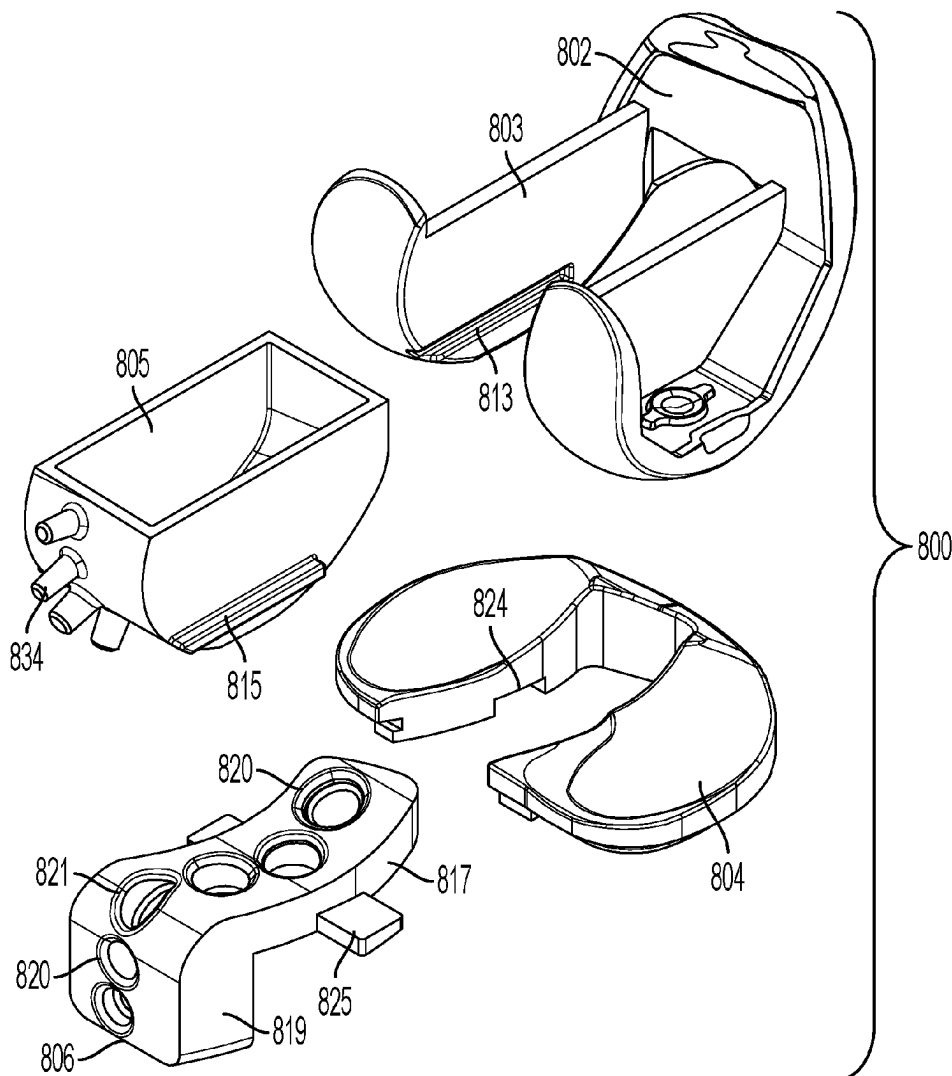




US 20250255727A1

(19) **United States**(12) **Patent Application Publication**
Garino(10) **Pub. No.: US 2025/0255727 A1**(43) **Pub. Date: Aug. 14, 2025**(54) **ARTIFICIAL KNEE SYSTEM HAVING A
GEAR ARRANGEMENT**(2013.01); *A61F 2002/30383* (2013.01); *A61F*
2002/30523 (2013.01); *A61F 2002/30604*
(2013.01); *A61F 2002/30894* (2013.01)(71) Applicant: **Jonathan P. Garino**, Villanova, PA
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(US)(21) Appl. No.: **18/440,041**(22) Filed: **Feb. 13, 2024****Publication Classification**(51) **Int. Cl.***A61F 2/38* (2006.01)*A61F 2/30* (2006.01)(52) **U.S. Cl.**CPC *A61F 2/3836* (2013.01); *A61F 2/3859*
(2013.01); *A61F 2/3868* (2013.01); *A61F*
2002/3021 (2013.01); *A61F 2002/30354*(57) **ABSTRACT**

A knee joint prosthesis moves between an extended and flexion positions. The prosthesis includes a femoral component configured to be mounted to a femur, the femoral component having a femoral gear including a plurality of posts arranged along a helical trajectory. The prosthesis also includes a tibial component configured to (i) be mounted either directly or indirectly to a tibia, and (ii) engage the femoral component. The tibial component has a tibial gear including a plurality of recesses that are configured to mesh with the posts of the femoral gear. The tibial gear has two intersecting portions including a horizontally-oriented curved portion and a vertical portion, wherein each portion includes at least one of the recesses. The plurality of posts follow a helical trajectory to cause movement of the tibial component in either a medial or lateral direction as the knee joint prosthesis is moved to the extended position.



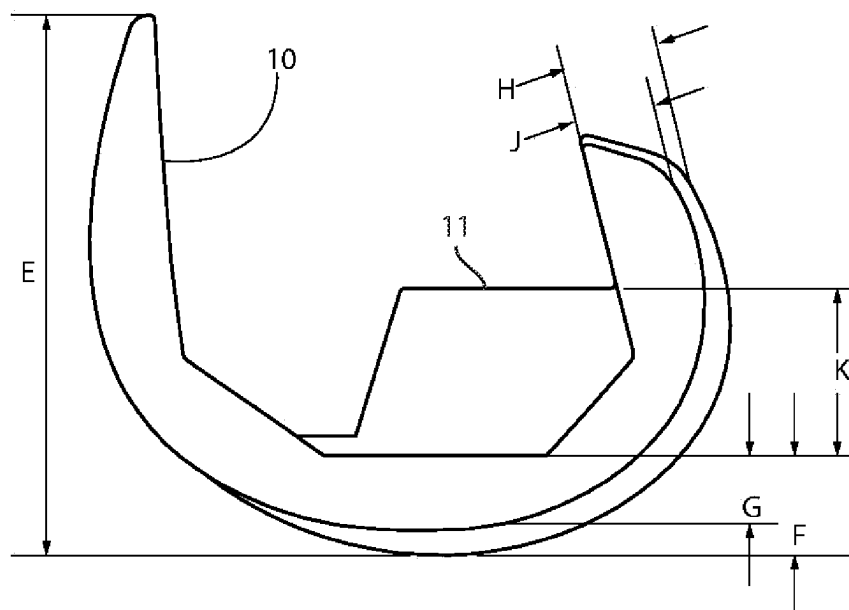


FIG. 1A
(PRIOR ART)

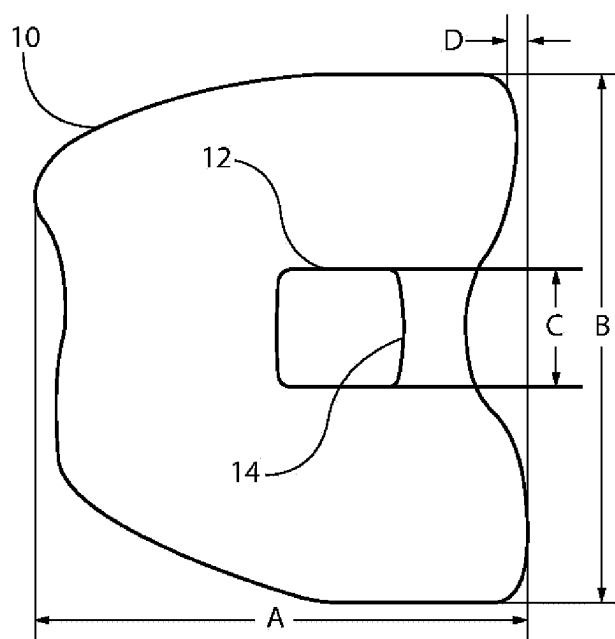


FIG. 1B
(PRIOR ART)

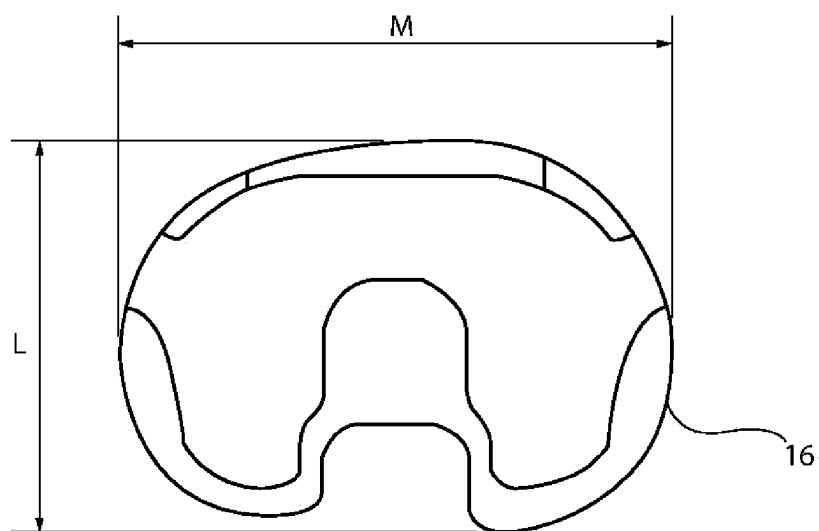


FIG. 2A
(PRIOR ART)

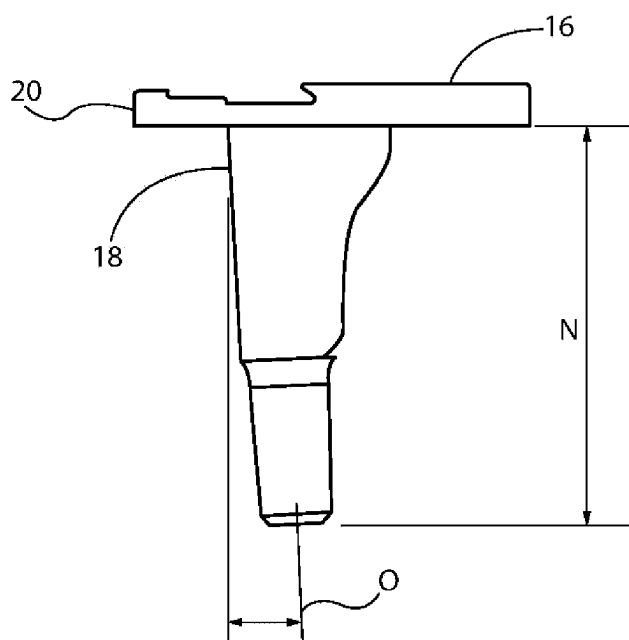


FIG. 2B
(PRIOR ART)

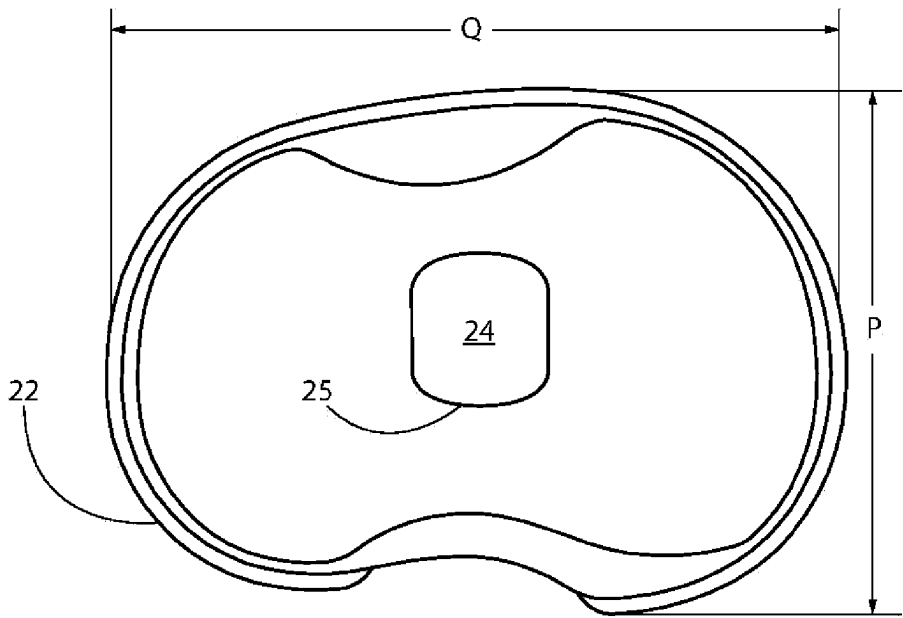


FIG. 3A
(PRIOR ART)

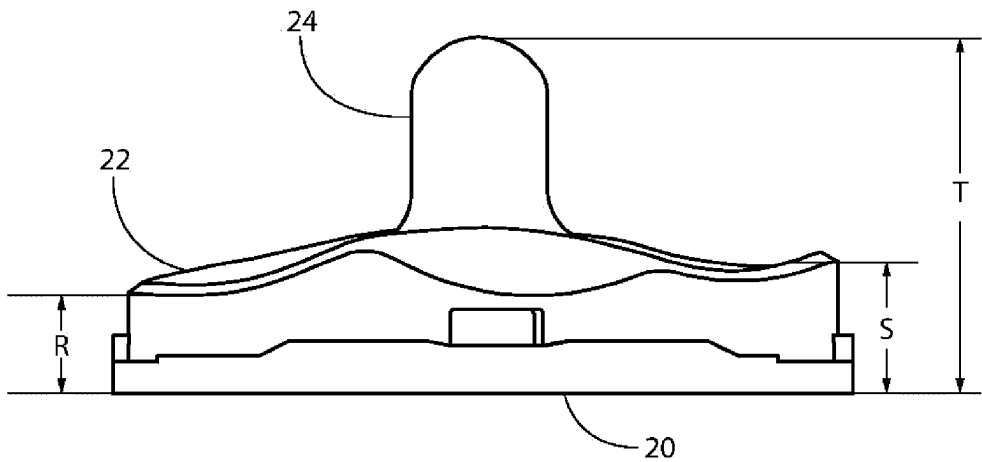


FIG. 3B
(PRIOR ART)

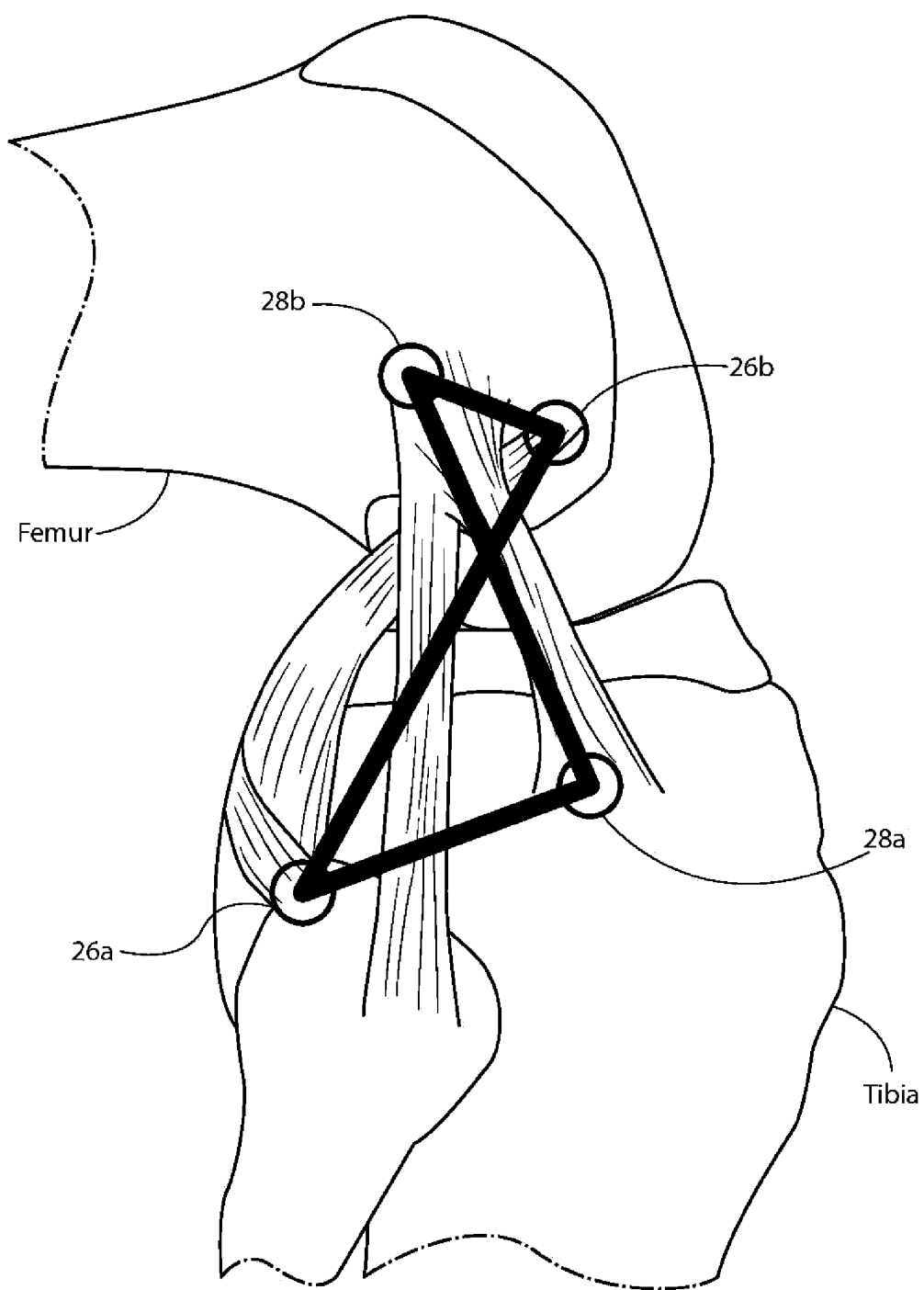


FIG. 4
(PRIOR ART)

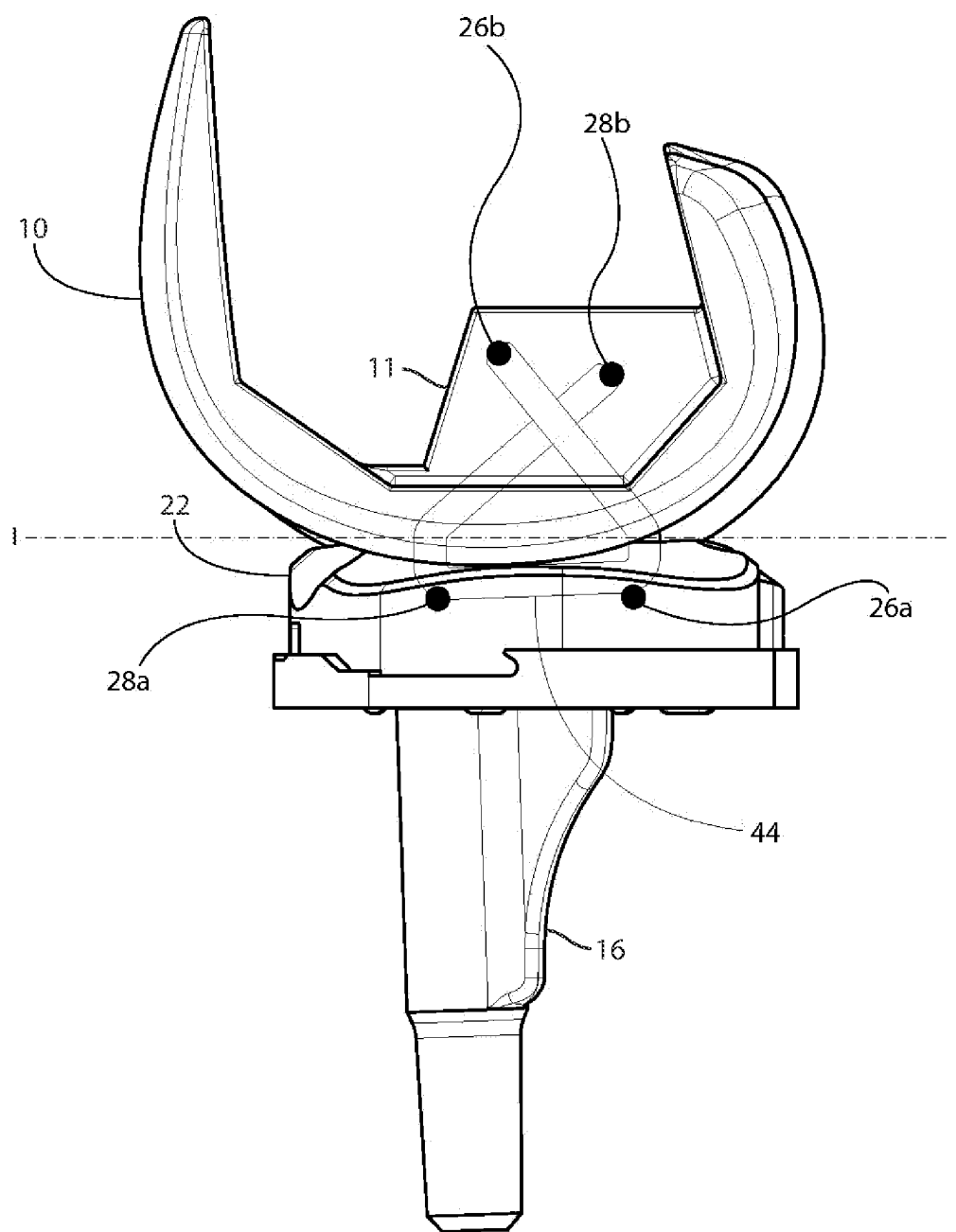


FIG. 5
(PRIOR ART)

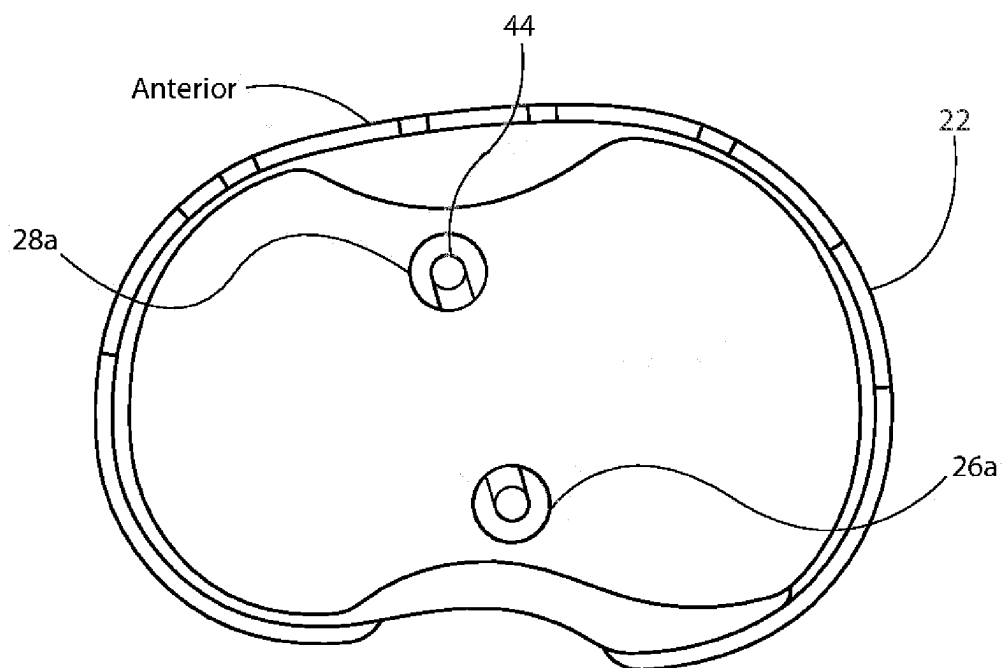


FIG. 6A
(PRIOR ART)

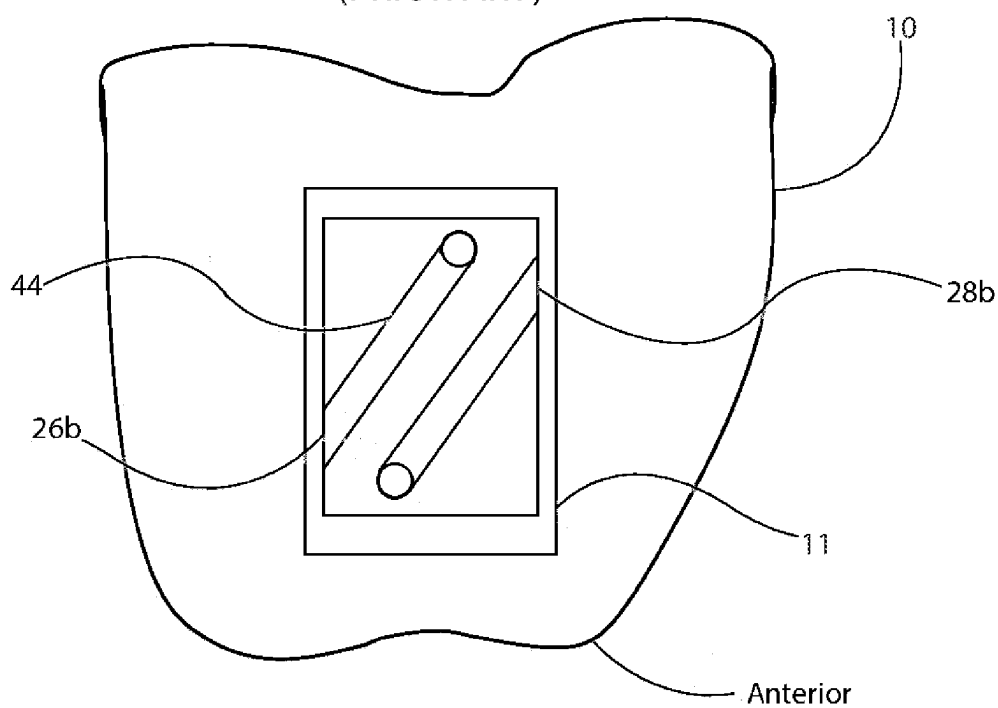
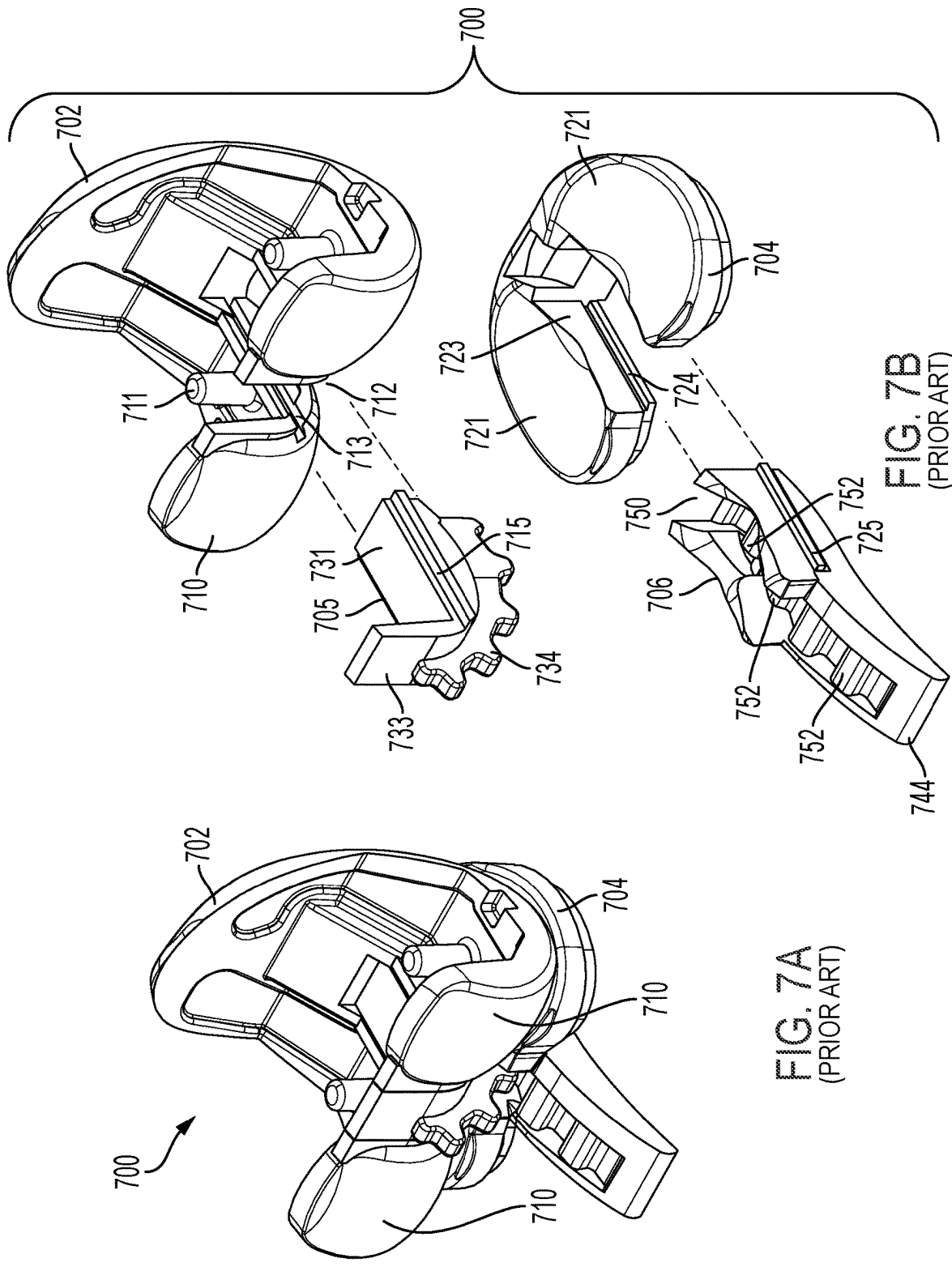


FIG. 6B
(PRIOR ART)



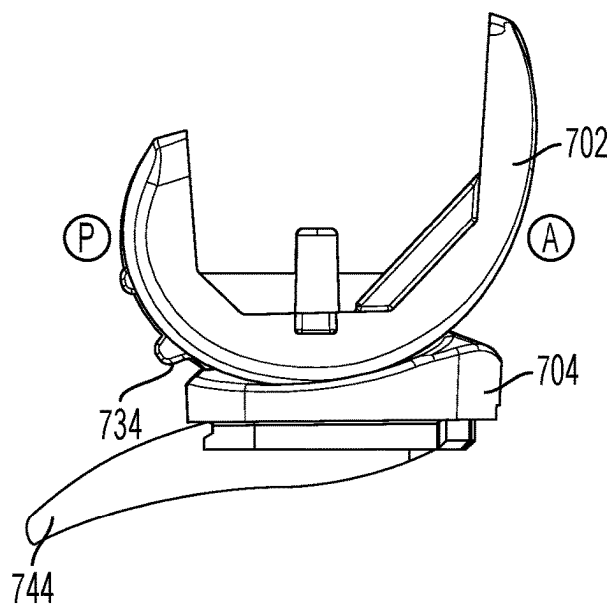


FIG. 7C
(PRIOR ART)

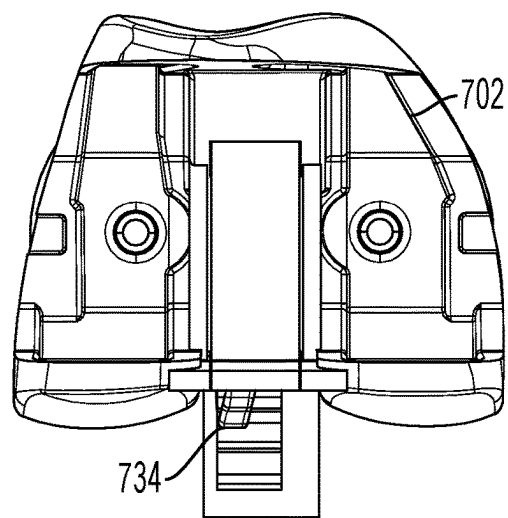


FIG. 7D
(PRIOR ART)

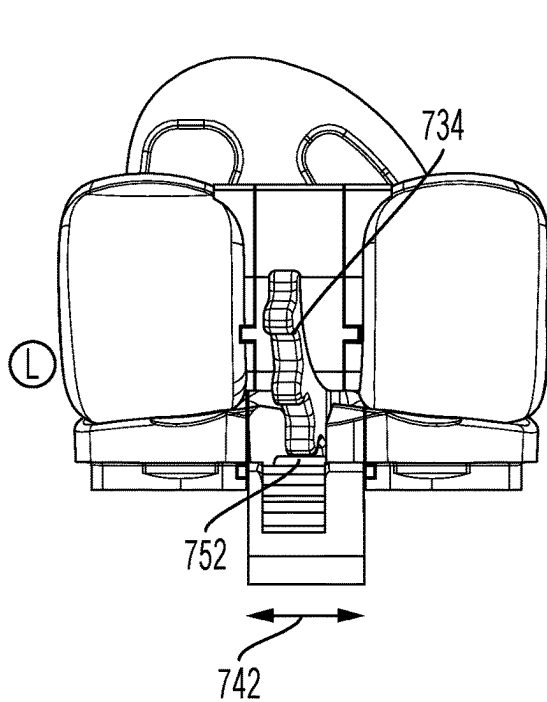


FIG. 7E
(PRIOR ART)

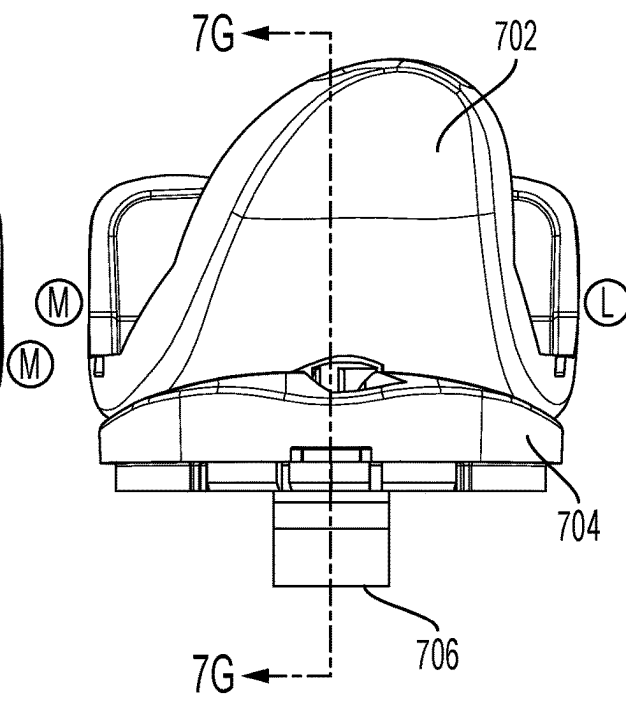


FIG. 7F
(PRIOR ART)

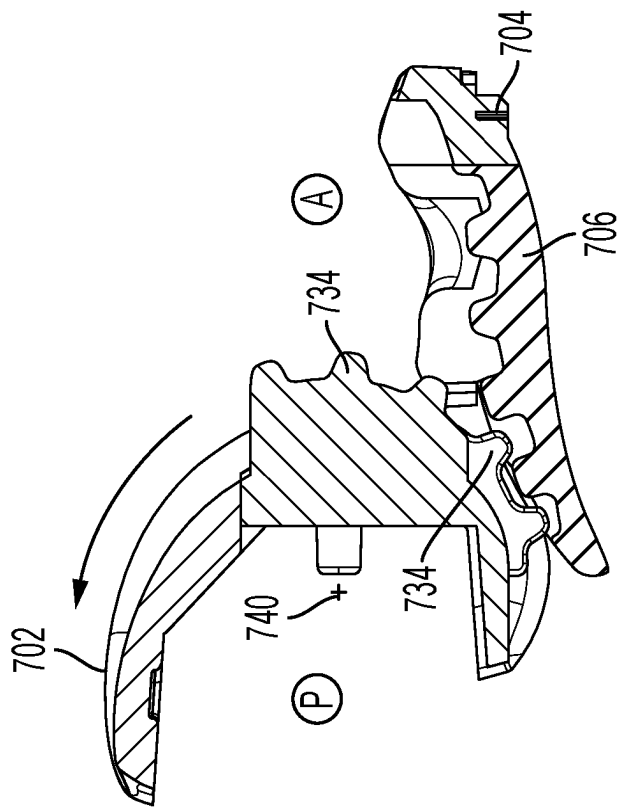


FIG. 7H
(PRIOR ART)

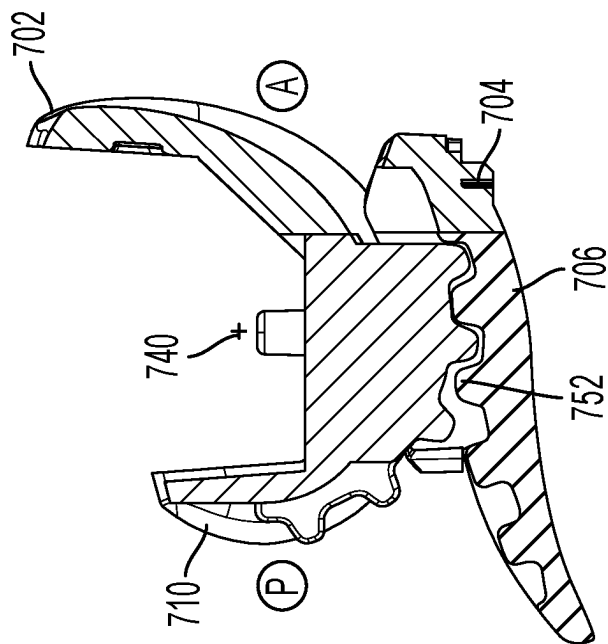


FIG. 7G
(PRIOR ART)

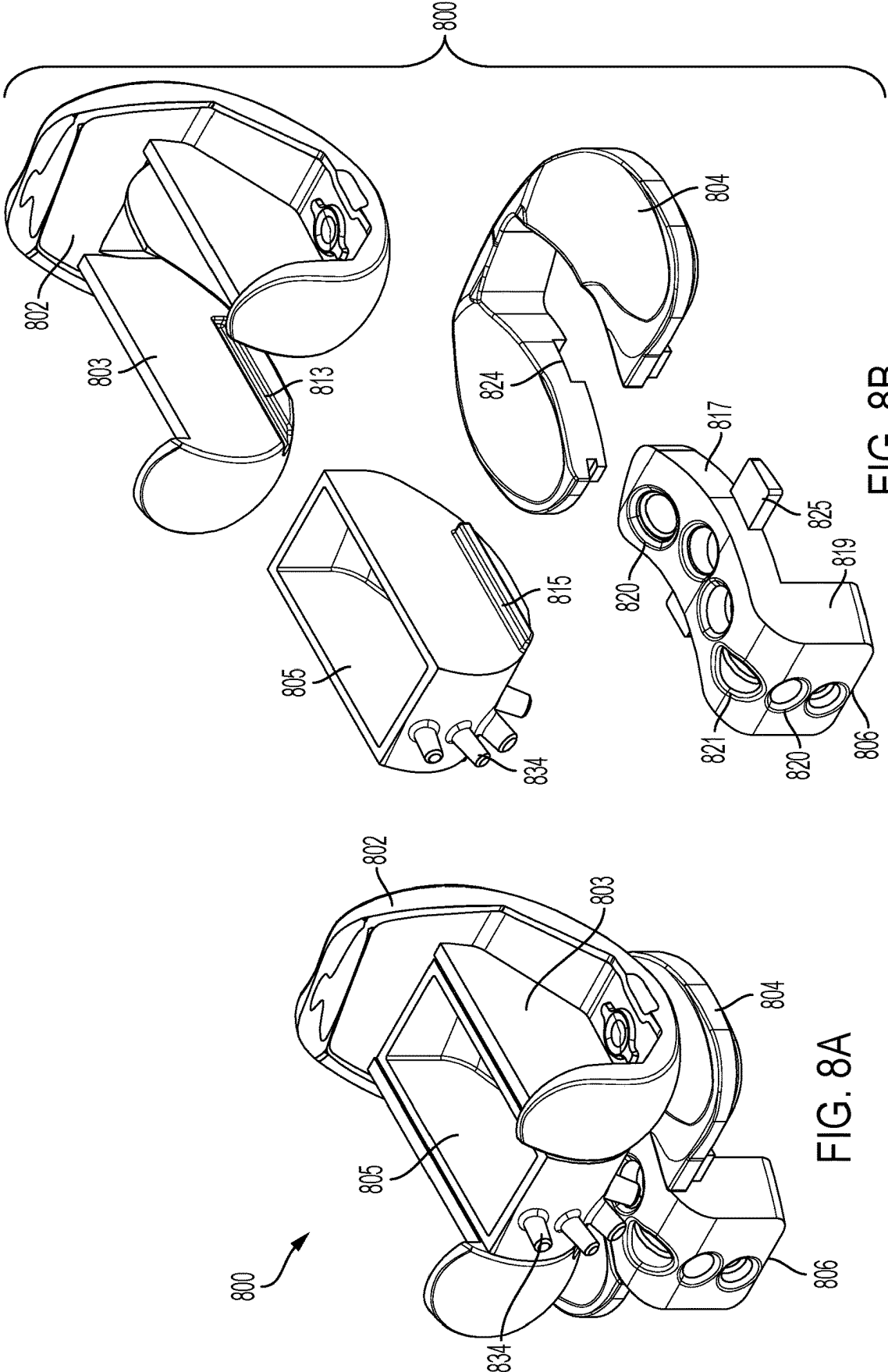


FIG. 8B

FIG. 8A

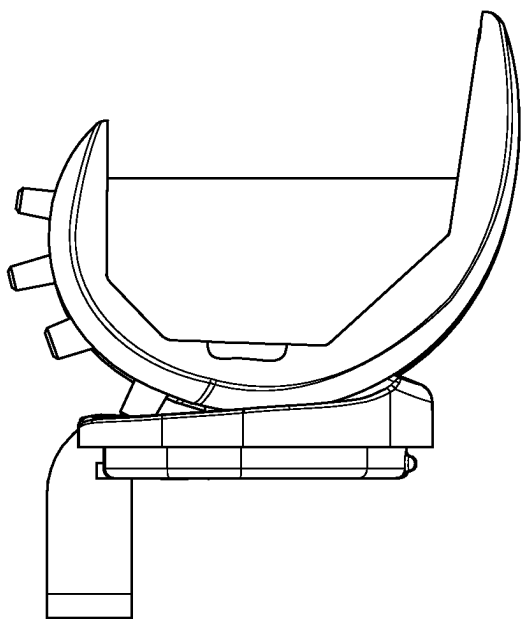


FIG. 8C

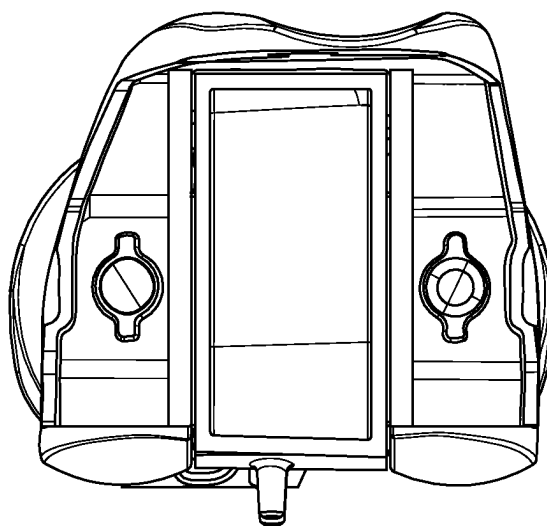


FIG. 8D

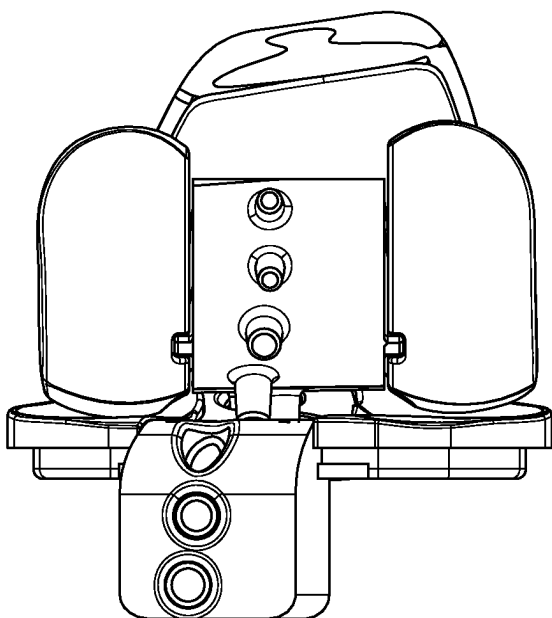


FIG. 8E

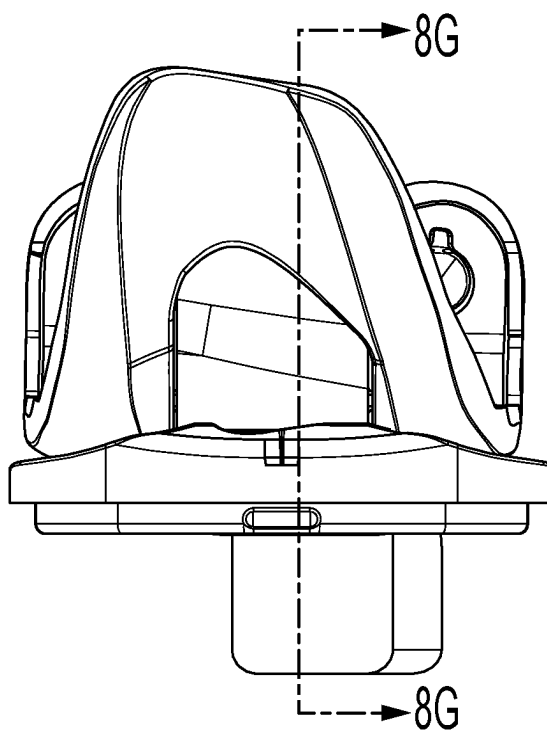


FIG. 8F

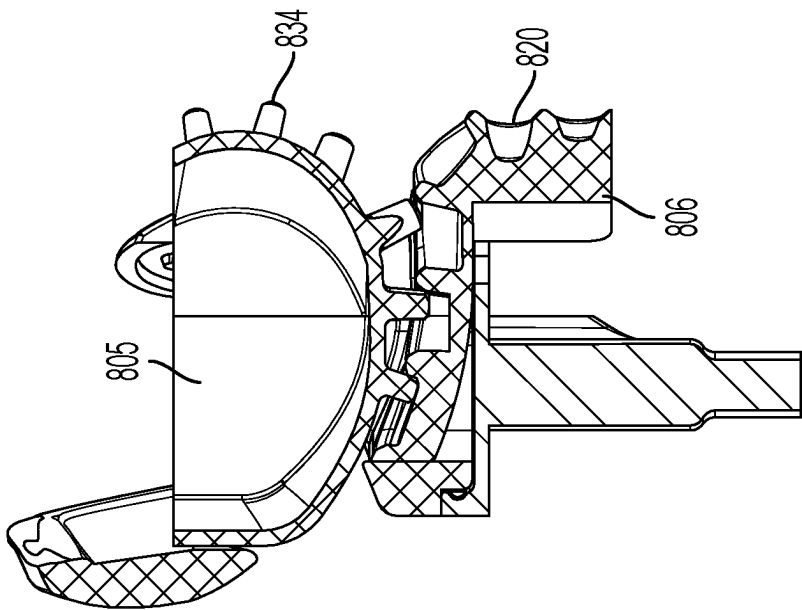


FIG. 8G

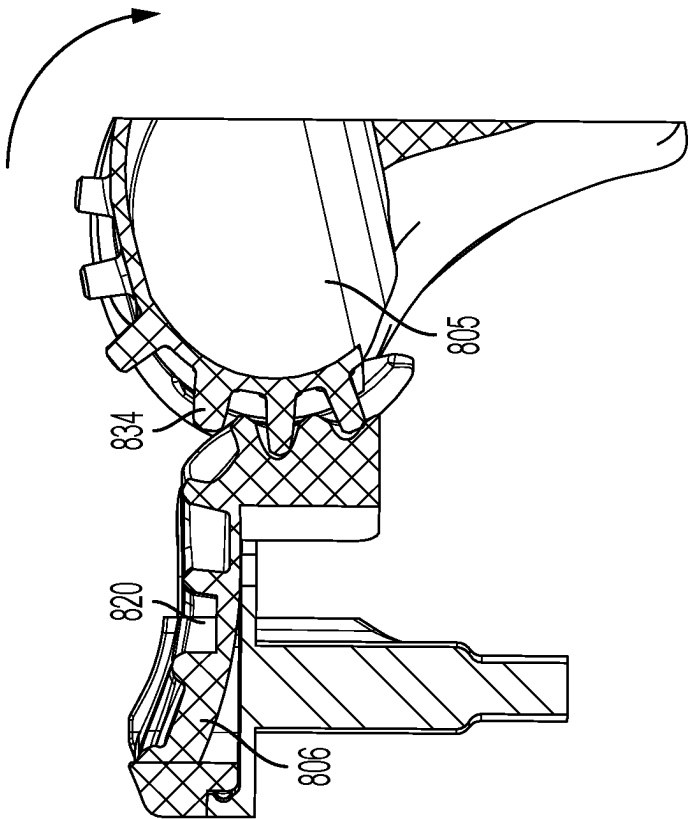


FIG. 8H

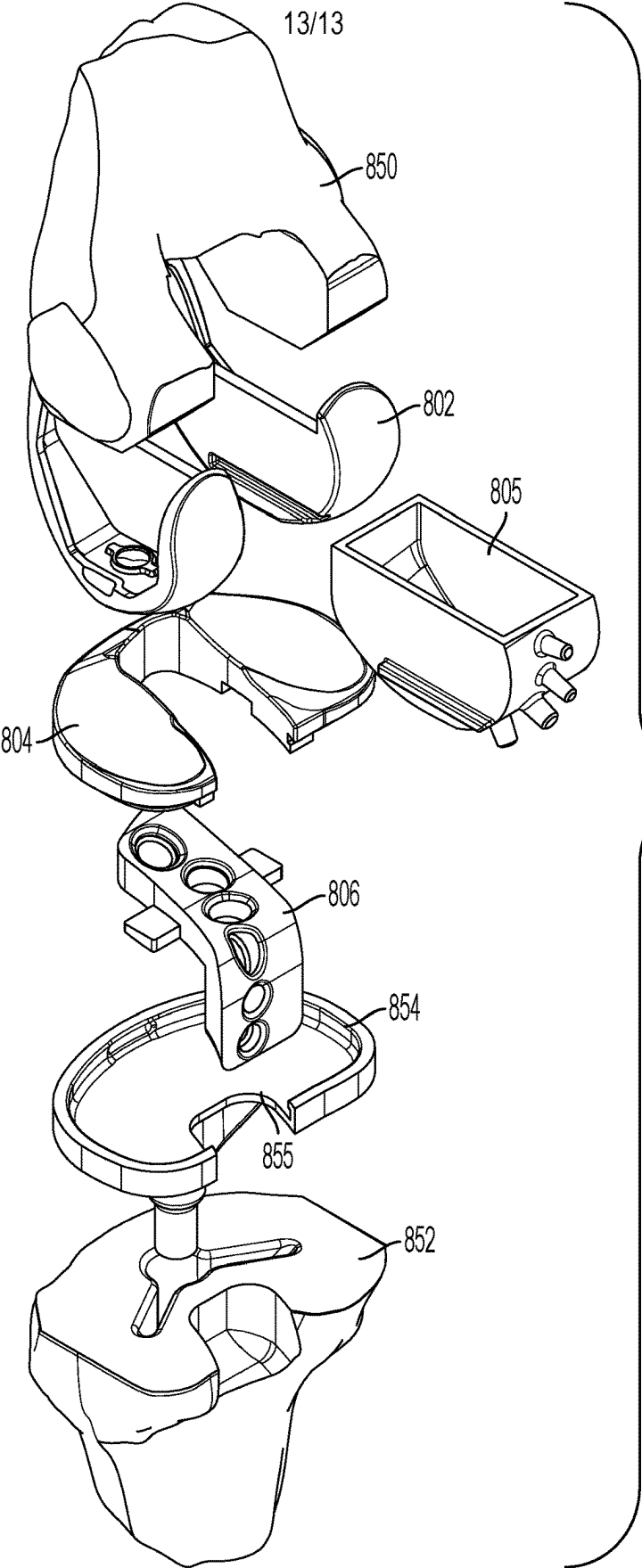


FIG. 8I

ARTIFICIAL KNEE SYSTEM HAVING A GEAR ARRANGEMENT

FIELD OF THE INVENTION

[0001] This invention relates generally to artificial knee prostheses used for Total Knee Replacement (TKR), and more particularly, to a knee joint prosthesis having an artificial anterior cruciate ligament (ACL) and/or posterior cruciate ligament (PCL).

BACKGROUND OF THE INVENTION

[0002] As is described in U.S. Patent App. Pub. No. 2017/0252173 to Garino, which is incorporated by reference herein in its entirety and for all purposes, prosthetic knees generally include three main components, a femoral component (FIGS. 1A and 1B), which is attached to the distal end of the femur, a tibial baseplate (FIGS. 2A and 2B), which is implanted onto the proximal end of the tibia, and an articular tibial insert (FIGS. 3A and 3B), which is mounted onto the tibial baseplate and provides a frictional surface for the femoral component. The components are designed to simulate a joint and the associated mechanics of a human knee throughout the knee's range of motion. The components are generally provided in a variety of shapes with varying dimensions (identified as dimensions A-H and J-T in FIGS. 1A to 3B), so that a physician is able to select the optimal combination of components depending on the specific anatomy of the patient. The size and shape of the knee is dependent on various factors including age, gender, and size of the patient. Therefore, a fairly large inventory of components are generally made available, so that the prosthetic knee may be tailored for the patient.

[0003] During the course of a routine knee construction with a TKR, the ACL is removed in a vast majority of all cases and depending on the selected TKR design, the patient's PCL is either retained or substituted with some mechanism to replace the lost function of the PCL. Even when the PCL is retained, often a portion of the PCL must be cut or partially cut during surgery to aid in the balancing of the knee replacement. When the PCL is completely removed, the PCL is substituted by a post and cam mechanism.

[0004] A TKR generally comprises a femoral component 10, a tibial baseplate 16 having a post 18 that is implanted within a bore formed in the tibia, and an articular insert 22 that resides on a top mounting portion 20 of the tibial baseplate 16 for interfacing with the femoral component 10. Articular insert 22 may be either separate from tibial baseplate 16, as shown, or integrated with tibial baseplate 16 into a single component. The articular insert 22 and tibial baseplate 16 may be referred to herein either together or individually as a "tibial component."

[0005] Referring to FIGS. 1A, 1B, 3A, and 3B, an illustration of a typical design of a post and cam mechanism is provided. An articular insert 22 includes an extension 24 that protrudes into an opening 12 of the femoral component 10. A box 11 having upwardly projecting walls is formed on the interior side of the femoral component 10 and includes an interior region that intersects the opening 12. The extension 24 includes a posterior surface 25 that is intended to be in frictional contact with the posterior surface 14 of the opening 12 when the joint is flexed. The resistance generated when the extension 24 bears against the posterior surface 14

of the opening 12 in the femoral component 10 is intended to simulate the resistance that would have been generated by a healthy posterior cruciate ligament (PCL).

[0006] Cam and post mechanisms have been manufactured that partially replace the function of an ACL by creating a cam surface between the anterior surface of the extension 24 and the anterior surface of the opening 12; however, this solution provides only a partial substitution of an ACL because the anterior side of the extension 24 is at best able to contact the anterior side of the opening only between 0 to 20 degrees of flexion.

[0007] The lack of an anatomically correct replacement may result in a TKR having reduced functionality as compared to the original knee. This may create difficulties during physical therapy following surgery, as well as limit the patient's ability or desire to participate in physical activity following therapy. Virtually all modern total knee replacements sacrifice the ACL or inadequately substitute it with a crude cam and post mechanism, thus leaving the reconstructed knee with kinematics similar to that of an ACL-deficient knee. Normal knee kinematics therefore remain elusive. In addition, the lack of proper interplay between an ACL and PCL (which together drive normal knee kinematics) leaves the TKR reconstruction short of producing a relatively normal knee for the patient.

[0008] Given the complexity of the mechanics of a knee joint and the difficulty for patients to adjust to an artificial knee after surgery, an anatomically correct knee replacement system is needed that more accurately simulates the resilience and support formerly provided by the removed ligaments. In order to provide a more anatomically correct TKR, prosthesis embodiments that replicate the function provided by both the ACL and PCL are desirable.

[0009] Referring now to FIG. 4, a healthy human knee is illustrated with a loop 30, representing an exemplary artificial ACL/PCL ligament, drawn over the location of the original anatomical ACL and PCL. The section of the loop 30 constituting the artificial PCL is bounded by points 26A and 26B. The section of the loop 30 constituting the artificial ACL is bounded by points 28A and 28B.

[0010] Referring now to FIGS. 5, 6A, and 6B illustrating an embodiment disclosed in U.S. Patent App. Pub. No. 2017/0252173 to Garino, the connection points 26a, 26b, 28a, and 28b of the artificial material, provided as ligament 44, and the lengths spanning between the connection points, provided as an outline of the artificial ligament 44, are configured to simulate the dimensions and attachment points of the ACL and PCL in a human knee, as illustrated in FIG. 4. At least one length of artificial ligament may be provided to connect the articular insert 22 and femoral component 10 of a TKR.

[0011] While U.S. Patent App. Pub. No. 2017/0252173 to Garino provides solutions to these complexities, developments in this area are continually sought in the interest of improving the mechanics of a knee joint.

SUMMARY OF THE INVENTION

[0012] In one embodiment of the present invention, a knee joint prosthesis is configured to move between an extended position and a flexion position. The prosthesis includes a femoral component configured to be mounted to a femur, the femoral component having a femoral gear including a plurality of conical shaped posts arranged along a helical trajectory. The prosthesis also includes a tibial component

configured to (i) be mounted either directly or indirectly to a tibia, and (ii) engage the femoral component. The tibial component has a tibial gear including a plurality of recesses that are configured to mesh with the conical shaped posts of the femoral gear. The tibial gear has two intersecting portions including a horizontally-oriented curved portion and a vertical portion, wherein each portion includes at least one of the recesses. The plurality of conical shaped posts follow a helical trajectory to cause movement of the tibial component in either a medial or lateral direction as the knee joint prosthesis is moved to the extended position.

BRIEF DESCRIPTION OF THE FIGURES

[0013] FIG. 1A is a side view of a femoral component for a knee joint prosthesis known by those of ordinary skill in the art.

[0014] FIG. 1B is a bottom view of the femoral component of FIG. 1A.

[0015] FIG. 2A is a top view of a tibial component for a knee joint prosthesis known by those of ordinary skill in the art.

[0016] FIG. 2B is a side view of the tibial component of FIG. 2A.

[0017] FIG. 3A is a top view of an articular insert for a knee joint prosthesis known by those of ordinary skill in the art.

[0018] FIG. 3B is a front view of the articular insert of FIG. 3B mounted on the baseplate of a tibial component.

[0019] FIG. 4 is a side view of a knee joint illustrating the anatomical location of the ACL and PCL and the configuration of an artificial material intended to replace the ACL and PCL.

[0020] FIG. 5 is a side view of a femoral component, articular insert, and artificial ligament for a TKR according to the prior art.

[0021] FIG. 6A is a top view of a cross-section along line I-I of FIG. 5.

[0022] FIG. 6B is a bottom view of a cross-section along line I-I of FIG. 5.

[0023] FIG. 7A is an assembled view of a modular knee joint prosthesis as viewed from the top, left and posterior sides, and according to a first example.

[0024] FIG. 7B is an exploded view of the modular knee joint prosthesis of FIG. 7A.

[0025] FIGS. 7C-7F depict side elevation, top plan, rear/posterior elevation and front/anterior elevation views, respectively, of the modular knee joint prosthesis of FIG. 7A.

[0026] FIG. 7G depicts a cross-sectional view of the modular knee joint prosthesis of FIG. 7F taken along the lines 7G-7G, wherein the modular knee joint prosthesis is shown in an extended position.

[0027] FIG. 7H depicts another cross-sectional view of the modular knee joint prosthesis like FIG. 7G, but with the modular knee joint prosthesis shown in a flexion position.

[0028] FIG. 8A is an assembled view of a modular knee joint prosthesis according to a second example.

[0029] FIG. 8B is an exploded view of the modular knee joint prosthesis of FIG. 8A.

[0030] FIGS. 8C-8F depict side elevation, top plan, rear elevation and front elevation views, respectively, of the modular knee joint prosthesis of FIG. 8A.

[0031] FIG. 8G depicts a cross-sectional view of the modular knee joint prosthesis of FIG. 8F taken along the

lines 8G-8G, wherein the modular knee joint prosthesis is shown in an extended position.

[0032] FIG. 8H depicts another cross-sectional view of the modular knee joint prosthesis like FIG. 8G, but with the modular knee joint prosthesis shown in a flexion position.

[0033] FIG. 8I depicts an exploded view of the modular knee joint prosthesis of FIG. 8A in addition to a femoral bone, a tibial bone and a tibial baseplate.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0034] The present invention provides various embodiments of a knee joint prosthesis. In the figures, 'A' represents the anterior side or direction, 'P' represents the posterior side or direction, 'M' represents the medial side or direction, and 'L' represents the lateral side or direction.

[0035] As is described in U.S. Pat. No. 11,419,731 to Garino, FIGS. 7A-7H depict a modular knee joint prosthesis 700 according to a first example. Although a prosthesis 700 for a left knee is shown and described hereinafter it should be understood that the right knee prosthesis is substantially similar and the explanation that follows also applies to the right knee prosthesis.

[0036] Prosthesis 700 generally comprises a modular femoral component 702, a femoral insert 705 that is configured to be mounted to the femoral component 702, a modular articular component 704, and a tibial insert 706 that is configured to be mounted to the articular component 704.

[0037] Modular femoral component 702 includes a U-shaped body having opposing condyles 710. Pins 711 extend upwardly from the inside surface of component 702 for implantation of femoral component 702 into a femur bone, as is known in the art. A rectangular cutout 712 is defined in the femoral component 702 at a central location between the condyles 710. Cutout 712 extends in the posterior-anterior direction and in the sagittal plane. Cutout 712 includes an opening at the posterior side of component 702. Cutout 712 extends through the entire wall thickness of component 702. Cutout 712 includes three interconnected and interior facing sides, namely, a lateral side extending in the sagittal plane, a medial side extending in the sagittal plane, and an anterior side that connects the lateral and medial sides. The posterior side of cutout 712 is open for receiving the insert 705.

[0038] A relief is formed on each of the opposing medial and lateral sides of cutout 712. Together the reliefs form a slot or track 713 that is configured to receive rails 715 (i.e., shoulders) formed on opposing sides of femoral insert 705 such that insert 705 can be installed on component 702. It should be understood that track 713 may be disposed on insert 705 and rails 715 may be disposed on component 702 to achieve either the same or a similar result.

[0039] It should be understood that means for mounting insert 705 to component 702, other than the tracks 713 and rails 715, may be provided. The means for mounting may alternatively comprise a slot, guide, rail, snap feature, friction fit, interference fit, fastener (screw, bolt, nut), weld, adhesive, dovetail (or other mating surface).

[0040] Modular articular component 704 is configured to reside on a top mounting portion of a tibial component (not shown) for interfacing with femoral component 702. Articular component 704 is configured to be mounted to the tibial baseplate 16 (see FIGS. 2B and 5) that is fixedly mounted to the tibia. Alternatively, and although not shown, articular

component **704** may be integrated with the tibial baseplate **16** to form a single unitary tibial component that is fixedly mounted to the tibia. Thus, a “tibial component” may comprise either articular component **704** (alone) or both articular component **704** and tibial baseplate **16**.

[0041] Articular component **704** includes two concave surfaces **721** for physically engaging with the convexly shaped condyles **710** of femoral component **702** as prosthesis **700** is moved between the flexion and extension positions. A rectangular cutout **723** is defined in the articular component **704** at a central location between the concave surfaces **721**. Cutout **723** extends in the posterior-anterior direction and in the sagittal plane. Cutout **723** includes an opening at the posterior side of articular component **704**. Cutout **723** extends through the wall thickness of articular component **704**. Cutout **723** includes three interconnected and interior facing sides, namely, a lateral side extending in the sagittal plane, a medial side extending in the sagittal plane, and an anterior side that connects the lateral and medial sides. A relief is formed on each of the opposing medial and lateral sides of cutout **723**. Together the reliefs form a slot or track **724** that is configured to receive rails **725** (shoulders) formed on opposing sides of tibial insert **706** such that insert **706** can be installed on articular component **704** by sliding rails **725** along tracks **724**. It should be understood that track **724** may be disposed on insert **706** while rails **725** may be disposed on articular component **704** to achieve either the same or a similar result.

[0042] It should be understood that means for mounting insert **706** to articular component **704**, other than the tracks **724** and rails **725**, may be provided. The means for mounting may alternatively comprise a slot, guide, rail, snap feature, friction fit, interference fit, fastener (screw, bolt, nut), weld, adhesive, dovetail (or other mating surface).

[0043] Femoral component **702** and articular component **704** are modular components that are common amongst the first through fourth embodiments. Femoral component **702** and articular component **704** may together form a modular sub-assembly.

[0044] Turning now to the components that are capable of being selectively installed on those modular components **702** and **704**, femoral insert **705** is configured to be mounted to femoral component **702**, and tibial insert **706** is configured to be mounted to articular component **704** (otherwise referred to tibial component **704**). Femoral and tibial inserts **705** and **706** work together to guide motion of the prosthesis **700** between the flexion and extension positions shown in FIGS. 7G and 7H.

[0045] Femoral insert **705** comprises an L-shaped body. The body defines an elongated horizontal portion **731** on which rails **715** protrude from the opposing side surfaces thereof. The horizontal portion **731** is sized to fit snugly within cutout **712** of femoral component **702**. A vertical portion **733** of the body extends orthogonally from the horizontal portion **731**. In an assembled form, the vertical portion **733** sits flush with and bridges the condyles **710** of femoral component **702**. Vertical portion **733** also serves as a finger tab for ease of manual insertion and/or removal of the insert **705** onto/from the femoral component **702**. Femoral insert **705** may be either releasably or non-releasably connected to femoral component **702**.

[0046] A gear **734**, in the form of a convex surface, protrudes outwardly from the front and rear exterior facing surfaces of the L-shaped body of insert **705**. Gear **734**

comprises a plurality of individual gear teeth having rounded outer surfaces. The gear teeth are uniformly spaced apart along the outer perimeter of gear **734**. Gear **734** follows a helical path, as can be viewed in FIGS. 7D and 7E. Specifically, gear **734** curves about (i) its own axis **740** (FIGS. 7G and 7H) extending in the medial-lateral direction and (ii) an axis that extends in the anterior-posterior direction (see FIG. 7E). Stated differently, gear **734** curves along two different axes that are oriented orthogonal to each other. Gear **734** resides on the front and rear surfaces of the L-shaped body, whereas the rails **715** are disposed on the left and right sides of the body, and the top and rear facing surfaces are planar. Femoral insert **705** may be a unitary, monolithic component.

[0047] Tibial insert **706** comprises an elongated rectangular body. Rails **725** extend in the anterior-posterior direction and protrude from the opposing side surfaces of the body. Rails **725** are sized to fit within the track **724** formed on articular component **704**, as described above, such that rails **725** slide in their corresponding tracks **724**. A finger tab **744** is defined on the lower posterior edge of insert **706** to ease manual handling of insert **706**. Tibial insert **706** may be either releasably or non-releasably connected to articular component **704**.

[0048] A curved channel **750** extends in the anterior-posterior direction through the body of the insert **706**. The channel **750** has opposing curved sidewalls that face each other. The channel **750** curves about a vertical axis (in the superior-inferior direction or along the sagittal plane), as shown in FIG. 7B, for example. The base surface of the channel **750** has a series of gear teeth **752** extending upwards therefrom for meshing with the teeth of gear **734**. The base surface may be flat (with the exception of the teeth **752**), or the base surface may be curved about axis **740** (FIG. 7H). Insert **706** may be a unitary, monolithic component.

[0049] Turning now to FIGS. 7G and 7H, the gear teeth **752** on the articular component **704** are meshed with the gear teeth **734** of the femoral component **702**, such that the articular component **704** rotates on the femoral component **702**, or vice versa. As the femoral component **702** rotates in a posterior direction to the flexion position shown in FIG. 7H (as designated by the arrow), the meshing teeth do not slide past one another. The slight rotation of the articular component **704** in the medial-lateral direction as the prosthesis **700** is moved between the flexion and extension positions, as a result of the curvature of gear teeth **734** in the medial lateral direction, mimics the slight rotation experienced in a real knee joint.

[0050] FIGS. 8A-8H depict a modular knee joint prosthesis **800** according to a second example. It should be understood that prosthesis **800** is similar to prosthesis **700** and only the primary differences therebetween will be described hereinafter. Thus, the details provided above with respect to prosthesis **700** also apply to prosthesis **800**, unless explained otherwise hereinafter.

[0051] Prosthesis **800** includes femoral component **802**, articular component **804**, femoral insert **805** (also referred to herein as a femoral gear), and a tibial insert **806** (also referred to herein as a tibial gear). FIG. 8I depicts an exploded view of the prosthesis **800** in addition to a femoral bone **850**, a tibial bone **852** and a tibial baseplate **854** (like baseplate **16**) for use with prosthesis **800**. Tibial baseplate **854** may also be considered as forming part of prosthesis **800**.

[0052] Femoral component **802** is similar to femoral component **702** with the exception that it includes vertical side walls **803** extending above the tracks **813**. Articular component **804** is also similar to articular component **704** with the exception that it includes a rectangular recess **824** on the bottom surface in lieu of a track (like track **724**). In assembled form, opposing tabs **825** on tibial insert **806**, which extend in the lateral-medial direction, are inserted into recess **824**, thereby captivating articular component **804** to tibial insert **806**.

[0053] Turning now to femoral insert **805**, insert **805** includes a hollow half-cylinder shaped body. Rails **815** extending in the posterior-anterior direction are disposed on opposing planar side walls of the body for engaging in tracks **813** of femoral component **802**. In an assembled form, the planar side walls of the body are both supported and constrained in the medial-lateral direction by the side walls **803** of femoral component **802**, as shown in FIG. 8A. A series of gear teeth in the form of pegs **834** are disposed on the rounded posterior face of insert **805**. Each peg **834** has a frusto-conical shape, as shown. Alternatively, each peg **834** could have cylindrical, triangular, conical, rectangular or trapezoidal shape (as viewed in cross-section, for example). The free end surface of such a cylindrically shaped peg could be flat or rounded. However, it was discovered that the frusto-conical shaped pegs **834** performed particularly well during testing in the way of smooth movement. Pegs **834** may be arranged along a helical path, as shown in FIG. 8E, to mimic motion of the knee (as was described above with reference to prosthesis **700**). The helical path is curved to drive rotation around the medial condyle forcing more translation of the lateral condyle as the knee is flexed. Alternatively, pegs **834** may be arranged along a straight path.

[0054] Pegs **834** may be evenly spaced apart in a uniform manner, or unevenly spaced apart. For example, to enhance stability of the prosthesis, adjacent pegs **834** that are active (i.e., meshed) in the deep flexion position (FIG. 8H) of prosthesis **800** may be positioned closer together than the adjacent pegs **834** that are active in the extension position (FIG. 8G) of prosthesis **800**. Also, the protruding length, thickness, width, etc. of each peg **834** may be either uniform or non-uniform. Specifically, adjacent pegs **834** that are active (i.e., meshed) in the deep flexion position (FIG. 8H) of prosthesis **800** may have a different protruding length, thickness, width, etc. than the adjacent pegs **834** that are active in the extension position (FIG. 8G) of prosthesis **800**.

[0055] Turning now to tibial insert **806**, insert **806** includes a substantially L-shaped body including a horizontally-oriented curved portion **817** and a substantially vertical portion **819**. The curvature of the horizontally-oriented curved portion **817** may match the curvature of the curved surface of femoral insert **805**. The vertical portion **819** extends downwardly. The vertical portion **819** is provided such that the femoral insert can engage the tibial insert at a position that is far posterior and even slightly down the back of the tibia in the deep flexion state shown in FIG. 8H.

[0056] In an assembled state, the vertical portion **819** passes through a rectangular channel **855** (FIG. 8I) formed in tibial baseplate **854**. A series of concave recesses **820** are formed on the exterior surface of insert **806**. The outer perimeter of each recess **820** is substantially circular with the exception of recess **821**, which has a teardrop shaped outer perimeter. The perimeter shape of recess **821** may also

be described as elliptical. Recess **821** is formed at the intersection of portions **817** and **819**. Recesses **820/821** may be arranged along a helical path, as shown in FIGS. 8B and 8E, to mimic motion of the knee (as was described above). Alternatively, recesses **820/821** may be arranged along a straight path. Although the circular/elliptical shape of recesses has been found to yield smooth kinematics for the prosthesis **800**, it should be understood that the outer perimeter of recesses **820/821** can vary and may take a rectangular, triangular or trapezoidal shape, for example.

[0057] It should be understood that the arrangement of the pegs and recesses may be reversed. In other words, the pegs **834** may be disposed on the tibial insert **806** and the recesses **820** may be disposed on the femoral insert **805**.

[0058] Prosthesis **800** includes access openings in the tibial and femoral components like those openings represented by items **712** and **723**, which enable a surgeon to access an intramedullary rod in the case of fracture.

[0059] Although the femoral insert **805** is shown as a separate component, it may be formed as a unitary component along with the femoral component **802**. Similarly, although the tibial insert **806** is shown as a separate component, it may be formed as a unitary component along with either the articular component **804** or the tibial baseplate **854**.

[0060] The geometries of the femoral inserts and tibial inserts can vary. A plurality of different femoral inserts and tibial inserts can be provided with one femoral component **802** and one articular component **804** as a kit, if so desired. In use, different femoral and tibial inserts may be selected by the surgeon based upon various factors including age, gender, ailments, and size of the patient, for example.

[0061] The components of the knee joint prosthesis may be made of the same or similar material. In general, however, all materials are preferably inert, not prone to cause infection, and otherwise safe and approved for use as a surgical implant. Exemplary materials include polyethylene, surgically approved metal alloys, surgically approved ceramic materials, or a combination thereof. Any well-known materials in the field of surgical implants may be used to fabricate any of the various embodiments or portions thereof according to the present invention.

[0062] While preferred embodiments of the invention have been shown and described herein, it will be understood that such embodiments are provided by way of example only. Numerous variations, changes, and substitutions may occur to those skilled in the art without departing from the spirit of the invention. Accordingly, it is intended that the appended claims cover all such variations that fall within the spirit and scope of the invention.

I claim:

1. A knee joint prosthesis configured to move between an extended position and a flexion position, the modular knee joint prosthesis comprising:

- a femoral component configured to be mounted to a femur, the femoral component having a femoral gear including a plurality of posts arranged along a helical trajectory; and
- a tibial component configured to (i) be mounted either directly or indirectly to a tibia, and (ii) engage the femoral component, the tibial component having a tibial gear including a plurality of recesses that are configured to mesh with the posts of the femoral gear, wherein the tibial gear has two intersecting portions

including a horizontally-oriented curved portion and a vertical portion, wherein each portion includes at least one of the recesses,

wherein the plurality of posts follow a helical trajectory to cause movement of the tibial component in either a medial or lateral direction as the knee joint prosthesis is moved to the extended position.

2. The knee joint prosthesis of claim 1, wherein the femoral and tibial gears are configured to be meshed together in both the extended and flexion positions.

3. The knee joint prosthesis of claim 1, wherein the plurality of recesses also follow a helical trajectory to cause movement of the tibial component in either the medial or lateral direction as the knee joint prosthesis is moved to the extended position.

4. The knee joint prosthesis of claim 1, wherein the knee joint prosthesis is a modular knee joint prosthesis, wherein the femoral gear is a femoral insert that is removably mounted in a first cutout or opening that is defined in a central region of the femoral component, and wherein the tibial gear is a tibial insert that is removably mounted in a second cutout or opening that is defined in a central region of the tibial component.

5. The knee joint prosthesis of claim 4, wherein the femoral insert is removably mounted within the first cutout or opening of the femoral component by a rail and slot engagement.

6. A kit comprising the knee joint prosthesis of claim 4, a plurality of different femoral gears and a plurality of different tibial gears.

7. The knee joint prosthesis of claim 1, wherein the femoral gear and the femoral component are formed as one unitary component.

8. The knee joint prosthesis of claim 1, wherein the tibial gear and the tibial component are formed as one unitary component.

9. The knee joint prosthesis of claim 1, wherein the tibial component is an articular component having concave bearing surfaces shaped to engage condyles on the femoral component.

10. The knee joint prosthesis of claim 1, wherein the tibial component is a tibial baseplate that is configured to be directly mounted to a tibial bone.

11. The knee joint prosthesis of claim 1, wherein the femoral component comprises opposing condyles, and the femoral and tibial gears are positioned in the medial-lateral direction at a location between the opposing condyles.

12. The knee joint prosthesis of claim 1, wherein the posts each have a conical or frusto-conical shape.

13. The knee joint prosthesis of claim 1, wherein the posts have different shapes and the recesses have different shapes.

14. The knee joint prosthesis of claim 1, wherein the posts are non-uniformly spaced apart.

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