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(74) Agents: WARNER, Richard, W. et al.; Harness, Dickey & Pierce, P.L.C., P.O. Box 828, Bloomfield Hills, MI 48303 (US).

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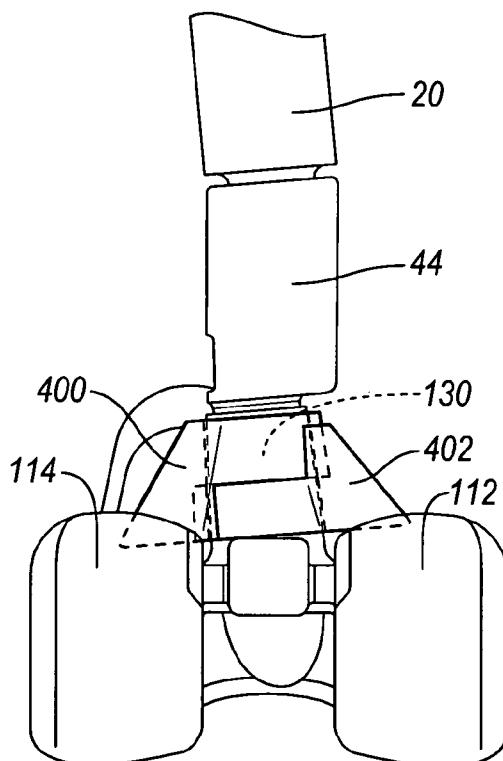
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(54) Title: KNEE JOINT PROSTHESIS SYSTEM AND METHOD FOR IMPLANTATION



(57) Abstract: A modular knee prosthesis can include a femoral component (112) having a superiorly extending portion (130), a first femoral bearing surface (114) and a second femoral bearing surface (116). The superiorly extending portion can define a first tapered augment receiving surface (132). A tibial component (12) can have an anteriorly extending portion (28) and a tibial bearing surface. The anteriorly extending portion can define a second tapered augment receiving surface (30). A first augment (400) can define a first receiving bore and a first stepped surface. A second augment (402) can define a second receiving bore and a second stepped surface. The first and second augments are adapted to mate at the first and second stepped surfaces in a first portion at the first tapered augment receiving surface of the femoral component and in a second position at the second tapered augment receiving surface of the tibial component.

FIG. 27



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KNEE JOINT PROSTHESIS SYSTEM AND METHOD FOR IMPLANTATION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/879,733, filed January 10, 2007, and U.S. Provisional Application No. 60/978,949, filed October 10, 2007. The disclosures of the above applications are incorporated herein by reference.

FIELD

[0002] The present disclosure relates generally to knee joint prostheses and more particularly to various tibial and femoral components and modular augments for cooperating with such tibial and femoral components.

BACKGROUND

[0003] A knee joint prosthesis typically comprises a femoral component and a tibial component. The femoral component and tibial component are designed to be surgically attached to the distal end of the femur and the proximal end of the tibia, respectively. The femoral component is further designed to cooperate with the tibial component in simulating the articulating motion of an anatomical knee joint. Such knee joint prostheses are generally referred to as primary knee prostheses.

[0004] Knee joint prostheses, in combination with ligaments and muscles, attempt to duplicate natural knee motion as well as absorb and control forces generated during the range of flexion. In some instances however, it may be necessary to replace an existing prosthesis. Such replacement prostheses are generally referred to as revision knee prostheses. Depending on the degree of damage or deterioration of the primary knee prosthesis, knee tendons and ligaments, however, it may be necessary for a revision knee joint prosthesis to eliminate one or more of these motions in order to provide adequate stability. In this way, it may be desirable to provide a cruciate retaining (CR) revision knee, a fully constrained revision knee, a posterior stabilized (PS) revision knee or a hinged revision knee for example. Furthermore, in some instances it may be

necessary to account for bone loss in areas adjacent to such knee joint prostheses.

SUMMARY

5 [0005] A knee joint prosthesis system and method for intraoperatively assembling the same can include a first knee prosthesis component having a first attachment portion and at least a first stem defining a stem engagement portion. A first adapter can have a first adapter engagement portion defining a first axis and a second adapter engagement portion defining a second axis. The
10 first and second axes can be parallel and offset. The first attachment portion can be operable to intraoperatively couple with the stem engagement portion or the first adapter engagement portion.

15 [0006] According to additional features, a second knee prosthesis component, distinct from the first knee prosthesis component, can have a second attachment portion. The second attachment portion can be operable to couple with the stem engagement portion or the first adapter engagement portion. The first knee prosthesis component can be a femoral component and the second knee prosthesis component can be a tibial component. At least one of the femoral components and at least one of the tibial components can
20 cooperate to form each of a cruciate retaining (CR) knee prosthesis, a posterior stabilized (PS) knee prosthesis, a fully constrained knee prosthesis, and a hinged knee prosthesis.

25 [0007] According to still other features, the stem engagement portion can be operable to couple with the second adapter engagement portion. A plurality of stems can be provided, each having a stem engagement portion and defining distinct lengths or diameters. Each of the stem engagement portions can be operable to couple with the first attachment portion of the knee prosthesis component or the second adapter engagement portion of the adapter.

30 [0008] According to other features, the first attachment portion can define a female tapered receiving portion. The stem engagement portion and the first adapter engagement portion can each define a male tapered insertion portion. The female tapered receiving portion can cooperatively engage the

male tapered insertion portion by way of a Morse-type taper fit. A first locking member can pass through an adapter bore defined in the first adapter. The first locking member can be operable to lock the first stem to the first adapter. The adapter bore can be threaded. The first locking member can threadably 5 advance along the adapter bore between an unsecured position and a secured position. An insert can be secured to the stem. The first locking member can engage the insert at an interface area in the secured position. The first locking member can be formed of a harder material than the insert such that the insert deforms at an interface area upon advancement of the first locking member to 10 the secured position.

[0009] According to yet other features, a plurality of augment defining various shapes and sizes can be provided. Each of the augments can define a passage having a conical engaging surface. Each of the plurality of augments can be operable to couple with a superiorly extending portion of the femoral 15 component or an inferiorly extending portion of the tibial component.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The present disclosure will become more fully understood from the detailed description and the accompanying drawings, wherein:

20 **[0011]** FIG 1 is an anterior view illustration of a knee joint prosthesis including a modular tibial component having a first adapter assembly for providing a first predetermined offset according to the present teachings;

[0012] FIG. 2 is an exploded view of the modular tibial component of FIG. 1;

25 **[0013]** FIG. 3A is an anterior view of the tibial component of FIG. 1;

[0014] FIG. 3B is an anterior view of a tibial component according to additional features;

[0015] FIG. 3C is a perspective view of a tibial component according to additional features;

30 **[0016]** FIG. 3D is a perspective view of a tibial component according to additional features;

[0017] FIG. 4 is a view of a first adapter body according to the present teachings;

[0018] FIG. 5 is a view of another adapter body according to additional features;

5 [0019] FIG. 6 is a view of an exemplary stem and fastener insert;

[0020] FIG. 7A is a cross-sectional view taken along a superior/inferior line through the adapter of FIG. 1;

[0021] FIG. 7B is a view of the knee joint prosthesis of FIG. 1 illustrating various offsets;

10 [0022] FIG. 7C is an exploded view of a locking assembly shown in FIG. 7A;

[0023] FIG. 8 is an anterior view of an exemplary femoral component according to the present teachings and shown with the adapter assembly of FIG. 1;

15 [0024] FIG. 9 is a perspective view of a tibial tray and bearing according to additional features;

[0025] FIG. 10 is a perspective view of the tibial tray of FIG. 9;

[0026] FIG. 11 is a perspective view of an inferior surface of the bearing of FIG. 9;

20 [0027] FIG. 12 is a perspective view of a superior surface of the bearing of FIG. 9;

[0028] FIG. 13 is a top view of the tibial tray and bearing of FIG. 9;

[0029] FIG. 14 is a cross-sectional view taken along the line 14-14 of FIG. 13;

25 [0030] FIG. 15 is a perspective view of a hinged knee joint prosthesis according to additional features;

[0031] FIG. 16A is a cross-sectional view taken along the line 16-16 of FIG. 15 and shown with the femoral component rotated;

30 [0032] FIG. 16B is a cross-sectional view of a hinged knee prosthesis according to additional features;

[0033] FIGS. 17-20 show an exemplary sequence of assembling the knee joint prosthesis of FIG. 15;

[0034] FIG. 21 is a perspective view of a first augment according to the present teachings;

[0035] FIG. 22 is a perspective view of a second augment according to the present teachings;

5 **[0036]** FIG. 23A is a plan view of the first and second augments of FIGS. 21 and 22;

[0037] FIG. 23B is side view of the first and second augments in an mated or interlocked position;

10 **[0038]** FIG. 24 is a perspective view of a third augment according to the present teachings;

[0039] FIG. 25 is a top view of the third augment of FIG. 24;

[0040] FIG. 26 is an anterior view of the femoral component of FIG. 8 shown with the first augment assembled on a superiorly extending portion;

15 **[0041]** FIG. 27 is an anterior view of the femoral component of FIG. 8 shown with the first and second augments assembled on a superiorly extending portion;

[0042] FIG. 28 is a superior view of the femoral component of FIG. 27 and shown with the augment of FIG. 24 secured to an inferiorly extending portion;

20 **[0043]** FIG. 29 is an anterior view of the tibial component of FIG. 1 shown with the first and second augments assembled on an inferiorly extending portion and without the adapter assembly;

[0044] FIG. 30 is an anterior view of the tibial component of FIG. 1 shown with the third augment assembled on the inferiorly extending portion;

25 **[0045]** FIG. 31 is an exploded view of a modular tibial component according to additional features;

[0046] FIG. 32 is a perspective view of an augment according to additional features;

30 **[0047]** FIG. 33 is a perspective view of another augment according to the present teachings;

[0048] FIG. 34 is an exploded perspective view of an adapter assembly according to additional features and shown with an exemplary tibial component and stem;

5 **[0049]** FIG. 35 is an anterior view of the prosthesis illustrated in FIG. 34;

[0050] FIG. 36A is a detail exploded view of the tibial tray and adapter illustrated in FIG. 34;

[0051] FIG. 36B is a partial sectional view taken along line 36B-36B of FIG. 36A;

10 **[0052]** FIG. 36C is a detail exploded view of an adapter assembly cooperating with a tibial component according to additional features;

[0053] FIG. 36D is a partial sectional view taken along line 36D-36D of FIG. 36C;

15 **[0054]** FIG. 37 is a sectional view of an exemplary adapter having a first offset;

[0055] FIG. 38 is a sectional view of another exemplary adapter having a second offset;

[0056] FIG. 39A is an exploded view of a fastener member and insert of the adapter assembly;

20 **[0057]** FIG. 39B is a partial exploded view of an adapter assembly;

[0058] FIG. 40A is an assembled view of a tibial component, adapter assembly and stem according to one example of the present teachings;

[0059] FIG. 40B is a sectional view taken along line 40B-40B of FIG. 40A;

25 **[0060]** FIG. 41A is an assembled view of an exemplary femoral component, adapter assembly and stem according to one example of the present teachings;

[0061] FIG. 41B is an assembled posterior perspective view of a pair of interlocking augments, adapter assembly and femoral component according to one example of the present teachings;

[0062] FIGS. 42-45 are perspective views of various tibial components and bearings used in cooperation with a bone conserving hinged knee;

[0063] FIG. 46 is a superior view of an assembled hinged knee;

[0064] FIG. 47 is a sectional view taken along line 47-47 of FIG. 46;

[0065] FIGS. 48A and 48B are exploded perspective views of a hinged knee prosthesis according to one example of the present teachings;

5 [0066] FIG. 49 is a sectional view of the hinged knee prosthesis of FIGS. 48A and 48B shown assembled;

[0067] FIGS. 50-54 are perspective views of various augments according to the present teachings;

10 [0068] FIG. 55A and 55B illustrates a kit of implants according to the present teachings; and

[0069] FIGS. 56-60 illustrate various augments shown during stages of assembly.

DETAILED DESCRIPTION

15 [0070] At the outset, the instant disclosure provides a knee joint prosthesis system having various knee joint prostheses that may be adapted for use in a revision knee procedure. Various tibial and femoral components are described that may be used alone or as part of a cruciate retaining (CR) knee revision, posterior stabilized (PS) knee revision, fully constrained knee revision
20 and hinged knee revision. As will be described, the instant disclosure further provides various modular adapters, stems and augments that may be used in any combination with any of the tibial and femoral components disclosed herein. In other words, all of the components disclosed that are above and below the joint line, such as the stems, adapters, augments, etc., can be inter-changeably
25 used with any of the knee prostheses disclosed herein and on the tibial or femoral side. Moreover, selection of any of the knee prostheses and related components from the knee joint prosthesis system may be selected intra-operatively by the surgeon performing the procedure.

[0071] With initial reference to FIG. 1, a knee joint prosthesis
30 constructed in accordance with the present teachings is illustrated and generally identified at reference number 10. The knee joint prosthesis 10 is generally shown to include a tibial component 12 that supports a bearing 14 which

engages an articulation surface of a femoral component (not shown). Insofar as the present teachings are concerned, it will be understood that the tibial tray 12 and bearing 14 can be adapted for use with any suitable femoral component.

For example, a first cruciate retaining (CR) bearing 14 is illustrated that is designed to articulate with a CR femoral component. However, a fixed PS bearing may be employed that is designed to articulate with a PS femoral component.

[0072] The tibial component 12 illustrated in FIG. 1 will be understood to be modular in construction and generally include a stem 20, a tray 22, and a first adapter assembly 24. In a manner which will be discussed more fully below, the adapter assembly 24 can connect the tray 22 and the stem 20 so as to provide an offset to the stem 20 in the transverse or coronal plane or in any other plane. Explaining further, when the stem 20 is attached to the tray 22 through the first adapter assembly 24, a central axis 25 of the stem 20 can be offset from a central axis 27 of an inferiorly extending portion 28 of the tray 22. In the embodiment illustrated, the first adapter assembly 24 can provide a first offset of approximately 5 mm. It is appreciated that the offset can range from 0 mm to approximately 5 mm or more and can be in any rotational direction relative to the central axis 27. Alternatively, a stem 20 can be attached directly to the tray 22 (FIG. 29). In other words, the offset axis 25 can be rotated 360 degrees relative to the central axis 27 to provide the surgeon with various intra-operative options to select depending on the patient's needs. Alternatively, the adapter assembly 24 or stem 20 can be rotational keyed to provide only a limited range of adjustment, such as providing only a single offset or two offset positions.

[0073] With reference to FIGS. 2 and 3A, the inferiorly extending portion 28 of the tibial tray 22 can define a female tapered receiving portion 30. The female tapered receiving portion 30 can taper slightly as it extends into the inferiorly extending portion 28. A central aperture 32 can be formed through the tray 22 and the inferiorly extending portion 28 into the female tapered receiving portion 30. The inferiorly extending portion 28 may also define an exterior tapered augment receiving surface 34. A retaining rail 36 (FIG. 2) can extend superiorly from a posterior edge of the tray 22. The tibial tray 22 can further

include a pair of posts 38 integrally formed on a superior surface at an anterior edge thereof. The posts 38 and rail 36 can cooperate to retain the modular bearing 14 in a fixed position on the tray 22. An alternate tibial tray 22' is shown in FIG. 3B.

5 [0074] The modular bearing 14 can be formed of ultra-high molecular weight polyethylene (UHMWPE) with anterior and posterior recesses (not specifically shown) to receive the posts 38 and rail 36, respectively, and with a uniformly flat inferior surface on its intercondylar and medial/lateral portions for direct contact with the superior surface of the tray 22. The modular bearing 14
10 can be designed to be locked in position with a transverse slide-in locking bar or clip 40 wedged between the posts 38 and the bearing 14 in opposed grooves provided therein for that purpose. A more detailed discussion of how the locking bar cooperates with the posts and bearing may be found in commonly owned U.S. Pat. No. 5,330,534 entitled "Knee Joint Prosthesis With Interchangeable
15 Components", which is hereby incorporated by reference. Modular tibial trays and bearings as generally described above are commercially available from Biomet Inc., the assignee of the present disclosure, as components of the Vanguard® Complete Knee System, which includes various sizes and configurations of trays, bearings and other knee components for different patient
20 requirements. The articulating surfaces of the modular bearing 14 can be substantially the same as provided by the Vanguard® Complete Knee System.

25 [0075] Turning now to FIGS. 2, 4 and 5, the adapter assembly 24 can generally include an adapter body 44 and a locking member or element 46 (FIG. 2). The adapter body 44 of the adapter assembly 24 can define a male tapered insertion portion 48 having a passage 50 formed therethrough. A female tapered receiving portion 52 can be formed in an offset body portion 53 of the adapter body 44 for receiving a male tapered insertion portion 58 of the stem 20. In one example, the female tapered receiving portion 52 can be generally cylindrical. A skirt 54 can be defined at a transition between the male tapered insertion portion
30 48 and the offset body portion 53.

35 [0076] With reference to FIG. 4, the male tapered insertion portion 48 of the adapter body 44 defines a first axis A₁ and the female tapered receiving

portion 52 defines a second axis A_2 . Further, in the embodiment illustrated, the first axis A_1 and the second axis A_2 are parallel to one another and spaced apart to provide the desired offset. In this regard, multiple adaptors each having a different offset can be provided to provide the surgeon with intra-operative

5 selection depending on the patient's needs. Insofar as the adapter body 44 provides a 5mm offset, the first and second central axes A_1 and A_2 are spaced apart 5mm. The adapter body 44' can define a skirt 54' having an alternate configuration. Other geometries are contemplated for the skirt 54, 54'.

[0077] The male tapered insertion portion 48 can taper slightly as it

10 extends away from the adapter body 44. The female tapered receiving portion 52 similarly tapers slightly as it extends into the adapter body 44 from an end of the adapter body 44. As will become appreciated from the following discussion, various male tapered insertion portions (such as portion 48) can be inserted in various female tapered receiving portions (such as portion 52) to form a locking 15 taper or Morse taper. The adapter body 44 is illustrated to further define a laterally extending channel 60 which intersects both the aperture 50 and the female tapered receiving portion 52. In a manner to be described further below, the locking element 46 can extend into the laterally extending channel 60 where it ultimately couples the tray 22 to the stem 20.

20 **[0078]** As shown in FIGS. 2 and 6, the stem 20 can include an upper portion 64 that cooperatively engages with the locking element 46. In the embodiment illustrated, the upper portion 64 of the stem 20 can include a fastener insert 66. Alternatively, the fastener insert 66 of the stem 20 may be integrally formed to cooperate with the locking element 46.

25 **[0079]** The fastener insert 66 can include a distal portion 70 which can be externally threaded for engaging an internally threaded aperture 72 of the male tapered insertion portion 58 of the stem 20. The fastener insert 66 can further include a central portion 74 having a hexagonal or other suitable cross-section which can be engaged by a tool (not shown) for rotating the fastener 30 insert 66 into the stem 20. Further, the fastener insert 66 can include a proximal end 78 including an enlarged diameter head 80.

[0080] The locking element 46 can be sized and configured to be inserted through an opening 81 in the sidewall of the adapter body 44 and into the channel 60 for coupling of the stem 20 and the tray 22. The locking element 46 can include an upper surface 84 (see FIG. 2) having an internally threaded aperture 86. The internally threaded aperture 86 can threadably receive a fastener 90 which can extend through the central aperture 32 provided in the tray 22. The fastener 90 can align with the central longitudinal axis 27 of the inferior portion 28 of the tray 22.

[0081] With additional reference to FIG. 7C, the locking element 46 can additionally include an open end 94 and a bottom surface having a slot 96. The slot 96 can intersect the open end 94. The open end 94 can receive the head 80 of the stem insert 66 as the locking element 46 is inserted through the opening 60. The slot 96 can accommodate a reduced diameter, central portion 100 of the fastener insert 66. The head 80 of the fastener insert 66 can have a diameter greater than a width of the slot 94 for coupling of the fastener insert 66 with the locking element 46.

[0082] The locking element 46 can further include a closed end 104. The closed end 104 can be convexly curved. When the locking element 46 is completely inserted into the channel 60, the closed end 104 can be flush with the sidewall of the adapter body 44.

[0083] In use, the fastener insert 66 can be screwed into the stem 20. Next, the adapter body 44 can be placed over the male insertion portion 64 of the stem 20 such that the male insertion portion 64 is received in a press fit within the female tapered receiving portion 52 of the adapter body 44 and the upper end 78 of the fastener insert 66 extends into the laterally extending channel 60.

[0084] The male taper extension 48 of the adapter 44 can now be press fit onto the female tapered receiving portion 30 of the tray 12 with the adapter body 44 oriented to provide the offset in the desired direction. As viewed in FIG. 7B, the adapter body 44 may be rotated about the axis A₁ prior to fastening to orient the stem 20 at the desired offset for a particular patient. As a result, the stem 20 may extend at a plurality of positions around a radius defined

by the axes A_1 and A_2 . Alternatively, the stem 20 may be keyed with the adapted body thus, precluding rotation. In addition, a set of stems may be provided having various lengths suitable for a range of patients. Likewise, a set of adapter bodies may be provided for providing various offsets.

5 [0085] At this point, the locking element 46 can be inserted into the laterally extending channel 60 through the opening 81. Upon complete insertion, the locking element 46 can engage the fastener insert 66. The tray 22 can be secured to the adapter body 44 by the threaded fastener 90 which extends through the central aperture 32 of the tray 22 and threadably engages the
10 internally threaded aperture 86 of the locking element 46. A further discussion of offset stems and their application with respect to various tibial and femoral components may be found in commonly owned U.S. Pat. Appl. No. 10/934,282 filed September 3, 2004 and entitled "Knee Joint Prosthesis", which is hereby incorporated by reference. In this commonly owned Application, the tibial tray
15 defines an inferiorly extending male portion whereas in the instant application, the tibial tray 22 defines the inferiorly extending the female receiving portion 30. In addition, while not specifically shown, the adapter body 44 may alternatively define an axis A_2 that defines an angle with respect to the axis A_1 .

20 [0086] In another example, the male insertion portion 58 may be inserted directly into the female receiving portion 30 of the tray 22. In this example, another threaded fastener 90' may be used that has a shorter shaft for spanning an appropriate distance to mate directly with the threaded aperture 72 of the stem 20. As shown in FIGS. 3A-3D, other tibial trays 22A, 22B, 22C and 22D, are shown for accommodating various combinations of fasteners 90, 90',
25 adapters 44, 44' and stems 20.

30 [0087] Turning now to FIG. 8, a knee joint prosthesis according to another example is shown and generally identified at reference number 110. The knee joint prosthesis 110 includes a femoral component 112. The femoral component 112 may be used as part of a posterior stabilized (PS) knee joint prosthesis. A PS knee joint prosthesis can provide adequate stability in case of moderate deterioration or instability of a knee. This most typically occurs when the anterior and posterior cruciate ligaments are sacrificed or dysfunctional and

the medial and lateral collateral ligaments remain functionally intact. The femoral component 112 can include a first condylar portion 114 and a second condylar portion 116 that provide a first femoral bearing surface 118 and a second femoral bearing surface 120, respectively. The first and second condylar 5 portions 114 and 116 of the femoral component 112 can be interconnected by an inner condylar portion 122 that defines an intercondylar recess 124. A superiorly extending portion 130 may be formed on the femoral component 112. The superiorly extending portion 130 can include a generally tapered outer body to receive the augments described herein and define a female tapered receiving 10 portion 132.

[0088] According to the present teachings, the female tapered receiving portion 132 of the femoral component 112 may be configured to accept one of the adapter bodies 44, 44' described above. In this way, the male tapered insertion portion 48 of the adapter body 44 can be adapted to be 15 inserted and press-fit into the female tapered receiving portion 132 of the femoral component 112. As can be appreciated, the first axis A₁ and the second axis A₂ are parallel to one another and spaced apart. Again, the exemplary adapter assembly 24 has been described as having a 5 mm offset however, other adapter bodies may be provided having various offsets. A locking element 46 20 and stem 20 may be used according to the description above.

[0089] Turning now to FIGS. 9-14, a knee joint prosthesis according to another example is shown and generally identified at reference number 210. The knee joint prosthesis 210 is generally shown to include a tibial component 212 that supports a rotating constrained bearing 214. The tibial component 212 25 can generally include a substantially planar platform-like tibial tray 216 (FIG. 10) and an inferiorly extending portion 218. The inferiorly extending portion 218 can define a tapered female receiving portion 220 and an outer tapered body for receiving augments disclosed herein.

[0090] The tibial tray 216 can further include a superiorly extending 30 post 224. A transition between the tibial tray 216 and the superiorly extending post 224 can be defined by a varying radius R, or more specifically transition between a radius R₁ having a radius of approximately 0.50 inches, and a radius

R_3 having a radius of approximately 1.50 inches. An intermediate radius R_2 can have a radius of approximately 0.38 inches. It is appreciated that the radius R may define other dimensions. The transition of the varying radius R can minimize stresses experienced on the superiorly extending post 224. An axis A_3

5 (FIG. 14) defined through the post 224 can be laterally offset in the posterior direction relative to an axis A_4 defined through the inferiorly extending portion 218. A threaded aperture 228 can be formed through the anterior portion of the tibial tray 216. The threaded aperture 228 can extend generally perpendicular to the axis A_4 .

10 [0091] The inferiorly extending portion 218 can define a tapered augment receiving surface 230. The tibial tray 216 can be formed from cobalt-chromium-molybdenum or any other suitable biocompatible material. A top 232 (FIG. 10) of the tibial tray 216 can be highly polished to provide a substantially smooth tibial bearing surface 234.

15 [0092] The rotating bearing 214 can have a substantially planar inferior bearing surface 238 (FIG. 11) which can rotatably move relative to the highly polished tibial bearing surface 234. The rotating bearing 212 can further include a first superior articulating or bearing surface 240 and a second superior articulating or bearing surface 242. The bearing surfaces 240 and 242 can be 20 formed anteriorly and laterally from a central superiorly extending portion 244. The first bearing surface 240 and the second bearing surface 242 can articulate with respective bearing surfaces of a first and second condyle of a constrained femoral component (not shown). The rotating bearing 212 can be formed from a surgical grade, low friction, low wearing plastic, such as UHMWPE or other 25 suitable material. As shown in FIG. 13, a posterior edge 246 of the tibial tray 216 can define a surface that defines an angle 247 relative to a posterior edge 250 of the bearing 214. The angle 247 can be approximately 8 degrees. Other angles are contemplated.

30 [0093] Turning now to FIG. 14, a stem 20 is shown received directly into the female tapered receiving portion 220 of the tray 216. Again, instead of inserting a stem 20 directly into the female tapered receiving portion 220 of the tray 216, an adapter body 44 or 44' may be used. The stem 20 can include a

fastener insert 66'. The fastener insert 66' can include a distal portion 70' which is externally threaded for engaging an internally threaded aperture 72 of the male tapered insertion portion 64 of the stem 20. The fastener insert 66' can further include a central portion 74' having a hexagonal or other suitable cross-section which can be engaged by a tool (not shown) for rotating the fastener insert 66' into the stem 20. Further, the fastener insert 66' can include an upper end 78' including a conical engaging head 80'. A set screw 252 can be advanced through the threaded aperture 228 of the tibial tray 216 to engage the conical engaging head 80'. In this way, advancement of the set screw 252 can 10 secure the fastener insert 66', and therefore, the stem 20 in a secure position. It is appreciated that when utilizing the adapter body 44, a fastener such as fastener insert 66' but having a longer shank, may alternately be used for threadably securing to the locking element 46.

[0094] Turning now to FIGS. 15-20, a hinged knee joint prosthesis 15 constructed in accordance with the present teachings is illustrated and generally identified at reference number 310. The knee joint prosthesis 310 is generally shown to include a tibial component 312 that supports a bearing 314 which engages an articulation surface of a femoral component 316. The tibial component 312 can generally include a substantially planar platform-like tibial tray 318 and an inferiorly extending portion 320. The inferiorly extending portion 20 320 can define a tapered female receiving portion 322.

[0095] With additional reference to FIG. 16A, the tibial tray 318 can further include a superiorly extending post 324. As will be described, a cap 326 can be securably inserted into an elongate bore 328 defined at a terminal 25 opening of the superiorly extending post 324. A threaded aperture 330 can be formed through the tibial tray 318. The threaded aperture 330 can extend generally perpendicular to an axis defined by the superiorly extending post 324. The tibial tray 318 can be formed from cobalt-chromium-molybdenum or any other suitable biocompatible material. A set screw (not shown) can be advanced 30 through the threaded aperture 330 of the tibial tray 318 to engage a conical engaging head of a fastener insert (as described in detail above regarding FIG. 14). In this way, advancement of the set screw can secure the fastener insert,

and therefore the adapter body 44 or the stem 20 in a secure position. The top of the tibial tray 318 can be highly polished to provide a substantially smooth tibial bearing surface 331.

[0096] The rotating bearing 314 can have a substantially planar inferior bearing surface 332 which can rotatably move relative to the highly polished tibial bearing surface 331. The rotating bearing 314 can further include a first superior articulating or bearing surface 336 and a second superior articulating or bearing surface 338. The first bearing surface 336 and the second bearing surface 338 can articulate with respective bearing surfaces of a first and second condyle 340 and 342, respectively of the femoral component 316. Again, as described above, the bearing surfaces may be similar to those provided in the Vanguard® Complete Knee System. To accommodate guiding movement of the femoral component 316, the bearing 314 can include a stabilizing post 350 which can project superiorly from the bearing surface. The stabilizing post 350 can include a fin-like body 352 having a raised posterior portion 354 and a lower anterior portion 356. The body 350 can define a first and second laterally spaced-apart sides 360 and 362 (FIG. 17). The first and second sides 360 and 362 of the stabilizing post 350 can be positioned so as to extend into an intercondylar recess 366 (FIG. 15) of the femoral component 316. A stabilizing post aperture 370 can be formed in a superior/inferior direction through the body 350.

[0097] A passage 372 can be formed through the raised posterior portion 354 of the body 350. The passage 372 can extend generally through the first and second sides 360 and 362 of the stabilizing post 350 in a direction generally perpendicular to the stabilizing post aperture 370. The rotating bearing 314 can be formed from a surgical grade, low friction, low wearing plastic, such as UHMWPE or other suitable material.

[0098] An alternate stabilizing post 350' is shown in FIG. 16B that accepts a cap or fastener 326'.

[0099] The first and second condylar portions 340 and 342 of the femoral component 316 can be interconnected by an inner condylar portion 380 that defines the intercondylar recess 366. The intercondylar portion 380 can

include a first lateral sidewall 382 and a second lateral sidewall 384 (FIG. 17) which can be planar and substantially parallel to each other. The first and second lateral sidewalls 382 and 384 can further define hinge passages 388 formed respectively therethrough.

5 [00100] Anterior portions of the first and second lateral sidewalls 382 and 384 can be connected by an anterior surface 390 (FIG. 15) of the intercondylar portion 380. In one example, the anterior surface 390 of the intercondylar portion 380 can angle anteriorly in an inferior direction at approximately 60 degrees with respect to a superior surface of the intercondylar
10 portion 380. A superiorly extending portion 392 may be formed on the femoral component 316 and generally extend from a superior surface 394 (FIG. 16A). The superiorly extending portion 392 can include a generally cylindrical body and define a female tapered receiving portion 394.

15 [00101] A hinge post 396 can securely extend through the respective hinge passages 388 of the first and second lateral sidewalls 382 and 384 of the femoral component 316 and through the passage 372 in the bearing 314. Of note, the lateral sidewalls 382 and 384 of the femoral component 316 can be positioned proximate an inboard portion of the respective first and second condyles 340 and 342. In this way, host bone need not be sacrificed in areas
20 outboard to the lateral sidewalls 382 and 384. As can be appreciated, during use, the femoral component 316 can rotate about the hinge pin 396.

25 [00102] With reference to FIGS. 17-20, an exemplary sequence of assembling the femoral component and bearing is shown. FIG. 17 illustrates an exploded view of the respective femoral component 310, hinge pin 396 and bearing 314. As viewed in FIG. 18, the femoral component 310 is placed onto the bearing 314 such that the respective passages 372 and 388 are aligned. FIGS. 19-20 show the hinge pin 296 inserted into the passages 372 and 388.

30 [00103] With reference now to FIGS. 21-25 a plurality of exemplary augments for use with any of the knee joint prostheses described above will be explained in detail. FIGS. 21-23B illustrate a first pair of augments 400 and 402. The first augment 400 can generally define a body 404 having first end 406 and a second end 408. The body 404 can further define a consistent radius portion

410 at the second end and 408 an outwardly tapered radially extending portion 412 near the first end 406. The consistent radius portion 410 can define a tapered receiving bore 416 formed therethrough. The receiving bore 416 can taper from the first end 406 to the second end 408. A first step 420 may be 5 formed in the body 404 between the consistent radius and the radially extending portions 410 and 412, respectively. As can be appreciated, a collection of first augments may be provided having various dimensions and configurations suitable for a particular patient.

[00104] The second augment 402 can generally define a body 424 having first end 426 and a second end 428. The body 424 can further define a consistent radius portion 430 at the first end 426 and an outwardly tapered radially extending portion 432 near the second end 428. The consistent radius portion 430 can define a tapered receiving bore 436 formed therethrough. The receiving bore 436 can taper from the first end 426 to the second end 428. A 10 second step 440 may be formed at the second end 428 between the consistent radius and the radially extending portions 430 and 432, respectively. As can be appreciated, a collection of first augments may be provided having various dimensions and configurations suitable for a particular patient.

[00105] As will be described in detail later, the first and second 15 augments 400 and 402 may be used singly or as a combination. As shown in FIG. 23B, the first and second augments 400 and 402 can interlock or mate at the first and second steps 420 and 440 when used concurrently with any of the tibial and femoral components described above.

[00106] With reference now to FIGS. 24 and 25, a third augment 450 is 20 shown. The third augment 450 can generally define a body 452 having a first end 454 and a second end 456. The body 452 can further define a pair of wing portions 460 extending radially therefrom to provide rotational stability to either the femoral component or the tibial component. In one example, the wing portions 460 may be offset toward the first end 454. The body 452 can define a 25 tapered receiving bore 464 formed therethrough. The receiving bore 464 can taper from the second end 456 to the first end 454.

[00107] According to the teachings of the present disclosure, the receiving bores 416, 436 and 464 of each of the augments 400, 402 and 450 can be slidably press-fit onto any of the inferior extensions of the tibial trays described above. More specifically, the receiving bores can define a tapered 5 interlock with the tapered augment receiving surfaces of the inferior extensions of the tibial trays. Likewise, any of the same augments can also be slidably press-fit onto any of the superior extensions of the femoral components described above. More specifically, the receiving bores can define a tapered interlock with the tapered augment receiving surfaces of the superior extensions 10 of the femoral components. As such, the respective tapered surfaces can cooperate to form a Morse taper.

[00108] To illustrate this compatibility, a second augment 402 is shown secured to the superior extension 130 of the femoral component 112 (FIG. 26). If a surgeon desires to account for additional bone loss, the first augment 400 15 may also be advanced onto the superior extension 130 of the femoral component 112 (FIGS. 27 and 29). As shown, the respective first and second steps 420 and 440 cooperate to mate or form an interlock.

[00109] With reference to FIG. 29, a first and second augment 400 and 402 are shown secured to the inferior extension 28 of the tibial tray 22. Notably, 20 the first and second augments 400 and 402 may be used with or without the adapter. It is appreciated, that any of the augments may be used with or without the adapter assemblies described above. FIG. 30 illustrates the third augment 450 secured to the inferior extension 28 of the tibial tray 22.

[00110] Turning now to FIGS. 31 and 32, another tibial component 522 25 is shown. The tibial component 522 can define one or more (such as a pair) of blind bores 524 and at least one opening 526 formed on an inferior surface. A recessed portion such as pocket 530 may also be optionally formed on an inferior surface of the tibial component 522. An augment 540 can define one or 30 more (such as a pair) of complementary locating pegs 542 and at least one complementary opening 544. The augment 540 can be adapted to secure onto the inferior surface of the tibial component 522 to compensate for bone loss. As can be appreciated, an augment may be provided on one of a lateral or medial

portion, or both, of the tibial component 522. During assembly, the locating peg 542 may nest within a blind bore 524. A fastener (not shown) may be inserted through the respective openings 526 and 544. Another augment 540' having at least one peg 542' can be provided for the opposite of the medial and lateral 5 sides of the inferior surface of the tibial component 522. In another example (FIG. 32), an augment 540" suitable for connecting to either of the medial and lateral sides is provided. In such an example, pegs (such as pegs 542, FIG. 31) need not be provided. As can be appreciated, a plurality of augments 540 can be provided having various thicknesses such that a surgeon can assemble a 10 particular augment suitable for a given patient. A stem 20 can be fixedly accepted into a female tapered extending portion 560 of the tray.

[00111] FIG. 33 illustrates another augment 590 that defines a tapered receiving bore 592 formed therethrough. The tapered receiving bore 592 can be slidably press-fit onto any of the inferior extensions of the tibial trays and/or the 15 superior extensions of the femoral components described above. A portion of the augment 590 can optionally be formed of porous metal 594. The porous metal 594 can comprise porous titanium alloy for example. The augment 590 can define an inner solid metal sleeve portion and an outer porous metal sleeve portion 594. Again, according to the present teachings, the respective femoral 20 components, tibial components, bearings and/or augments may be part of a kit wherein a surgeon may intra-operatively select a desired component or components needed for a particular patient.

[00112] Turning now to FIGS. 34-36B, the modular tibial component 22 (as described above with respect to FIGS. 1-3A) is shown cooperating with an 25 adapter assembly 600 according to additional features. The adapter assembly 600 can cooperate with the stem 20. In a manner which will be discussed more fully below, the adapter assembly 600 can connect the tray 22 and the stem 20 so as to provide an offset to the stem 20 in the transverse or coronal plane or in any other plane. Explaining further, when the stem 20 is attached to the tray 22 30 through the first adapter assembly 600, the central axis 25 of the stem 20 can be offset from the central axis 27 of the inferiorly extending portion 28 of the tray 22. In the embodiment illustrated, the adapter assembly 600 can provide a first offset

of approximately 5mm. It is appreciated that the offset can range from 0mm to approximately 5mm or more and can be in any rotational direction relative to the central axis 27. In other words, the offset axis 25 can be rotated 360 degrees relative to the central axis 27 to provide the surgeon with various intra-operative options to select depending on the patient's needs. Alternatively, the adapter assembly 600 or stem 20 can be rotational keyed to provide only a limited range of adjustment, such as providing only a single offset or two offset positions.

[00113] With continued reference to FIGS. 34-36D and additional reference to FIGS. 37-39B, the adapter assembly 600 can generally include an adapter body 604 and a locking member or element 606. The adapter body 604 of the adapter assembly 600 can define a male tapered insertion portion 608 and a female tapered receiving portion 610. The male tapered insertion portion 608 can define a threaded bore 611. The female tapered receiving portion 610 can be formed in an offset body portion 612 of the adapter body 604 for receiving a male tapered insertion portion 58 of the stem 20. The adapter body 604 can define flats 614 on an outer surface for gripping and facilitating alignment as will be described. A skirt (not shown), similar to the skirt 54 formed on the adapter body 44 illustrated in FIG. 2, can be defined at a transition between the male tapered insertion portion 608 and the offset body portion 612. A non-skirted transition can alternatively be formed as shown herein. A bore 614 can be defined from an outer surface of the adapter body 604 to the female tapered receiving portion 610. The bore 614 can define threads 616 that threadably receive the locking member 606.

[00114] With reference to FIG. 37, the male tapered insertion portion 608 of the adapter body 604 defines a first axis A₅ and the female tapered receiving portion 610 defines a second axis A₆. Further, in the embodiment illustrated, the first axis A₅ and the second axis A₆ are parallel to one another and spaced apart to provide the desired offset. In this regard, multiple adaptors each having a different offset can be provided to provide the surgeon with intra-operative selection depending on the patient's needs. Insofar as the adapter body 604 provides a 5mm offset, the first and second central axes A₅ and A₆ are spaced apart 5mm. Again, the adapter body 604 can define axes having an

alternate offset. In one such alternate configuration, an adapter body 604' (FIG. 38) includes a male tapered insertion portion 608' that defines a first axis A₇ and the female tapered receiving portion 610' that defines a second axis A₈. The adapter body 604' can define an offset of 2.5mm.

5 [00115] The male tapered insertion portion 608 can taper slightly as it extends away from the adapter body 604. The female tapered receiving portion 610 similarly tapers slightly as it extends into the adapter body 604 from an end of the adapter body 604. As will become appreciated from the following discussion, various male tapered insertion portions (such as portion 608) can be
10 inserted in various female tapered receiving portions (such as portion 610) to form a locking taper or Morse taper. In a manner to be described further below, the locking member 606 can extend into the bore 614 where it ultimately engages a fastener insert 620.

[00116] The fastener insert 620 can include a distal portion 622 which
15 can be externally threaded for engaging the internally threaded aperture 72 of the male tapered insertion portion 58 of the stem 20. The fastener insert 620 can further include a central portion 624 and a proximal portion 626. The proximal portion 626 can define a conical engaging head 630. A gripping detail 632 (such as, but not limited to, a hex-bore for receiving an Allen wrench), can
20 be formed in an upper surface of the proximal portion 626. As will be described in more detail, the fastener insert 620, or more specifically the conical engaging head 630 can be formed of a first biocompatible material while the locking member 606 can be formed of a second biocompatible material. The second biocompatible material can be a higher durometer (harder) material than the first
25 biocompatible material.

[00117] Turning now to FIGS. 36C and 36D, a tibial tray 636 according to additional features is shown. As will be described more fully herein, the tibial tray 636 can be part of a bone-conserving hinge knee prosthesis (FIG. 48A). The tibial tray 636 can define a superiorly extending stub 637 and an inferiorly
30 extending portion 638 that defines a female tapered receiving portion 640. The inferiorly extending portion 638 can define an exterior tapered augment receiving surface 642. The tibial tray 636 can define a threaded passage 646 formed

through the tray portion of the tibial tray 636. The treaded passage 646 can be adapted to threadably accept the locking member 606. Unlike the cruciate retaining tibial tray 22 (FIG. 34) that provides the central aperture 32 for receiving the fastener 90' in the superior/inferior direction, the tibial tray 636 can provide the threaded passage 646 for receiving the locking member 606 in the anterior/posterior direction.

[00118] With reference now to FIGS. 39A-40B, an exemplary sequence of assembling the tibial tray 636, the adapter body 604, and the stem 20 will be described. At the outset, the fastener insert 620 can be threaded into the threaded bore 611. In one example, the fastener insert 620 can be threaded until the central portion 624 engages a terminal surface 650 of the male tapered insertion portion 608 of the adapter body 604. At this point, the stem 20 can be coupled to the adapter body or the adapter body 604 can be coupled to the tibial tray 636. While the order can be reversed, the adapter body 604 can be coupled to the tibial tray 636, by inserting the male tapered insertion portion 608 of the adapter body 604 into the female tapered receiving portion 640 of the tibial tray 636. The surgeon can then rotate the male tapered insertion portion 608 within the female tapered receiving portion 640 to attain the desired orientation. As will be described later, the instant disclosure provides various tools for verifying a correct orientation of the adapter body 604 prior to securing the adapter body 604 in a fixed position relative to the tibial tray 636. Once the desired orientation has been attained, the locking member 606 can be threaded from an unsecured position (FIG. 36C) into engagement with the conical engaging head 630 to a secured position (FIG. 36D).

[00119] As mentioned above, the locking member 606 can be formed of a biocompatible material that is harder than the fastener insert 620. As a result, a distal end 654 of the locking member 606 can deform (e.g. create a depression at) an interface area of the conical engaging head 630. The deformed area is identified at reference numeral 656 (FIGS. 39A and 40B). By deforming an area 656 of the fastener insert 620, the locking function of the locking member 606 can be improved by providing a greater resistance to separation. Explained

further, the resultant depression can inhibit sliding, rotation, or other relative movement between the locking member 606 and the fastener insert 620.

[00120] Next, the stem 20 can be coupled to the adapter body 604 by driving the locking member 606 (i.e. another identical locking member 606) into 5 the fastener insert 620 (i.e. another identical fastener insert 620).

[00121] According to another feature, the threads 616 defined by the bore 614 can define a thread profile that is slightly different (i.e. pitch) than threads 662 defined by the locking member 606. Alternatively, one of the threads 616 or 662 can be deformed initially. Such a relationship can allow the 10 locking member 606 to be retained within the bore 614 upon initial handling by a surgeon. In other words, the locking member 606 can already be positioned within the bore such that the surgeon would not need to locate the distal tip 654 of the locking member 606 into the bore 616 (i.e. mate two separate components). It is appreciated that such thread configuration would not preclude 15 rotation of the locking member 606 within the bore 616 during fastening.

[00122] Turning now to FIG. 41A, the adapter assembly 600 including the adapter body 604 and the locking member 606 are shown assembled with a femoral component 112'. The femoral component 112' is substantially similar to the femoral component 112 (FIG. 8), but can define a threaded bore 668 formed 20 in a femoral box 670. As can be appreciated, the threaded bore 668 can provide a similar function to the threads 616 of the bore 614 of the adapter body 604. As a result, a locking member 606 can be driven to engage a conical engaging head 630 of fastener insert 620.

[00123] As shown in FIG. 41B, a skirt 54" is shown on the adapter body 25 604. The skirt 54" generally defines a flared contour portion that can provide a generally smooth geometrical transition onto the outwardly tapered radially extending portion 432 (see also FIG. 21) of the augment 402. The geometrical transition between the skirt 54" and the augment 402 can reduce otherwise sharp transitions between implanted components to provide a favorable nesting 30 configuration with surrounding bone in an implanted position. Explained more specifically, the male tapered insertion portion 608 of the adapter 604 can define an attachment axis 671. The outwardly tapered radially extending portion 432 of

the body 424 can define a plane 673. The flared contour portion of the skirt 54" can taper generally along the plane 673 in an implanted position. The skirt 54" can therefore cooperate with the augment 402 to effectively fill bone voids.

[00124] As can now be appreciated, the instant disclosure provides a 5 simplified set of interchangeable components wherein an adapter assembly 600 can be used on either side of the joint line (e.g. with a tibial component, such as described in relation to FIG. 35, and also a femoral component, such as described in relation to FIG. 41). Moreover, the locking member 606 and fastener insert 620 combination can be used in several distinct areas as 10 described above. Additionally, the augments such as disclosed in FIGS. 21-25 can be used in cooperation with either a superiorly extending portion (such as portion 130, FIG. 8) of a femoral component or an inferiorly extending portion (such as portion 638, FIG. 36C) of a tibial component.

[00125] Turning now to FIGS. 42-49, additional components that may 15 be used in cooperation with the tibial tray 636 will be described in greater detail. As explained, the tibial tray 636 can be used as part of a bone-conserving hinge knee prosthesis. The tibial tray 636 can cooperate with a bearing 672. A keel 680 can define a first bore 682 for receiving the superiorly extending stub 637, and a second bore 684 for receiving an axle 686. A pair of hubs 688 can 20 engage opposite ends of the axle 686. In one example, a biasing member 687 can bias against an outer surface on the keel 680 to bias the axle 686 outward.

[00126] The keel 680 can be intraoperatively coupled to the femoral component 692 by depressing the axle 686 in a direction inwardly and locating the keel 680 generally into the femoral box 696 of the femoral component 692 25 until the axle 686 aligns with passages 695 and 697 formed in the femoral box. The hubs 688 can nest in the passages 695 and 697 on opposite ends of the axle 686. The axle 686 can bias outwardly encouraging the hubs 688 to seat into the passages 695 and 697. As can be appreciated, during use, the hubs 688 can provide a rotational surface for supporting the axle 686. The hubs 688 30 can be formed of any suitable bearing material such as PEEK, polyethylene, carbon reinforced PEEK. A pin 700 can then be inserted into the keel 680 to inhibit inward compression of the axle 686.

[00127] A shoe 690 can be disposed intermediate of the keel 680 and a femoral component 692. The femoral component 692 can define a threaded bore 694 through the box 696. A superiorly extending portion 698 can receive a male tapered insertion portion 608 of the adapter body 604. The locking member 606 can be used as described above to engage a fastener insert 620 (not specifically shown) extending proud from the male insertion portion 608. Alternatively, a fastener can extend superiorly through the femoral component 692 to securably mate with the adapter body 604 (such as shown in FIG. 8). A horseshoe clip 702 can securably nest in an annular pocket 704 defined on the stub 637.

[00128] With reference now to FIGS. 50-54, additional augments are shown. An augment 710 can define a substantially symmetric profile for securing to either a medial or lateral inferior side of a tibial tray (i.e. such as a tibial tray 22D, FIG. 3D). Passages 712 can be formed through the augment 710 for receiving a fastener (not shown) in an assembled position. Augments 716 and 718 can define passages 720 and 722, respectively for receiving a superiorly extending portion 724 of a femoral component 730 (see FIG. 58). The augments 716 and 718 can define a profile unique for cooperating with a medial or lateral side of a femoral box 732. The augment 716 can be implanted to occupy an area of bone loss on a medial side of the femoral component 730. The augment 718 can be implanted to occupy an area of bone loss on a lateral side of the femoral component. Augments 734 and 736 can define passages 738 and 740 respectively (FIG. 59). The augments 734 and 736 can be used individually or in combination. The respective passages 720, 722, 738 and 740 and the superiorly extending portion 724 of the femoral component 730 can define conical engaging surfaces that are adapted to provide a friction fit formed by a Morse-type taper. The augments 734 and 736 can define a profile different than the augments 716 and 718.

[00129] Returning now to FIG. 53, another augment 744 is shown. The augment 744 can define a passage 746. In one example, the augment 744 can be symmetric for coupling to either a medial or lateral surface of the femoral component 730. Threaded blind bores 750 and 752 can be defined on the

femoral component 730 for accepting a fastener (not shown) for securing an augment 744. Another augment 744' can be provided (that can have a mirror image profile relative to the augment 744) for compatibility with only the medial (or lateral) side of the femoral component.

5 [00130] With reference to FIGS. 54 and 57, a saddlebag augment 754 having a central passage 756 is shown. The central passage 756 can receive the superiorly extending portion 724 of a femoral component 730. As with the other augments provided herein, the central passage 756 and the superiorly extending portion 724 can define conical engaging surfaces that are adapted to
10 provide a friction fit formed by a Morse-type taper. FIG. 60 illustrates a femoral component 730 having the winged augment 450 (FIG. 24) secured to the superiorly extending portion 724.

[00131] Each of the augments disclosed herein can be formed of biocompatible material such as solid metal, porous metal or a combination of
15 solid metal and porous metal. In one example, the solid metal or porous metal can comprise stainless steel, titanium, titanium alloys, cobalt-chromium alloys and other materials that are suited for use in a biocompatible environment. As is generally known in the art, porous metal can provide a suitable surface area for encouraging ingrowth of natural bone and/or soft tissue. Various compositions
20 and methods of making such porous metal may be found in co-pending applications, U.S. Serial Nos. 11/111,123, filed April 21, 2005; 11/294,692, filed December 5, 2005; 11/357,868, filed February 17, 2006 each entitled "Method and Apparatus for Use of Porous Implants"; U.S. Serial No. 11/546,500, filed October 11, 2006, entitled "Method for Use of Porous Implants"; U.S. Serial No.
25 11/709,549, filed February 22, 2007, entitled "Porous Metal Cup with Cobalt Bearing Surface; and U.S. Serial No. 11/357,929, filed February 17, 2006, entitled "Method and Apparatus for Forming Porous Metal Implants", all of which are also assigned to Biomet, Inc., of Warsaw Indiana, which are incorporated herein by reference.

30 [00132] FIGS. 55A illustrates a kit of components 760. The kit of components can be used interchangeably as discussed herein. The stems can define various lengths and diameters. The adapters can define various offsets.

FIG. 55B illustrates such interchangeability. For instance, a surgeon can intraoperatively select a desired femoral component A, a tibial component B, a bearing C, and augment D and an offset adapter E. While not shown, a suitable stem (such as stem 20) can also be coupled to the offset adapter E as described 5 herein.

[00133] As described herein, the tapered female receiving portions have been described as receiving the tapered male insertion portions by way of press-fit. Explained further, the female receiving portions and male insertion portions all define conical engaging surfaces adapted to provide a friction fit formed by a 10 Morse-type taper.

[00134] While the disclosure has been described in the specification and illustrated in the drawings with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the 15 scope of the disclosure as defined in the claims. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the disclosure without departing from the essential scope thereof. Therefore, it is intended that the disclosure not be limited to the particular embodiment illustrated by the drawings and described in the specification as the best mode 20 presently contemplated for carrying out this disclosure, but that the disclosure will include any embodiments falling within the description of the appended claims.

CLAIMS

What is claimed is:

1. A knee joint prosthesis system comprising:

5 a first knee prosthesis component having a first attachment portion formed thereon;

at least a first stem defining a stem engagement portion; and

10 a first adapter having a first adapter engagement portion defining a first axis and a second adapter engagement portion defining a second axis, the first and second axes being parallel and offset;

wherein the first attachment portion is operable to intraoperatively couple with the stem engagement portion or the first adapter engagement portion.

15 2. The system of claim 1, further comprising a second knee prosthesis component distinct from the first knee prosthesis component and having a second attachment portion, wherein the second attachment portion is operable to couple with the stem engagement portion or the first adapter engagement portion.

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3. The system of claim 2 wherein the first knee prosthesis component is a femoral component and the second knee prosthesis component is a tibial component.

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4. The system of claim 3 wherein the first knee prosthesis component includes a plurality of femoral components and the second knee prosthesis component includes a plurality of tibial components.

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5. The system of claim 4 wherein at least one of the femoral components and at least one of the tibial components cooperate to form each of a cruciate retaining (CR) knee prosthesis, a posterior stabilized (PS) knee prosthesis, a fully constrained knee prosthesis, and a hinged knee prosthesis.

6 The system of claim 5, further comprising a tibial bearing selected from the group consisting of a fixed bearing, a floating bearing, and a rotating bearing.

5

7. The system of claim 1 wherein the stem engagement portion is operable to couple with the second adapter engagement portion.

8. The system of claim 1, further comprising a plurality of stems each 10 having a stem engagement portion and defining distinct lengths or diameters, wherein each of the stem engagement portions are operable to couple with the first attachment portion of the knee prosthesis component or the second adapter engagement portion of the adapter.

15 9. The system of claim 1, further comprising a plurality of adapters each defining a first axis through a first adapter engagement portion and a second axis through a second adapter engagement portion, wherein an offset defined between a first and a second axis of the first adapter is distinct from an offset defined between a first and a second axis of another adapter of the 20 plurality of adapters.

10. The system of claim 1 wherein the first attachment portion defines a female tapered receiving portion, and the stem engagement portion and the first adapter engagement portion each define a male tapered insertion portion, 25 wherein the female tapered receiving portion cooperatively engages the male tapered insertion portion by way of a Morse-type taper fit.

11. The system of claim 1, further comprising a first locking member that passes through an adapter bore defined in the first adapter, the first locking 30 member operable to lock the first stem to the first adapter.

12. The system of claim 11 wherein the adapter bore is threaded and wherein the first locking member threadably advances along the adapter bore between an unsecured position and a secured position.

5 13. The system of claim 12, further comprising an insert secured to the stem wherein the first locking member engages the insert at an interface area in the secured position.

10 14. The system of claim 13 wherein the first locking member is formed of a harder material than the insert such that the insert deforms at an interface area upon advancement of the first locking member to the secured position.

15 15. The system of claim 14 wherein the insert defines a conical head, wherein the first locking member engages the conical head in the secured position.

20 16. The system of claim 12, further comprising a second locking member that passes through a prosthesis bore defined in the first prosthesis, the second locking member operable to lock the first prosthesis to the first adapter, wherein the first and second locking members are substantially equivalent.

17. The system of claim 16 wherein the prosthesis bore is defined through a femoral box in a femoral component.

25 18. The system of claim 16 wherein the prosthesis bore is defined through a tray portion of a tibial tray.

30 19. The system of claim 4, further comprising a plurality of augments each defining a passage having a conical engaging surface, wherein each of the plurality of augments are operable to couple with a superiorly extending portion of the femoral component or an inferiorly extending portion of the tibial component.

20. The system of claim 19 wherein one of the augments defines an outwardly tapered, radially extending portion.

5 21. The system of claim 20 wherein the conical engaging surface of the augment defines an attachment axis, the augment further including a radially extending body that tapers along a plane that intersects the attachment axis, wherein the adapter defines a flared contour portion that tapers along the plane in an implanted position.

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22. The system of claim 19 wherein the plurality of augments each define a conical engaging surface defining an attachment axis, the plurality of augments including a first augment defining a first step and a second augment defining a second step, wherein the first and second augments are operable to 15 rotate around the attachment axis to locate at a desired location relative to the femoral component or the tibial component.

23. The system of claim 22 wherein the first and second augments can be used individually or in combination, wherein the first and second steps mate 20 when the first and second augments are used in combination.

24. The system of claim 4, further comprising a first augment and a second augment each having a conical engaging surface and operable to couple individually or in combination with a superiorly extending portion of the femoral 25 component, wherein the first augment defines a first body that occupies an anatomical space on a medial side of a femoral box and the second augment defines a second body that occupies an anatomical space on a lateral side of the femoral box.

30 25. The system of claim 3 wherein the femoral component and the tibial component are cooperatively coupled by a hinge, wherein the hinge defines a keel having an axle that is biased outwardly along its length, the axle engaging

hubs disposed on a femoral box of the femoral component in an implanted position.

26. A knee joint prosthesis system comprising:

5 a femoral component having a first attachment portion formed thereon;

a tibial component having a second attachment portion formed thereon; and

10 a first adapter having a first adapter engagement portion defining a first axis and a second adapter engagement portion defining a second axis, the first and second axes being parallel and offset;

wherein the first adapter engagement portion is operable to intraoperatively couple with the first attachment portion or the second attachment portion.

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27. The system of claim 26, further comprising a plurality of stems each having a stem engagement portion and defining distinct lengths, wherein each of the stem engagement portions are operable to couple with the first attachment portion of the knee prosthesis component or the second adapter 20 engagement portion of the adapter.

28. The system of claim 26, further comprising a plurality of adapters each defining a first axis through a first adapter engagement portion and a second axis through a second adapter engagement portion, wherein an offset 25 defined between a first and a second axis of the first adapter is distinct from an offset defined between a first and a second axis of another adapter of the plurality of adapters.

29. The system of claim 27 wherein the first attachment portion defines 30 a female tapered receiving portion, and the stem engagement portion and the first adapter engagement portion each define a male tapered insertion portion,

wherein the female tapered receiving portion cooperatively engages the male tapered insertion portion by way of a Morse-type taper fit.

30. The system of claim 27, further comprising a locking member that
5 threadably advances along a threaded bore defined in the first adapter between
an unsecured position and a secured position, the locking member engaging
structure associated with the first stem and locking the first stem to the first
adapter in the secured position.

10 31. The system of claim 30 wherein the structure comprises an insert
secured to the stem wherein the locking member engages the insert at an
interface area in the secured position.

15 32. The system of claim 31 wherein locking member is formed of a
harder material than the insert such that the insert deforms at an interface area
upon advancement of the locking member to the secured position and wherein
the insert defines a conical head, wherein the locking member engages the
conical head in the secured position.

20 33. The system of claim 32, further comprising a plurality of augments
each defining a passage defining a conical engaging surface, wherein each of
the plurality of augments are operable to couple with a superiorly extending
portion of the femoral component or an inferiorly extending portion of the tibial
component.

25 34. A method of performing knee surgery, the method comprising:
providing a plurality of femoral components each having a first
attachment portion formed thereon and a plurality of tibial components each
having a second attachment portion formed thereon;
30 providing a plurality of adapters each having a first adapter
engagement portion defining a first axis and a second adapter engagement
portion defining a second axis, the first and second axes being offset, wherein

one adapter of the plurality of adapters has an offset distinct from another adapter of the plurality of adapters and wherein the first adapter engagement portion of each of the plurality of adapters is operable to couple with the first attachment portion or the second attachment portion;

5 providing a plurality of stems having various lengths or diameters, each of the plurality of stems defining a stem engagement portion that is operable to couple with the first attachment portion, the second attachment portion or the second adapter engagement portion;

10 determining a desired implant configuration from the femoral component, tibial component, plurality of adapters and plurality of stems; and intraoperatively coupling the desired configuration.

35. The method of claim 34 wherein intraoperatively coupling the desired configuration includes forming a cruciate retaining (CR) knee prosthesis, 15 a posterior stabilized (PS) knee prosthesis, a fully constrained knee prosthesis, or a hinged knee prosthesis.

36. The method of claim 35, further comprising providing a tibial bearing selected from the group consisting of a fixed bearing, a floating bearing, 20 and a rotating bearing.

37. The method of claim 34 wherein intraoperatively coupling the desired configuration includes inserting a male tapered insertion portion defined on the first adapter engagement portion of a first adapter into a female tapered 25 receiving portion defined on the first attachment portion or the second attachment portion to form a Morse-type taper fit.

38. The method of claim 37 wherein intraoperatively coupling the desired configuration includes advancing a locking member through an adapter 30 bore defined on the first adapter.

39. The method of claim 38 wherein advancing the locking member includes threadably advancing the locking member through a threaded bore defined on the first adapter.

5 40. The method of claim 39 wherein advancing the locking member includes engaging an insert associated with a stem of the plurality of stems at an interface area, wherein the insert deforms at the interface area upon advancement of the locking member to a secured position.

10 41. The method of claim 38 wherein the locking member locks a desired stem of the plurality of stems to the first adapter.

15 42. The method of claim 38 wherein the locking member locks a desired femoral component of the plurality of femoral components to the first adapter.

20 43. The method of claim 37 wherein intraoperatively coupling the desired configuration includes advancing a locking member through a bore defined through a platform portion of a tibial component of the plurality of tibial components.

44. The method of claim 34, further comprising providing a plurality of 25 augments each defining a passage having a conical engaging surface defining an attachment axis, wherein each of the plurality of augments are operable to couple with a superiorly extending portion of each femoral component of the plurality of femoral components or an inferiorly extending portion of each of the tibial component of the plurality of tibial components; and

30 wherein intraoperatively coupling the desired configuration includes slidably attaching a first augment of the plurality of augments onto either of the superiorly extending portion or the inferiorly extending portion creating a Morse-type taper fit.

45. The method of claim 44 wherein slidably attaching the first augment includes rotating the first augment around the attachment axis to attain a desired orientation relative to the superiorly extending portion or the inferiorly extending portion.

5

46. The method of claim 45, further comprising slidably attaching a second augment of the plurality of augments onto either of the superiorly extending portion or the inferiorly extending portion creating a Morse-type taper fit, wherein the first and second augments each define stepped portions that 10 cooperatively mate in an implanted position.

10

47. A knee joint prosthesis system comprising:

a femoral component having a superiorly extending portion formed thereon;

15

a tibial component having an inferiorly extending portion formed thereon; and

20

a plurality of augments each defining a passage having a conical engaging surface, wherein each of the plurality of augments are operable to couple with the superiorly extending portion of the femoral component or the inferiorly extending portion of the tibial component.

48. The system of claim 47 wherein the conical engaging surface cooperates with the superiorly extending portion or the inferiorly extending portion to form a Morse-type taper fit in an assembled position.

25

49. The system of claim 48 wherein the plurality of augments each define an attachment axis through the conical engaging surface, the plurality of augments including a first augment defining a first step and a second augment defining a second step, wherein the first and second augments are operable to 30 rotate around the attachment axis to locate at a desired location relative to the femoral component or the tibial component.

50. The system of claim 47 wherein the first and second augments can be used individually or in combination, wherein the first and second steps mate when the first and second augments are used in combination.

5 51. The system of claim 48, further comprising a plurality of stems each having a stem engagement portion and defining distinct lengths, wherein each of the stem engagement portions are operable to couple with a first female tapered receiving portion formed on the superiorly extending portion or a second female tapered receiving portion formed on the inferiorly extending portion.

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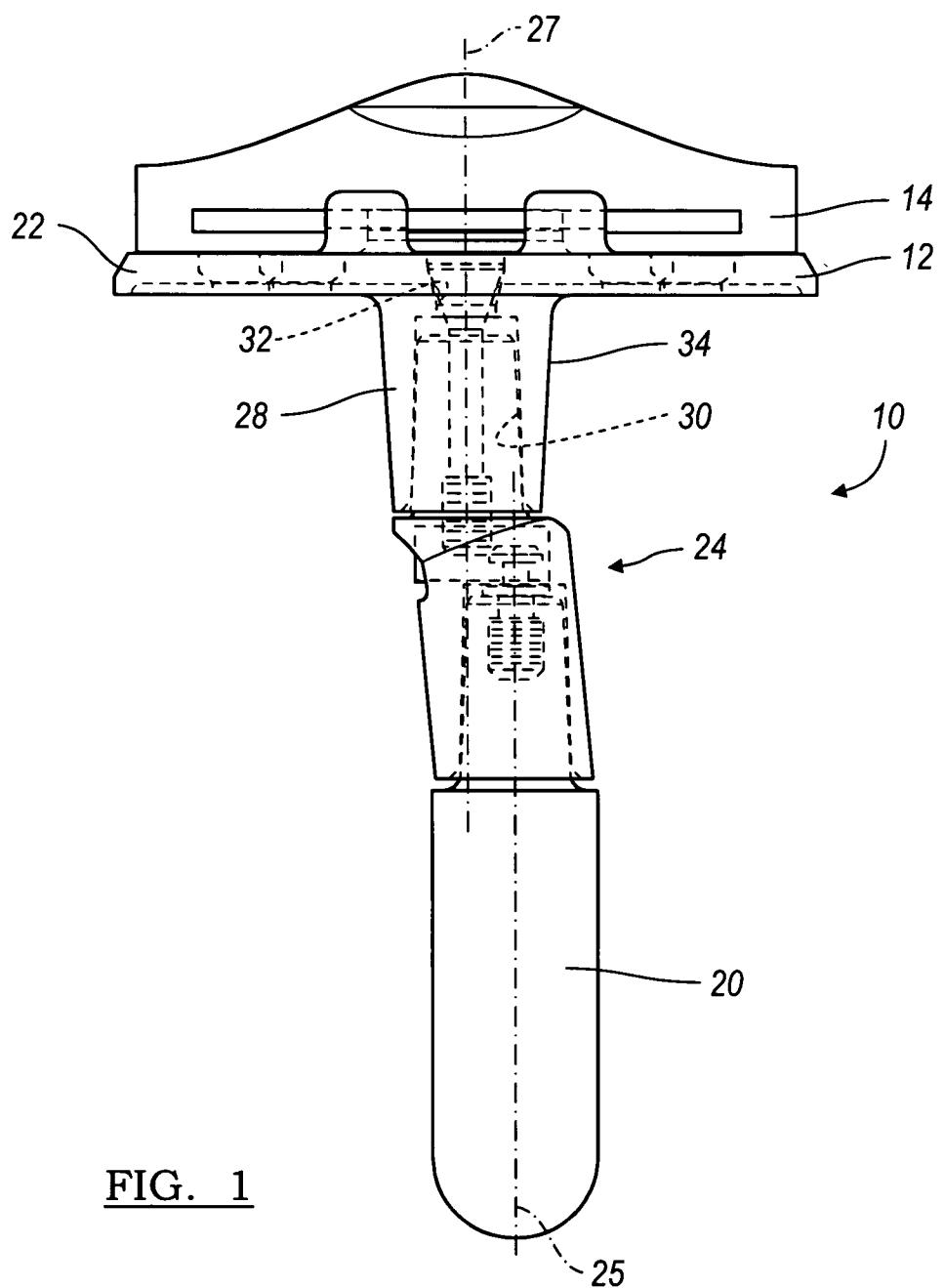
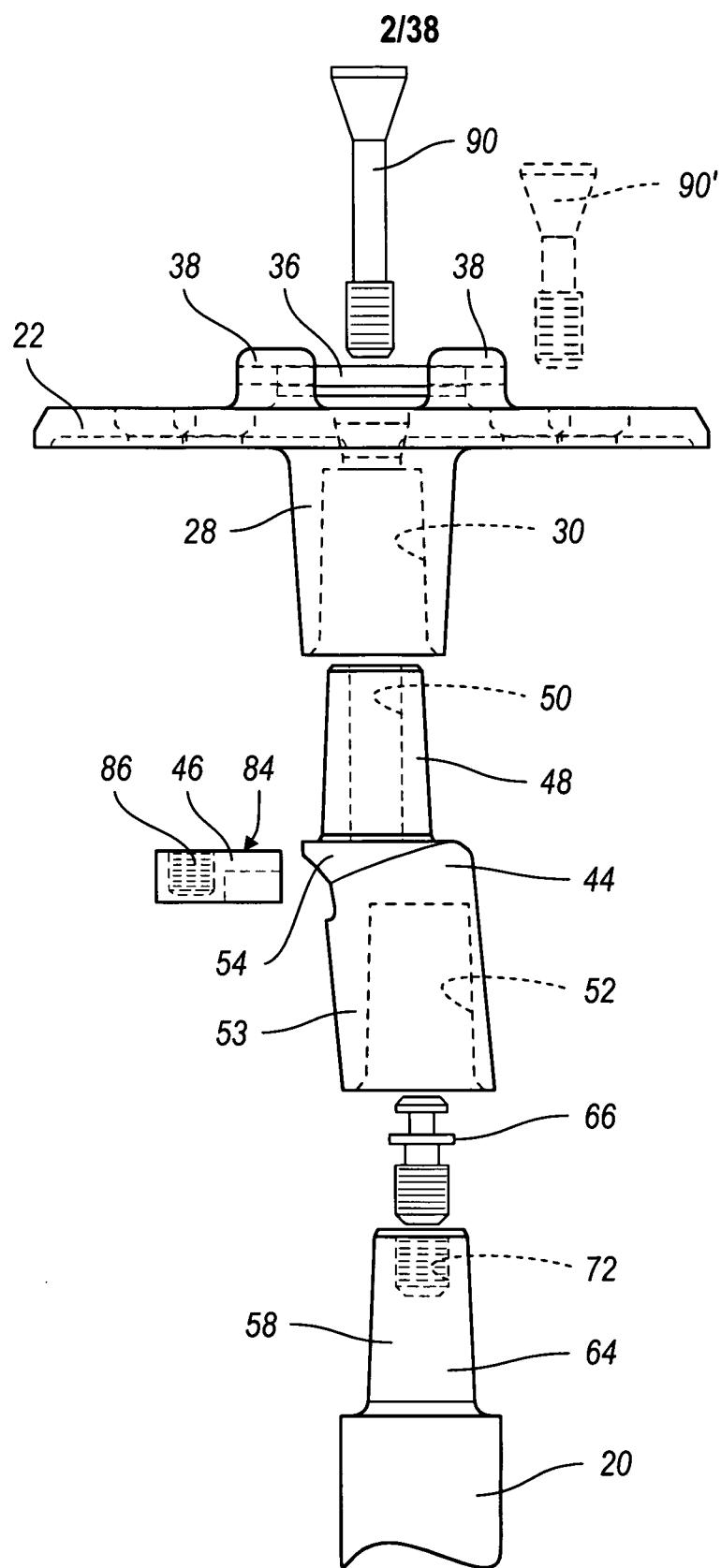


FIG. 1



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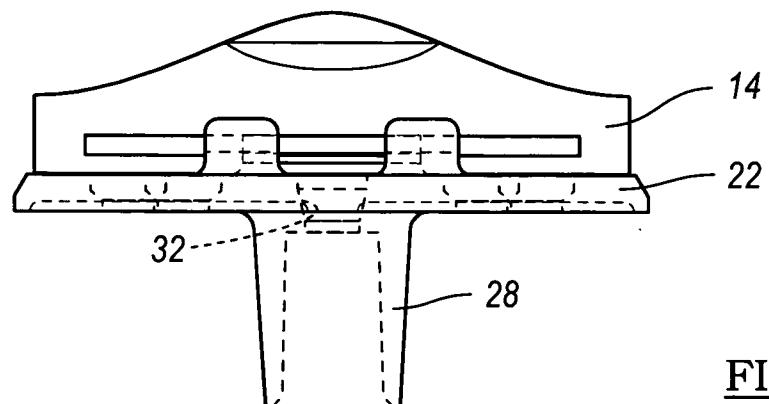


FIG. 3A

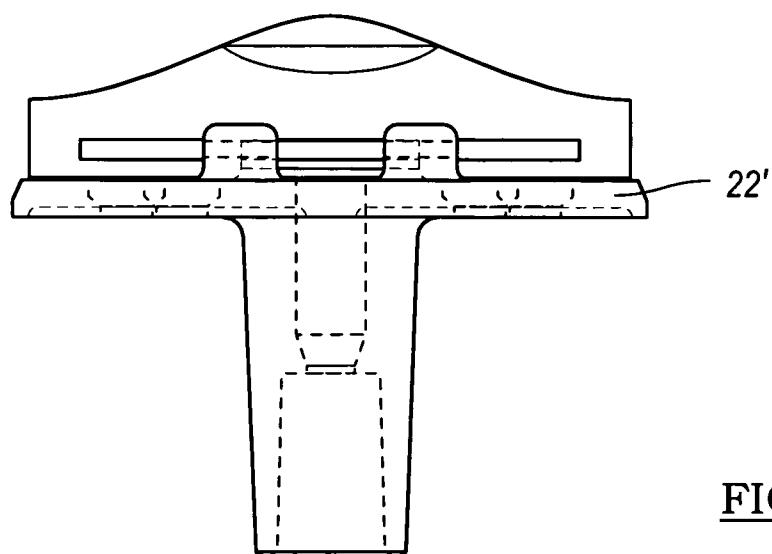


FIG. 3B

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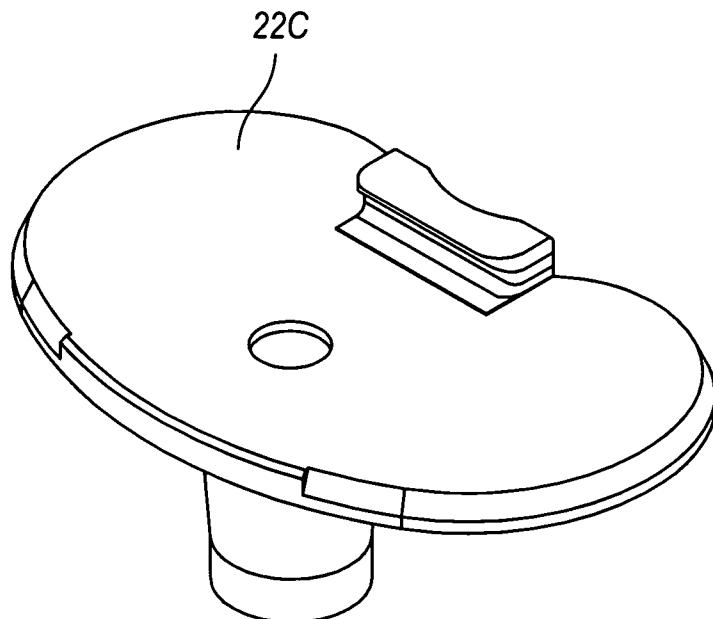


FIG. 3C

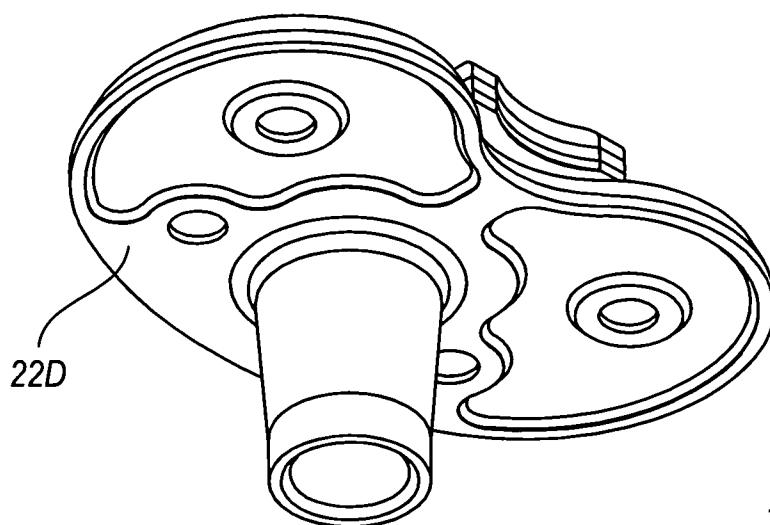
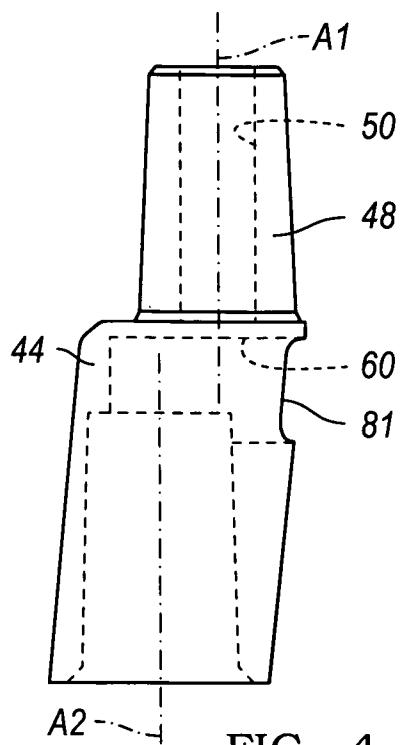
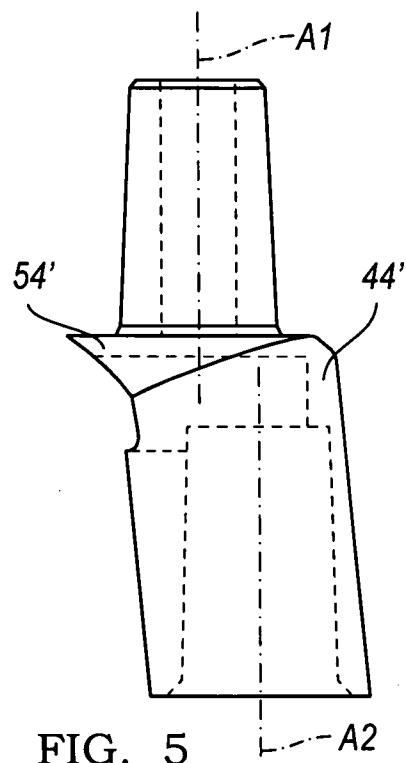
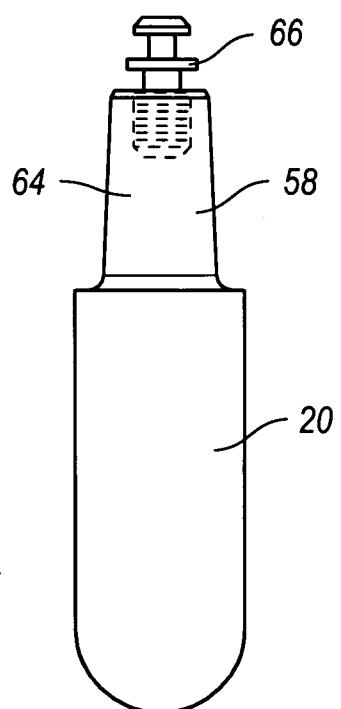


FIG. 3D

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FIG. 4FIG. 5FIG. 6

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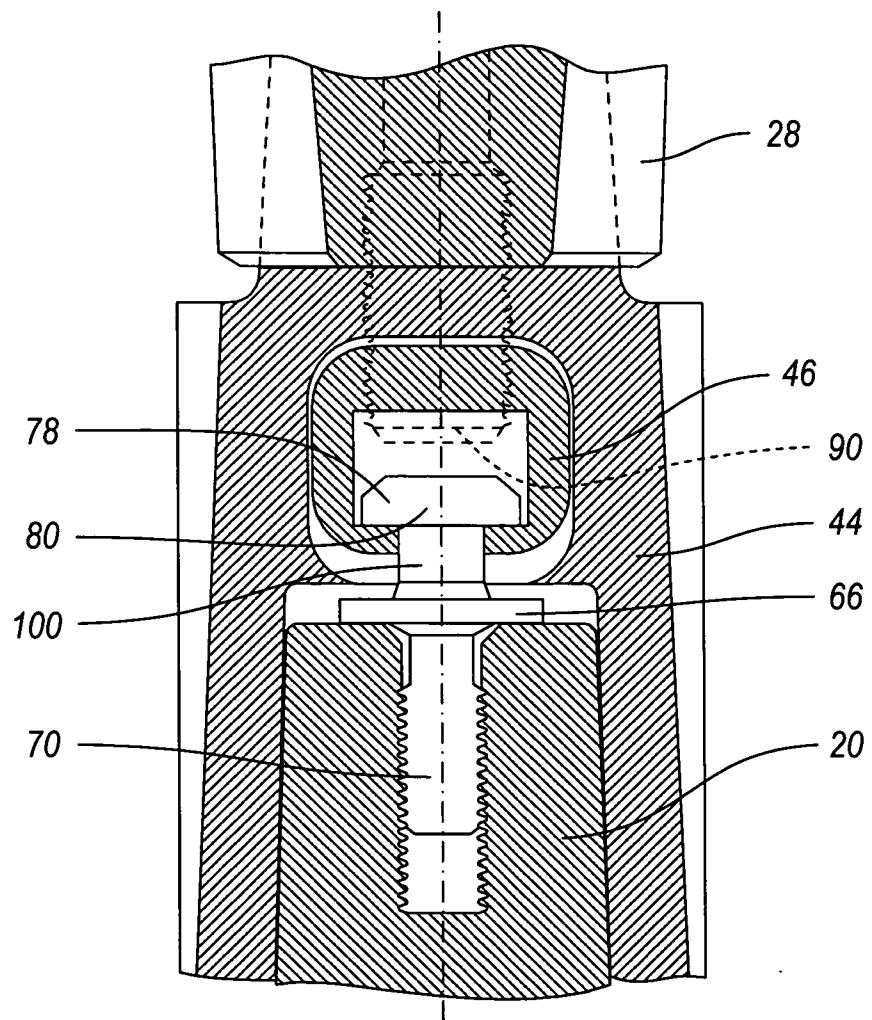
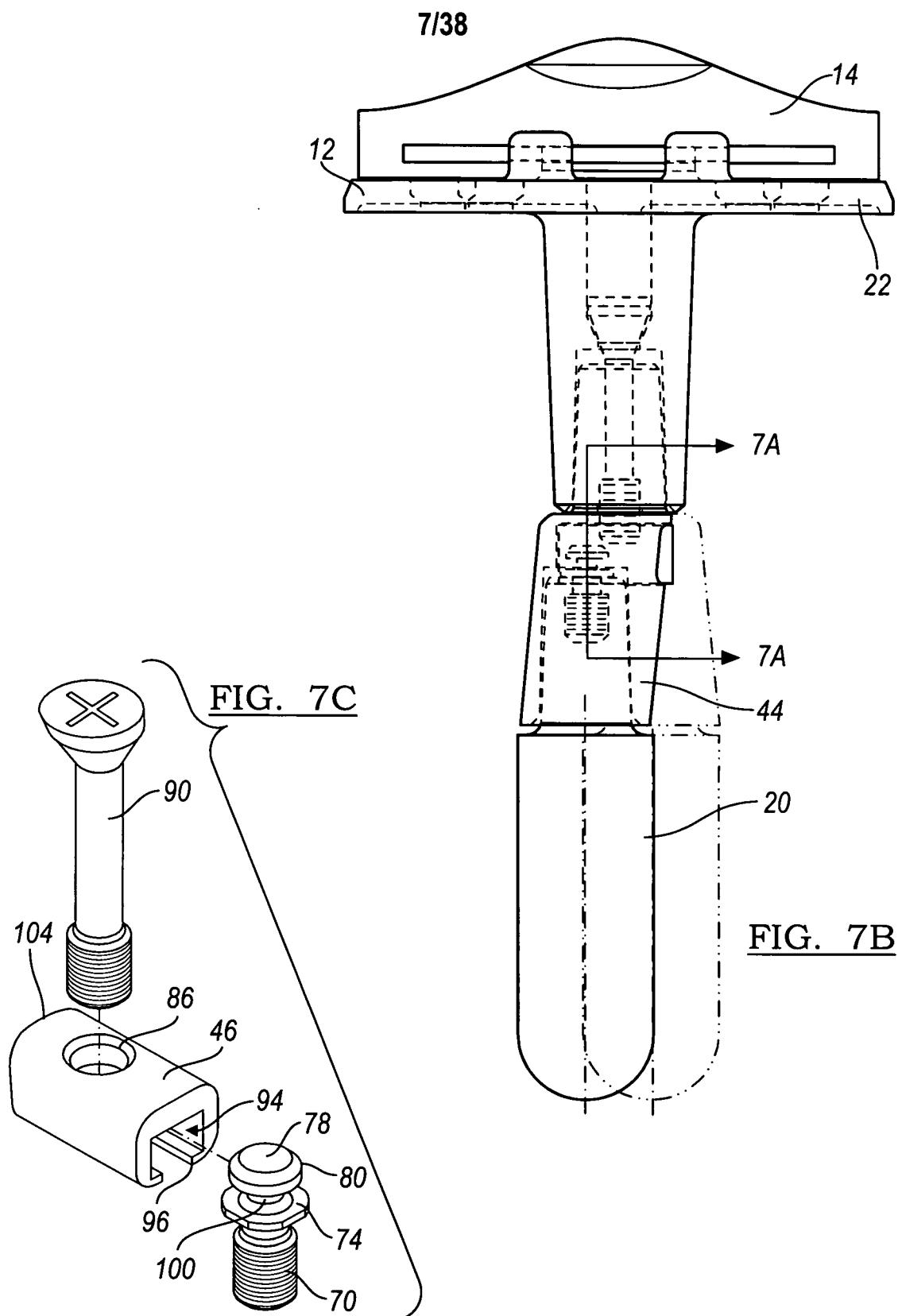


FIG. 7A



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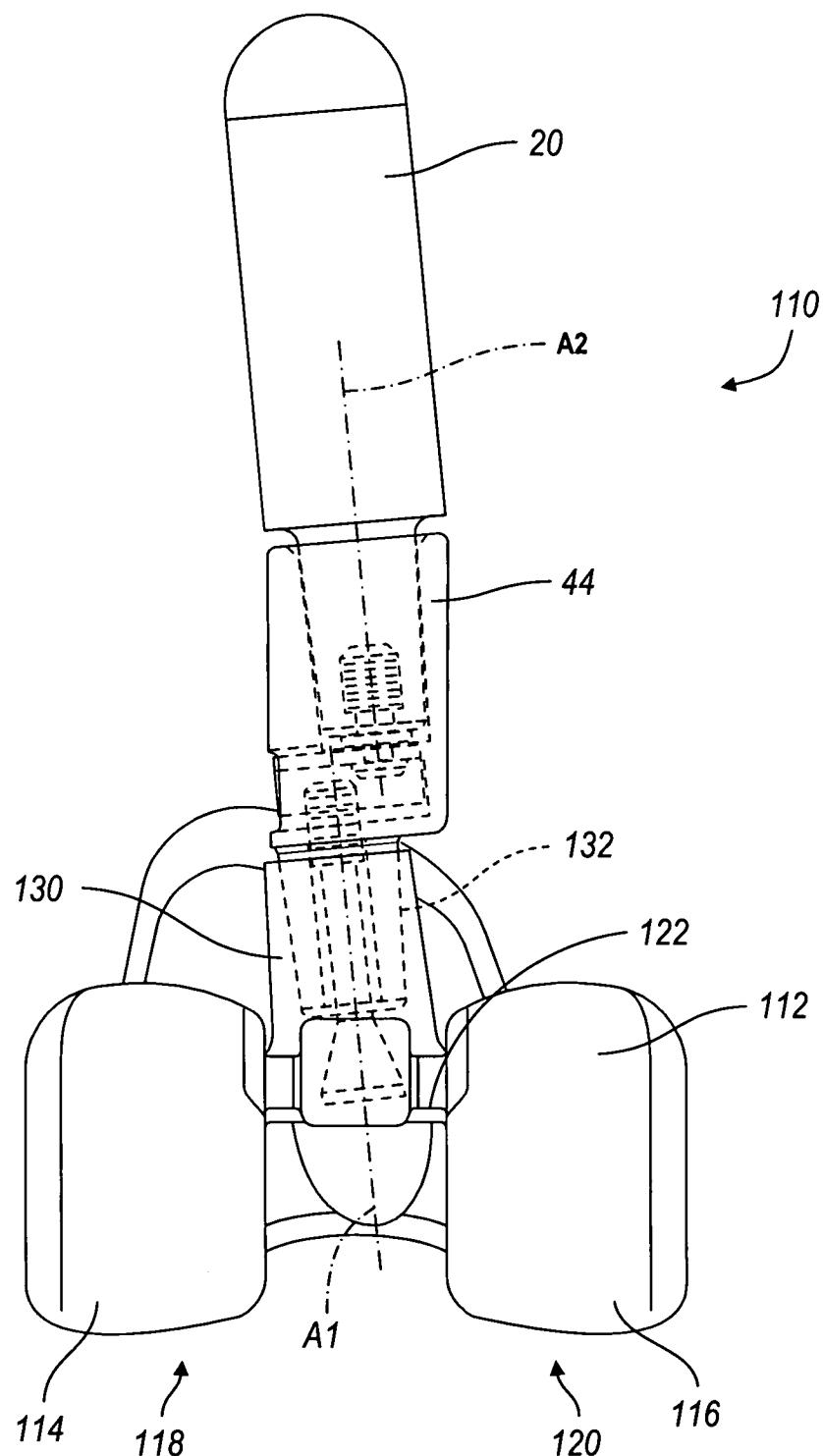
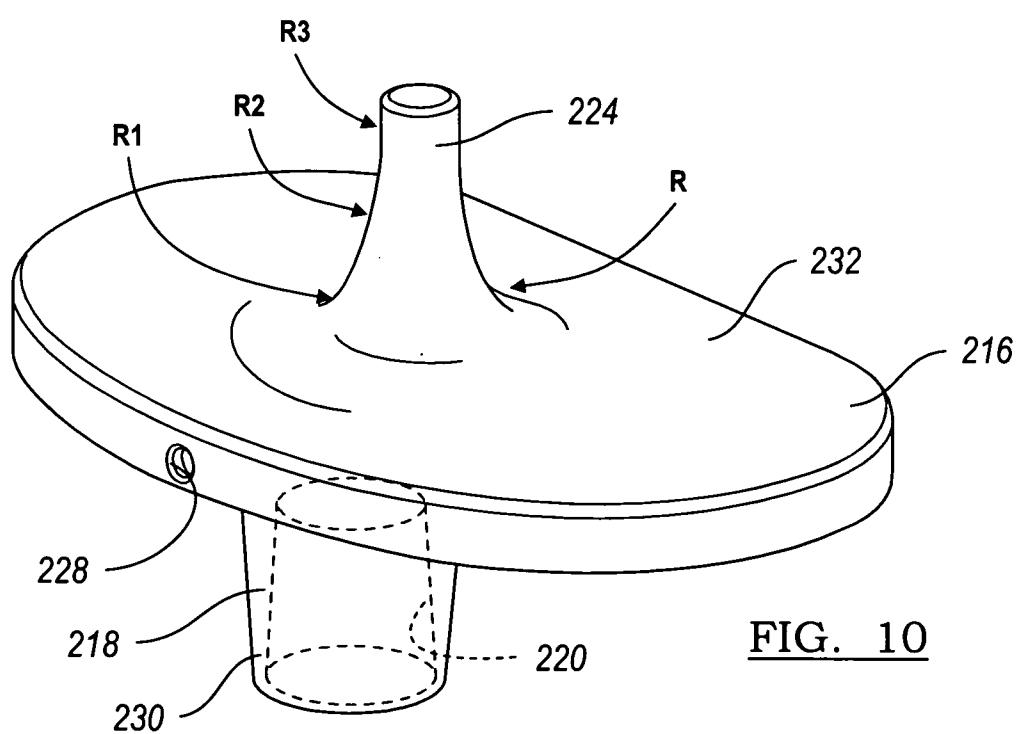
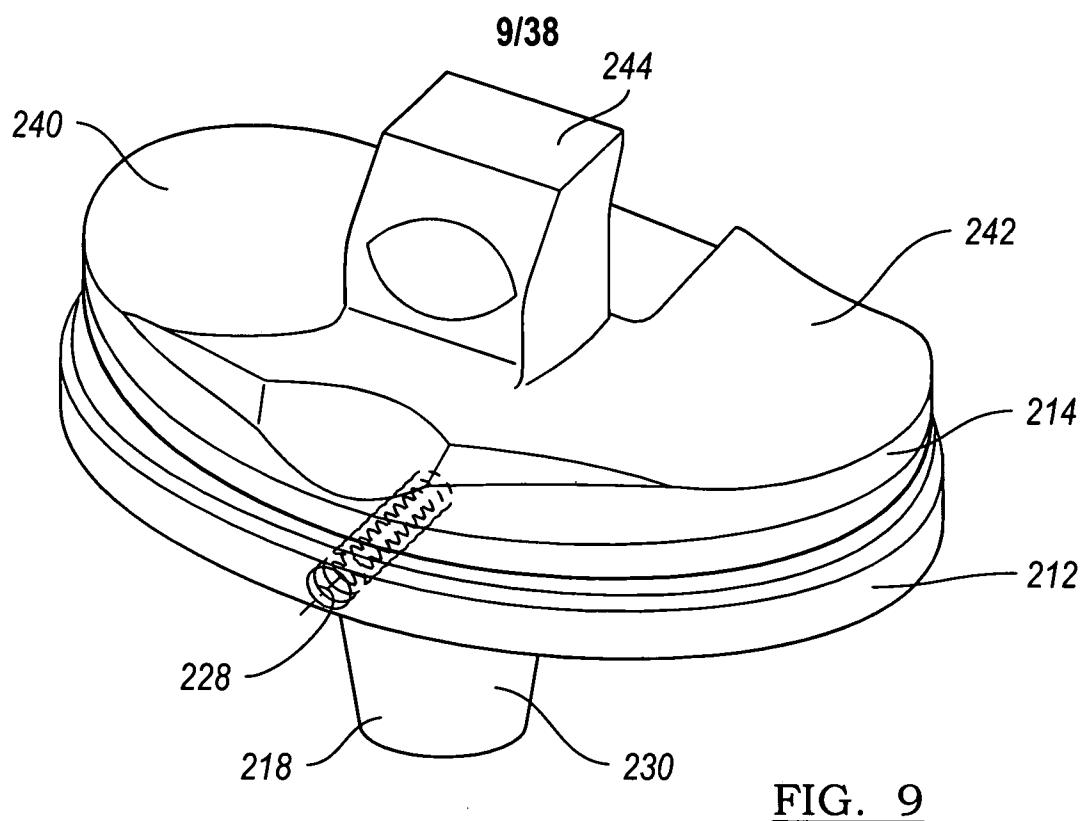
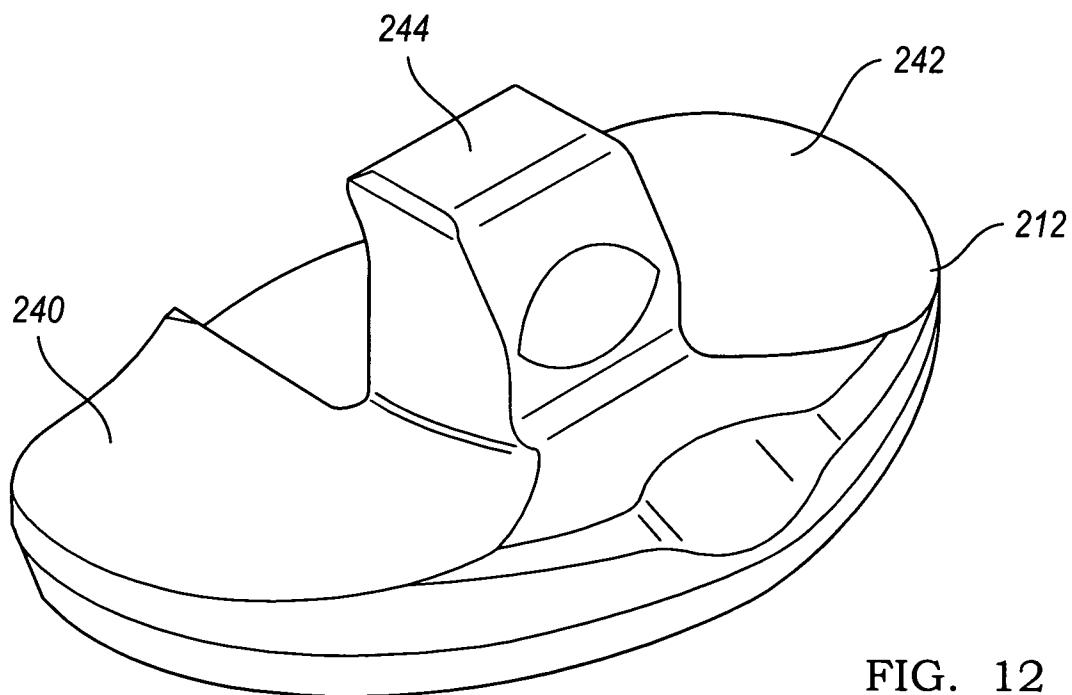
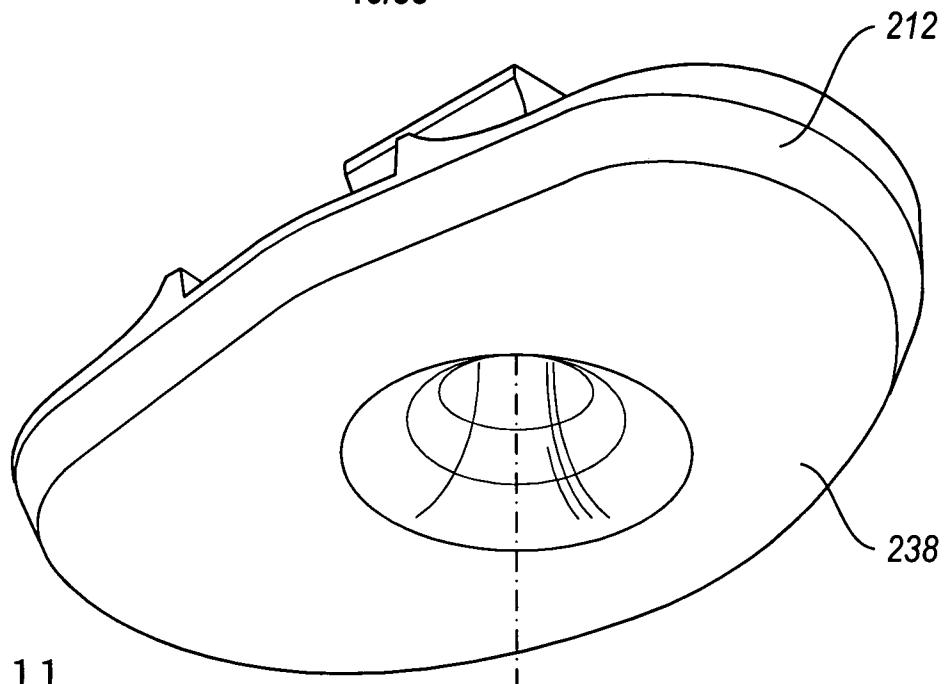
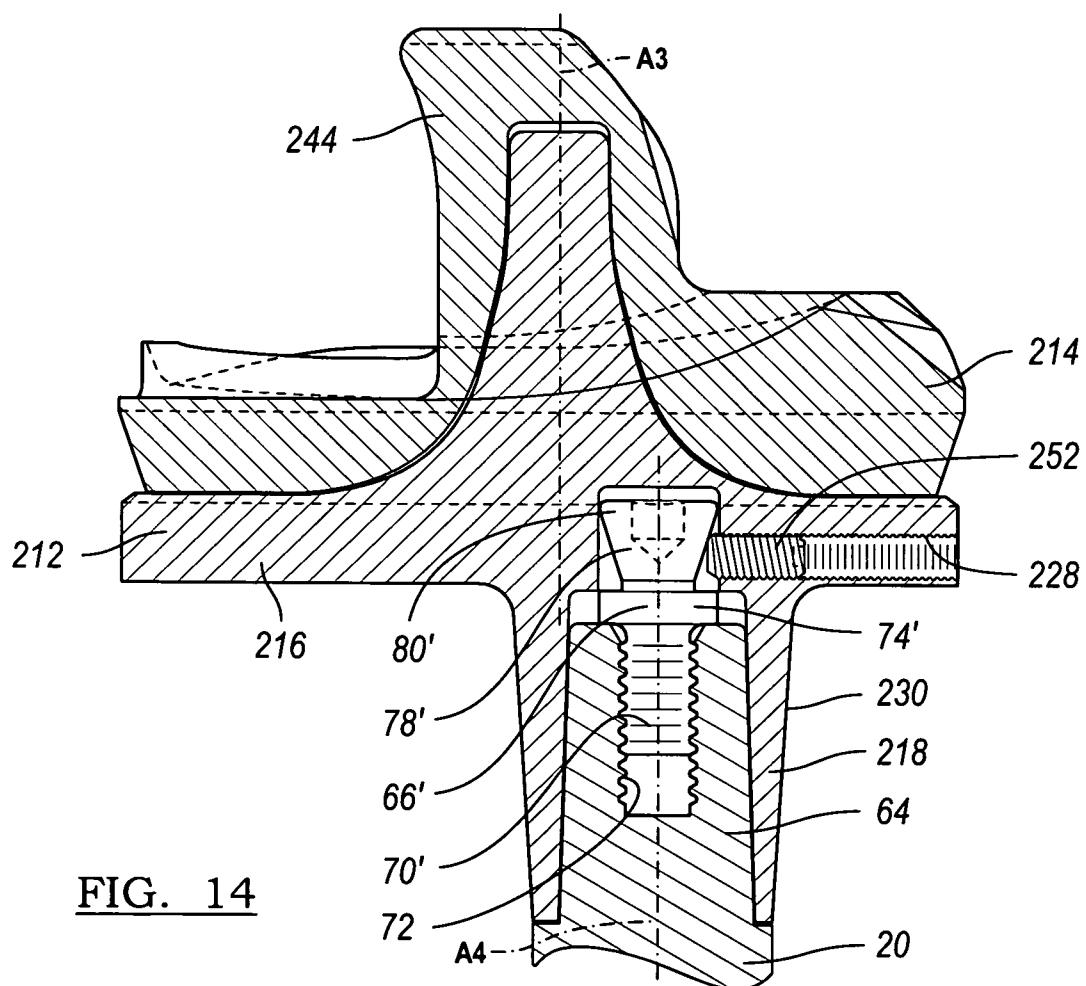
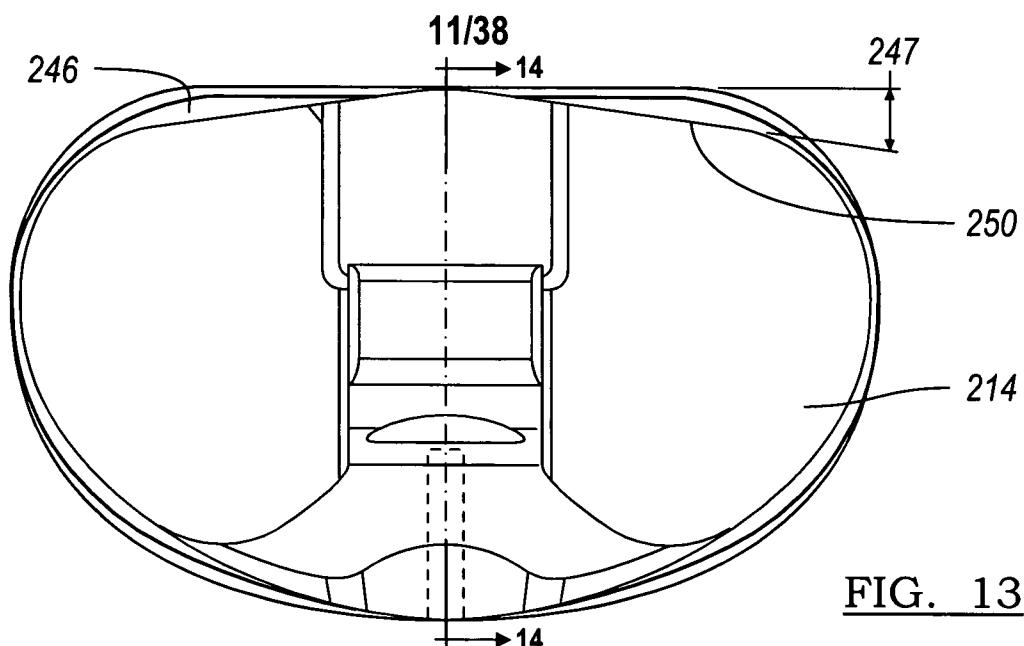


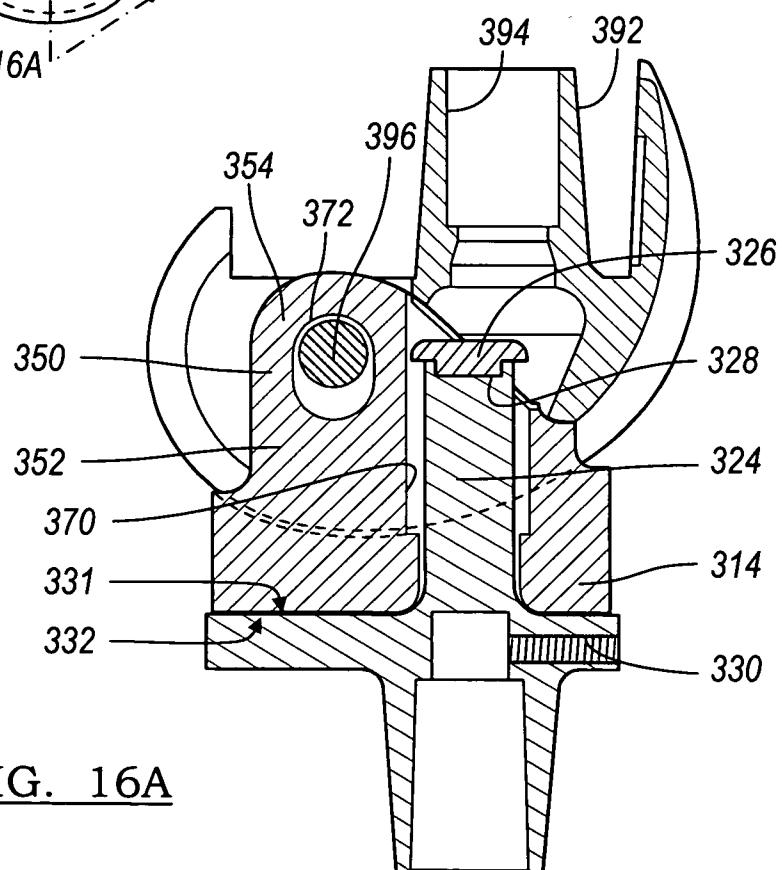
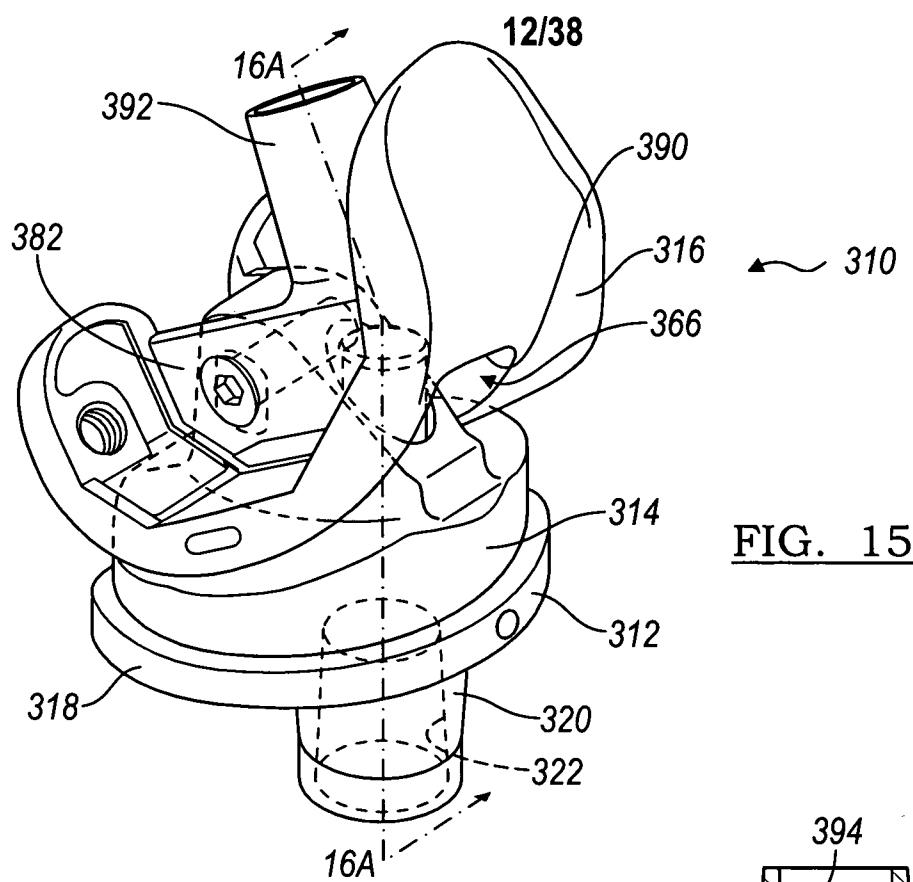
FIG. 8



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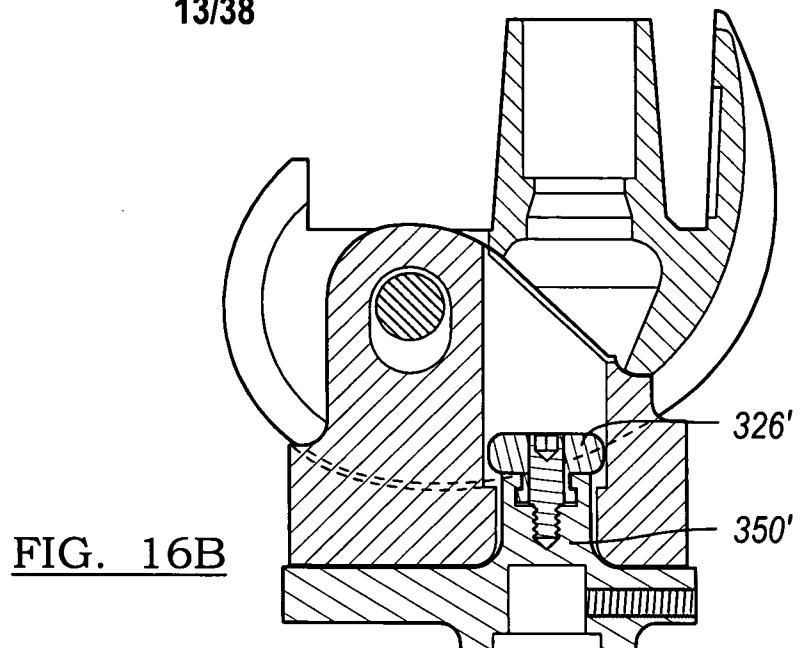


FIG. 16B

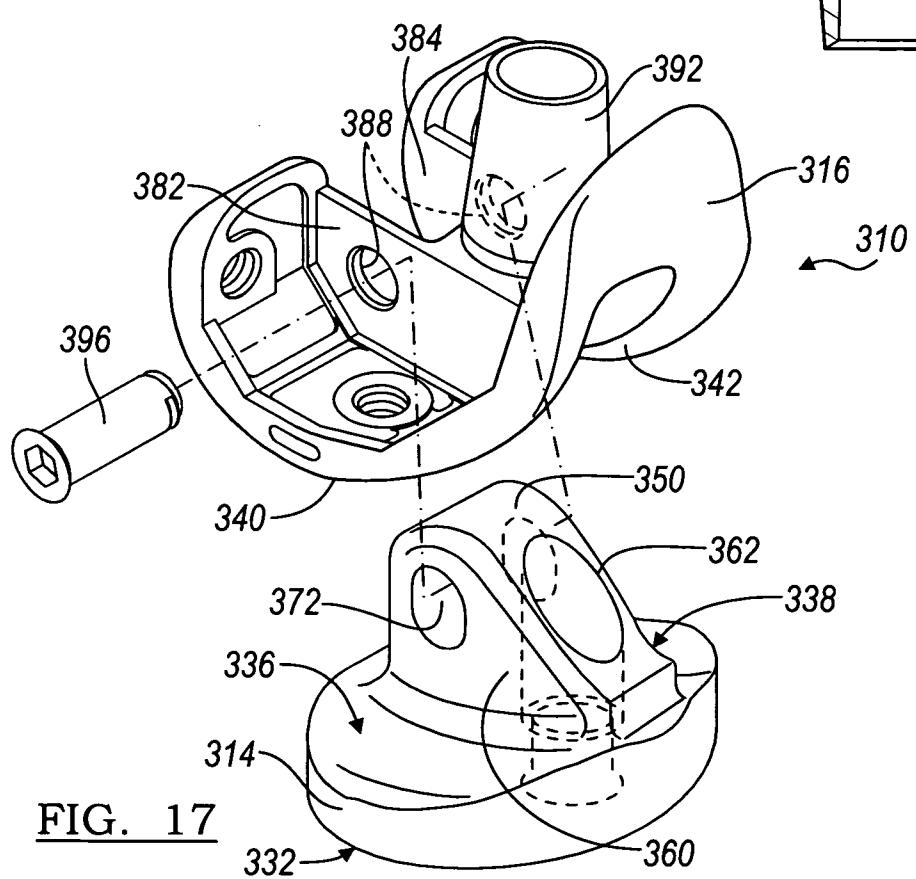
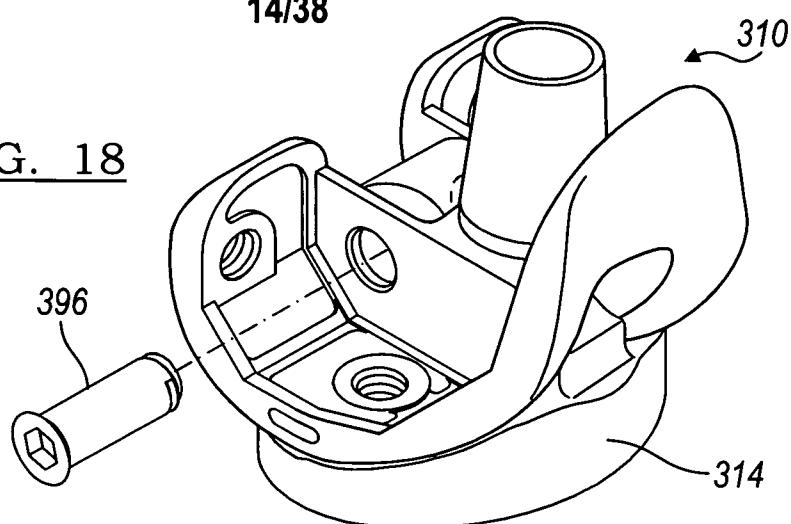
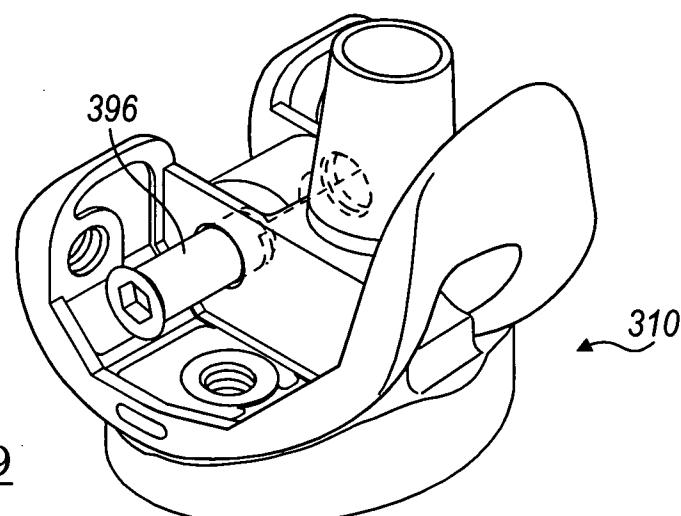
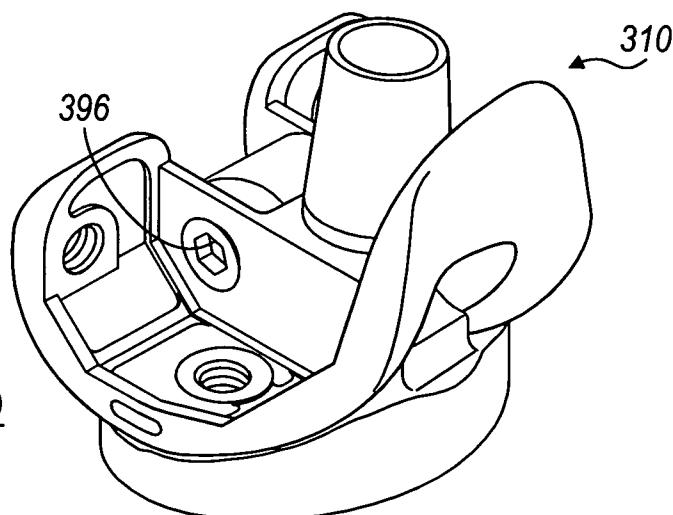
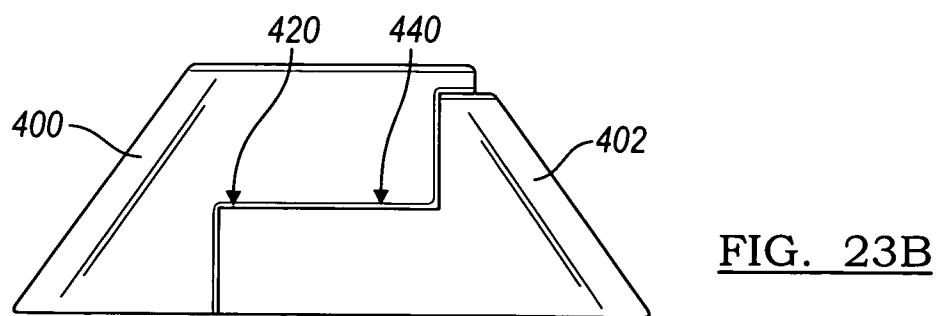
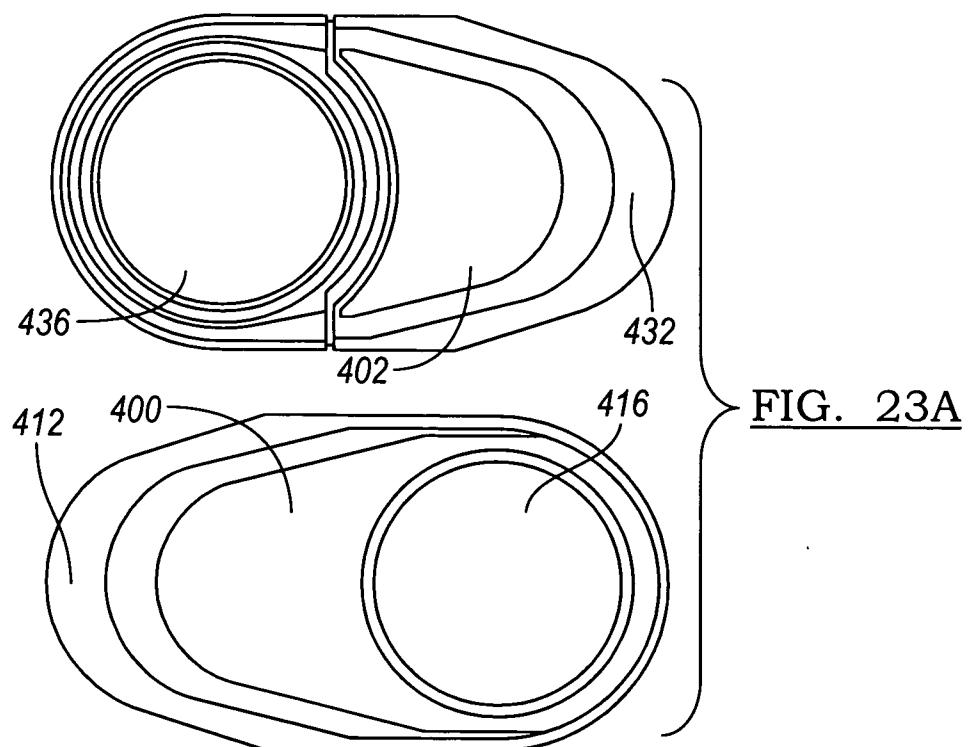
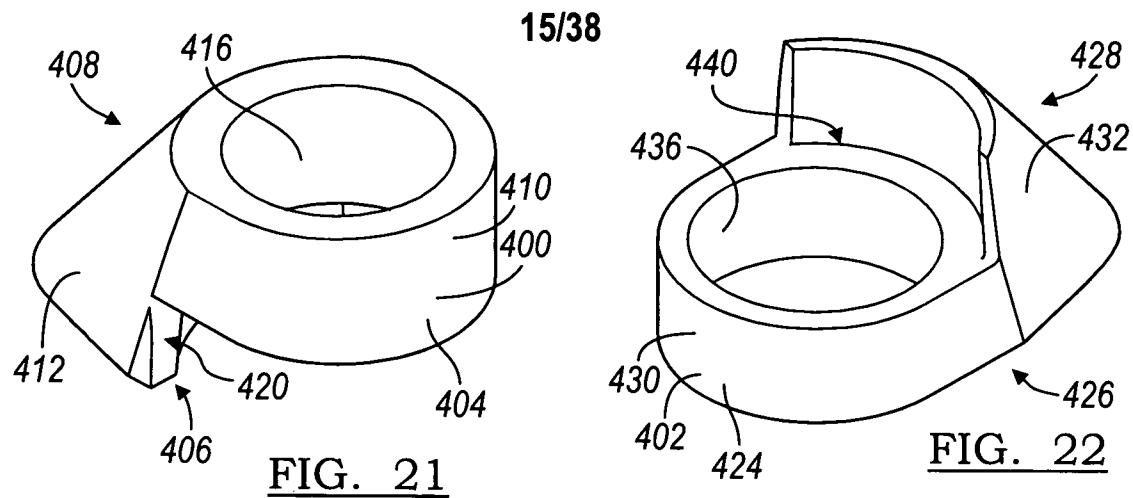


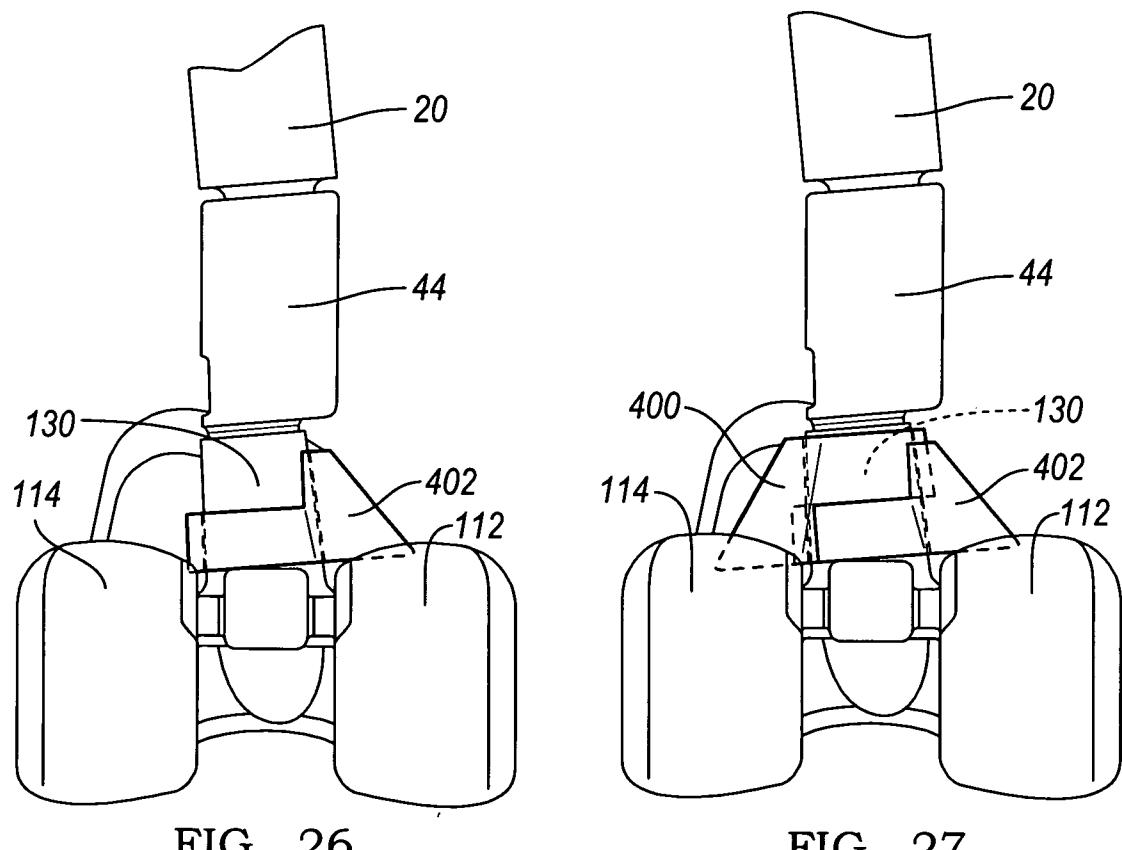
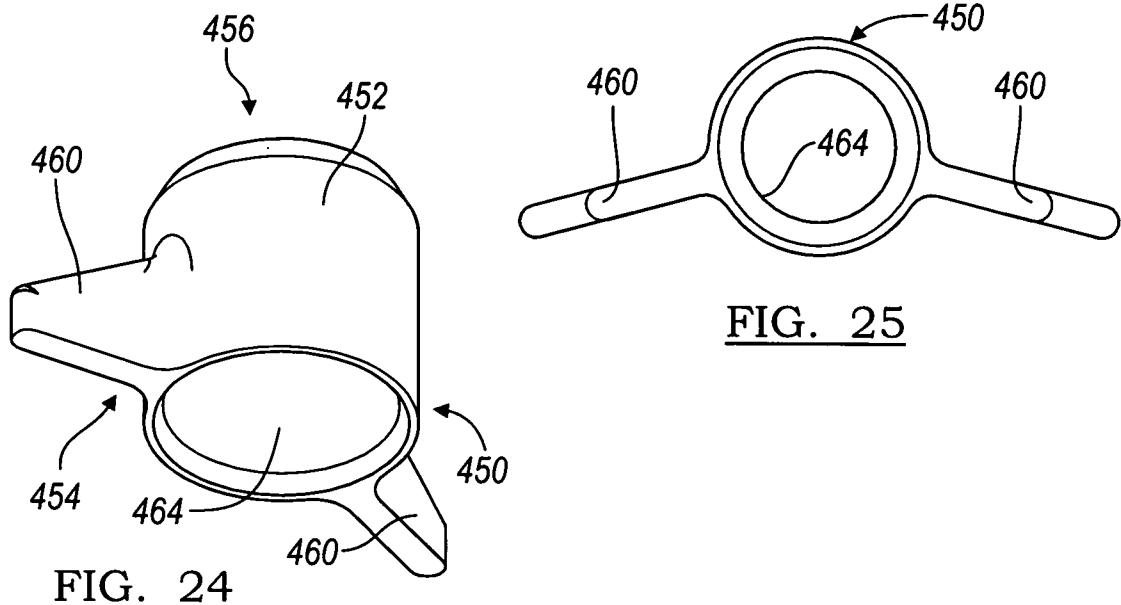
FIG. 17

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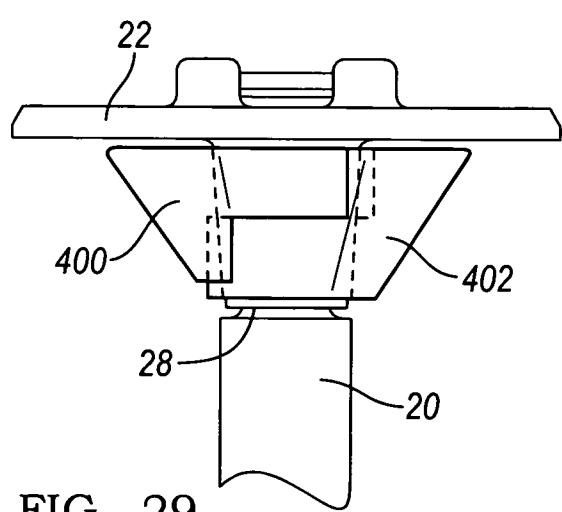
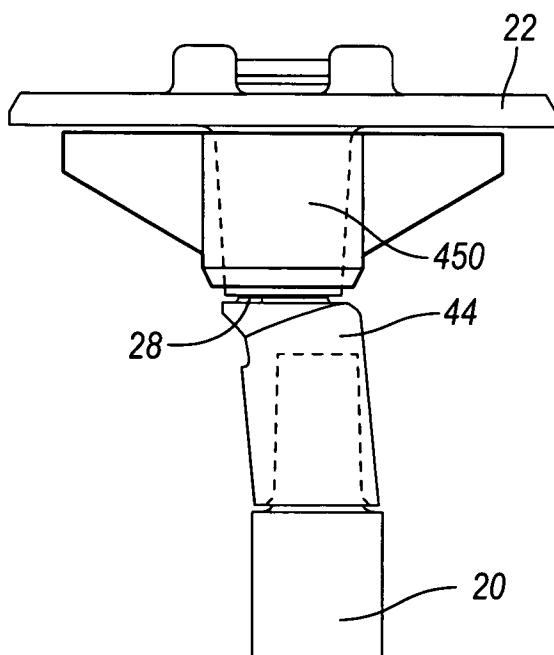
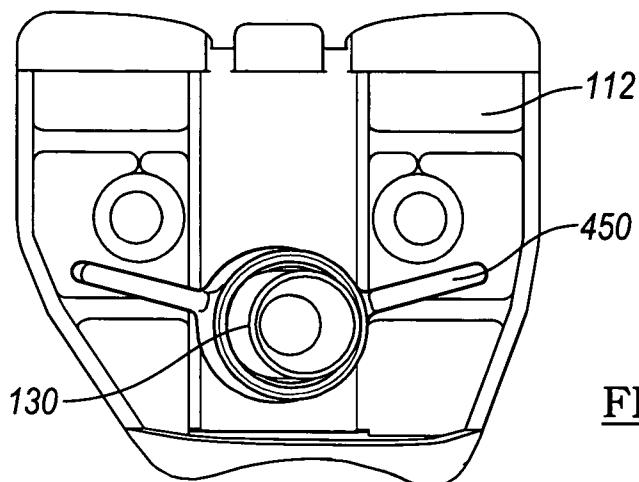
FIG. 18FIG. 19FIG. 20

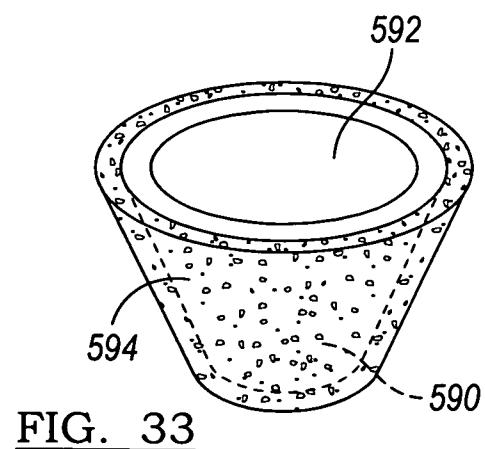
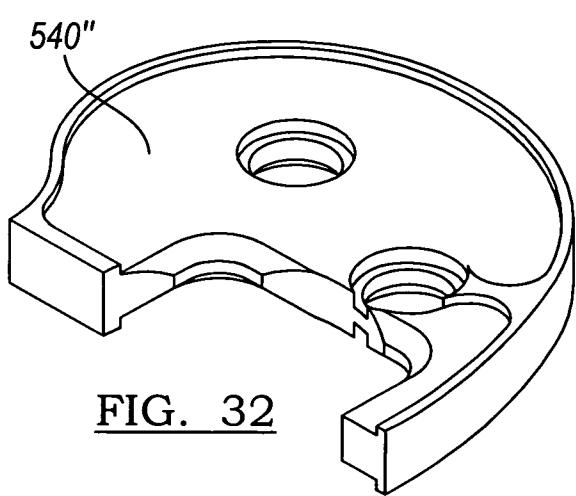
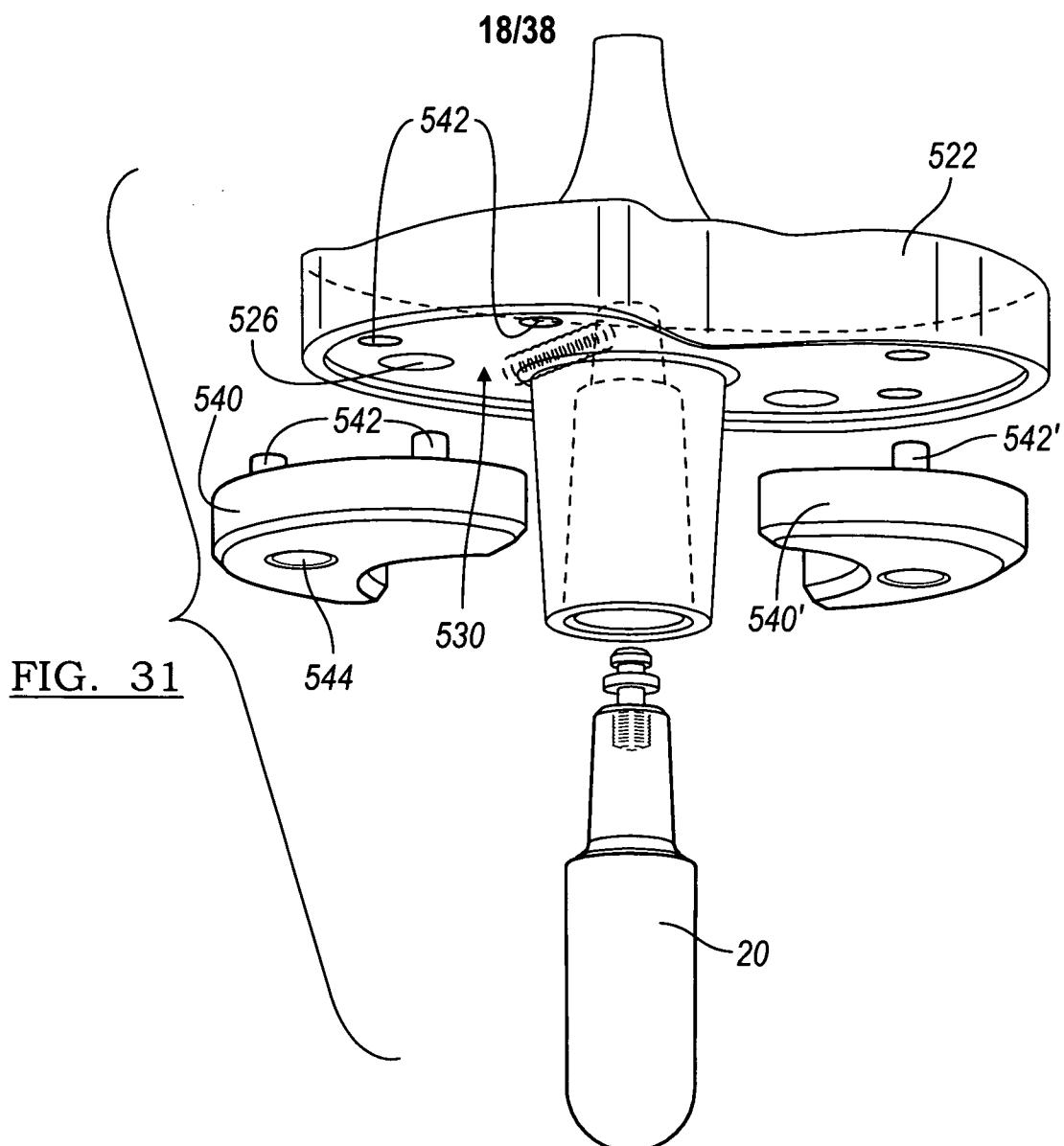


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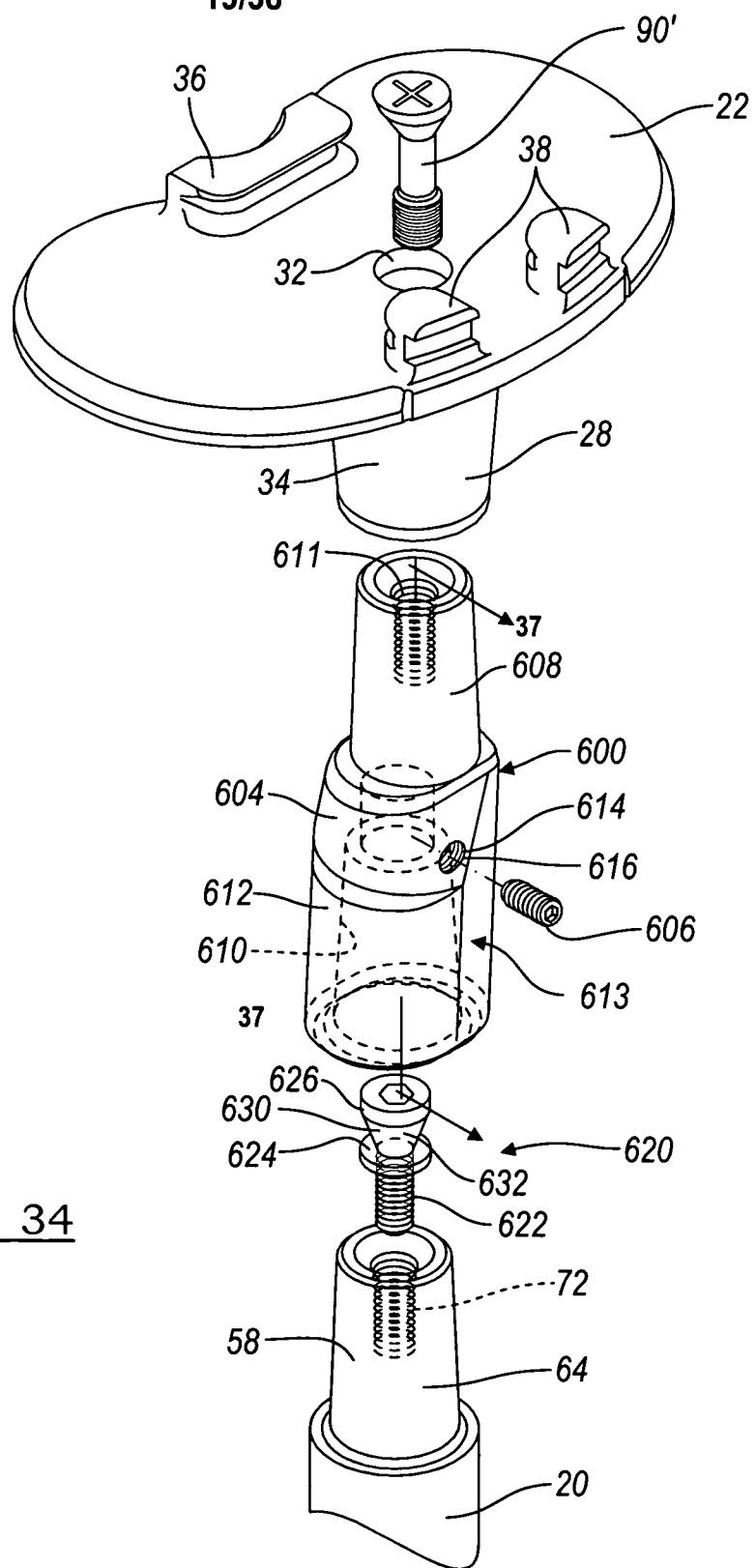


FIG. 34

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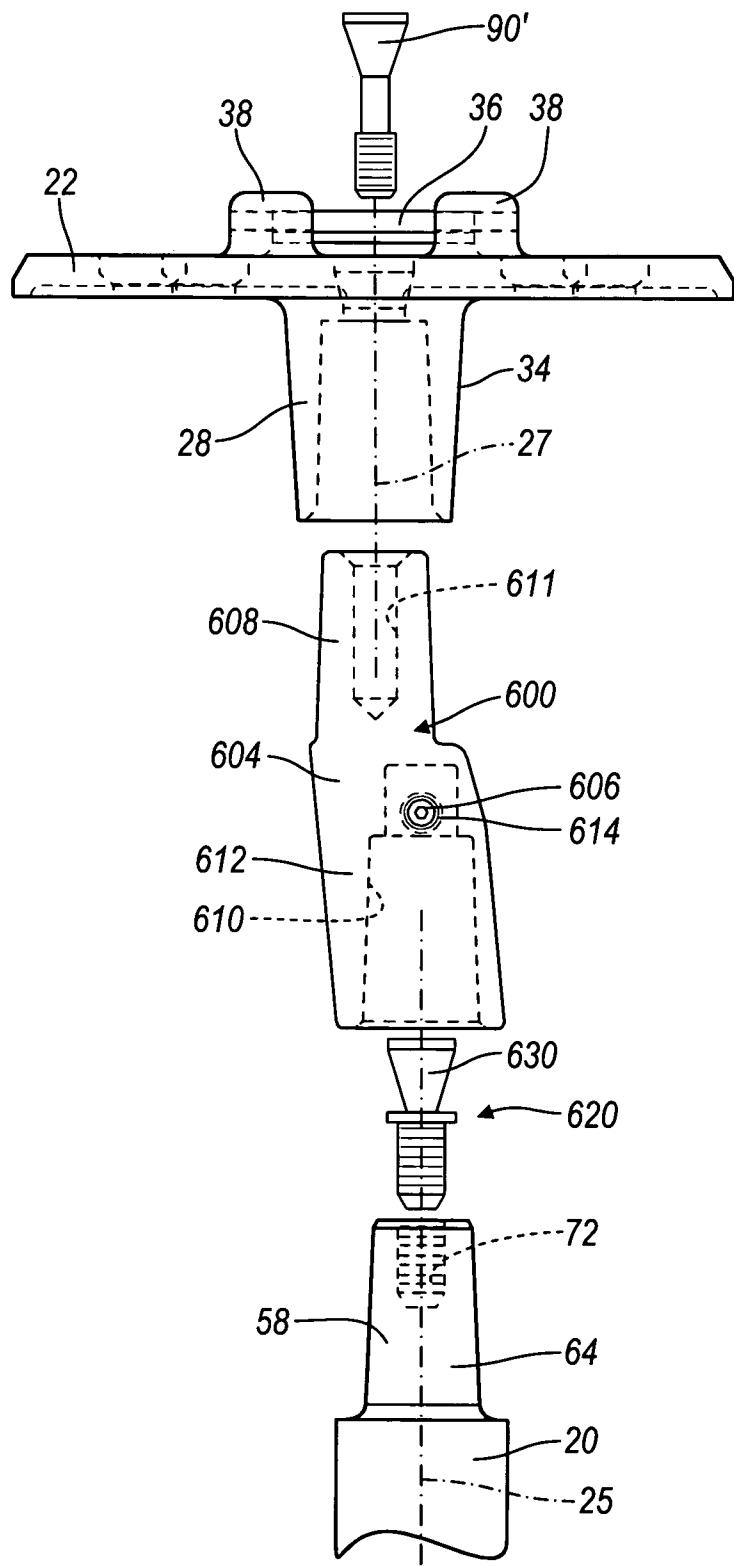
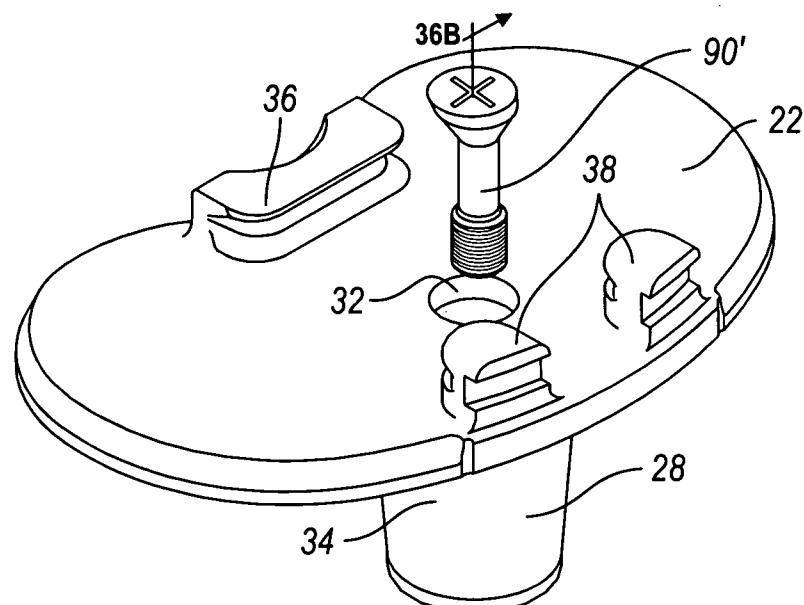
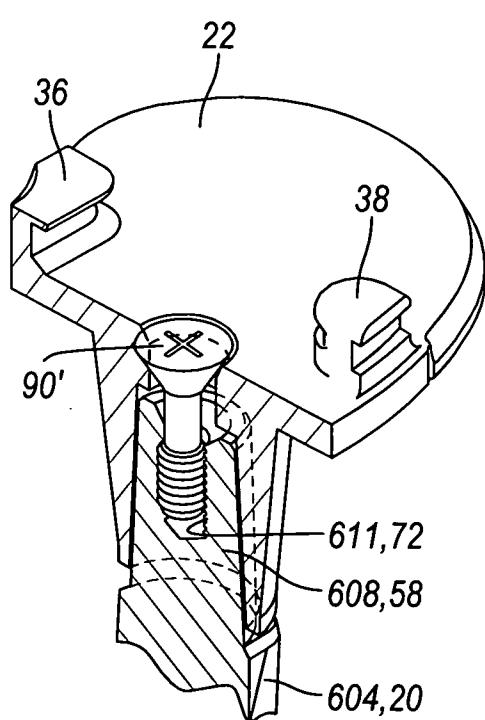
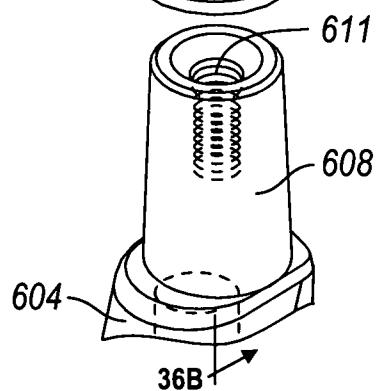
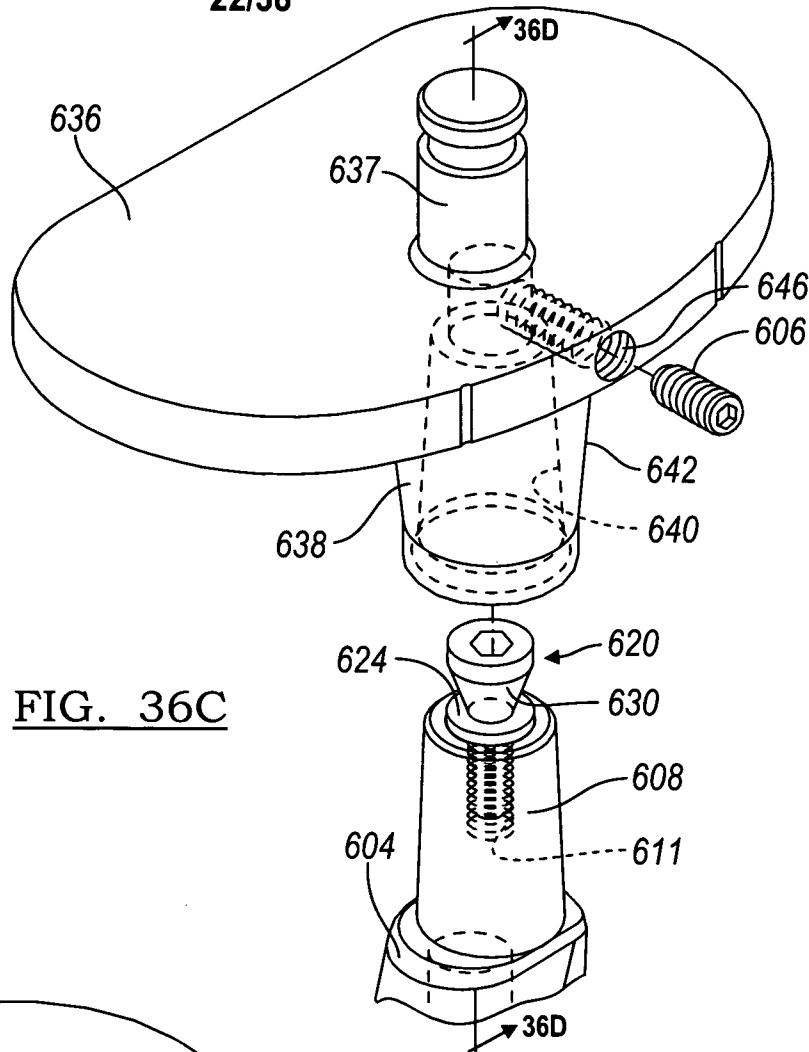
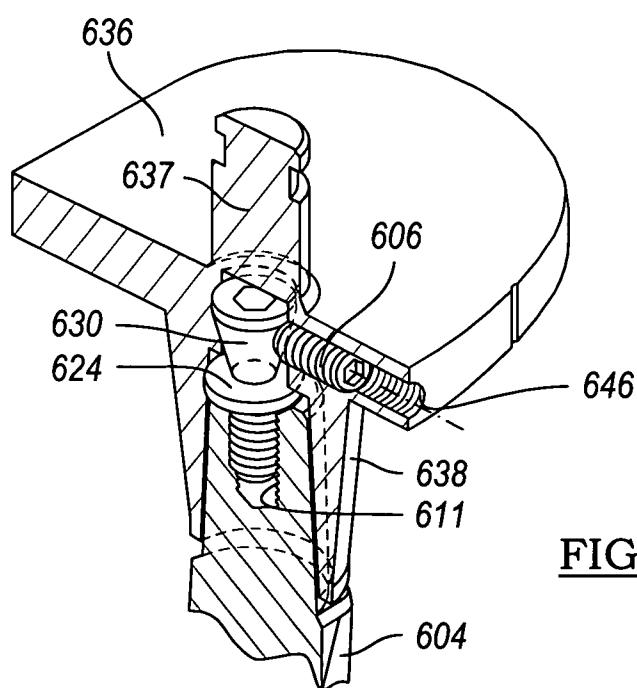


FIG. 35

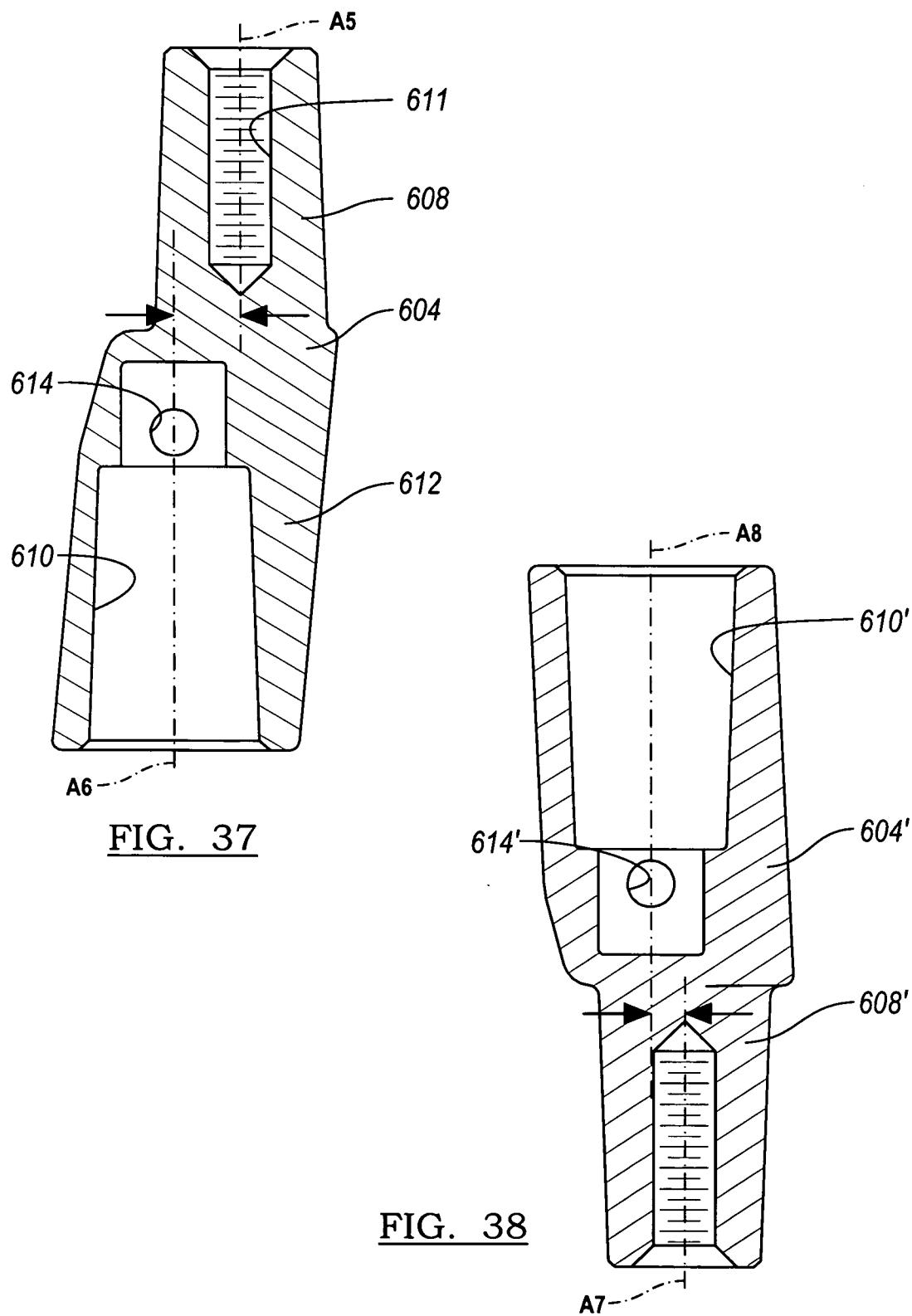
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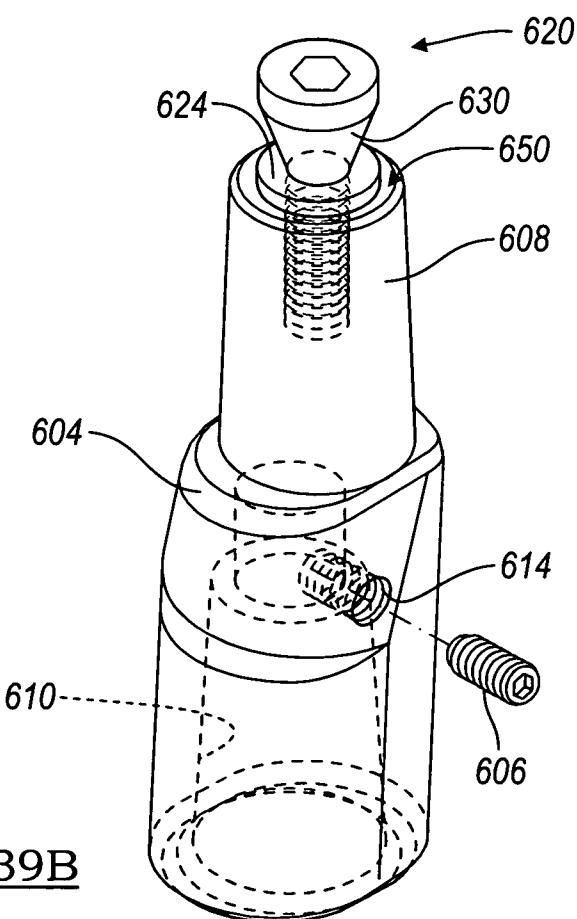
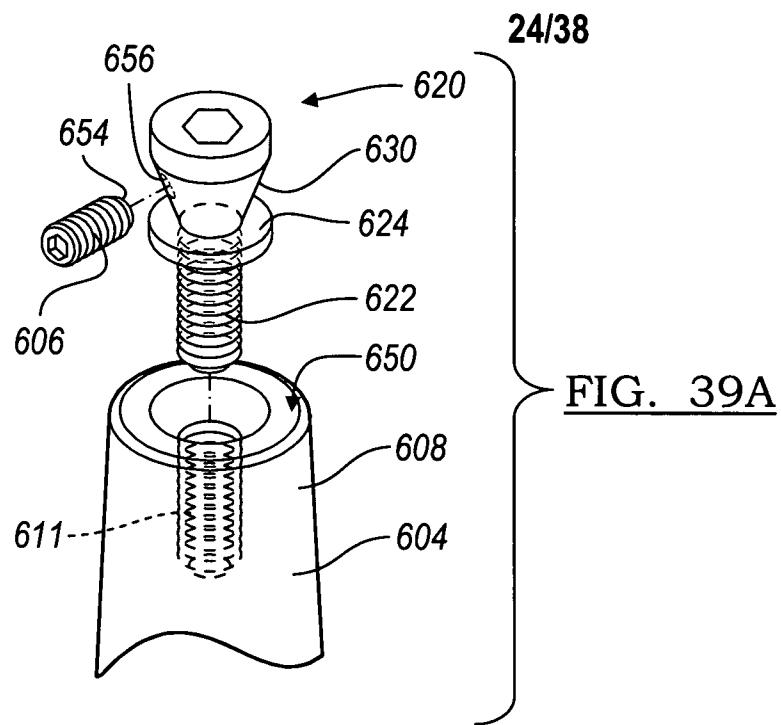
FIG. 36AFIG. 36B

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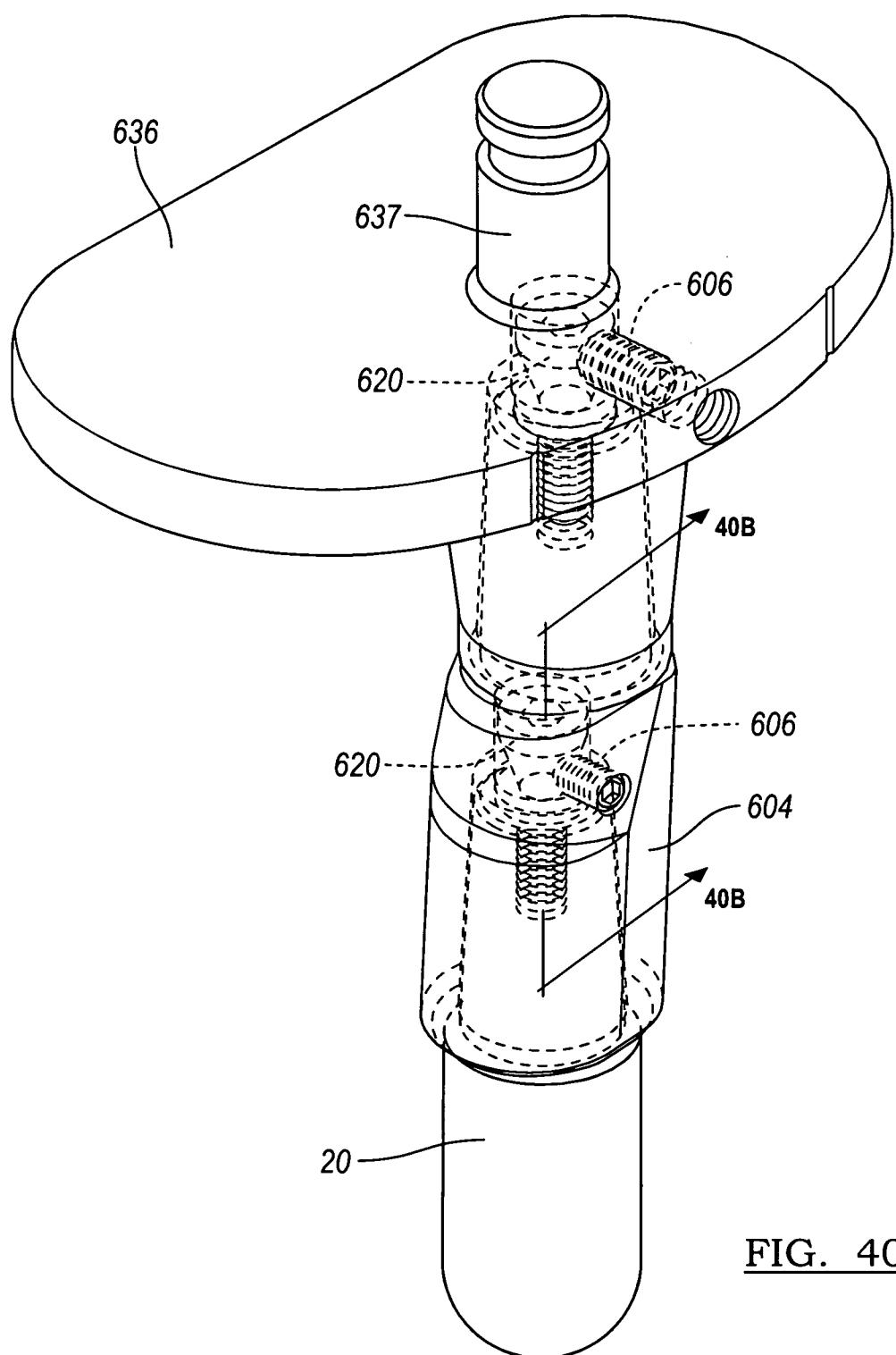
FIG. 36CFIG. 36D

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FIG. 40A

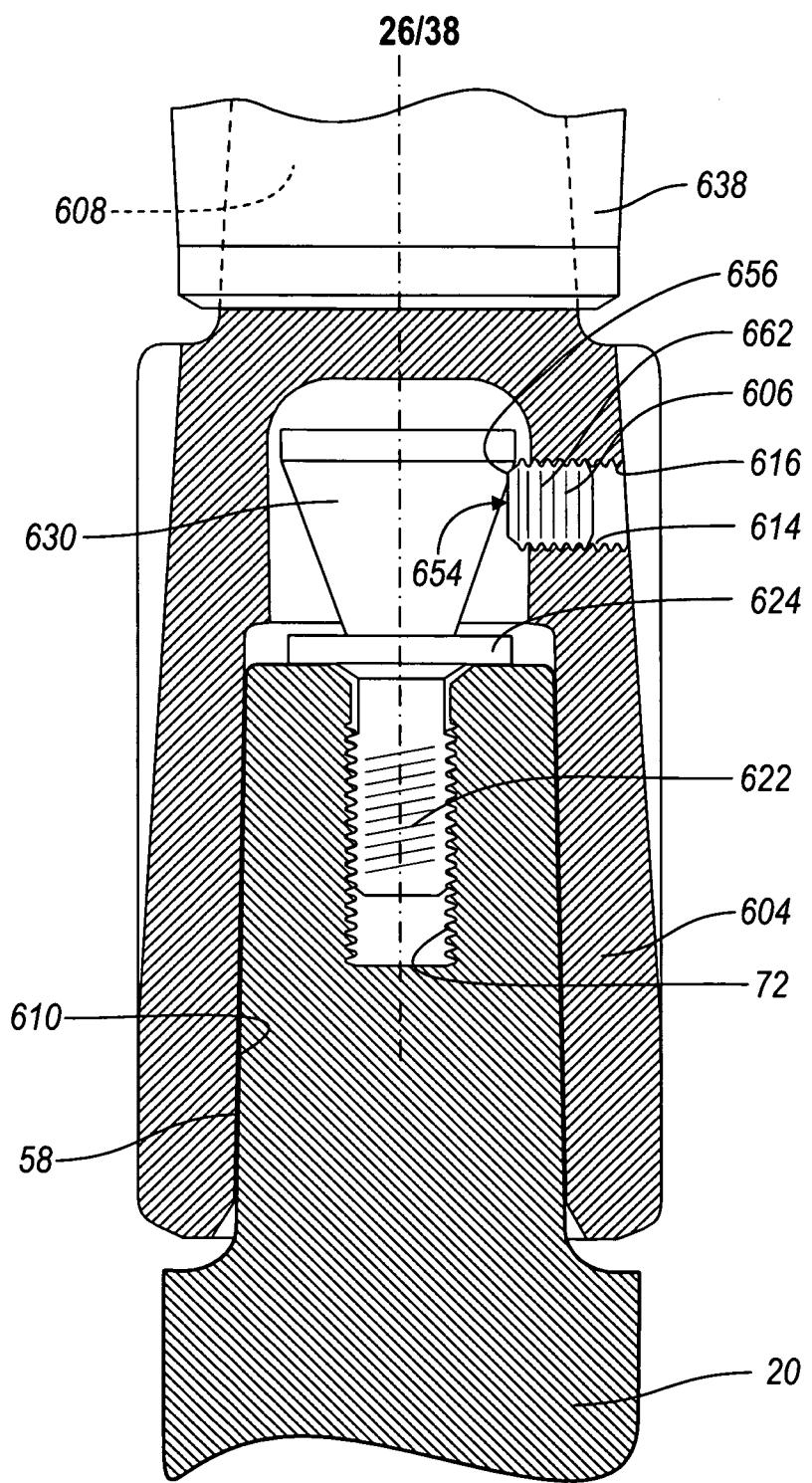


FIG. 40B

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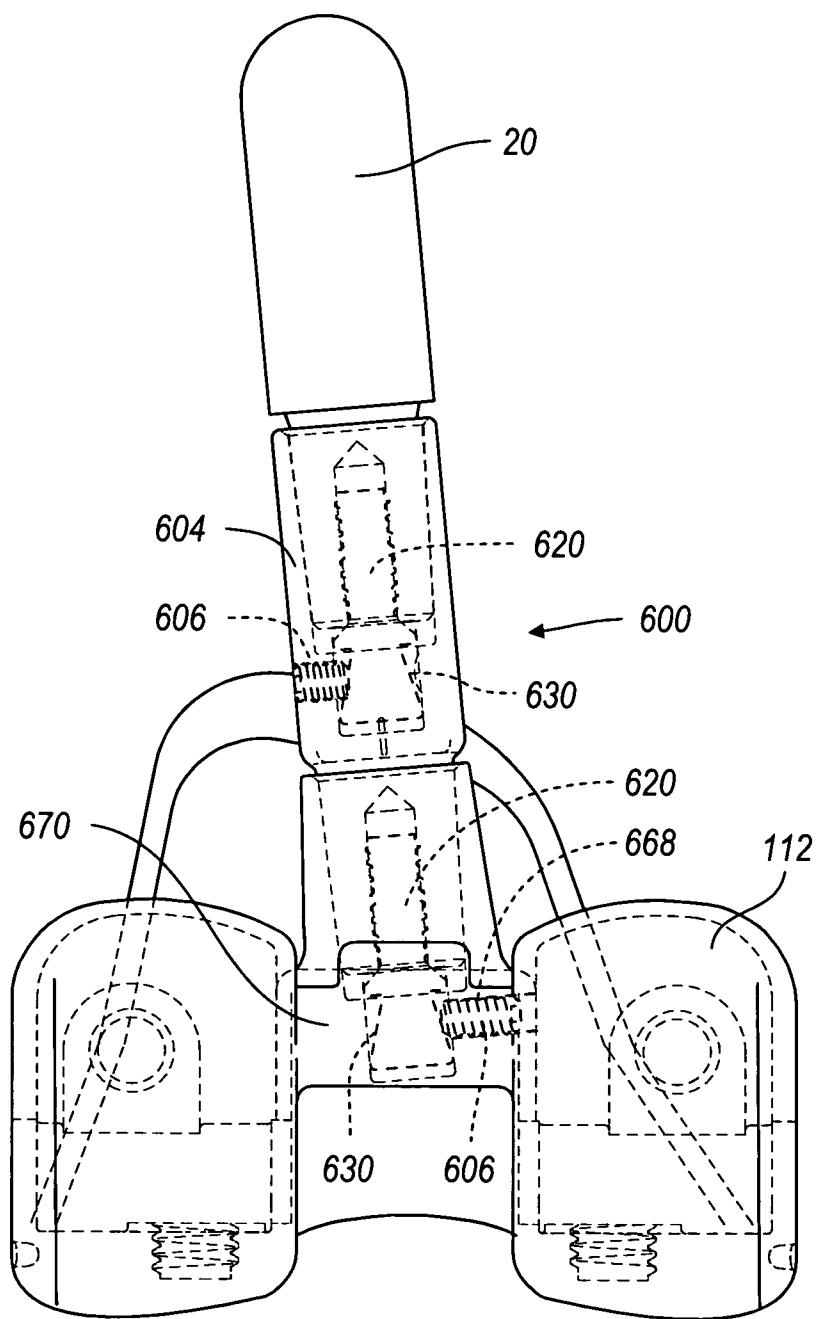


FIG. 41A

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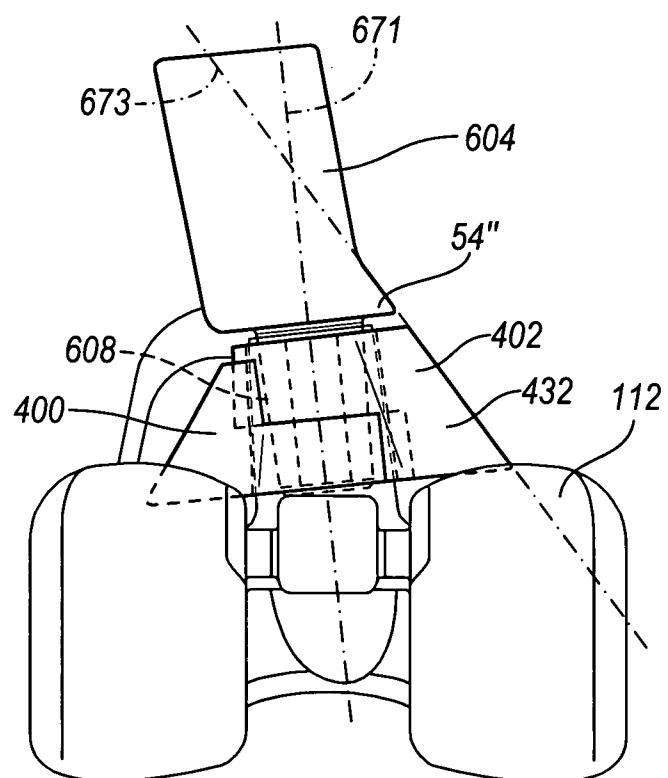
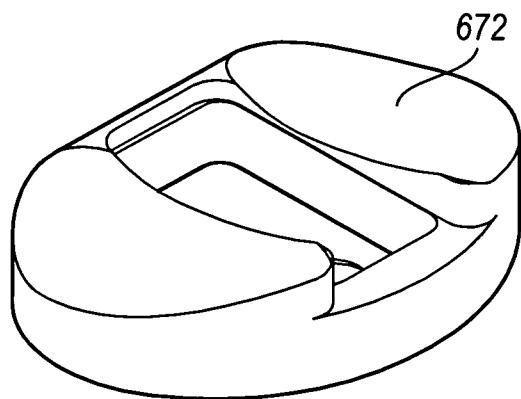
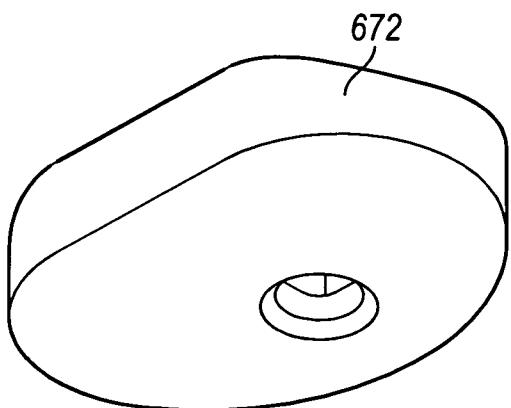
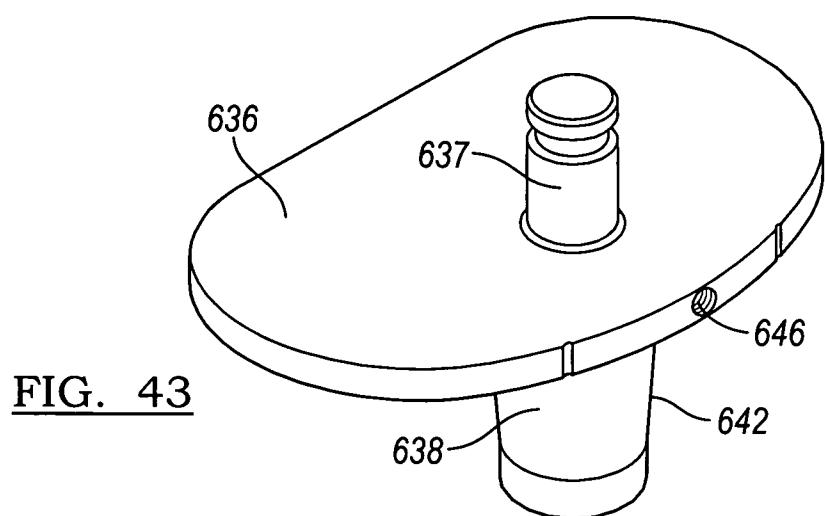
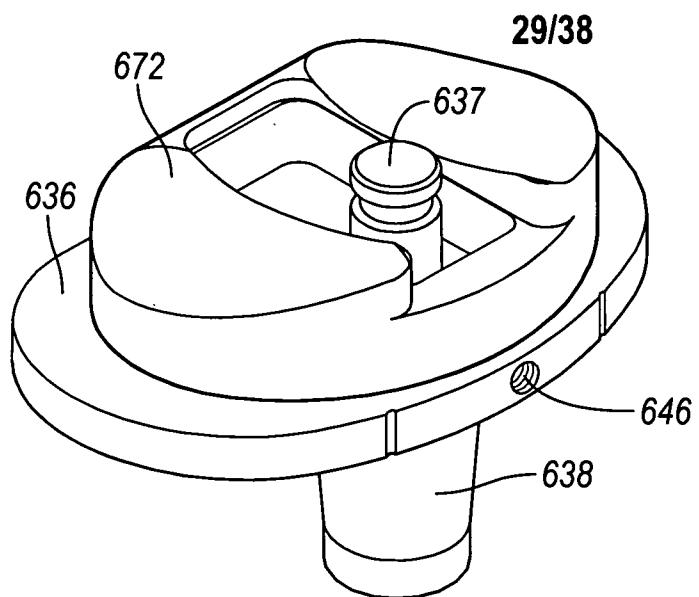


FIG. 41B



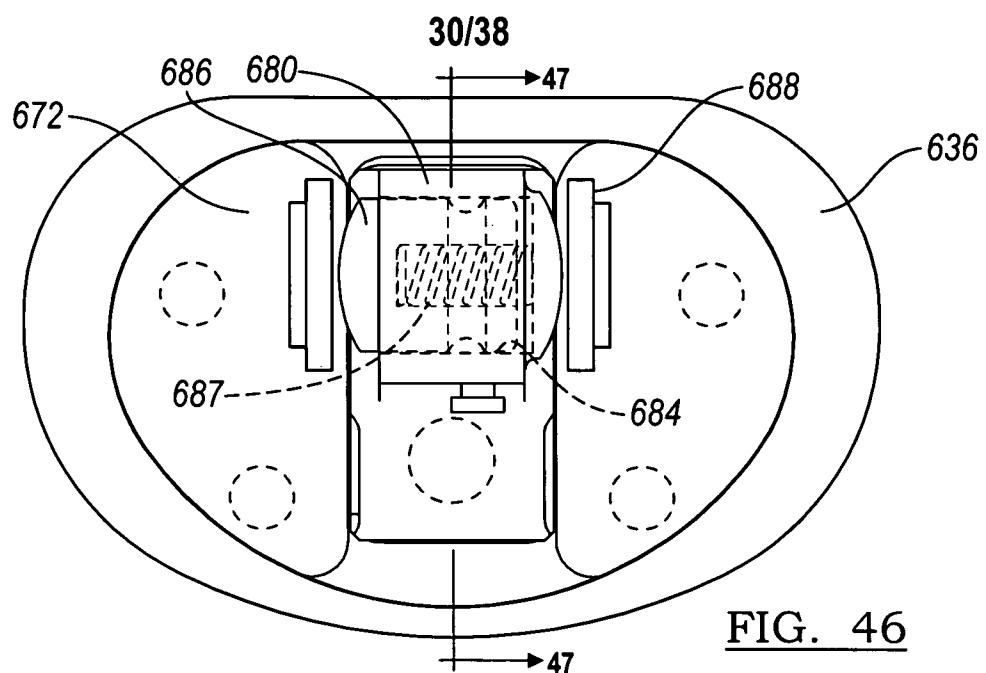


FIG. 46

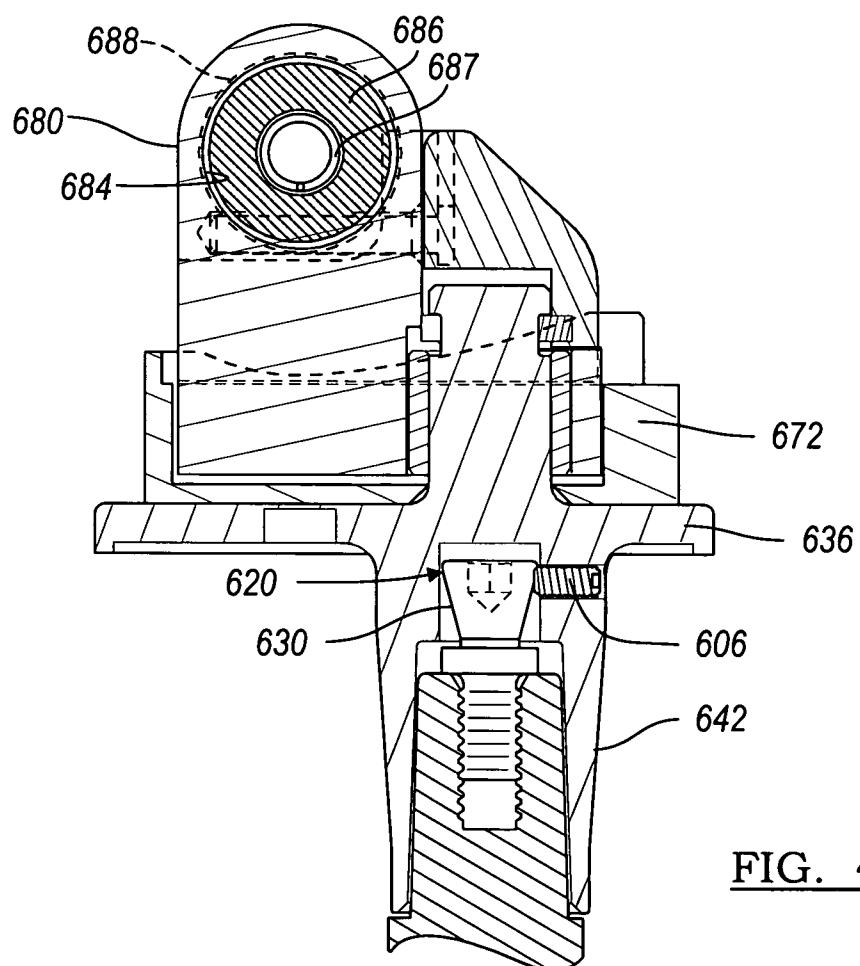
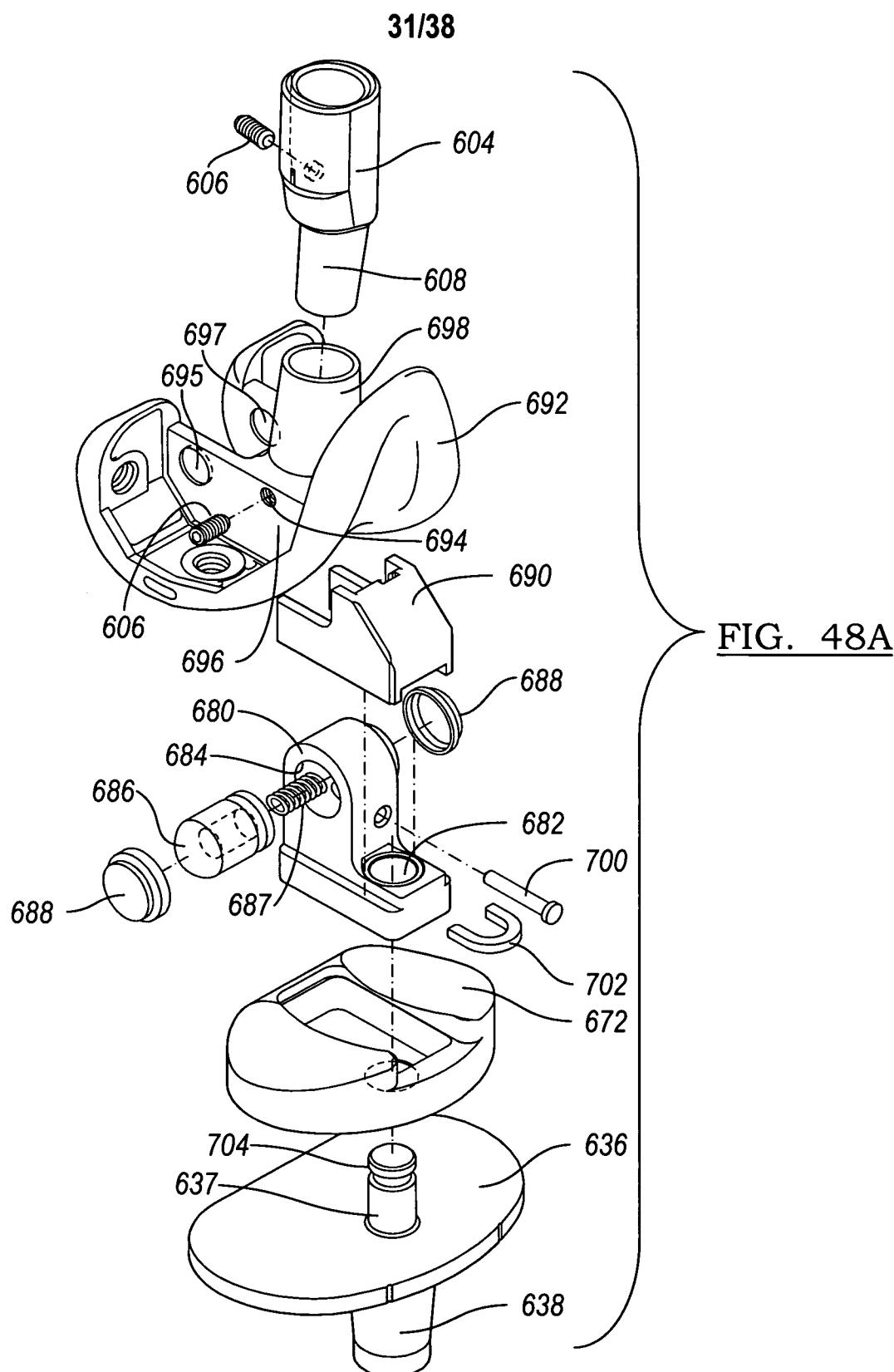
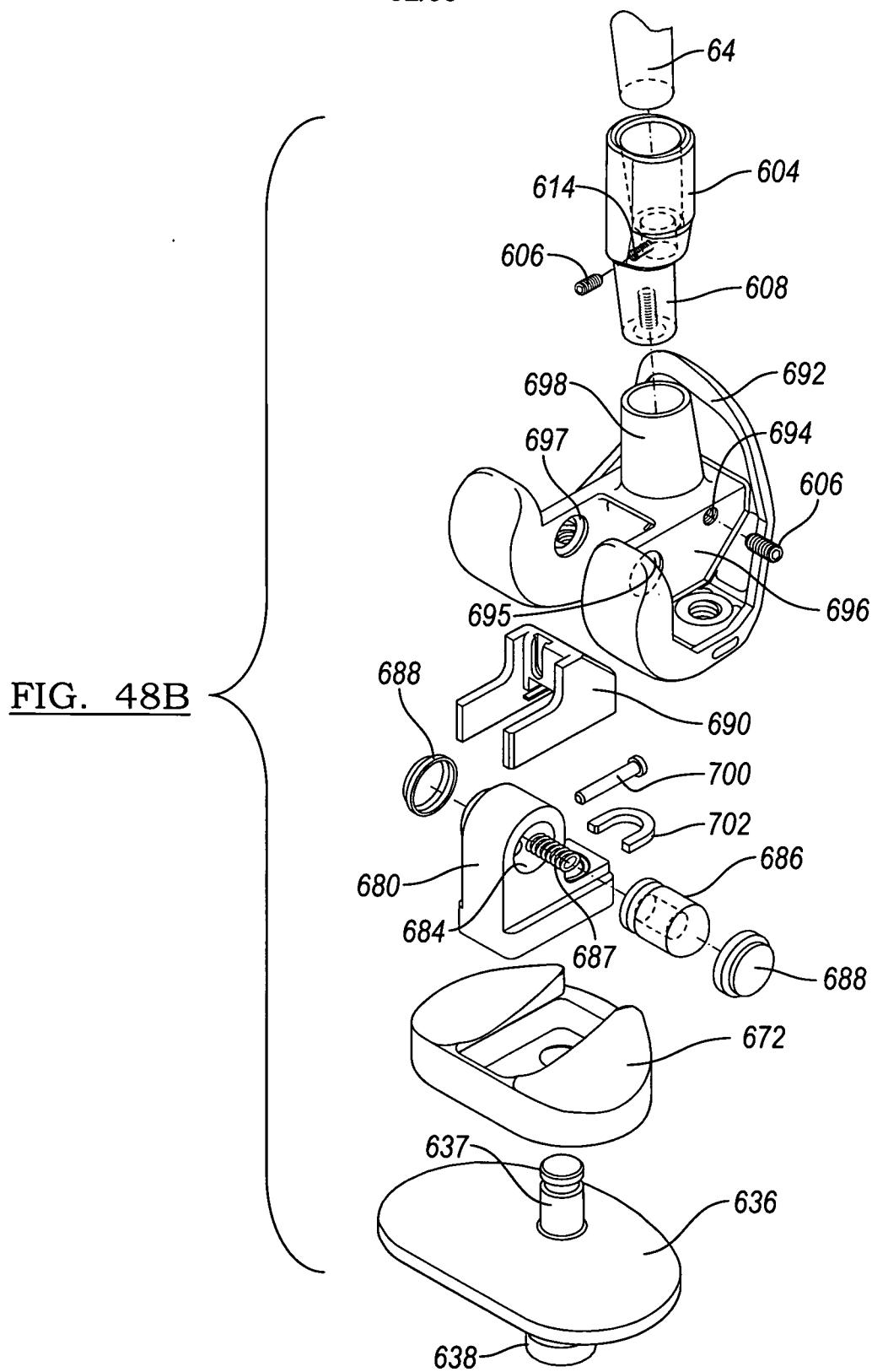


FIG. 47



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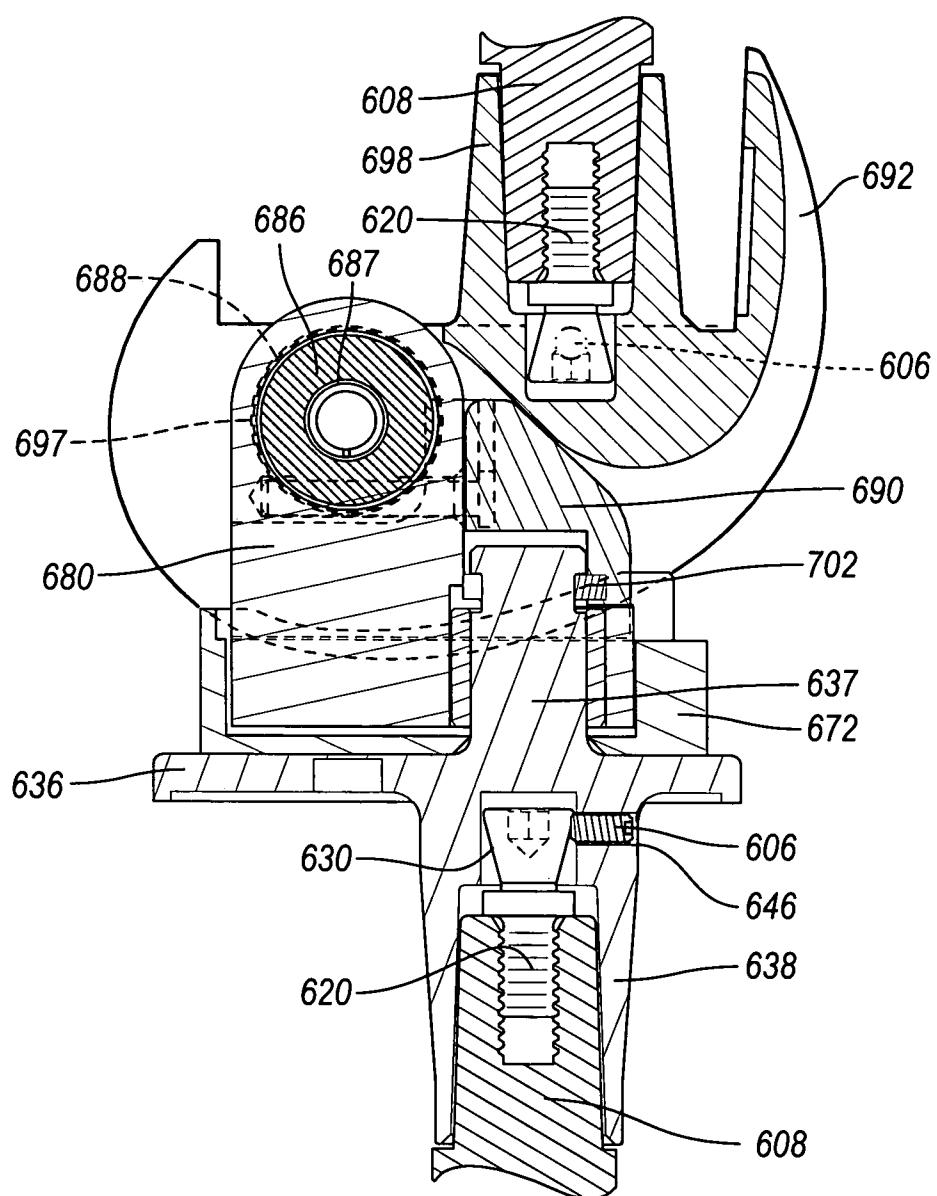


FIG. 49

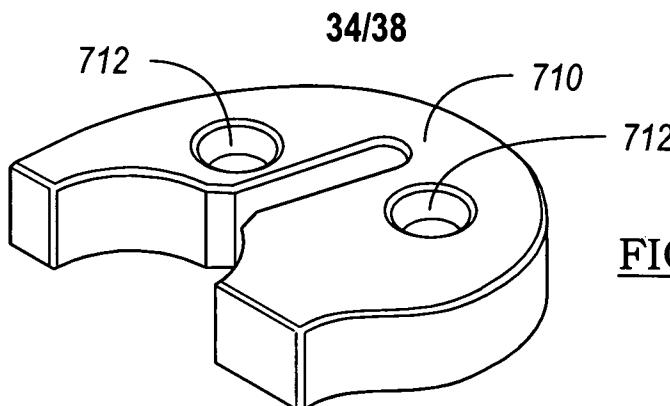


FIG. 50

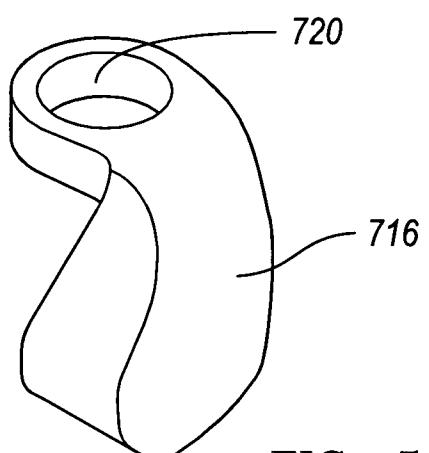


FIG. 51

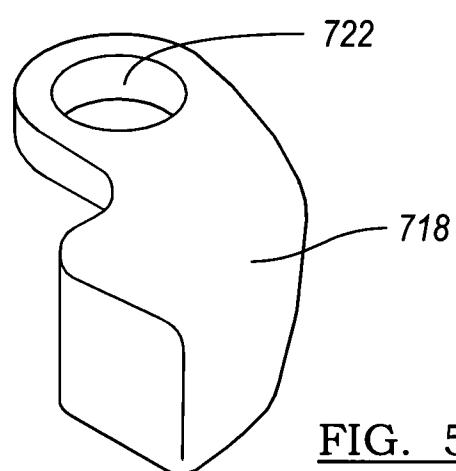


FIG. 52

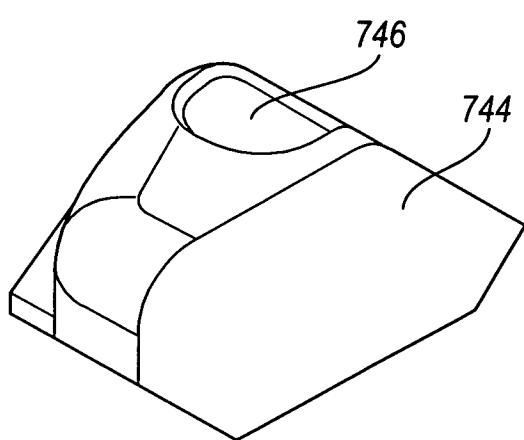


FIG. 53

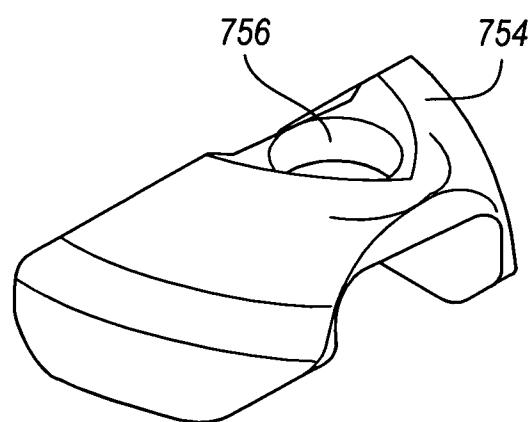


FIG. 54

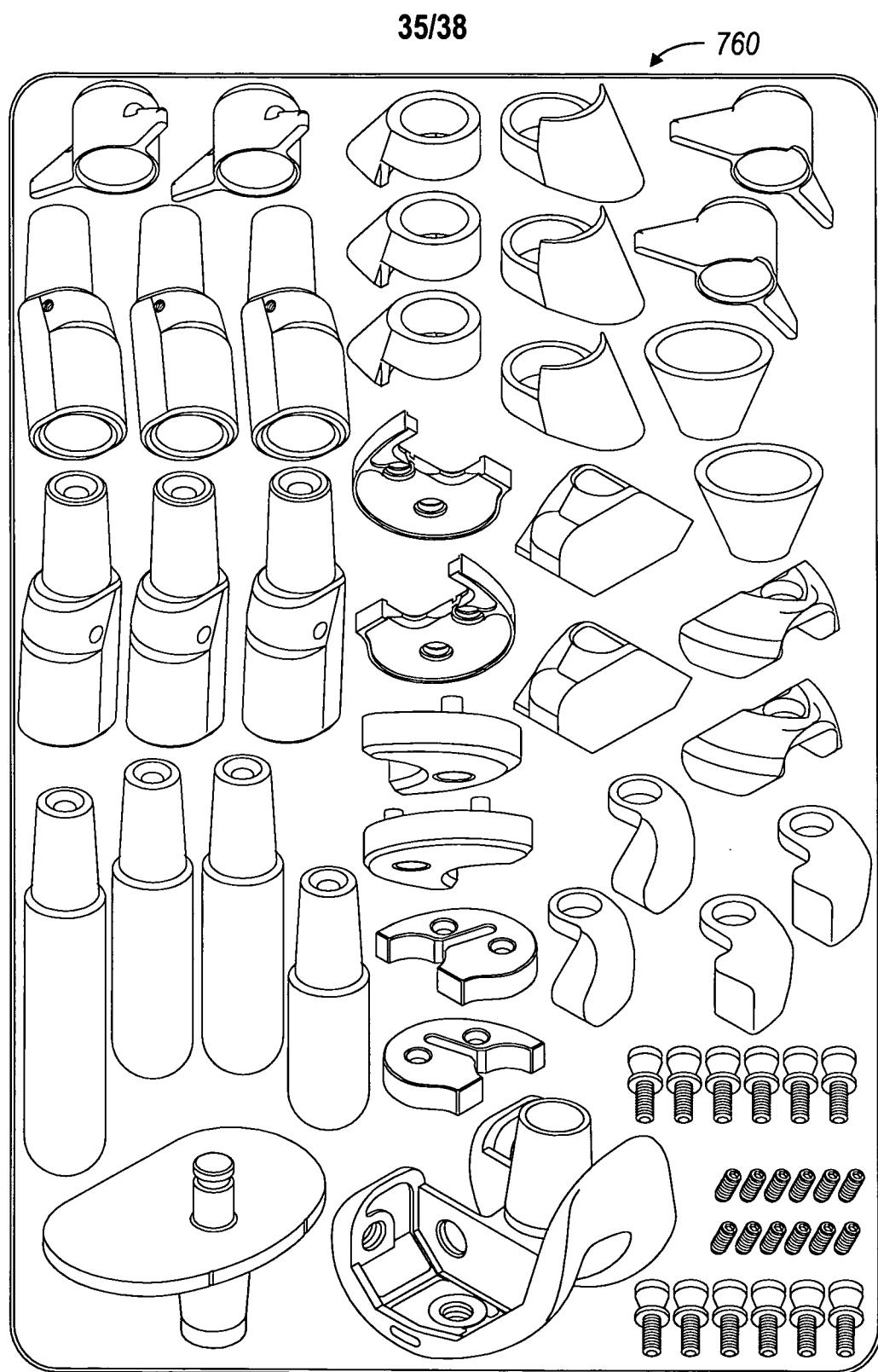


FIG. 55A

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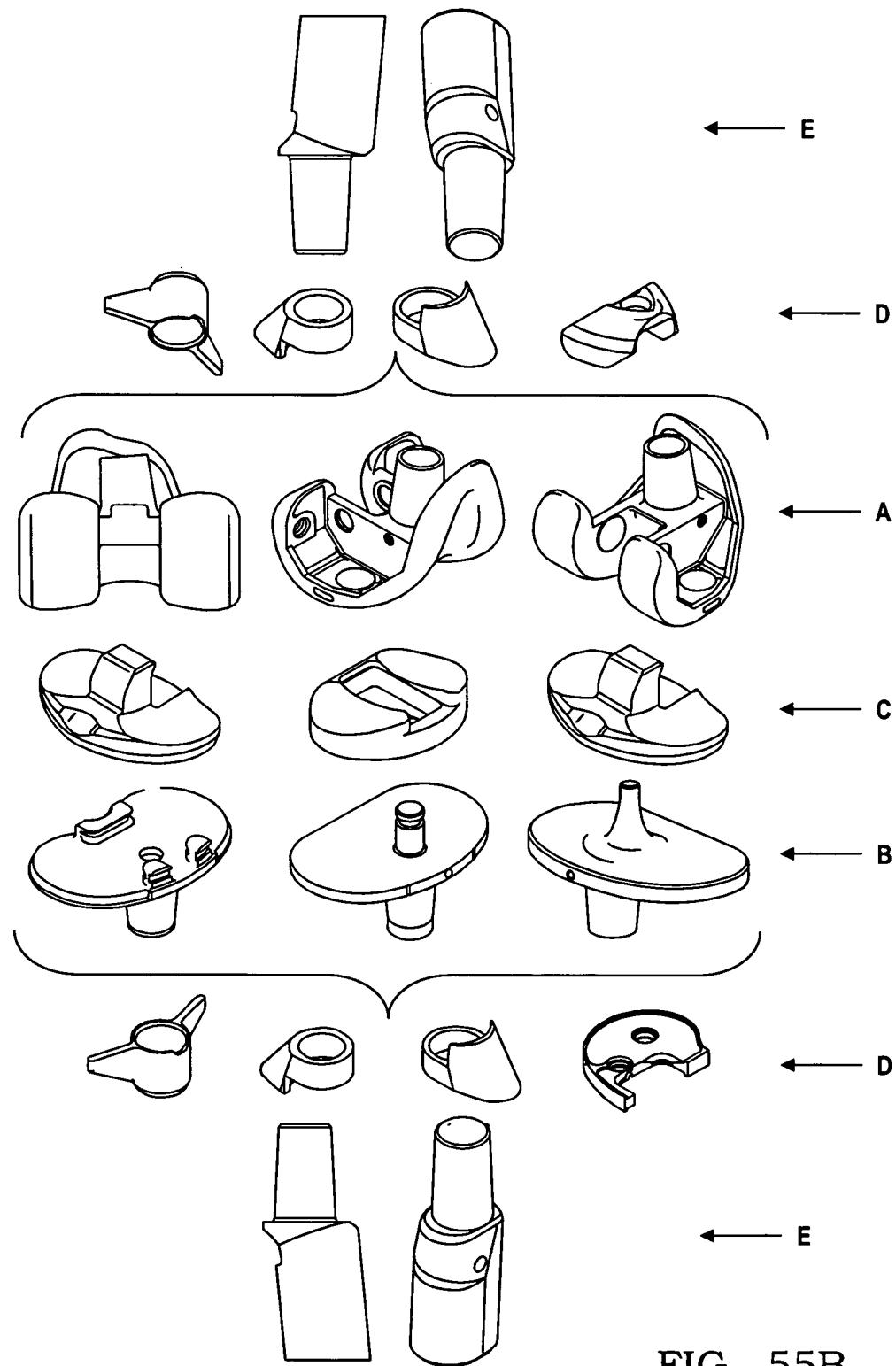
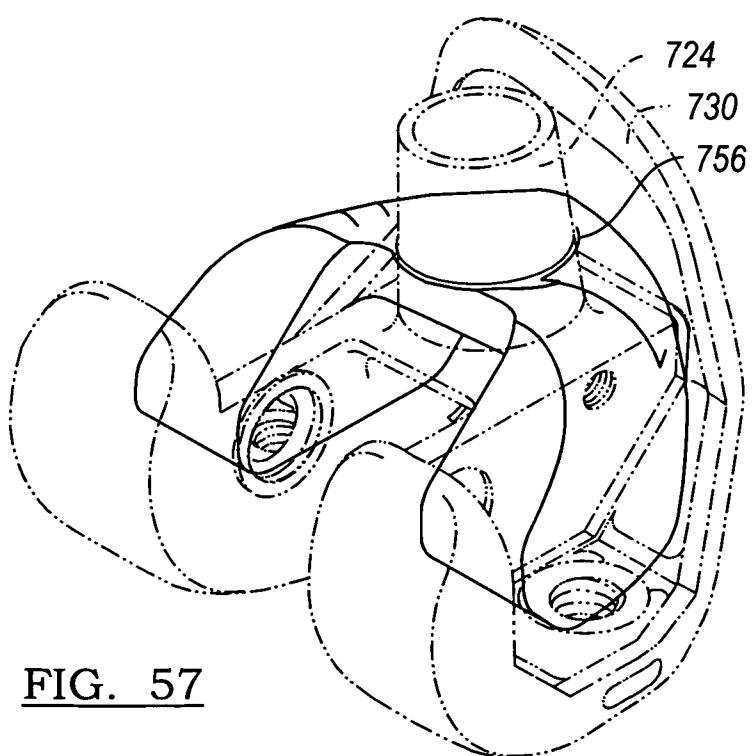
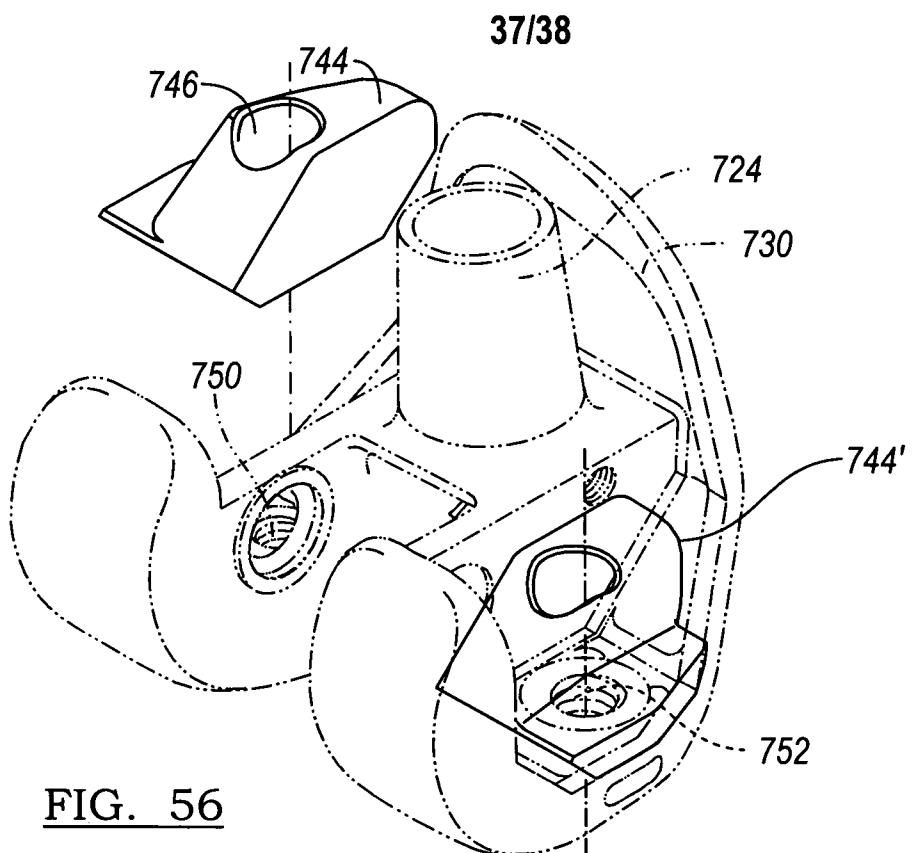
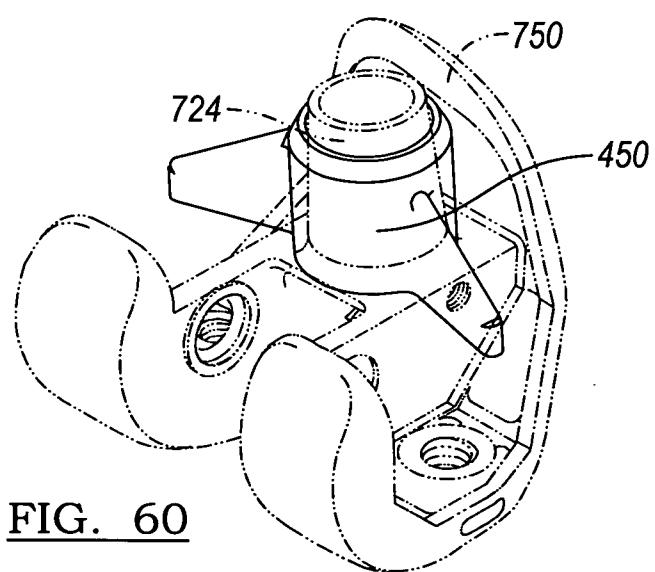
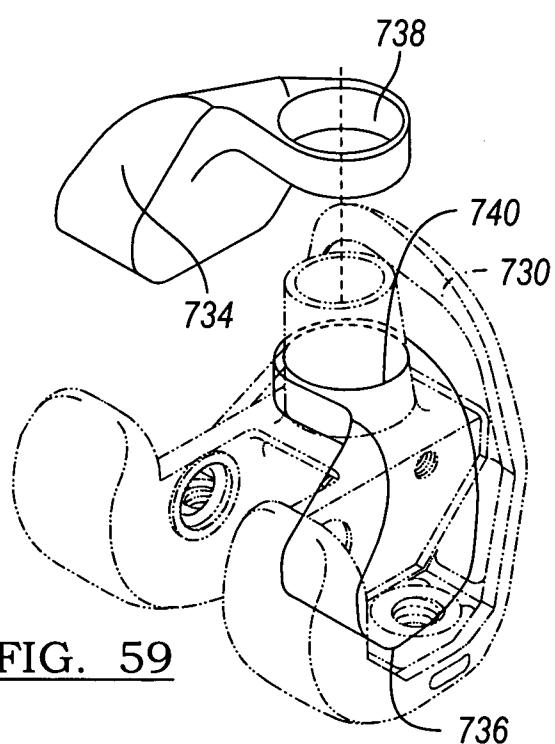
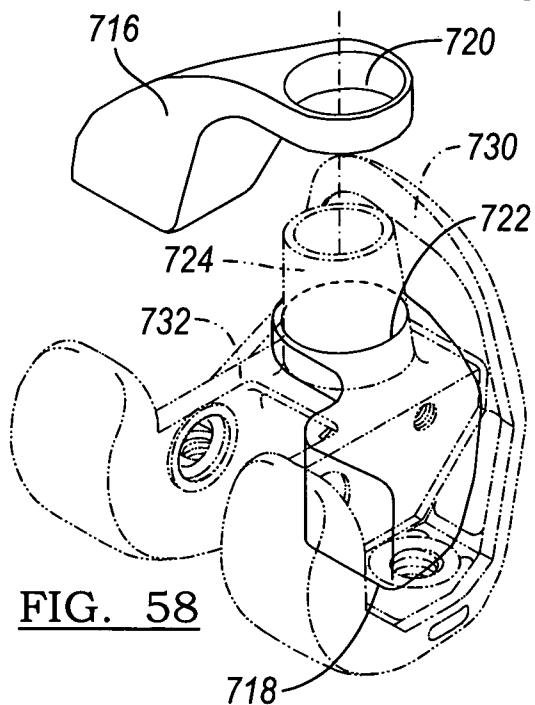


FIG. 55B



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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2008/000374

A. CLASSIFICATION OF SUBJECT MATTER
 INV. A61F2/30 A61F2/38

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)

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	US 2003/014120 A1 (CARSON CHRISTOPHER PATRICK [US] ET AL) 16 January 2003 (2003-01-16) paragraph [0068] – paragraph [0075] figures 1,2 ----- EP 0 947 181 A (JOHNSON & JOHNSON PROFESSIONAL [US]) 6 October 1999 (1999-10-06) paragraph [0095] – paragraph [0097] figures 17-29 ----- -/-	1-10, 19-23, 26-29, 47-49
Y		1-10, 19-23, 26-29, 47-49

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 document but published on or after the international filing date
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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

23 May 2008

Date of mailing of the international search report

06/06/2008

Name and mailing address of the ISA/
 European Patent Office, P.B. 5818 Patentlaan 2
 NL – 2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl.
 Fax: (+31-70) 340-3016

Authorized officer

Storer, John

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2008/000374

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 2003/055508 A1 (METZGER ROBERT G [US] ET AL) 20 March 2003 (2003-03-20) paragraph [0038] paragraph [0040] paragraph [0053] figures 1,18 -----	
A	WO 03/065939 A (PORTLAND ORTHOPAEDICS PTY LTD [AU]; SEKEL RONALD [AU]) 14 August 2003 (2003-08-14) abstract figures 7,25-29 -----	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/000374

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.: **34-46**
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 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.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2008/000374

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