<br>0036328-\$   US-<br>0037153-\$   US-<br>0038302-\$   US-<br>0038401-\$   US-<br>0039449-\$   US-<br>0039451-\$   US-<br>0043805-\$   US-<br>0045323-\$   US-<br>0047210-\$   US-<br>0049709-\$   US-<br>0050042-\$   US-<br>0055380-\$   US-<br>0055783-\$   US-<br>0056187-\$   US-<br>0059424-\$   US-<br>0060346-\$   US-<br>0064187-\$   US-<br>0064189-\$   US-<br>0064190-\$   US-<br>0065612-\$   US-<br>0069443-\$   US-<br>0069444-\$   US-<br>0069445-\$   US-<br>0071104-\$   US-<br>0071749-\$   US-<br>0078024-\$   US-<br>0078377-\$   US-<br>0080207-\$   US-<br>0081505-\$   US-<br>0082175-\$   US-<br>0082702-\$   US-<br>0087213-\$   US-<br>0090736-\$   US-<br>0095214-\$   US- | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                     | OR | ON | ON | 2023/04/07<br>02:23 PM |

|  |  |            |     |  |  |  |  |  |
|--|--|------------|-----|--|--|--|--|--|
|  |  | 0100952-\$ | US- |  |  |  |  |  |
|  |  | 0105837-\$ | US- |  |  |  |  |  |
|  |  | 0105861-\$ | US- |  |  |  |  |  |
|  |  | 0106266-\$ | US- |  |  |  |  |  |
|  |  | 0107002-\$ | US- |  |  |  |  |  |
|  |  | 0107794-\$ | US- |  |  |  |  |  |
|  |  | 0107882-\$ | US- |  |  |  |  |  |
|  |  | 0111689-\$ | US- |  |  |  |  |  |
|  |  | 0112433-\$ | US- |  |  |  |  |  |
|  |  | 0112648-\$ | US- |  |  |  |  |  |
|  |  | 0114326-\$ | US- |  |  |  |  |  |
|  |  | 0114933-\$ | US- |  |  |  |  |  |
|  |  | 0119531-\$ | US- |  |  |  |  |  |
|  |  | 0122519-\$ | US- |  |  |  |  |  |
|  |  | 0122520-\$ | US- |  |  |  |  |  |
|  |  | 0125113-\$ | US- |  |  |  |  |  |
|  |  | 0125809-\$ | US- |  |  |  |  |  |
|  |  | 0137424-\$ | US- |  |  |  |  |  |
|  |  | 0137692-\$ | US- |  |  |  |  |  |
|  |  | 0137693-\$ | US- |  |  |  |  |  |
|  |  | 0138148-\$ | US- |  |  |  |  |  |
|  |  | 0144738-\$ | US- |  |  |  |  |  |
|  |  | 0144758-\$ | US- |  |  |  |  |  |
|  |  | 0151795-\$ | US- |  |  |  |  |  |
|  |  | 0158605-\$ | US- |  |  |  |  |  |
|  |  | 0161066-\$ | US- |  |  |  |  |  |
|  |  | 0161169-\$ | US- |  |  |  |  |  |
|  |  | 0163202-\$ | US- |  |  |  |  |  |
|  |  | 0166033-\$ | US- |  |  |  |  |  |
|  |  | 0167629-\$ | US- |  |  |  |  |  |
|  |  | 0167630-\$ | US- |  |  |  |  |  |
|  |  | 0172996-\$ | US- |  |  |  |  |  |
|  |  | 0175543-\$ | US- |  |  |  |  |  |
|  |  | 0175544-\$ | US- |  |  |  |  |  |
|  |  | 0177241-\$ | US- |  |  |  |  |  |
|  |  | 0177327-\$ | US- |  |  |  |  |  |
|  |  | 0193150-\$ | US- |  |  |  |  |  |
|  |  | 0193168-\$ | US- |  |  |  |  |  |
|  |  | 0193275-\$ | US- |  |  |  |  |  |
|  |  | 0193276-\$ | US- |  |  |  |  |  |
|  |  | 0193277-\$ | US- |  |  |  |  |  |
|  |  | 0193278-\$ | US- |  |  |  |  |  |
|  |  | 0195909-\$ | US- |  |  |  |  |  |
|  |  | 0197651-\$ | US- |  |  |  |  |  |
|  |  | 0200067-\$ | US- |  |  |  |  |  |
|  |  | 0200249-\$ | US- |  |  |  |  |  |
|  |  | 0202674-\$ | US- |  |  |  |  |  |
|  |  | 0209392-\$ | US- |  |  |  |  |  |
|  |  | 0217399-\$ | US- |  |  |  |  |  |
|  |  | 0220674-\$ | US- |  |  |  |  |  |
|  |  | 0223941-\$ | US- |  |  |  |  |  |
|  |  | 0225817-\$ | US- |  |  |  |  |  |
|  |  | 0225818-\$ | US- |  |  |  |  |  |
|  |  | 0228112-\$ | US- |  |  |  |  |  |
|  |  | 0230311-\$ | US- |  |  |  |  |  |
|  |  | 0234820-\$ | US- |  |  |  |  |  |
|  |  | 0236572-\$ | US- |  |  |  |  |  |
|  |  | 0239156-\$ | US- |  |  |  |  |  |

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|--|--|----------------------|--|--|--|--|--|
|  |  | 0244547-\$   US-     |  |  |  |  |  |
|  |  | 0249938-\$   US-     |  |  |  |  |  |
|  |  | 0251640-\$   US-     |  |  |  |  |  |
|  |  | 0253641-\$   US-     |  |  |  |  |  |
|  |  | 0257499-\$   US-     |  |  |  |  |  |
|  |  | 0260398-\$   US-     |  |  |  |  |  |
|  |  | 0261775-\$   US-     |  |  |  |  |  |
|  |  | 0265411-\$   US-     |  |  |  |  |  |
|  |  | 0273806-\$   US-     |  |  |  |  |  |
|  |  | 0274360-\$   US-     |  |  |  |  |  |
|  |  | 0276144-\$   US-     |  |  |  |  |  |
|  |  | 0278030-\$   US-     |  |  |  |  |  |
|  |  | 0287309-\$   US-     |  |  |  |  |  |
|  |  | 0304063-\$   US-     |  |  |  |  |  |
|  |  | 0313533-\$   US-     |  |  |  |  |  |
|  |  | 0336293-\$   US-     |  |  |  |  |  |
|  |  | 0338446-\$   US-     |  |  |  |  |  |
|  |  | 0360456-\$   US-     |  |  |  |  |  |
|  |  | 0368982-\$   US-     |  |  |  |  |  |
|  |  | 1234567-\$   US-     |  |  |  |  |  |
|  |  | 10143559-\$   US-    |  |  |  |  |  |
|  |  | 10492926-\$   US-    |  |  |  |  |  |
|  |  | 10702390-\$   US-    |  |  |  |  |  |
|  |  | 10779952-\$   US-    |  |  |  |  |  |
|  |  | 10786265-\$   US-    |  |  |  |  |  |
|  |  | 11065125-\$   US-    |  |  |  |  |  |
|  |  | 2781758-\$   US-     |  |  |  |  |  |
|  |  | 20010011192-\$   US- |  |  |  |  |  |
|  |  | 20010037153-\$   US- |  |  |  |  |  |
|  |  | 20010047210-\$   US- |  |  |  |  |  |
|  |  | 20020055783-\$   US- |  |  |  |  |  |
|  |  | 20020082702-\$   US- |  |  |  |  |  |
|  |  | 20020087213-\$   US- |  |  |  |  |  |
|  |  | 20020095214-\$   US- |  |  |  |  |  |
|  |  | 20020111689-\$   US- |  |  |  |  |  |
|  |  | 20020138148-\$   US- |  |  |  |  |  |
|  |  | 20030100952-\$   US- |  |  |  |  |  |
|  |  | 20030114933-\$   US- |  |  |  |  |  |
|  |  | 20030125809-\$   US- |  |  |  |  |  |
|  |  | 20030144738-\$   US- |  |  |  |  |  |
|  |  | 20030158605-\$   US- |  |  |  |  |  |
|  |  | 20030163202-\$   US- |  |  |  |  |  |
|  |  | 20030236572-\$   US- |  |  |  |  |  |
|  |  | 20040002766-\$   US- |  |  |  |  |  |
|  |  | 20040039449-\$   US- |  |  |  |  |  |
|  |  | 20040039451-\$   US- |  |  |  |  |  |
|  |  | 20040059424-\$   US- |  |  |  |  |  |
|  |  | 20040064187-\$   US- |  |  |  |  |  |
|  |  | 20040064189-\$   US- |  |  |  |  |  |
|  |  | 20040064190-\$   US- |  |  |  |  |  |
|  |  | 20040107002-\$   US- |  |  |  |  |  |
|  |  | 20040122519-\$   US- |  |  |  |  |  |
|  |  | 20040122520-\$   US- |  |  |  |  |  |
|  |  | 20040167629-\$   US- |  |  |  |  |  |
|  |  | 20040167630-\$   US- |  |  |  |  |  |
|  |  | 20040193168-\$   US- |  |  |  |  |  |
|  |  | 20040193275-\$   US- |  |  |  |  |  |
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|     |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|-----|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L77 | 22  | 20040193277-\$   US-<br>20040193278-\$   US-<br>20040220674-\$   US-<br>20040230311-\$   US-<br>20040260398-\$   US-<br>20050043805-\$   US-<br>20050049709-\$   US-<br>20050065612-\$   US-<br>20050107882-\$   US-<br>20050119531-\$   US-<br>20050177241-\$   US-<br>20050261775-\$   US-<br>20050278030-\$   US-<br>20060036328-\$   US-<br>20060069443-\$   US-<br>20060069444-\$   US-<br>20060069445-\$   US-<br>20060200249-\$   US-<br>20070038302-\$   US-<br>20070050042-\$   US-<br>20070055380-\$   US-<br>20070112433-\$   US-<br>20070225817-\$   US-<br>20070225818-\$   US-<br>20080082175-\$   US-<br>20080177327-\$).DID.<br><br>L76 AND (washer OR nut) | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/04/07 02:23 PM |
| L78 | 270 | (US-20080234820-\$  <br>US-20090105837-\$  <br>US-20090125113-\$  <br>US-20090228112-\$  <br>US-20090287309-\$  <br>US-20100114326-\$  <br>US-20100161066-\$  <br>US-20100217399-\$  <br>US-20100249938-\$  <br>US-20100274360-\$  <br>US-20110029089-\$  <br>US-20110106266-\$  <br>US-20110112648-\$  <br>US-20110137424-\$  <br>US-20110144758-\$                                                                                                                                                                                                                                                                                                                        | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT;          | OR | ON | ON | 2023/04/07 02:27 PM |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |  |  |  |  |
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|  |  | US-20110276144-\$  <br>US-20110313533-\$  <br>US-20120172996-\$  <br>US-20120209392-\$  <br>US-20120239156-\$  <br>US-20130060346-\$  <br>US-20130090736-\$  <br>US-20130166033-\$  <br>US-20130197651-\$  <br>US-20140107794-\$  <br>US-20140253641-\$  <br>US-20140257499-\$  <br>US-20150105861-\$  <br>US-20150223941-\$  <br>US-20150265411-\$  <br>US-20160045323-\$  <br>US-20170000617-\$  <br>US-20170056187-\$  <br>US-20170071749-\$  <br>US-20170202674-\$  <br>US-20170273806-\$  <br>US-20170304063-\$  <br>US-20170360456-\$  <br>US-20180071104-\$  <br>US-20180078377-\$  <br>US-20180161169-\$  <br>US-20180193150-\$  <br>US-20180200067-\$  <br>US-20180368982-\$  <br>US-20190336293-\$  <br>US-20210038401-\$  <br>US-20210137692-\$  <br>US-20210137693-\$  <br>US-20210244547-\$  <br>US-20210251640-\$  <br>US-20210338446-\$  <br>US-20220151795-\$  <br>US-20220175543-\$  <br>US-20220175544-\$  <br>US-20230078024-\$  <br>US-20230080207-\$  <br>US-20230081505-\$  <br>US-3979778-\$   US-<br>4003095-\$   US-<br>4045826-\$   US-<br>4206517-\$   US-<br>4261062-\$   US-<br>4404693-\$   US-<br>4550450-\$   US-<br>4865605-\$   US-<br>4964865-\$   US-<br>4986833-\$   US-<br>4990161-\$   US-<br>5030219-\$   US-<br>5032132-\$   US-<br>5080673-\$   US-<br>5108440-\$   US-<br>5282865-\$   US- | IBM_TDB) |  |  |  |  |
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|--|--|-------------|-----|--|--|--|--|--|
|  |  | 5314479-\$  | US- |  |  |  |  |  |
|  |  | 5314489-\$  | US- |  |  |  |  |  |
|  |  | 5344458-\$  | US- |  |  |  |  |  |
|  |  | 5358525-\$  | US- |  |  |  |  |  |
|  |  | 5370694-\$  | US- |  |  |  |  |  |
|  |  | 5462563-\$  | US- |  |  |  |  |  |
|  |  | 5487677-\$  | US- |  |  |  |  |  |
|  |  | 5489309-\$  | US- |  |  |  |  |  |
|  |  | 5489310-\$  | US- |  |  |  |  |  |
|  |  | 5507819-\$  | US- |  |  |  |  |  |
|  |  | 5514184-\$  | US- |  |  |  |  |  |
|  |  | 5549683-\$  | US- |  |  |  |  |  |
|  |  | 5593448-\$  | US- |  |  |  |  |  |
|  |  | 5702486-\$  | US- |  |  |  |  |  |
|  |  | 5755811-\$  | US- |  |  |  |  |  |
|  |  | 5769856-\$  | US- |  |  |  |  |  |
|  |  | 5800551-\$  | US- |  |  |  |  |  |
|  |  | 5928285-\$  | US- |  |  |  |  |  |
|  |  | 57419657-\$ | US- |  |  |  |  |  |
|  |  | 6037724-\$  | US- |  |  |  |  |  |
|  |  | 6228119-\$  | US- |  |  |  |  |  |
|  |  | 6231913-\$  | US- |  |  |  |  |  |
|  |  | 6290726-\$  | US- |  |  |  |  |  |
|  |  | 6334874-\$  | US- |  |  |  |  |  |
|  |  | 6364910-\$  | US- |  |  |  |  |  |
|  |  | 6368353-\$  | US- |  |  |  |  |  |
|  |  | 6379386-\$  | US- |  |  |  |  |  |
|  |  | 6458136-\$  | US- |  |  |  |  |  |
|  |  | 6514287-\$  | US- |  |  |  |  |  |
|  |  | 6520964-\$  | US- |  |  |  |  |  |
|  |  | 6589281-\$  | US- |  |  |  |  |  |
|  |  | 6610067-\$  | US- |  |  |  |  |  |
|  |  | 6620197-\$  | US- |  |  |  |  |  |
|  |  | 6673115-\$  | US- |  |  |  |  |  |
|  |  | 6679916-\$  | US- |  |  |  |  |  |
|  |  | 6679917-\$  | US- |  |  |  |  |  |
|  |  | 6699289-\$  | US- |  |  |  |  |  |
|  |  | 6709463-\$  | US- |  |  |  |  |  |
|  |  | 6712823-\$  | US- |  |  |  |  |  |
|  |  | 6761740-\$  | US- |  |  |  |  |  |
|  |  | 6783549-\$  | US- |  |  |  |  |  |
|  |  | 6875234-\$  | US- |  |  |  |  |  |
|  |  | 7011686-\$  | US- |  |  |  |  |  |
|  |  | 7044973-\$  | US- |  |  |  |  |  |
|  |  | 7238089-\$  | US- |  |  |  |  |  |
|  |  | 7238208-\$  | US- |  |  |  |  |  |
|  |  | 7294149-\$  | US- |  |  |  |  |  |
|  |  | 7320709-\$  | US- |  |  |  |  |  |
|  |  | 7329284-\$  | US- |  |  |  |  |  |
|  |  | 7465319-\$  | US- |  |  |  |  |  |
|  |  | 7517364-\$  | US- |  |  |  |  |  |
|  |  | 7618462-\$  | US- |  |  |  |  |  |
|  |  | 7678151-\$  | US- |  |  |  |  |  |
|  |  | 7749278-\$  | US- |  |  |  |  |  |
|  |  | 7776098-\$  | US- |  |  |  |  |  |
|  |  | 7892287-\$  | US- |  |  |  |  |  |
|  |  | 7922769-\$  | US- |  |  |  |  |  |
|  |  | 8048161-\$  | US- |  |  |  |  |  |

|     |    |            |      |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|----|------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L79 | 18 | 8048167-\$ | US-  | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/04/07<br>02:28 PM |
|     |    | 8529629-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | 8608805-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | 8840671-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | 8920508-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | 8940054-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | 9283083-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | 9381086-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | 9545311-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | 9545312-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | 9610166-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | 9693784-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | 9867710-\$ | US-  |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|     |    | D977643-\$ | DID. |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
| L80 | 69 | "2689750"  |      | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/05/29<br>01:58 PM |
| L81 | 67 | "1488764"  |      | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,                                                                                               | OR | ON | ON | 2023/05/29<br>01:59 PM |

|     |   |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |    |    |    |                        |
|-----|---|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L82 | 2 | ("8177786").pn.  | RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/05/29<br>02:01 PM |
| L83 | 2 | ("8870962").pn.  | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                               | OR | ON | ON | 2023/05/29<br>02:02 PM |
| L84 | 4 | ("11259931").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                               | OR | ON | ON | 2023/05/29<br>02:03 PM |
| L85 | 4 | "20140277520"    | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,                                                                                                                                                                                                                                                                                                                                                                          | OR | ON | ON | 2023/05/29<br>02:04 PM |



|     |    |                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |    |    |    |                     |
|-----|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L86 | 4  | "20180243102"                                                                                                                                                                                                    | CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)<br>(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/05/29 02:05 PM |
| L87 | 11 | "20140025173"                                                                                                                                                                                                    | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                                                                                                                                                                                                           | OR | ON | ON | 2023/05/29 02:06 PM |
| L88 | 65 | ((US-20180078377-A1 OR US-20180071104-A1 OR US-20180161169-A1 OR US-20170202674-A1 OR US-20040064189-A1 OR US-20070179624-A1 OR US-20040030400-A1 OR US-20030060890-A1 OR US-20040199260-A1 OR US-20080294268-A1 | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                                                                                                                                                                                                           | OR | ON | ON | 2023/05/29 02:08 PM |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                        |  |  |  |  |
|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--|--|--|--|
|  |  | OR US-20080009952-A1 OR US-20130090737-A1 OR US-20150025641-A1 OR US-20130150972-A1 OR US-20140142711-A1 OR US-20200188121-A1 OR US-20210236292-A1 OR US-20210137693-A1 OR US-20070156246-A1 OR US-20160302934-A1 OR US-20200261209-A1 OR US-20040220674-A1 OR US-20030114933-A1 OR US-20030163202-A1 OR US-20040167629-A1 OR US-20100161066-A1 OR US-20110029089-A1 OR US-20220151795-A1 OR US-20140277520-A1 OR US-20180243102-A1 OR US-20140025173-A1).did. AND PGPB.dbnm.) OR ((US-10357373-B2 OR US-10258478-B2 OR US-10925745-B2 OR US-9283083-B2 OR US-9545312-B2 OR US-5702447-A OR US-11166733-B2 OR US-10034757-B2 OR US-9615839-B2 OR US-11564802-B2 OR US-9668873-B2 OR US-11464645-B2 OR US-6953478-B2 OR US-7766969-B2 OR US-9114017-B2 OR US-8940054-B2 OR US-6290726-B1 OR US-8920508-B2 OR US-8870962-B2).did. AND USPT.dbnm.) OR ((WO-2018022227-A1 OR WO-2012096965-A1 OR WO-2018191420-A1 OR WO-2020023975-A1 OR EP-3598957-A1 OR EP-2601912-A1 OR WO-2012109245-A2 | VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) |  |  |  |  |
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|     |       |                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|-------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L92 | 25266 | ball.in.                                                                             | VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L93 | 13    | L10 AND ((shoulder<br>AND screw AND<br>glenoid AND (implant<br>OR prosthesis)).clm.) | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                 | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L94 | 11    | L11 NOT L9                                                                           | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                 | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L95 | 2038  | slone.in.                                                                            | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,                                                                                                                                                                                                                                                                          | OR | ON | ON | 2023/06/29<br>06:45 PM |



|      |      |                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                  |    |    |    |                     |
|------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L99  | 477  | ((shoulder AND screw AND glenoid AND (implant OR prosthesis)).clm.)                                                                                                                                                                                                                                                             | IBM_TDB)<br>(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:45 PM |
| L100 | 6969 | ((shoulder AND screw AND glenoid AND (implant OR prosthesis)))                                                                                                                                                                                                                                                                  | (US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)             | OR | ON | ON | 2023/06/29 06:45 PM |
| L101 | 3837 | L18 AND ((A61F2/4081 OR A61F2/30749 OR A61F2002/30616 OR A61F2002/4085 OR A61F2/4612 OR A61F2002/30011 OR A61F2002/30433 OR A61F2002/30507 OR A61F2002/30604 OR A61F2002/30774 OR A61F2002/30827 OR A61F2002/30901 OR A61F2002/3092 OR A61F2002/3093 OR A61F2002/4659 OR A61F2002/4662 OR A61F2002/4668 OR A61F2002/4681).cpc.) | (US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)             | OR | ON | ON | 2023/06/29 06:45 PM |
| L102 | 108  | ("3815157"   "3842442"   "3916451"   "3978528"   "3979778"   "4003095"   "4030143"   "4040131"   "4135517"   "4179758"                                                                                                                                                                                                          | (US-PGPUB; USPAT; USOCR)                                                                                                                                                                                                                                                                                                         | OR | ON | ON | 2023/06/29 06:45 PM |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |  |  |  |  |
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|  |  | "4206517" "4693723"<br>"4822370" "4865605"<br>"4865609" "4919670"<br>"4957510" "4963155"<br>"4964865" "5080673"<br>"5080685" "5135529"<br>"5181928" "5201882"<br>"5222984" "5314479"<br>"5358526" "5462563"<br>"5507817" "5507818"<br>"5507824" "5549682"<br>"5580352" "5702457"<br>"5702486" "5723018"<br>"5728161" "5902340"<br>"5910171" "5961555"<br>"6033439" "6045582"<br>"6102953" "6129764"<br>"6171341" "6197062"<br>"6197063" "6206925"<br>"6228120" "6364910"<br>"6368352" "6620197"<br>"6626946" "6719799"<br>"6761740" "6790234"<br>"6890358" "6942699"<br>"6974483" "6986790"<br>"7022141" "7097663"<br>"7135044" "7175663"<br>"7189261" "7238207"<br>"7621961" "7819923"<br>"8062376" "8070820"<br>"20010049561"  <br>"20010053935"  <br>"20020120339"  <br>"20020138148"  <br>"20020156534"  <br>"20030028253"  <br>"20030097183"  <br>"20030114933"  <br>"20030158605"  <br>"20040064189"  <br>"20040064190"  <br>"20040220673"  <br>"20040220674"  <br>"20050197708"  <br>"20060020344"  <br>"20070142918"  <br>"20070179624"  <br>"20070198094"  <br>"20090192621"  <br>"20090210065"  <br>"20090270993"  <br>"20110035013"  <br>"20110035015"  <br>"20110054624"  <br>"20110118846").pn. OR<br>("9283083").urpn. AND<br>(PGPB   USPT  <br>USOC).dbnm. |  |  |  |  |  |
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|      |      |                                                                        |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|------|------|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L103 | 589  | ((shoulder AND screw AND glenoid AND (implant OR prosthesis)) AND nut) | (US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:45 PM |
| L104 | 17   | L20 AND nut AND screw                                                  | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:45 PM |
| L105 | 1359 | L18 AND ((A61B17/1778 OR A61B17/8605).cpc.)                            | (US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:45 PM |
| L106 | 81   | L21 AND ((A61B17/1778 OR A61B17/8605).cpc.)                            | (US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,                                                                                                                        | OR | ON | ON | 2023/06/29 06:45 PM |



|      |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                             |    |    |    |                        |
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| L107 | 172 | ("4986833"   "5033036"<br>  "5080673"   "5458637"<br>  "5489309"   "5489311"<br>  "5531973"   "5800551"<br>  "5954722"   "6102954"<br>  "6171342"   "6228119"<br>  "6406495"   "6508841"<br>  "6514287"   "6673115"<br>  "6679916"   "6699289"<br>  "6761740"   "6790234"<br>  "6860903"   "6953478"<br>  "7169184"   "7175663"<br>  "7175665"   "7204854"<br>  "7316715"   "7462197"<br>  "7462199"   "7604665"<br>  "7608109"   "7621961"<br>  "7637928"   "7648530"<br>  "7666522"   "7753959"<br>  "7766969"   "7854768"<br>  "7892287"   "7922769"<br>  "7927335"   "7993408"<br>  "8007523"   "8048161"<br>  "8062376"   "8070820"<br>  "8092545"   "8206453"<br>  "8231683"   "8241365"<br>  "8287600"   "8308807"<br>  "8357201"   "8361157"<br>  "8425614"   "8444680"<br>  "8449617"   "8454702"<br>  "8465548"   "8480750"<br>  "8532806"   "8556902"<br>  "8556980"   "8556981"<br>  "8591591"   "8597334"<br>  "8632597"   "8690951"<br>  "8753402"   "8790402"<br>  "8840676"   "8864834"<br>  "8961611"   "9114017"<br>  "9498345"   "9629725"<br>  "10064734"  <br>"20020095214"  <br>"20030149485"  <br>"20040106928"  <br>"20040220673"  <br>"20040220674"  <br>"20050049709"  <br>"20050143831"  <br>"20050149044"  <br>"20050261775"  <br>"20050278030"  <br>"20060074353"  <br>"20060100714" | NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br><br>(US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2023/06/29<br>06:45 PM |
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|  |  | "20060122705" |  |  |  |  |  |
|  |  | "20060142865" |  |  |  |  |  |
|  |  | "20060200248" |  |  |  |  |  |
|  |  | "20060200249" |  |  |  |  |  |
|  |  | "20070016304" |  |  |  |  |  |
|  |  | "20070055380" |  |  |  |  |  |
|  |  | "20070100458" |  |  |  |  |  |
|  |  | "20070142921" |  |  |  |  |  |
|  |  | "20070156246" |  |  |  |  |  |
|  |  | "20070179624" |  |  |  |  |  |
|  |  | "20070219638" |  |  |  |  |  |
|  |  | "20070244563" |  |  |  |  |  |
|  |  | "20080269906" |  |  |  |  |  |
|  |  | "20080294268" |  |  |  |  |  |
|  |  | "20080306601" |  |  |  |  |  |
|  |  | "20090149961" |  |  |  |  |  |
|  |  | "20090204225" |  |  |  |  |  |
|  |  | "20090216332" |  |  |  |  |  |
|  |  | "20090281630" |  |  |  |  |  |
|  |  | "20100016975" |  |  |  |  |  |
|  |  | "20100023068" |  |  |  |  |  |
|  |  | "20100049327" |  |  |  |  |  |
|  |  | "20100087927" |  |  |  |  |  |
|  |  | "20100161066" |  |  |  |  |  |
|  |  | "20100217399" |  |  |  |  |  |
|  |  | "20100234959" |  |  |  |  |  |
|  |  | "20100274359" |  |  |  |  |  |
|  |  | "20100291401" |  |  |  |  |  |
|  |  | "20100331990" |  |  |  |  |  |
|  |  | "20110035013" |  |  |  |  |  |
|  |  | "20110118846" |  |  |  |  |  |
|  |  | "20110144760" |  |  |  |  |  |
|  |  | "20110190899" |  |  |  |  |  |
|  |  | "20110282393" |  |  |  |  |  |
|  |  | "20120004733" |  |  |  |  |  |
|  |  | "20120029647" |  |  |  |  |  |
|  |  | "20120165954" |  |  |  |  |  |
|  |  | "20120191201" |  |  |  |  |  |
|  |  | "20120209392" |  |  |  |  |  |
|  |  | "20120221111" |  |  |  |  |  |
|  |  | "20120221112" |  |  |  |  |  |
|  |  | "20120232670" |  |  |  |  |  |
|  |  | "20120239156" |  |  |  |  |  |
|  |  | "20120253467" |  |  |  |  |  |
|  |  | "20120277880" |  |  |  |  |  |
|  |  | "20130018483" |  |  |  |  |  |
|  |  | "20130053968" |  |  |  |  |  |
|  |  | "20130096631" |  |  |  |  |  |
|  |  | "20130110470" |  |  |  |  |  |
|  |  | "20130150972" |  |  |  |  |  |
|  |  | "20130150973" |  |  |  |  |  |
|  |  | "20130150975" |  |  |  |  |  |
|  |  | "20130226309" |  |  |  |  |  |
|  |  | "20130231754" |  |  |  |  |  |
|  |  | "20130253656" |  |  |  |  |  |
|  |  | "20130261751" |  |  |  |  |  |
|  |  | "20130261752" |  |  |  |  |  |
|  |  | "20130264749" |  |  |  |  |  |

|      |    |                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
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| L108 | 16 | "20130282135"<br>"20140025173"<br>"20140142711"<br>"20140194995"<br>"20140257499"<br>"20140277180"<br>"20140371863"<br>"20150094819"<br>"20150142122"<br>"20150150688"<br>"20150272741"<br>"20150305877"<br>"20160270922"<br>"20160287401"<br>"20160310285"<br>"20160324649"<br>"20170042690"<br>"20170172764"<br>"20180243102").pn. OR<br>("10357373").urpn.<br>AND (PGPB   USPT  <br>USOC).dbnm.<br>L25 AND nut AND<br>(fastener OR screw) | (US-PGPUB; USPAT;<br>USOCR; FIT (AP, AT,<br>AU, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, MC, MD, MY, NL,<br>NO, NZ, OA, PH, PL,<br>PT, RO, RS, RU, SE,<br>SG, SI, SK, SU, TH,<br>TN, TR, TW, UA, VN,<br>WO); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L109 | 20 | "2020023975"                                                                                                                                                                                                                                                                                                                                                                                                                                 | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L110 | 5  | "20200188121"                                                                                                                                                                                                                                                                                                                                                                                                                                | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,                                                                                                                                                                                                                                                                                                   | OR | ON | ON | 2023/06/29<br>06:45 PM |

|      |    |                  |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|------|----|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L111 | 4  | ("11166733").pn. | CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                           | OR | ON | ON | 2023/06/29 06:45 PM |
| L112 | 55 | "3777777"        | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:45 PM |
| L113 | 24 | "3598957"        | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:45 PM |

|      |    |                  |                                                                                                                                                                                                                                                                                                                                                                                    |    |    |    |                     |
|------|----|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L114 | 57 | "2601912"        | TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)<br>(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:45 PM |
| L115 | 5  | ("10034757").pn. | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                               | OR | ON | ON | 2023/06/29 06:45 PM |
| L116 | 2  | "20210236292"    | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                               | OR | ON | ON | 2023/06/29 06:45 PM |
| L117 | 17 | "2012109245"     | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA,                                                                                                                                                                                                                                                                                  | OR | ON | ON | 2023/06/29 06:45 PM |

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| L118 | 21 | "2019006205"    | EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L119 | 7  | ("9615839").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                                                                                     | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L120 | 8  | "2019173139"    | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                                                                                     | OR | ON | ON | 2023/06/29<br>06:45 PM |

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|------|----|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L121 | 2  | ("11564802").pn. | JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L122 | 16 | "2013148437"     | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                              | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L123 | 5  | "20210137693"    | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                              | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L124 | 62 | "2013085552"     | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,                                                                                                                                                                                                                            | OR | ON | ON | 2023/06/29<br>06:45 PM |

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|------|----|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L125 | 34 | "3090705"     | IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L126 | 21 | "2014138424"  | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                               | OR | ON | ON | 2023/06/29<br>06:45 PM |
| L127 | 6  | "20210077264" | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                                                                                                                                                               | OR | ON | ON | 2023/06/29<br>06:45 PM |



|      |    |                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L128 | 2  | ("11464645").pn.                                                                                                                                                                                                                                                                                                                                                                                                  | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:45 PM |
| L129 | 24 | "3332750"                                                                                                                                                                                                                                                                                                                                                                                                         | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:45 PM |
| L130 | 42 | ((US-20180078377-A1 OR US-20180071104-A1 OR US-20180161169-A1 OR US-20170202674-A1 OR US-20040064189-A1 OR US-20070179624-A1 OR US-20040030400-A1 OR US-20030060890-A1 OR US-20040199260-A1 OR US-20080294268-A1 OR US-20080009952-A1 OR US-20130090737-A1 OR US-20150025641-A1 OR US-20130150972-A1 OR US-20140142711-A1 OR US-20200188121-A1 OR US-20210236292-A1 OR US-20210137693-A1).did. AND PGPB.dbnm.) OR | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:45 PM |

|      |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L131 | 69 | ((US-10357373-B2 OR US-10258478-B2 OR US-10925745-B2 OR US-9283083-B2 OR US-9545312-B2 OR US-5702447-A OR US-11166733-B2 OR US-10034757-B2 OR US-9615839-B2 OR US-11564802-B2 OR US-9668873-B2 OR US-11464645-B2).did. AND USPT.dbnm.) OR ((WO-2018022227-A1 OR WO-2012096965-A1 OR WO-2018191420-A1 OR WO-2020023975-A1 OR EP-3777777-A2 OR EP-3598957-A1 OR EP-2601912-A1 OR WO-2012109245-A2 OR WO-2019006205-A1 OR WO-2013148437-A1 OR EP-3090705-A1 OR EP-3332750-A1).did. AND FTDB.dbnm.) |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|      |    | "2689750"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:45 PM |
| L132 | 67 | "1488764"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,                                        | OR | ON | ON | 2023/06/29 06:46 PM |

|      |   |                  |                                                                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|------|---|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L133 | 2 | ("8177786").pn.  | VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)<br>(US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2023/06/29<br>06:46 PM |
| L134 | 2 | ("8870962").pn.  | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                 | OR | ON | ON | 2023/06/29<br>06:46 PM |
| L135 | 4 | ("11259931").pn. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB)                                                 | OR | ON | ON | 2023/06/29<br>06:47 PM |
| L136 | 4 | "20140277520"    | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,                                                                                                                                                                                                                                                                          | OR | ON | ON | 2023/06/29<br>06:47 PM |

|      |    |               |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|------|----|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L137 | 4  | "20180243102" | HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)                                                                                                                           | OR | ON | ON | 2023/06/29 06:47 PM |
| L138 | 11 | "20140025173" | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2023/06/29 06:47 PM |

## PE2E SEARCH - Search History (Interference)

| Ref # | Hits | Search Query                                                                                    | DBs               | Default Operator | Plurals | British Equivalents | Time Stamp          |
|-------|------|-------------------------------------------------------------------------------------------------|-------------------|------------------|---------|---------------------|---------------------|
| N1    | 2    | (reverse AND shoulder AND baseplate AND channel AND screw AND locking AND nut AND glenoid).clm. | (US-PGPUB; USPAT) | OR               | ON      | ON                  | 2023/04/06 02:16 PM |
| N2    | 2    | (glenosphere AND reverse AND shoulder AND baseplate AND screw AND nut AND                       | (US-PGPUB; USPAT) | OR               | ON      | ON                  | 2023/04/06 02:16 PM |

|     |   |                                                                                                                                   |                   |    |    |    |                        |
|-----|---|-----------------------------------------------------------------------------------------------------------------------------------|-------------------|----|----|----|------------------------|
| N3  | 0 | glenoid).clm.<br>((spherical OR sphere)<br>AND reverse AND<br>shoulder AND<br>baseplate AND screw<br>AND nut AND<br>glenoid).clm. | (US-PGPUB; USPAT) | OR | ON | ON | 2023/04/06<br>02:17 PM |
| N4  | 2 | (baseplate AND reverse<br>AND shoulder AND<br>baseplate AND screw<br>AND nut AND<br>glenoid).clm.                                 | (US-PGPUB; USPAT) | OR | ON | ON | 2023/04/06<br>02:17 PM |
| N5  | 1 | (thread\$4 AND reverse<br>AND shoulder AND<br>baseplate AND screw<br>AND (washer OR nut)<br>AND glenoid).clm.                     | (US-PGPUB; USPAT) | OR | ON | ON | 2023/04/06<br>02:18 PM |
| N6  | 2 | (reverse AND shoulder<br>AND baseplate AND<br>channel AND screw<br>AND locking AND nut<br>AND glenoid).clm.                       | (US-PGPUB; USPAT) | OR | ON | ON | 2023/06/29<br>06:50 PM |
| N7  | 2 | (glenosphere AND<br>reverse AND shoulder<br>AND baseplate AND<br>screw AND nut AND<br>glenoid).clm.                               | (US-PGPUB; USPAT) | OR | ON | ON | 2023/06/29<br>06:50 PM |
| N8  | 0 | ((spherical OR sphere)<br>AND reverse AND<br>shoulder AND<br>baseplate AND screw<br>AND nut AND<br>glenoid).clm.                  | (US-PGPUB; USPAT) | OR | ON | ON | 2023/06/29<br>06:50 PM |
| N9  | 2 | (baseplate AND reverse<br>AND shoulder AND<br>baseplate AND screw<br>AND nut AND<br>glenoid).clm.                                 | (US-PGPUB; USPAT) | OR | ON | ON | 2023/06/29<br>06:50 PM |
| N10 | 1 | (thread\$4 AND reverse<br>AND shoulder AND<br>baseplate AND screw<br>AND (washer OR nut)<br>AND glenoid).clm.                     | (US-PGPUB; USPAT) | OR | ON | ON | 2023/06/29<br>06:50 PM |



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## BIB DATA SHEET

CONFIRMATION NO. 5500

| SERIAL NUMBER                                                                                                                                                                                                                                                                    | FILING or<br>371(c) DATE                                                                                          | CLASS                                                          | GROUP ART UNIT                    | ATTORNEY<br>DOCKET NO.                                                                                                                                                                                                                                                    |                               |                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|------------------------------------|
| 18/058,058                                                                                                                                                                                                                                                                       | 11/22/2022                                                                                                        | 623                                                            | 3774                              | SHOLD.013C1                                                                                                                                                                                                                                                               |                               |                                    |
| <b>RULE</b>                                                                                                                                                                                                                                                                      |                                                                                                                   |                                                                |                                   |                                                                                                                                                                                                                                                                           |                               |                                    |
| <b>APPLICANTS</b><br>SHOULDER INNOVATIONS, INC., Holland, MI;                                                                                                                                                                                                                    |                                                                                                                   |                                                                |                                   |                                                                                                                                                                                                                                                                           |                               |                                    |
| <b>INVENTORS</b><br>Donald E. Running, Missoula, MT;<br>Robert J. Ball, Holland, MI;<br>Jason Slone, Silver Lake, IN;                                                                                                                                                            |                                                                                                                   |                                                                |                                   |                                                                                                                                                                                                                                                                           |                               |                                    |
| <b>** CONTINUING DATA *****</b><br>This application is a CON of 17/435,333 08/31/2021<br>which is a 371 of PCT/US2020/022094 03/11/2020<br>which claims benefit of 62/816,708 03/11/2019                                                                                         |                                                                                                                   |                                                                |                                   |                                                                                                                                                                                                                                                                           |                               |                                    |
| <b>** FOREIGN APPLICATIONS *****</b>                                                                                                                                                                                                                                             |                                                                                                                   |                                                                |                                   |                                                                                                                                                                                                                                                                           |                               |                                    |
| <b>** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** ** SMALL ENTITY **</b><br>12/09/2022                                                                                                                                                                                        |                                                                                                                   |                                                                |                                   |                                                                                                                                                                                                                                                                           |                               |                                    |
| Foreign Priority claimed <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>35 USC 119(a-d) conditions met <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>Verified and Acknowledged <u>/Ann Schillinger/</u><br>Examiner's Signature |                                                                                                                   | <input type="checkbox"/> Met after Allowance<br>AS<br>Initials | <b>STATE OR<br/>COUNTRY</b><br>MT | <b>SHEETS<br/>DRAWINGS</b><br>21                                                                                                                                                                                                                                          | <b>TOTAL<br/>CLAIMS</b><br>16 | <b>INDEPENDENT<br/>CLAIMS</b><br>1 |
| <b>ADDRESS</b><br>KNOBBE MARTENS OLSON & BEAR LLP<br>2040 MAIN STREET<br>FOURTEENTH FLOOR<br>IRVINE, CA 92614<br>UNITED STATES                                                                                                                                                   |                                                                                                                   |                                                                |                                   |                                                                                                                                                                                                                                                                           |                               |                                    |
| <b>TITLE</b><br>TOTAL REVERSE SHOULDER SYSTEMS AND METHODS                                                                                                                                                                                                                       |                                                                                                                   |                                                                |                                   |                                                                                                                                                                                                                                                                           |                               |                                    |
| <b>FILING FEE<br/>RECEIVED</b><br>0.00                                                                                                                                                                                                                                           | FEES: Authority has been given in Paper<br>No. _____ to charge/credit DEPOSIT ACCOUNT<br>No. _____ for following: |                                                                |                                   | <input type="checkbox"/> All Fees<br><input type="checkbox"/> 1.16 Fees (Filing)<br><input type="checkbox"/> 1.17 Fees (Processing Ext. of time)<br><input type="checkbox"/> 1.18 Fees (Issue)<br><input type="checkbox"/> Other _____<br><input type="checkbox"/> Credit |                               |                                    |

TO: cassie.wolf@knobbe.com,efiling@knobbe.com  
FROM: noreply@uspto.gov  
CC: patentcenter\_eofficeaction@uspto.gov  
SUBJECT: USPTO: Patent Electronic System - Correspondence Notification for Customer Number 20995

Fri Jul 21 05:01:24 EDT 2023

Dear Patent Center Customer:

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| Application | Document | Mailroom Date | Attorney Docket No. |
|-------------|----------|---------------|---------------------|
| 18058058    | NOA      | 07/21/2023    | SHOLD.013C1         |
| 18058058    | 1449     | 07/21/2023    | SHOLD.013C1         |

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Sincerely,

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Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

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|                         |
|-------------------------|
| (Typed or printed name) |
| (Signature)             |
| (Date)                  |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 18/058,058      | 11/22/2022  | Donald E. Running    | SHOLD.013C1         | 5500             |

TITLE OF INVENTION: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | SMALL         | \$480         | \$0.00              | \$480.00             | \$0              | 10/23/2023 |

| EXAMINER           | ART UNIT | CLASS-SUBCLASS |
|--------------------|----------|----------------|
| SCHILLINGER, ANN M | 3774     | 623-019130     |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Knobb Martens  
2 Olson & Bear, LLP  
3

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE  
Shoulder Innovations, Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY)  
Grand Rapids, Michigan

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☐ Issue Fee ☐ Publication Fee (if required) (ISSUE FEE PREVIOUSLY PAID ON APRIL 20, 2023)

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

☐ Electronic Payment via Patent Center or EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 11-1410

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Andrew I. Kimmel/

Date August 29, 2023

Typed or printed name Andrew I. Kimmel

Registration No. 58,855





## ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #  
**18/058,058**

RECEIPT DATE / TIME  
**08/29/2023 07:24:03 PM ET**

ATTORNEY DOCKET #  
**SHOLD.013C1**

### Title of Invention

TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

### Application Information

APPLICATION TYPE Utility - Nonprovisional Application  
under 35 USC 111(a)

PATENT # -

CONFIRMATION # 5500

FILED BY Debbie Munson

PATENT CENTER # 62702194

FILING DATE 11/22/2022

CUSTOMER # 20995

FIRST NAMED  
INVENTOR Donald E. Running

CORRESPONDENCE  
ADDRESS -

AUTHORIZED BY Andrew Kimmel

### Documents

**TOTAL DOCUMENTS: 1**

| DOCUMENT                            | PAGES | DESCRIPTION                 | SIZE (KB) |
|-------------------------------------|-------|-----------------------------|-----------|
| SHOLD-013C1_ISSUEFEETRANSMITTAL.pdf | 1     | Issue Fee Payment (PTO-85B) | 1316 KB   |

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| DOCUMENT | MESSAGE DIGEST(SHA-512)                           |
|----------|---------------------------------------------------|
| SHOLD-   | 0BBD33B62FC60FF1E3A7A6D2B2D16C3024AE726101FB25D9A |

013C1\_ISSUEFEETRANSMITT  
AL.pdf

09B4D41C968B6BEC D7D56528C7337077A3A2D69212BCFD886  
E 63824F2D8B6EE9E74704BCFE1CC4D

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**New Applications Under 35 U.S.C. 111**

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

**New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



# United States Patent and Trademark Office

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Sale Accounting Date:08/30/2023

Sale Item Reference Number  
18058058

Effective Date  
08/29/2023

| Document Number  | Fee Code | Fee Code Description   | Amount Paid | Payment Method |
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| I20238TJ49287902 | 2501     | UTILITY APPL ISSUE FEE | \$480.00    | Salea          |



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www.uspto.gov

| APPLICATION NO. | ISSUE DATE | PATENT NO. | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|------------|------------|---------------------|------------------|
| 18/058,058      | 10/03/2023 | 11771561   | SHOLD.013C1         | 5500             |

20995 7590 09/13/2023  
KNOBBE MARTENS OLSON & BEAR LLP  
2040 MAIN STREET  
FOURTEENTH FLOOR  
IRVINE, CA 92614

## ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at <https://patentcenter.uspto.gov/>. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at <https://certifiedcopycenter.uspto.gov/index.html>. The Certified Copy Center may be reached at (800)972-6382.

### **Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)** (application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (<https://patentcenter.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

**INVENTOR(s)** (Please see PATENT CENTER site <https://patentcenter.uspto.gov> for additional inventors):

Donald E. Running, Missoula, MT;  
Robert J. Ball, Holland, MI;  
Jason Slone, Silver Lake, IN;

**APPLICANT(s)** (Please see PATENT CENTER site <https://patentcenter.uspto.gov> for additional applicants):

SHOULDER INNOVATIONS, INC., Holland, MI;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit [SelectUSA.gov](http://SelectUSA.gov).

TO: efiling@knobbe.com,cassie.wolf@knobbe.com  
FROM: noreply@uspto.gov  
CC: patentcenter\_eofficeaction@uspto.gov  
SUBJECT: USPTO: Patent Electronic System - Correspondence Notification for Customer Number 20995

Fri Sep 15 05:02:21 EDT 2023

Dear Patent Center Customer:

Correspondence Address:

KNOBBE MARTENS OLSON & BEAR LLP  
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FOURTEENTH FLOOR  
IRVINE, CALIFORNIA, 92614  
UNITED STATES

This is a courtesy notification regarding the following USPTO patent application(s) associated with your Customer Number, 20995, that have new outgoing correspondence. This correspondence is now available for viewing in Patent Center.

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| Application | Document  | Mailroom Date | Attorney Docket No. |
|-------------|-----------|---------------|---------------------|
| 18058058    | ISSUE.NTF | 09/13/2023    | SHOLD.013C1         |

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Sincerely,

The Patent Center Team

## PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

AUG 29 2023

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. Because electronic patent issuance may occur shortly after issue, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

## Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

|                         |
|-------------------------|
| (Typed or printed name) |
| (Signature)             |
| (Date)                  |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 18/058,058      | 11/22/2022  | Donald E. Running    | SHOLD.013C1         | 5500             |

TITLE OF INVENTION: TOTAL REVERSE SHOULDER SYSTEMS AND METHODS

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | SMALL         | \$480         | \$0.00              | \$480.00             | \$0              | 10/23/2023 |

| EXAMINER           | ART UNIT | CLASS-SUBCLASS |
|--------------------|----------|----------------|
| SCHILLINGER, ANN M | 3774     | 623-019130     |

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1 Knobbe Martens

2 Olson &amp; Bear, LLP

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3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

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(A) NAME OF ASSIGNEE

Shoulder Innovations, Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Grand Rapids, Michigan

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government4a. Fees submitted: ☐ Issue Fee ☐ Publication Fee (if required) (ISSUE FEE PREVIOUSLY PAID ON APRIL 20, 2023)

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Authorized Signature /Andrew I. Kimmel/

Date August 29, 2023

Typed or printed name Andrew I. Kimmel

Registration No. 58,855



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| APPLICATION NO.                                                                                                      | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.            | CONFIRMATION NO. |
|----------------------------------------------------------------------------------------------------------------------|-------------|----------------------|--------------------------------|------------------|
| 18/058,058                                                                                                           | 11/22/2022  | Donald E. Running    | SHOLD.013C1                    | 5500             |
| 20995 7590 10/03/2023<br>KNOBBE MARTENS OLSON & BEAR LLP<br>2040 MAIN STREET<br>FOURTEENTH FLOOR<br>IRVINE, CA 92614 |             |                      | EXAMINER<br>SCHILLINGER, ANN M |                  |
|                                                                                                                      |             |                      | ART UNIT                       | PAPER NUMBER     |
|                                                                                                                      |             |                      | 3774                           |                  |
|                                                                                                                      |             |                      | NOTIFICATION DATE              | DELIVERY MODE    |
|                                                                                                                      |             |                      | 10/03/2023                     | ELECTRONIC       |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

cassie.wolf@knobbe.com  
efiling@knobbe.com





## UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
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[www.uspto.gov](http://www.uspto.gov)

| APPLICATION NO. | ISSUE DATE  | PATENT NO. |
|-----------------|-------------|------------|
| 18/058,058      | 03-Oct-2023 | 11771561   |

KNOBBE MARTENS OLSON & BEAR LLP  
2040 MAIN STREET  
IRVINE, CA 92614

### EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at <https://patentcenter.uspto.gov>

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit <https://www.uspto.gov/electronicgrants>

TO: efiling@knobbe.com,cassie.wolf@knobbe.com  
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CC: patentcenter\_eofficeaction@uspto.gov  
SUBJECT: USPTO: Patent Electronic System - eGrant Notification for Customer Number 20995

Tue Oct 03 06:01:35 EDT 2023

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Correspondence Address:

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