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(54) **MODULAR KNEE PROTHESIS**

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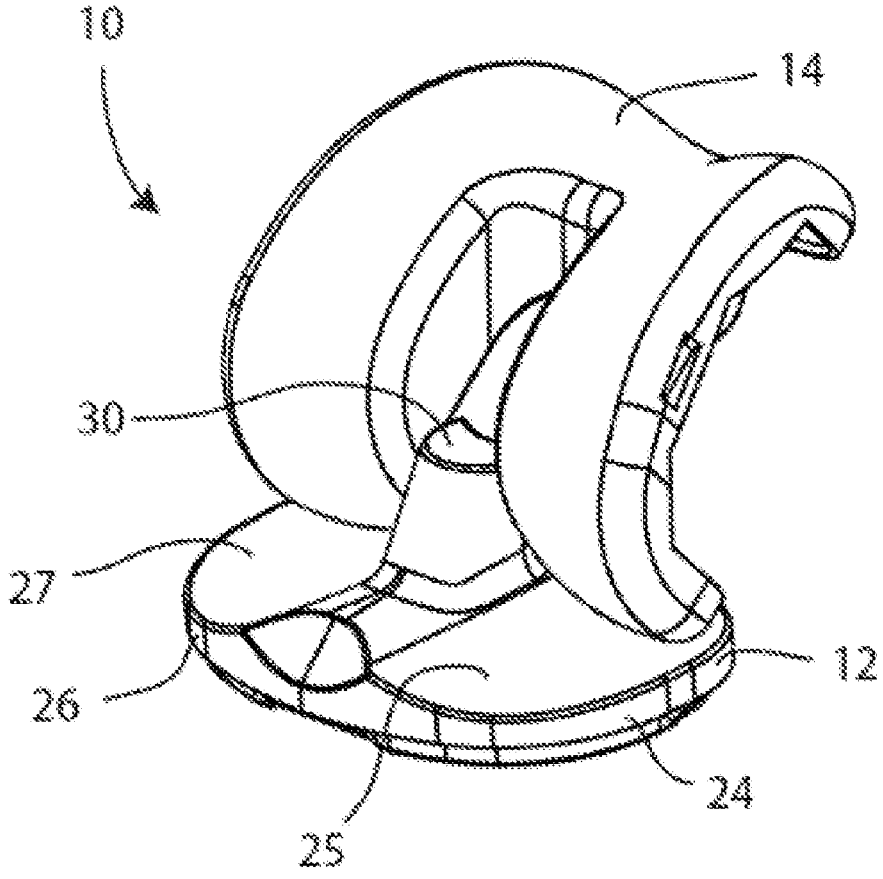
A61F 2/38	(2006.01)
A61F 2/46	(2006.01)

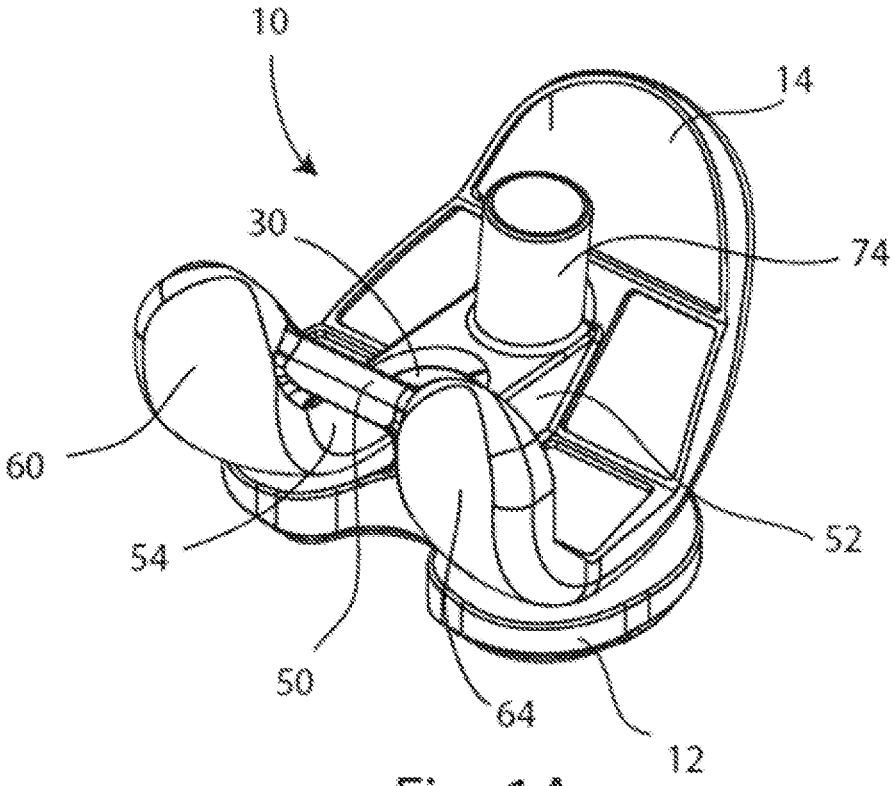
(52) **U.S. Cl.**

CPC ***A61F 2/30734*** (2013.01); ***A61F 2/389*** (2013.01); ***A61F 2/3859*** (2013.01); ***A61F 2/4684*** (2013.01); *A61F 2002/3895* (2013.01); *A61F 2002/4687* (2013.01); *A61F 2002/30131* (2013.01); *A61F 2002/30607* (2013.01); *A61F 2002/30736* (2013.01); *A61F 2002/3069* (2013.01); *A61F 2002/30113* (2013.01)

(57) **ABSTRACT**

Implant assemblies, systems, and methods for replacing a knee joint may include a method of revising a knee joint prosthesis implanted in a knee of a patient to provide increased stability to the knee joint prosthesis by replacing a first tibial insert with a second tibial insert that provides more constraint that the first tibial insert. A knee joint prosthesis system and kit are also provided that may include a tibial baseplate component, a femoral component, and a tibial insert that is selectively interchangeable with other tibial inserts to provide varying levels of constraint and stability to the knee joint prosthesis.





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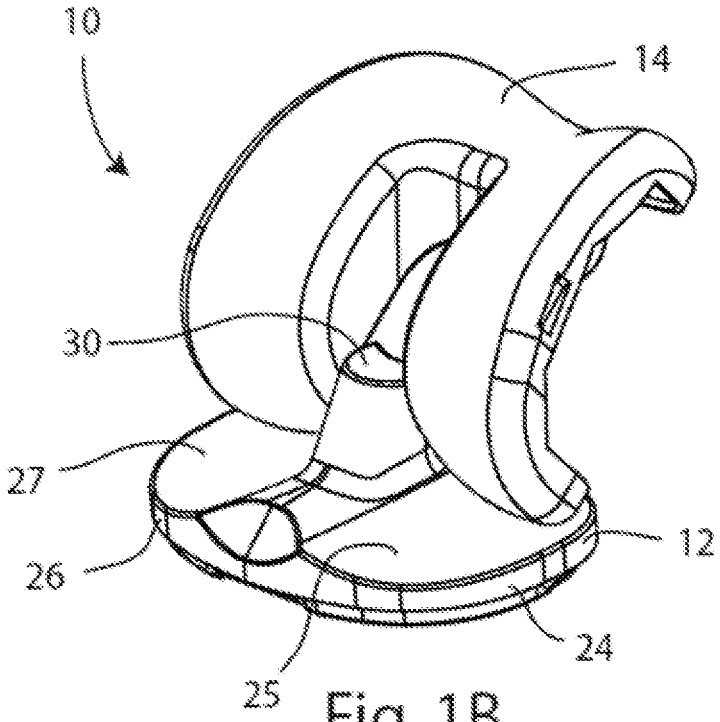
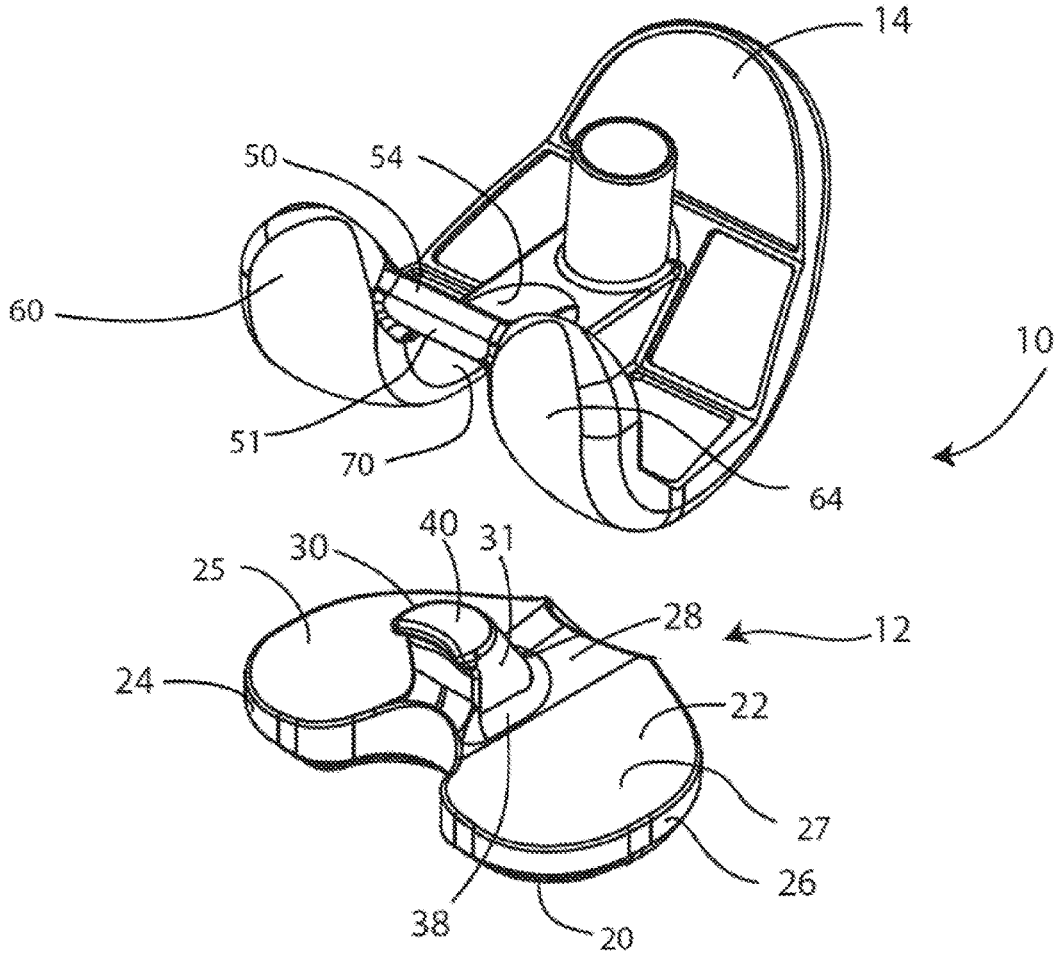


Fig. 1B



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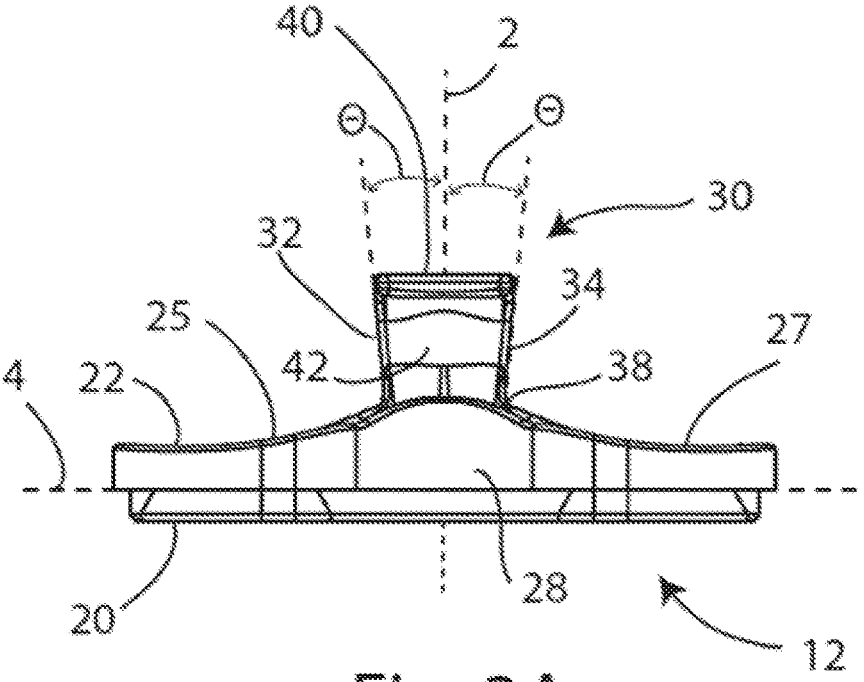
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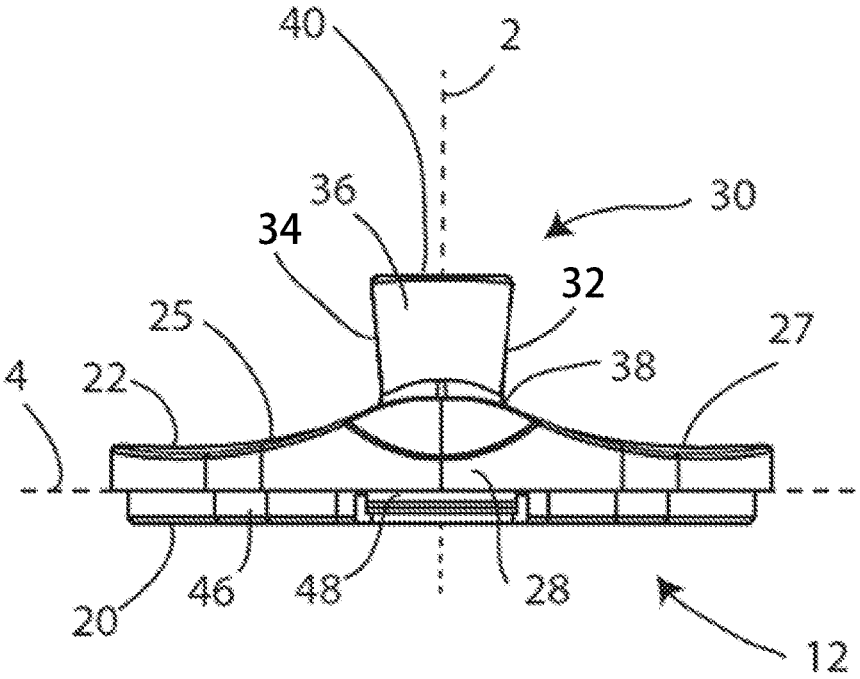
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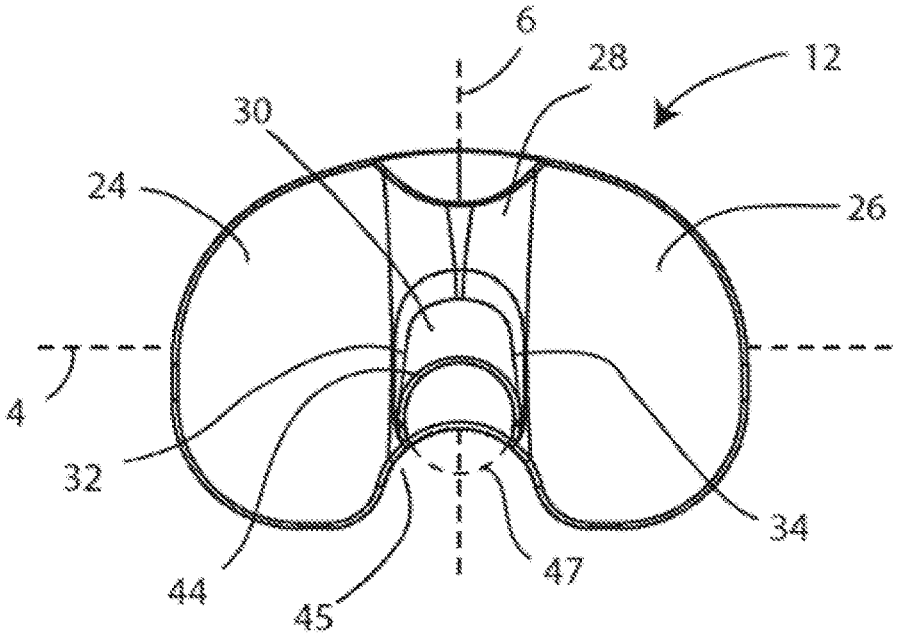
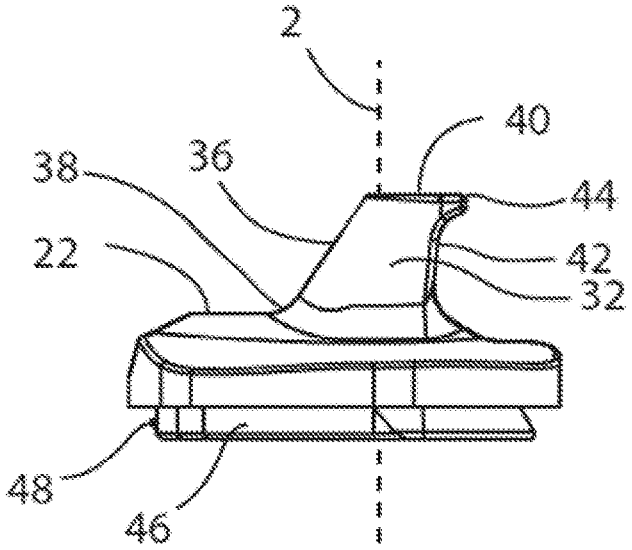


Fig. 3C



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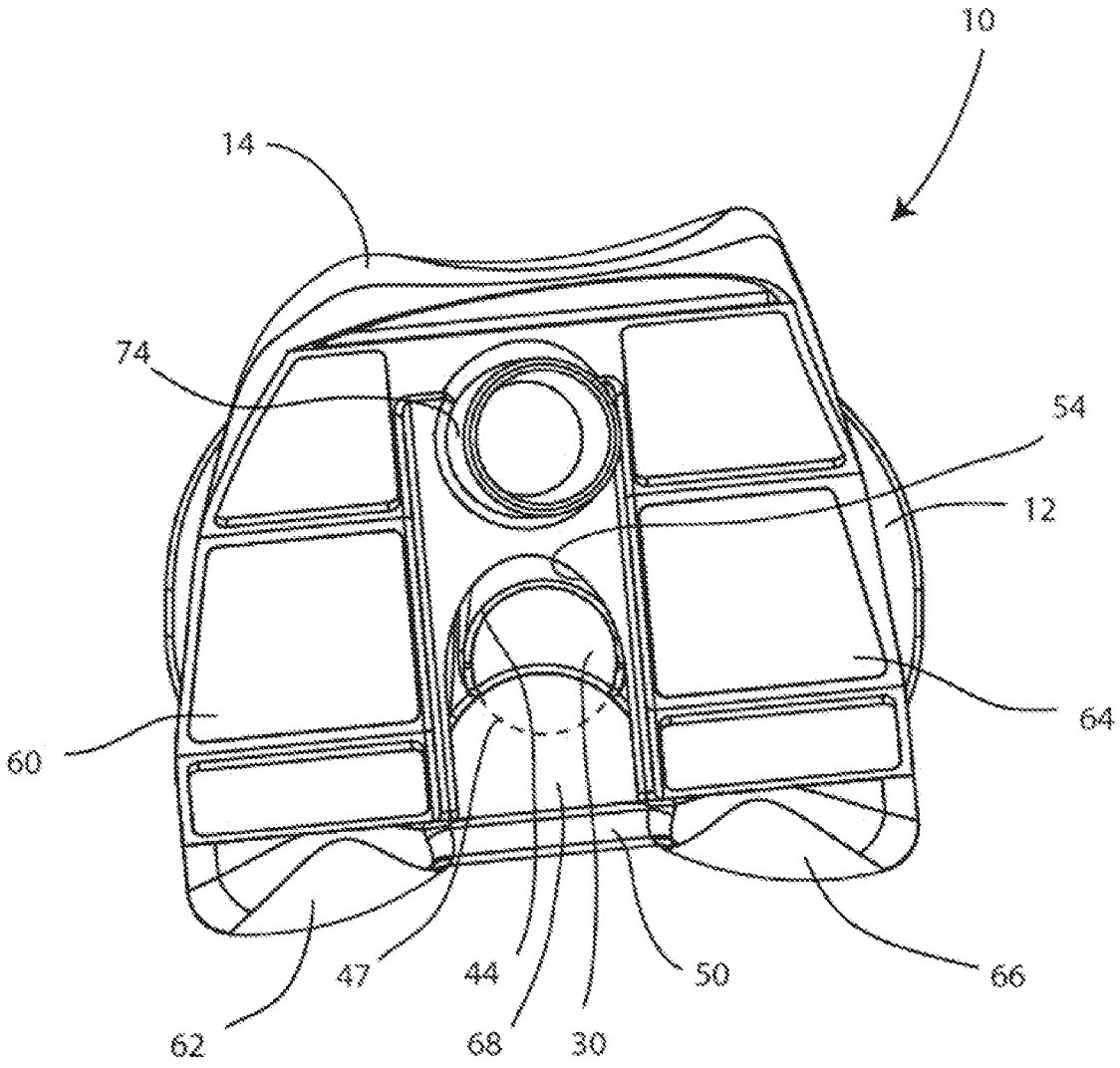

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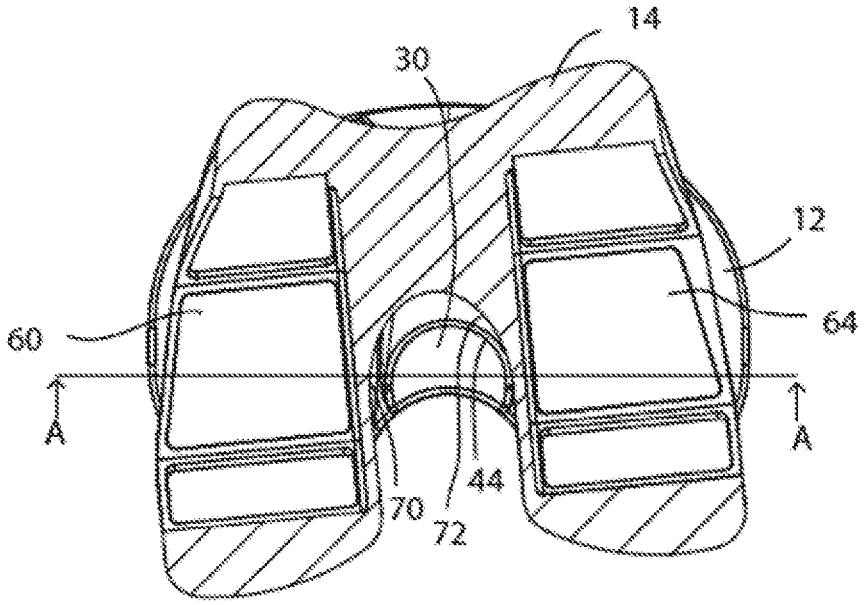
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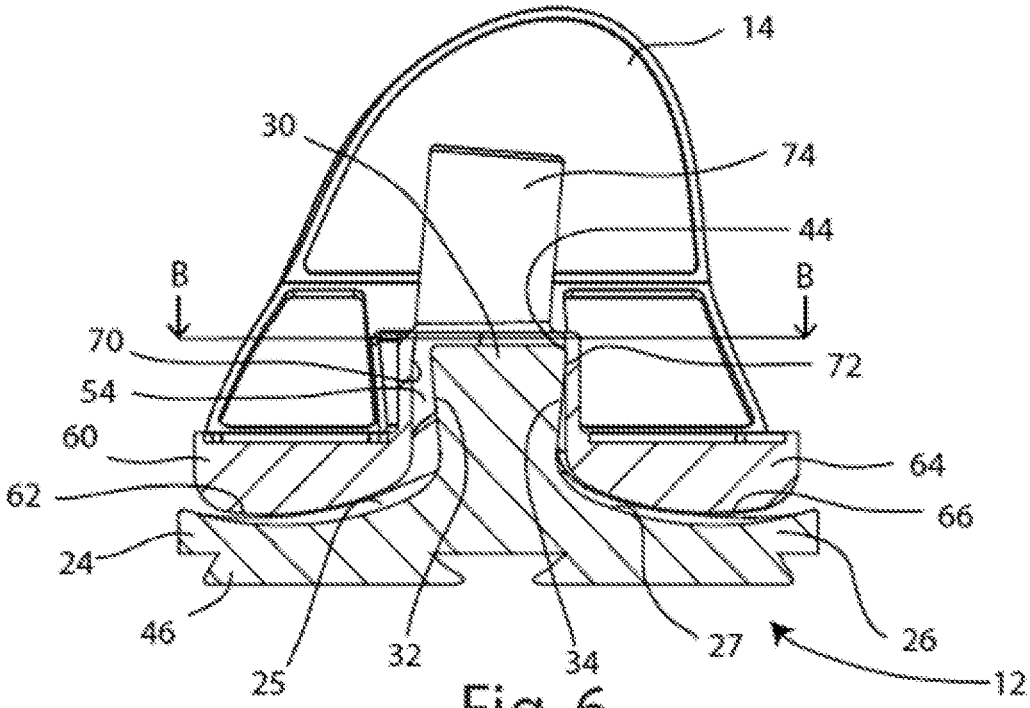
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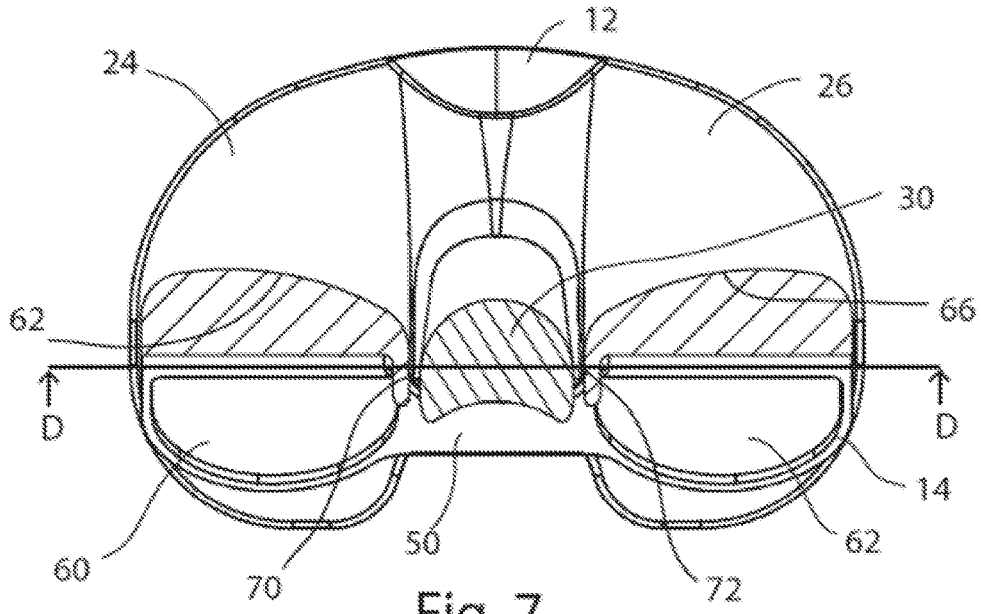
Fig. 6



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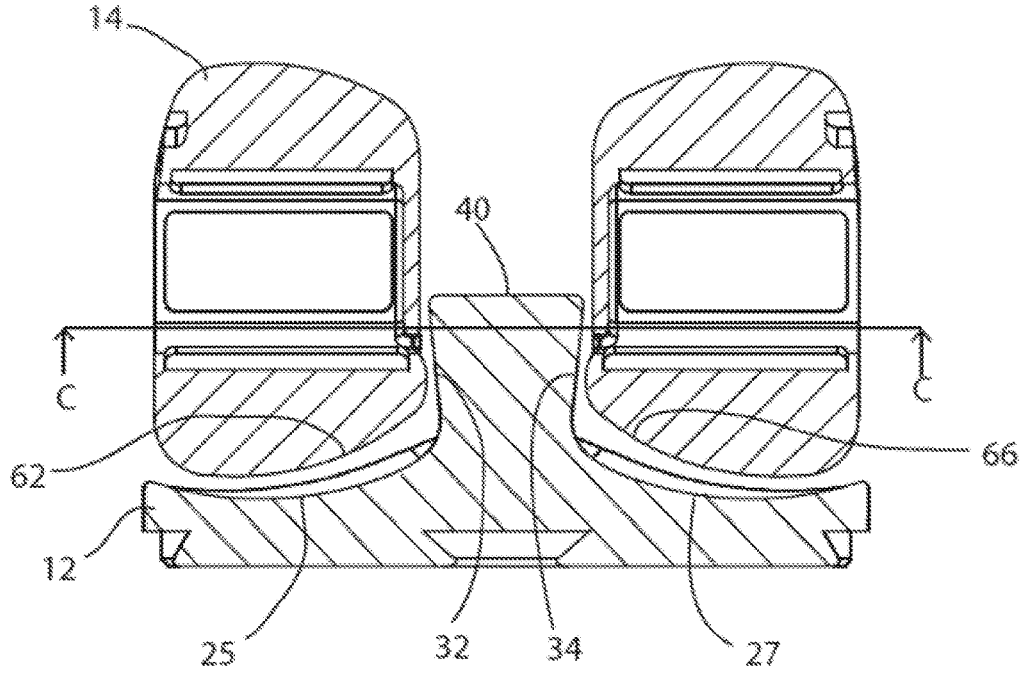

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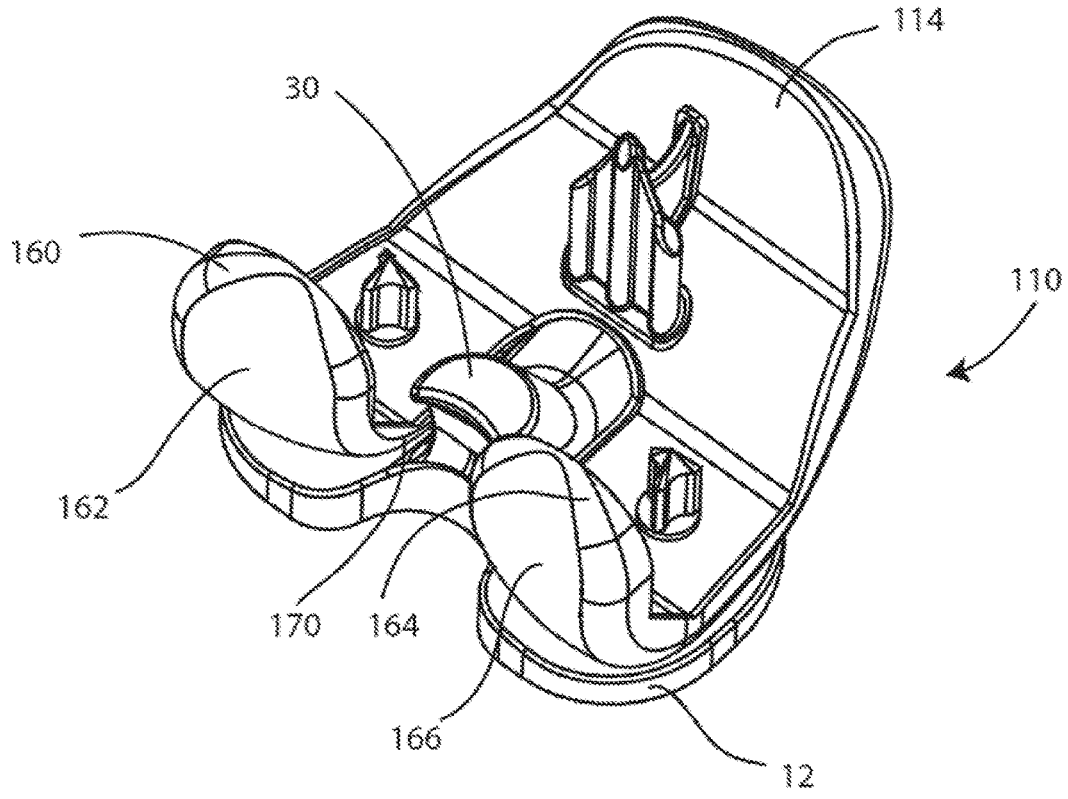

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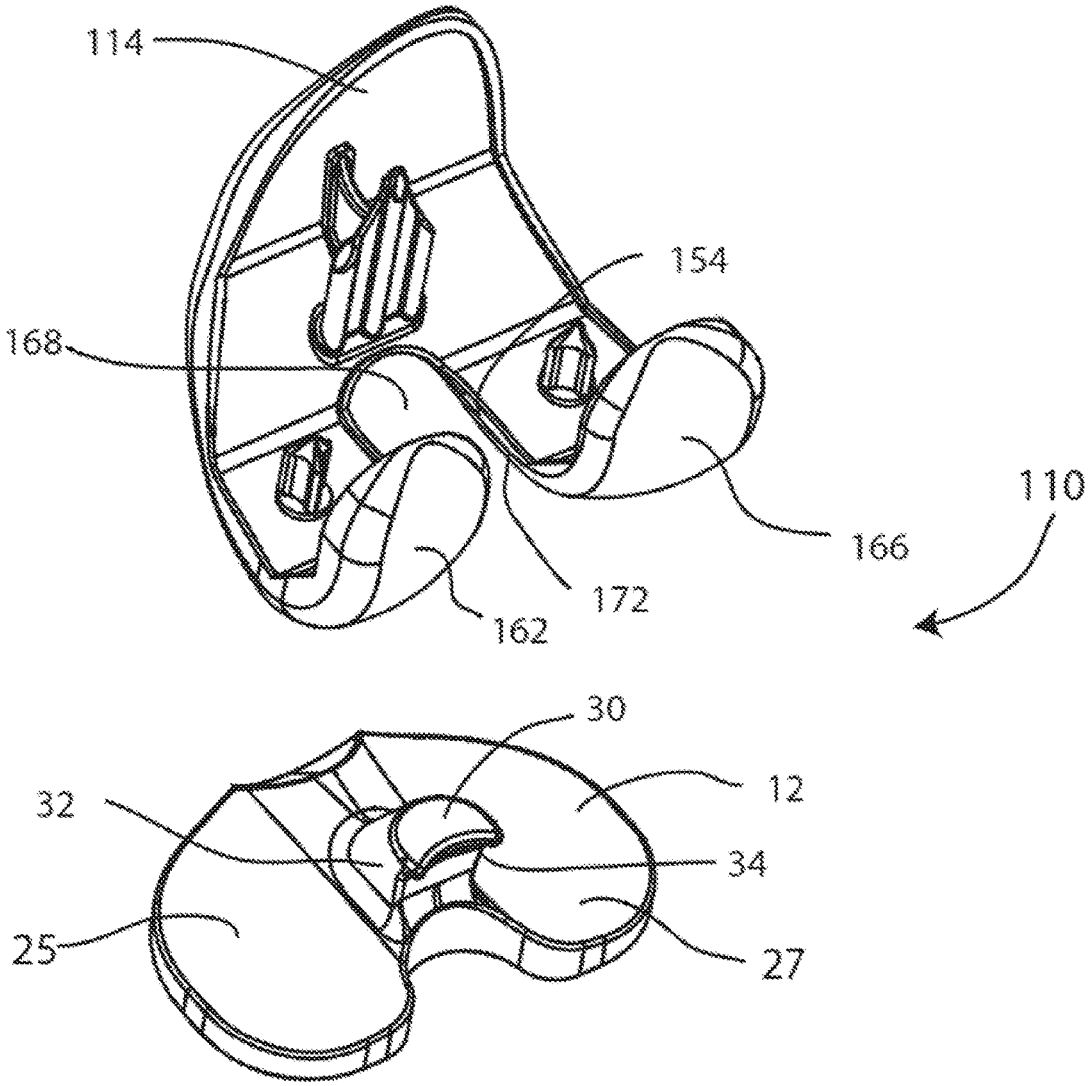

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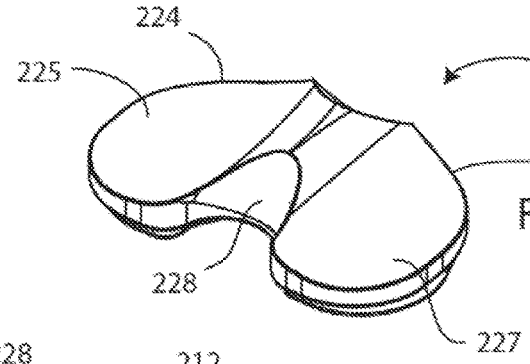

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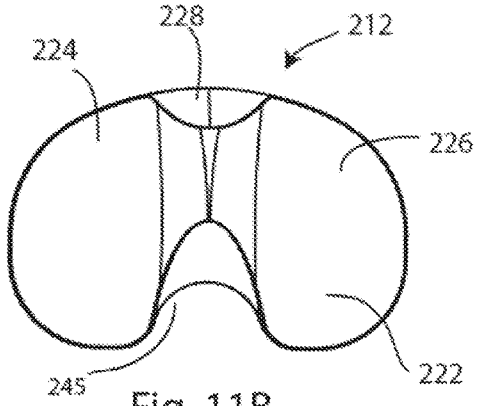

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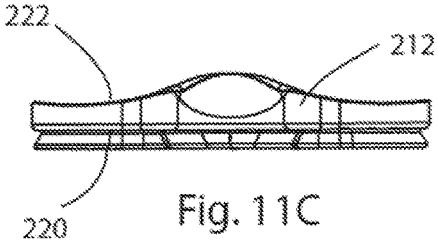

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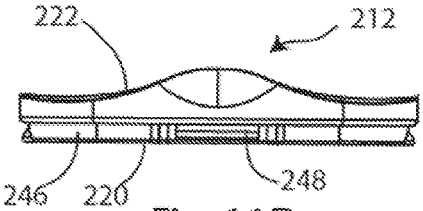

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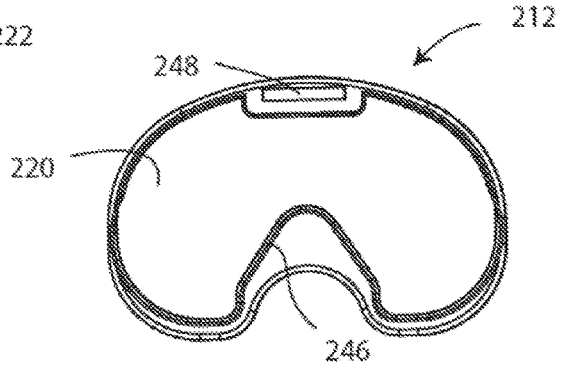

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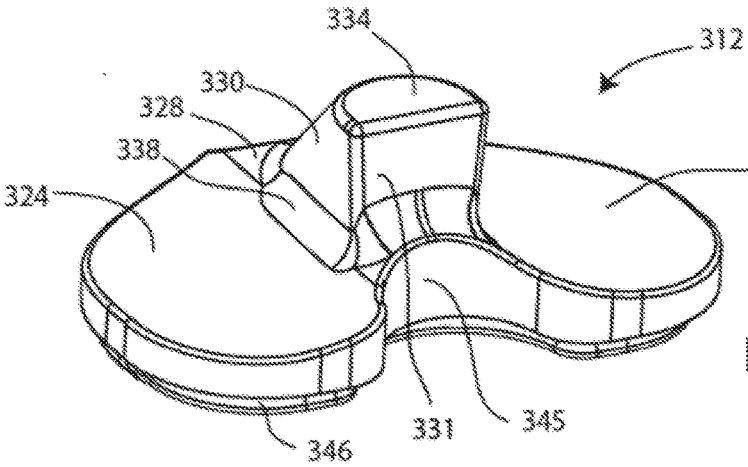

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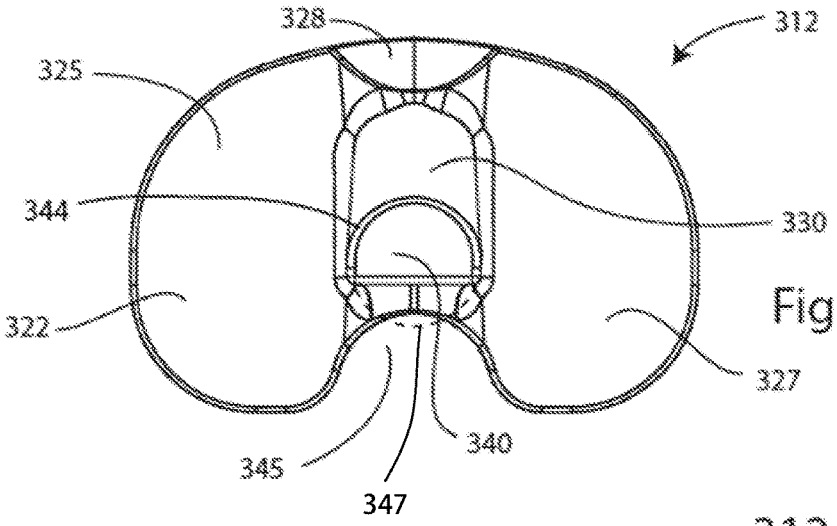

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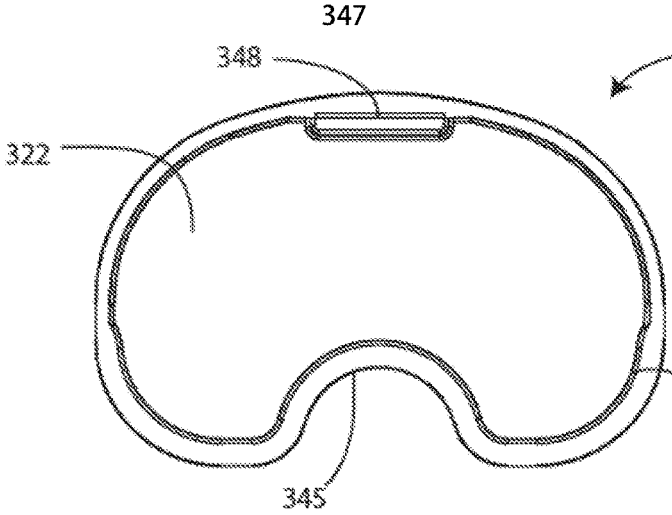

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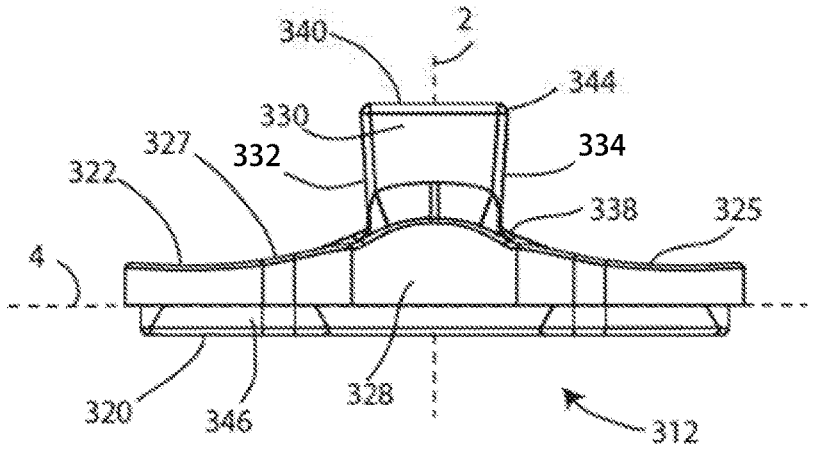

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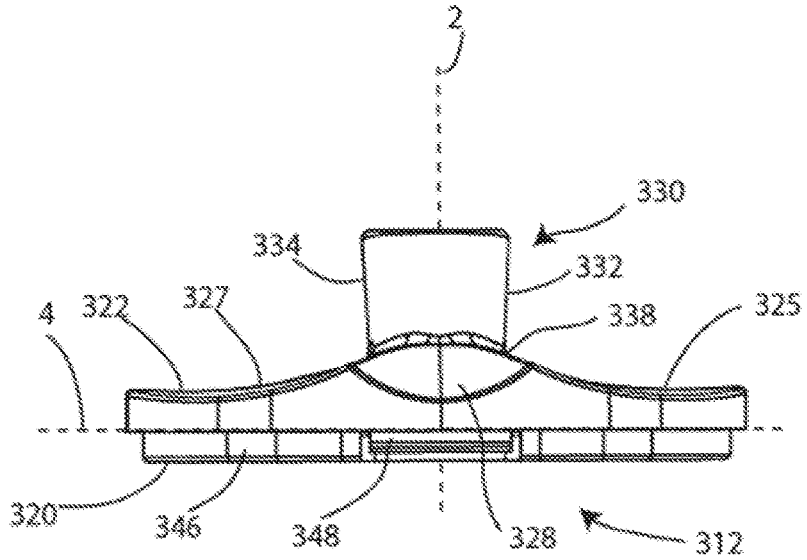

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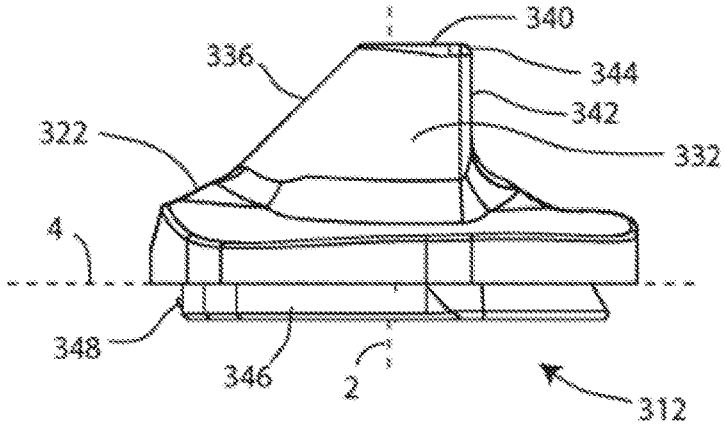
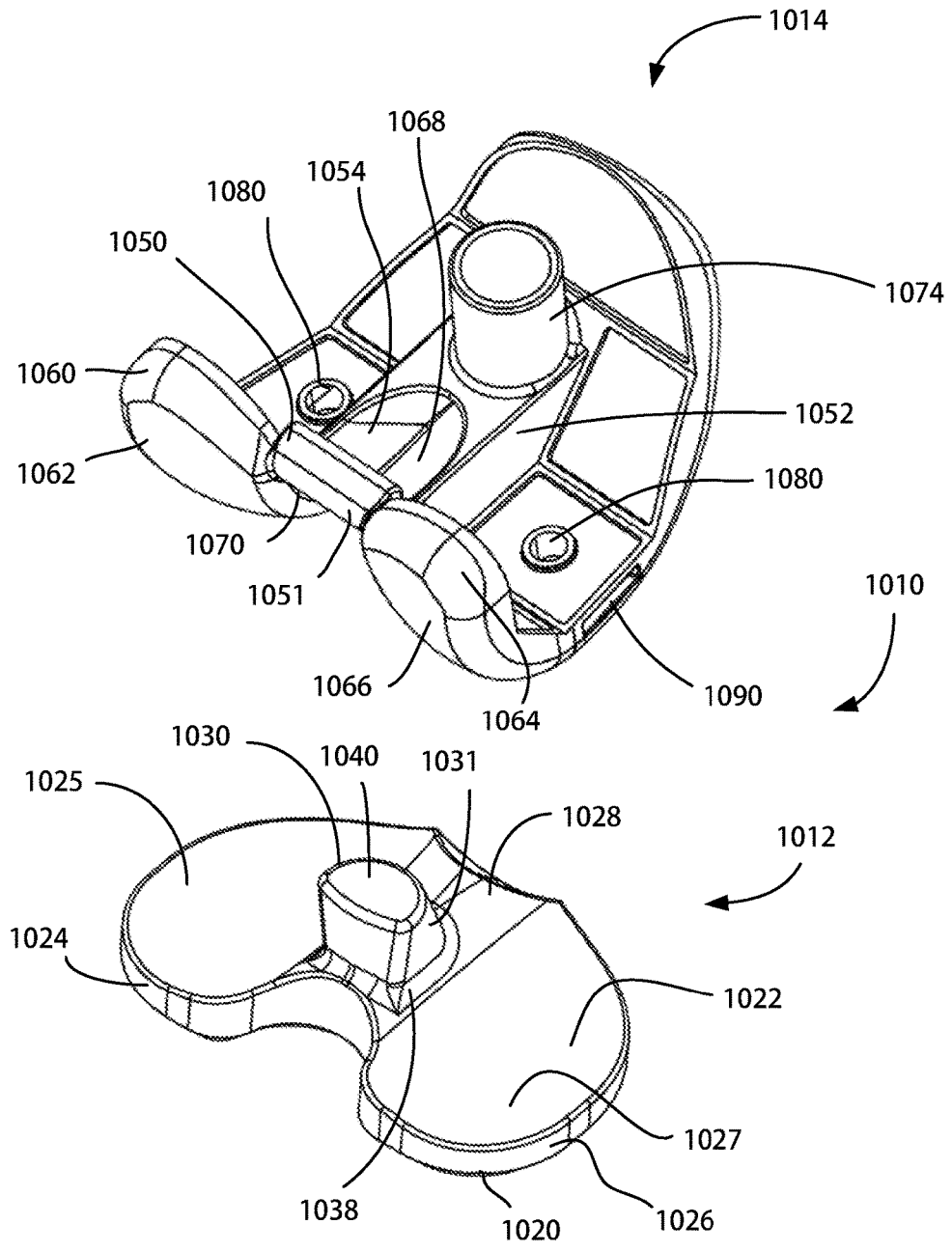


Fig. 12F

	Cruciate Retaining Insert	Posterior Stabilizing Insert	Constrained Condylar Knee Insert
Cruciate Retaining Femoral Component	X	X	X
Posterior Stabilizing Femoral Component	X	X	X

Fig. 13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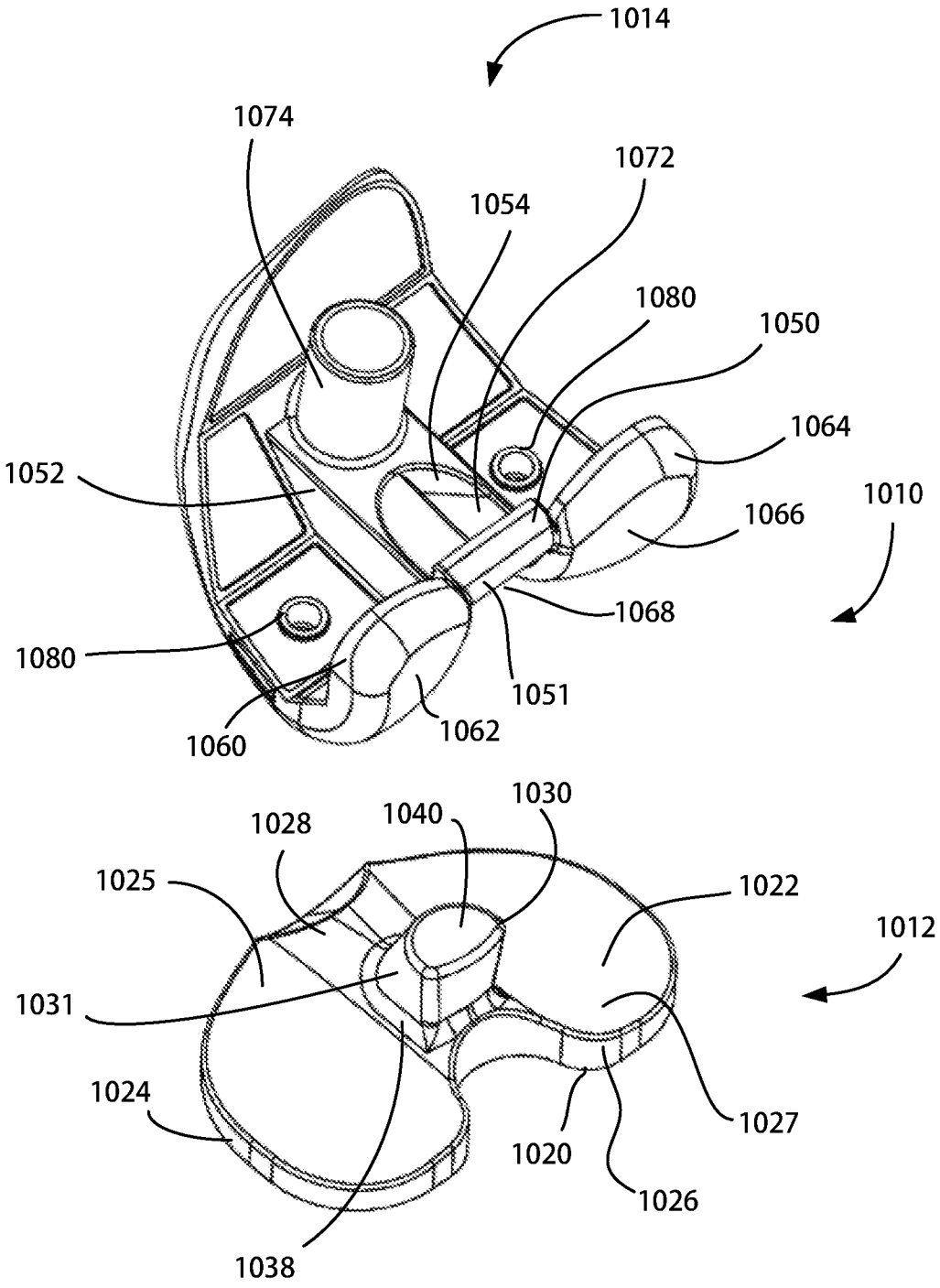
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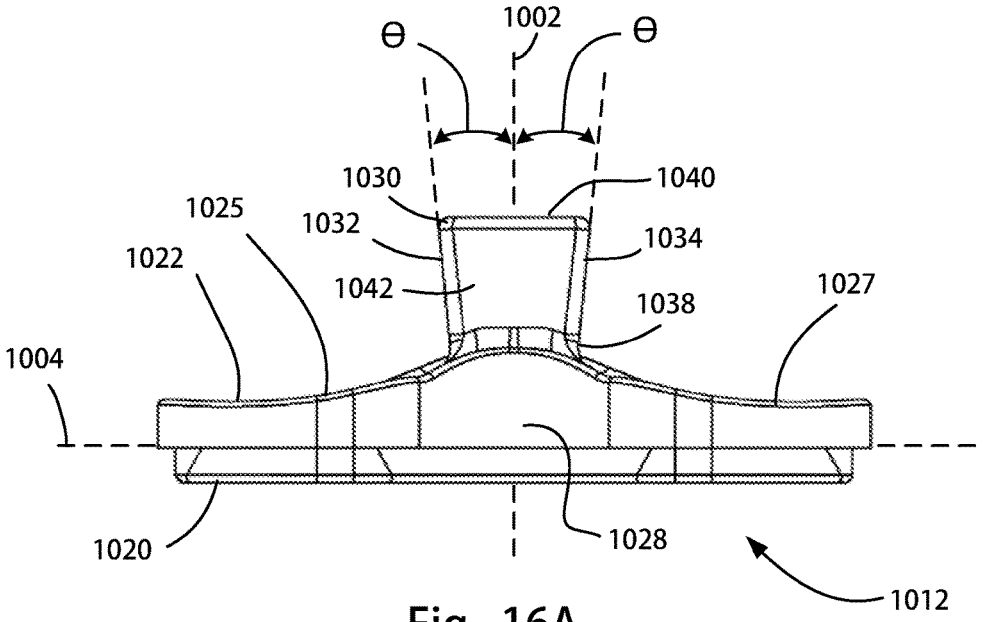

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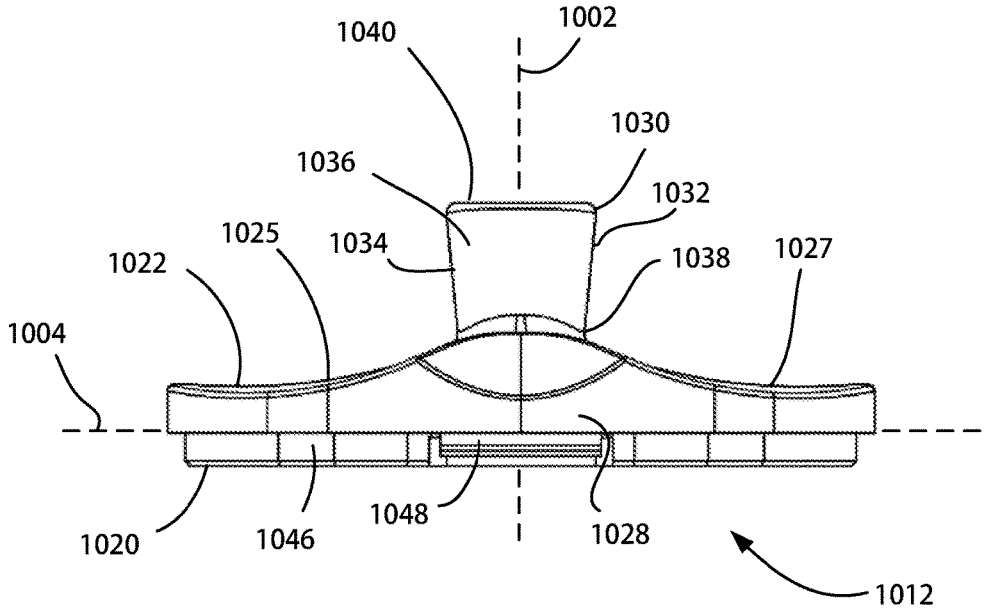

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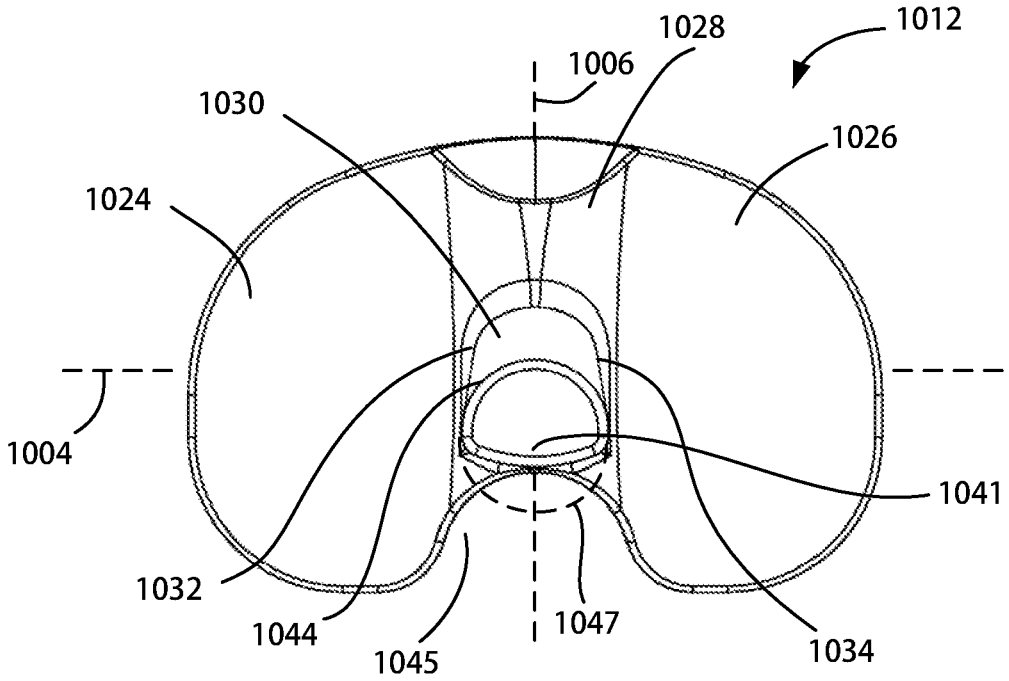

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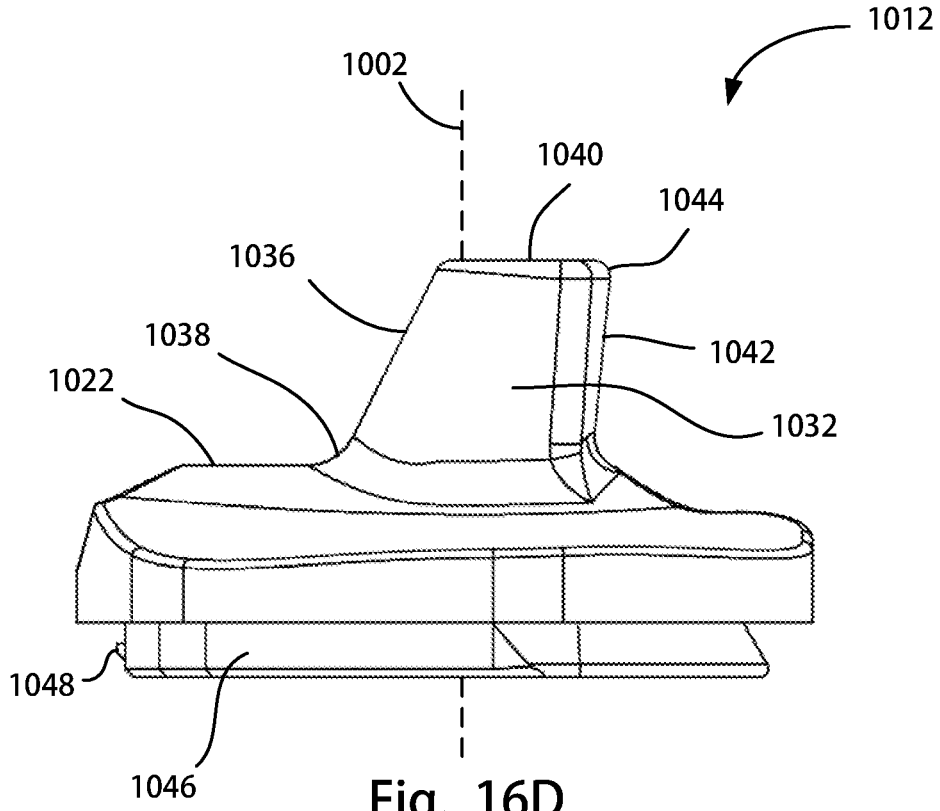

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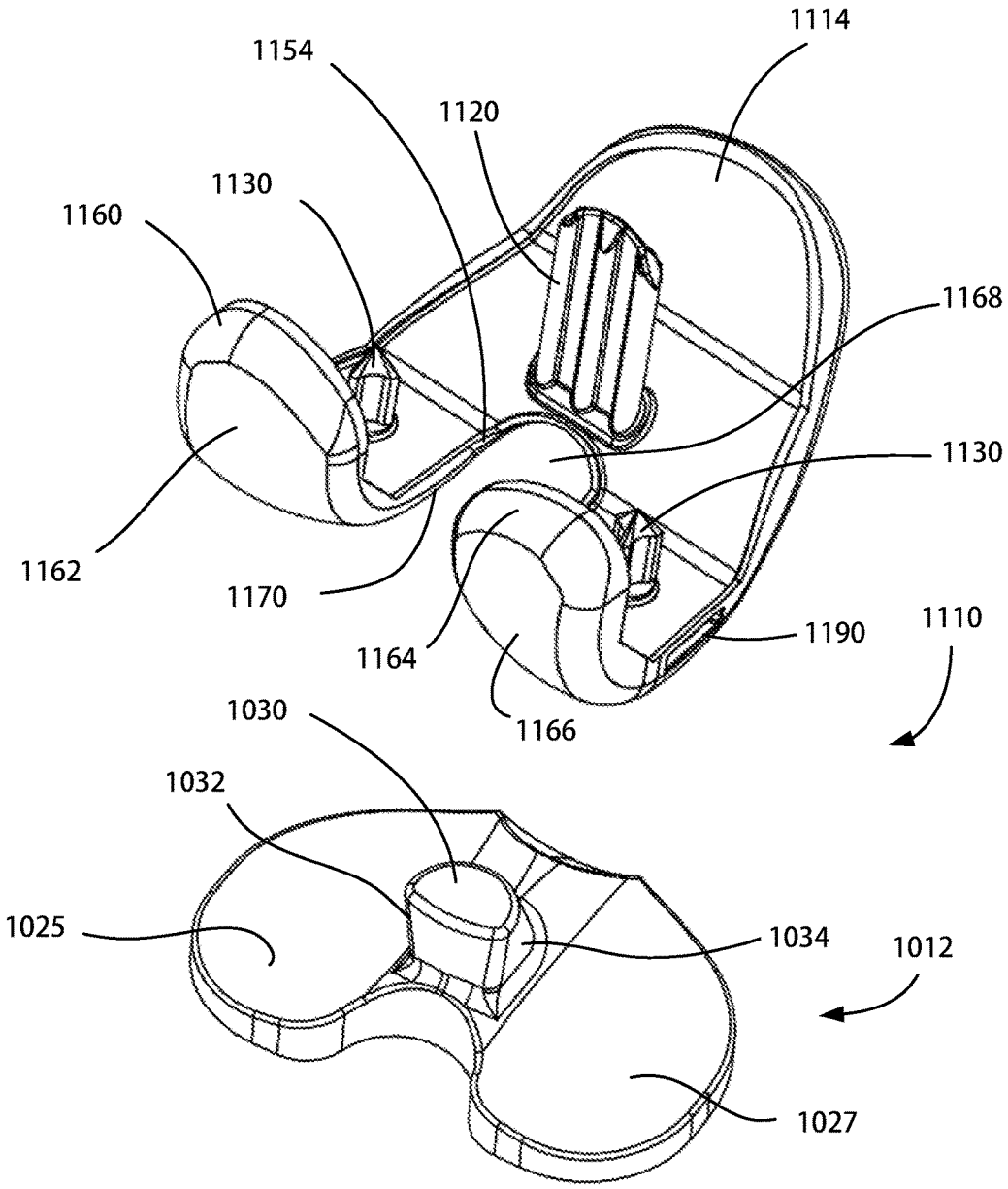
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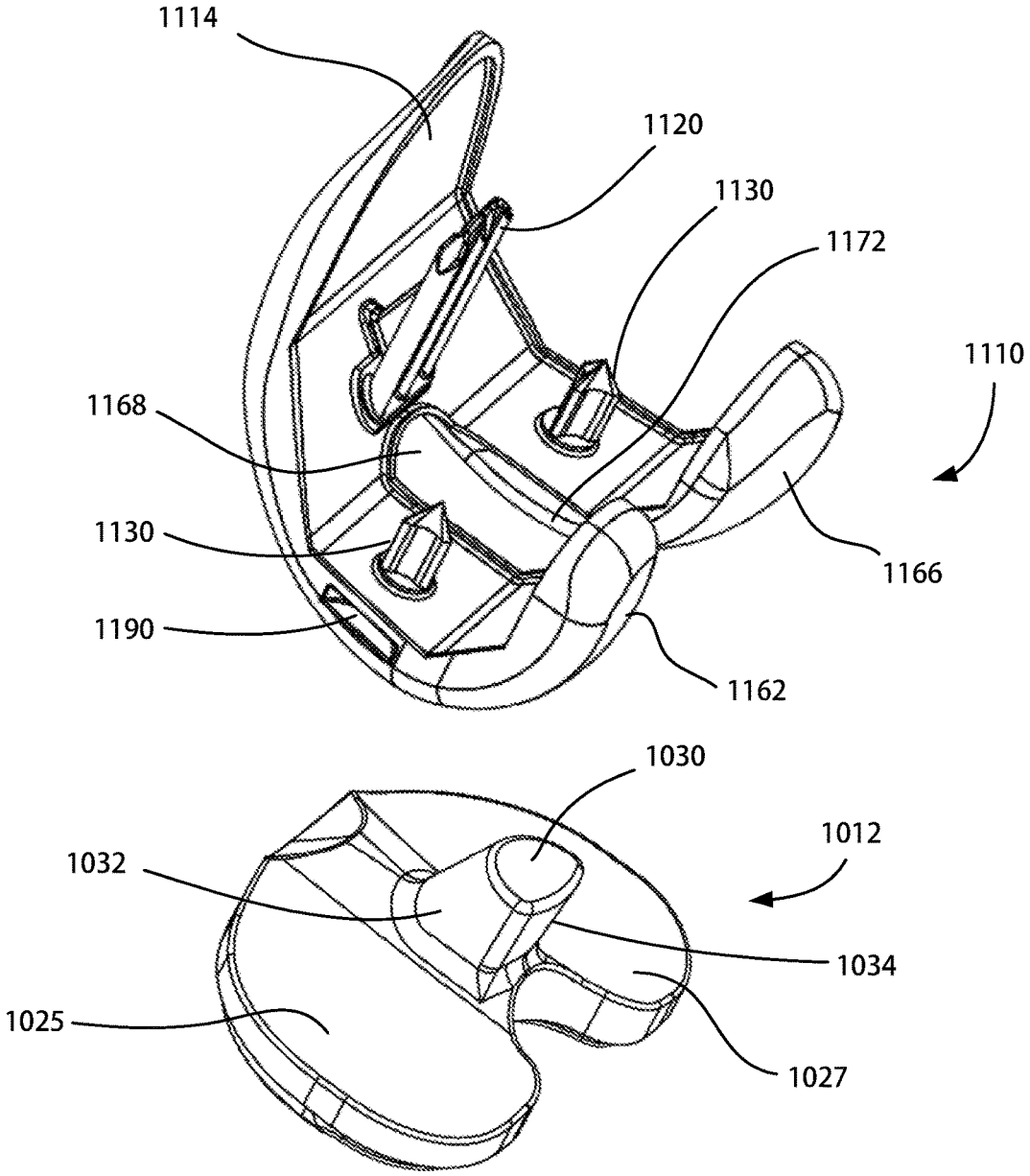
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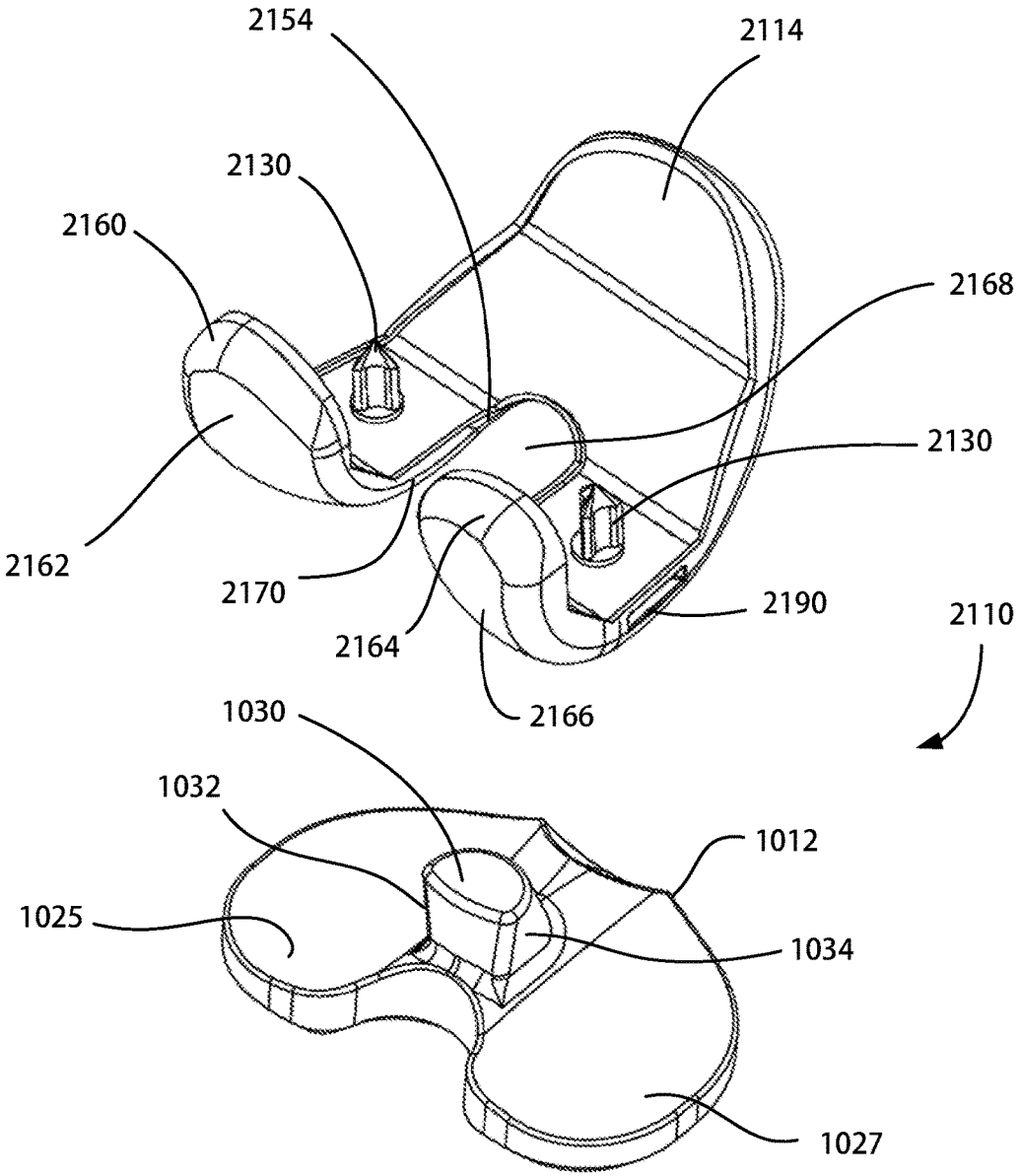
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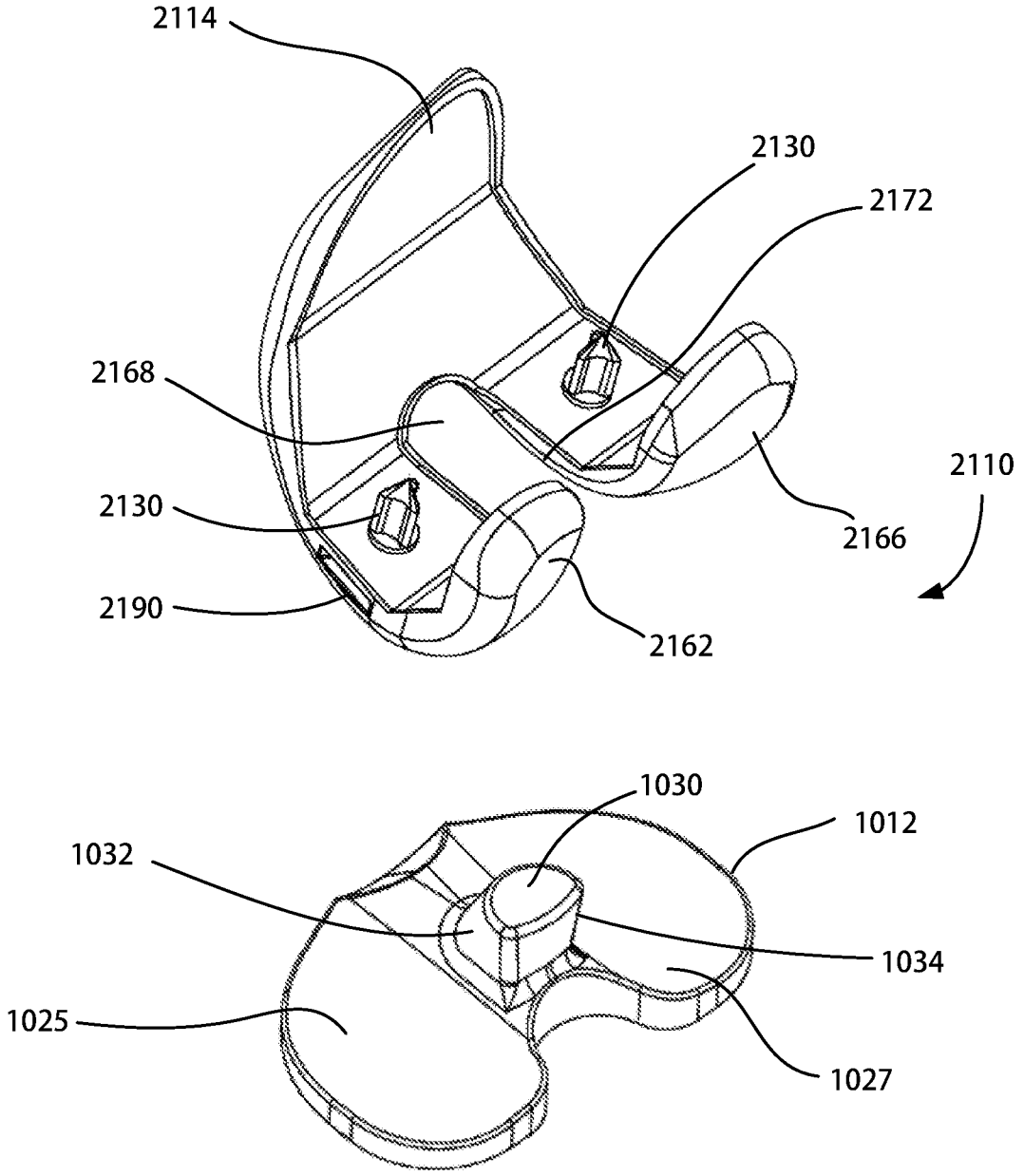
Fig. 19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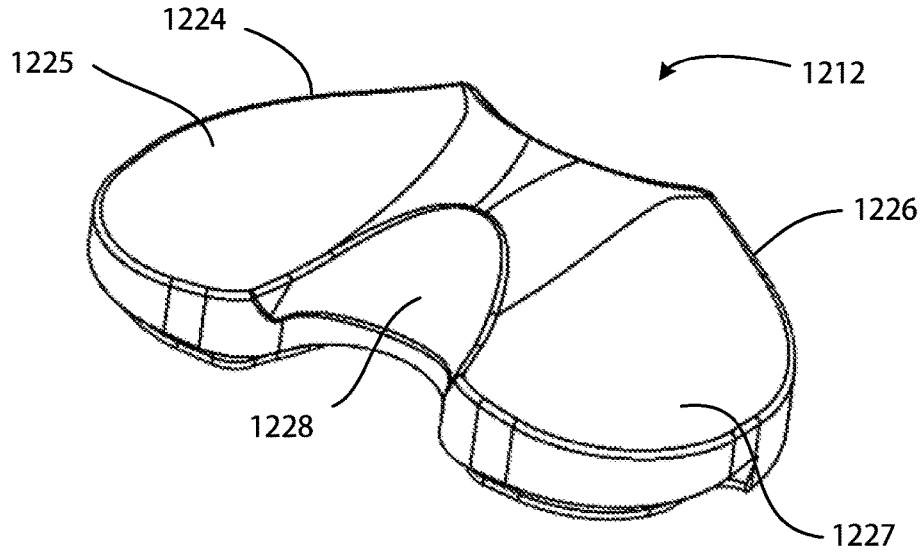

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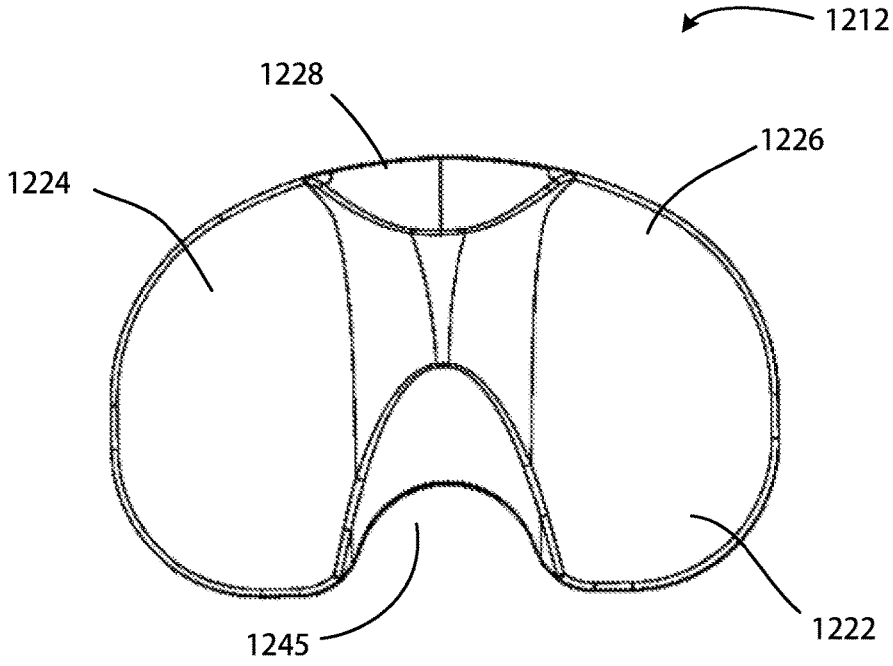
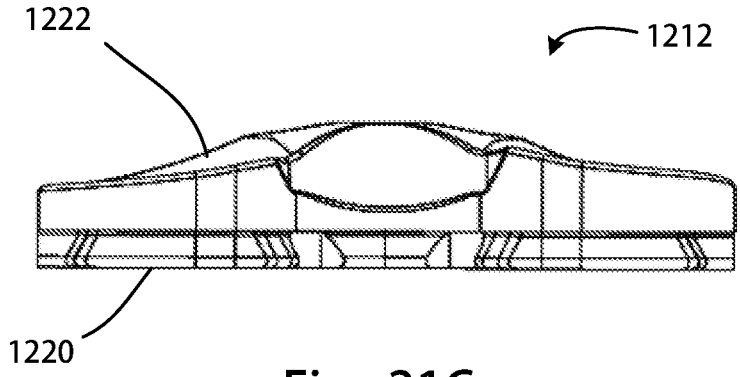


Fig. 21B



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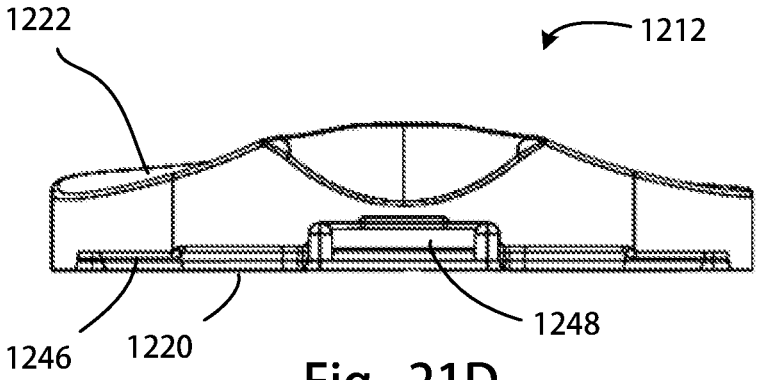

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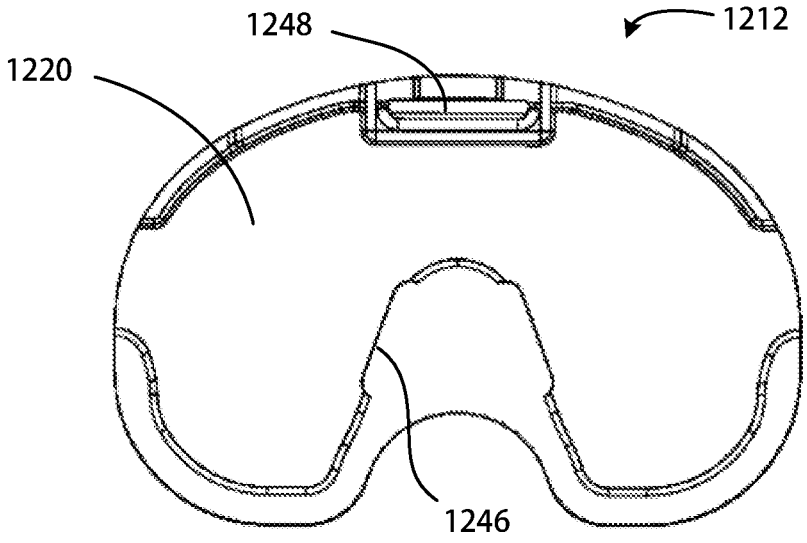

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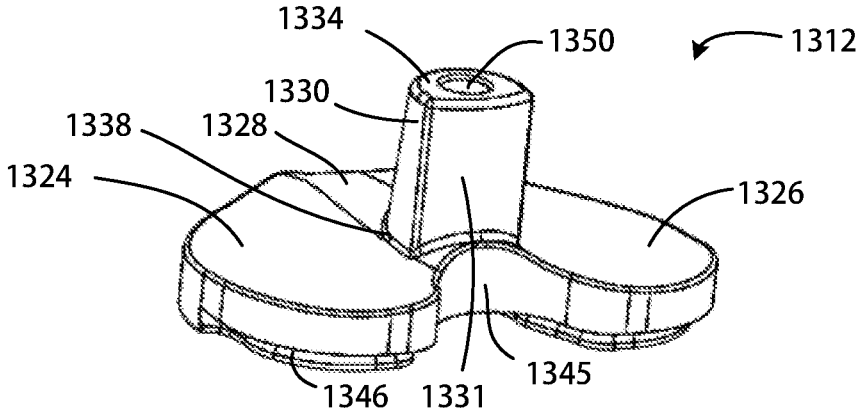
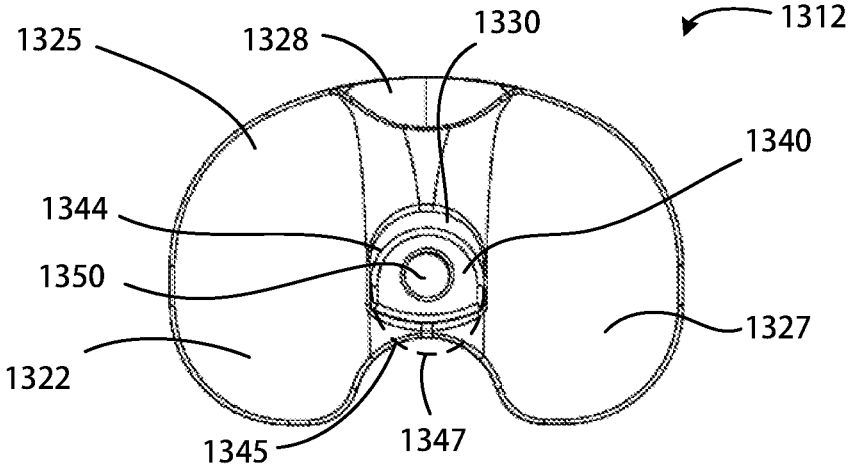


Fig. 22A



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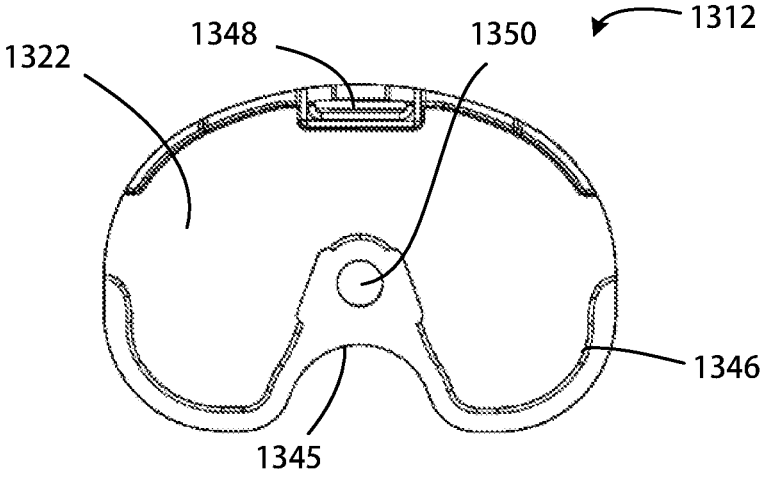

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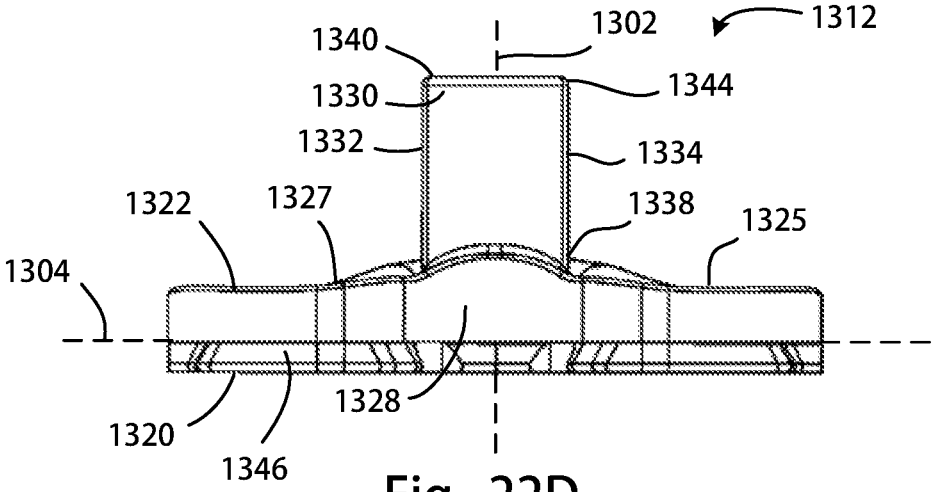

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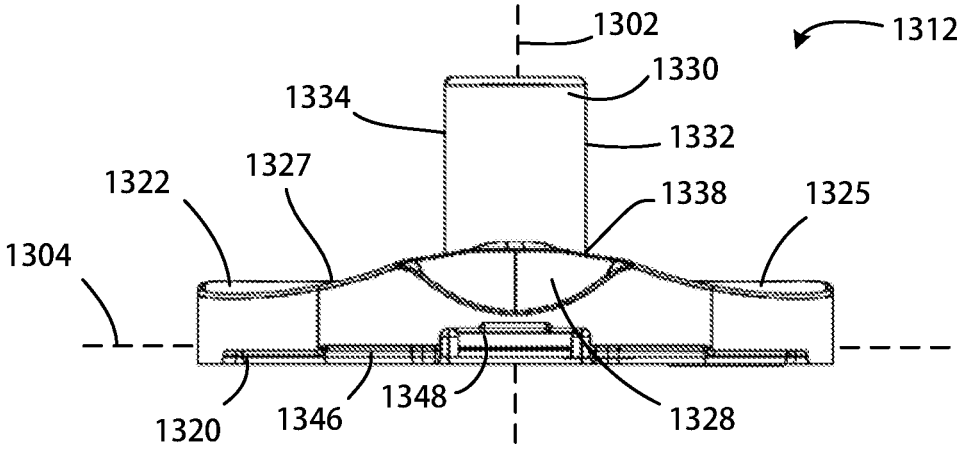

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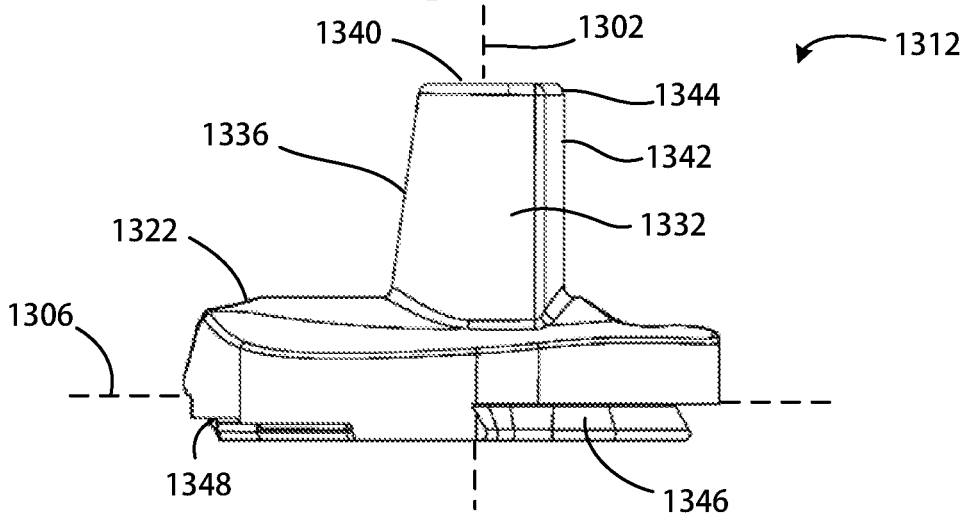

Fig. 22F

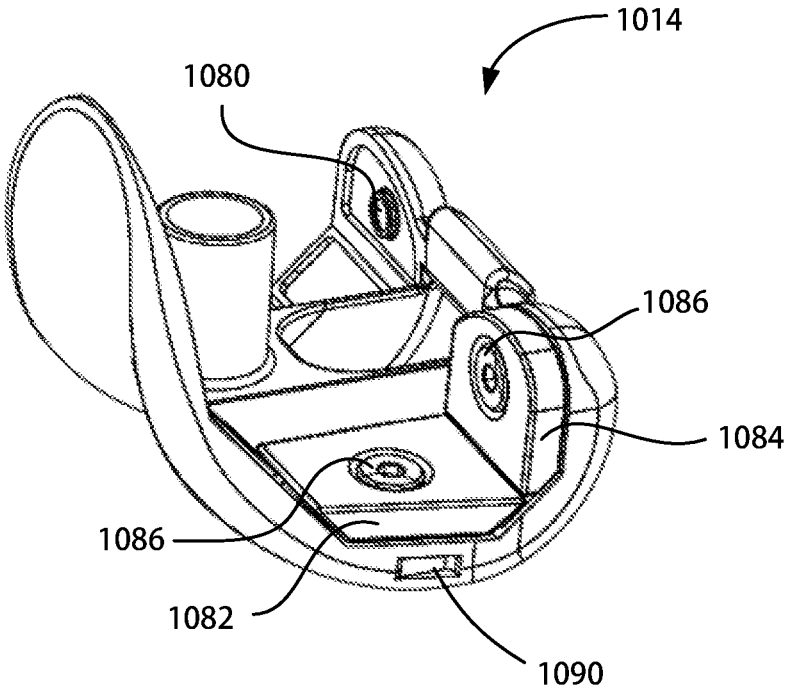

Fig. 23A

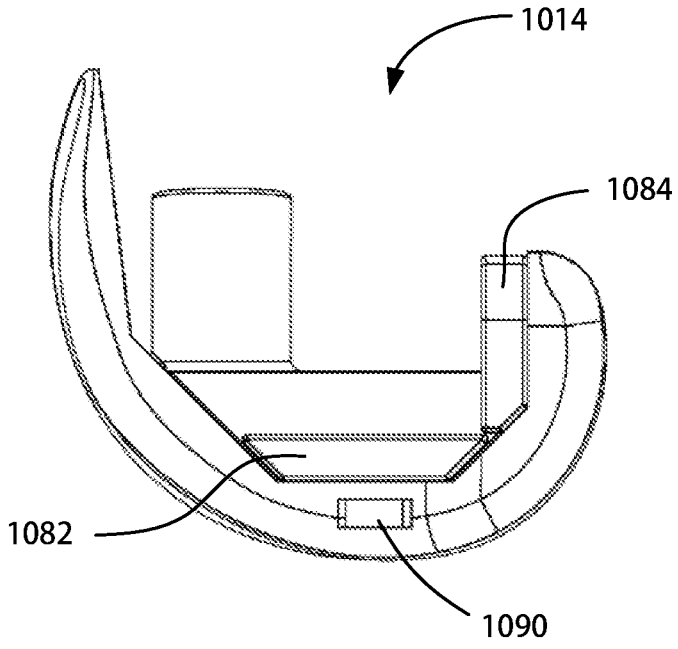

Fig. 23B

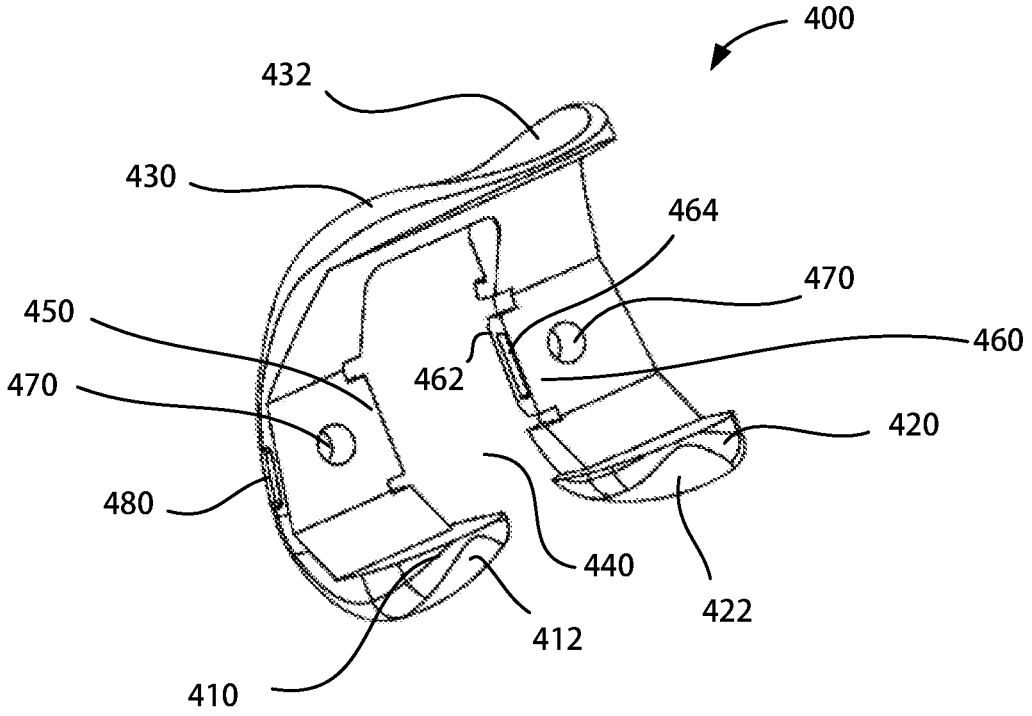

Fig. 24A

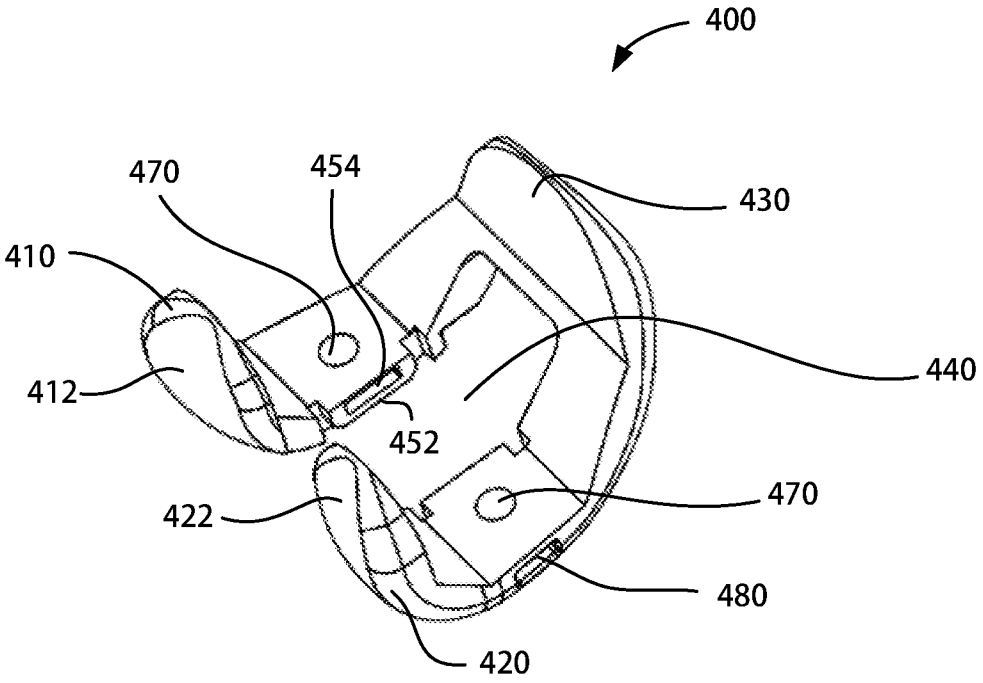

Fig. 24B

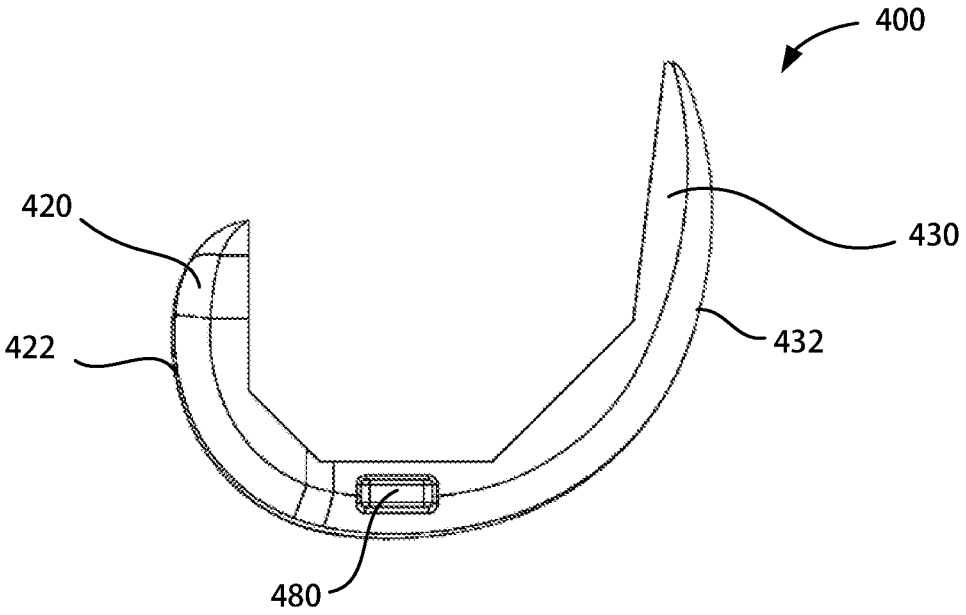

Fig. 24C

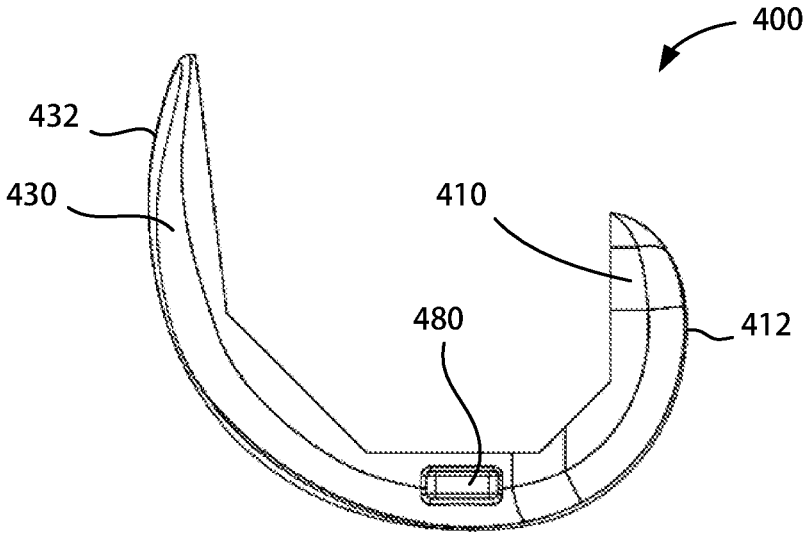

Fig. 24D

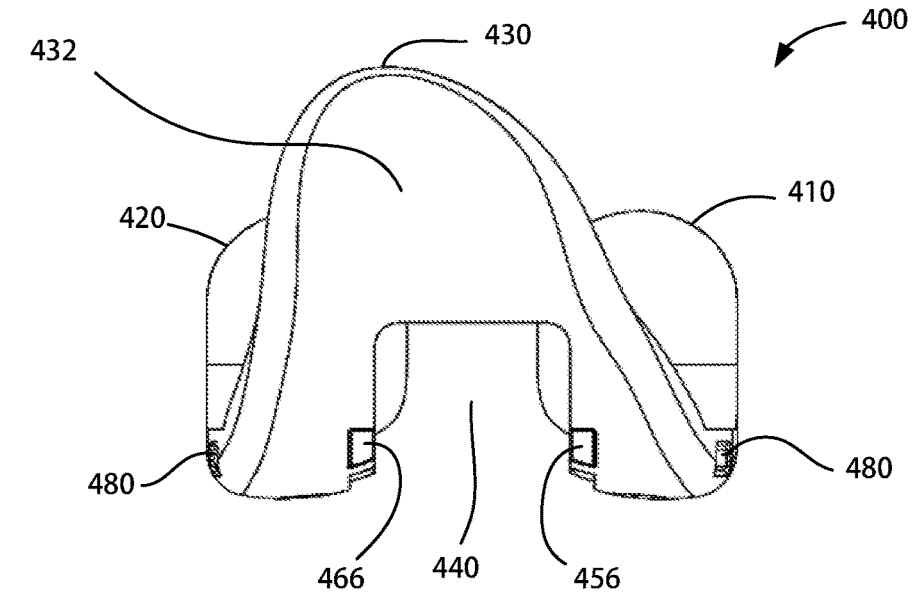

Fig. 24E

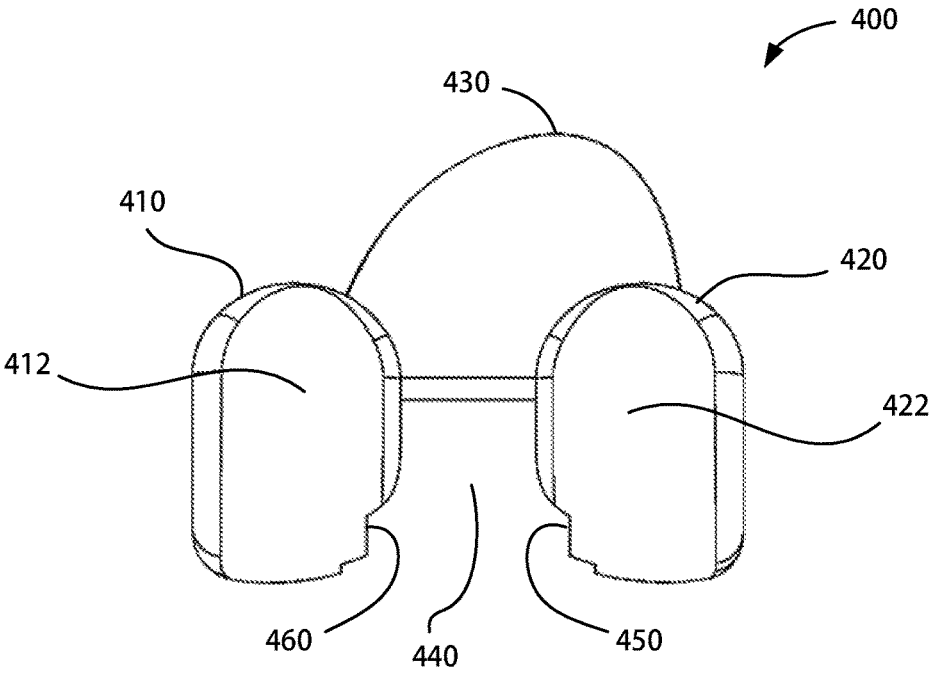

Fig. 24F

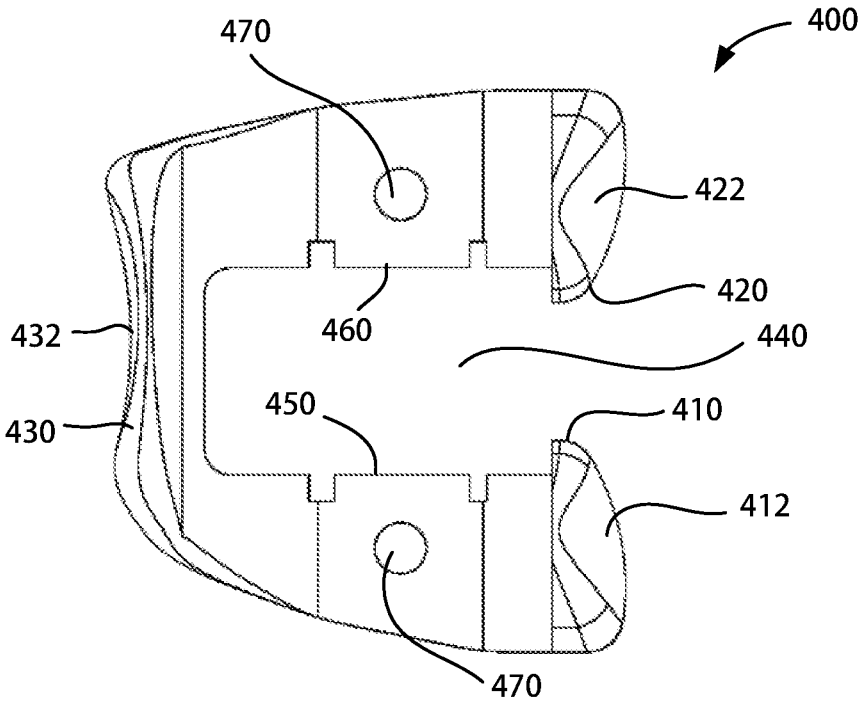

Fig. 24G

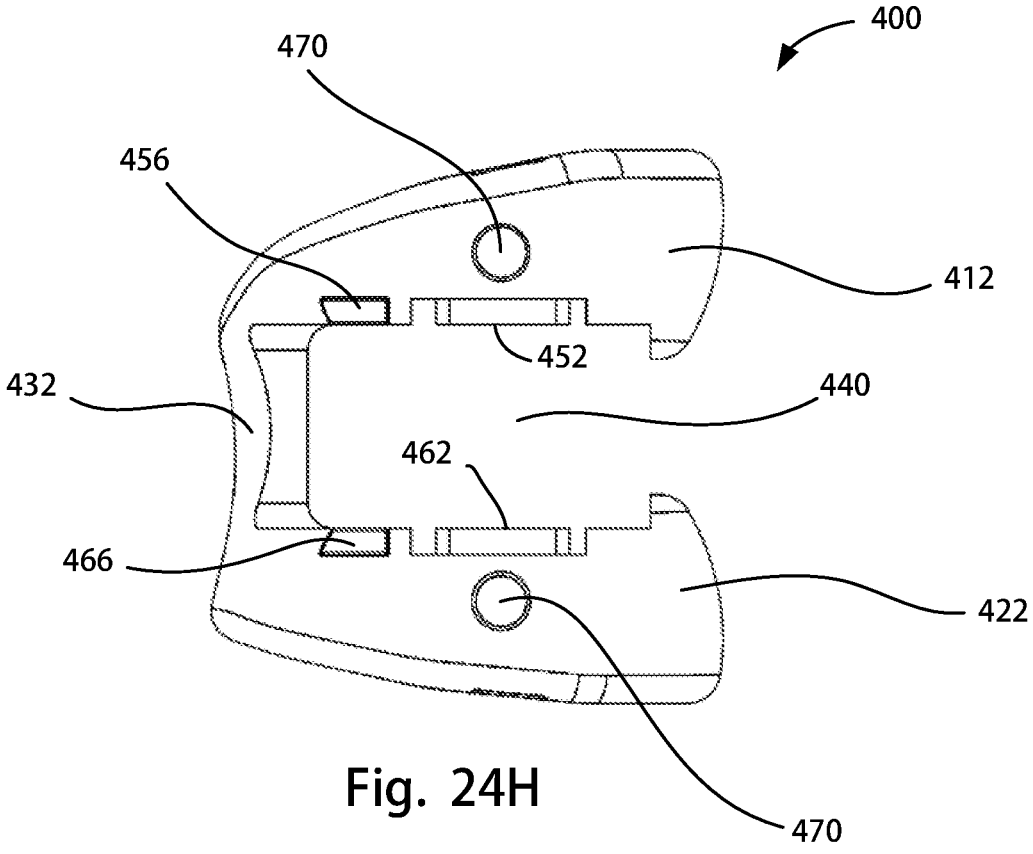

Fig. 24H

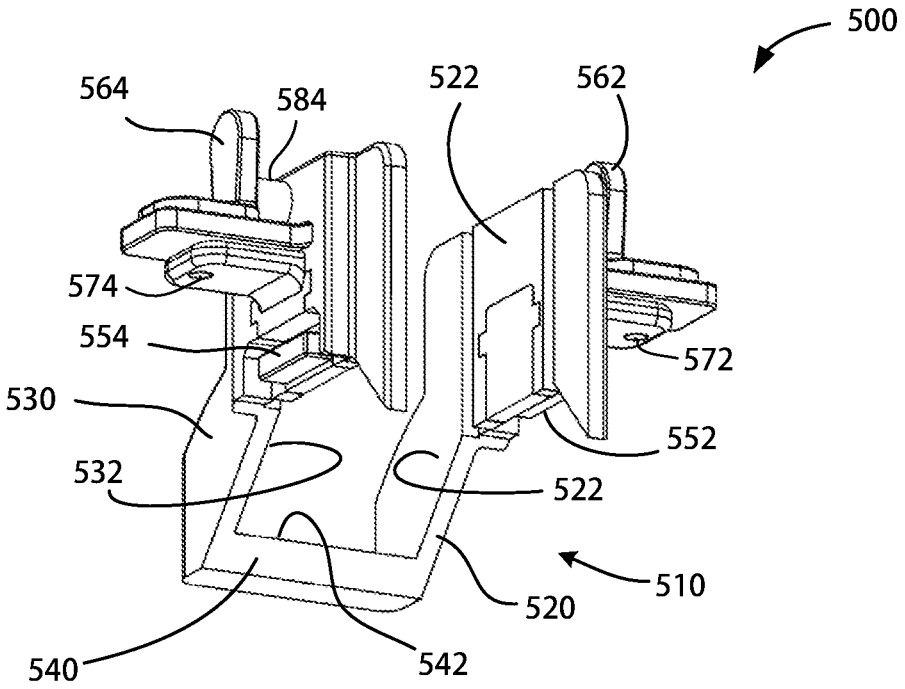

Fig. 25A

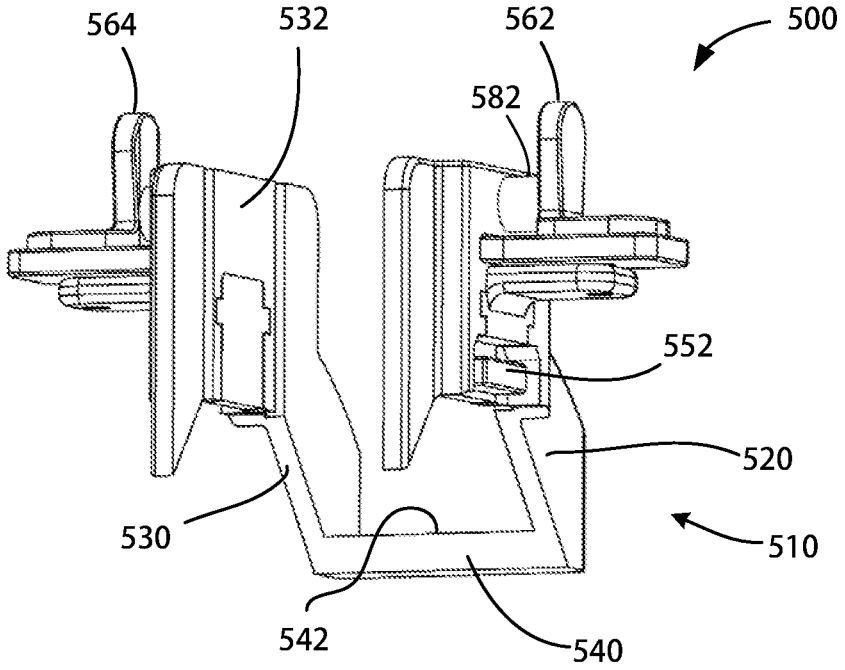

Fig. 25B

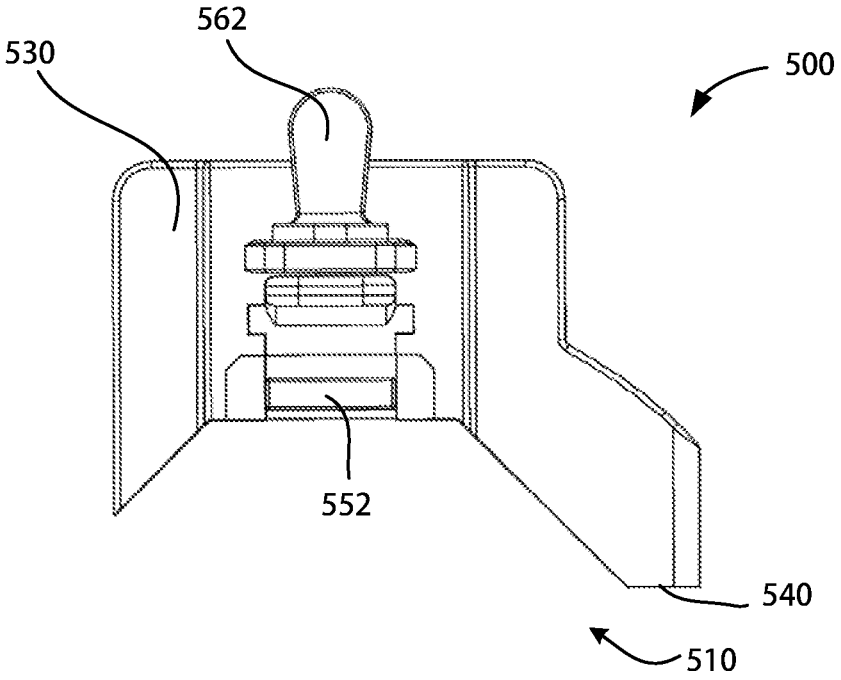

Fig. 25C

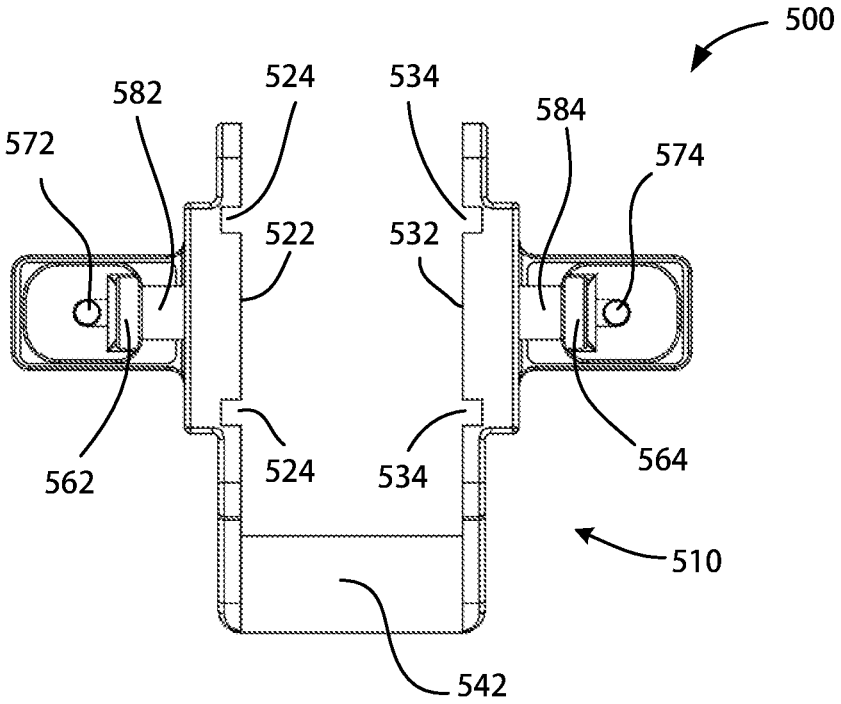

Fig. 25D

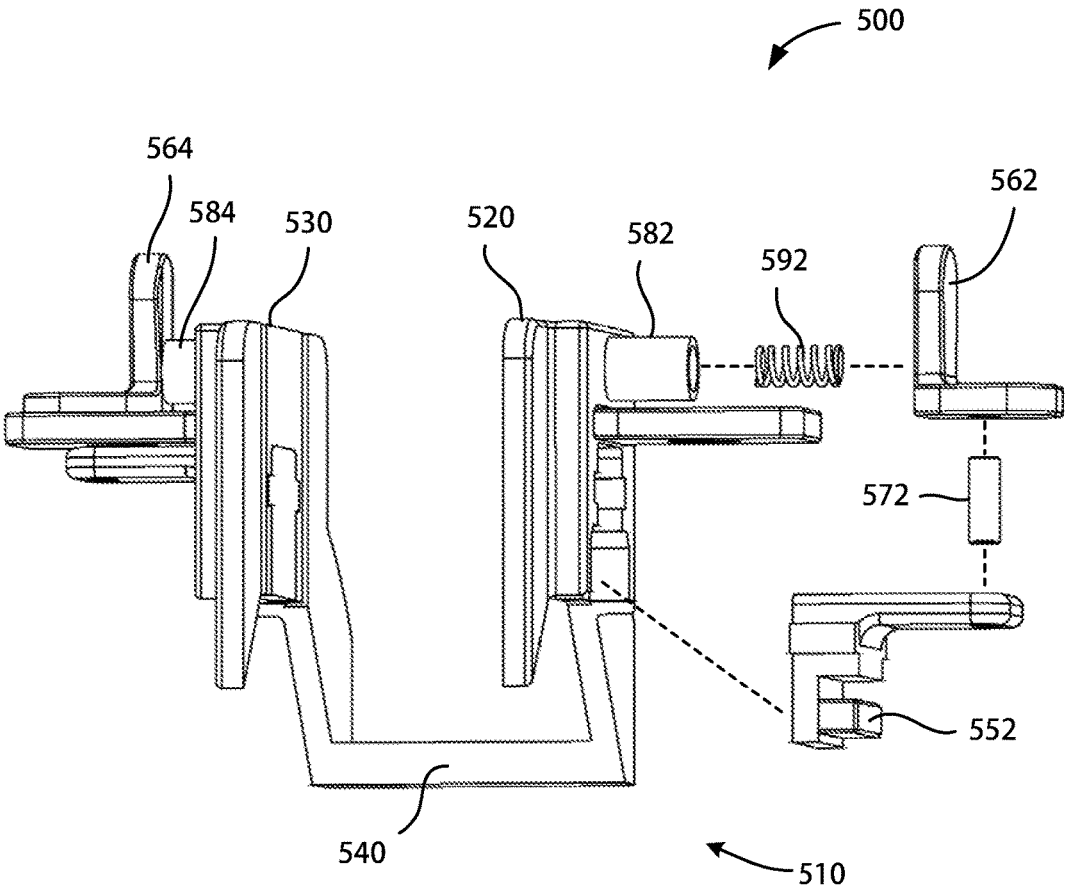

Fig. 26

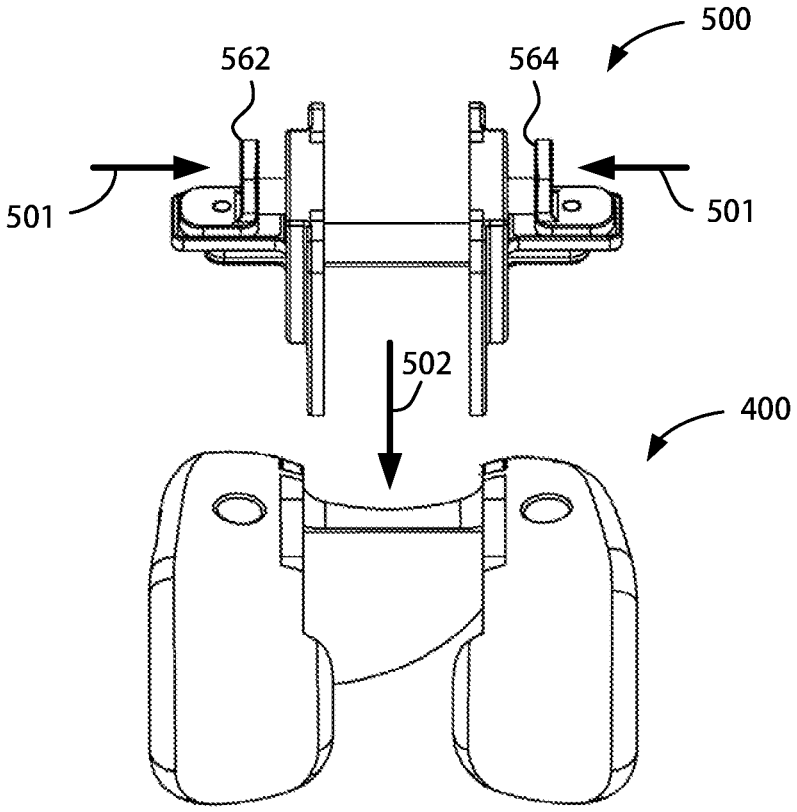

Fig. 27A

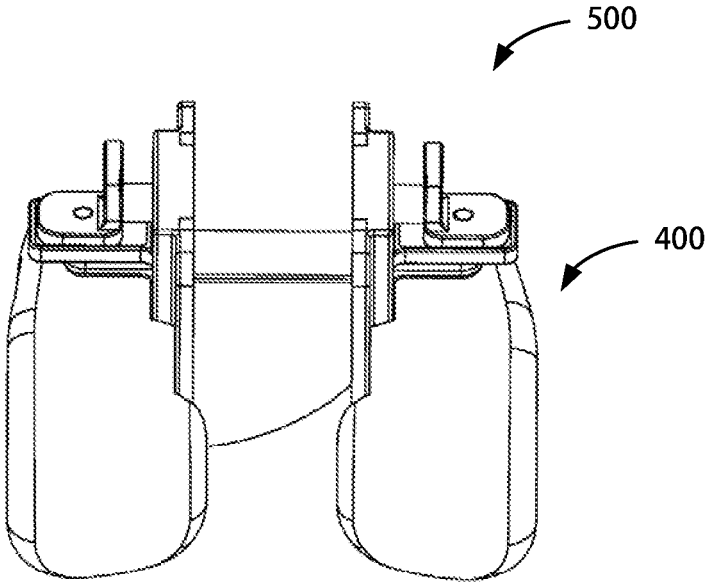

Fig. 27B

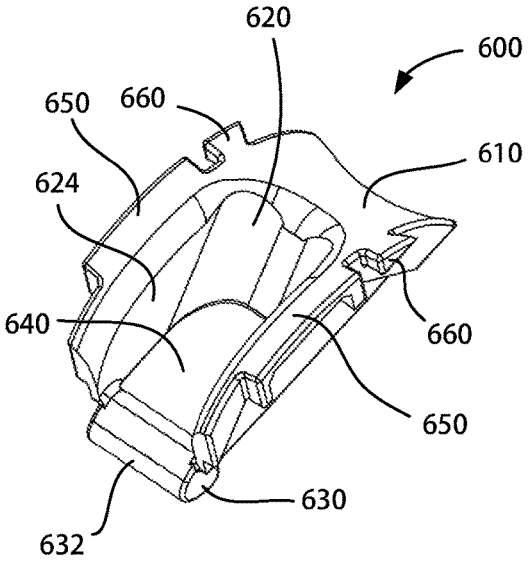

Fig. 28A

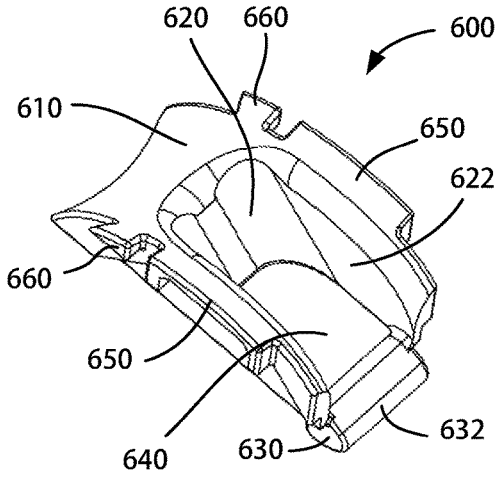

Fig. 28B

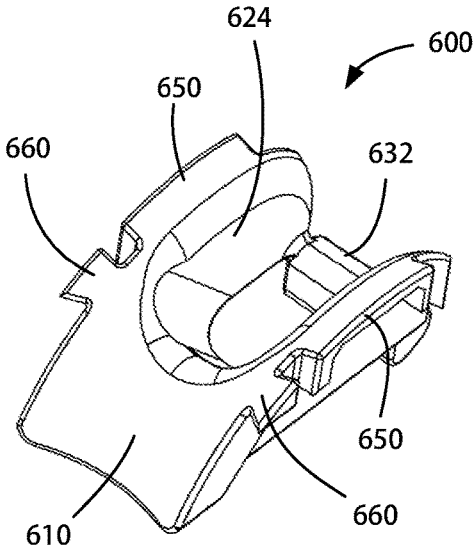

Fig. 28C

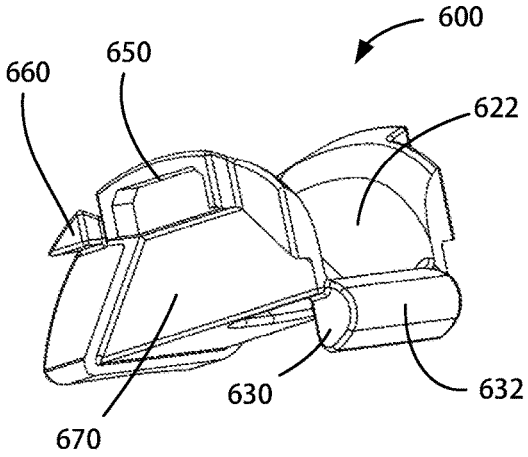

Fig. 28D

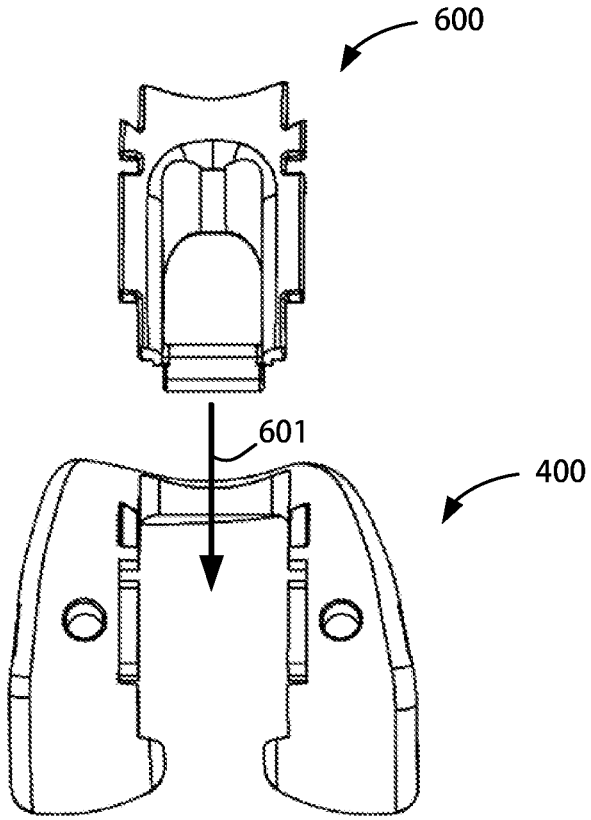

Fig. 29A

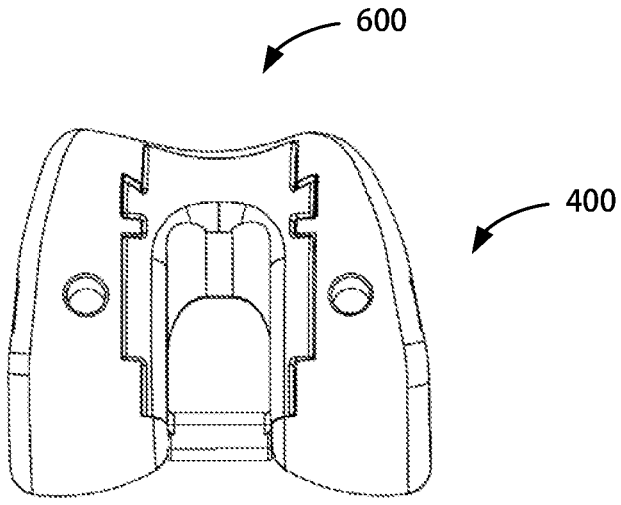

Fig. 29B

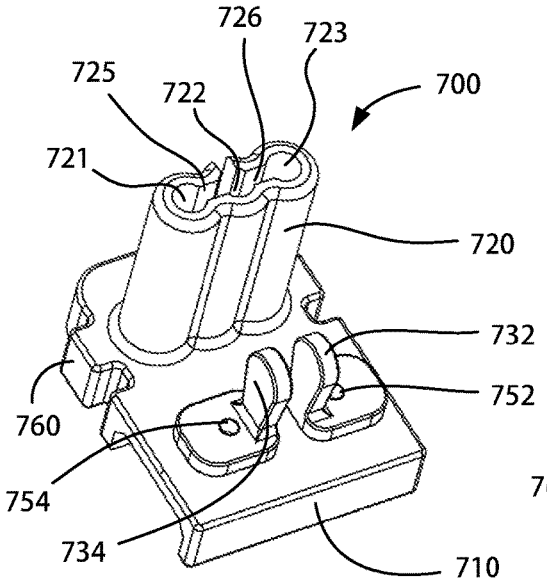

Fig. 30A

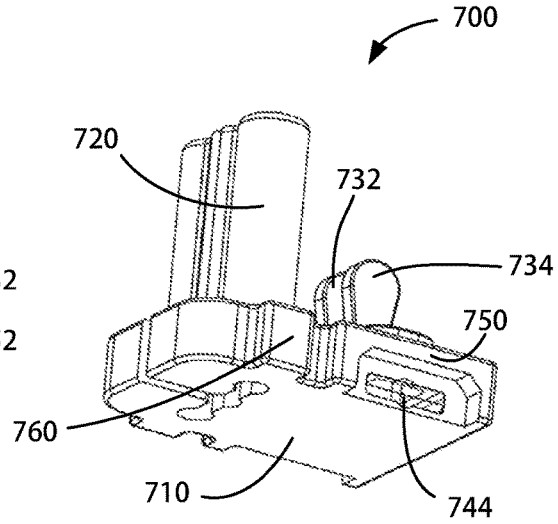

Fig. 30B

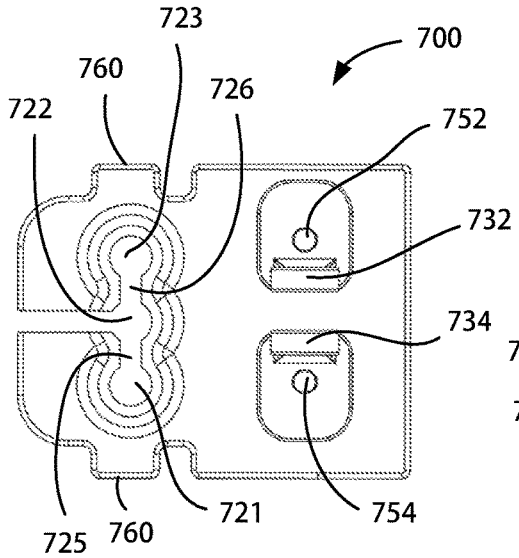

Fig. 30C

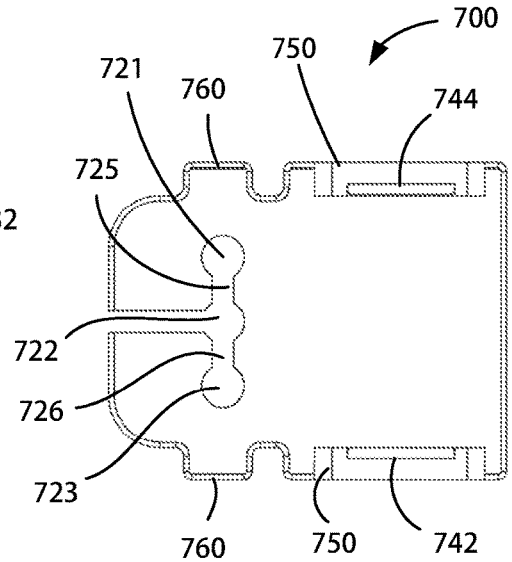

Fig. 30D

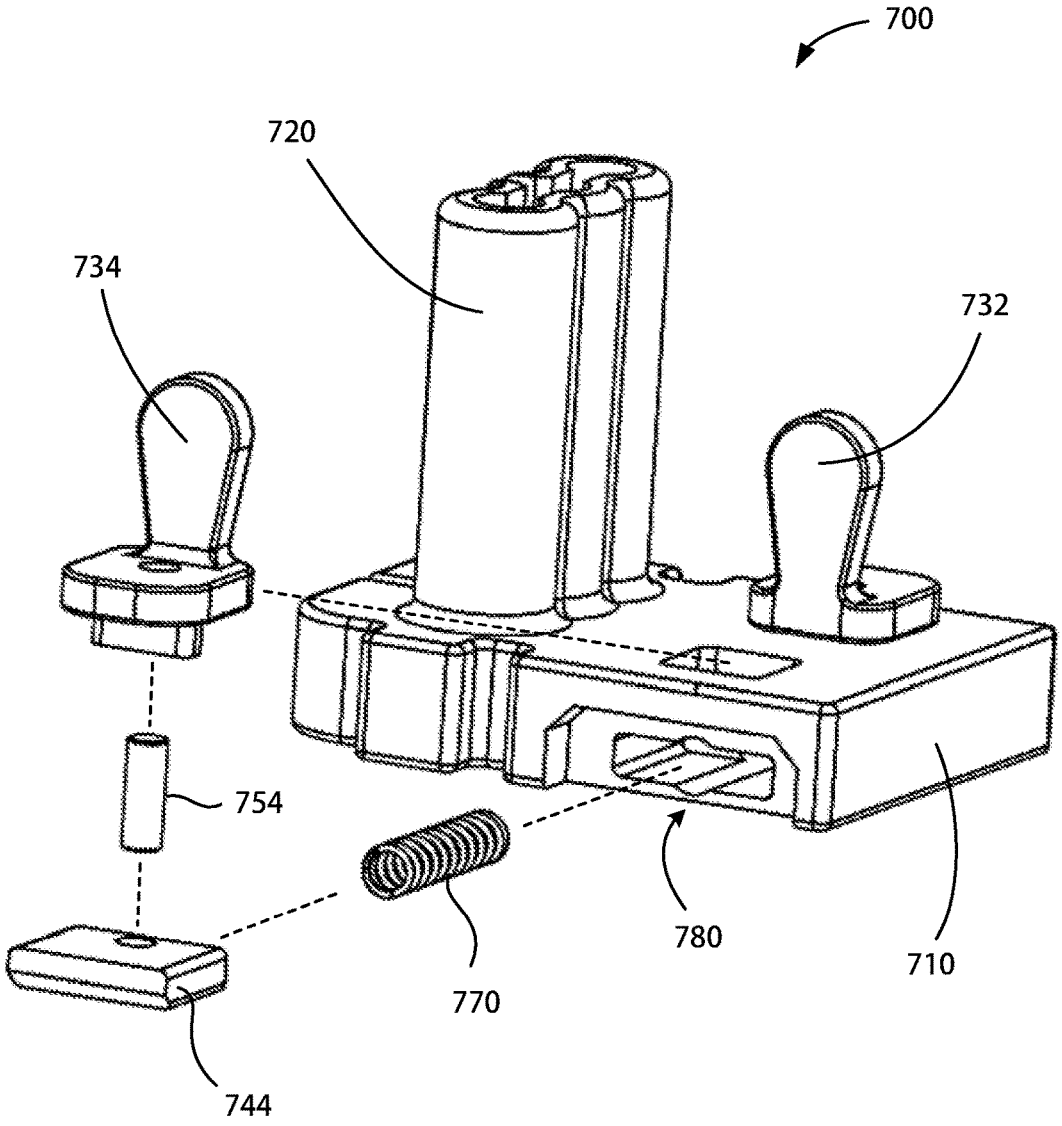

Fig. 31

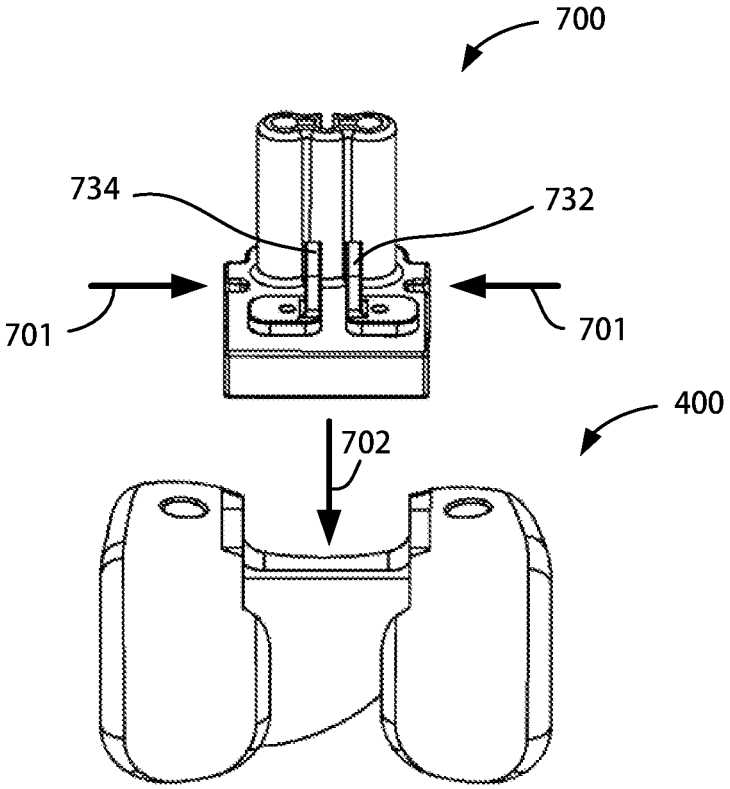

Fig. 32A

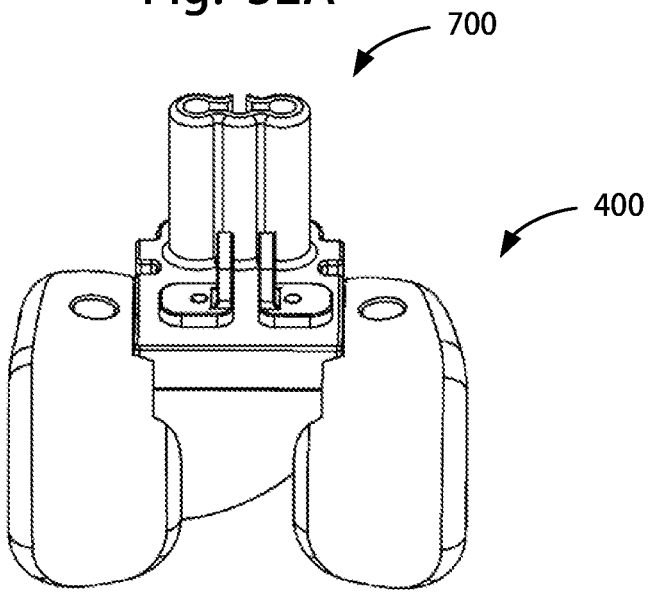

Fig. 32B

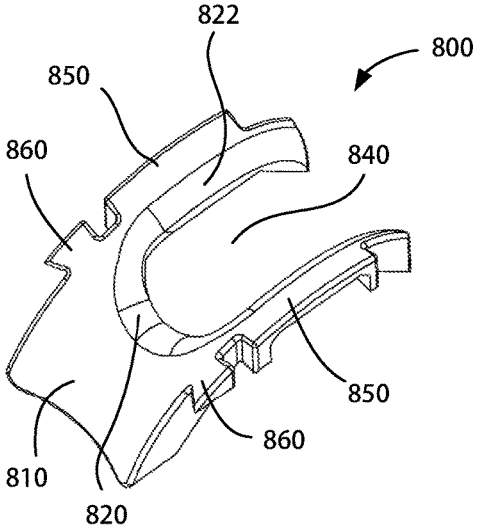

Fig. 33A

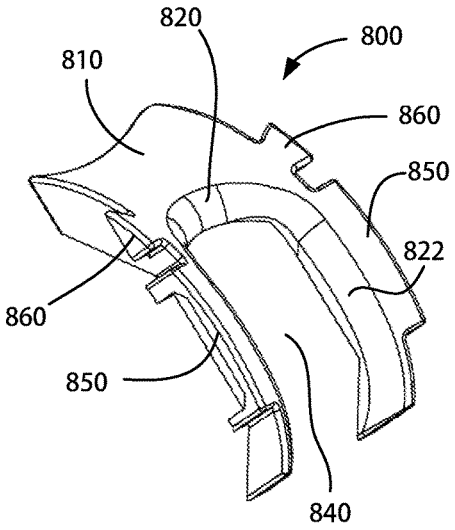

Fig. 33B

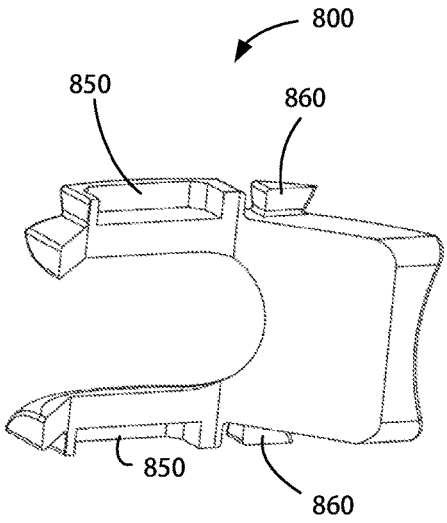

Fig. 33C

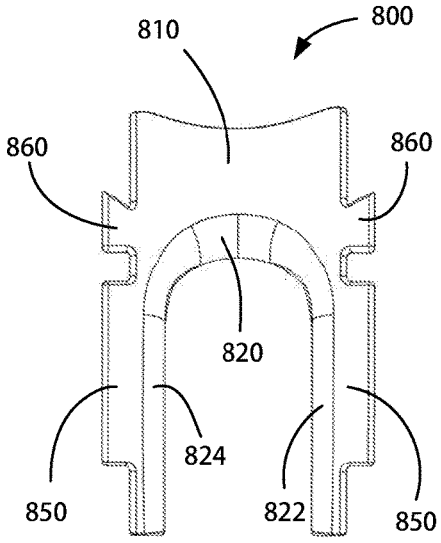

Fig. 33D

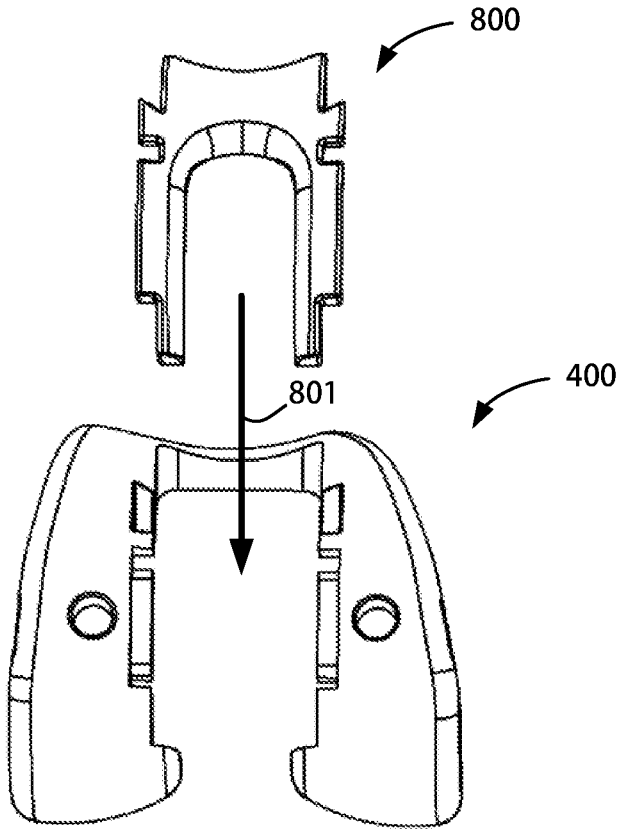

Fig. 34A

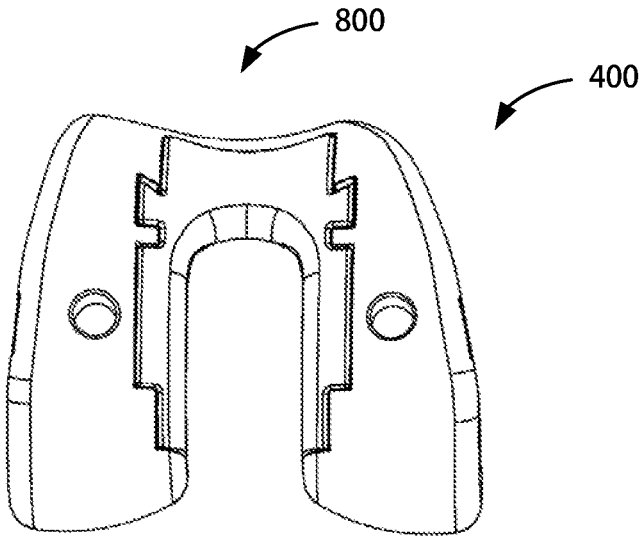

Fig. 34B

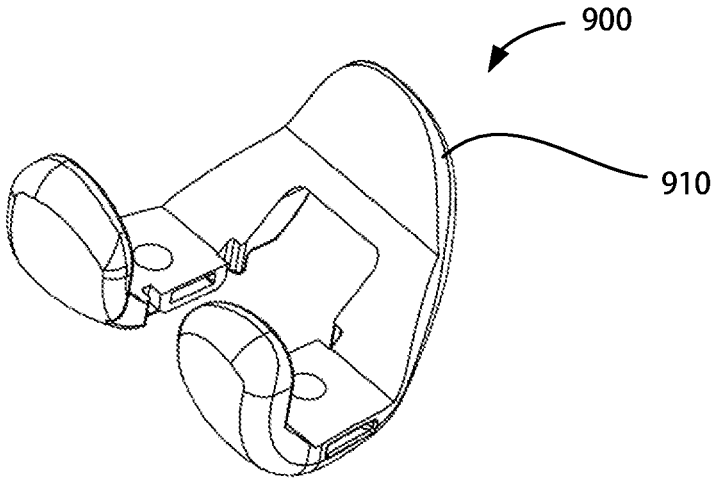

Fig. 35A

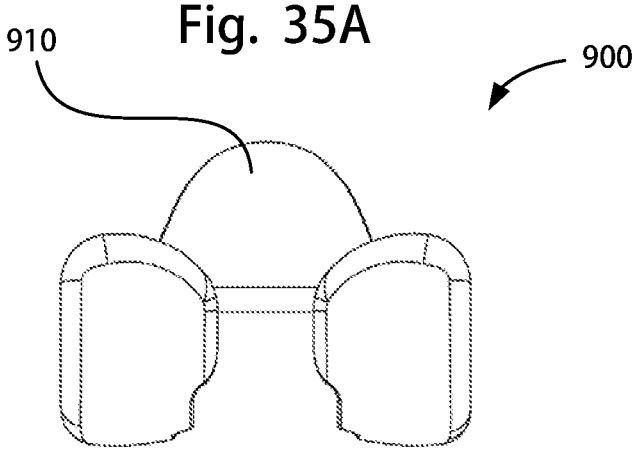

Fig. 35B

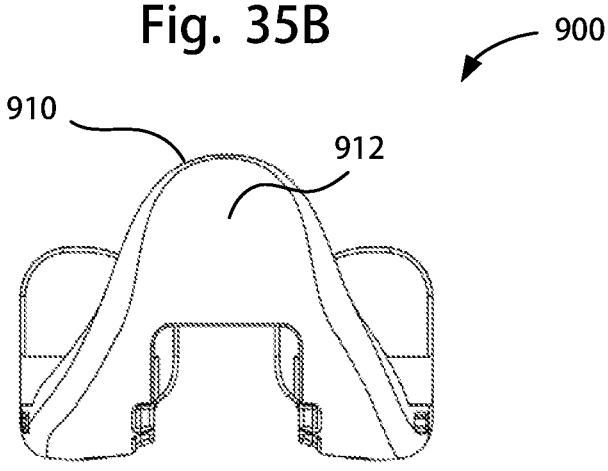

Fig. 35C

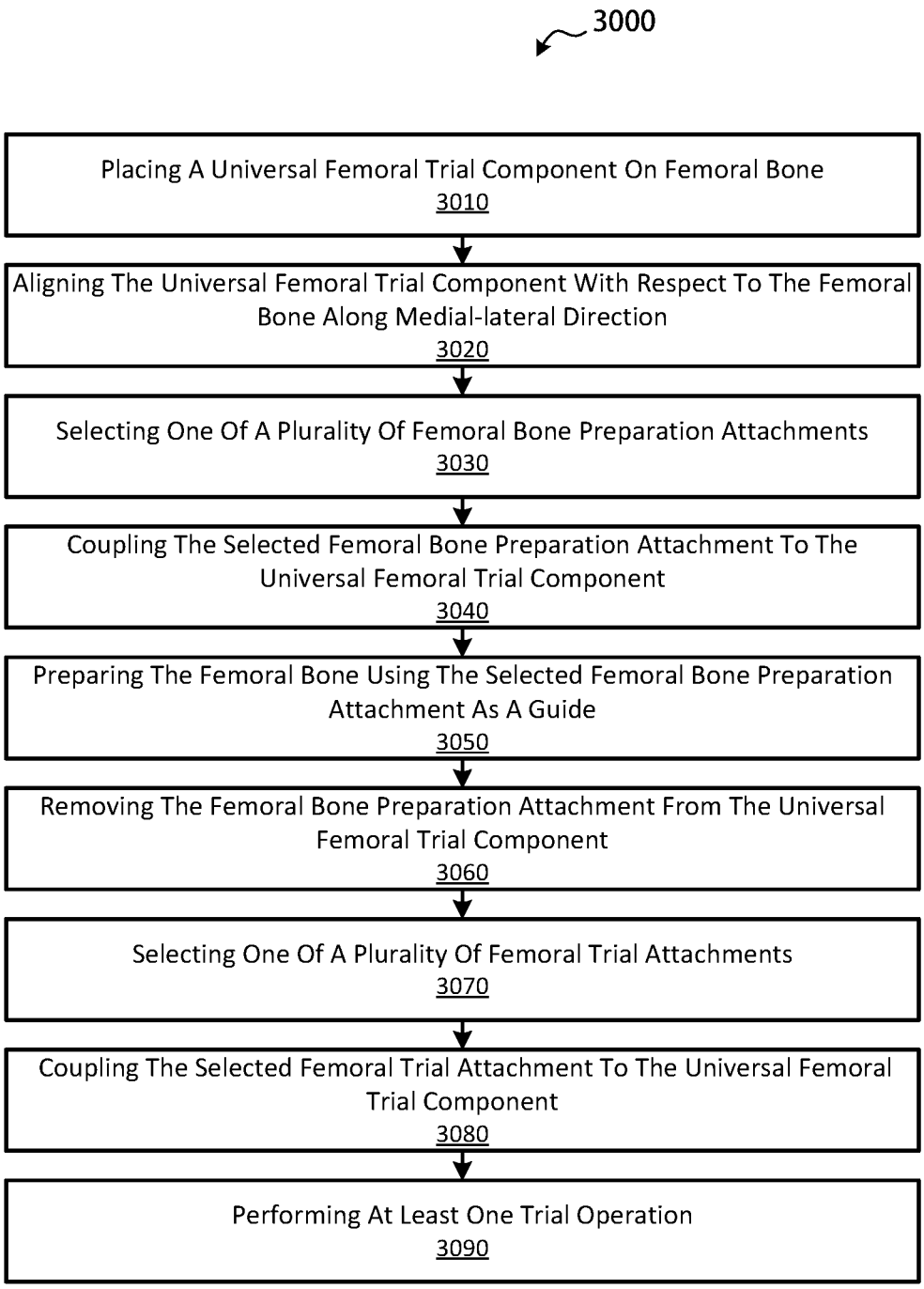
3000
Placing A Universal Femoral Trial Component On Femoral Bone
3010
Aligning The Universal Femoral Trial Component With Respect To The Femoral Bone Along Medial-lateral Direction
3020
Selecting One Of A Plurality Of Femoral Bone Preparation Attachments
3030
Coupling The Selected Femoral Bone Preparation Attachment To The Universal Femoral Trial Component
3040
Preparing The Femoral Bone Using The Selected Femoral Bone Preparation Attachment As A Guide
3050
Removing The Femoral Bone Preparation Attachment From The Universal Femoral Trial Component
3060
Selecting One Of A Plurality Of Femoral Trial Attachments
3070
Coupling The Selected Femoral Trial Attachment To The Universal Femoral Trial Component
3080
Performing At Least One Trial Operation
3090

Fig. 36

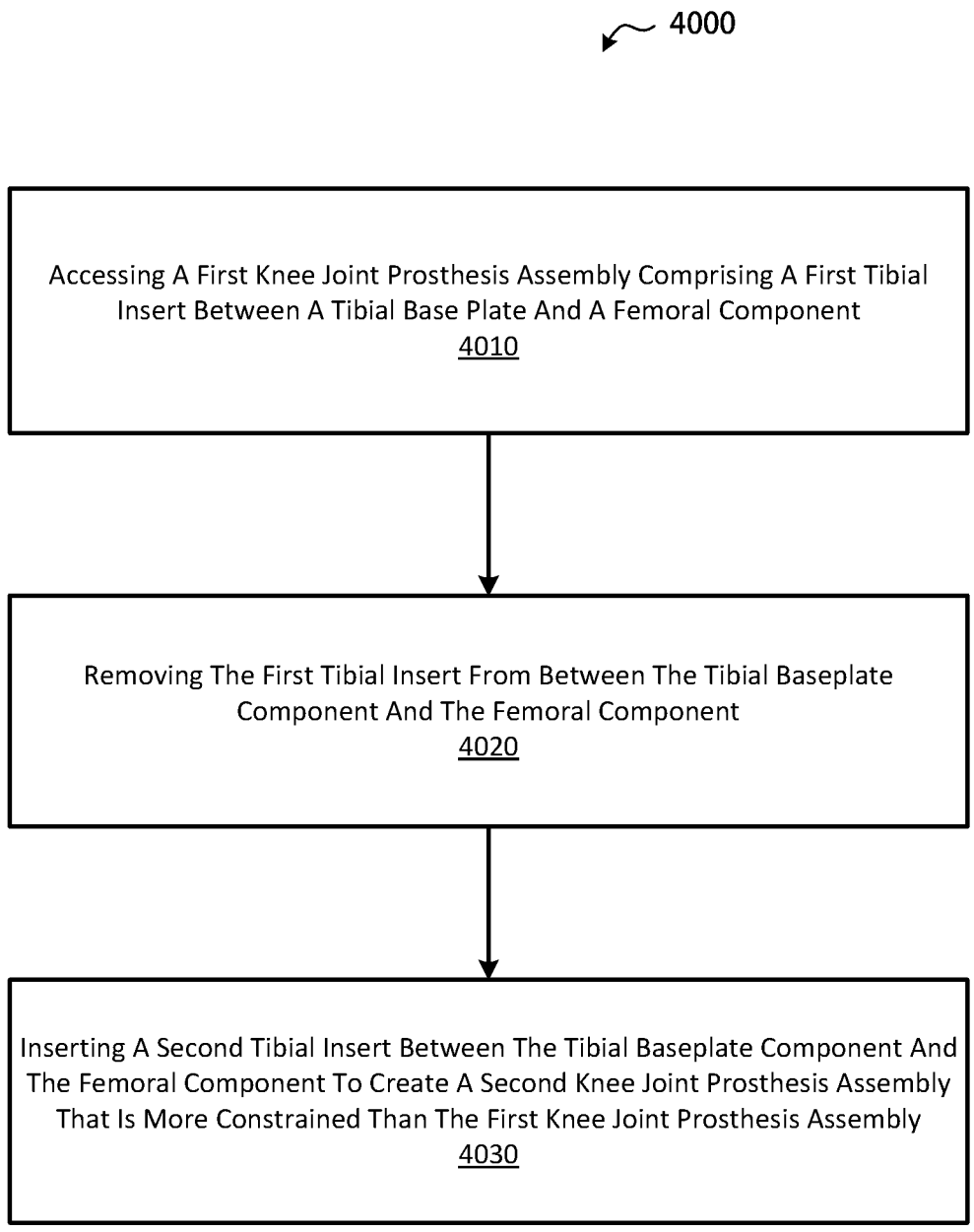
4000
Accessing A First Knee Joint Prosthesis Assembly Comprising A First Tibial Insert Between A Tibial Base Plate And A Femoral Component
4010
Removing The First Tibial Insert From Between The Tibial Baseplate Component And The Femoral Component
4020
Inserting A Second Tibial Insert Between The Tibial Baseplate Component And The Femoral Component To Create A Second Knee Joint Prosthesis Assembly That Is More Constrained Than The First Knee Joint Prosthesis Assembly
4030

Fig. 37

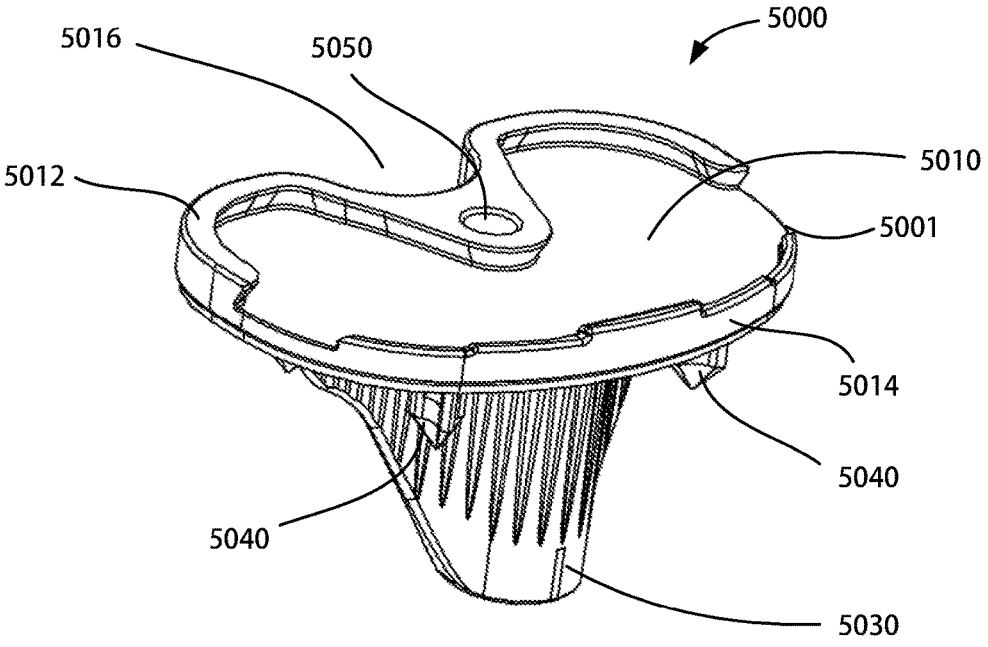

Fig. 38A

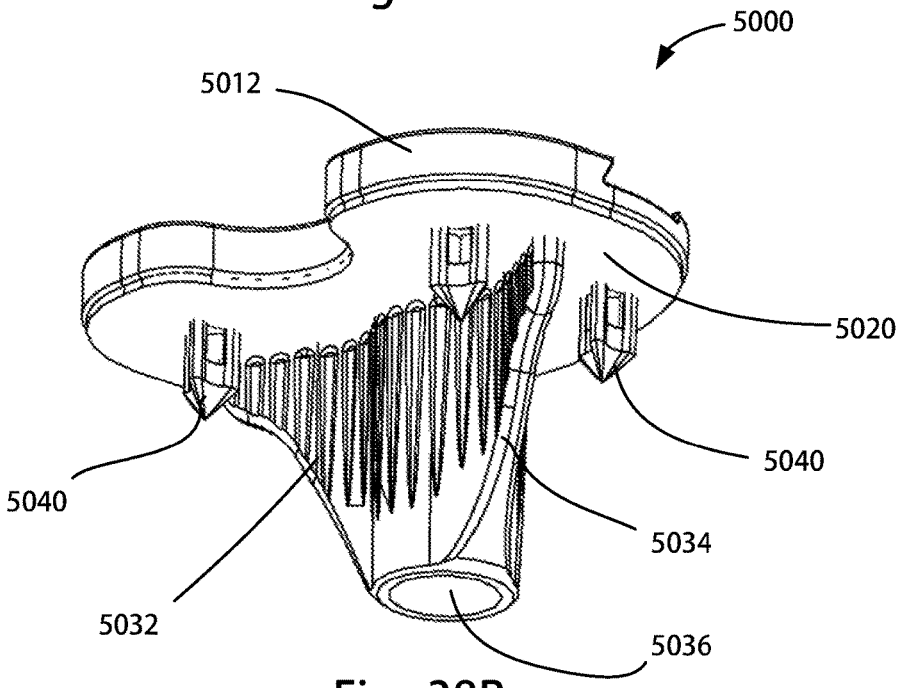

Fig. 38B

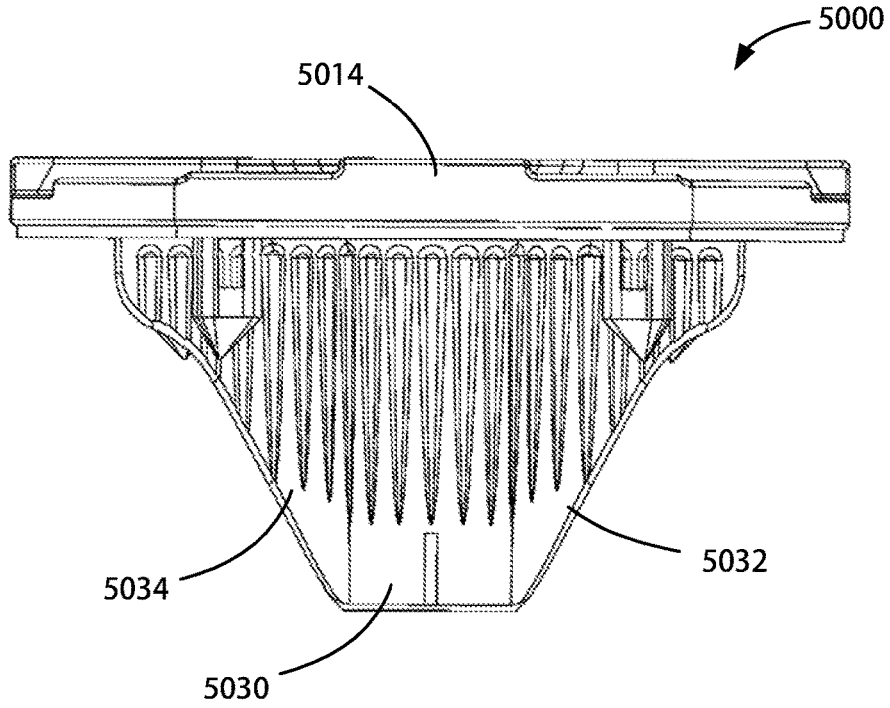

Fig. 38C

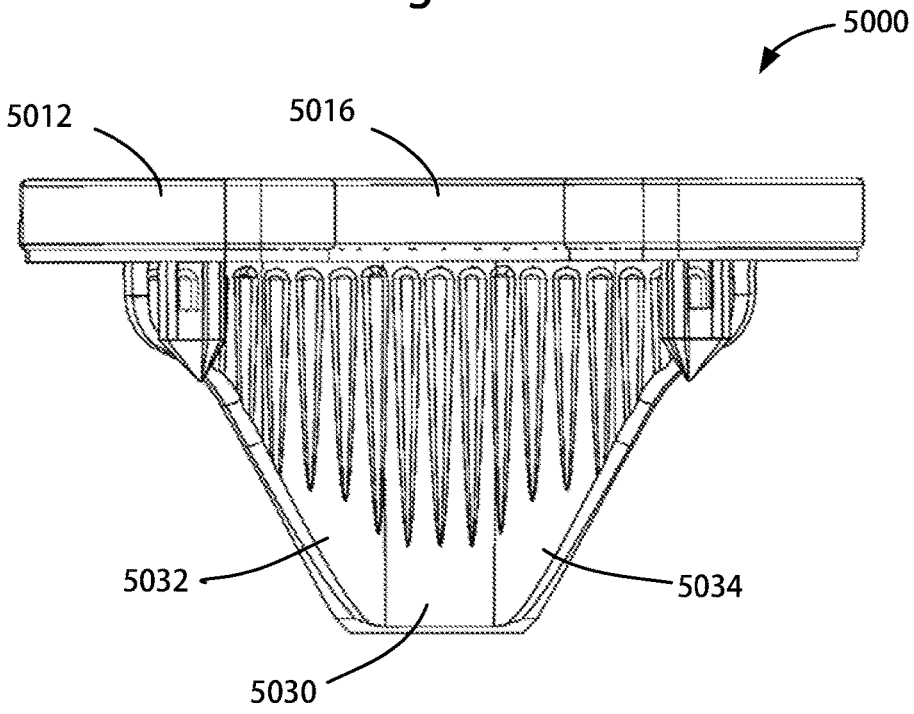

Fig. 38D

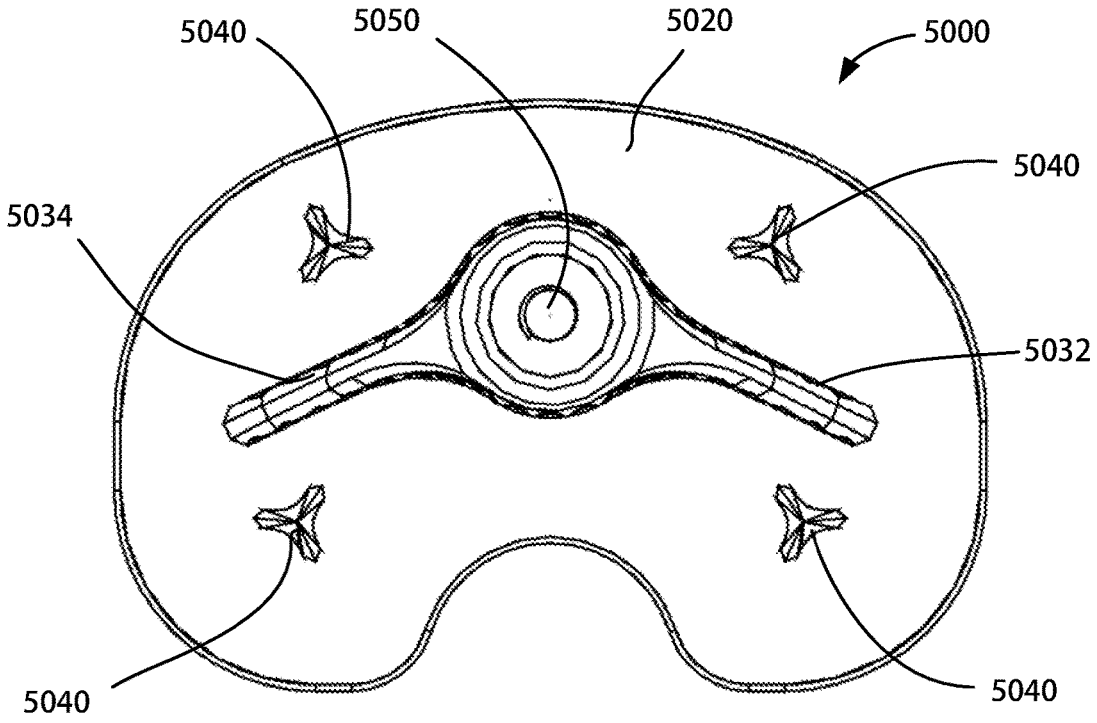

Fig. 38E

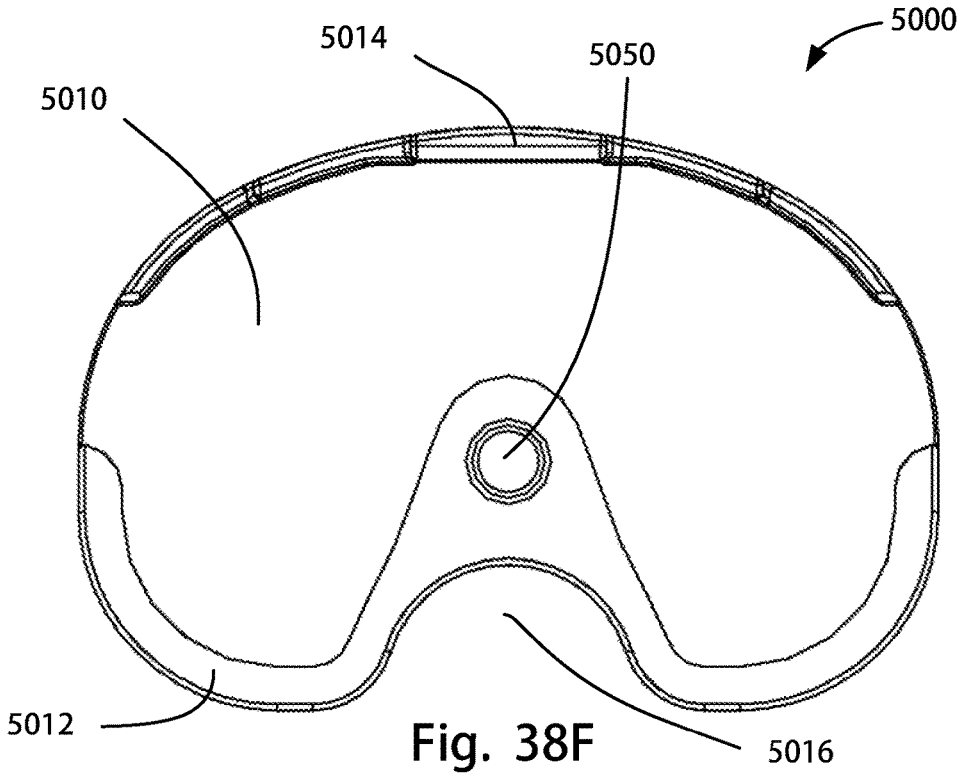

Fig. 38F

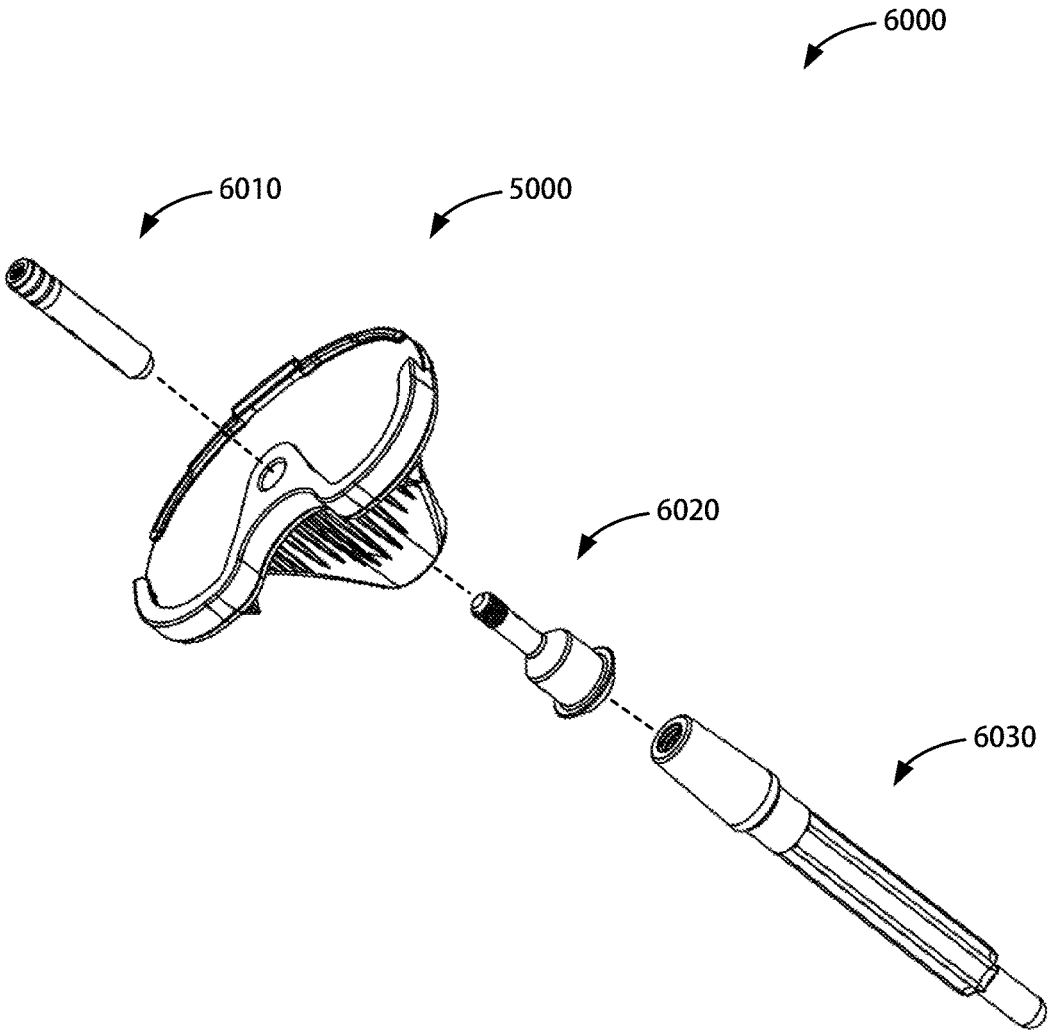

Fig. 39

MODULAR KNEE PROTHESIS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims the benefit of U.S. Provisional Patent Application Ser. No. 62/537,106, Attorney's Docket No. OPT-3PROV, entitled MODULAR KNEE PROSTHESIS, which was filed on Jul. 26, 2017. The above-referenced application is incorporated by reference herein as though set forth in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to surgical devices, systems, instruments, and methods. More specifically, the present disclosure relates to orthopedic knee replacement surgical devices, instruments, systems, and methods.

BACKGROUND

[0003] A number of knee replacement options exist which may be implemented depending upon the level of compromise of the natural knee anatomy. The knee anatomy complex includes the knee joint between the femur distal end and the tibia proximal end, and the surrounding anterior and posterior cruciate ligaments (ACL, PCL), and medial and lateral collateral ligaments (MCL, LCL), which provide support and stabilization to the knee joint. When one or more ligaments are compromised, for example through injury, disease, or aging, a knee prosthesis system may be implanted to replace the knee joint.

[0004] In a situation where the anterior cruciate ligament is compromised, it may be removed and a cruciate retaining (CR) knee prosthesis system, which allows retention of the posterior cruciate ligament and the collateral ligaments, may be implanted. Typical CR knee prosthesis femoral components and tibial inserts have large U-shaped openings providing room for the extant PCL, MCL, and LCL ligaments.

[0005] In a case where both the anterior and posterior cruciate ligaments are compromised but, yet the collateral ligaments are functional, both the ACL and PCL may be removed, and a posterior stabilizing (PS) knee prosthesis system may be implanted. A typical PS tibial insert includes a central post, and many PS femoral components include a cam element extending between the medial and lateral condyles. The post and cam interact to provide stability in place of the removed PCL ligament.

[0006] In a case where the anterior and posterior cruciate ligaments are compromised, and the collateral ligaments are unstable, both the ACL and PCL may be removed and a constrained condylar knee (CCK) prosthesis system may be implanted. In a case where all four ligaments are compromised, all ligaments may be removed, and a hinge type knee replacement system may be implanted.

[0007] A typical knee prosthesis system includes a tibial bone anchoring component, a tibial articulating component, which may be called a tibial insert, and a femoral bone anchoring component. Since the tibial and femoral bone anchoring components are anchored to bone through various fasteners, cement, and/o bone ingrowth, it may be difficult and invasive to remove and replace either of the bone anchoring components, should the need arise. The tibial insert is typically made of polyethylene, and since it is not anchored to bone, is much more easily replaced if necessary. For example, a patient may have a CR knee prosthesis and then experience compromise of the PCL, thus requiring replacement of the CR knee prosthesis with a PS knee prosthesis. Or, a patient may have a PS knee prosthesis and then experience instability of the collateral ligaments, thus requiring replacement of the PS knee prosthesis with a CCK prosthesis.

SUMMARY

[0008] The various systems and methods of the present disclosure have been developed in response to the present state of the art, and in particular, in response to the problems and needs in the art that have not yet been fully solved by currently available technology.

[0009] In some embodiments, a method for revising a knee joint prosthesis implanted in a knee of a patient, to provide increased stability to the knee joint prosthesis, may include accessing a knee joint prosthesis implanted in a knee of a patient. The knee joint prosthesis may include a tibial baseplate component implanted on a tibia of the patient, a femoral component implanted on a femur of the patient, and a first tibial insert implanted between the tibial baseplate component and the femoral component to form a first knee joint prosthesis assembly. The method may also include removing the first tibial insert from between the tibial baseplate component and the femoral component of the knee joint prosthesis and inserting a second tibial insert between the tibial baseplate component and the femoral component to form a second knee joint prosthesis assembly that is more constrained than the first knee joint prosthesis assembly, in order to provide increased stability to the knee joint prosthesis.

[0010] The femoral component may be a cruciate retaining femoral component. The first tibial insert may be a cruciate retaining tibial insert. The second tibial insert may be a posterior stabilizing tibial insert.

[0011] The femoral component may be a cruciate retaining femoral component. The first tibial insert may be a cruciate retaining tibial insert. The second tibial insert may be a constrained condylar knee tibial insert.

[0012] The femoral component may be a cruciate retaining femoral component. The first tibial insert may be a posterior stabilizing tibial insert. The second tibial insert may be a constrained condylar knee tibial insert.

[0013] The femoral component may be a posterior stabilizing femoral component. The first tibial insert may be a cruciate retaining tibial insert. The second tibial insert may be a posterior stabilizing tibial insert.

[0014] The femoral component may be a posterior stabilizing femoral component. The first tibial insert may be a cruciate retaining tibial insert. The second tibial insert may be a constrained condylar knee tibial insert.

[0015] The femoral component may be a posterior stabilizing femoral component. The first tibial insert may be a posterior stabilizing tibial insert. The second tibial insert may be a constrained condylar knee tibial insert.

[0016] In other embodiments, a knee joint prosthesis system for implantation in a knee of a patient may include a tibial baseplate component configured to be implanted on a tibia of a patient, a femoral component configured to be implanted on a femur of the patient, and a tibial insert configured to be implanted between the tibial baseplate component and the femoral component. The femoral component may include a cruciate retaining femoral component and/or a posterior stabilizing femoral component. The tibial

insert may include a cruciate retaining tibial insert, a posterior stabilizing tibial insert, and/or a constrained condylar knee tibial insert. The cruciate retaining tibial insert, the posterior stabilizing tibial insert, and the constrained condylar knee tibial insert may be selectively interchangeable such that each of the cruciate retaining tibial insert, the posterior stabilizing tibial insert, and the constrained condylar knee tibial insert may be individually inserted between the tibial baseplate component and the femoral component to form a functioning knee joint replacement.

[0017] The tibial insert may be a posterior stabilizing tibial insert with a medial articulation portion, a lateral articulation portion, a central portion positioned between the medial articulation portion and the lateral articulation portion, and a post protruding superiorly from the central portion along a midline vertical axis. A superior end of the post may be shaped as a portion of a circle, as seen from a superior perspective, and the superior end of the post may define a circular envelope in a cross-section transverse to the midline vertical axis.

[0018] The superior end of the post may be shaped as a portion of a circle, as seen from a superior perspective, with a crescent shape with a concave recess toward a posterior end of the post.

[0019] The superior end of the post may be shaped as a portion of a circle, as seen from a superior perspective, with a convex protrusion toward a posterior end of the post.

[0020] The post may protrude superiorly from the central portion, from a base of the post to the superior end of the post. The post may further have a medial side and a lateral side. The medial side and the lateral side may each extend from the base of the post to the superior end of the post. The medial side and the lateral side may each taper inwardly from the superior end of the post toward the base of the post. The post may be widest at the superior end of the post and narrowest at the base of the post.

[0021] The medial side and the lateral side may each extend at an angle relative to the midline vertical axis, wherein the angle is within the range of 6° to 11°.

[0022] The angle may be approximately 6.5°.

[0023] In yet other embodiments, a modular knee joint replacement kit may include a tibial baseplate component configured to be implanted on a tibia of a patient, a femoral component configured to be implanted on a femur of the patient, and a tibial insert configured to be implanted between the tibial baseplate component and the femoral component. The femoral component may include a cruciate retaining femoral component and/or a posterior stabilizing femoral component. The tibial insert may include a cruciate retaining tibial insert, a posterior stabilizing tibial insert, and/or a constrained condylar knee tibial insert. The cruciate retaining tibial insert, the posterior stabilizing tibial insert, and the constrained condylar knee tibial insert may be selectively interchangeable such that each of the cruciate retaining tibial insert, the posterior stabilizing tibial insert, and the constrained condylar knee tibial insert may be individually inserted between the tibial baseplate component and the femoral component to form a functioning knee joint replacement. The modular knee joint replacement kit may also include a package that contains at least one tibial insert.

[0024] The package may further contains at least the tibial base plate and the at least one femoral component.

[0025] The at least one tibial insert may include a posterior stabilizing tibial insert with a medial articulation portion, a lateral articulation portion, a central portion positioned between the medial articulation portion and the lateral articulation portion, and a post protruding superiorly from the central portion along a midline vertical axis. A superior end of the post may be shaped as a portion of a circle, as seen from a superior perspective, and the superior end of the post may define a circular envelope in a cross-section transverse to the midline vertical axis.

[0026] The superior end of the post may be shaped as a portion of a circle, as seen from a superior perspective, and may have a crescent shape with a concave recess toward a posterior end of the post.

[0027] The superior end of the post may be shaped as a portion of a circle, as seen from a superior perspective, with a convex protrusion toward a posterior end of the post.

[0028] The post may protrude superiorly from the central portion, from a base of the post to the superior end of the post. The post may further have a medial side and a lateral side. The medial side and the lateral side may each extend from the base of the post to the superior end of the post. The medial side and the lateral side may each taper inwardly from the superior end of the post toward the base of the post. The post may be widest at the superior end of the post and narrowest at the base of the post. The medial side and the lateral side may each extend at an angle relative to the midline vertical axis. The angle may be within the range of 6° to 11°.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The advantages, nature, and additional features of exemplary embodiments of the disclosure will become more fully apparent from the following description and appended claims, taken in conjunction with the accompanying drawings. Understanding that these drawings depict only exemplary embodiments and are, therefore, not to be considered limiting of the disclosure's scope, the exemplary embodiments of the disclosure will be described with additional specificity and detail through use of the accompanying drawings in which:

[0030] FIG. **1**A is a perspective rear view of an assembly of the disclosure, including a posterior stabilizing femoral component and a tibial insert coupled in extension; FIG. **1**B is a perspective front view of the assembly of FIG. **1**A in flexion;

[0031] FIG. **2** is an exploded view of the assembly of FIG. **1**A;

[0032] FIG. **3**A is a posterior view of the tibial insert of FIG. **1**A; FIG. **3**B is an anterior view of the tibial insert of FIG. **1**A; FIG. **3**C is a superior view of the tibial insert of FIG. **1**A; FIG. **3**D is a medial side view of the tibial insert of FIG. **1**A;

[0033] FIG. **4** is a top down view of the assembly of FIG. **1**A;

[0034] FIG. **5** is a top down cross-sectional view of the assembly of FIG. **1**A, taken along line B-B in FIG. **6**;

[0035] FIG. **6** is a posterior cross-sectional view of the assembly of FIG. **1**A, taken along line A-A in FIG. **5**;

[0036] FIG. **7** is a top down cross-sectional view of the assembly of FIG. **1**B, taken along line C-C in FIG. **8**;

[0037] FIG. **8** is a posterior cross-sectional view of the assembly of FIG. **1**B, taken along line D-D in FIG. **7**;

[0038] FIG. **9** is a perspective rear view of an assembly of the disclosure, including a cruciate retaining femoral component and the tibial insert of FIG. **1**A coupled in extension;

[0039] FIG. **10** is an exploded perspective rear view of the assembly of FIG. **9**;

[0040] FIG. **11**A is a perspective rear view of another tibial insert of the disclosure; FIG. **11**B is a top view of the tibial insert of FIG. **11**A; FIG. **11**C is a posterior view of the tibial insert of FIG. **11**A; FIG. **11**D is an anterior view of the tibial insert of FIG. **11**A; FIG. **11**E is a bottom view of the tibial insert of FIG. **11**A;

[0041] FIG. **12**A is a perspective rear view of another tibial insert of the disclosure; FIG. **12**B is a top view of the tibial insert of FIG. **12**A; FIG. **12**C is a bottom view of the tibial insert of FIG. co **12**A; FIG. **12**D is a posterior view of the tibial insert of FIG. **12**A; FIG. **12**E is an anterior view of the tibial insert of FIG. **12**A; FIG. **12**F is a medial side view of the tibial insert of FIG. **12**A;

[0042] FIG. **13** is a chart demonstrating the interchangeability of the tibial inserts disclosed herein with various femoral components;

[0043] FIG. **14** is an exploded rear view of another assembly of the disclosure, including a posterior stabilizing femoral component and a posterior stabilizing tibial insert;

[0044] FIG. **15** is another exploded rear view of the assembly of FIG. **14**;

[0045] FIG. **16**A is a posterior view of the tibial insert of FIG. **14**; FIG. **16**B is an anterior view of the tibial insert of FIG. **14**; FIG. **16**C is a superior view of the tibial insert of FIG. **14**; FIG. **16**D is a medial side view of the tibial insert of FIG. **14**;

[0046] FIG. **17** is an exploded rear view of another assembly of the disclosure, including a cruciate retaining femoral component with a keel and the posterior stabilizing tibial insert of FIG. **14**;

[0047] FIG. **18** is another exploded rear view of the assembly of FIG. **17**;

[0048] FIG. **19** is an exploded rear view of another assembly of the disclosure, including a cruciate retaining femoral component without a keel and the posterior stabilizing tibial insert of FIG. **14**;

[0049] FIG. **20** is another exploded rear view of the assembly of FIG. **19**;

[0050] FIG. **21**A is a perspective rear view of another tibial insert of the disclosure; FIG. **21**B is a top view of the tibial insert of FIG. **21**A; FIG. **21**C is a posterior view of the tibial insert of FIG. **21**A; FIG. **21**D is an anterior view of the tibial insert of FIG. **21**A; FIG. **21**E is a bottom view of the tibial insert of FIG. **21**A;

[0051] FIG. **22**A is a perspective rear view of another tibial insert of the disclosure; FIG. **22**B is a top view of the tibial insert of FIG. **22**A; FIG. **22**C is a bottom view of the tibial insert of FIG. **22**A; FIG. **22**D is a posterior view of the tibial insert of FIG. **22**A; FIG. **22**E is an anterior view of the tibial insert of FIG. **22**A; FIG. **22**F is a medial side view of the tibial insert of FIG. **22**A;

[0052] FIG. **23**A is a perspective front view of the femoral component of FIG. **14** coupled to one or more augments of the present disclosure; FIG. **23**B is a medial side view of the femoral co component of FIG. **23**A;

[0053] FIG. **24**A is a perspective top view of a femoral trial component of the disclosure; FIG. **24**B is a perspective rear view of the femoral trial component of FIG. **24**A; FIG. **24**C is a lateral side view of the femoral trial component of FIG. **24**A; FIG. **24**D is a medial side view of the femoral trial component of FIG. **24**A; FIG. **24**E is an anterior view of the femoral trial component of FIG. **24**A; FIG. **24**F is a posterior view of the femoral trial component of FIG. **24**A; FIG. **24**G is a superior view of the femoral trial component of FIG. **24**A; FIG. **24**H is an inferior view of the femoral trial component of FIG. **24**A;

[0054] FIG. **25**A is a perspective rear view of a posterior stabilizing notch cutting guide assembly of the disclosure; FIG. **25**B is another perspective rear view of the posterior stabilizing notch cutting guide assembly of FIG. **25**A; FIG. **25**C is a medial side view of the posterior stabilizing notch cutting guide assembly of FIG. **25**A; FIG. **25**D is a top view of the posterior stabilizing notch cutting guide assembly of FIG. **25**A;

[0055] FIG. **26** is a partial exploded view of the posterior stabilizing notch cutting guide assembly of FIG. **25**A;

[0056] FIG. **27**A is a posterior view of the posterior stabilizing notch cutting guide assembly of FIG. **25**A above the femoral trial component of FIG. **24**A; FIG. **27**B is posterior view of the posterior stabilizing notch cutting guide assembly of FIG. **27**A coupled to the femoral trial component of FIG. **27**A;

[0057] FIG. **28**A is a perspective rear view of a posterior stabilizing trial attachment of the disclosure; FIG. **28**B is another perspective rear view of the posterior stabilizing trial attachment of FIG. **28**A; FIG. **28**C is a perspective front view of the posterior stabilizing trial attachment of FIG. **28**A; FIG. **28**D is a perspective side view of the posterior stabilizing trial attachment of FIG. **28**A;

[0058] FIG. **29**A is a posterior view of the posterior stabilizing trial attachment of FIG. **28**A above the femoral trial component of FIG. **24**A; FIG. **29**B is a posterior view of the posterior stabilizing trial attachment of FIG. **29**A coupled to the femoral trial component of FIG. **29**A;

[0059] FIG. **30**A is a perspective rear view of a drill and broach guide assembly of the disclosure; FIG. **30**B is a perspective bottom view of the drill and broach guide assembly of FIG. **30**A; FIG. **30**C is a top view of the drill and broach guide assembly of FIG. **30**A; FIG. **30**D is a bottom view of the drill and broach guide assembly of FIG. **30**A;

[0060] FIG. **31** is a partial exploded view of the drill and broach guide assembly of FIG. **30**A;

[0061] FIG. **32**A is a posterior view of the drill and broach guide assembly of FIG. **30**A above the femoral trial component of FIG. **24**A; FIG. **32**B is a posterior view of the drill and broach guide assembly of FIG. **32**A coupled to the femoral trial component of FIG. **32**A;

[0062] FIG. **33**A is a perspective front view of a cruciate retaining trial attachment of the disclosure; FIG. **33**B is a perspective rear view of the cruciate retaining trial attachment of FIG. **33**A; FIG. **33**C is a perspective bottom view of the cruciate retaining trial attachment of FIG. **33**A; FIG. **33**D is a top view of the cruciate retaining trial attachment of FIG. **33**A;

[0063] FIG. **34**A is a posterior view of the cruciate retaining trial attachment of FIG. **33**A above the femoral trial component of FIG. **24**A; FIG. **34**B is a posterior view of the cruciate retaining trial attachment of FIG. **34**A coupled to the femoral trial component of FIG. **34**A;

[0064] FIG. **35**A is a perspective rear view of another femoral trial component of the disclosure; FIG. **35**B is a posterior view of the femoral trial component of FIG. **35**A; FIG. **35**C is an anterior view of the femoral trial component of FIG. **35**A;

[0065] FIG. **36** is a flow chart diagram of a method for preparing and trialing a femoral bone with a femoral trial component;

[0066] FIG. **37** is a flow chart diagram of a method for revising a knee joint prosthesis to provide increased stability;

[0067] FIG. **38**A is a perspective front view of a tibial tray of the disclosure; FIG. **38**B is a perspective rear view of the tibial tray of FIG. **38**A; FIG. **38**C is an anterior view of the tibial tray of FIG. **38**A; FIG. **38**D is a posterior view of the tibial tray of FIG. **38**A; FIG. **38**E is a bottom view of the tibial tray of FIG. **38**A; FIG. **38**F is a top view of the tibial tray of FIG. **38**A; and

[0068] FIG. **39** is an exploded view of a tibial tray mounting system of the disclosure that utilizes the tibial tray of FIG. **38**A.

[0069] It is to be understood that the drawings are for purposes of illustrating the concepts of the disclosure and may not be to scale. Furthermore, the drawings illustrate exemplary embodiments and do not represent limitations to the scope of the disclosure.

DETAILED DESCRIPTION

[0070] Exemplary embodiments of the disclosure will be best understood by reference to the drawings, wherein like parts are designated by like numerals throughout. It will be readily understood that the components of the disclosure, as generally described and illustrated in the Figures herein, could be arranged and designed in a wide variety of different configurations. Thus, the following more detailed description of the embodiments of the apparatus, instruments, systems, and methods, as represented in the Figures, is not intended to limit the scope of the disclosure, as claimed, but is merely representative of exemplary embodiments of the disclosure.

[0071] Disclosed herein are components for a modular knee prosthesis system. This system may allow for revision procedures by replacement of only the tibial insert, allowing the originally implanted femoral and tibial anchoring components to remain implanted. The system may include CR tibial inserts, PS tibial inserts, and/or CCK tibial inserts. Any one of these tibial inserts may be interchangeably used with CR and/or PS femoral components disclosed herein to provide the stabilization needed to substitute for compromised or removed ligaments. The system may be used with any suitable tibial baseplate component, or tibial tray, to support the tibial insert. The PS tibial inserts disclosed herein may include tapered posts that permit the inserts to be used with cruciate retaining (CR) femoral components and/or posterior stabilizing (PS) femoral components.

[0072] Referring to FIGS. **1**A-**2**, an assembly **10** for an implantable knee prosthesis is shown including a femoral component **14** and a tibial insert **12**. The femoral component **14** and tibial insert **12** are shown coupled in extension in FIG. **1**A, coupled in flexion in FIG. **1**B, and shown in an exploded view in FIG. **2**. The tibial insert **12** may be further coupled to a tibial baseplate component (not shown) which may be implanted in a prepared tibia of a patient (also not shown). The femoral component **14** and tibial insert **12** illustrated in FIGS. **1**A-**2** are right femoral and tibial insert components. Left femoral and tibial insert components (not shown) would be mirror images of the right femoral and tibial insert components shown in FIGS. **1**A-**2**. The femoral component **14** may also be referred to as a posterior stabilizing femoral component **14** (or "PS femoral component") and the tibial insert **12** may also be referred to as a posterior stabilizing tibial insert (or "PS insert").

[0073] FIGS. **3**A-**3**D show the PS insert **12** of FIGS. **1**A-**2** in isolation. The PS insert **12** may include a fixation side **20**, which may be an inferior side, opposite an articulation side **22**, which may be a superior side. The articulation side **22** may include a medial articulation portion **24** having a medial condylar articulation surface **25** and a lateral articulation portion **26** having a lateral condylar articulation surface **27**. A central portion **28** may separate the medial articulation portion **24** from the lateral articulation portion **26**. A post **30** may protrude superiorly from the central portion **28** and extend from a post base **38** to a post top or post superior end **40**. From the anterior perspective (shown in FIG. **3**B) and/or the posterior perspective (shown in FIG. **3**A), the post **30** may have its maximum medial-lateral or horizontal width toward the post superior end **40** of the post **30**, and its minimum medial-lateral or horizontal width toward the post base **38** of the post **30**. The post **30** may also be bilaterally symmetrical from the anterior and/or posterior perspectives. A recess **45** may be formed posterior to the central portion **28**, between the medial and lateral articulation portions **24**, **26**, and may provide room for a posterior cruciate ligament (not shown). The PS insert **12** may further include an insert base **46**, which may further include an engagement feature **48** for engagement with a tibial baseplate component.

[0074] Continuing with FIGS. **1**A-**3**D, the post **30** may have an articulation surface **31** extending around the post **30** on the medial, posterior, lateral, and anterior aspects of the post **30**. The articulation surface **31** may include a medial articulation surface **32**, a lateral articulation surface **34**, an anterior post surface **36**, and a posterior articulation surface **42**. The medial and lateral articulation surfaces **32**, **34** may be non-parallel to one another and taper inward from the post superior end **40** to the post base **38** relative to an insert midline vertical axis **2**, as shown in FIGS. **3**A and **3**B. As shown in FIG. **3**A, an angle θ between the vertical axis **2** and each tapered surface **32**, **34** may be about 6.5°, in at least one embodiment. Since the post **30** may be bilaterally symmetrical, the angle θ may be the same on both the medial and lateral articulation surfaces **32**, **34** of the post **30**. In other embodiments of the disclosure, angle θ may range from about 6° to 11° degrees. The medial articulation surface **32** may be continuous with the medial condylar articulation surface **25**, and the lateral articulation surface **34** may be continuous with the lateral condylar articulation surface **27**, as can been further seen in cross-section in FIGS. **6** and **8**. The anterior post surface **36** may extend between the medial and lateral articulation surfaces **32**, **34** and may be convexly rounded. The anterior post surface **36** may also taper outward from the post superior end **40** to the post base **38** relative to the midline vertical axis **2**, as best seen in FIG. **3**D. In other embodiments of the PS insert **12**, the anterior post surface **36** may include less or no taper.

[0075] Referring to FIG. **3**C, the boundary of the post superior end **40** defines a rounded rim **44** shaped as a portion of a circle defined by a circular envelope **47**, as seen from a superior perspective. The post superior end **40** and rim **44** may be crescent-shaped with a concave recess toward a posterior end of the post **30** as shown, and may permit passage of the posterior cruciate ligament. The post superior end **40** may be circular; the rim **44** may provide increased rotational range of motion and surface contact against the

femoral component **14** in comparison to traditional posts with a more square or rectangular shape and no rim. Thus, the rounded post superior end **40** and rim **44** may allow for surface contact with the femoral component **14** in contrast to the mere point or edge contact that is achieved by traditional posts that do not have these features.

[0076] The PS femoral component **14** depicted in FIGS. **1-8** may include a cam element or cam bar **50** and a box structure **52** for providing posterior stabilization in place of absent ligaments. The cam bar **50** may include a cam articulating surface **51** which may contact the posterior articulation surface **42** of the post **30** during flexion, as in FIGS. **1**B and **7**. An internal articulation surface **54** may reside on the inside of the box structure **52** and may contact the post **30** during articulation and rotation of the knee joint. The internal articulating surface **54** may be concavely curved, and may contact the rim **44** of the post **30** during axial rotation of the knee joint about the post. The PS femoral component **14** may further include a medial condyle **60** having a medial condylar articulation surface **62**, and a lateral condyle **64** having a lateral condylar articulation surface **66**. The medial and lateral condylar articulation surfaces **62**, **66** may articulate against the PS insert **12** medial and lateral condylar articulation surfaces **25**, **27** respectively. A gap **68** may be formed between the medial and lateral condyles **60**, **64**, with the cam bar **50** extending medial-laterally across the gap **68**. The internal articulation surface **54** may include a medial portion **70** continuous with a lateral portion **72**. In the embodiment depicted, a fixation post **74** may protrude superiorly from the PS femoral component **14**. However, in other embodiments of the PS femoral component **14**, the fixation post **74** may be absent and/or other fixation features such as posts, spikes, pegs, webs, keels or teeth may be present to affix the PS femoral component **14** to a prepared femur (not shown).

[0077] Referring to FIGS. **9** and **10**, another assembly **110** embodiment of the disclosure may include the PS insert **12** of FIGS. **1-8** coupled with a cruciate retaining femoral component **114** (or "CR femoral component"). The CR femoral component **114** may include medial and lateral condyles **160**, **164**, with a gap **168** formed between the medial and lateral condyles **160**, **164**. As a CR femoral component **114**, no cam bar or box may be present. The medial and lateral condyles **160**, **164** may include medial and lateral condylar articulation surfaces **162**, **166**, and an internal articulation surface **154** with medial and lateral articulating surfaces **170**, **172**.

[0078] The medial and lateral articulation surfaces **32**, **34** of the post **30** may be tapered and may permit natural articulation of the CR femoral component **114** with the PS insert **12**, which may not be achievable if the post **30** were not tapered. For example, if the post **30** had straight sides instead of tapered sides, the wider width of the post **30** at the base of the post **30** would interfere with the internal articulating surfaces **170**, **172** of the medial and lateral condyles **160**, **164**. When the PS femoral component **14** is coupled with the PS insert **12** to form assembly **10**, as in FIG. **1**A and FIG. **4**, the circular shape of the post superior end **40** in combination with the tapered medial and lateral articulation surfaces **32**, **34** of the post **30**, may permit the PS femoral component **14** to articulate relative to the PS insert **12** in the manner of a posterior stabilized femoral component. However, when the PS insert **12** is paired and implanted with the CR femoral component **114**, the resultant assembly **110** may provide the native articulation and rotation of co a cruciate retaining implant.

[0079] Referring to FIGS. **11**A-**11**E, an alternative embodiment of a tibial insert **212** is shown. Tibial insert **212** may be referred to as a cruciate retaining tibial insert **212** (or "CR insert"). In a system of the disclosure, CR insert **212** may be implanted with the CR femoral component **114** and a tibial baseplate component (not shown) to form a cruciate retaining knee prosthesis system. The CR insert **212** may include a fixation side **220**, which may be an inferior side, opposite an articulation side **222**, which may be a superior side. The articulation side **222** may include a medial articulation portion **224** having a medial condylar articulation surface **225** and a lateral articulation portion **226** having a lateral condylar articulation surface **227**. A central portion **228** may separate the medial articulation portion **224** from the lateral articulation portion **226**. A recess **245** may be formed posterior to the central portion **228**, between the medial and lateral articulation portions **224**, **226**, and may provide room for a posterior cruciate ligament. The CR insert **212** may further include an insert base **246** and an engagement feature **248** for engagement with a tibial baseplate component. The CR insert **212** may be coupled with the CR femoral component **114** to form a cruciate retaining assembly. This assembly may be implanted with a suitable tibial baseplate as a cruciate retaining knee prosthesis. The CR insert **212** may also be coupled with the PS femoral component **14** and implanted with a suitable tibial baseplate.

[0080] Referring to FIGS. **12**A-**12**F, another alternative embodiment of a tibial insert **312** is shown. The tibial insert **312** may be referred to as a constrained condylar knee (CCK) tibial insert **312** (or "CCK insert"). The CCK insert **312** may include a fixation side **320**, which may be an inferior side, opposite an articulation side **322**, which may be a superior side. The articulation side **322** may include a medial articulation portion **324** having a medial condylar articulation surface **325** and a lateral articulation portion **326** having a lateral condylar articulation surface **327**. A central portion **328** may separate the medial articulation portion **324** from the lateral articulation portion **326**. A post **330** may protrude superiorly from the central portion **328**, and extend from a post base **338** to a top, or post superior end **340**. From the anterior perspective, as shown in FIG. **12**E, and the posterior perspective, as shown in FIG. **12**D, the post **330** may have its maximum medial-lateral or horizontal width at the superior end **340** of the post **330**, and its minimum medial-lateral or horizontal width at the post base **338** of the post **330**. The post **330** may be bilaterally co symmetrical from the anterior and posterior perspectives. The CCK insert **312** may further include an insert base **346** and an engagement feature **348** for engagement with a tibial tray (not shown).

[0081] The post **330** may have an articulation surface **331** extending around the post **330** on the medial, posterior, lateral, and anterior aspects of the post **330**. The articulation surface **331** may include a medial articulation surface **332**, a lateral articulation surface **334**, an anterior post surface **336**, and a posterior articulation surface **342**. The medial and lateral articulation surfaces **332**, **334** may taper slightly inward from the post superior end **340** to the post base **338** of the post **330** relative to an insert midline vertical axis **2**. However, some embodiments of CCK insert **312** may include no taper of the medial and lateral articulation

surfaces **332**, **334**. The medial articulation surface **332** may be continuous with the medial condylar articulation surface **325**, and the lateral articulation surface **334** may be continuous with the lateral condylar articulation surface **327**. The anterior post surface **336** may extend between the medial and lateral surfaces **332**, **334** and may be convexly rounded. The anterior post surface **336** may taper outward from the post superior end **340** to the post base **338** relative to the midline axis **2**, as best seen in FIG. **12**F. In other embodiments of the CCK insert **312**, the anterior post surface **336** may include less taper, more taper, and/or no taper. The post **330** of the CCK insert **312** may be wider and bigger in diameter than the post **30** of PS insert **12**, for example to provide increased stability in the case of removal of the collateral ligaments.

[0082] Referring to FIG. **12**B, the boundary of the post superior end **340** may define a rounded rim **344** shaped as a portion of a circle, from a superior perspective. The post superior end **340** and rim **344** may be semi-circular as shown, however the rim **344** may define a circular envelope **347**. The post superior end **340** may be circular and rim **344** may provide increased surface contact and rotational range of motion when coupled and implanted with the PS femoral component **14** in comparison to traditionally shaped posts with a more square or rectangular shaped post. Thus, the rounded post superior end **340** and rim **344** may allow for surface contact with the femoral component **14** in contrast to the mere point or edge contact that is achieved by traditional posts that do not have these features. The CCK insert **312** may be coupled with the PS femoral component **14** to form a constrained condylar knee assembly, and this assembly may be implanted with a suitable tibial baseplate as a constrained condylar knee prosthesis. The CCK insert **312** may also be coupled with the CR femoral component **114** and implanted with a suitable tibial baseplate. Thus, all of the tibial inserts **12**, **212**, and **312** disclosed herein are interchangeable with both the CR femoral component **114** and the PS femoral component **14**. FIG. **13** is a chart showing the potential combinations of components.

[0083] The tibial inserts **12**, **212**, **312**, PS femoral component **14** and CR femoral component **114** may be grouped together as a modular knee replacement system and provided as a kit in one or more packages, in one non-limiting example. Another kit may include a CR femoral component **114**, a PS insert **12** and a CR insert **212**, in one or more packages in another non-limiting example. Yet another kit may include a PS femoral component **14**, a PS insert **12**, a CR insert **212**, and a CCK insert **312**, in one or more packages in yet another non-limiting example. However, it will also be understood that other kit embodiments may utilize any of the tibial inserts and/or femoral components described herein in any number or combination, in one or more packages. Furthermore, other components may also be including in any kit described herein, such as suitable tibial baseplate components, patellar components, etc., in one or more packages. It will also be understood that any of the tibial inserts disclosed herein may be formed of vitamin E polyethylene, highly cross linked polyethylene, ultra-high molecular weight polyethylene (UHMWPE), or any other suitable material.

[0084] In a method of the disclosure, a patient may initially experience compromise of the anterior cruciate ligament. The ACL may be removed, and a CR type prosthesis may be implanted, including a CR femoral component **114**, a CR insert **212**, and a tibial baseplate component. Later, the same patient may experience compromise of the PCL and may need additional stabilization of the knee joint. The PCL may be removed, the CR tibial insert **212** may be removed, and a PS tibial insert **12** of the disclosure may be inserted between the originally implanted CR femoral component **114** and the tibial baseplate component, thus providing additional stability for the missing PCL. Even later, the same patient may experience instability of the collateral ligaments. The PS tibial insert **12** may be removed, and the CCK tibial insert **312** of the disclosure may be inserted between the originally implanted CR femoral component **114** and the tibial baseplate component. Thus, the patient may progress from a CR knee prosthesis, to a PS knee prosthesis, and finally to a CCK knee prosthesis without requiring replacement of the originally implanted femoral and/or tibial baseplate components. The interchangeability of the inserts **12**, **212**, **312** permit replacement of only the tibial insert component in order to provide increasing levels of support and stability to the knee joint.

[0085] In another method of the disclosure, a patient may initially experience compromise of both the ACL and the PCL. These ligaments may be removed, and a PS type prosthesis may be implanted, including a PS femoral component **14**, a PS insert **12**, and a tibial baseplate component. Later, the same patient may experience instability of the collateral ligaments. The PS insert **12** may be removed, and a CCK insert **312** may be inserted between the originally implanted PS femoral component **14** and the tibial baseplate component. Thus, the patient may progress from a PS knee prosthesis to a CCK knee prosthesis without requiring replacement of the originally implanted PS femoral component **14** and tibial baseplate component.

[0086] Referring to FIGS. **14** and **15**, another assembly **1010** of the disclosure for an implantable knee prosthesis is shown in various exploded rear views. The assembly **1010** may include a femoral component **1014** and a tibial insert **1012**. The tibial insert **1012** may be further coupled to a tibial baseplate component (not shown) which may also be implanted in a prepared tibia of a patient (not shown). The femoral component **1014** and tibial insert **1012** illustrated in FIGS. **14** and **15** are right side femoral and tibial insert components. Left side femoral and tibial insert components (not shown) would be mirror images of the right side femoral and tibial insert components that are shown in FIGS. **14** and **15**. The femoral component **1014** may also be referred to as a posterior stabilizing femoral component **1014** (or "PS femoral component") and the tibial insert **1012** may also be referred to as a posterior stabilizing tibial insert (or "PS insert").

[0087] FIGS. **16**A-**16**D show the PS insert **1012** of FIGS. **15** and **14** in isolation. The PS insert **1012** may include a fixation side **1020**, which may be an inferior side, opposite an articulation side **1022**, which may be a superior side. The articulation side **1022** may include a medial articulation portion **1024** having a medial condylar articulation surface **1025** and a lateral articulation portion **1026** having a lateral condylar articulation surface **1027**. A central portion **1028** may separate the medial articulation portion **1024** from the lateral articulation portion **1026**. A post **1030** may protrude superiorly from the central portion **1028** and extend from a post base **1038** to a post top **1040** or post superior end. From the anterior perspective (shown in FIG. co **16**B) and/or the posterior perspective (shown in FIG. **16**A), the post **1030**

may have its maximum medial-lateral or horizontal width toward the top **1040** of the post **1030**, and its minimum medial-lateral or horizontal width toward the base **1038** of the post **1030**. The post **1030** may also be bilaterally symmetrical from the anterior and/or posterior perspectives. A recess **1045** may be formed posterior to the central portion **1028**, between the medial and lateral articulation portions **1024**, **1026**, and may provide room for a posterior cruciate ligament (not shown). The PS insert **1012** may further include an insert base **1046**, which may further include an engagement feature **1048** for engagement with a tibial baseplate component.

[0088] Continuing with FIGS. **14-16**D, the post **1030** may have an articulation surface **1031** extending around the post **1030** on the medial, posterior, lateral, and anterior aspects of the post **1030**. The articulation surface **1031** may include a medial articulation surface **1032**, a lateral articulation surface **1034**, an anterior post surface **1036**, and a posterior articulation surface **1042**. The medial and lateral articulation surfaces **1032**, **1034** may be non-parallel to one another and taper inward from the post superior end **1040** to the post base **1038** relative to an insert midline vertical axis **1002**, as shown in FIGS. **16**A and **16**B. As shown in FIG. **16**A, an angle θ between the vertical axis **1002** and each tapered surface **1032**, **1034** may be about 6.5°, in at least one embodiment. Since the post **1030** may be bilaterally symmetrical, the angle θ may be the same on both the medial and lateral sides **1032**, **1034** of the post **1030**. In other embodiments of the disclosure, angle θ may range from about 6° to 11° degrees. The medial articulation surface **1032** may be continuous with the medial condylar articulation surface **1025**, and the lateral articulation surface **1034** may be continuous with the lateral condylar articulation surface **1027**. The anterior post surface **1036** may extend between the medial and lateral surfaces **1032**, **1034** and may be convexly rounded. The anterior post surface **1036** may also taper outward from the post superior end **1040** to the post base **38** relative to the insert midline vertical axis **1002**, as best seen in FIG. **16**D. In other embodiments of the PS insert **1012**, the anterior post surface **1036** may include less taper, more taper, and/or no taper. A midline medial-lateral axis **1004** and a mid-line anterior-posterior axis **1006** are also shown.

[0089] Referring to FIG. **16**C, the boundary of the superior end **1040** may define a rounded rim **1044** shaped as a portion of a circle defined by a circular envelope **1047**, as seen from a co superior perspective. The superior end **1040** and rim **1044** may have a convex protrusion **1041** toward a posterior end of the post **1030** as shown, and may permit passage of the posterior cruciate ligament. The circular superior end **1040** with rim **1044** may provide increased rotational range of motion and surface contact against the femoral component **1014** in comparison to traditional posts with a more square or rectangular shape and no rim. Thus, the rounded superior end **1040** and rim **1044** may allow for greater surface contact with the femoral component **1014** in contrast to the mere point or edge contact that is achieved by traditional posts that do not have these features.

[0090] The PS femoral component **1014** depicted in FIGS. **14-15** may include augment fixation apertures **1080**, impact driver apertures **1090**, a cam element or cam bar **1050**, and a box structure **1052** for providing posterior stabilization in place of absent ligaments. The cam bar **1050** may include a cam articulating surface **1051** which may contact the posterior articulation surface **1042** of the post **1030** during flexion. An internal articulation surface **1054** may reside on the inside of the box structure **1052** and may contact the post **1030** during articulation and rotation of the knee joint. The internal articulating surface **1054** may be concavely curved, and may contact the rim **1044** of the post **1030** during axial rotation of the knee joint about the post **1030**. The PS femoral component **1014** may further include a medial condyle **1060** having a medial condylar articulation surface **1062**, and a lateral condyle **1064** having a lateral condylar articulation surface **1066**. The medial and lateral condylar articulation surfaces **1062**, **1066** may articulate against the PS insert **1012** medial and lateral articulation surfaces **1025**, **1027** respectively. A gap **1068** may be formed between the medial and lateral condyles **1060**, **1064**, with the cam bar **1050** extending medial-laterally across the gap **1068**. The internal articulation surface **1054** may include a medial portion **1070** continuous with a lateral portion **1072**. In the embodiment depicted, a fixation post **1074** may protrude superiorly from the PS femoral component **1014**. However, in other embodiments of the PS femoral component **1014**, the fixation post **1074** may be absent and/or other fixation features such as posts, spikes, pegs, webs, keels or teeth may be present to affix the PS femoral component **1014** to a prepared femur (not shown).

[0091] Referring to FIGS. **17** and **18**, another assembly **1110** embodiment of the disclosure may include the PS insert **1012** of FIGS. **14-16**D coupled with a cruciate retaining femoral component **1114** (or "CR femoral component"). The CR femoral component **1114** may include, a keel **1120**, fixation members **1130**, impact driver apertures **1190**, and medial and lateral condyles **1160**, **1164** with a gap **1168** formed between the condyles **1160**, **1164**. As a CR femoral component **1114**, no cam bar or box may be present. The condyles **1160**, **1164** may include medial and lateral condylar articulation surfaces **1162**, **1166**, and an internal articulation surface **1154** with medial and lateral portions **1170**, **1172**.

[0092] The tapered sides **1032**, **1034** of the post **1030** may permit natural articulation of the CR femoral component **1114** with the PS insert **1012**, which may not be achievable if the post **1030** were not tapered. For example, if the post **1030** had straight sides instead of tapered sides, the wider width of the post **1030** at the base of the post **1030** may interfere with the internal articulating surfaces **1170**, **1172** of the condyles **1160**, **1164**. When the PS femoral component **1014** is coupled with the PS insert **1012** to form assembly **1010**, as in FIGS. **14** and **15**, the circular shape of the post superior end **1040** in combination with the tapered medial and lateral surfaces **1032**, **1034** of the post **1030**, may permit the PS femoral component **1014** to articulate relative to the PS insert **1012** in the manner of a posterior stabilized femoral component. However, when the PS insert **1012** is paired and implanted with the CR femoral component **1114**, the resultant assembly **1110** may provide the native articulation and rotation of a cruciate retaining implant.

[0093] Referring to FIGS. **19** and **20**, another assembly **2110** embodiment of the disclosure may include the PS insert **1012** of FIGS. **14-16**D coupled with a cruciate retaining femoral component **2114** (or "CR femoral component"). The CR femoral component **2114** may not include a keel, as opposed to the CR femoral component **1114** shown in FIGS. **17** and **18**, and the CR femoral component **2114** may be configured for cemented and/or cementless fixation to a

femoral bone. The CR femoral component **2114** may include fixation members **2130**, impact driver apertures **2190**, and medial and lateral condyles **2160**, **2164** with a gap **2168** formed between the condyles **2160**, **2164**. As a CR femoral component **2114**, no cam bar or box may be present. The condyles **2160**, **2164** may include medial and lateral condylar articulation surfaces **2162**, **2166**, and an internal articulation surface **2154** with medial and lateral portions **2170**, **2172**.

[0094] The tapered sides **1032**, **1034** of the post **1030** may permit natural articulation of the CR femoral component **2114** with the PS insert **1012**, which may not be achievable if the post **1030** were not tapered. For example, if the post **1030** had straight sides instead of tapered sides, the wider width of the post **1030** at the base **1038** of the post **1030** may interfere with the internal articulating surfaces **2170**, **2172** of the condyles **2160**, **2164**. When the PS femoral component **1014** is coupled with the PS insert **1012** to form assembly **1010**, as in FIGS. **14** and **15**, the circular shape of the post superior end **1040** in combination with the tapered medial and lateral surfaces **1032**, **1034** of the post **1030**, may permit the PS femoral component **1014** to articulate relative to the PS insert **1012** in the manner of a posterior stabilized femoral component. However, when the PS insert **1012** is paired and implanted with the CR femoral component **2114**, the resultant assembly **2110** may provide the native articulation and rotation of a cruciate retaining implant.

[0095] Referring to FIGS. **21**A-**21**E, an alternative embodiment of a tibial insert **1212** is shown. The tibial insert **1212** may be referred to as a cruciate retaining tibial insert **1212** (or "CR insert"). In a system of the disclosure, the CR insert **1212** may be implanted with the CR femoral components **114**, **1114**, **2114** and a tibial baseplate component (not shown) to form a cruciate retaining knee prosthesis system. The CR insert **1212** may include a fixation side **1220**, which may be an inferior side, opposite an articulation side **1222**, which may be a superior side. The articulation side **1222** may include a medial articulation portion **1224** having a medial condylar articulation surface **1225** and a lateral articulation portion **1226** having a lateral condylar articulation surface **1227**. A central portion **1228** may separate the medial articulation portion **1224** from the lateral articulation portion **1226**. A recess **1245** may be formed posterior to the central portion **1228**, between the medial and lateral articulation portions **1224**, **1226**, and may provide room for a posterior cruciate ligament. The CR insert **1212** may further include an insert base **1246** and an engagement feature **1248** for engagement with a tibial baseplate component.

[0096] The CR insert **1212** may be coupled with CR femoral components **114**, **1114**, **2114** to form a cruciate retaining assembly. This cruciate retaining assembly may be implanted with a suitable tibial baseplate as a complete cruciate retaining knee prosthesis. The CR insert **1212** may also be coupled with PS femoral components **14**, **1014** to form a posterior stabilizing assembly and implanted with a suitable tibial baseplate as a complete posterior stabilizing knee prosthesis.

[0097] Referring to FIGS. **22**A-**22**F, another alternative embodiment of a tibial insert **1312** is shown. The tibial insert **1312** may be referred to as a constrained condylar knee (CCK) tibial insert **1312** (or "CCK insert"). The CCK insert **1312** may include a fixation side **1320**, which may be an inferior side, opposite an articulation side **1322**, which may be a superior side. The articulation side **1322** may include a medial articulation portion **1324** having a medial condylar articulation surface **1325** and a lateral articulation portion **1326** having a lateral condylar articulation surface **1327**. A central portion **1328** may separate the medial articulation portion **1324** from the lateral articulation portion **1326**. A post **1330** may protrude superiorly from the central portion **1328**, and extend from a post base **1338** to a top, or post superior end **1340**. From the anterior perspective, as shown in FIG. **22**E, and the posterior perspective, as shown in FIG. **22**D, the post **1330** may have its maximum medial-lateral or horizontal width at the post superior end **1340** of the post **1330**, and its minimum medial-lateral or horizontal width at the post base **1338** of the post **1330**. The post **1330** may be bilaterally symmetrical from the anterior and posterior perspectives. The CCK insert **1312** may further include a posterior recess **1345**, an insert base **1346**, and an engagement feature **1348** for engagement with a tibial tray (not shown). An opening **1350** may be present in the superior surface of the post **1330**.

[0098] The post **1330** may have an articulation surface **1331** extending around the post **1330** on the medial, posterior, lateral, and anterior aspects of the post **1330**. The articulation surface **1331** may include a medial articulation surface **1332**, a lateral articulation surface **1334**, an anterior post surface **1336**, and a posterior articulation surface **1342**. The medial and lateral articulation surfaces **1332**, **1334** may taper slightly inward from the post superior end **1340** to the post base **1338** of the post **1330** relative to an insert midline vertical axis **1302**. However, some embodiments of CCK insert **1312** may include less taper, more taper, and/or no taper of the medial and lateral articulation surfaces **1332**, **1334**. The medial articulation surface **1332** may be continuous with the medial condylar articulation surface **1325**, and the lateral articulation surface **1334** may be continuous with the lateral condylar articulation surface **1327**. The anterior post surface **1336** may extend between the medial and lateral articulation surfaces **1332**, **1334** and may be convexly rounded. The anterior post surface **1336** may taper outward from the post superior end **1340** to the post base **1338** relative to the midline axis **1302**, as best seen in FIG. **22**F. In other embodiments of the CCK insert **1312**, the anterior post surface **1336** may include less taper, more taper, and/or no taper. The post **1330** of the CCK insert **1312** may be wider and bigger in diameter than the post **30** of PS insert **12**, for example to provide increased stability in the case of removal of the collateral ligaments. A midline medial-lateral axis **1304** and a mid-line anterior-posterior axis **1306** are also shown in FIGS. **22**D through **22**F.

[0099] Referring to FIG. **22**B, the boundary of the post superior end **1340** may define a rounded rim **1344** shaped as a portion of a circle, from a superior perspective, and may have a convex protrusion toward a posterior end of the post **1330**. The post superior end **1340** and rim **1344** may be semi-circular as shown, however the rim **1344** may define a circular envelope **1347**. The post superior end **1340** may be circular and the rim **1344** may provide increased surface contact and rotational range of motion when coupled and implanted with the PS femoral components disclosed herein in comparison to traditionally shaped posts with a more square or rectangular shaped post. Thus, the rounded post superior end **1340** and rim **1344** may allow for greater surface contact with the femoral components **14**, **1014** in contrast to the mere point or edge contact that is achieved by traditional posts that do not include these features.

[0100] The CCK insert **1312** may be coupled with the PS femoral components **14**, **1014** to form a constrained condylar knee assembly, and this assembly may be implanted with a suitable tibial baseplate as a constrained condylar knee prosthesis. The CCK insert **1312** may also be coupled with any of the CR femoral components disclosed herein and implanted with a suitable tibial baseplate. Thus, all of the tibial inserts disclosed herein are interchangeable with all of the CR and PS femoral components disclosed herein.

[0101] Any of the tibial inserts, CR femoral components, and/or PS femoral components disclosed herein may be grouped together in any number or combination as one or more modular knee replacement systems or kits. A particular kit may include a CR femoral component, a PS insert, and a CR insert. Yet another particular kit may include a PS femoral component, a PS insert, a CR insert, and a CCK insert. Suitable tibial baseplate components may also be included with any kit. Moreover, any of the tibial inserts disclosed herein may be formed of vitamin E polyethylene, highly cross linked polyethylene, ultra-high molecular weight polyethylene (UHMWPE), and/or the like.

[0102] In an example method of the disclosure, a patient may initially experience compromise of the anterior cruciate ligament. The ACL may be removed, and a CR type prosthesis may be implanted, including a CR femoral component, a CR insert, and a tibial baseplate component. Later, the same patient may experience compromise of the PCL and may need additional stabilization of the knee joint. The PCL may be removed, the CR tibial insert may be removed, and a PS tibial insert of the disclosure may be inserted between the originally implanted CR femoral component and the tibial baseplate component, thus providing additional stability for the missing PCL. Even later, the same patient may experience instability of the collateral ligaments. The PS tibial insert may be removed, and the CCK tibial insert of the disclosure may be inserted between the originally implanted CR femoral component and the tibial baseplate component. Thus, the patient may progress from a CR knee prosthesis, to a PS knee prosthesis, and finally to a CCK knee prosthesis without requiring replacement of the originally implanted femoral and/or tibial baseplate components. The interchangeability of the inserts permits replacement of only the tibial insert component in order to provide increasing levels of support and stability to the knee joint.

[0103] In another example method of the disclosure, a patient may initially experience compromise of both the ACL and the PCL. These ligaments may be removed, and a PS type prosthesis may be implanted, including a PS femoral component, a PS insert, and a tibial baseplate component. Later, the same patient may experience instability of the collateral ligaments. The PS insert may be removed, and a CCK insert may be inserted between the originally implanted PS femoral component and the tibial baseplate component. Thus, the patient may progress from a PS knee prosthesis to a CCK knee prosthesis without requiring replacement of the originally implanted PS femoral component and tibial baseplate component.

[0104] Referring now to FIGS. **23**A-B, FIG. **23**A is a perspective front view of the femoral component **1014** of FIG. **14** coupled to one or more augments **1082**, **1084** of the present disclosure and FIG. **23**B is a medial side view of the femoral component **1014** of FIG. **23**A. As briefly mentioned above with reference to FIGS. **14** and **15**, the femoral component **1014** may include augment fixation apertures **1080** that may be configured to secure the one or more augments **1082**, **1084** to the femoral component **1014**, as well as impact driver apertures **1090** configured to receive a femoral component impact driver tool (not shown) to allow a surgeon to press fit the femoral component **1014** to the end of a prepared femur. The augments **1082**, **1084** may be secured to the femoral component **1014** with fixation members **1086** and the augments **1082**, **1084** may generally act to replace missing and/or compromised femoral bone and allow the femoral component **1014** to be adequately secured to a femoral bone under such conditions.

[0105] Referring now to FIGS. **24**A-H, a femoral trial component **400** of the disclosure is illustrated in FIGS. **24**A-H. In particular, FIG. **24**A shows a perspective top view of a femoral trial component of the disclosure, FIG. **24**B shows a perspective rear view of the femoral trial component of FIG. **24**A, FIG. **24**C shows a lateral side view of the femoral trial component of FIG. **24**A, FIG. **24**D shows a medial side view of the femoral trial component of FIG. **24**A, FIG. **24**E shows an anterior view of the femoral trial component of FIG. **24**A, FIG. **24**F shows a posterior view of the femoral trial component of FIG. **24**A, FIG. **24**G shows a superior view of the femoral trial component of FIG. **24**A, and FIG. **24**H shows an inferior view of the femoral trial component of FIG. **24**A.

[0106] The femoral trial component **400** may be referred to as a universal femoral trial component **400** because the femoral trial component **400** may be used as part of a universal femoral trial system for preparing and trialing a femoral bone of a patient (not shown) to receive a plurality of different femoral implant types, as will be discussed in more detail below. The femoral trial component **400** may include a medial condyle **410** having a medial condylar articulation surface **412**, a lateral condyle **420** having a lateral condylar articulation surface **422**, an attachment aperture **440** located intermediate the medial condyle **410** and the lateral condyle **420**, a patellar projection **430** located anterior to the medial condyle **410** and the lateral condyle **420**, a patellar articulation surface **432**, fixation member drill apertures **470**, impact driver apertures **480**, medial attachment features **450** proximate the medial condyle **410**, and lateral attachment features **460** proximate the lateral condyle **420**. The medial attachment features **450** may further include a medial attachment projection **452**, a medial attachment aperture **454** formed within the medial attachment projection **452**, and a medial attachment recess **456**. The lateral attachment features **460** may likewise include a lateral attachment projection **462**, a lateral attachment aperture **464** formed within the lateral attachment projection **462**, and a co lateral attachment recess **466**.

[0107] In practice, the femoral trial component **400** may be coupled to a partially prepared distal end of a femur (not shown). For example, a partially prepared distal end of a femur may include five distal cuts that are made to the distal end of the femur using standard techniques and tools (not shown) that are well known in the art. These five cuts may be made to correspond in both shape and angle to the five surfaces on the inner portion of the femoral trial component **400**, as best seen in FIGS. **24**C and **24**D. The femoral trial component **400** may then be press fit onto the partially prepared distal end of the femur and the femoral trial component **400** may also be aligned relative to the distal end of the femur in the medial-lateral directions. The femoral trial component **400** may then be used to further prepare the

distal end of the femur and/or perform one or more trial operations with the femoral trial component **400** still in place on the distal end of a femur.

[0108] For example, the attachment aperture **440** formed in the femoral trial component **400**, along with the medial and lateral attachment features **450**, **460**, may be configured to receive any of a plurality of removably couplable femoral bone preparation attachments and/or any of a plurality of femoral trial attachments. Example femoral bone preparation attachments may include a posterior stabilizing notch cutting guide assembly **500**, an augment cutting guide assembly (not shown), and a drill and broach guide assembly **700**, as will be discussed in more detail below. Each of these femoral bone preparation attachments may be configured to removably couple to the universal femoral trial component **400** to allow a femoral bone of a patient to be selectively modified and prepared to receive a selected femoral implant type. Example femoral trial attachments may include a cruciate retaining trial attachment **800** including a cruciate retaining central portion articulation surface **810** and a posterior stabilizing trial attachment **600** including a posterior stabilizing central portion articulation surface **610**, as will be discussed in more detail below. The cruciate retaining trial attachment **800** and the posterior stabilizing trial attachment **600** may each be configured to removably couple to the universal femoral trial component **400** to provide a central portion articulation surface **610**, **810** above the attachment aperture **440** and allow for trialing of an articulation surface for a selected femoral implant type that includes a medial condylar articulation surface, a lateral condylar articulation surface, and a central portion articulation surface, for the selected femoral implant type. In this manner, the femoral bone preparation attachments and the femoral trial attachments may be used to help finish preparing the femur of the patient to receive any type of femoral component disclosed herein, and/or further perform one or more trial operations with the femoral trial component **400** still in place on the femur, as will be discussed in more detail below.

[0109] The femoral trial component **400** shown in FIGS. **24**A-H is a right side femoral trial component **400** having a patellar projection **430** with a right angled medial-lateral shape, as best seen in FIGS. **24**E and **24**F, which mimics the patellar region of a right femur (not shown). Note how the patellar projection **430** angles towards the right in the posterior view of the femoral trial component **400** shown in FIG. **24**F and towards the left in the anterior view of the femoral trial component **400** shown in FIG. **24**E. A left side femoral trial component (not shown) will have a patellar projection **430** shape that is a mirror image of that shown in FIGS. **24**E and **24**F, having a left angled medial-lateral shape that mimics the patellar region of a left femur (not shown). In another embodiment of the disclosure illustrated in FIGS. **35**A-C, a universal femoral trial component **900** may include a patellar projection **910** with a universal shape that does not angle towards the right or left, but rather, the patellar projection **910** in this embodiment may have a symmetrical medial-lateral shape. In this manner, the universal femoral trial component **900** shown in FIGS. **35**A-C has a universal shape that may be used to prepare and trial both right and left side femurs. The patellar projection **910** may have a patellar articular surface **912**.

[0110] FIGS. **25**A-**26** illustrate a posterior stabilizing notch cutting guide assembly **500** that may be used with the femoral trial component **400** shown in FIGS. **24**A-H to help prepare a femur of a patient to receive a PS femoral component of the present disclosure by guiding bone resection. In particular, FIG. **25**A is a perspective rear view of the posterior stabilizing notch cutting guide assembly **500**, FIG. **25**B is another perspective rear view of the posterior stabilizing notch cutting guide assembly **500**, FIG. **25**C is a medial side view of the posterior stabilizing notch cutting guide assembly **500**, FIG. **25**D is a top view of the posterior stabilizing notch cutting guide assembly **500**, and FIG. **26** is a partial exploded view of the posterior stabilizing notch cutting guide assembly **500**.

[0111] The posterior stabilizing notch cutting guide assembly **500** may include a posterior stabilizing notch cutting guide body **510** that includes a medial member **520** having a medial cutting guide surface **522** and medial channels **524** formed therein, a lateral member **530** having a lateral cutting guide surface **532** and lateral channels **534** formed therein, and a patellar member **540** having a patellar cutting guide surface **542**.

[0112] The posterior stabilizing notch cutting guide assembly **500** may also include a locking mechanism which may include: a first locking member **552**, a second locking member **554**, a first release lever **562** coupled to the first locking member **552** via a first pin **572**, a second release lever **564** coupled to the second locking member **554** via a second pin **574**, a first resilient member **592** located between the first release lever **562** and the posterior stabilizing notch cutting guide body **510**, with the first resilient member **592** housed in a first resilient member housing **582**, a second resilient member (not shown) similarly located between the second release lever **564** and the posterior stabilizing notch cutting guide body **510**, with the second resilient member housed in a second resilient member housing **584**.

[0113] The first resilient member **592** may be configured to apply a biasing force that acts to push the first locking member **552** away from the posterior stabilizing notch cutting guide body **510** in the medial direction and the second resilient member may be configured to apply a biasing force that acts to push the second locking member **554** away from the posterior stabilizing notch cutting guide body **510** in the lateral direction.

[0114] Referring to FIGS. **27**A and **27**B, the posterior stabilizing notch cutting guide assembly **500** may be removably coupled to the universal femoral trial component **400** by squeezing the first release lever **562** and the second release lever **564** together toward each other (see arrows **501** in FIG. **27**A) in order to overcome the biasing forces of the first resilient member **592** and the second resilient member; then inserting the posterior stabilizing notch cutting guide assembly **500** into the attachment aperture **440** of the universal femoral trial component **400** (see arrow **502** in FIG. **27**A); and finally releasing the first release lever **562** and the second release lever **564** to allow the biasing forces of the first resilient member **592** and the second resilient member to push the first locking member **552** and the second locking member **554** away from the posterior stabilizing notch cutting guide body **510**, causing the first locking member **552** to enter within the medial attachment aperture **454** of the femoral trial component **400** and the second locking member **554** to enter within the lateral attachment aperture **464** of the femoral trial component **400** to couple

the posterior stabilizing notch cutting guide assembly **500** to the universal femoral trial component **400**, as shown in FIG. **27**B.

[0115] FIGS. **28**A-D illustrate a posterior stabilizing trial attachment **600** that may be used with the femoral trial component **400** shown in FIGS. **24**A-H to aid performance of one or more trial operations with the femoral trial component **400** in place on the distal end of the femoral bone. In particular, FIG. **28**A is a perspective rear view of the posterior stabilizing trial attachment **600**, FIG. **28**B is another perspective rear view of the posterior stabilizing trial attachment **600**, FIG. **28**C is a perspective front view of the posterior stabilizing trial attachment **600**, and FIG. **28**D is a perspective side view of the posterior stabilizing trial attachment **600**.

[0116] The posterior stabilizing trial attachment **600** may include a central portion articulation surface **610**, an internal articulation surface **620** having a medial portion **622** and a lateral portion **624**, a cam bar element **630** having a cam bar articulating surface **632**, a posterior stabilizing box **670**, and a gap **640** formed between the medial and lateral portions **622**, **624** within the posterior stabilizing box **670**. Each of these components of the posterior stabilizing trial attachment **600**, such as the posterior stabilizing box **670** and the cam bar element **630**, may be configured to allow for trialing of a complete posterior stabilizing femoral implant.

[0117] The posterior stabilizing trial attachment **600** may also include attachment projections **650**, **660** on the medial and lateral sides of the posterior stabilizing trial attachment **600**. The attachment projections **650**, **660** may have shapes that are complementary to the medial and lateral attachment features **450**, **460** and/or the medial and lateral attachment recesses **456**, **466** that are formed in the femoral trial component **400**. In this manner, the attachment projections **650**, **660** may be configured to couple to the medial and lateral attachment features **450**, **460** and/or the medial and lateral attachment recesses **456**, **466** formed in the femoral trial component **400**, as shown in FIGS. **29**A and **29**B. This may be accomplished by holding the posterior stabilizing trial attachment **600** above the femoral trial component **400** and moving the posterior stabilizing trial attachment **600** toward the attachment aperture **440** formed in the universal femoral trial component **400** (see arrow **601** in FIG. **29**A) until the posterior stabilizing trial attachment **600** is coupled to the femoral trial component **400**, as shown in FIG. **29**B. In at least one embodiment, the posterior stabilizing trial attachment **600** may be further configured to magnetically couple to the femoral trial component **400**.

[0118] In this manner, the posterior stabilizing trial attachment **600** may removably couple to the universal femoral trial component **400** and provide the central portion articulation surface **610** above the attachment aperture **440** of the femoral trial component **400** to allow for trialing of a complete articulation surface for a selected femoral implant type, such as a PS femoral component disclosed herein. A complete articulation surface may include a medial condylar articulation surface, a lateral condylar articulation surface, and the central portion articulation surface **610**, for the selected femoral implant type.

[0119] FIGS. **30**A-**31** illustrate a drill and broach guide assembly **700** that may be used with the femoral trial component **400** shown in FIGS. **24**A-H to help prepare a femur of a patient to receive a femoral component of the present disclosure that utilizes a keel or other bone fixation member that may require a pre-drilled and/or broached bone aperture. In particular, FIG. **30**A is a perspective rear view of the drill and broach guide assembly **700**, FIG. **30**B is a perspective bottom view of the drill and broach guide assembly **700**, FIG. **30**C is a top view of the drill and broach guide assembly **700**, FIG. **30**D is a bottom view of the drill and broach guide assembly **700**, and FIG. **31** is a partial exploded view of the drill and broach guide assembly **700**.

[0120] The drill and broach guide assembly **700** may include a drill and broach guide body **710**, attachment projections **750**, **760**, and a drill and broach guide **720**. The drill and broach guide **720** may further include a first drill guide aperture **721**, a second drill guide aperture **722**, a third drill guide aperture **723**, a first broach guide aperture **725** intermediate the first drill guide aperture **721** and the second drill guide aperture **722**, and a second broach guide aperture **726** intermediate the second drill guide aperture **722** and the third drill guide aperture **723**. The second drill guide aperture **722** may also be located intermediate the first broach guide aperture **725** and the second broach guide aperture **726**.

[0121] The drill and broach guide assembly **700** may also include a drill and broach guide locking mechanism which may include: a first locking member **742**, a second locking member **744**, a first release lever **732** coupled to the first locking member **742** via a first pin **752**, a second release lever **734** coupled to the second locking member **744** via a second pin **754**, and a resilient member **770** located between the first locking member **742** and the second locking member **744** within a locking member housing **780** formed within the drill and broach guide body **710**. The resilient member **770** may be configured to apply a biasing force between the first locking member **742** and the second locking member **744** to push the first locking member **742** and the second locking member **744** away from each other.

[0122] Referring to FIGS. **32**A and **32**B, the drill and broach guide assembly **700** may be removably coupled to the universal femoral trial component **400** by squeezing the first release lever **732**, and the second release lever **734** together toward each other (see arrows **701** in FIG. **32**A) in order to overcome the biasing force of the resilient member **770** between the first locking member **742** and the second locking member **744**; then inserting the drill and broach guide assembly **700** into the attachment aperture **440** formed in the universal femoral trial component **400** (see arrow **702** in FIG. **32**A); and finally releasing the first release lever **732** and the second release lever **734** to allow the biasing force of the resilient member **770** to push the first locking member **742** and the second locking member **744** away from each other, causing the first locking member **742** to enter within the medial attachment aperture **454** of the femoral trial component **400** and the second locking member **744** to enter within the lateral attachment aperture **464** of the femoral trial component **400** to couple the drill and broach guide assembly **700** to the universal femoral trial component **400**, as shown in FIG. **32**B. The attachment projections **750**, **760** may also have shapes that are complementary to the medial and lateral attachment features **450**, **460** and/or the medial and lateral attachment recesses **456**, **466** formed in the femoral trial component **400** to aid coupling of the drill and broach guide assembly **700** to the universal femoral trial component **400**, as well as magnetic coupling capabilities.

[0123] FIGS. **33**A-D illustrate a cruciate retaining trial attachment **800** that may be used with the femoral trial

component **400** shown in FIGS. **24**A-H to aid performance of one or more trial operations with the femoral trial component **400** in place on the distal end of the femoral bone. In particular, FIG. **33**A is a perspective front view of the cruciate retaining trial attachment **800**, FIG. **33**B is a perspective rear view of the cruciate retaining trial attachment **800**, FIG. **33**C is a perspective bottom view of the cruciate retaining trial attachment **800**, and FIG. **33**D is a top view of the cruciate retaining trial attachment **800**.

[0124] The cruciate retaining trial attachment **800** may include a central portion articulation surface **810**, an internal articulation surface **820** having a medial portion **822** and a lateral portion **824**, and a gap **840** formed between the medial and lateral portions **822**, **824**. Each of these components of the cruciate retaining trial attachment **800** may be configured to allow for trialing of a complete cruciate retaining femoral implant.

[0125] The cruciate retaining trial attachment **800** may also include attachment projections **850**, **860** on the medial and lateral sides of the cruciate retaining trial attachment **800**. The attachment projections **850**, **860** may have shapes that are complementary to the medial and lateral attachment features **450**, **460** and/or the medial and lateral attachment recesses **456**, **466** that are formed in the femoral trial component **400**. In this manner, the attachment projections **850**, **860** may be configured to couple to the medial and lateral attachment features **450**, **460** and/or the medial and lateral attachment recesses **456**, **466** formed in the femoral trial component **400**, as shown in FIGS. **34**A and **34**B. This may be accomplished by holding the cruciate retaining trial attachment **800** above the femoral trial component **400** and moving the cruciate retaining trial attachment **800** toward the attachment aperture **440** formed in the universal femoral trial component **400** (see arrow **801** in FIG. **34**A) until the cruciate retaining trial attachment **800** is coupled to the femoral trial component **400**, as shown in FIG. **34**B. In at least one embodiment, the cruciate retaining trial attachment **800** may be further configured to magnetically couple to the femoral trial component **400**.

[0126] In this manner, the cruciate retaining trial attachment **800** may removably couple to the universal femoral trial component **400** and provide the central portion articulation surface **810** above the attachment aperture **440** of the femoral trial component **400** to allow for trialing of a complete articulation surface for a selected femoral implant type, such as a CR femoral component disclosed herein. A complete articulation surface may include a medial condylar articulation surface, a lateral condylar articulation surface, and the central portion articulation surface **810**, for the selected femoral implant type.

[0127] Any of the components disclosed herein may be included in a modular universal femoral trial kit (not shown) to aid in preparing and trialing a femoral bone of a patient to receive a plurality of different femoral implant types. In at least one embodiment, the modular universal femoral trial kit may include a container (not shown) that contains a femoral trial component **400**, **900** and at least one femoral bone preparation attachment, such as the posterior stabilizing notch cutting guide assembly **500** and/or the drill and broach guide assembly **700**, as one non-limiting example. In other embodiments, the modular universal femoral trial kit may also include at least one femoral trial attachment, such as the cruciate retaining trial attachment **800** and/or the posterior stabilizing trial attachment **600**, as another non-limiting example.

[0128] FIG. **36** illustrates a flow chart diagram of a method **3000** for preparing and trialing a femoral bone with a universal femoral trial component **400**, **900**, according to one embodiment of the present disclosure. The method **3000** will be described in connection with the components and instrumentation described herein. However, those of skill in the art will recognize that alternative implants, assemblies, systems, and instrumentation may be used in the performance of the method **3000**.

[0129] The method **3000** may begin with a step **3010** in which a universal femoral trial component **400**, **900** may be placed on an inferior or distal end of a femoral bone. The distal end of the femoral bone may first be partially prepared with five distal cuts that are made to the distal end of the femur using standard techniques and tools (not shown) that are well known in the art. These five cuts may be made to correspond in both shape and angle to the five surfaces on the inner portion of the universal femoral trial component **400**, **900** (e.g., see FIGS. **24**C and **24**D). The universal femoral trial component **400**, **900** may then be press fit onto the partially prepared distal end of the femur.

[0130] In a step **3020**, the universal femoral trial component **400**, **900** may be further aligned with respect to the femoral bone along a medial-lateral direction in order to place the universal femoral trial component **400**, **900** at a desired medial-lateral location with respect to the femoral bone.

[0131] In a step **3030**, one of a plurality of femoral bone preparation attachments may be selected in order to guide resection of portions of the femoral bone, as desired. Example, femoral bone preparation attachments may include the posterior stabilizing notch cutting guide assembly **500** and the drill and broach guide assembly **700**, as two non-limiting examples.

[0132] In a step **3040**, the selected femoral bone preparation attachment may be coupled to the universal femoral trial component **400**, **900** using techniques described previously herein (e.g., see description related to FIGS. **27**A-B and FIGS. **32**A-B).

[0133] In a step **3050**, the femoral bone may be prepared to receive a desired femoral component by using the selected femoral bone preparation attachment as a guide to resect at least a portion of the femoral bone in order to prepare the femoral bone to receive the desired femoral component. Once the femoral bone has been prepared with the selected femoral bone preparation attachment, the method may move to a step **3060**.

[0134] In the step **3060**, the selected femoral bone preparation attachment may be removed from the universal femoral trial component **400**, **900**.

[0135] In a step **3070**, one of a plurality of femoral trial attachments may be selected in preparation for performing one or more trial operations with the universal femoral trial component **400**, **900** still in place on the femoral bone.

[0136] In a step **3080**, the selected femoral trial attachment may be coupled to the universal femoral trial component **400**, **900** using techniques described previously herein (e.g., see description related to FIGS. **29**A-B and FIGS. **34**A-B).

[0137] In a step **3090**, at least one trial operation may be performed with the selected femoral trial attachment coupled to the universal femoral trial component **400**, **900**,

and the method **300** may end. For example, the surgeon may perform trialing of articulation surfaces of the knee joint to ensure that the articulation characteristics of the prosthetic knee joint will be satisfactory.

[0138] Various steps of any method disclosed herein may be reordered, omitted, and/or replaced with different steps within the scope of the present disclosure. Those of skill in the art, with the aid of the present disclosure, will recognize that many variations may be made to any other method disclosed herein, depending on the particular surgical procedure to be carried out, as well as the configuration of the system used in the performance of that surgical procedure. Moreover, any methods disclosed herein may include one or more steps or actions for performing the described method. These method steps and/or actions may be interchanged with one another. In other words, unless a specific order of steps or actions is required for proper operation of the embodiment, the order and/or use of specific steps and/or actions may be modified.

[0139] FIG. **37** illustrates a flow chart diagram of a method **4000** for revising a knee joint prosthesis implanted in a knee of a patient to provide increased stability to the knee joint prosthesis, according to one embodiment of the present disclosure. The method **4000** will be described in connection with the components and instrumentation described herein. However, those of skill in the art will recognize that alternative implants, assemblies, systems, and instrumentation may also be used in the performance of the method **4000**.

[0140] The method **4000** may begin with a step **4010**, in which a first knee joint prosthesis that is implanted in a knee of a patient is surgically accessed. The first knee joint prosthesis may comprise a first tibial insert that is located between a tibial base plate component that is implanted on a tibia of the patient and a femoral component that is implanted on a femur of the patient.

[0141] The method **4000** may then proceed to a step **4020**, in which the first tibial insert may be removed from between the tibial base plate component and the femoral component.

[0142] The method **4000** may then proceed to a step **4030**, in which a second tibial insert may be inserted between the tibial baseplate component and the femoral component to create a second knee joint prosthesis assembly that is more constrained that the first knee joint prosthesis assembly, and the method **4000** may end.

[0143] FIGS. **38**A-F and **39** illustrate an example tibial tray **5000** that may be used with any of the tibial inserts and femoral components described herein to create various prosthetic knee assemblies, according to embodiments of the present disclosure. In particular, FIG. **38**A shows a perspective front view of the tibial tray **5000**, FIG. **38**B shows a perspective rear view of the tibial tray **5000**, FIG. **38**C shows an anterior view of the tibial tray **5000**, FIG. **12**D shows a posterior view of the tibial tray, FIG. **38**E shows a bottom view of the tibial tray **5000**, FIG. **38**F shows a top view of the tibial tray **5000**, and FIG. **39** shows an exploded view of an example tibial tray mounting system **6000** that utilizes the tibial tray **5000**.

[0144] The tibial tray **5000** may generally include a tibial base plate **5001** that is superiorly mounted on top of a keel **5030**. The tibial base plate **5001** may have a superior end **5010** configured to receive any of the tibial inserts described herein, and an inferior end **5020** configured to engage a superior surface of a prepared tibia of a patient (not shown). The superior end **5010** of the tibial base plate **5001** may include a posterior lip **5012** and an anterior lip **5014**, each configured to couple to and retain any of the tibial inserts described herein. The superior end **5010** of the tibial base plate **5001** may also include a tibial insert retaining aperture **5050** configured to receive a tibial insert retaining rod **6010**, which may be used to further couple to and retain a suitable tibial insert to the tibial base plate **5001**, as shown in FIG. **39**, provided the tibial insert has a corresponding opening in the post of the tibial insert configured to receive the tibial insert retaining rod **6010** (e.g., see the tibial insert shown in FIGS. **22**A-F).

[0145] The inferior end **5020** of the tibial base plate **5001** may include one or more spikes **5040** configured to penetrate tibial bone to further couple the tibial base plate **5001** to the superior surface of a prepared tibia. The Keel **5030** may also include a medial fin **5032** and a lateral fin **5034** each configured to penetrate tibial bone and provide additional coupling of the tibial tray **5000** to the tibia. Moreover, in some embodiments the Keel **5030** may also include a tibial stem aperture **5036** configured to receive a tibial stem **6030** and/or a stem adapter member **6020** to further couple the tibial tray **5000** to the tibia of a patient (see FIG. **39**). The tibial stem **6030** may be configured to penetrate and reside within an intramedullary canal of the tibia to provide increased fixation of the tibial tray **5000** to the tibia.

[0146] It will be understood that the tibial tray **5000** and tibial tray mounting system **6000** shown in FIGS. **38**A-F and **39** are merely one example of a tibial tray and tibial tray mounting system that may be used with the tibial inserts and femoral components described in the present disclosure and that other tibial trays and tibial tray mounting systems are also contemplated herein.

[0147] Reference throughout this specification to "an embodiment" or "the embodiment" means that a particular feature, structure or characteristic described in connection with that embodiment is included in at least one embodiment. Thus, the quoted phrases, or variations thereof, as recited throughout this specification are not necessarily all referring to the same embodiment.

[0148] Similarly, it should be appreciated that in the above description of embodiments, various features are sometimes grouped together in a single embodiment, Figure, or description thereof for the purpose of streamlining the disclosure. This method of disclosure, however, is not to be interpreted as reflecting an intention that any claim require more features than those expressly recited in that claim. Rather, as the following claims reflect, inventive aspects lie in a combination of fewer than all features of any single foregoing disclosed embodiment. Thus, the claims following this Detailed Description are hereby expressly incorporated into this Detailed Description, with each claim standing on its own as a separate embodiment. This disclosure includes all permutations of the independent claims with their dependent claims.

[0149] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any embodiment described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments. While the various aspects of the embodiments are presented in drawings, the drawings are not necessarily drawn to scale unless specifically indicated.

[0150] Recitation in the claims of the term "first" with respect to a feature or element does not necessarily imply the existence of a second or additional such feature or element.

Elements recited in means-plus-function format are intended to be construed in accordance with 35 U.S.C. § 112 Para. 6. It will be apparent to those having skill in the art that changes may be made to the details of the above-described embodiments without departing from the underlying principles set forth herein.

[0151] The phrases "connected to," "coupled to" and "in communication with" refer to any form of interaction between two or more entities, including mechanical, electrical, magnetic, electromagnetic, fluid, and thermal interaction. Two components may be functionally coupled to each other even though they are not in direct contact with each other. The term "abutting" refers to items that are in direct physical contact with each other, although the items may not necessarily be attached together. The phrase "fluid communication" refers to two features that are connected such that a fluid within one feature is able to pass into the other feature.

[0152] The Figures may show simplified or partial views, and the dimensions of elements in the Figures may be exaggerated or otherwise not in proportion for clarity. In addition, the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to a terminal includes reference to one or more terminals. In addition, where reference is made to a list of elements (e.g., elements a, b, c), such reference is intended to include any one of the listed elements by itself, any combination of less than all of the listed elements, and/or a combination of all of the listed elements.

[0153] The term "substantially" means that the recited characteristic, parameter, or value need not be achieved exactly, but that deviations or variations, including for example, tolerances, measurement error, measurement accuracy limitations and other factors known to those of skill in the art, may occur in amounts that do not preclude the effect the characteristic was intended to provide.

[0154] As used herein, the term "proximal", "top", "up" or "upwardly" may refer to a location on the device that is closest to the clinician using the device and farthest from the patient in connection with whom the device is used when the device is used in its normal operation. Conversely, the term "distal", "bottom", "down" or "downwardly" may refer to a location on the device that is farthest from the clinician using the device and closest to the patient in connection with whom the device is used when the device is used in its normal operation. Moreover, the terms "upper" and "lower", and "top" and "bottom", "front" and "rear" may be used as relative terms herein for ease of description and understanding. It is understood that in embodiments of the disclosure, upper and lower entities may be reversed, as may top and bottom, front and rear.

[0155] As used herein, the term "in" or "inwardly" refers to a location with respect to the device that, during normal use, is toward the inside of the device. Conversely, as used herein, the term "out" or "outwardly" refers to a location with respect to the device that, during normal use, is toward the outside of the device.

[0156] While specific embodiments and applications of the present disclosure have been illustrated and described, it is to be understood that the scope of this disclosure is not limited to the precise configuration and components disclosed herein. Various modifications, changes, and variations which will be apparent to those skilled in the art may be made in the arrangement, operation, and details of the methods and systems of the present disclosure set forth herein without departing from it spirit and scope.

What is claimed is:

1. A method of revising a knee joint prosthesis implanted in a knee of a patient to provide increased stability to the knee joint prosthesis, the method comprising:

accessing a knee joint prosthesis implanted in a knee of a patient, the knee joint prosthesis comprising:

a tibial baseplate component implanted on a tibia of the patient;

a femoral component implanted on a femur of the patient; and

a first tibial insert implanted between the tibial baseplate component and the femoral component,

wherein the tibial baseplate component, the femoral component, and the first tibial insert together comprise a first knee joint prosthesis assembly;

removing the first tibial insert from between the tibial baseplate component and the femoral component of the knee joint prosthesis; and

inserting a second tibial insert between the tibial baseplate component and the femoral component,

wherein the tibial baseplate component, the femoral component, and the second tibial insert together comprise a second knee joint prosthesis assembly, and

wherein the second knee joint prosthesis assembly is more constrained than the first knee joint prosthesis assembly to provide increased stability to the knee joint prosthesis.

2. The method of claim **1**, wherein:

the femoral component comprises a cruciate retaining femoral component;

the first tibial insert comprises a cruciate retaining tibial insert; and

the second tibial insert comprises a posterior stabilizing tibial insert.

3. The method of claim **1**, wherein:

the femoral component comprises a cruciate retaining femoral component;

the first tibial insert comprises a cruciate retaining tibial insert; and

the second tibial insert comprises a constrained condylar knee tibial insert.

4. The method of claim **1**, wherein:

the femoral component comprises a cruciate retaining femoral component;

the first tibial insert comprises a posterior stabilizing tibial insert; and

the second tibial insert comprises a constrained condylar knee tibial insert.

5. The method of claim **1**, wherein:

the femoral component comprises a posterior stabilizing femoral component;

the first tibial insert comprises a cruciate retaining tibial insert; and

the second tibial insert comprises a posterior stabilizing tibial insert.

6. The method of claim **1**, wherein:

the femoral component comprises a posterior stabilizing femoral component;

the first tibial insert comprises a cruciate retaining tibial insert; and

the second tibial insert comprises a constrained condylar knee tibial insert.

7. The method of claim **1**, wherein:

the femoral component comprises a posterior stabilizing femoral component;

the first tibial insert comprises a posterior stabilizing tibial insert; and

the second tibial insert comprises a constrained condylar knee tibial insert.

8. A knee joint prosthesis system for implantation in a knee of a patient, the knee joint prosthesis system comprising:

a tibial baseplate component configured to be implanted on a tibia of a patient;

a femoral component configured to be implanted on a femur of the patient,

wherein the femoral component comprises at least one of:

a cruciate retaining femoral component; and

a posterior stabilizing femoral component; and

a tibial insert configured to be implanted between the tibial baseplate component and the femoral component,

wherein the tibial insert comprises at least one of:

a cruciate retaining tibial insert;

a posterior stabilizing tibial insert; and

a constrained condylar knee tibial insert,

wherein each of the cruciate retaining tibial insert, the posterior stabilizing tibial insert, and the constrained condylar knee tibial insert are selectively interchangeable such that each of the cruciate retaining tibial insert, the posterior stabilizing tibial insert, and the constrained condylar knee tibial insert may be individually inserted between the tibial baseplate component and the femoral component to form a functioning knee joint replacement.

9. The knee joint prosthesis system of claim **8**, wherein:

the tibial insert comprises a posterior stabilizing tibial insert, the posterior stabilizing tibial insert comprising:

a medial articulation portion;

a lateral articulation portion;

a central portion positioned between the medial articulation portion and the lateral articulation portion; and

a post protruding superiorly from the central portion along a midline vertical axis, wherein a superior end of the post is shaped as a portion of a circle, as seen from a superior perspective, and the superior end of the post defines a circular envelope in a cross-section transverse to the midline vertical axis.

10. The knee joint prosthesis system of claim **9**, wherein the superior end of the post is shaped as a portion of a circle, as seen from a superior perspective, and has a crescent shape with a concave recess toward a posterior end of the post.

11. The knee joint prosthesis system of claim **9**, wherein the superior end of the post is shaped as a portion of a circle, as seen from a superior perspective, and has a convex protrusion toward a posterior end of the post.

12. The knee joint prosthesis system of claim **9**, wherein the post protrudes superiorly from the central portion, from a base of the post to the superior end of the post, the post further comprising:

a medial side; and

a lateral side,

wherein the medial side and the lateral side each extend from the base of the post to the superior end of the post,

the medial side and the lateral side each taper inwardly from the superior end of the post toward the base of the post, and

the post is widest at the superior end of the post and narrowest at the base of the post.

13. The knee joint prosthesis system of claim **12**, wherein the medial side and the lateral side each extend at an angle relative to the midline vertical axis, wherein the angle within the range of 6° to 11°.

14. The knee joint prosthesis system of claim **13**, wherein the angle is 6.5°.

15. A modular knee joint replacement kit, the modular knee joint replacement kit comprising:

a tibial baseplate component configured to be implanted on a tibia of a patient;

at least one femoral component configured to be implanted on a femur of the patient,

wherein the at least one femoral component comprises at least one of:

a cruciate retaining femoral component; and

a posterior stabilizing femoral component;

at least one tibial insert configured to be implanted between the tibial baseplate component and the femoral component,

wherein the at least one tibial insert comprises at least one of:

a cruciate retaining tibial insert;

a posterior stabilizing tibial insert; and

a constrained condylar knee tibial insert,

wherein each of the cruciate retaining tibial insert, the posterior stabilizing tibial insert, and the constrained condylar knee tibial insert are selectively interchangeable such that each of the cruciate retaining tibial insert, the posterior stabilizing tibial insert, and the constrained condylar knee tibial insert may be individually inserted between the tibial baseplate component and the femoral component to form a functioning knee joint replacement; and

a package containing at least the at least one tibial insert.

16. The modular knee joint replacement kit of claim **15**, wherein the package further contains at least the tibial base plate and the at least one femoral component.

17. The modular knee joint replacement kit of claim **15**, wherein:

the at least one tibial insert comprises a posterior stabilizing tibial insert, the posterior stabilizing tibial insert comprising:

a medial articulation portion;

a lateral articulation portion;

a central portion positioned between the medial articulation portion and the lateral articulation portion; and

a post protruding superiorly from the central portion along a midline vertical axis, wherein a superior end of the post is shaped as a portion of a circle, as seen from a superior perspective, and the superior end of the post defines a circular envelope in a cross-section transverse to the midline vertical axis.

18. The modular knee joint replacement kit of claim **17**, wherein the superior end of the post shaped as a portion of a circle, as seen from a superior perspective, and has a crescent shape with a concave recess toward a posterior end of the post.

19. The modular knee joint replacement kit of claim **17**, wherein the superior end of the post shaped as a portion of

a circle, as seen from a superior perspective, and has a convex protrusion toward a posterior end of the post.

20. The modular knee joint replacement kit of claim **17**, wherein the post protrudes superiorly from the central portion, from a base of the post to the superior end of the post, the post further comprising:

a medial side; and

a lateral side,

wherein the medial side and the lateral side each extend from the base of the post to the superior end of the post,

the medial side and the lateral side each taper inwardly from the superior end of the post toward the base of the post,

the post is widest at the superior end of the post and narrowest at the base of the post, and

wherein the medial side and the lateral side each extend at an angle relative to the midline vertical axis, wherein the angle within the range of 6° to 11°.

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