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SURGICAL TRAYS, INSTRUMENTS AND METHODS FOR IMPLANTING A HIP REPLACEMENT PROSTHESIS

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Abstract

A trial acetabular cup for a reverse hip prosthesis.

SURGICAL TRAYS, INSTRUMENTS AND METHODS FOR IMPLANTING A HIP REPLACEMENT PROSTHESIS

BACKGROUND OF THE INVENTION

[0001] The present application is a divisional application from Australian patent application number 2016311057, the entire disclosure of which is incorporated herein by reference.

Field of the Invention

[0001a] The present invention relates to surgical instruments and methods used in connection with a reverse hip prosthesis. More particularly, the invention has to do with instrument trays, surgical tools, and trial implants used in hip replacement surgery.

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.

[0002a] A reference herein to a patent document or any other matter identified as prior art, is not to be taken as an admission that the document or other matter was known or that the information it contains was part of the common general knowledge as at the priority date of any of the claims.

[0002b] Where any or all of the terms "comprise", "comprises", "comprised" or "comprising" are used in this specification (including the claims) they are to be interpreted as specifying the presence of the stated features, integers, steps or components, but not precluding the presence of one or more other features, integers, steps or components.

SUMMARY OF THE INVENTION

[0002c] In a first aspect, the invention provides a combination of trial components for use in hip replacement surgery comprising:

at least one trial acetabular implant for sizing a reverse hip acetabular cup and an acetabular ball,

at least one trial femoral implant for sizing a femoral cup used with the reverse hip acetabular cup and acetabular ball.

[0002d] Described herein is trial acetabular cup for a reverse hip prosthesis comprising:

a cup having an outer surface adapted to fit in a prepared surface of an acetabular bone; and

an inner concave surface;

the outer and inner surfaces having optional through openings; and

the inner concave surface having a stem extending from the bottom thereof, the stem being internally threaded.

[0002e] Also described herein is a trial femoral cup for a reverse hip prosthesis comprising:

a cup having a concave surface adapted to articulate on an acetabular ball; and

a stem extending from an outer surface of the cup opposite the concave surface, the stem being adapted to be affixed to a proximal end of a broach or a proximal end of a femoral implant.

[0002f] Also described herein is a press for pressing a polymer liner into a femoral cup for a reverse hip prosthesis comprising a base having a bracket affixed thereon, the bracket being adapted to receive a shaft having a press bar at its proximal end and a cylinder at its distal end, the cylinder being adapted to press upon a plunger;

a femoral cup locator positioned on a base opposing the cylinder;

wherein a femoral cup having a concave surface positioned in the femoral cup locator with the concave surface in an upwardly directed position and a polymer liner having a concave portion positioned on the plunger and a convex portion positioned over the concave portion of the femoral cup such that when the plunger is pushed downwardly using the press bar to cause the cylinder to contact and press down upon the plunger, the liner is caused to snap into place in the femoral cup.

[0002g] Also described herein is a trial acetabular ball having a circumferential groove therein to provide a gripping surface for insertion or removal of the ball into or out of an acetabular cup or a trial acetabular cup.

[0002h] Also described herein is a tool for inserting or removing the trial acetabular ball of the fourth aspect, the tool comprising a handle at its proximal end proximate a ratcheting portion, grippers at its distal end and a hinge disposed between the proximal and distal ends; the grippers being adapted to grip the circumferential groove of the trial acetabular ball.

[0002i] Also described herein are surgical tray apparatus and components thereof for use in hip replacement surgery comprising:

a first set of trays including tools for preparation of a femur for implant surgery,

a second set of trays including tools for preparing an acetabulum for implant surgery,

a third set of trays including trial acetabular implants and tools for sizing, locating and implanting a reverse hip acetabular cup and an acetabular ball, and

a fourth set of trays including trial implants and tools for sizing and implanting a femoral cup for use with a reverse hip prosthesis.

[0003] As described in the patents referenced above, the reverse hip prosthesis generally comprises an acetabular ball affixed to a stem in an acetabular cup and a femoral cup affixed to a femoral stem wherein the femoral cup articulates on the acetabular ball. The surgical trays, tools, and methods of the invention enable a surgeon to identify the optimum components of the reverse hip prosthesis based on size and angles, for implantation in a patient using trial implants and specialized surgical tools. In the present disclosure we use the term "tools" from time to time to mean surgical tools.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Figs. 1 A and 1 B illustrate of a set of trays containing tools for preparing a femur for implant surgery.

[0005] Figs. 2A, 2B and 2C illustrate of a set of trays containing tools for preparing an acetabulum for implant surgery.

[0006] Figs. 3A, 3B and 3C illustrate of a set of trays containing trial implants and tools for sizing and implanting the acetabular cup and the acetabular ball.

[0007] Figs. 4A, 4B, and 4C illustrate of a set of trays containing trial implants and tools for sizing and implanting the femoral cup.

[0008] Figs. 5A, 5B, 5C, 5D and 5E include elevation, section and perspective views of a trial acetabular cup.

[0009] Figs. 6A, 6B, 6C and 6D include elevation, section and perspective views of a first trial acetabular ball for use with the trial acetabular cup.

[0010] Figs. 7A, 7B, 7C, 7D, 7E and 7F include elevation, section, detail and perspective views of a second trial acetabular ball for use with an implanted acetabular cup.

[0011] Figs. 8A, 8B, 8C, 8D and 8E include illustrate various views of the second trial acetabular ball, the type illustrated in Figs. 7A-F, and elevation and section views of said ball placed over the stem of an acetabular cup.

[0012] Figs. 9A, 9B and 9C illustrate in perspective and elevation a handle used to install and remove a trial acetabular cup and a section view of the handle threaded into the trial acetabular cup which is in a representative section of an acetabulum.

[0013] Figs. 10A, 10B, 10C, 10D, 10E and 10F include elevation, section, detail and perspective views of a first trial femoral cup.

[0014] Figs. 11 A, 11B, 11C, 11D, 11E and 11F include additional views of the first trial femoral cup, the type illustrated in Figs. 10A-F, and perspective and elevation views of said cup in a first femoral implant.

[0015] Figs. 12A, 12B, 12C, 12D, 12E and 12F illustrate elevation, section, detail and perspective views of a second trial femoral cup.

[0016] Figs. 3A, 13B, 3C, 13D, 13E, 13F and 3G illustrate additional views of the second trial femoral cup, the type illustrated in Figs. 12A-F, and perspective, elevation and section views of said cup in a second femoral implant.

[0017] Fig. 14 is a section view illustrating a first trial acetabular ball in a trial acetabular cup and a tool used to attach and remove said ball from said cup.

[0018] Fig. 15 is a section view illustrating a first trial femoral cup in an articulating position on a first trial acetabular ball.

[0019] Figs. 16A, 16B, 16C, 16D, 16E, 16F, 16G and 16H illustrate various views of a press assembly and components thereof, the press assembly being used to press a liner in a femoral cup.

[0020] Fig. 17 is an elevation view of the press assembly of Figs. 16A-H with a femoral cup therein.

[0021] Fig. 18 is a section view of Fig. 17.

[0022] Fig. 19 is a perspective view of an insertion-removal tool.

[0023] Fig. 20 is an elevation view of the tool of Fig. 19.

[0024] Fig. 21 is an elevation view of another embodiment of a trial acetabular ball adapted for use with the insertion-removal tool.

[0025] Fig. 22 is a perspective view illustrating the position of the tool of Figs. 19 and 20 when the tool is in contact with the trial acetabular ball of Fig. 21 to facilitate removal of the ball from an acetabular cup.

[0026] Fig. 23 is an elevation view of a conventional electric drill used in surgery.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] The tools used to prepare a femur for hip implant surgery are contained in a first set of steel trays 1 and 2 of Figs. 1A and 1B, respectively. Tray 1 contains a reamer 3, a right handed handle 4 and a left handed handle 5. Also included in tray 1 are a T-handle 6 and a box osteotome 7. After the femur has been prepared for surgery by cutting off the femoral head, the box osteotome 7 is used as a center punch to make an initial opening in the femur as a guide for correct positioning of the reamer 3. Then the T-handle 6, which is adapted for connection to the proximal end 3a of reamer 3, is affixed to the reamer and the surgeon places the distal end 3b of reamer 3 into the initial opening and turns the handle while applying pressure to create a pocket in the femur. The right and left handed handles, 4 and 5 respectively, are adapted for connection to the proximal end 3a of the reamer for rotating the reamer to make a deep pocket in the femur in preparation for use of the broaches 8 as explained below in connection with tray 2. The right handed handle 4 is used by a right handed surgeon and the left handed handle 5 is used by a left handed surgeon.

[0028] Tray 2 contains a set of two or more than two different sized broaches 8. The broaches have sizes ranging from 9mm (on the left hand side of Fig. 1 B) to 21 mm (on the right hand side of Fig. 1 B). In the drawing, each broach 8 going from left to right is 1 mm larger than the one to the left. As can be seen from the drawing, the broaches are tapered and the size of each broach refers to the maximum diameter at the top, the proximal end Ba, of the broach. The broach 8, also known as a rasp, is inserted into the deep pocket and pounded at the proximal end Ba, using hammer 9, into the femur. Handle 10 is threaded into the threaded recess 75a at or near the proximal end of the femoral implant 75 (see Fig. 13) and is used to implant the femoral implant into the femur.

[0029] The tools used to prepare an acetabulum for hip transplant surgery are contained in a second set of steel trays 11, 12 and 13 of Figs. 2A, 2B and 2C, respectively. Trays 11 and 12 cumulatively contain two or more than two (twenty-five being illustrated in Figs. 2A and 2B) different sized acetabular bone cutters 14 which are used to cut the acetabular bone to the appropriate size to receive a correspondingly sized acetabular cup. A drive shaft and a drive shaft handle are used to connect a drill 140 (see Fig. 23) to acetabular bone cutters 14. Tray 13 illustrates two different sized drive shafts 15 and two drive shaft handles16. The drive shaft has a distal end 15b adapted for connection to a bone cutter and a proximal end 15a adapted for connection to the distal end 16b of a drive shaft handle 16. The proximal end 16a of the drive shaft handle 16 is adapted for connection to chuck 141 of the drill 140.

[0030] Trial implants and tools for implanting an acetabular cup and an acetabular ball are contained in a third set of steel trays 21, 22 and 23 of Figs. 3A, 38 and 3C respectively.

[0031] Tray 21 contains a drill guide handle 24, two or more than two drill bits 25, two or more than two drill guides 26, two or more than two second trial acetabular balls 27 and a trial acetabular ball insertion-removal tool 28. Each drill bit 25 has a correspondingly sized drill guide.

[0032] Tray 22 contains two or more than two first trial acetabular balls 29, two or more than two trial acetabular cups 30 and a universal handle 31.

[0033] Tray 23 contains elements of an acetabular cup impactor assembly. This includes another universal handle 31, an acetabular cup handle 32, an inner shaft 33 having a knob 34 at the proximal end thereof, two anteversion guide rods 35, at least one and preferably three collets 38 and at least one and preferably three acetabular ball impactors 37. The inclination and anteversion guide 36 has a thumb screw (not shown) for maintaining the guide 36 in the appropriate position on the acetabular cup handle 32. This is described in detail in our co-pending international application No. PCT/US 16/42441 filed on July 15, 2016.

[0034] Trial implants and tools for implanting a femoral cup are contained in a fourth set of steel trays 41, 42, and 43, of Figs. 4A, 4B and 4C respectively.

[0035] Trays 41 and 42 only contain two or more than two first trial femoral cups 44. These first trial femoral cups 44 may vary in size, neck length and offset angle. They are preferably adapted to be temporarily affixed to the proximal end of a broach 8 from tray 2 before the broach is removed from the femur. Alternatively, they can be temporarily affixed to the proximal end of a femoral implant 49 as shown in Figs. 11E and 11F.

[0036] Tray 43 contains two or more than two second trial femoral cups 45 which are adapted to be temporarily affixed to the femoral implant 49. (See Figs. 11E and 11F.) The tray also contains a press 46, femoral cup locator 47 and plungers 48 and 48a for pressing a polymer liner into a femoral cup. (See also Figs. 16C, D, E and F.)

[0037] Turning more specifically to the various components contained in the trays discussed above, Figs. 5A - 5E illustrate various views of the trial acetabular cups 30. Fig. 5E is a perspective view of a trial acetabular cup. Fig. 5A is a side elevation view and Fig. 5D is a section view of Fig. 5A. Fig. 58 is a top elevation view and Fig. 5C is a bottom elevation view.

[0038] Trial acetabular cup 30 has an outer surface adapted to fit in a prepared surface of an acetabular bone and an inner concave surface. The outer surface preferably is a convex surface. A stem 50 with an internally threaded opening 51 extends from the bottom of the concave surface and the cup is characterized by

multiple optional through openings 52. The threaded opening 51 receives the threads of universal handle 31 which is used to install and remove the cup 30 from the acetabulum. (See Fig. 9C.) The threads of opening 51 also receive the first trial acetabular balls 29 which are illustrated in Figs. 6A-6D. The trial acetabular balls of the invention are hemispherical and may include flattened portions and bevels as described below. Fig. 6D is a perspective view of a trial acetabular ball 29, Fig. 6A is a side elevation view, Fig. 6B is a top elevation view and Fig. 6C is a section view. The threaded portion 60 is threaded into opening 51. A hexagonal opening 61 is illustrated in flattened portion 62a and accommodates tool 28 (see Fig. 3A) which is used to thread ball 29 into and out of cup 30. Optional beveled portion 62b is proximate to the threaded portion 60 and creates a beveled edge surrounding the base of the ball 29.

[0039] Figs. 7 and 8 have to do with a second trial acetabular ball 27.

[0040] Figs. 7A--7F illustrates various views of said ball 27. The ball 27 can be temporarily affixed to an implanted acetabular cup 70 (see Figs. 8D and 8E) in order to determine the optimum ball size for the prosthesis. Figs. 8A- 8C illustrate the second trial acetabular ball 27 in a different size.

[0041] Figs. 7F and 8C are perspective views of ball 27, Figs. 7 A and 8A are side elevation views of ball 27 and Figs. 78 and 88 are top elevation views. Fig. 7C is a bottom elevation view of ball 27 and Fig. 7D is a section view taken along section line 7D of Fig. 7A. A detail view of encircled portion 7E of Fig. 7D is shown in Fig. 7E.

[0042] Second trial acetabular ball 27 is comprised of a flattened top portion 62 which is used to imprint identifying size information. The ball 27 has an opening 63 which is sized to fit over the stem 71 of acetabular cup 70. A slot 64 is provided on the side of projection 65 to make it easier to place the ball on stem 71 and to remove it from the stem.

[0043] A universal handle 31 is illustrated in a side elevation view in Fig. 9B and a perspective view in Fig. 9A. Fig. 9C is a section view of universal handle 31 threaded into trial acetabular cup 30 which is in a representative portion of acetabular bone 80. Handle 31 is used to place trial cup 30 into acetabular bone 80.

[0044] Multiple views of a first trial femoral cup 44 are illustrated in Fig. 10. Fig.

11 illustrates more views of cup 44 as well as views of cup 44 in a femoral implant 49.

[0045] Three different perspective views of first trial femoral cup 44 are illustrated in Figs. 10F, 11A and 11C. Side elevation views of the cup 44 taken from different angles are illustrated in Figs. 10A, 11 B and 11D. Fig. 10B is a top elevation view, Fig. 10C is a bottom elevation view and Fig. 10D is a section view taken along section line 10D of Fig. 10A. Fig. 10E is a detail view taken from encircled portion 10E of Fig. 10D. Fig. 11F is a side elevation view of cup 44 affixed to implant 49 and Fig. 11E is a perspective view of cup 44 affixed to implant 49.

[0046] First trial femoral cup 44 has a base portion 90 in the form of a stem extending away from (i.e. opposite from) first concave portion 91. Included within base portion 90 is an opening 92 which receives the proximal end of a broach 8 or a stem of an implant 49. Slots 93 and 93a are provided to make it easier to place the cup on a broach or a stem and then remove it.

[0047] Second trial femoral cup 45 is illustrated in multiple views in Figs. 12A-F. Figs. 13A-G illustrate more views of cup 45 as well as views of cup 45 in femoral implant 75. Perspective views of cup 45 are illustrated in Figs.12F and 13D, side elevation views are illustrated in Figs. 12A and 13A, top elevation views are illustrated in Figs. 12B and 13C and bottom elevation views are illustrated in Figs. 12C and 13B. Fig. 12D is a section view taken along section line 12D of Fig. 12A and Fig. 12E is a detail view taken from encircled portion 12E of Fig. 12D. Fig. 13E is a perspective view of cup 45 in implant 75, Fig. 13G is a side elevation view of cup 45 in

implant 75 and Fig. 13F is a section view of Fig. 13G.

[0048] Second trial femoral cup 45 has a stem 95 which extends away from second concave portion 96 and which is adapted to be received within a femoral implant 75. An opening 97 in stem 95 works in coordination with slot 98 to facilitate attaching cup 45 to femoral implant 75 and removing it therefrom.

[0049] Fig. 14 illustrates in section the trial acetabular ball insertion-removal tool 28 inserted into the hexagonal opening of trial acetabular ball 29. This is the position of the tool relative to the ball for threading the ball into or out of trial acetabular cup 30, the cup 30 shown in the representative portion of acetabular bone 80.

[0050] A trial femoral cup 44 is shown in position on trial acetabular ball 29 in Fig. 15. The femoral cup 44 is attached to implant 49 and trial acetabular cup 30 is shown in acetabular bone 80.

[0051] The elements of a press 46 which is used to press a polymer liner into the femoral cup are illustrated in Fig. 16. A perspective view of press 46 is shown in Fig. 16A. Referring to Figs. 16A-16F and Figs. 17 and 18, the press is comprised of a base 101 having a bracket 102 affixed thereon. A press bar 103 is provided on shaft 104 and a cylinder 105 is provided at the distal end of shaft 104. The cylinder 105 contacts and presses upon an appropriately sized plunger 48. The femoral cup locator 47 having a femoral cup 110 therein is positioned on base 101. The concave portion of a polymer liner 111 is positioned on plunger 106 and the convex portion of liner 111 is positioned over the concave portion of femoral cup 110 as illustrated in section in Fig. 18. Then the plunger 48 is pushed downwardly using press bar 103 to cause cylinder 105 to contact and press downwardly upon the plunger while also holding stabilizing handle 108 until liner 111 snaps into place in the concave portion of femoral cup 110.

[0052] Insertion-removal tool 120 is illustrated in Figs. 19 and 20. The tool is similar to a hemostat in size and construction. The tool comprises handles 121 at its proximal end and a ratcheting portion 122. A hinge 123 is positioned to provide leverage and grippers 124 are disposed at the distal end. The portion of the tool located between the hinge 123 and grippers 124 may optionally be angled (for example at about 20°) (not shown).

[0053] In this application, the preferred use for the tool 120 is to remove a trial acetabular ball 27a from an acetabular cup 70. Fig. 22 illustrates the tool 120 positioned on ball 27a for this purpose. The ball 27a has all of the same features as ball 27 described above with the added feature of indent 130 in the form of a circumferential groove which is provided to allow gripping the ball and pulling it off of the stem 71 (see Fig. BE) of acetabular cup 70.

EMBODIMENTS OF THE INVENTION

In one embodiment, the invention provides a surgical tray apparatus and components thereof for use in hip replacement surgery comprising:

a first set of trays including tools for preparation of a femur for implant surgery,

a second set of trays including tools for preparing an acetabulum for implant surgery,

a third set of trays including trial implants and tools for sizing, locating and implanting a reverse hip acetabular cup and an acetabular ball, and

a fourth set of trays including trial implants and tools for sizing and implanting a femoral cup for use with a reverse hip prosthesis.

Preferably, wherein the tools of the apparatus in the first set of trays comprise:

a reamer having a distal end for insertion into a femur and a proximal end;

a right handed handle and a left handed handle adapted for connection to the proximal end of the reamer;

a T-handle adapted for connection to the proximal end of the reamer;

a box osteotome;

two or more than two broaches each being sized to make a correspondingly sized opening in the femur;

a hammer for pounding a broach into the femur; and

a handle having a threaded portion adapted to be threaded into a proximal end of a femoral implant.

Preferably, the tools of the apparatus in the second set of trays comprise:

two or more than two different sized acetabular bone cutters;

a drive shaft having a distal end adapted for connection to a bone cutter;

a drive shaft handle adapted for connection to a proximal end of the drive shaft.

Preferably, a distal end of the drive shaft handle is adapted for connection to the drive shaft and a proximal end of the drive shaft handle is adapted for connection to a drill.

Preferably, the tools in the apparatus in the third set of trays comprise:

a drill guide handle;

two or more than two drill bits;

two or more than two drill guides;

two or more than two second trial acetabular balls;

a trial acetabular ball insertion-removal tool;

two or more than two first trial acetabular balls;

two or more than two trial acetabular cups;

elements of an acetabular cup impactor assembly comprising another universal handle;

an acetabular cup handle;

an inner shaft having a knob at a proximal end thereof;

two anteversion guide rods;

a collet; and

an acetabular ball impactor.

Preferably, the tools in the fourth set of trays comprise:

two or more than two first trial femoral cups adapted to be temporarily affixed to the proximal end of a broach or a femoral implant;

two or more than two second trial femoral cups which are adapted to be temporarily affixed to the femoral implant; and

a press, a femoral cup locator and a plunger for pressing a polymer liner into a femoral cup.

In one embodiment, the invention provides a trial acetabular cup for a reverse hip prosthesis comprising:

a cup having an outer surface adapted to fit in a prepared surface of an acetabular bone; and

an inner concave surface;

the outer and inner surfaces having optional through openings; and

the inner concave surface having a stem extending from the bottom thereof, the stem being internally threaded.

Preferably, the outer surface is convex.

In one embodiment, the invention provides a trial acetabular ball for a reverse hip

prosthesis comprising:

a hemispherical ball having a stem extending therefrom and a flattened portion on the ball surface opposite the stem.

Preferably, the stem is externally threaded.

Preferably, the stem comprises an opening sized to receive a stem of an acetabular cup.

Preferably, the ball of one embodiment further comprises an opening centered in the flattened portion, the opening being sized and shaped to receive a tool for tightening and loosening the ball when the threaded portion is threaded into an internally threaded stem of a trial acetabular cup.

In one embodiment, the invention provides a trial femoral cup for a reverse hip prosthesis comprising:

a cup having a concave surface adapted to articulate on an acetabular ball; and

a stem extending from an outer surface of the cup opposite the concave surface, the stem being adapted to be affixed to a proximal end of a broach or a proximal end of a femoral implant.

Preferably, the stem of the cup is adapted to receive a proximal end of a broach or a proximal end of a femoral implant.

Preferably, the stem of the cup is adapted to be received within a proximal end of a femoral implant.

In one embodiment, the invention provides a press for pressing a polymer liner into a femoral cup for a reverse hip prosthesis comprising a base having a bracket affixed thereon, the bracket being adapted to receive a shaft having a press bar at its proximal end and a cylinder at its distal end, the cylinder being adapted to press upon a plunger;

a femoral cup locator positioned on a base opposing the cylinder;

wherein a femoral cup having a concave surface positioned in the femoral cup locator with the concave surface in an upwardly directed position and a polymer liner having a concave portion positioned on the plunger and a convex portion positioned over the concave portion of the femoral cup such that when the plunger is pushed

downwardly using the press bar to cause the cylinder to contact and press down upon the plunger, the liner is caused to snap into place in the femoral cup.

In one embodiment, the invention provides a trial acetabular ball having a circumferential groove therein to provide a gripping surface for insertion or removal of the ball into or out of an acetabular cup or a trial acetabular cup.

In one embodiment, the invention provides a tool for inserting or removing the trial acetabular ball one embodiment, the tool comprising a handle at its proximal end proximate a ratcheting portion, grippers at its distal end and a hinge disposed between the proximal and distal ends; the grippers being adapted to grip the circumferential groove of the trial acetabular ball.

In one embodiment, the invention provides a surgical method using the tools and trial implants from the surgical trays and components of embodiment comprising:

preparing the femur using the tools for preparation of a femur and preparing an acetabulum using the tools for preparing an acetabulum;

then placing the trial acetabular cup and trial acetabular ball in the acetabulum and the trial femoral implants in the femur and repeating this process until proper sizing of the implants is identified; and

then removing the trial implants and implanting the properly sized permanent implants.

Preferably in one embodiment a drill guide is used to drill the acetabulum to accommodate screws to affix the permanent acetabular cup to the acetabulum.

In one embodiment, the invention provides a trial acetabular cup for a reverse hip prosthesis comprising:

a cup having an outer surface adapted to fit in a prepared surface of an acetabular bone; and

an inner concave surface;

the outer and inner surfaces having optional through openings; and

the inner concave surface having a stem extending from the bottom thereof, the stem being internally threaded.

Preferably the outer surface of the cup is convex.

In one embodiment, the invention provides a trial acetabular ball for a reverse hip prosthesis comprising:

a hemispherical ball having a stem extending therefrom and a flattened portion on the ball surface opposite the stem.

Preferably, the stem of the ball is externally threaded.

Preferably, the stem of the ball comprises an opening sized to receive a stem of an acetabular cup.

Preferably, the ball further comprises an opening centered in the flattened portion, the opening being sized and shaped to receive a tool for tightening and loosening the ball when the threaded portion is threaded into an internally threaded stem of a trial acetabular cup.

In one embodiment, the invention provides a trial femoral cup for a reverse hip prosthesis comprising:

a cup having a concave surface adapted to articulate on an acetabular ball; and

a stem extending from an outer surface of the cup opposite the concave surface, the stem being adapted to be affixed to a proximal end of a broach or a proximal end of a femoral implant.

Preferably, the stem of the cup is adapted to receive a proximal end of a broach or a proximal end of a femoral implant.

Preferably, the stem of the cup is adapted to be received within a proximal end of a femoral implant.

In one embodiment, the invention provides a press for pressing a polymer liner into a femoral cup for a reverse hip prosthesis comprising a base having a bracket affixed thereon, the bracket being adapted to receive a shaft having a press bar at its proximal end and a cylinder at its distal end, the cylinder being adapted to press upon a plunger;

a femoral cup locator positioned on a base opposing the cylinder;

wherein a femoral cup having a concave surface positioned in the femoral cup locator with the concave surface in an upwardly directed position and a polymer liner having a concave portion positioned on the plunger and a convex portion positioned

over the concave portion of the femoral cup such that when the plunger is pushed downwardly using the press bar to cause the cylinder to contact and press down upon the plunger, the liner is caused to snap into place in the femoral cup.

In one embodiment, the invention provides a trial acetabular ball having a circumferential groove therein to provide a gripping surface for insertion or removal of the ball into or out of an acetabular cup or a trial acetabular cup.

In one embodiment, the invention provides a tool for inserting or removing the trial acetabular ball of the invention, the tool comprising a handle at its proximal end proximate a ratcheting portion, grippers at its distal end and a hinge disposed between the proximal and distal ends; the grippers being adapted to grip the circumferential groove of the trial acetabular ball.

Claims

1. A combination of trial components for use in hip replacement surgery comprising:

at least one trial acetabular implant for sizing a reverse hip acetabular cup and an acetabular ball,

at least one trial femoral implant for sizing a femoral cup used with the reverse hip acetabular cup and acetabular ball.

2. The combination of trial components of claim 1 wherein:

the at least one trial acetabular implant includes a trial acetabular cup having

a cup having an outer convex surface adapted to fit in a prepared surface of an acetabular bone; and an inner concave surface and an internally threaded integral stem extending within the cup from a base;

the outer and inner surfaces having an optional through opening;

the integral stem being internally threaded, and having an end opposite the base, wherein the entirety of the integral stem is within the cup, and further,

the integral stem is affixable to a part of a hemispherical trial acetabular ball having a stem extending therefrom, the stem having a threaded portion, which threaded portion is engaged with the threads of the integral stem when the trial acetabular ball is mounted to the trial acetabular cup.

3. The combination of trial components according to claim 2 wherein:

the combination comprises at least two differently sized hemispherical trial acetabular balls each of which is removably mountable to the integral stem.

4. The combination of trial components according to claim 2 or 3, wherein the hemispherical trial acetabular ball includes a threaded stem extending therefrom, having threads engageable with the internal threads of the integral stem of the trial acetabular cup, and a flattened portion on the ball surface opposite the stem.

5. The combination of trial components according to claim 4, wherein the flattened

portion comprises an opening centered in the flattened portion, the opening being sized and shaped to receive a tool for tightening and loosening the trial acetabular ball when the threaded portion is threaded into an internally threaded stem of a trial acetabular cup.

6. The combination of trial components according to any one of claims 2 – 5, wherein the

trial acetabular ball has a circumferential groove therein to provide a gripping surface for insertion or removal of the trial acetabular ball into or out of the trial acetabular cup.

7. The combination of trial components according to claim 6, which further comprises:

a tool for inserting or removing the trial acetabular ball, the tool comprising a handle at its proximal end proximate a ratcheting portion, grippers at its distal end and a hinge disposed between the proximal and distal ends; the grippers being adapted to grip the circumferential groove of the trial acetabular ball.

8. The combination of trial components according to any one of claims 1 – 7, wherein:

the at least one trial femoral implant includes a trial femoral cup having,

a cup having a concave surface adapted to articulate on a hemispherical trial acetabular ball; and

a stem extending from an outer surface of the cup opposite the concave surface, the stem being adapted to be affixed to a proximal end of a broach or a proximal end of a femoral implant.

9. The combination of trial components according to claim 8, wherein the cup, when articulating on the hemispherical trial acetabular ball, enters the interior of the trial acetabular cup in the region between the integral stem and the inner concave surface thereof.

10. The combination of trial components according to any one of claims 1 – 9, which

further comprises:

a press for pressing a polymer liner into a femoral cup for a reverse hip prosthesis comprising a base having a bracket affixed thereon, the bracket being adapted to receive a shaft having a press bar at its proximal end and a cylinder at its distal end, the cylinder being adapted to press upon a plunger;

a femoral cup locator positioned on a base opposing the cylinder;

wherein a femoral cup having a concave surface positioned in the femoral cup locator with the concave surface in an upwardly directed position and a polymer liner having a concave portion positioned on the plunger and a convex portion positioned over the concave portion of the femoral cup such that when the plunger is pushed downwardly using the press bar to cause the cylinder to contact and press down upon the plunger, the liner is caused to snap into place in the femoral cup.

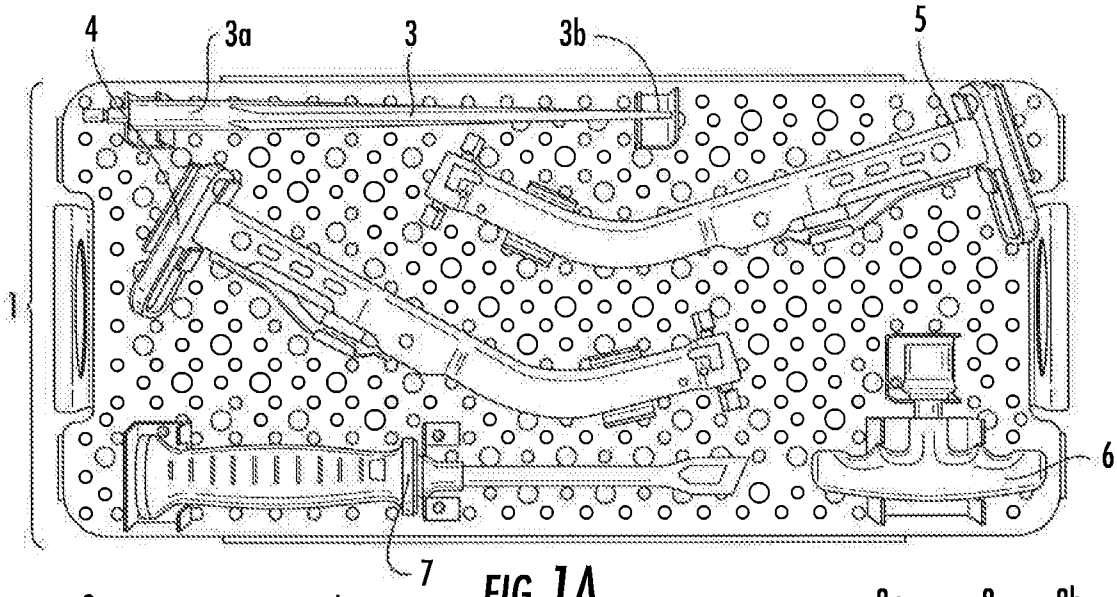

FIG. 1A

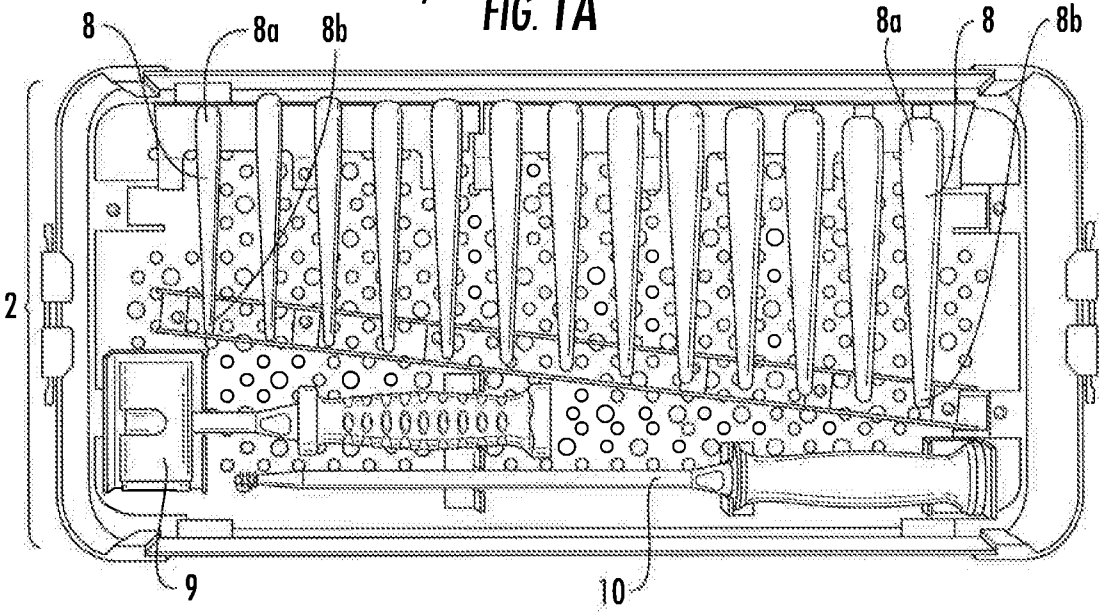

FIG. 1B

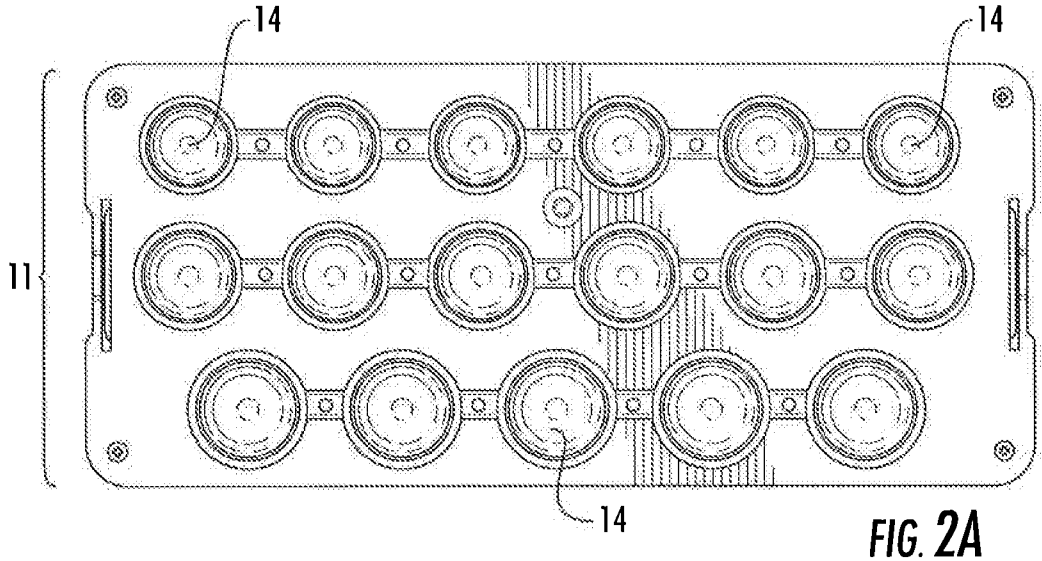

FIG. 2A

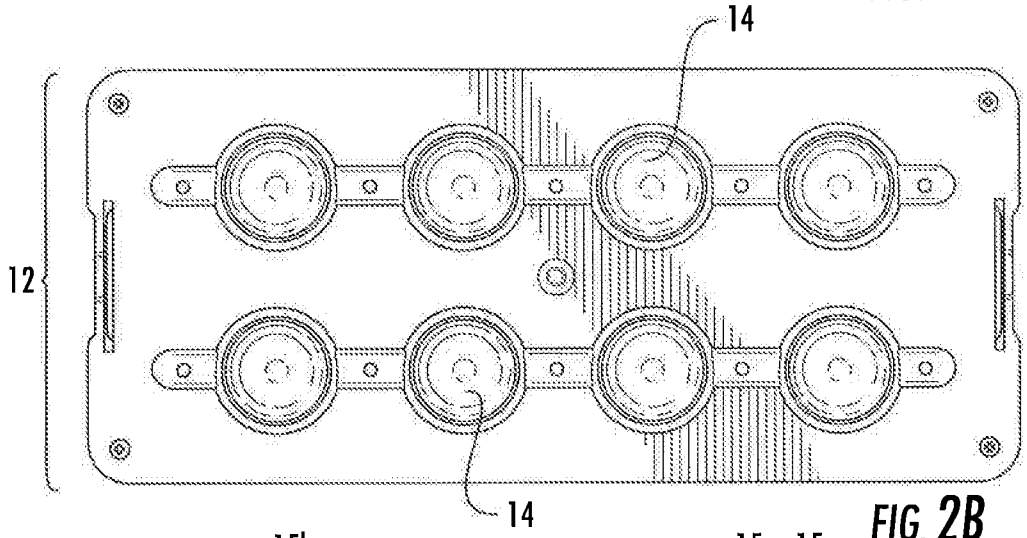

FIG. 2B

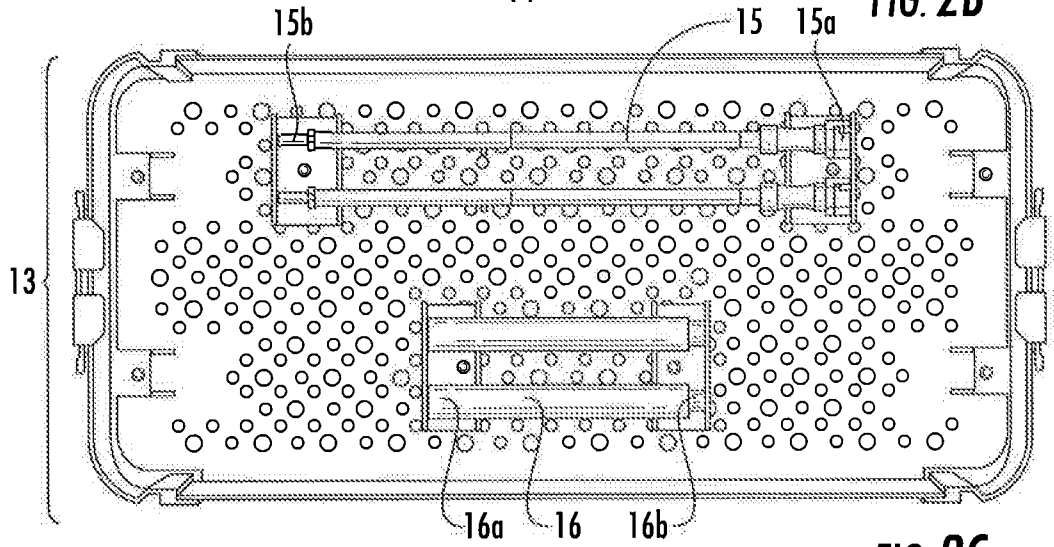

FIG. 2C

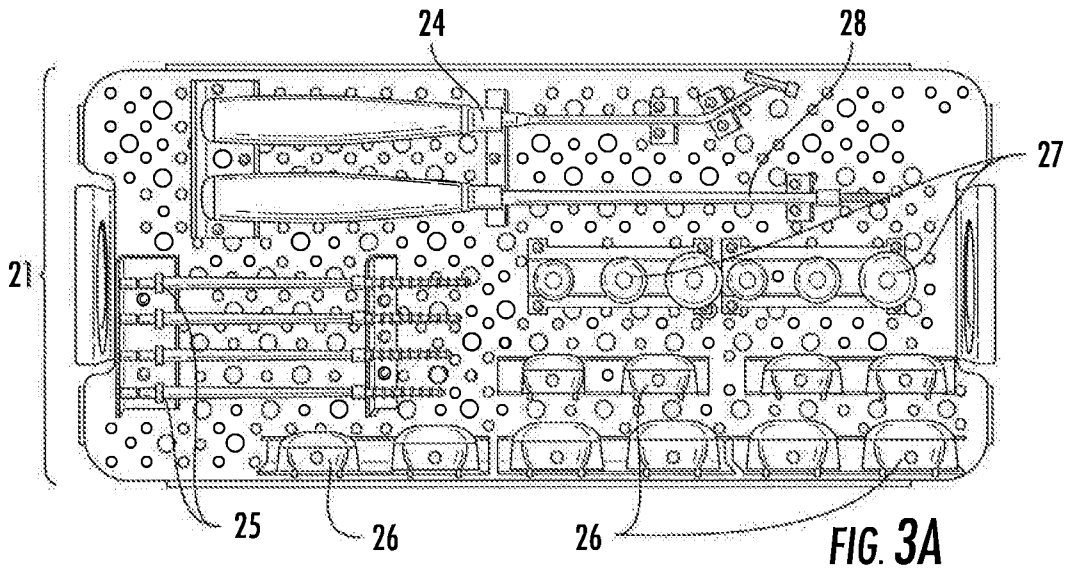

FIG. 3A

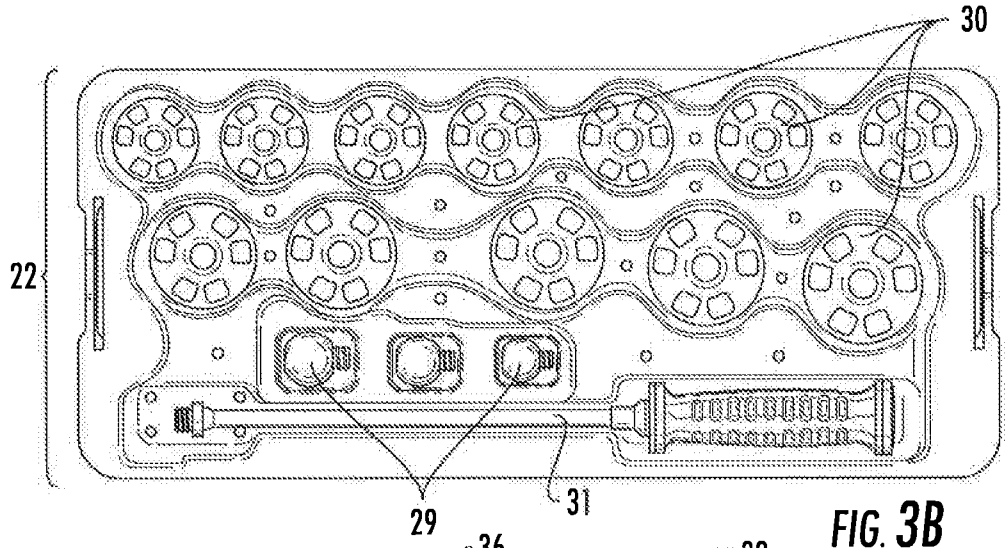

FIG. 3B

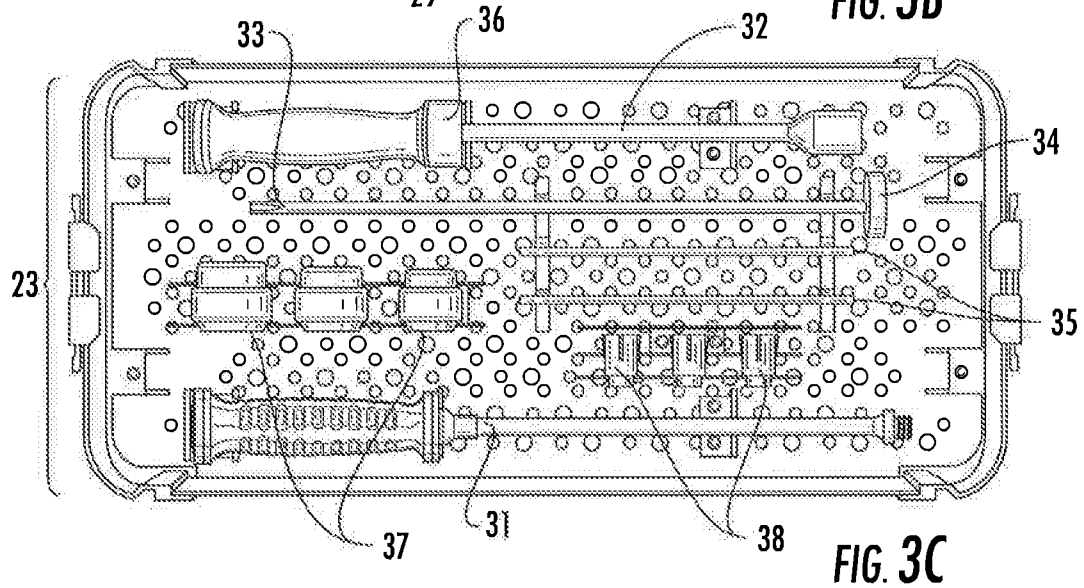

FIG. 3C

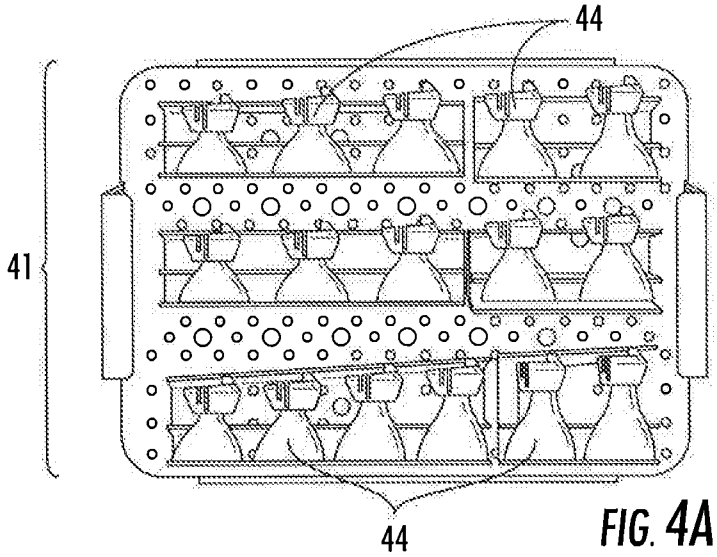

FIG. 4A

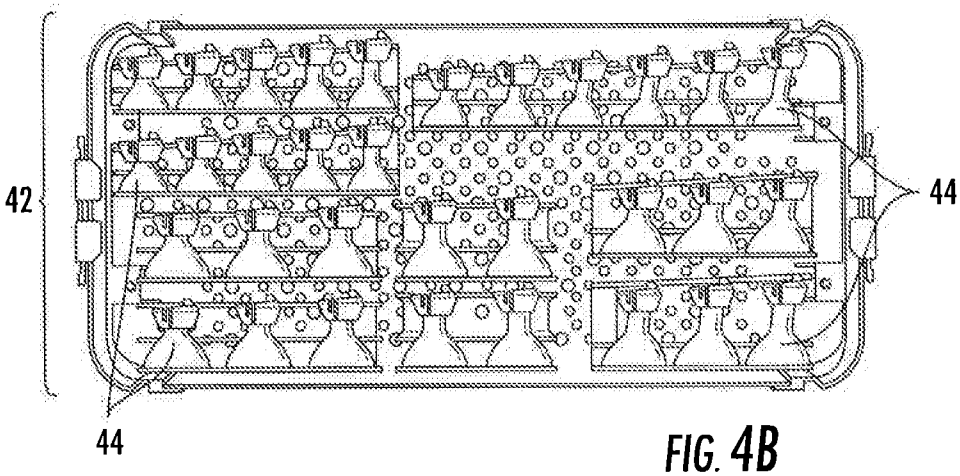

FIG. 4B

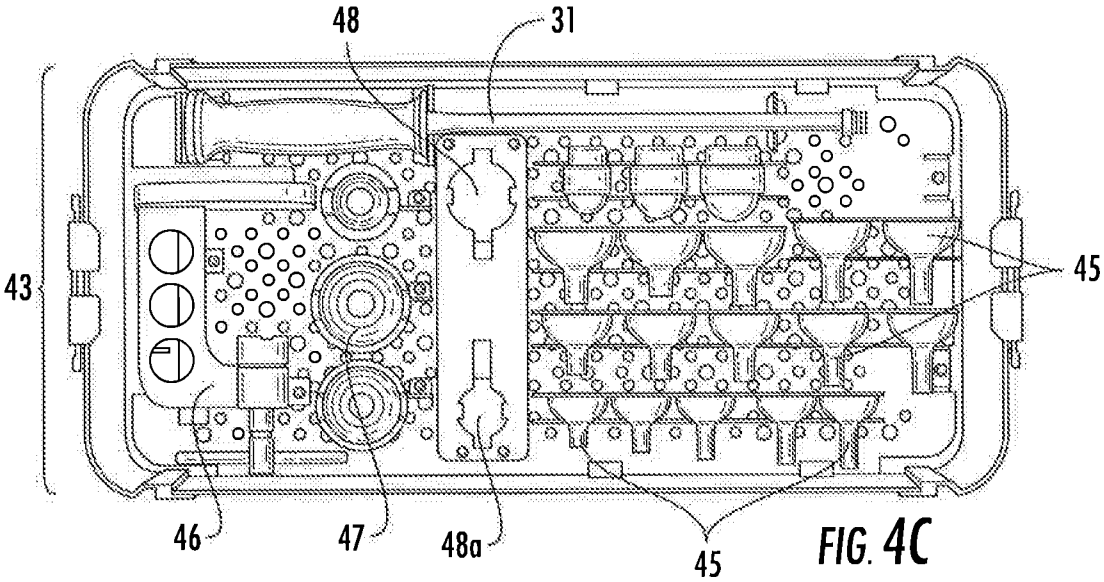

FIG. 4C

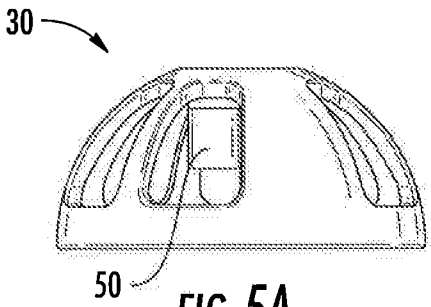

FIG. 5A

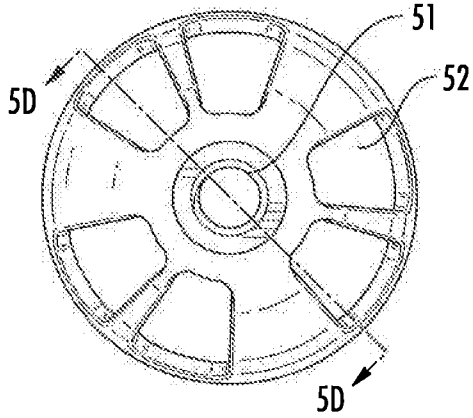

FIG. 5B

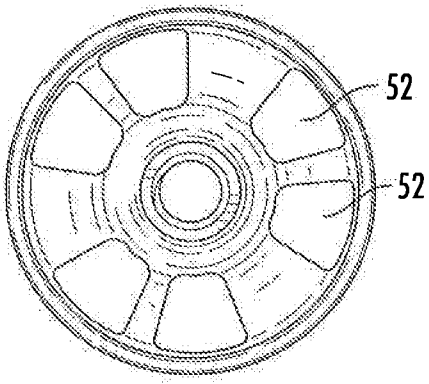

FIG. 5C

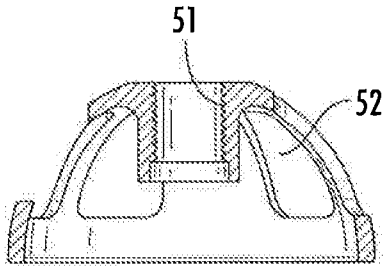

FIG. 5D

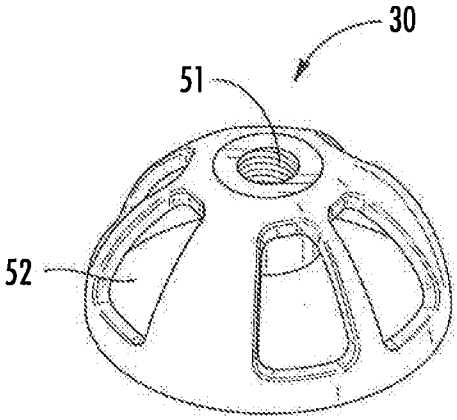

FIG. 5E

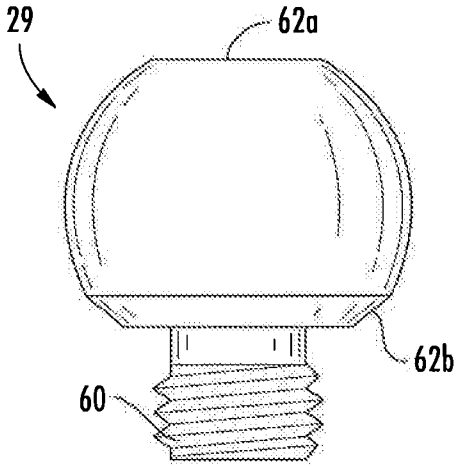

FIG. 6A

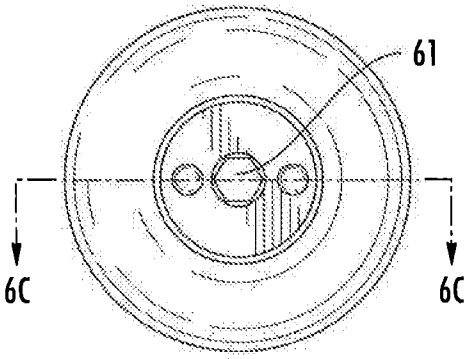

FIG. 6B

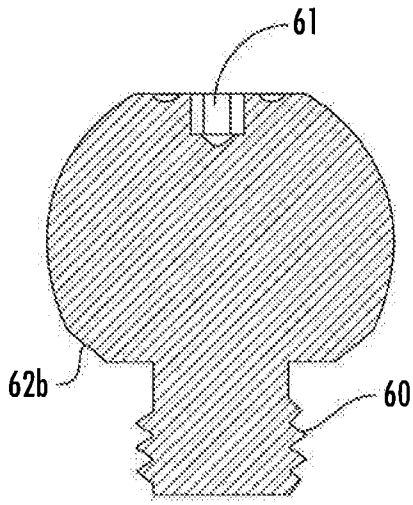

FIG. 6C

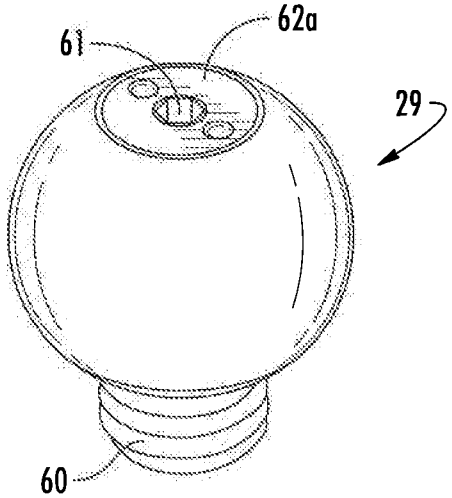

FIG. 6D

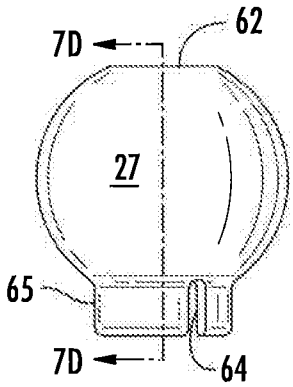

FIG. 7A

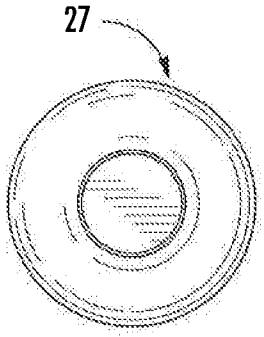

FIG. 7B

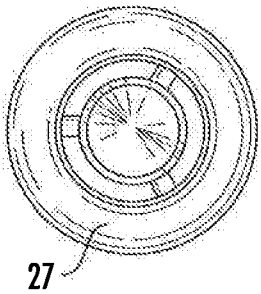

FIG. 7C

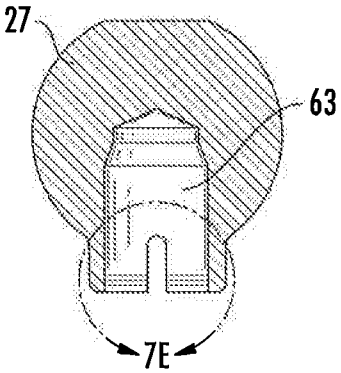

FIG. 7D

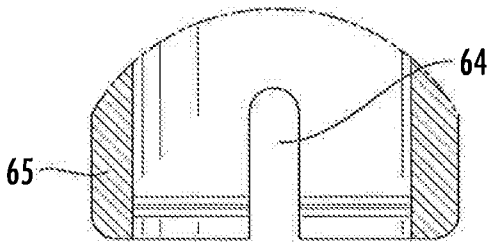

FIG. 7E

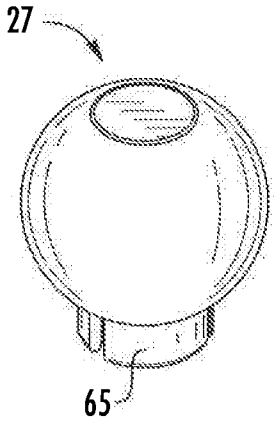

FIG. 7F

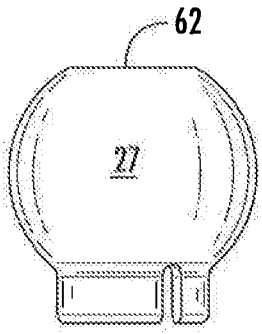

FIG. 8A

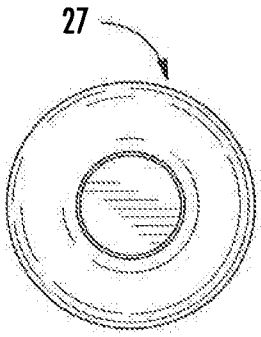

FIG. 8B

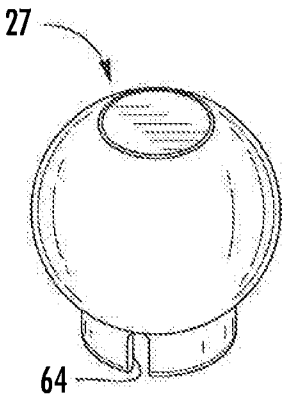

FIG. 8C

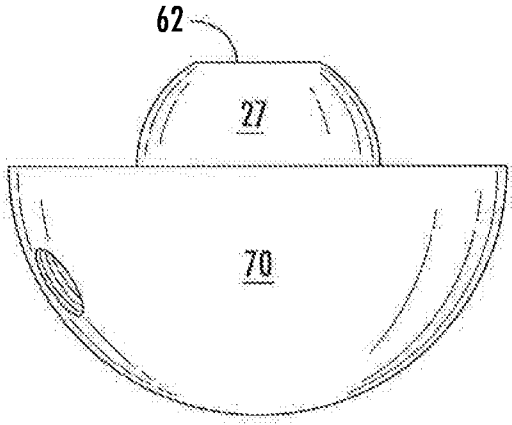

FIG. 8D

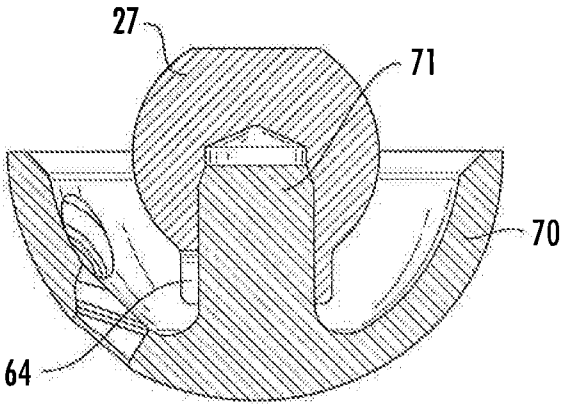

FIG. 8E

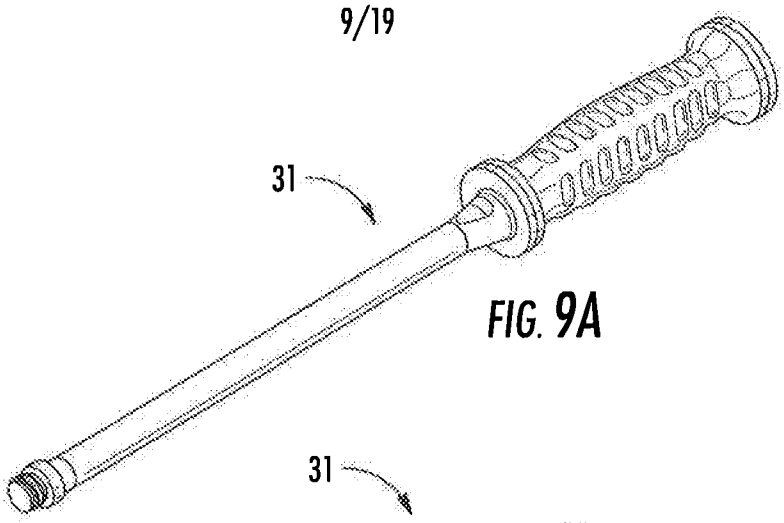

FIG. 9A

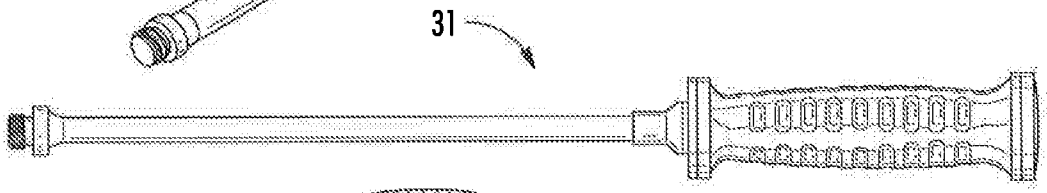

FIG. 9B

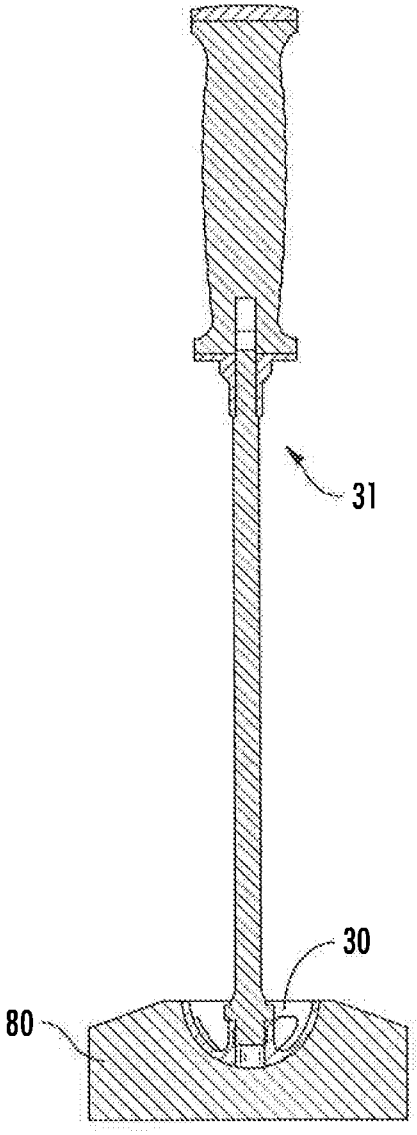

FIG. 9C

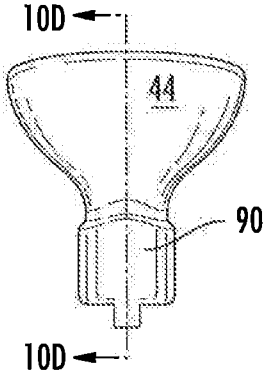

FIG. 10A

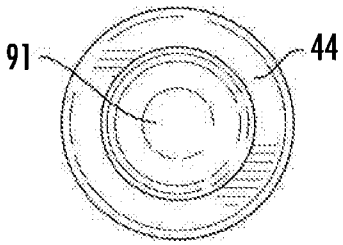

FIG. 10B

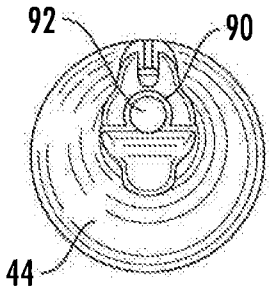

FIG. 10C

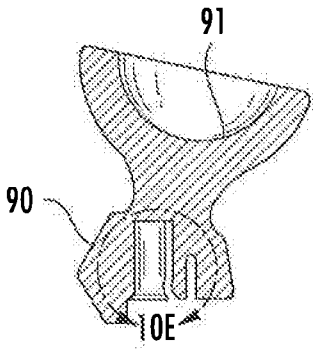

FIG. 10D

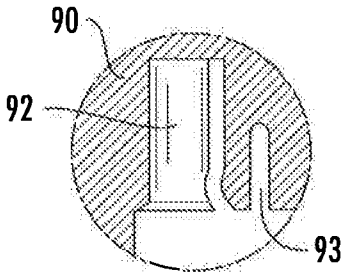

FIG. 10E

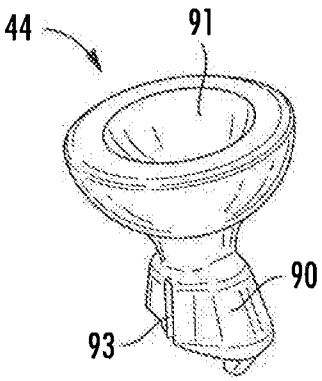

FIG. 10F

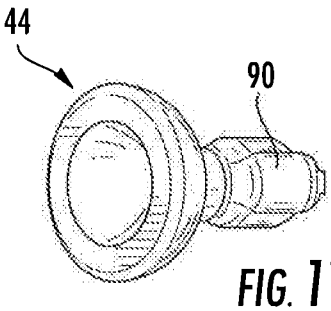

FIG. 11A

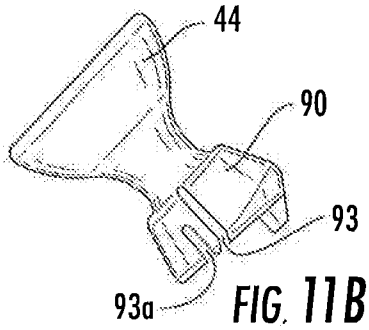

FIG. 11B

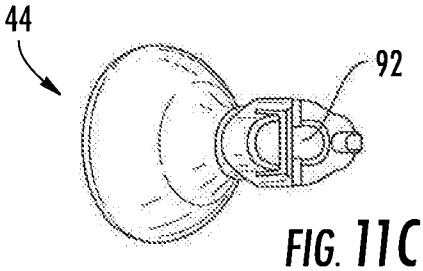

FIG. 11C

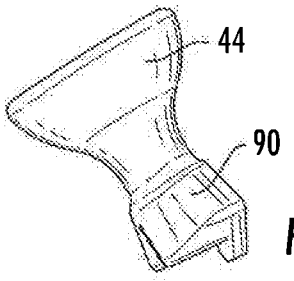

FIG. 11D

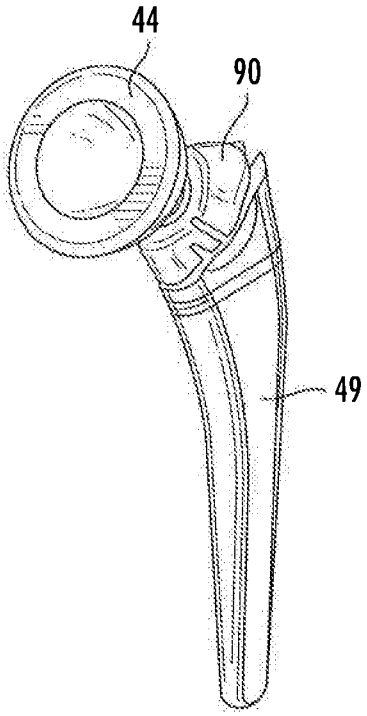

FIG. 11E

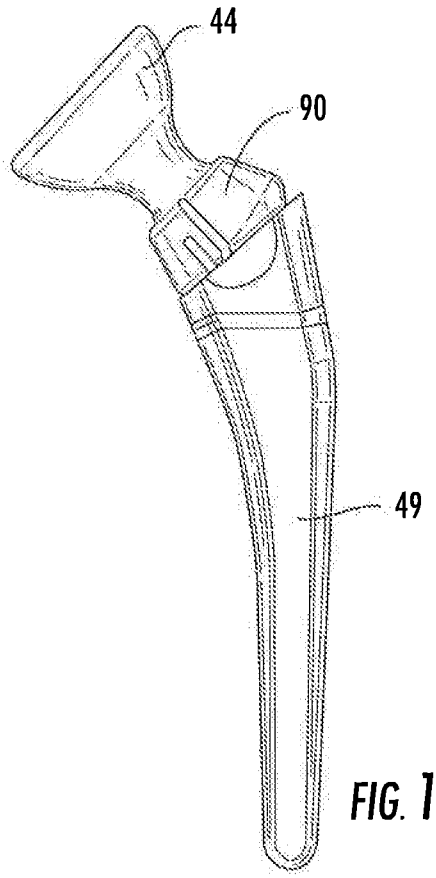

FIG. 11F

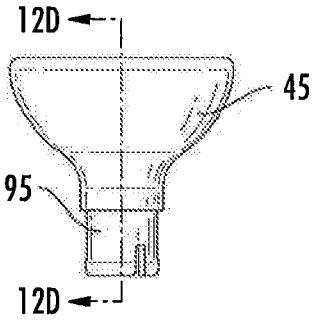

FIG. 12A

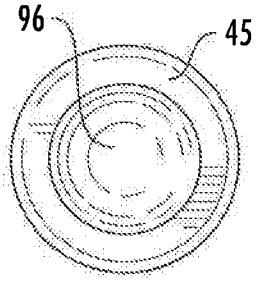

FIG. 12B

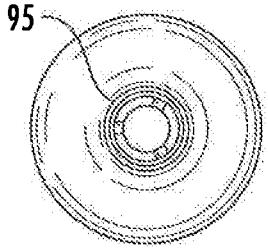

FIG. 12C

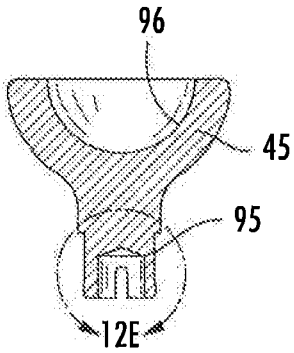

FIG. 12D

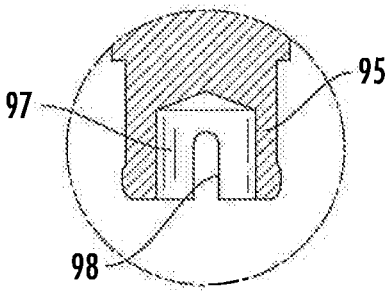

FIG. 12E

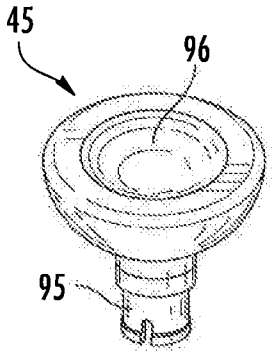

FIG. 12F

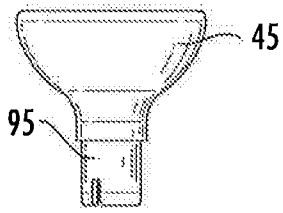

FIG. 13A

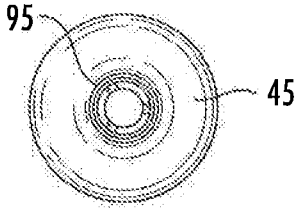

FIG. 13B

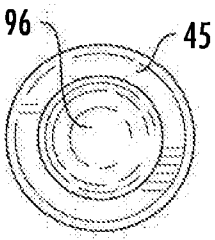

FIG. 13C

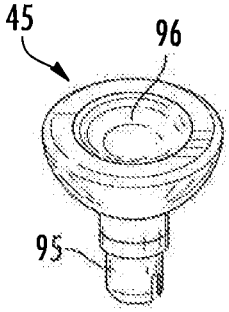

FIG. 13D

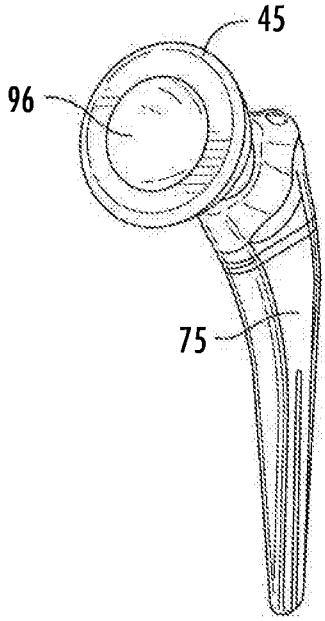

FIG. 13E

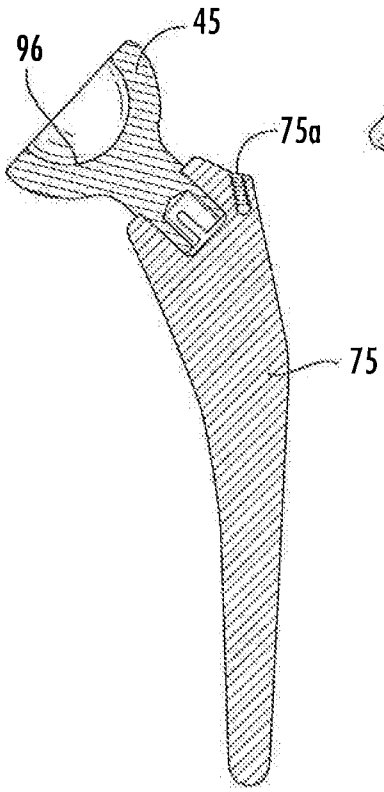

FIG. 13F

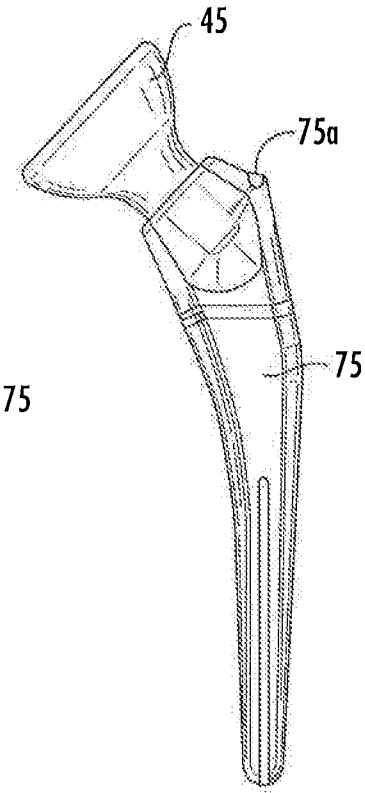

FIG. 13G

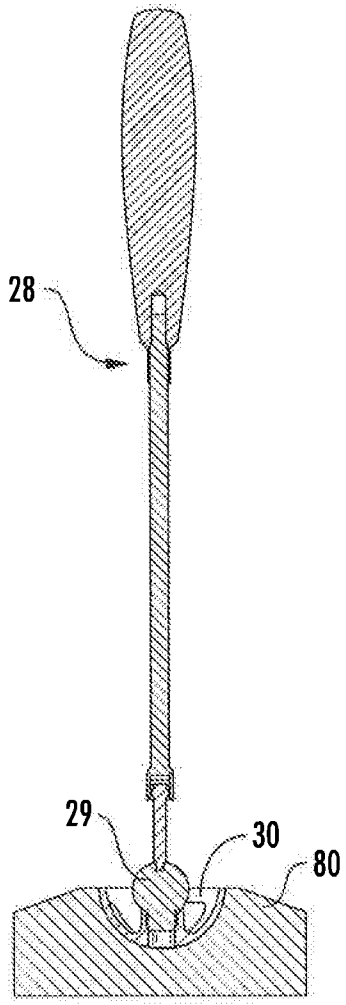

FIG. 14

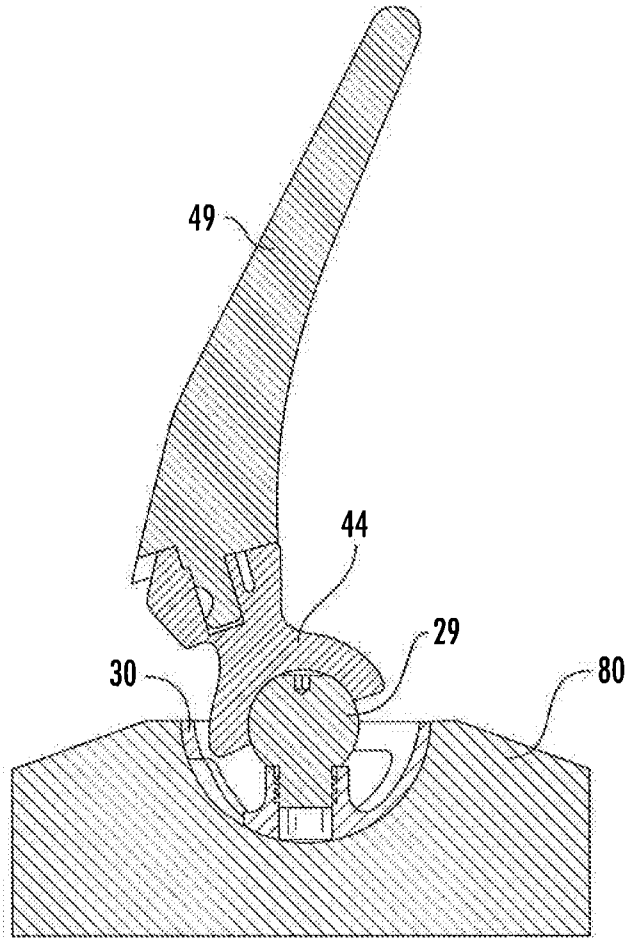

FIG. 15

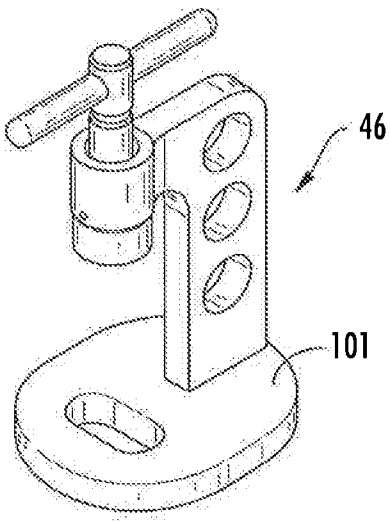

FIG. 16A

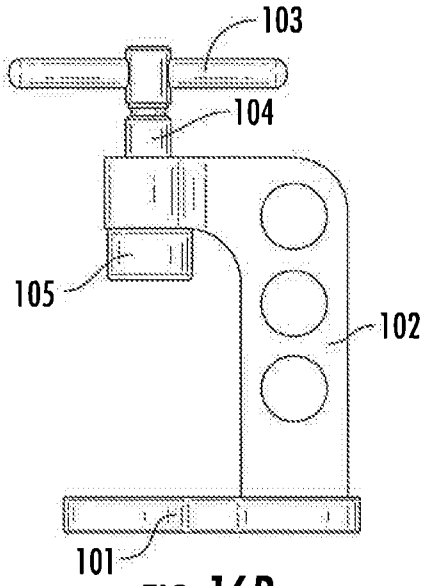

FIG. 16B

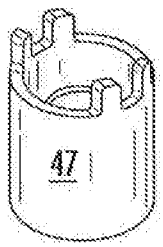

FIG. 16C

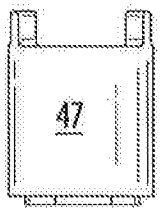

FIG. 16D

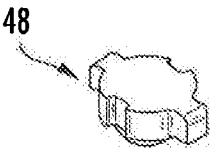

FIG. 16E

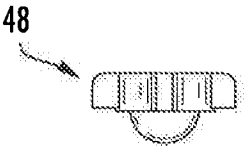

FIG. 16F

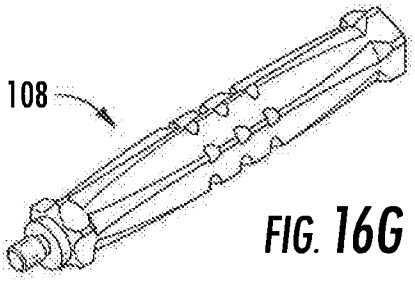

FIG. 16G

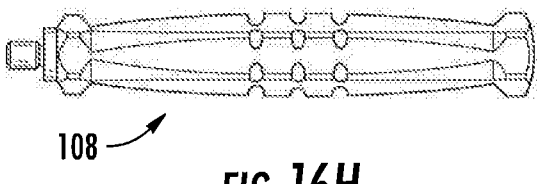

FIG. 16H

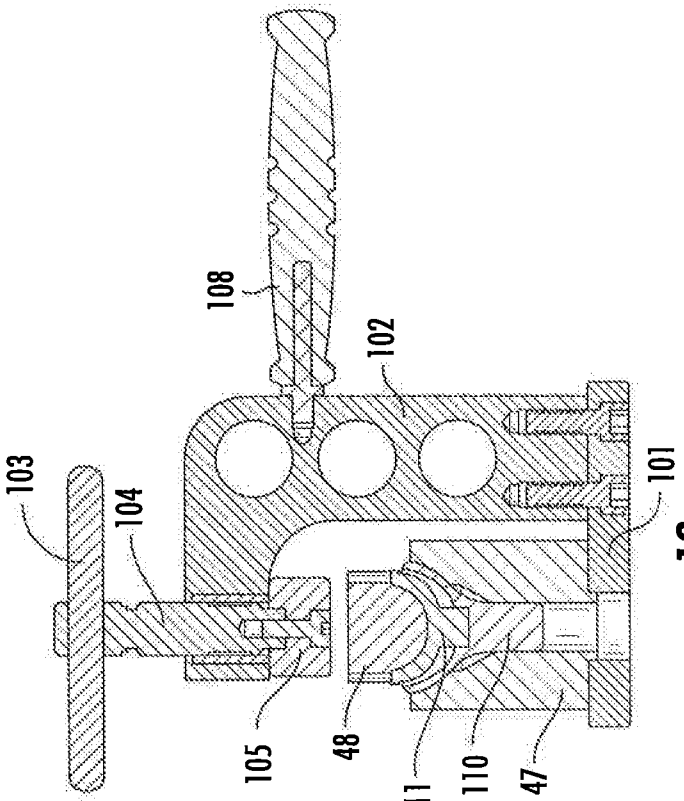

FIG. 18

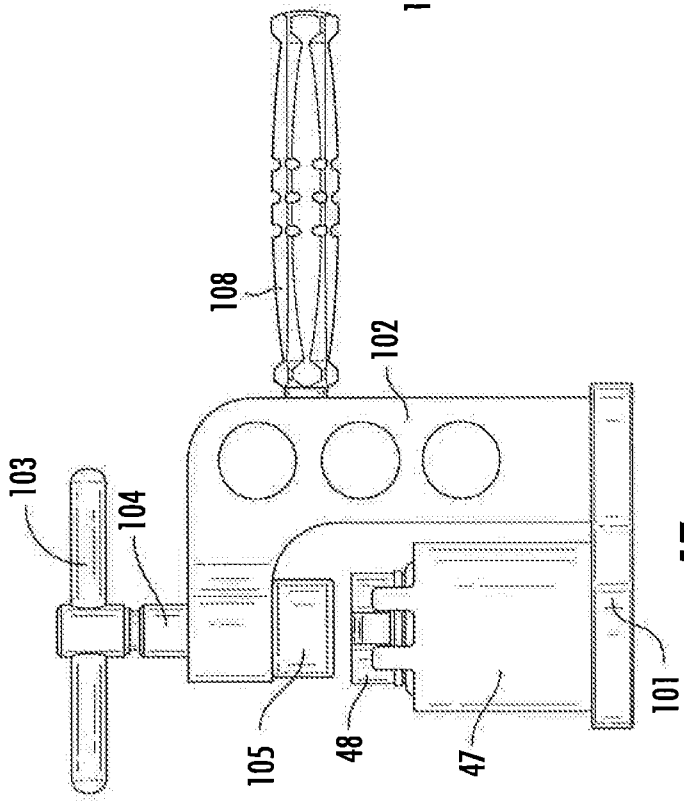

FIG. 17

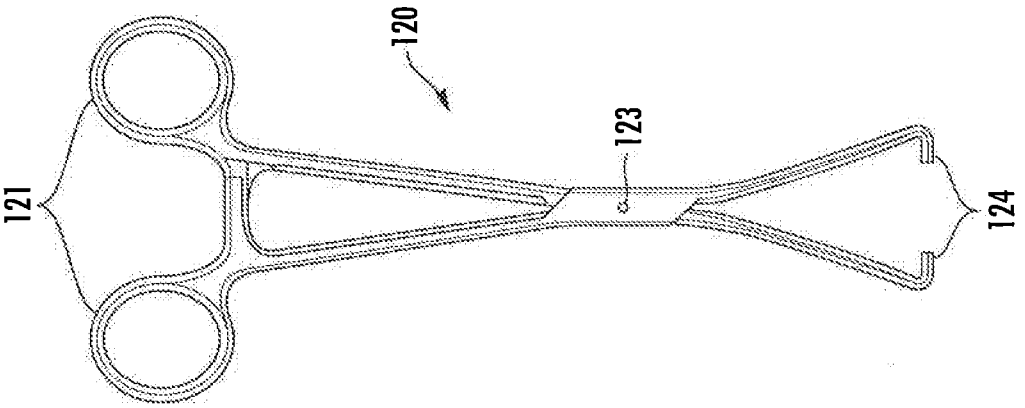

FIG. 20

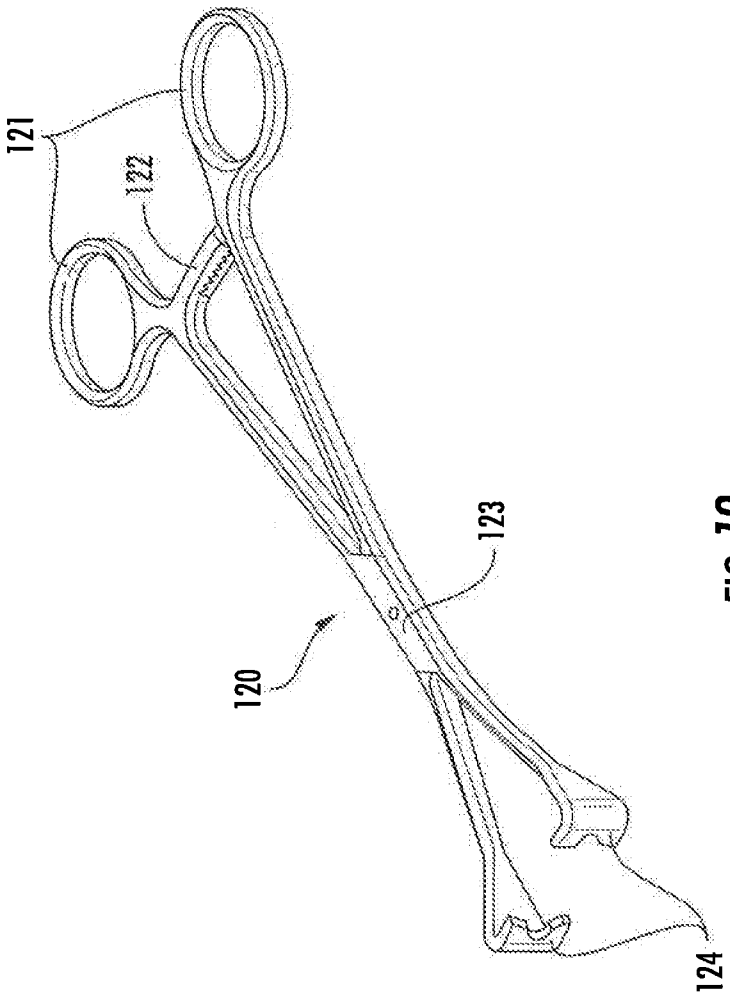

FIG. 19

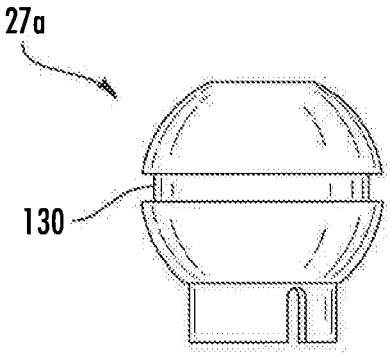

FIG. 21

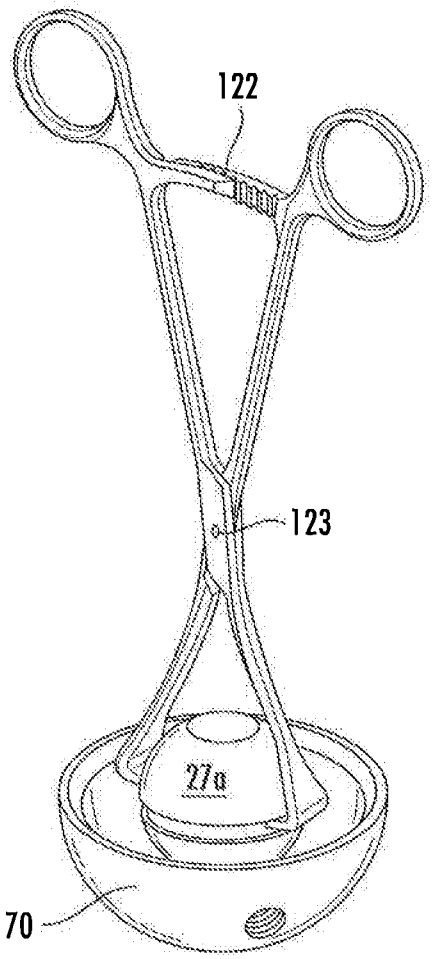

FIG. 22

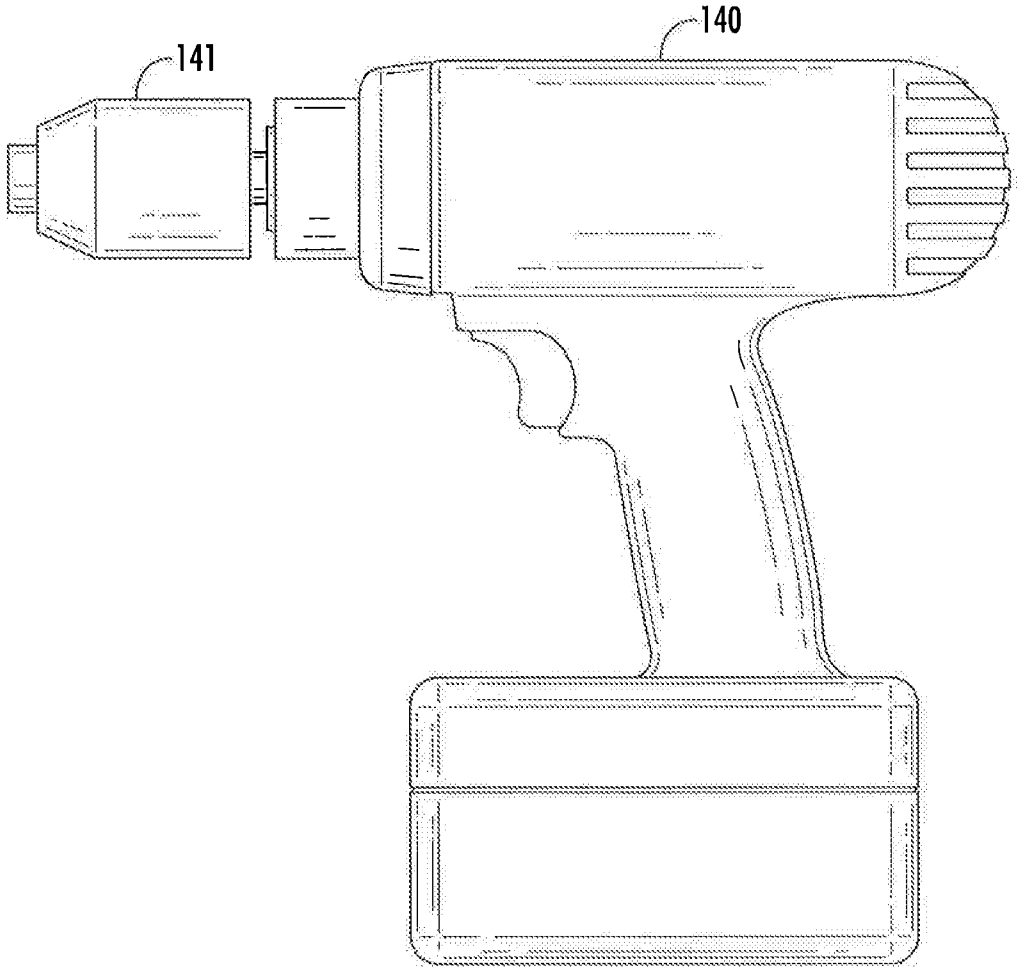

FIG. 23