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(54) Title: BALL AND CUP IMPACTORS FOR IMPLANTING A HIP PROSTHESIS

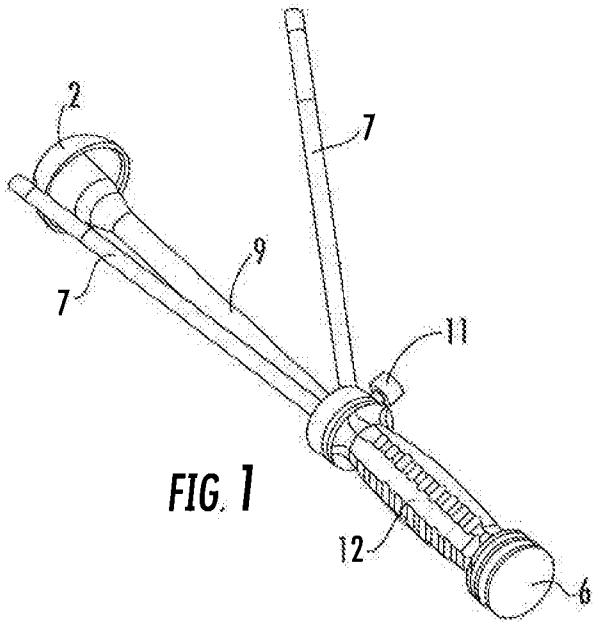

FIG. 1

(57) Abstract: New surgical instruments and methods used to implant elements of a reverse hip prosthesis in a patient are described. The instruments are impactors which are struck with a hammer at their proximal ends after the instrument has been used to position the implant element in the patient. An acetabular cup impactor has inclination and anteversion rods which are used to position the acetabular cup optimally in the acetabulum. An acetabular ball impactor affixes the acetabular ball in the acetabular cup by means of a Morse taper. And a femoral cup impactor affixes the femoral cup in the femoral stem by means of a Morse taper.

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BALL AND CUP IMPACTORS FOR IMPLANTING A HIP PROSTHESIS

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to surgical instruments used in connection with implanting a reverse hip prosthesis in a patient. More particularly, the invention has to do with impactors for implanting an acetabular cup, an acetabular ball and a femoral cup.

The Related Art

[0002] A reverse hip prosthesis is described in U.S. Patents Nos. 8,313,531 B2 and 8,540,779 B2. The prosthesis and a revision surgery method also are described in U.S. Patent No. 8,992,627 B2. The disclosures of these three patents are incorporated herein in their entireties by reference.

SUMMARY OF THE INVENTION

[0003] As described in the patents referenced above, the acetabular cup is affixed in the acetabulum by impacting it therein and then, if needed, affixing it further using screws. The acetabular ball is affixed by means of a Morse taper to a stem extending from the bottom of the concave surface of the acetabular cup and the femoral cup is affixed to the femoral implant (or femoral stem) by means of a Morse Taper. The surgical instruments of the invention, sometimes referred to herein as surgical tools, enable a surgeon to impact each of these components of the prosthesis with optimal placement of the acetabular cup and secure affixation of the acetabular ball and the femoral cup.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Fig. 1 is a perspective view of the acetabular cup impactor assembly of the invention.

[0005] Fig. 2 is an elevation view of the acetabular cup impactor assembly.

[0006] Fig. 3 is a section view of Fig. 2 illustrating a partial acetabular bone element.

[0007] Fig. 4 is an exploded view of the acetabular cup impactor assembly.

[0008] Fig. 5 is an elevation view of an acetabular cup handle for the acetabular cup impactor assembly.

[0009] Fig. 6 is an elevation view of an inner shaft for the acetabular cup impactor assembly.

[0010] Fig. 7 is an elevation view of an inclination-anteversion guide rod for the acetabular cup impactor assembly.

[0011] Fig. 8 is an elevation view of a collet for the acetabular cup impactor assembly.

[0012] Fig. 9 is an elevation view of a universal handle for the acetabular ball impactor assembly and the femoral cup impactor assembly.

[0013] Fig. 10 is a perspective view of an acetabular ball impactor assembly, acetabular ball and acetabular cup.

[0014] Fig. 11 is an elevation view of Fig. 10.

[0015] Fig. 12 is a section view of Fig. 11 with an added acetabular bone element.

[0016] Fig. 13 is an elevation view of an acetabular ball impactor.

[0017] Fig. 13A is a section view of the acetabular ball impactor of Fig. 13.

[0018] Fig. 14 is an elevation view of a femoral cup impactor assembly.

[0019] Fig. 15 is a perspective view of a femoral cup impactor.

[0020] Fig. 16 is a side elevation view of Fig. 15.

[0021] Fig. 17 is a top elevation view of Fig. 16.

[0022] Fig. 18 is a bottom elevation view of Fig. 16.

[0023] Fig. 19 is an elevation view of a femoral cup impactor assembly and a femoral cup positioned in a femoral implant, the femoral implant being illustrated in section.

[0024] Fig. 20 is a section view of Fig. 19.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] The impactors of the present invention are used to implant in a patient three elements of a reverse hip prosthesis. The elements are the acetabular cup, the acetabular ball and the femoral cup.

[0026] Following preparation of the acetabulum to receive the acetabular cup, the acetabular cup is positioned in the acetabulum and impacted therein using the acetabular cup impactor assembly 1 illustrated in Figs. 1-4. Elements of acetabular cup impactor assembly 1 are illustrated in Figs. 5-8.

Figs. 1-3 illustrate acetabular cup 2 in relation to the assembly 1 and Fig. 3 includes a portion of the acetabulum 3.

[0027] The acetabular cup impactor assembly 1 is comprised of acetabular cup handle 4, having a channel extending annularly along the length thereof, the channel being open at the proximal and distal ends of the handle 4, inner shaft 5 having a knob 6 at the proximal end thereof, inclination-anteversion guide rods 7 and collet 8. Guide rods 7 are threaded at their distal ends. The acetabular cup handle 4 has a handle shaft 9 and an inclination-anteversion guide collar 10 rotatably mounted on handle shaft 9. Inclination-anteversion guide collar 10, sometimes referred to herein as rotatable guide 10, has threaded holes (See Fig. 4.) designated as anteversion holes 15 and inclination hole 16. A rod 7 is threaded into hole 16 and one of holes 15, depending on whether the right or left hip is being replaced. Thumb screw 11 is tightened to prevent rotation of guide collar 10 when a rod 7 is optimally positioned during surgery. Handle element 12 is affixed proximally on shaft 9 and sleeve 13 is affixed to the distal end of shaft 9. The sleeve 13 has a tapered annular inner portion, the taper narrowing in the proximal direction, the tapered annular inner portion of the sleeve 13 being sized to cause a distal end of the collet 8 to contract when the collet 8 moves into the sleeve 13 in a proximal direction. Fig. 4 illustrates three collets 8, each being of a different size for different sizes of acetabular cups 2. Acetabular cup 2 has a stem 14 projecting from the bottom of the concave surface thereof. The size of the collet 8 refers to an annular inner portion thereof which is sized to releasably grip a proximal portion of the stem 14. The collet 8

grips the stem 14 when the collet 8 is contracted and releases the stem 14 when the collet 8 is open, i.e., not contracted.

[0028] In the surgical method of the invention, the acetabulum 3 is prepared to receive an appropriately sized acetabular cup 2 and a collet 8 sized for the cup is selected. Inner shaft 5 is inserted into the distal end of acetabular cup handle 4 and the collet 8 is then attached to the distal end of inner shaft 5. The collet 8 is then pushed over the stem 14 of acetabular cup 2 and the collet 8 is pulled into sleeve 13 so that the collet 8 firmly grips the stem 14. This causes shaft 5 to move proximally leaving a space between knob 6 and the proximal end of handle element 12. An inclination-anteversion guide rod 7 is threaded into hole 16 of inclination-anteversion guide collar 10, another inclination-anteversion guide rod 7 is threaded into a hole 15 (see Fig. 4), and the acetabular cup 2 is placed in acetabulum 3. Then the screw holes in cup 2 are aligned properly in the acetabulum for eventual fixation of the cup to the acetabulum using screws. The inclination-anteversion guide collar 10 is then rotated until the rods 7 are properly positioned and thumb screw 11 then is tightened. It should be noted that the guide rods are set at a 45 degree angle relative to the shaft 9 and at a 20 degree angle relative to one another. The surgeon sets the inclination using the rod threaded into hole 16 by keeping the rod parallel to the floor and pointing it toward the shoulder of the patient. If a left hip is being replaced it is pointed at the left shoulder and if a right hip is being replaced it is pointed at the right shoulder. When the inclination is set, the surgeon then sets the anteversion using the rod 7 threaded into a hole 15. Either hole 15 is used, depending on

whether the right hip or left hip is being replaced as will be apparent to those having ordinary skill in the art based on the disclosures herein. The anteversion rod creates 20 degrees of anteversion with the inclination rod by orienting the anteversion rod toward the same shoulder. The rods are used in this manner with a posterior surgical approach and this properly sets the orientation of the cup 2 at a compound angle of 45 degrees of inclination and 20 degrees of anteversion. The assembly is maintained in position by holding handle element 12 as the proximal end of knob 6 is struck with a hammer thereby impacting the acetabular cup in the acetabulum. Assembly 1 is then removed from the operating site.

[0029] An acetabular ball impactor assembly is illustrated in Figs 10-12 and the acetabular ball impactor 20 is illustrated in elevation in Fig. 13. The acetabular ball impactor assembly 13 is comprised of acetabular ball impactor 20 and universal handle 40. (See also Fig. 9). The universal handle 40 is comprised of shaft 41 having a threaded portion 42 at its distal end and a handle element 43 at its proximal end. The acetabular ball impactor 20 has a proximal end and a distal end. As illustrated in Fig. 13A, the proximal end of acetabular ball impactor 20 has threads 22 and the distal end has a concave surface portion 23. The concave surface portion being in the shape of a section of a sphere. The threaded portion 42 is threaded into the threads 22 of the acetabular ball impactor 20.

[0030] Acetabular ball impactor 20 is made in sizes compatible with differently sized acetabular balls 21. When a ball 21 is selected, it is placed over

stem 14 of acetabular cup 2. The appropriately sized acetabular ball impactor 20 is threaded onto the universal handle 40 and the concave surface of acetabular ball impactor 20 is placed over the ball, allowing the ball to be received therein. Appropriate sizing in this context means the concave surface portion of the acetabular ball impactor is sized to receive the acetabular ball. Thus the concave surface has the shape of a section of a sphere and a size the same as or approximately the same as the spherical size of the acetabular ball to be received therein. With the universal handle 40 held in a position wherein the central axis of the stem 14 and the central axis of the shaft 41 are in the same or approximately the same line (as illustrated in Figs. 11 and 12) the proximal end of handle element 43 is struck with a hammer to cause the acetabular ball 21 to be firmly affixed to stem 14 by means of the Morse taper.

[0031] A femoral cup impactor 30 is illustrated in Figs. 15-18. It is comprised of a convex surface portion, referred to herein as impactor tip 31, at its distal end and a threaded portion 32 at its proximal end. The convex surface portion is in the shape of a sphere. Threaded portion 32 is used to affix the impactor to universal handle 40. When the femoral cup impactor 30 is affixed to universal handle 40, the combination of elements is referred to herein as a femoral cup impactor assembly.

[0032] Figs. 19 and 20 further illustrate the femoral cup impactor, a femoral cup 50 and a femoral implant 51. The femoral cup 50 has a stem 52 which is sized to fit in a Morse taper relationship in recess 53 of femoral stem 51.

[0033] Femoral cup impactor 30 is made in sizes compatible with differently sized femoral cups 50. The femoral cup 50 has a concave surface portion in the shape of a section of a sphere sized to articulate on acetabular ball 21. When a femoral cup 50 is selected, the stem 52 is placed in recess 53. The appropriately sized acetabular cup impactor is threaded onto the universal handle 40 and the convex impactor tip 31 is placed into the concave portion of femoral cup 50. Appropriate sizing in this context means the convex surface of the femoral cup impactor is sized to be received in the concave surface portion of the femoral cup. Thus the convex surface has the shape of a section of a sphere and a size the same as or approximately the same as the concave surface portion of the femoral cup. Thus the convex surface has the shape of a section of a sphere and a size the same as or approximately the same as the concave surface portion of the femoral cup. With the universal handle 40 held in a position wherein the central axis of the stem 52 and the central axis of the shaft 41 are in the same or approximately the same line (as illustrated in Figs. 19 and 20) the proximal end of handle element 43 is struck with a hammer to cause the femoral cup 50 to be firmly affixed to femoral implant 51 by means of the Morse taper.

[0034] The surgical instruments of the invention may comprise a portion of surgical kits. The kits may contain one or more than one of the surgical instruments of the invention along with other surgical instruments and/or implants.

CLAIMS

1. A surgical instrument for impacting an acetabular cup in the acetabulum of a patient wherein the acetabular cup has a stem extending from the concave surface thereof, comprising

a handle having a proximal end and distal end, a sleeve disposed on the distal end concentric with the handle and an annular channel extending therethrough, the channel being open at the proximal and distal ends of the handle,

a shaft having a proximal end and a distal end and a knob affixed to the proximal end, the shaft being slidably disposed in the channel and a collet being removably affixed to the distal end of the shaft proximate the sleeve wherein the sleeve has a tapered annular inner portion, the taper narrowing in a proximal direction, the tapered annular inner portion of the sleeve being sized to cause a distal end of the collet to contract when the collet moves into the sleeve in a proximal direction,

a rotatable guide collar mounted externally on the handle and rotatable about the central axis of the handle, an inclination guide rod and an anteversion guide rod each having proximal ends affixed to the rotatable guide collar and extending outwardly therefrom at an angle relative to the central axis, and

a thumb screw threaded into the rotatable guide perpendicularly or approximately perpendicularly to the central axis wherein tightening of the thumb screw prevents movement of the rotatable guide.

2. The surgical instrument of claim 1 wherein the collet has a collet inner portion sized to releaseably grip a proximal portion of the stem, gripping the stem when the collet is contracted and releasing the stem when the collet is not contracted.

3. A kit containing the surgical instrument of claim 1.

4. A method of using the surgical instrument of claim 1 comprising attaching a stem extending from a concave portion of an acetabular cup to the collet by disposing the collet over the stem and causing the collet to enter the sleeve and contract, thereby firmly holding the stem, placing the acetabular cup in a prepared socket of an acetabulum and, with the use of the inclination-anteversion guide rods, optimally positioning the acetabular cup in the acetabulum; then striking the knob to impact the acetabular cup in the acetabulum and release the collet from the stem.

5. The method of claim 4 wherein the acetabular cup is optimally positioned by first setting the inclination using the inclination guide rod and then setting the anteversion using the anteversion guide rod.`

6. A surgical instrument for impacting an acetabular ball on a stem of an acetabular cup to cause the acetabular ball to be affixed to the stem by means of a Morse taper, the acetabular cup having been affixed to the acetabulum of a patient, comprising

a handle comprised of a shaft having a proximal end and a distal end, a threaded portion at the distal end and a handle element at the proximal end, and

an acetabular ball impactor having a proximal end and a distal end, threads disposed at the proximal end and a concave surface disposed at the distal end, the threads being sized to receive the threaded portion at the distal end of the shaft and the concave surface being sized to receive the acetabular ball.

7. A kit containing the surgical instrument of claim 6.

8. A method of using the surgical instrument of claim 6 comprising placing an acetabular ball onto the stem of an acetabular cup, positioning the concave surface of the acetabular ball impactor on the acetabular ball, holding the universal handle in a position wherein the central axis of the stem and the shaft are in the same or approximately the same line and then striking a proximal end of the handle element with a hammer.

9. A surgical instrument for impacting a femoral cup into a femoral implant to cause the femoral cup to be affixed to the femoral implant by means of a Morse taper, the femoral cup having a concave surface portion in the shape of a section of a sphere at the proximal end thereof and a stem extending distally therefrom and the femoral implant having an opening sized to receive the stem, the femoral implant having been implanted in the femur of a patient, comprising

a handle comprised of a shaft having a proximal end and a distal end, a threaded portion at the distal end and a handle element at the proximal end, and

a femoral cup impactor having a proximal end and a distal end, threads disposed at the proximal end and a convex surface potion in the shape

of a section of a sphere disposed at the distal end, the threads being sized to receive the threaded portion at the distal end of the shaft and the convex surface portion being sized to be received in the concave surface portion of the femoral cup.

10. A kit containing the surgical instrument of claim 9.

11. A method of using the surgical instrument of claim 9 comprising placing the stem of the femoral cup into the opening of the femoral implant, positioning the convex surface portion of the femoral cup impactor into the concave surface portion of the femoral cup, aligning the shaft with the femoral cup and then striking a proximal end of the handle element with a hammer.

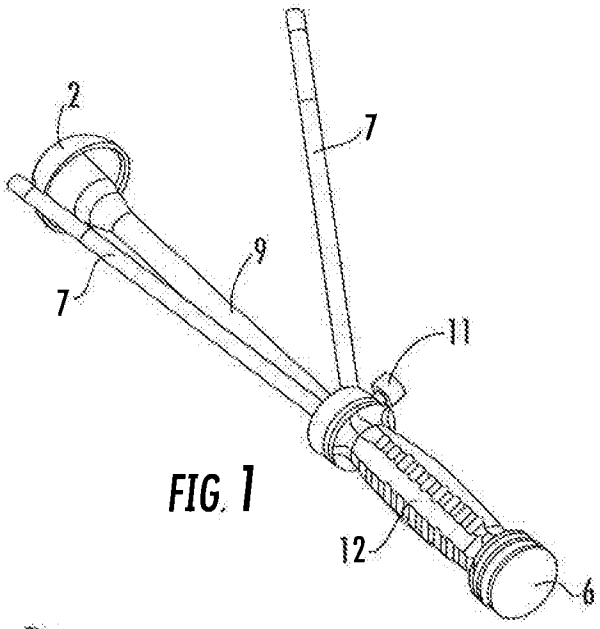


FIG. 1

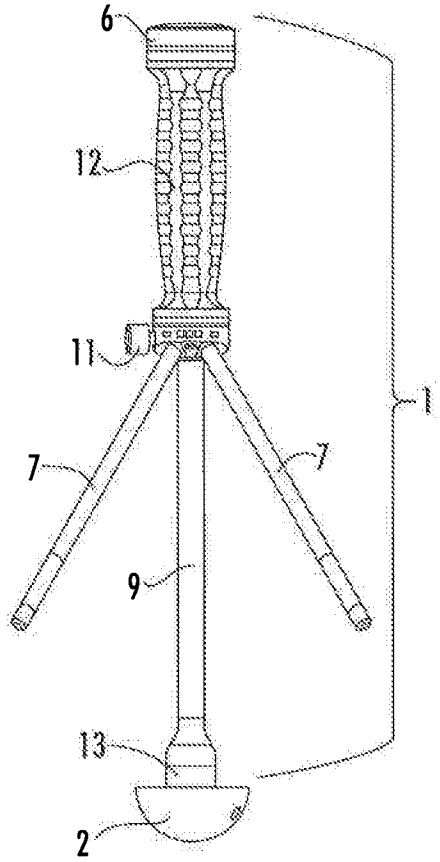
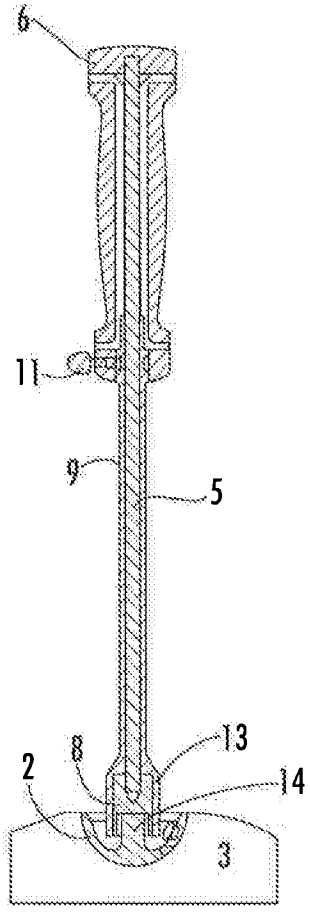


FIG. 2



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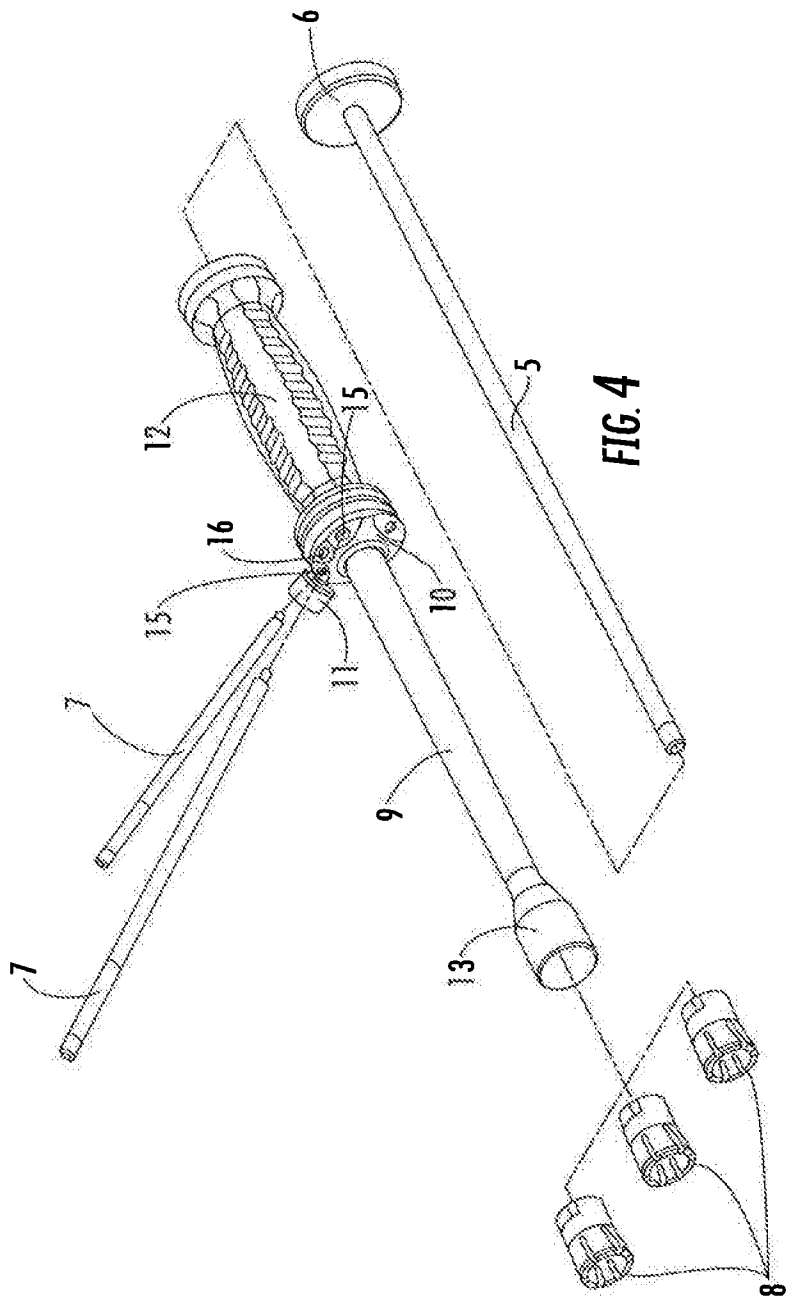

FIG. 4

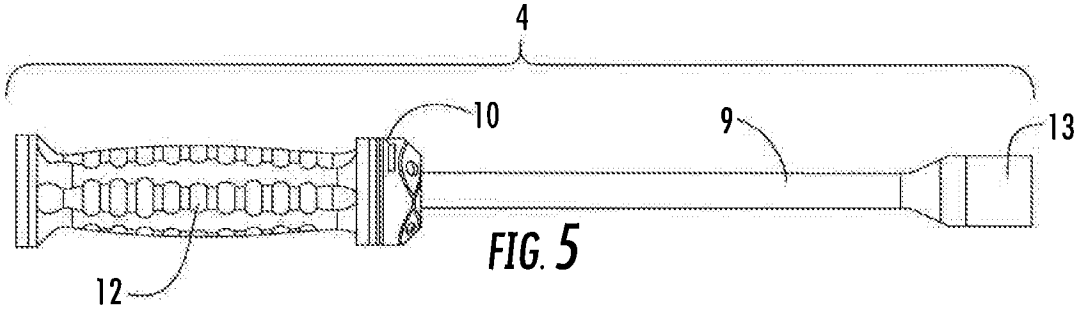

FIG. 5

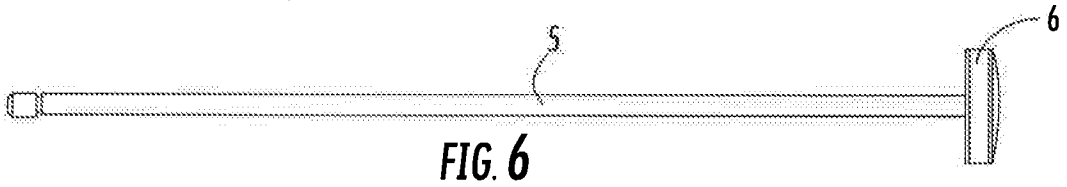

FIG. 6

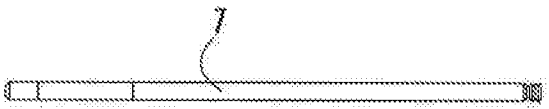

FIG. 7

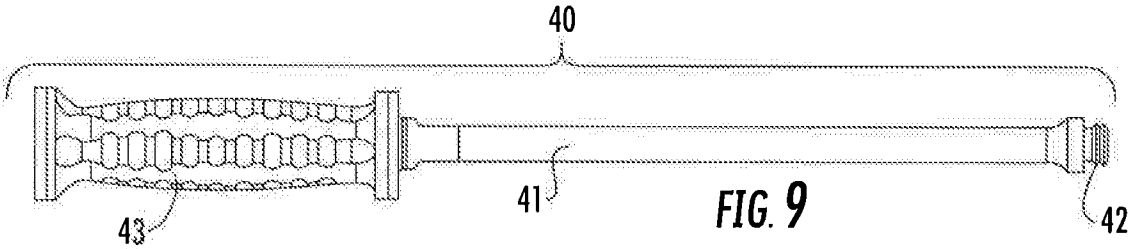

FIG. 9

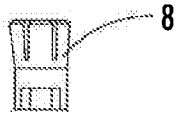

FIG. 8

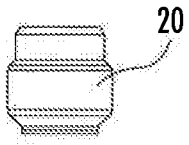

FIG. 13

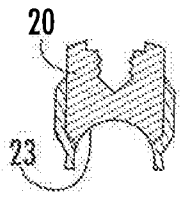

FIG. 13A

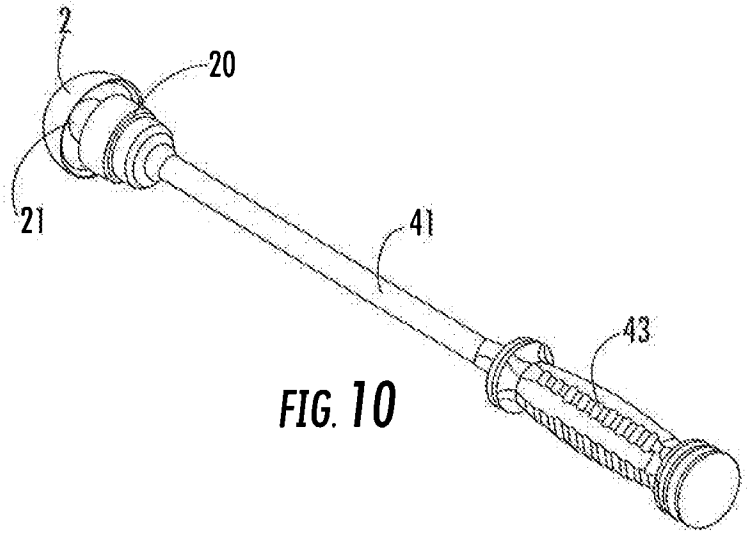

FIG. 10

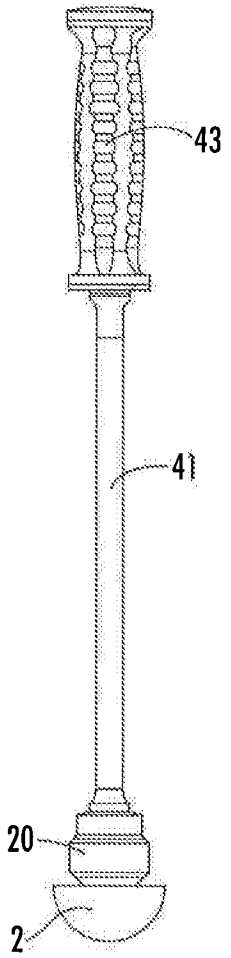

FIG. 11

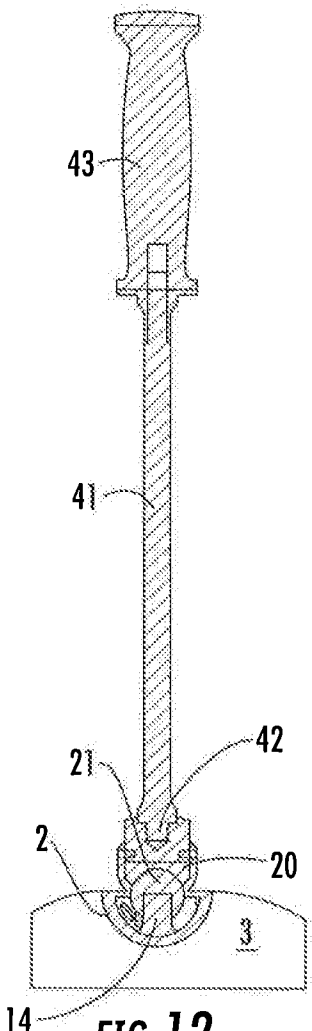

FIG. 12

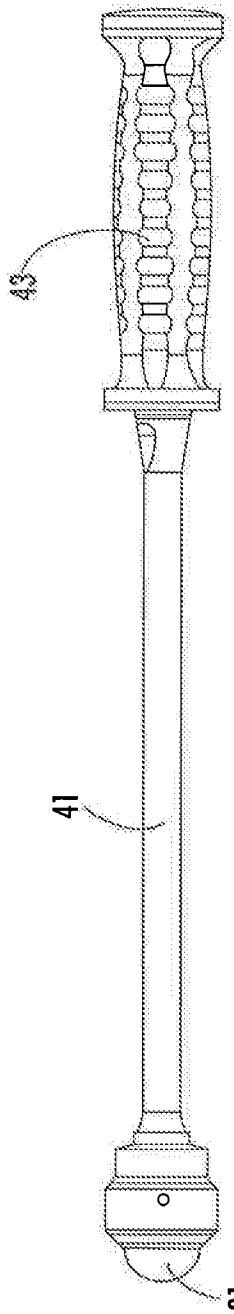

FIG. 14

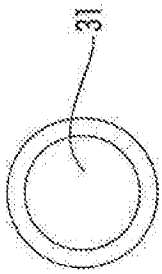

FIG. 18

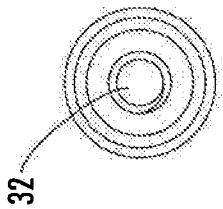

FIG. 17

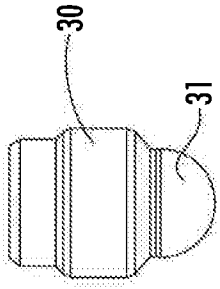

FIG. 16

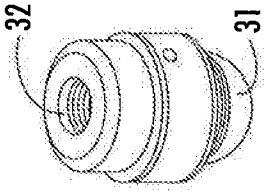

FIG. 15

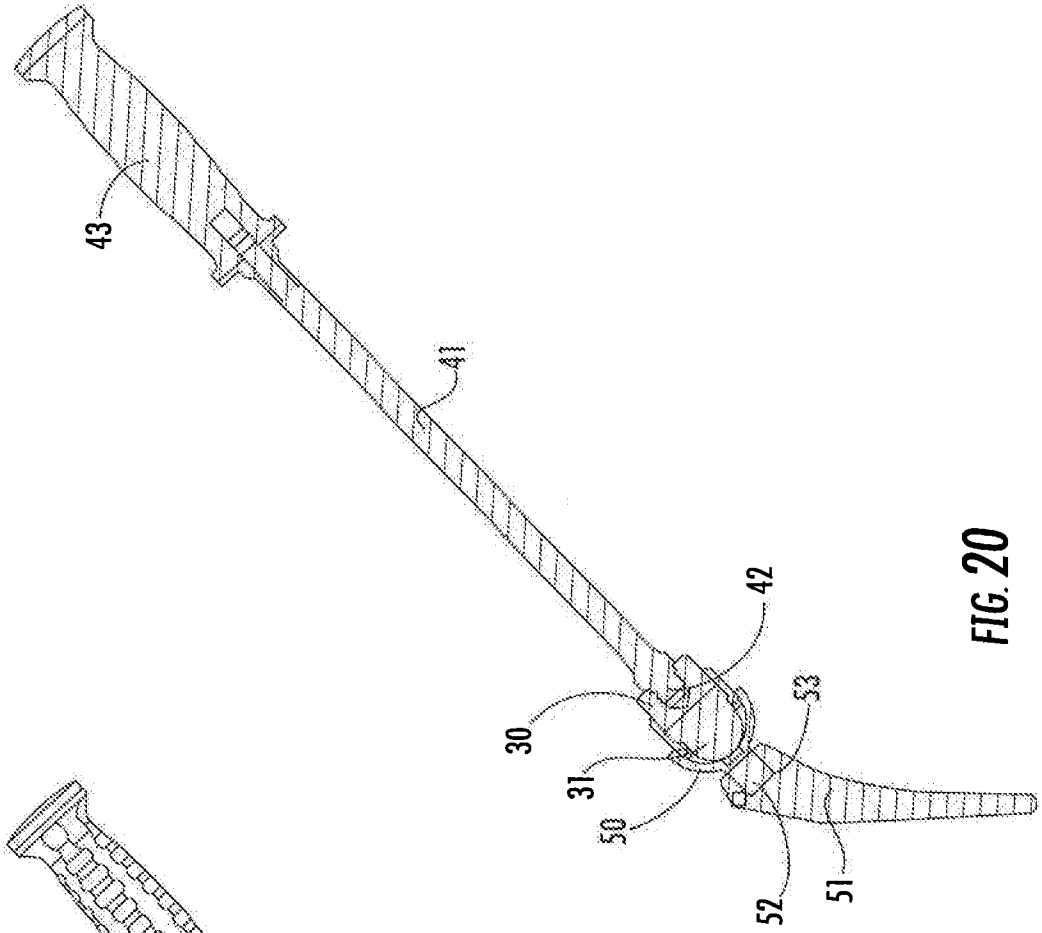

FIG. 20

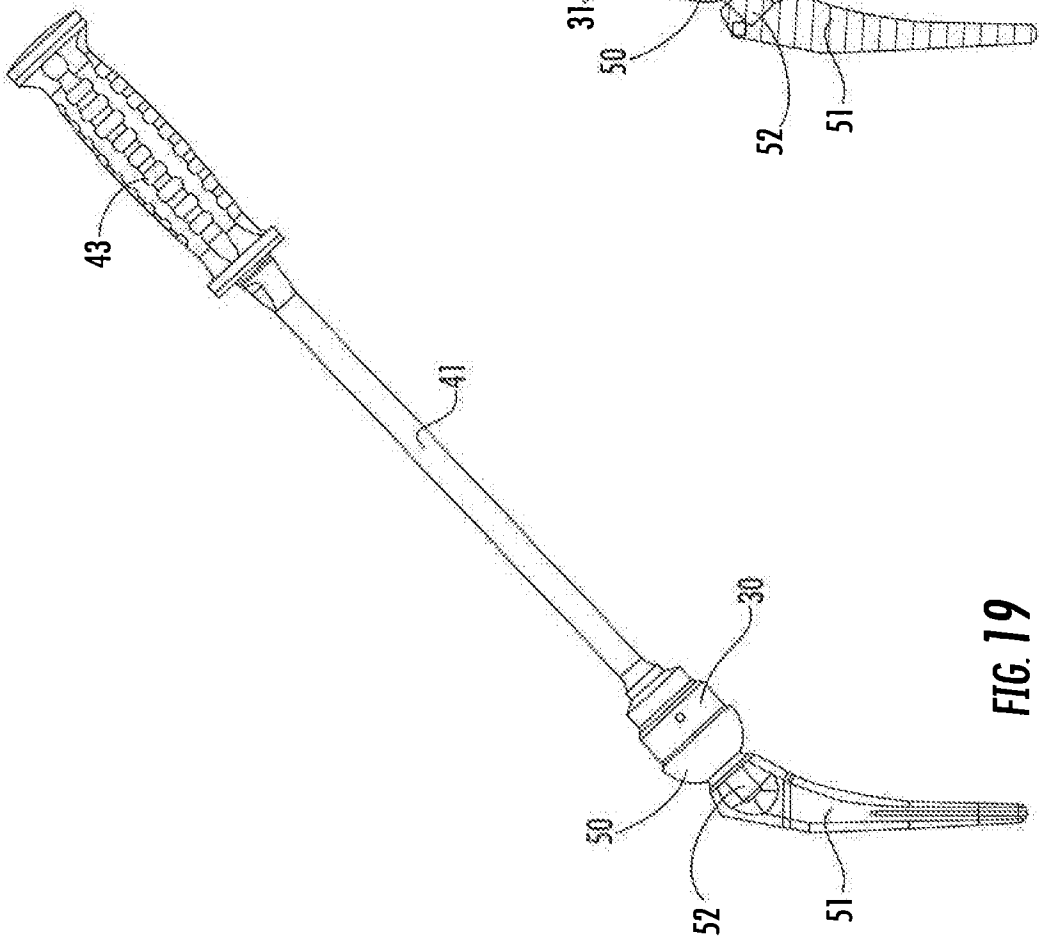

FIG. 19

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/042441

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61B 17/00; A61F 2/30; A61F 2/46 (2016.01)
CPC - A61B 17/1664; A61B 17/1666; A61F 2/4609; A61F 2002/4623 (2016.08)
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)
IPC - A61B 17/00; A61F 2/30; A61F 2/46
CPC - A61B 17/1664; A61B 17/1666; A61F 2/4609; A61F 2002/4623

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 606/91; 606/99; 623/22.12 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patents, Google Scholar
Search terms used: acetabular, concave, morse taper, impactor, stem, collar, sleeve, handle, collet, inclination, anteversion, guide rod, screw, knob, hip, prosthesis

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/0331849 A1 (SPLIETH et al) 12 December 2013 (12.12.2013) entire document	6, 7
X	US 2005/0085823 A1 (MURPHY) 21 April 2005 (21.04.2005) entire document	9, 10
A	US 2012/0184965 A1 (BURGI) 19 July 2012 (19.07.2012) entire document	1-11
A	US 2005/0228395 A1 (AUXEPAULES et al) 13 October 2005 (13.10.2005) entire document	1-11
A	US 2007/0293869 A1 (CONTE et al) 20 December 2007 (20.12.2007) entire document	1-11

☐ 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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 September 2016	13 OCT 2016
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774