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Goble et al.

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(54) IMPLANTS AND RELATED METHODS AND APPARATUS FOR SECURING AN IMPLANT ON AN ARTICULATING SURFACE OF AN ORTHOPEDIC JOINT

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(73) Assignee: **Zimmer, Inc.**, Warsaw, IN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 922 days.

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(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation-in-part of application No. 10/749,346, filed on Dec. 30, 2003, now Pat. No. 7,771,483, and a continuation-in-part of application No. 10/444,927, filed on May 23, 2003, now Pat. No. 7,615,081.

(60) Provisional application No. 60/383,348, filed on May 24, 2002.

(51) **Int. Cl.**
A61F 2/30 (2006.01)

(52) **U.S. Cl.** **623/23.46**

(58) **Field of Classification Search** 623/20.14, 623/20.15, 20.21, 20.31, 20.32, 20.34, 23.44, 623/23.45, 23.46, 23.47
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,748,662	A	7/1973	Helfet	
4,000,525	A *	1/1977	Klawitter et al.	623/20.32
4,224,696	A	9/1980	Murray et al.	
4,479,271	A	10/1984	Bolesky et al.	
4,502,161	A	3/1985	Wall	
4,627,853	A	12/1986	Campbell et al.	
4,657,549	A	4/1987	Keller	
4,673,407	A	6/1987	Martin	

(Continued)

FOREIGN PATENT DOCUMENTS

DE 3 917 285 11/1990

(Continued)

OTHER PUBLICATIONS

Office Action mailed Apr. 9, 2009 in related Canadian application No. 2,490,673.*

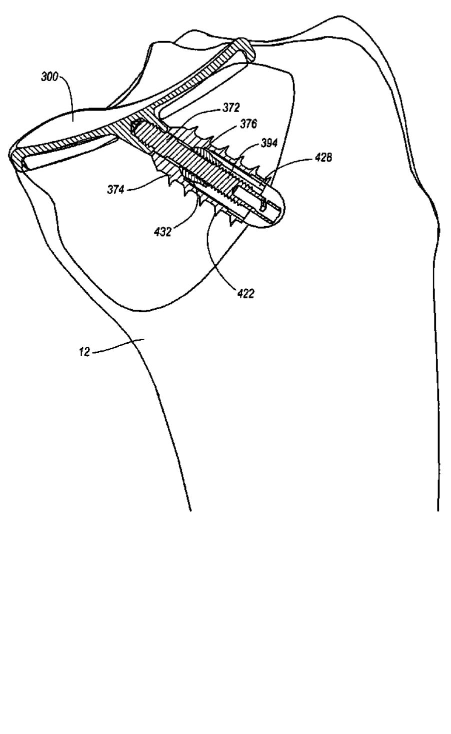
(Continued)

Primary Examiner — Eduardo C Robert
Assistant Examiner — David Comstock
(74) *Attorney, Agent, or Firm* — Baker & Daniels LLP

(57) **ABSTRACT**

A method for mounting an implant at an orthopedic joint includes forming a tunnel through a bone, the tunnel having an open second end on a natural or resected articulating surface of the bone and an open first end at a location on the bone spaced apart from the natural or resected articulating surface. A fastener is advanced into the tunnel from the first end of the tunnel. The fastener, which is at least partially disposed within the tunnel, is then secured to the implant which is disposed over the second end of the tunnel.

43 Claims, 39 Drawing Sheets



U.S. PATENT DOCUMENTS

4,838,891	A	6/1989	Branemark et al.	
4,919,671	A	4/1990	Karpf	
4,927,421	A	5/1990	Goble et al.	
4,950,270	A	8/1990	Bowman et al.	
4,963,153	A	10/1990	Noesberger et al.	
4,964,868	A	10/1990	Bloebaum	
5,019,103	A	5/1991	Van Zile et al.	
5,035,699	A	7/1991	Coates	
5,037,439	A	8/1991	Albrektsson et al.	
5,092,895	A	3/1992	Albrektsson et al.	
5,100,409	A	3/1992	Coates et al.	
5,176,684	A	1/1993	Ferrante et al.	
5,180,383	A	1/1993	Haydon	
5,258,015	A	11/1993	Li et al.	
5,282,868	A	2/1994	Bahler	
5,346,496	A	9/1994	Pennig	
5,474,559	A	12/1995	Bertin et al.	
5,489,311	A	2/1996	Cipolletti	
5,507,812	A	4/1996	Moore	
5,549,683	A	8/1996	Bonutti	
5,569,259	A	10/1996	Ferrante et al.	
5,571,196	A	11/1996	Stein	
5,571,203	A *	11/1996	Masini	623/22.46
5,593,411	A	1/1997	Stalcup et al.	
5,634,927	A	6/1997	Houston et al.	
5,674,224	A	10/1997	Howell et al.	
5,702,397	A	12/1997	Goble et al.	
5,702,459	A	12/1997	Hummer et al.	
5,709,689	A	1/1998	Ferrante et al.	
5,741,262	A	4/1998	Albrektsson et al.	
5,743,915	A	4/1998	Bertin et al.	
5,746,771	A	5/1998	Clement, Jr. et al.	
5,755,800	A	5/1998	O'Neil et al.	
5,755,803	A	5/1998	Haines et al.	
5,766,255	A	6/1998	Slamin et al.	
5,769,855	A	6/1998	Bertin et al.	
5,776,201	A	7/1998	Colleran et al.	
5,782,924	A	7/1998	Johnson	
5,800,553	A	9/1998	Albrektsson et al.	
5,824,098	A	10/1998	Stein	
5,860,981	A	1/1999	Bertin et al.	
5,879,391	A	3/1999	Slamin	
5,885,035	A	3/1999	Hoffschneider	
5,968,045	A	10/1999	Frazier	
6,068,648	A	5/2000	Cole et al.	
6,071,311	A	6/2000	O'Neil et al.	
6,102,954	A	8/2000	Albrektsson et al.	
6,132,468	A	10/2000	Mansmann	
6,162,234	A	12/2000	Freedland et al.	
6,168,629	B1	1/2001	Timoteo	
6,171,342	B1	1/2001	O'Neil et al.	
6,245,110	B1	6/2001	Grundei et al.	
6,299,645	B1	10/2001	Ogden	
6,319,271	B1	11/2001	Schwartz et al.	
6,368,326	B1	4/2002	Dakin et al.	
6,436,101	B1	8/2002	Hamada	
6,461,373	B2	10/2002	Wyman et al.	
6,508,841	B2	1/2003	Martin et al.	
6,520,964	B2	2/2003	Tallarida et al.	
6,544,267	B1	4/2003	Cole et al.	
6,554,838	B2	4/2003	McGovern et al.	
6,610,067	B2	8/2003	Tallarida et al.	
6,652,587	B2	11/2003	Felt et al.	
6,679,917	B2	1/2004	Ek	
6,736,819	B2	5/2004	Tiirneni	
6,773,461	B2	8/2004	Meyers	
6,866,683	B2	3/2005	Gerbec et al.	
6,905,514	B2	6/2005	Carignan et al.	
6,969,393	B2	11/2005	Pinczewski et al.	
6,994,725	B1	2/2006	Goble	
7,150,761	B2	12/2006	Justin et al.	
7,250,061	B2	7/2007	Jacobsson et al.	
2002/0019637	A1	2/2002	Frey et al.	
2002/0055783	A1	5/2002	Tallarida et al.	
2002/0107520	A1	8/2002	Hoffman	
2002/0138150	A1	9/2002	Leclercq	
2002/0147498	A1	10/2002	Tallarida et al.	
2002/0198528	A1	12/2002	Engh et al.	
2003/0033018	A1	1/2003	Stolowitz et al.	
2003/0060887	A1	3/2003	Ek	
2003/0120276	A1	6/2003	Tallarida et al.	
2003/0158606	A1	8/2003	Coon et al.	
2003/0225456	A1	12/2003	Ek	
2003/0225457	A1	12/2003	Justin et al.	
2004/0015170	A1	1/2004	Tallarida et al.	
2004/0106928	A1	6/2004	Ek	
2004/0148030	A1	7/2004	Ek	
2005/0137708	A1	6/2005	Clark	
2005/0143831	A1	6/2005	Justin et al.	
2005/0149044	A1	7/2005	Justin et al.	
2005/0154398	A1	7/2005	Miniaci et al.	
2005/0177242	A1	8/2005	Lotke	
2006/0004461	A1	1/2006	Justin et al.	

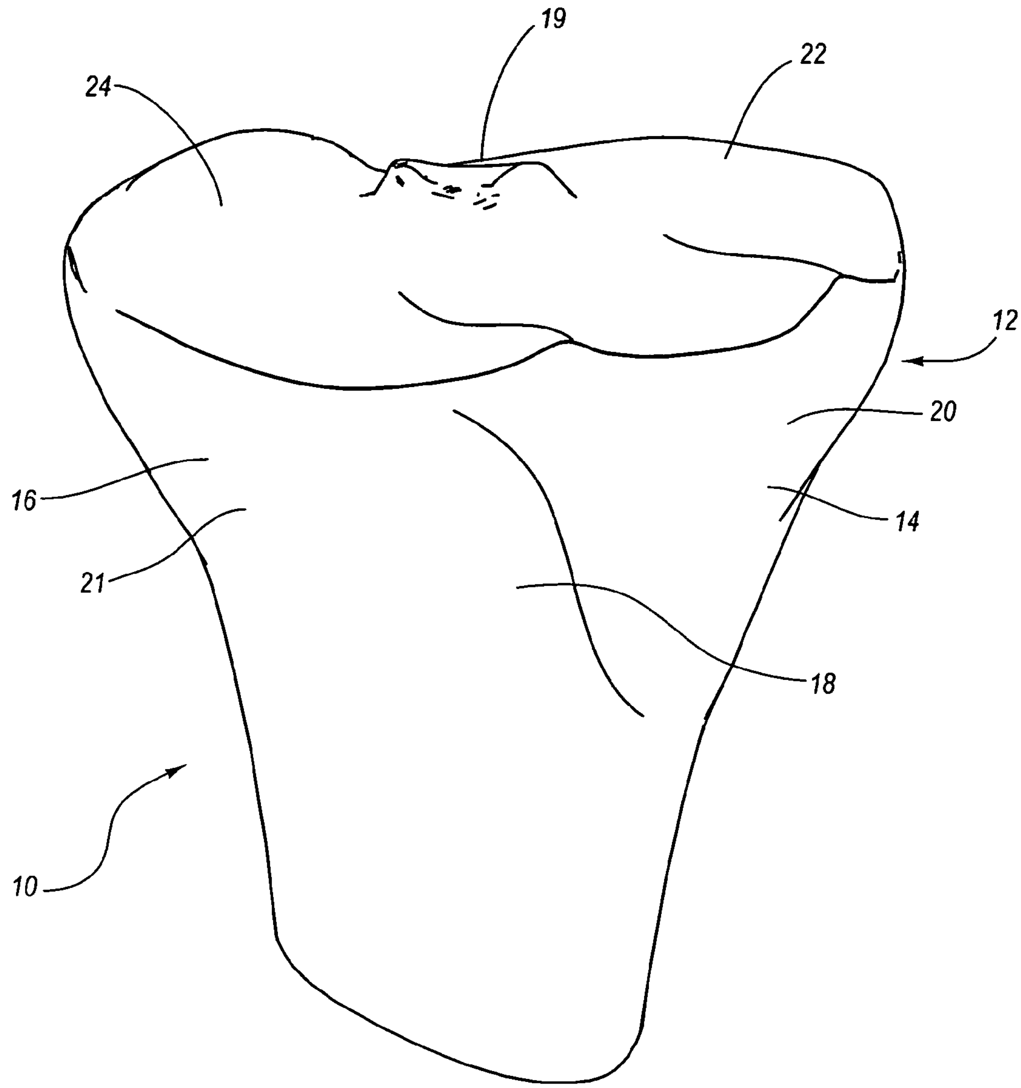
FOREIGN PATENT DOCUMENTS

EP	0 336 774	B1	10/1989
EP	0 714 645	B1	6/1996
EP	0 850 606	A2	7/1998
EP	0 980 679	A2	2/2000
EP	0 985 386	A2	3/2000
FR	2 521 421		11/1975
FR	2 521 421	A1	8/1983
FR	2 630 639		3/1988
FR	2 682 589		4/1993
FR	2 718 953		10/1995
GB	2 007 980	A	5/1979
WO	WO 89/09578	A1	10/1989
WO	WO 89/11837		12/1989
WO	WO 91/06260		5/1991
WO	WO 94/09723		5/1994
WO	WO 01/28457	A1	4/2001
WO	WO 01/66021	A1	9/2001
WO	WO 01/66022	A1	9/2001
WO	WO 03/051210	A2	6/2003
WO	WO 03/051211	A1	6/2003
WO	WO 03/099159	A2	12/2003
WO	WO 2005/069809	A3	8/2005

OTHER PUBLICATIONS

Response filed Oct. 8, 2009 to the Office Action mailed Apr. 9, 2009 in related Canadian application No. 2,490,673.*
Office Action mailed Nov. 3, 2005 in U.S. Appl. No. 10/749,346.
Response/Amendment to Office Action filed Jan. 30, 2006 in U.S. Appl. No. 10/749,346.
Office Action mailed Apr. 12, 2006 in U.S. Appl. No. 10/749,346.
Response/Amendment to Office Action filed Aug. 14, 2006 in U.S. Appl. No. 10/749,346.
Office Action mailed Oct. 20, 2006 in U.S. Appl. No. 10/749,346.
Response/Amendment to Office Action filed Jan. 23, 2007 in U.S. Appl. No. 10/749,346.
Office Action mailed Apr. 16, 2007 in U.S. Appl. No. 10/749,346.
Response/Amendment to Office Action filed May 31, 2007 in U.S. Appl. No. 10/749,346.
Advisory Action mailed Jul. 1, 2007 in U.S. Appl. No. 10/749,346.
Response/Amendment to Office Action filed Oct. 9, 2007 in U.S. Appl. No. 10/749,346.
Office Action mailed Dec. 10, 2007 in U.S. Appl. No. 10/749,346.
Response/Amendment to Office Action filed Jun. 5, 2008 in U.S. Appl. No. 10/749,346.
Office Action mailed Aug. 13, 2008 in U.S. Appl. No. 10/749,346.
Response/Amendment to Office Action filed Nov. 25, 2007 in U.S. Appl. No. 10/749,346.
Advisory Action mailed Dec. 12, 2008 in U.S. Appl. No. 10/749,346.
Response/Amendment to Office Action filed Jan. 13, 2009 in U.S. Appl. No. 10/749,346.
Office Action mailed Dec. 27, 2007 in U.S. Appl. No. 11/219,098.
Response/Amendment to Office Action filed May 20, 2008 in U.S. Appl. No. 11/219,098.

* cited by examiner



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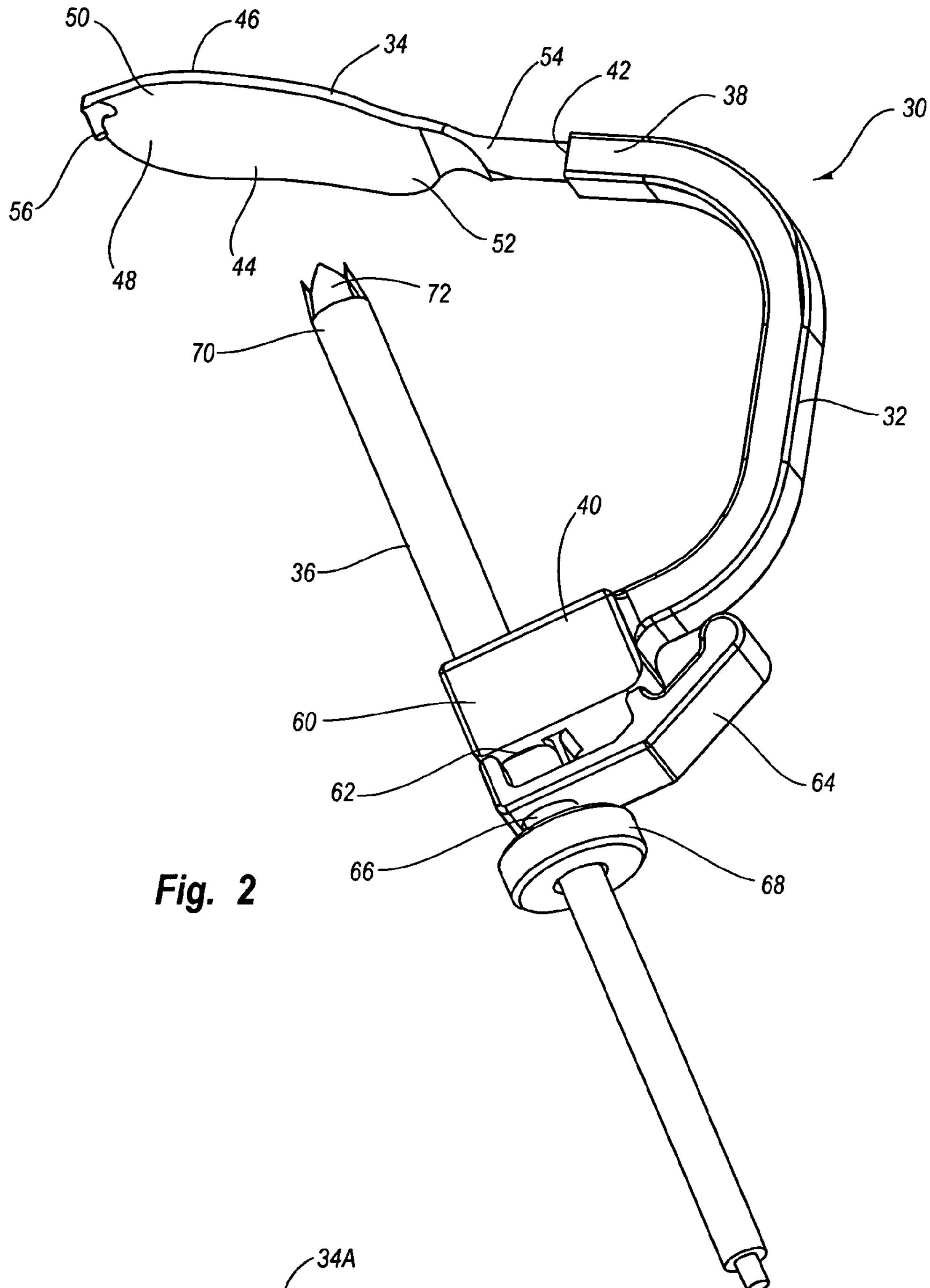
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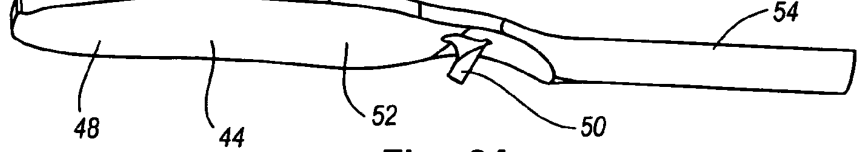
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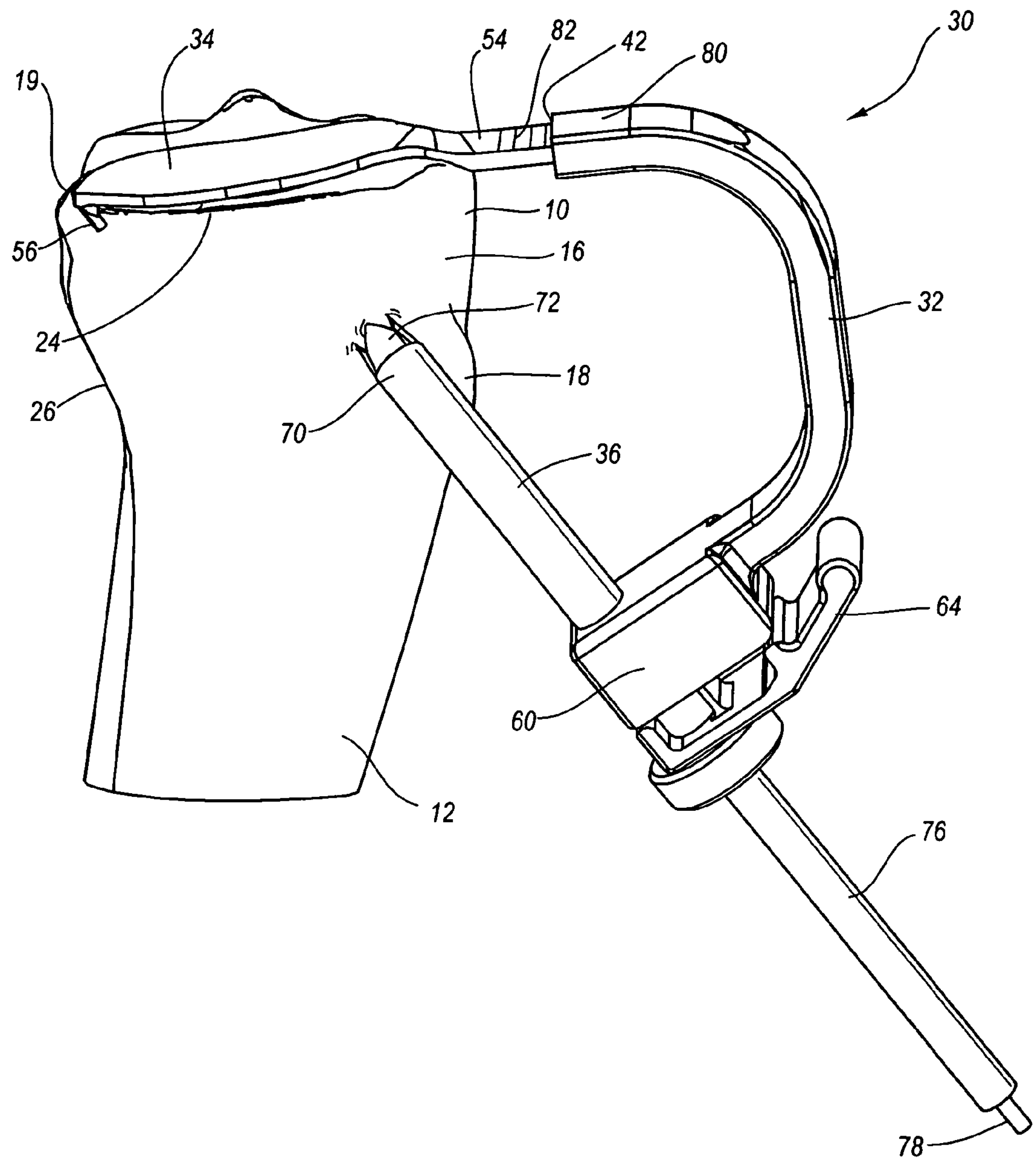

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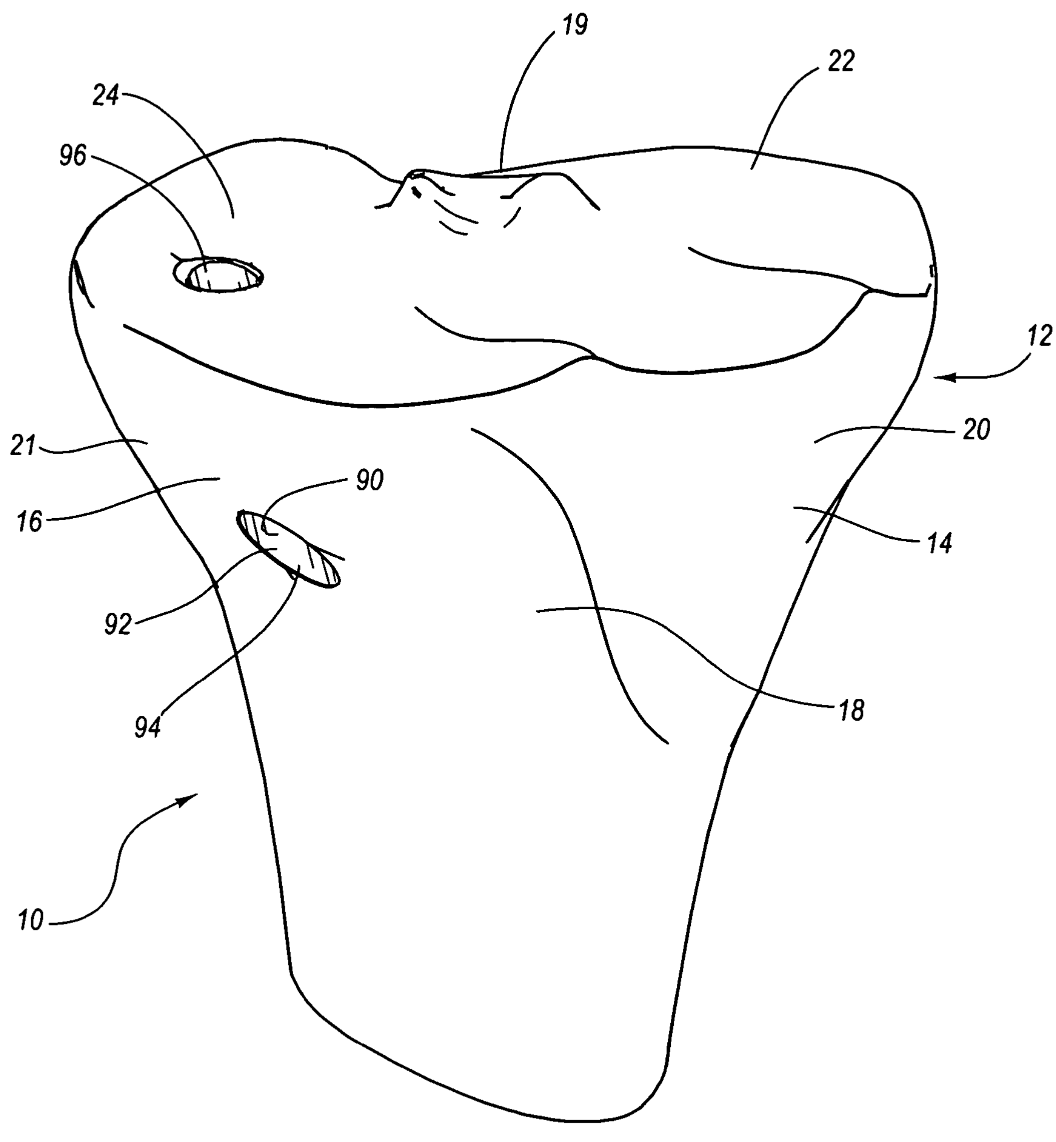

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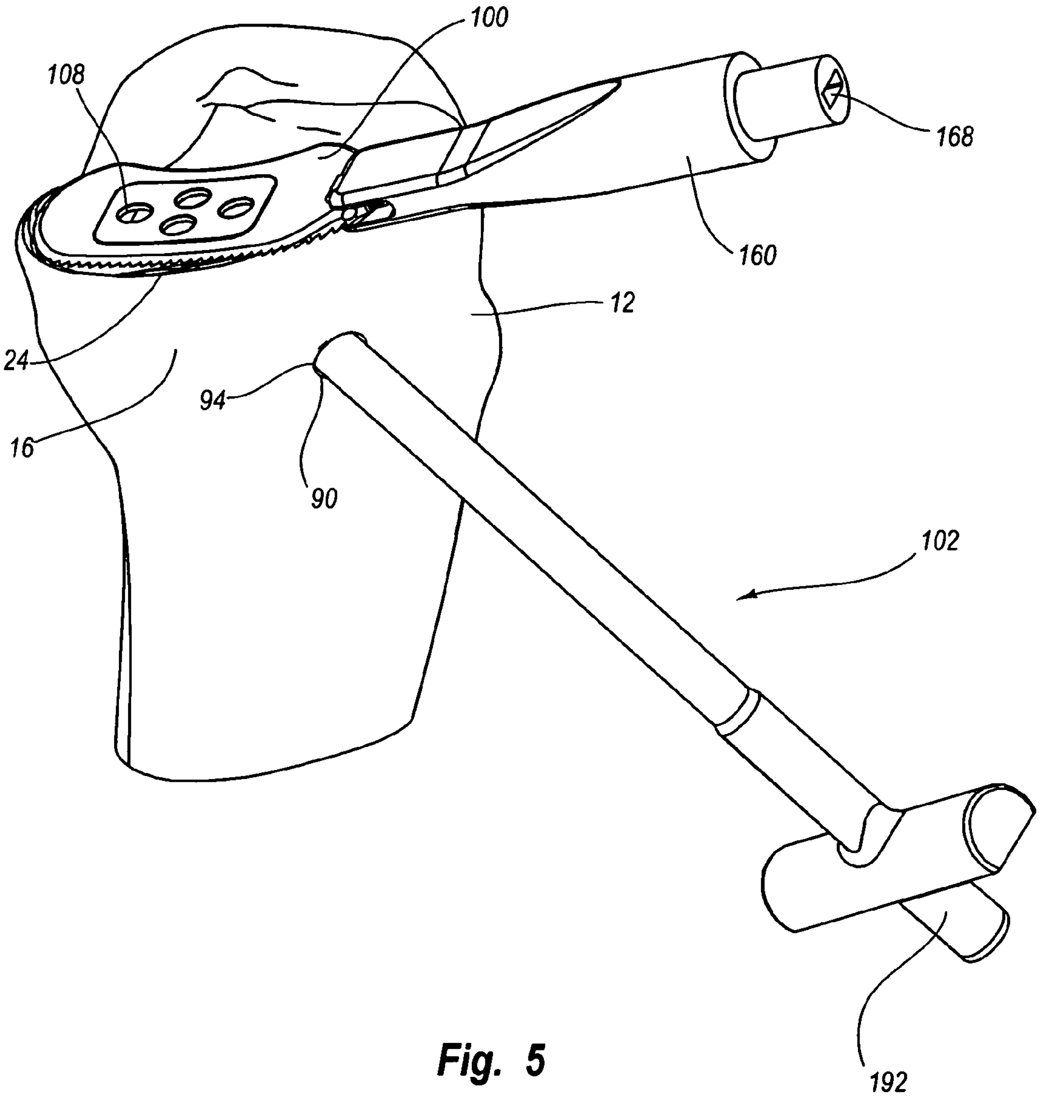

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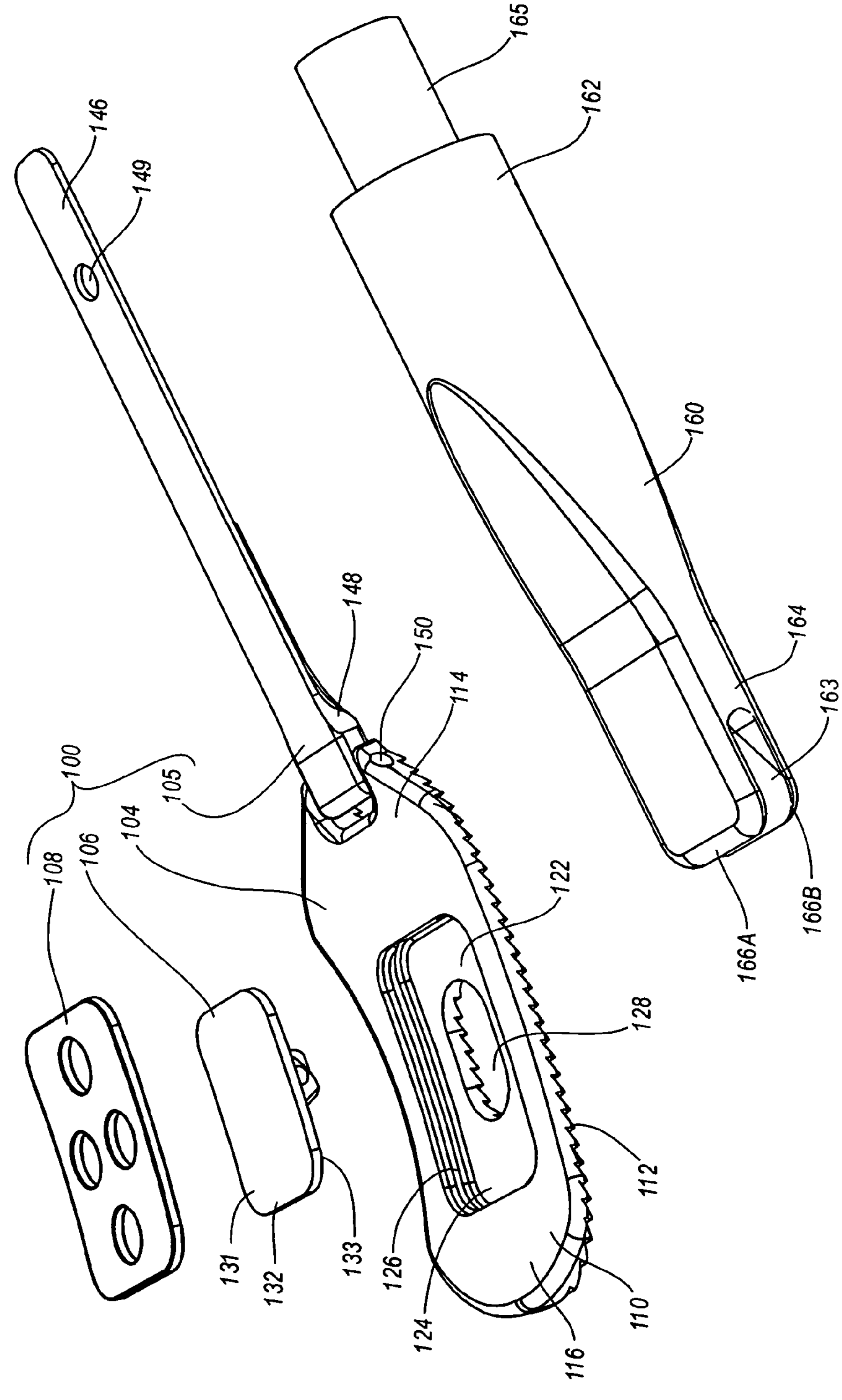
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Fig. 6

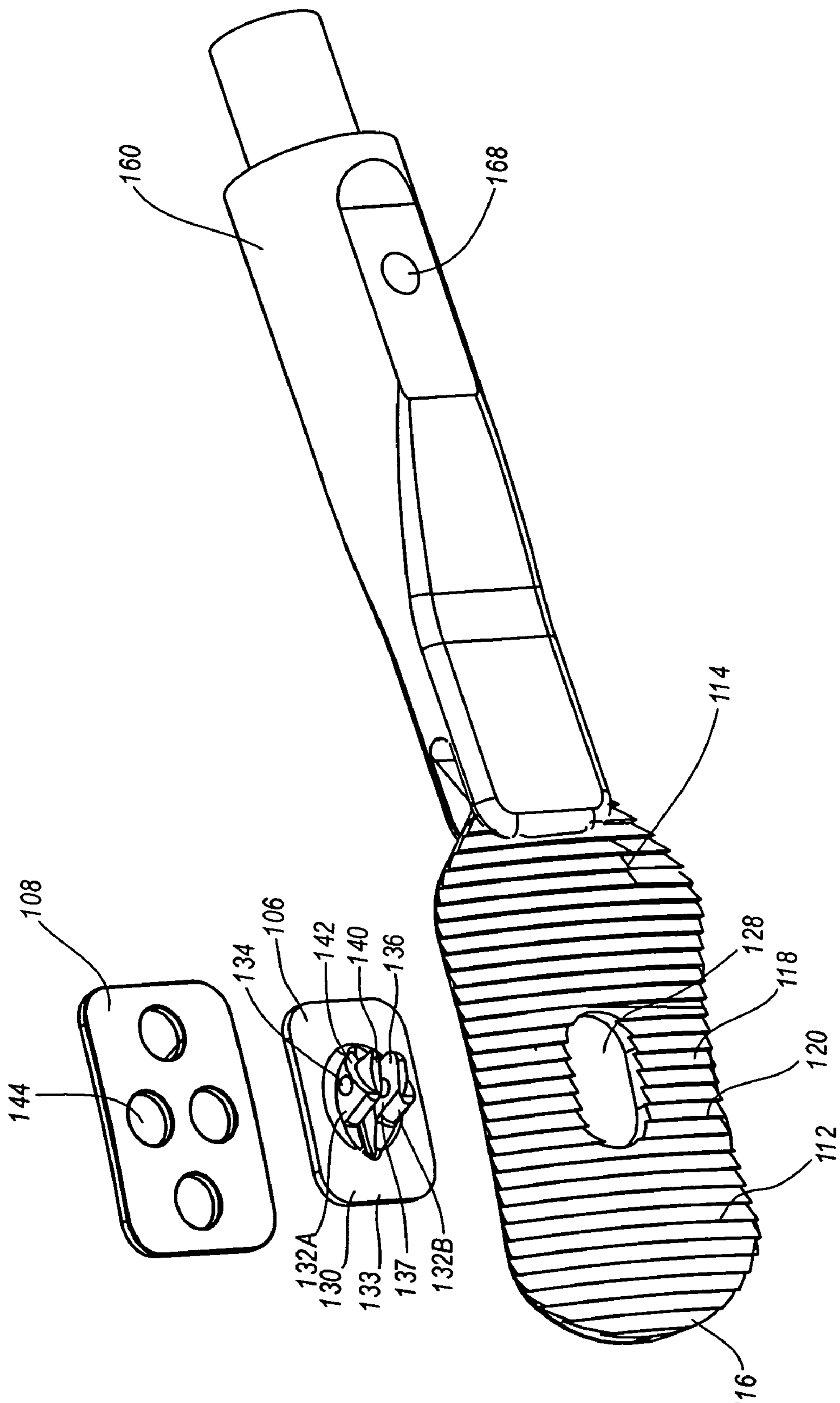
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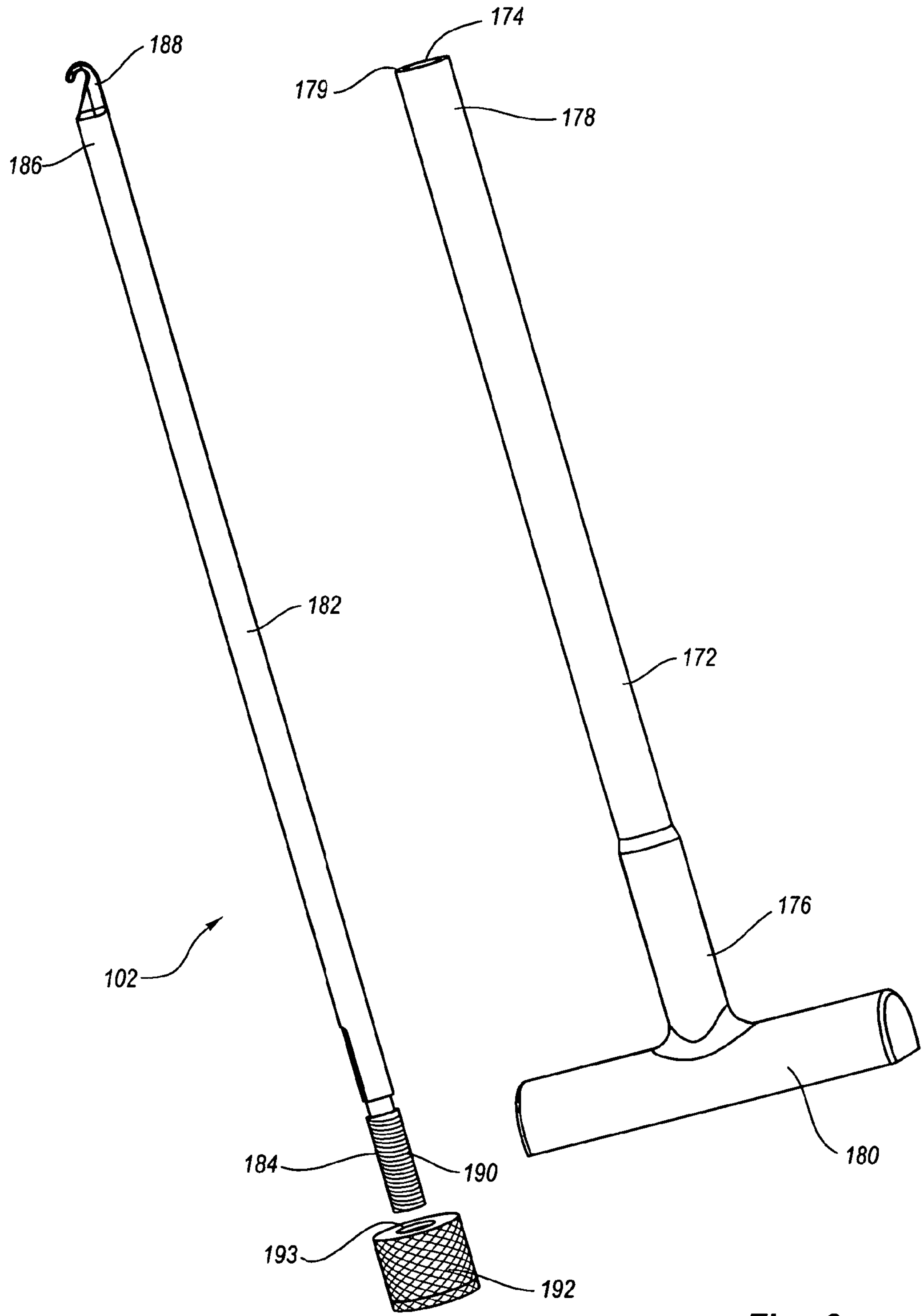
Fig. 7



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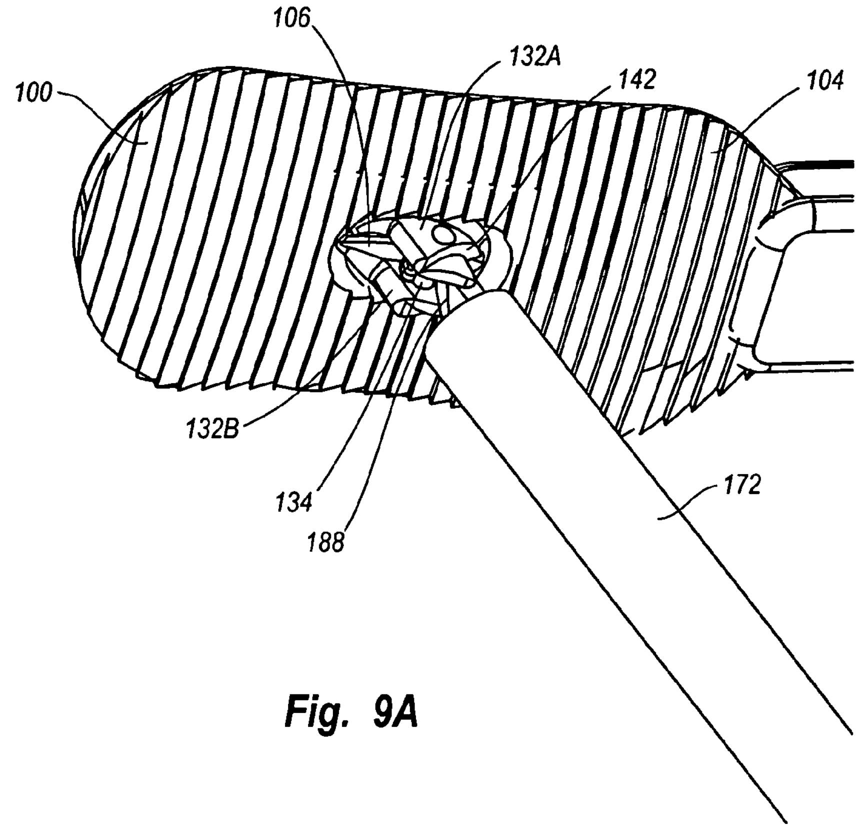
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Fig. 9A

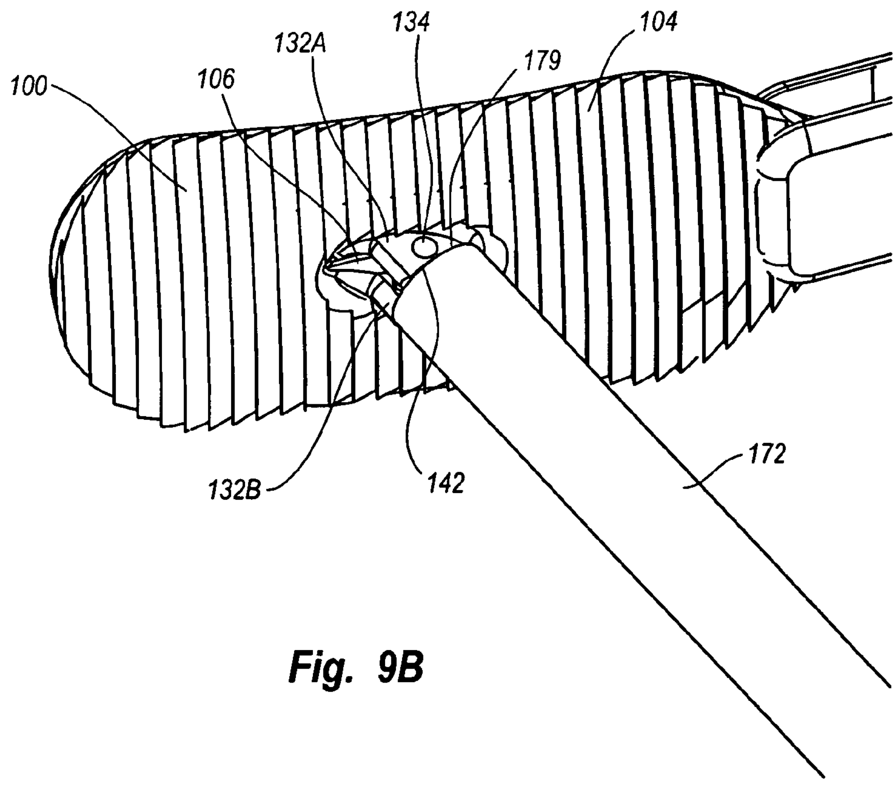
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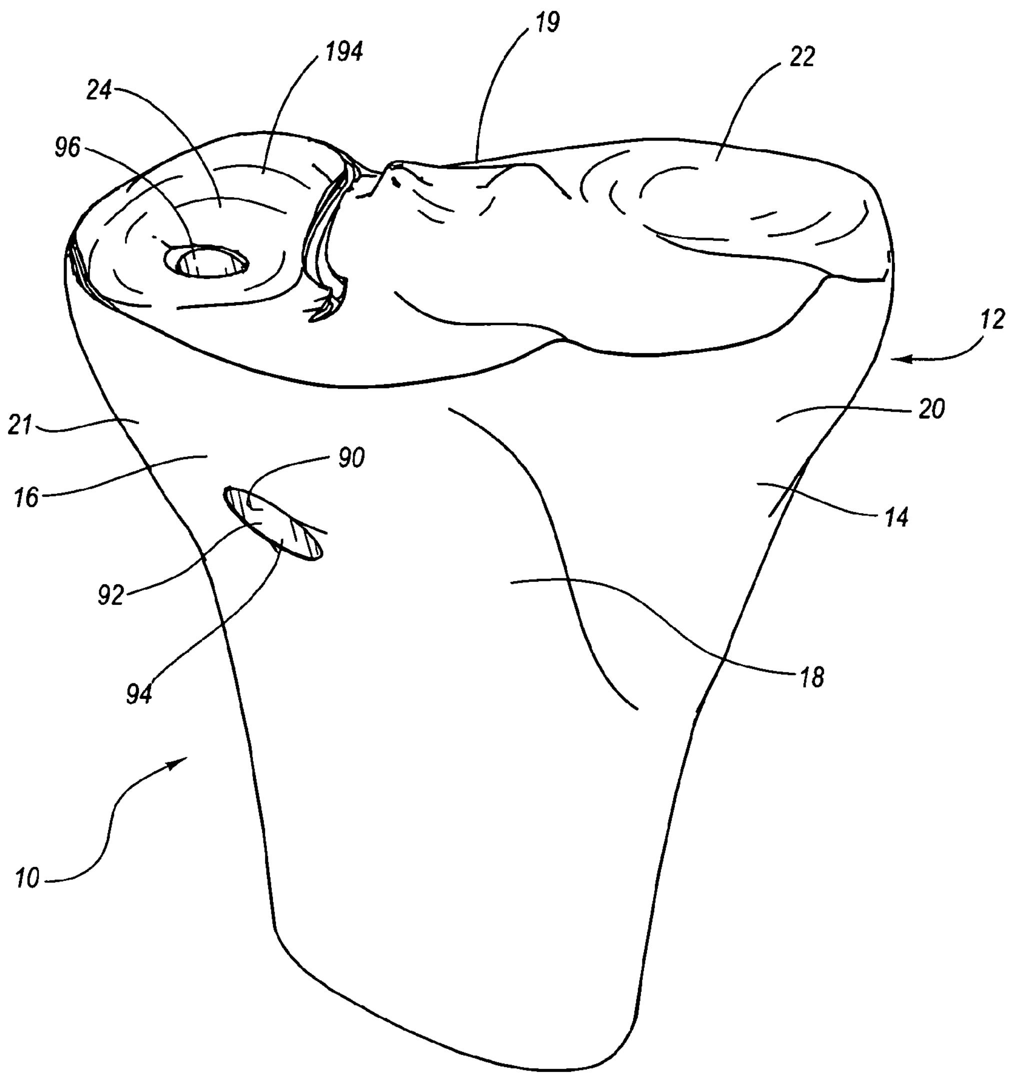
Fig. 9B



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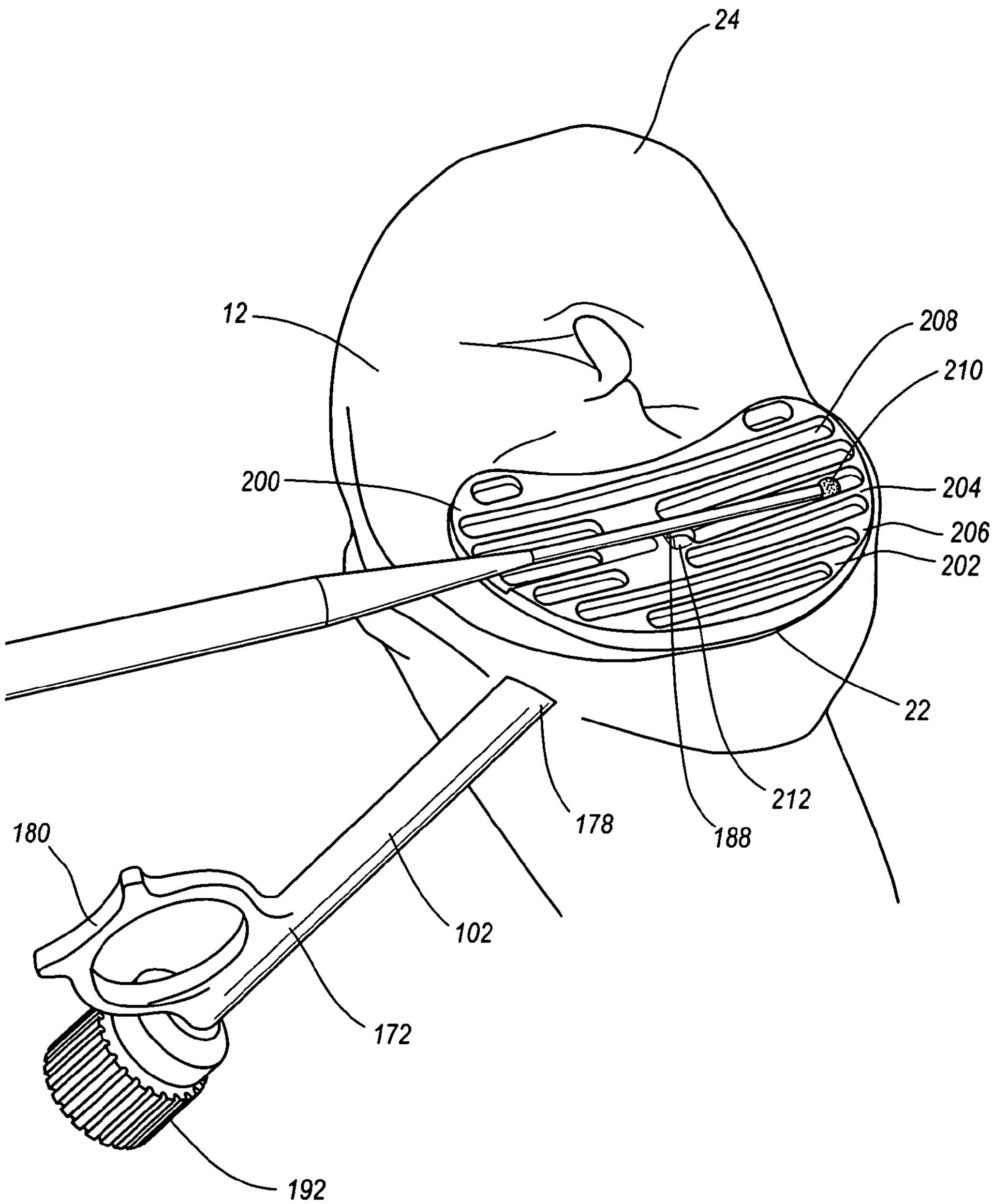

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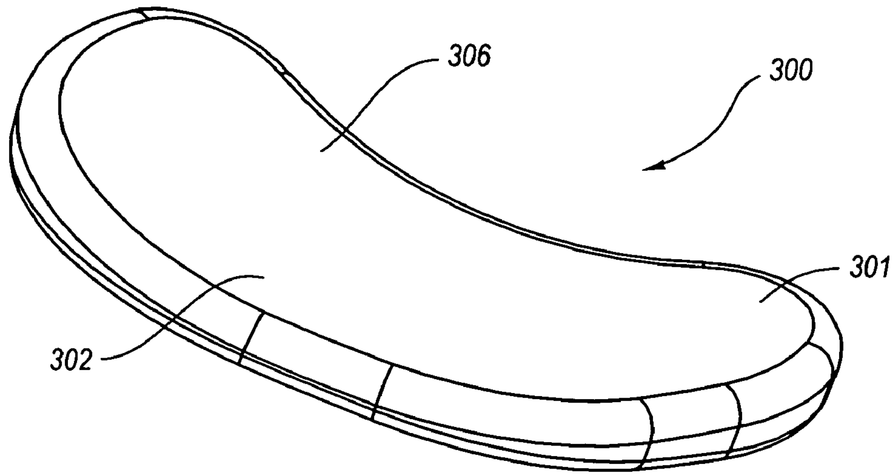

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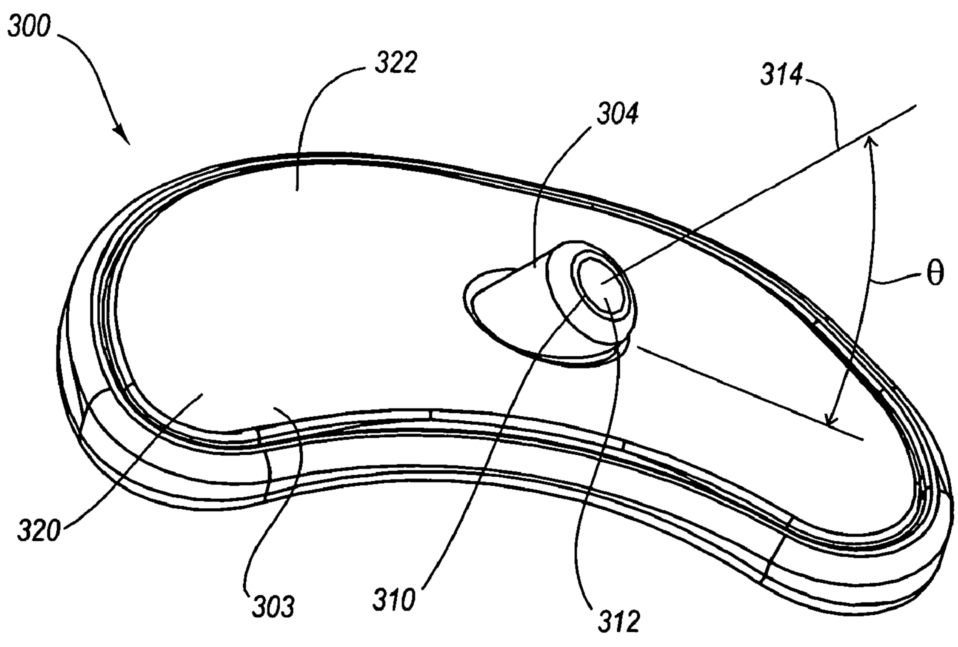

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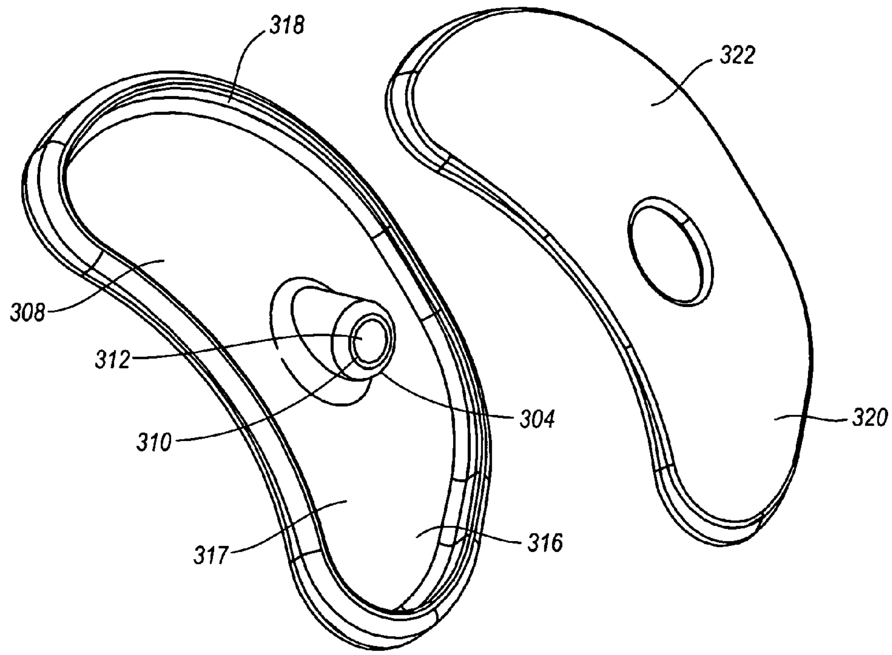

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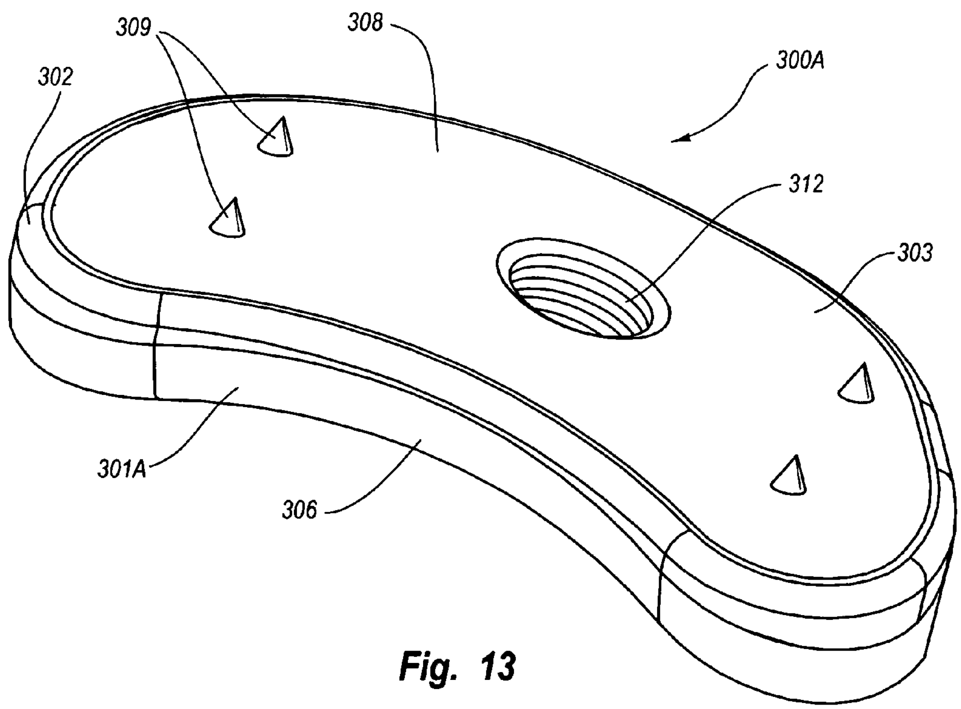

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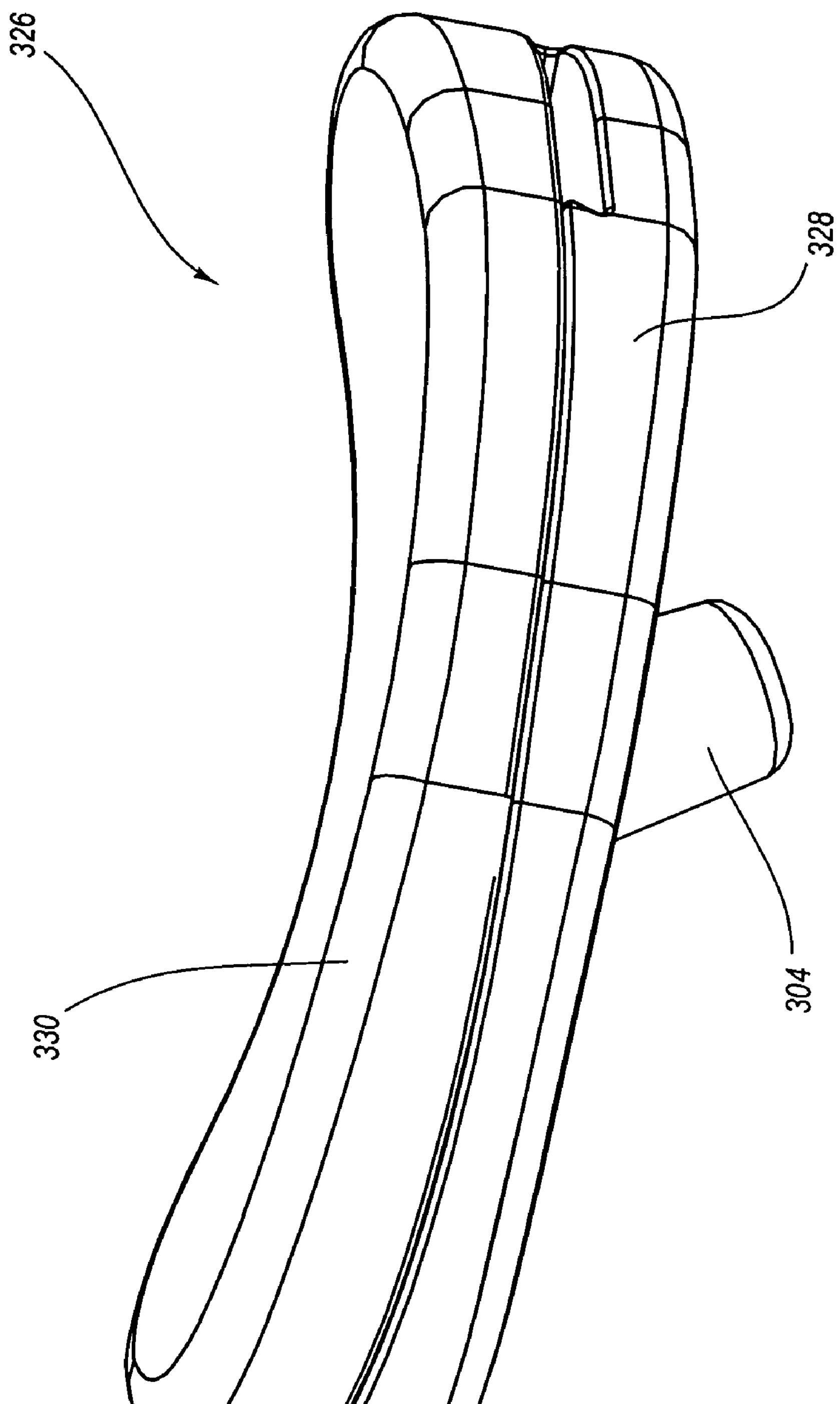

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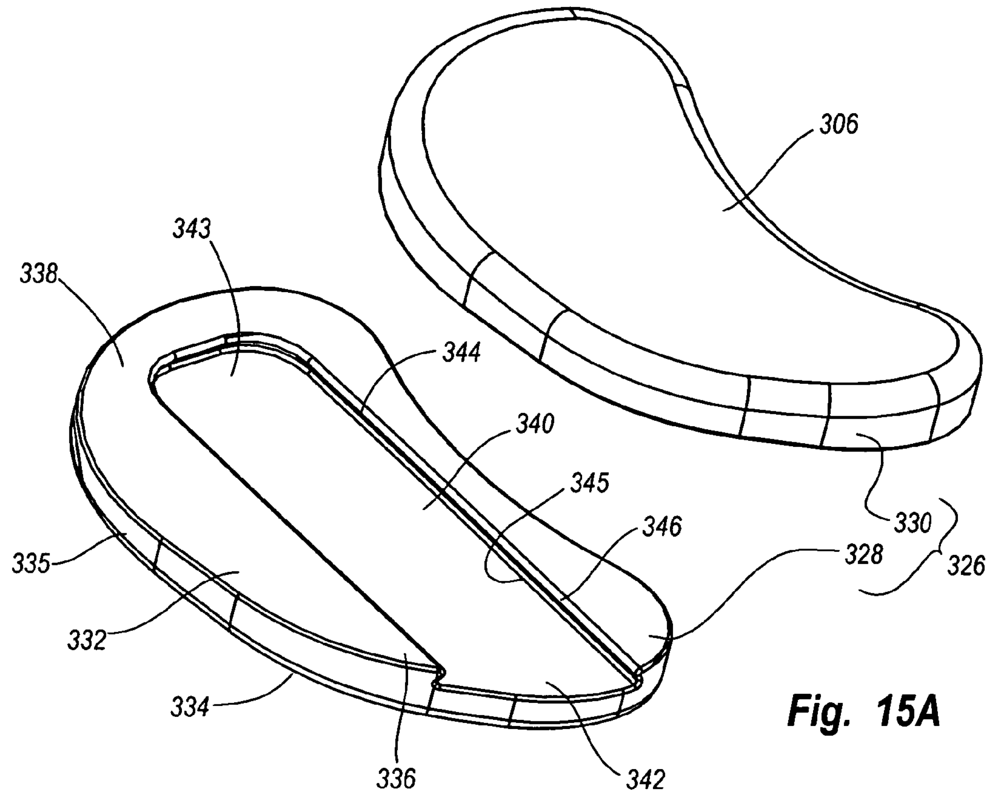

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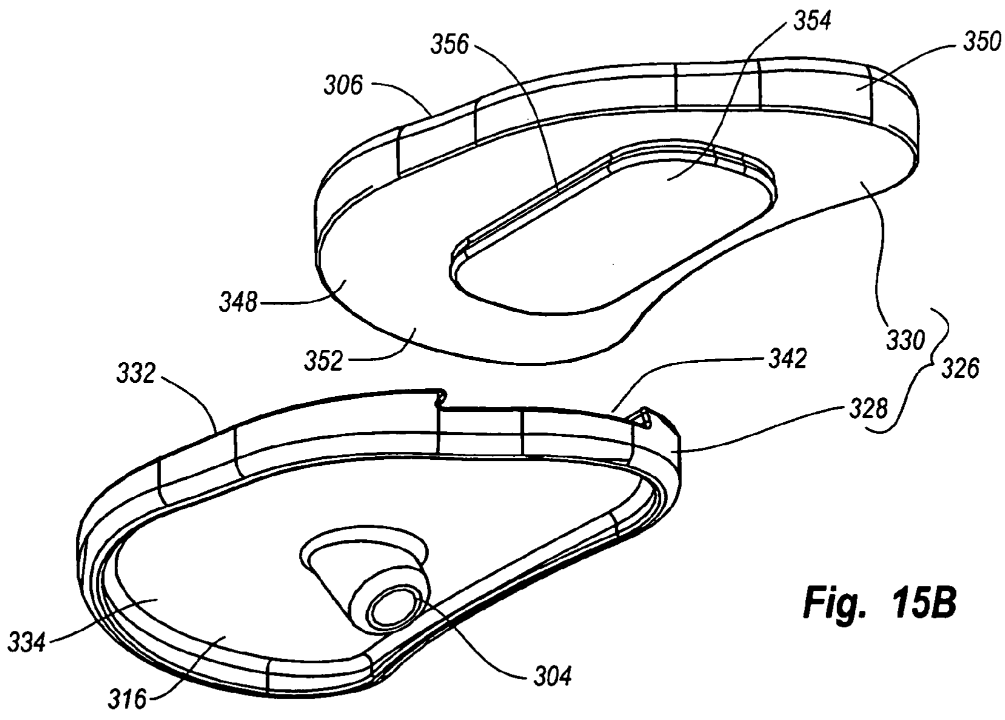

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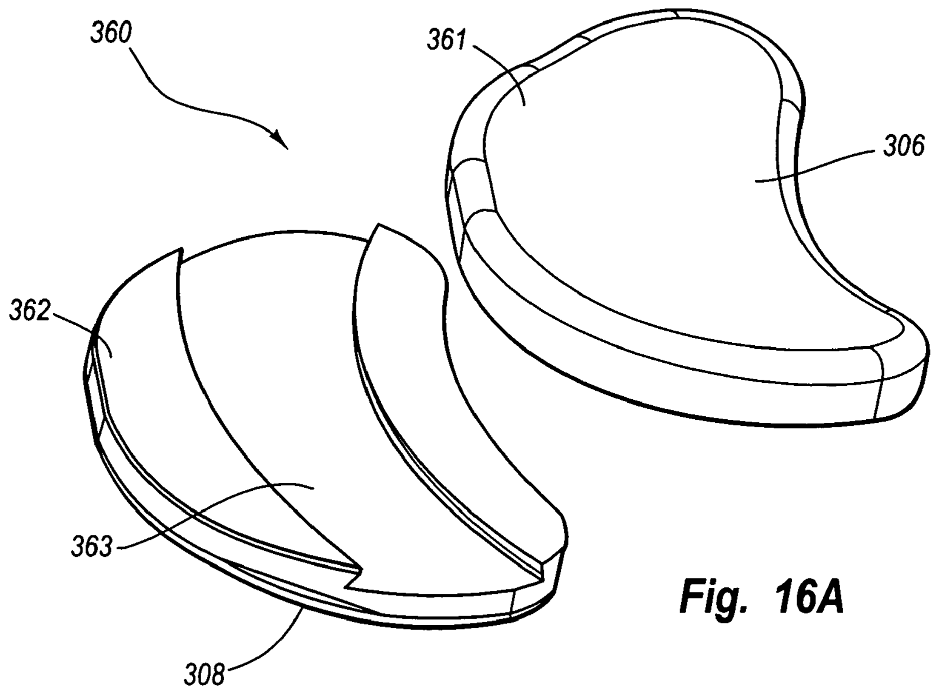

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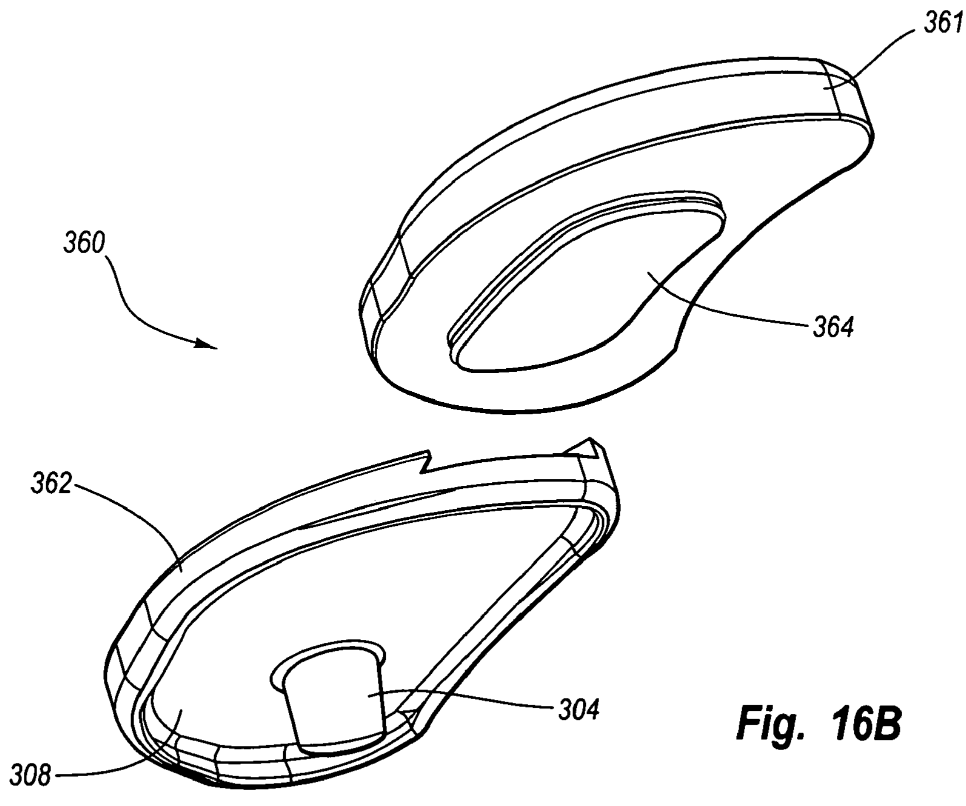

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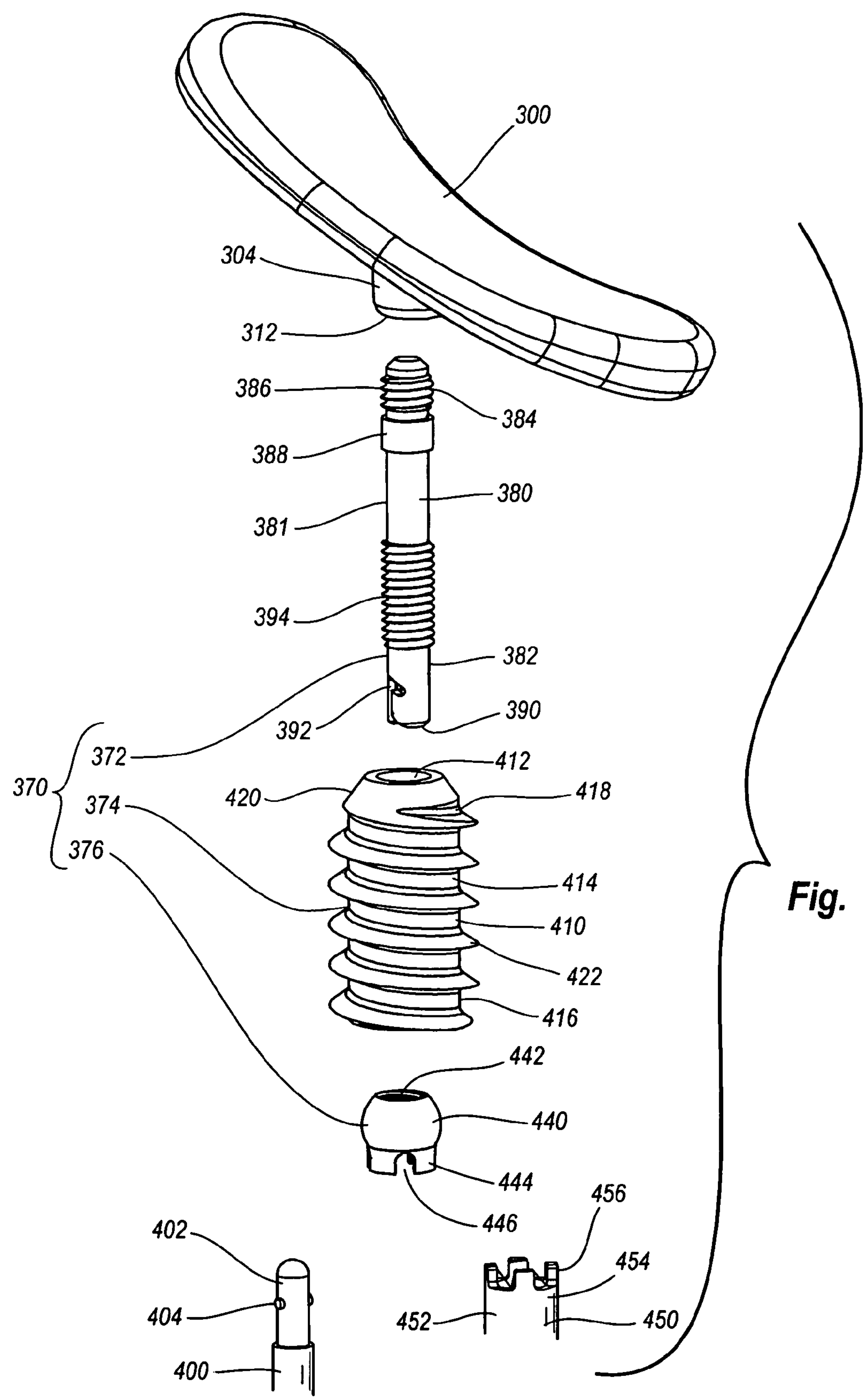
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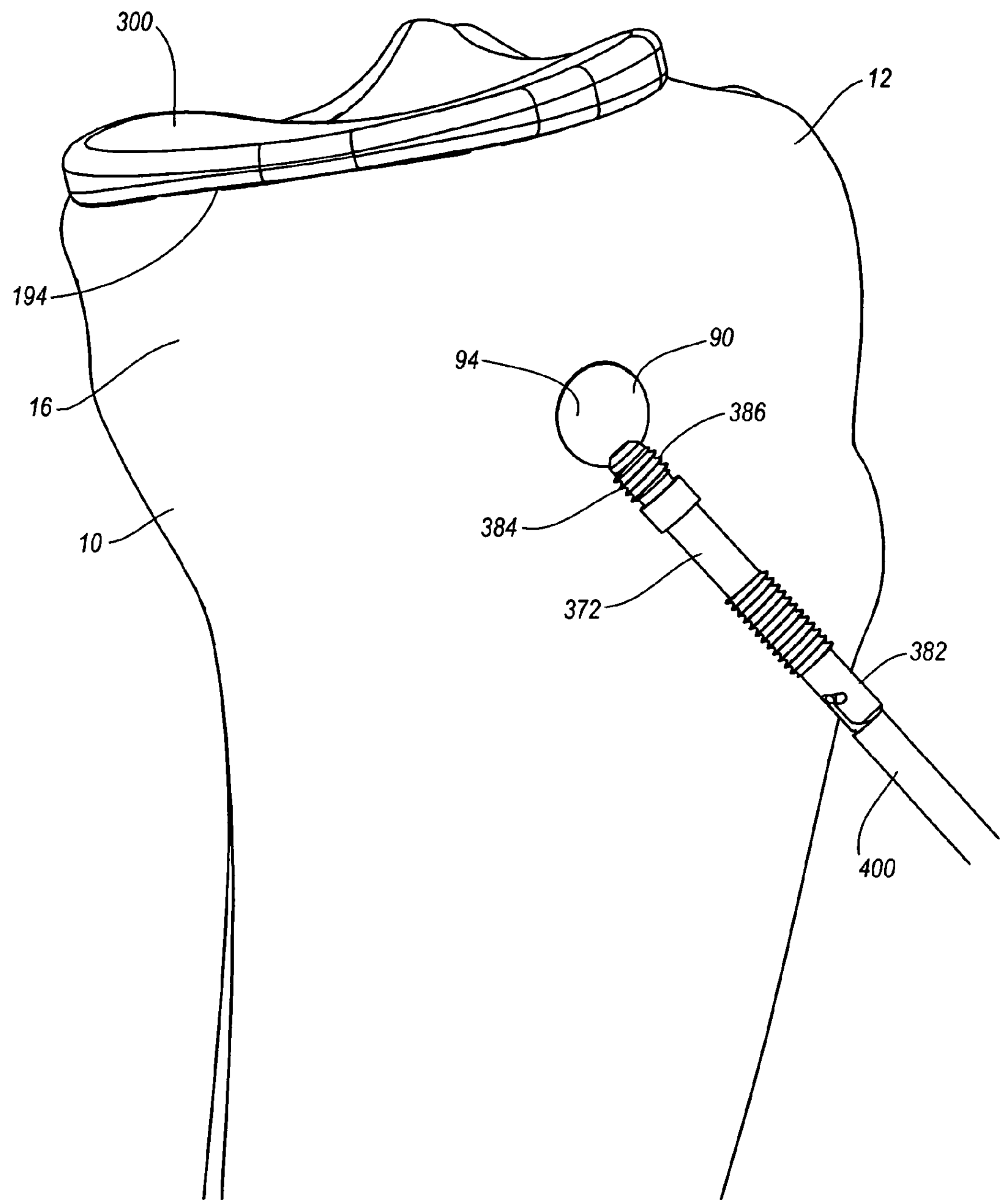

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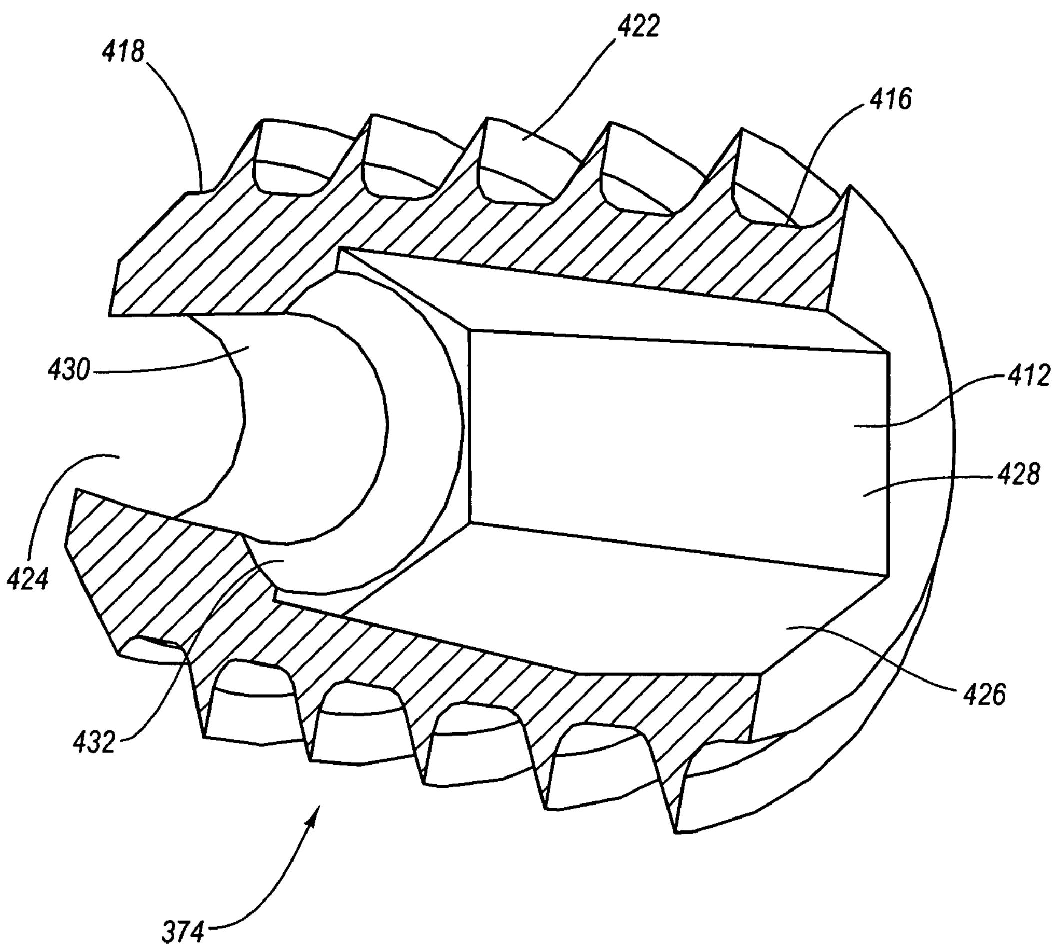

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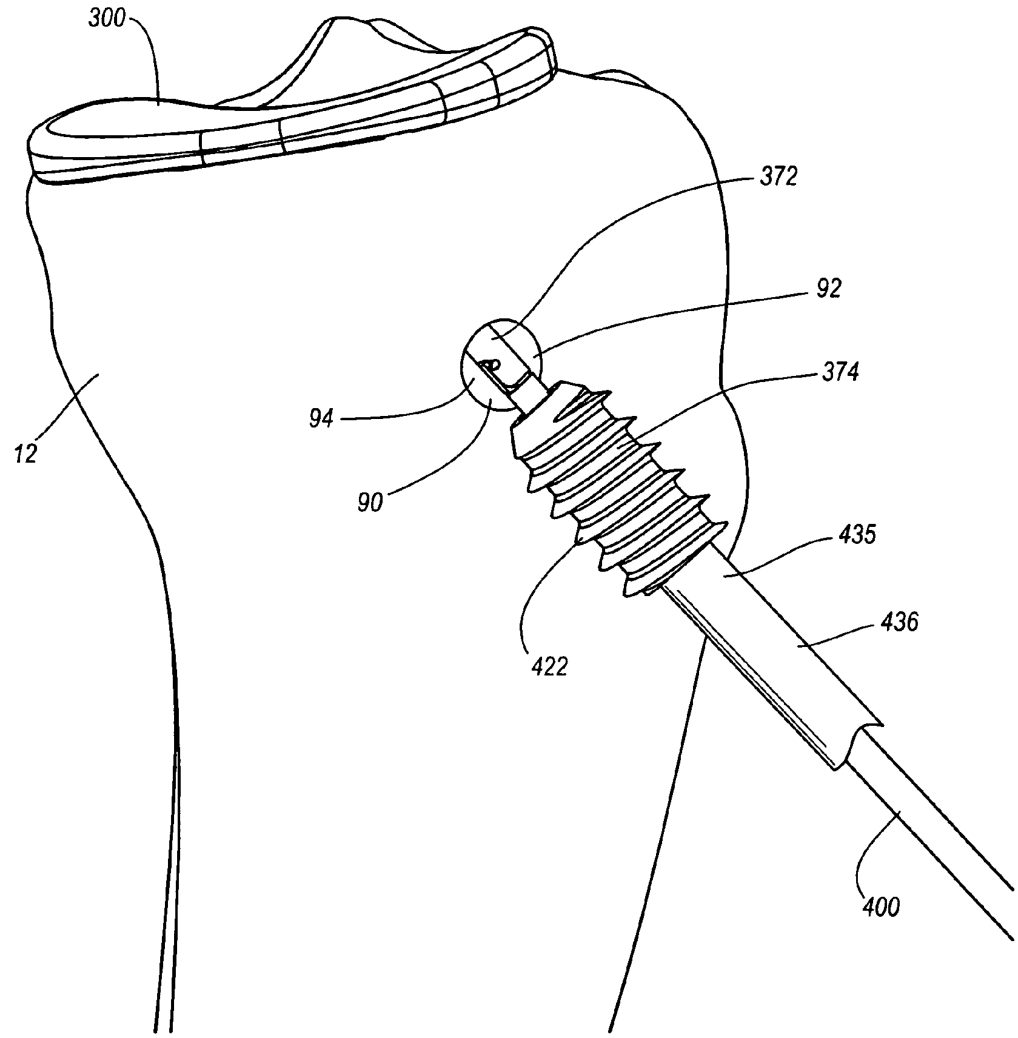

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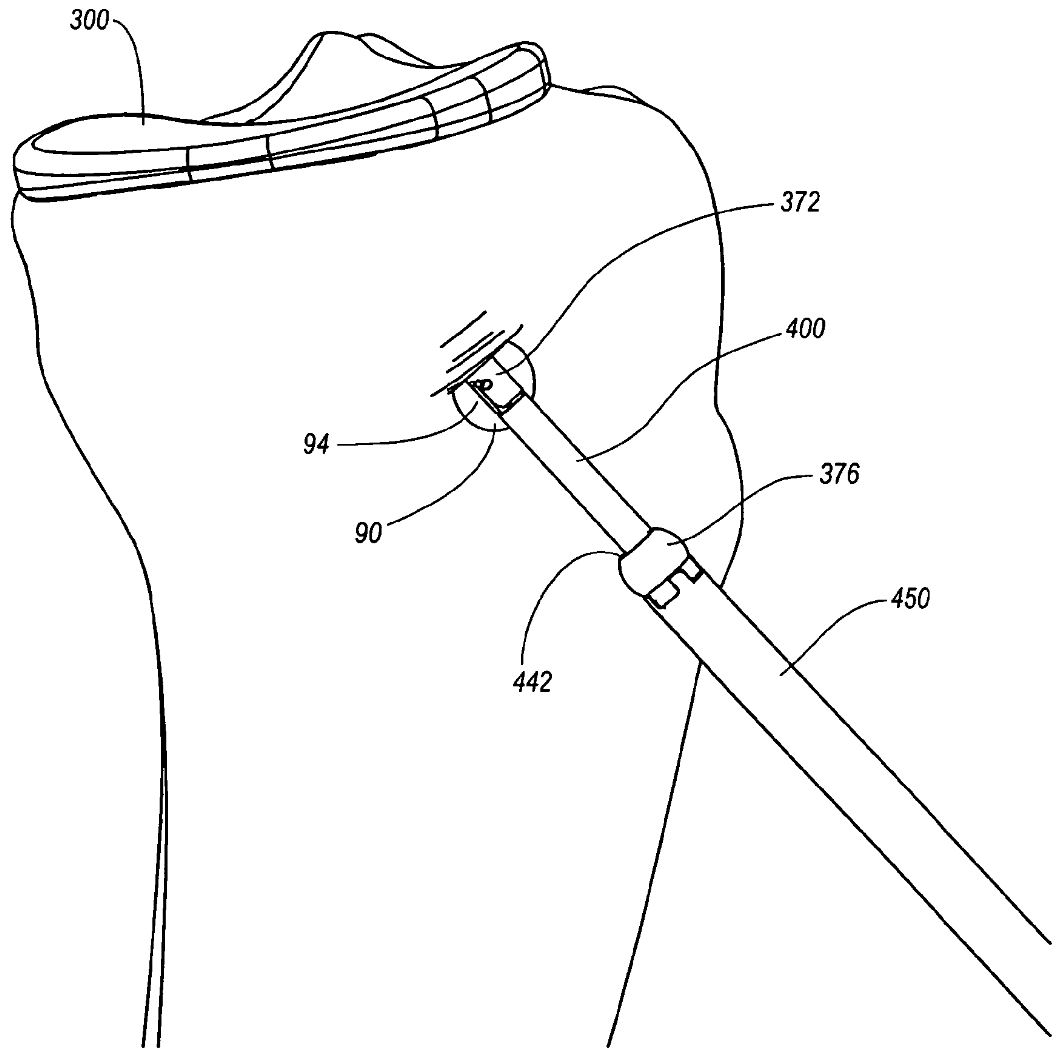

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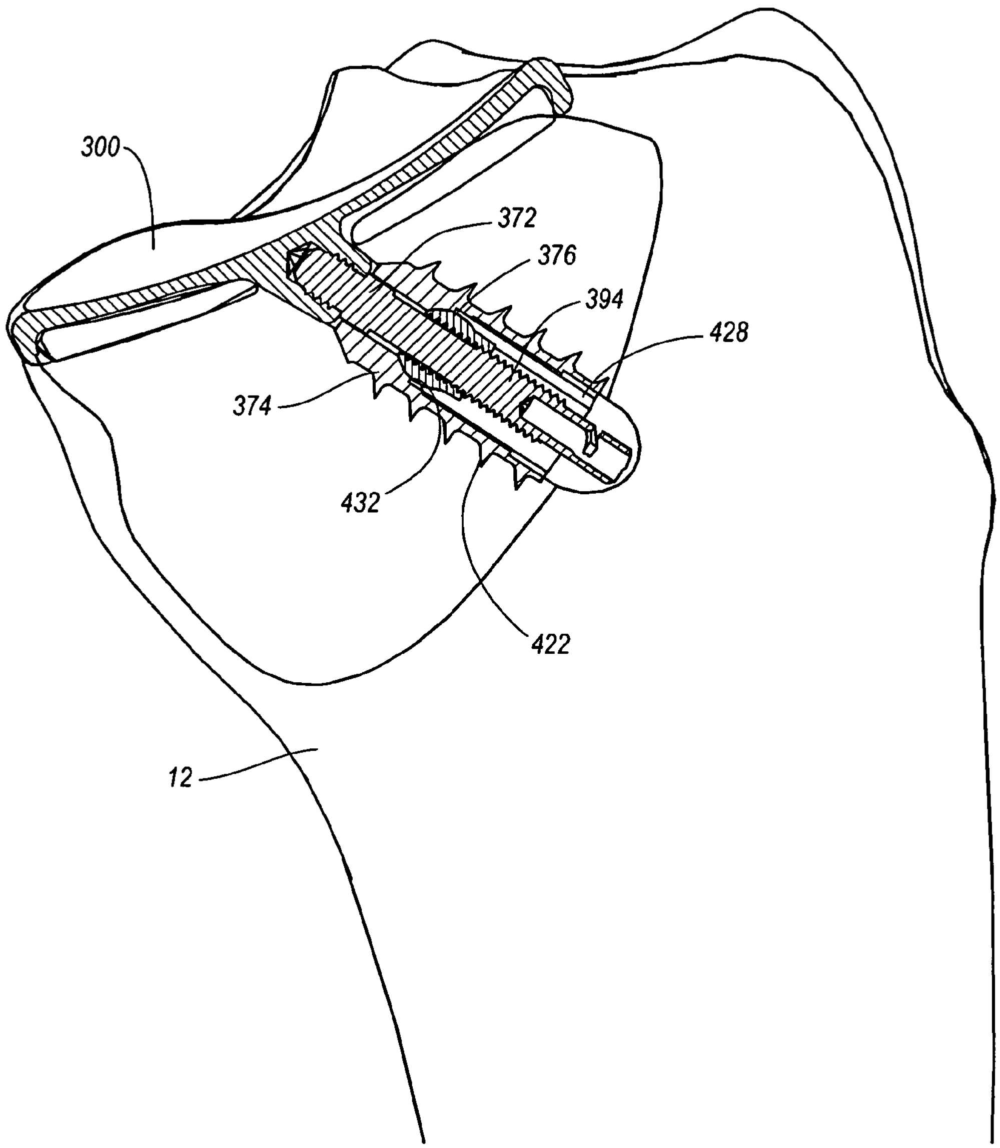

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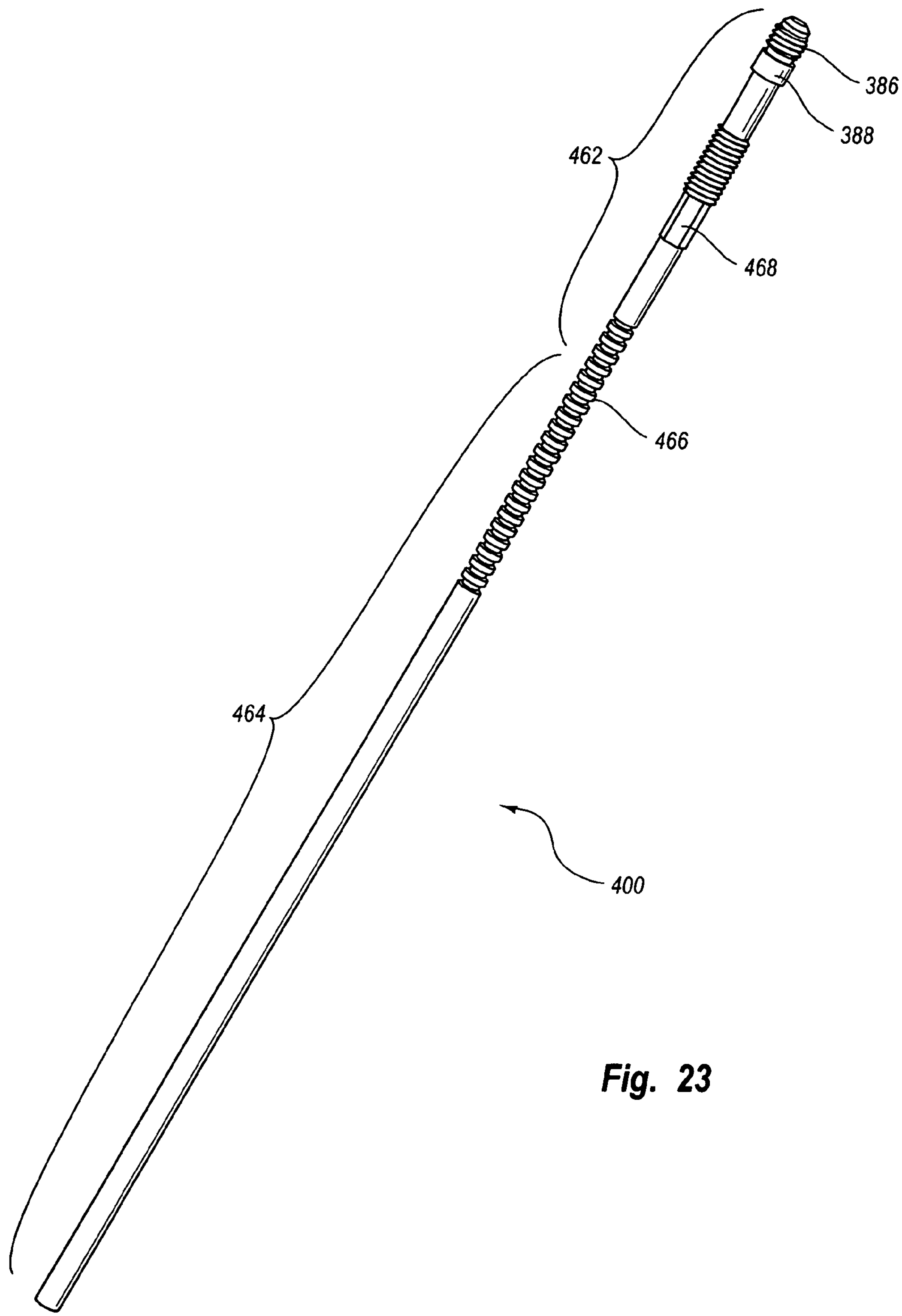

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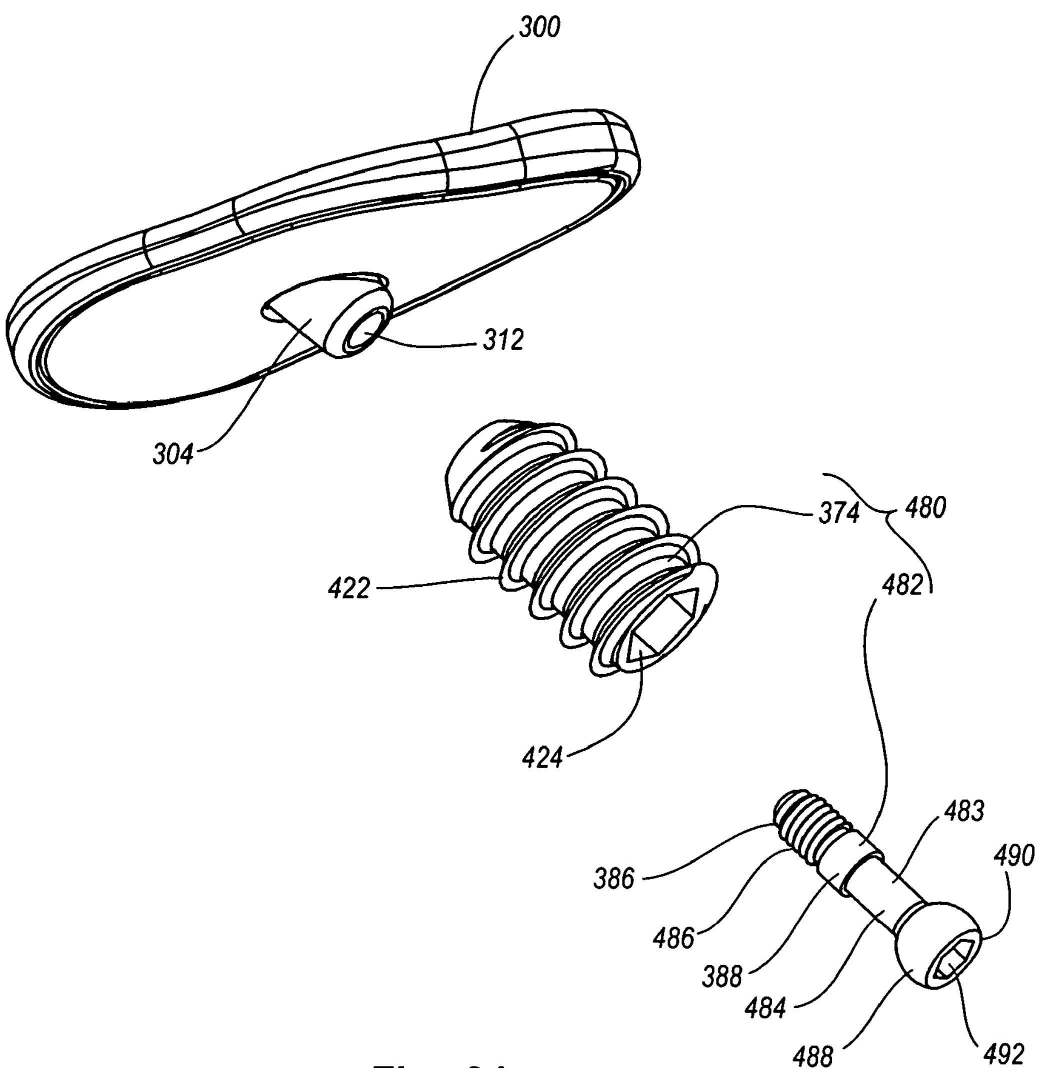

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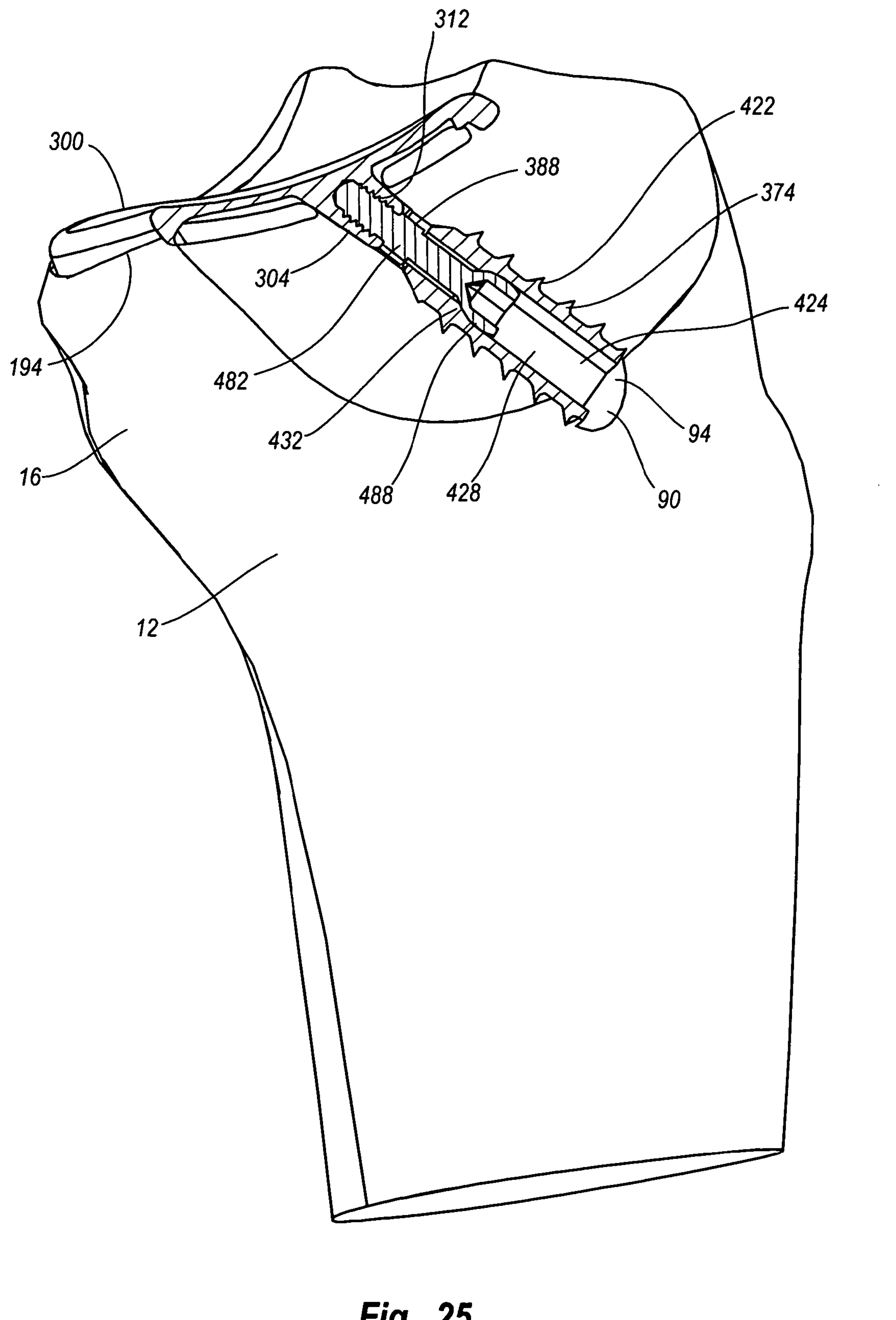

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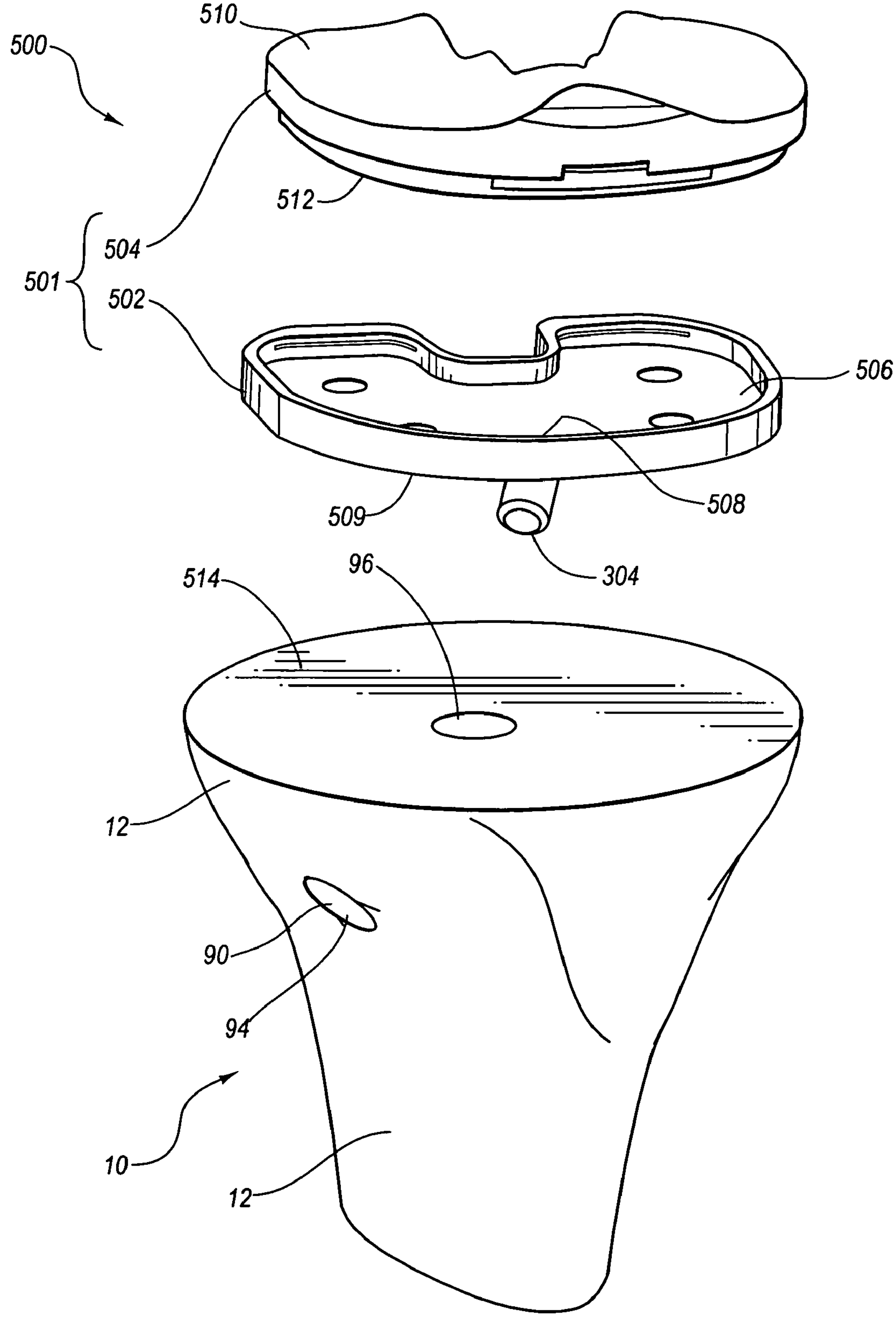

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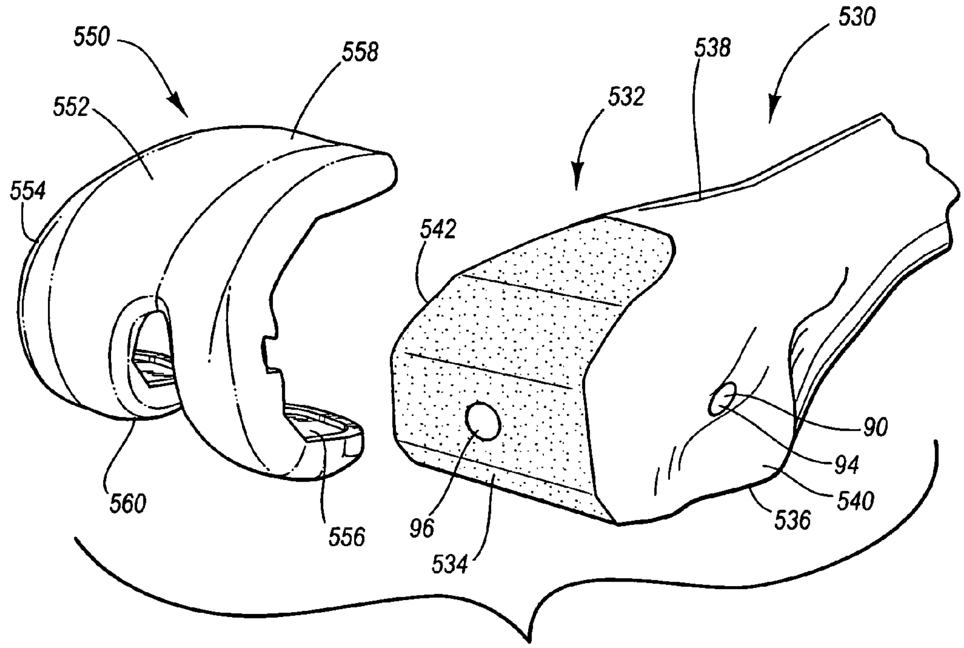
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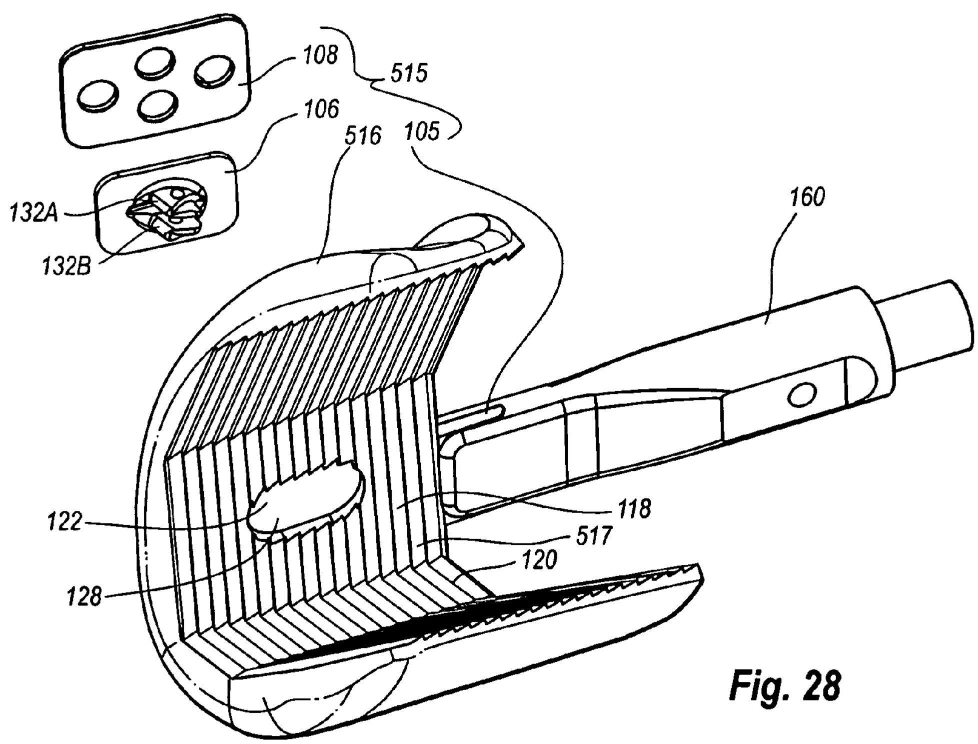
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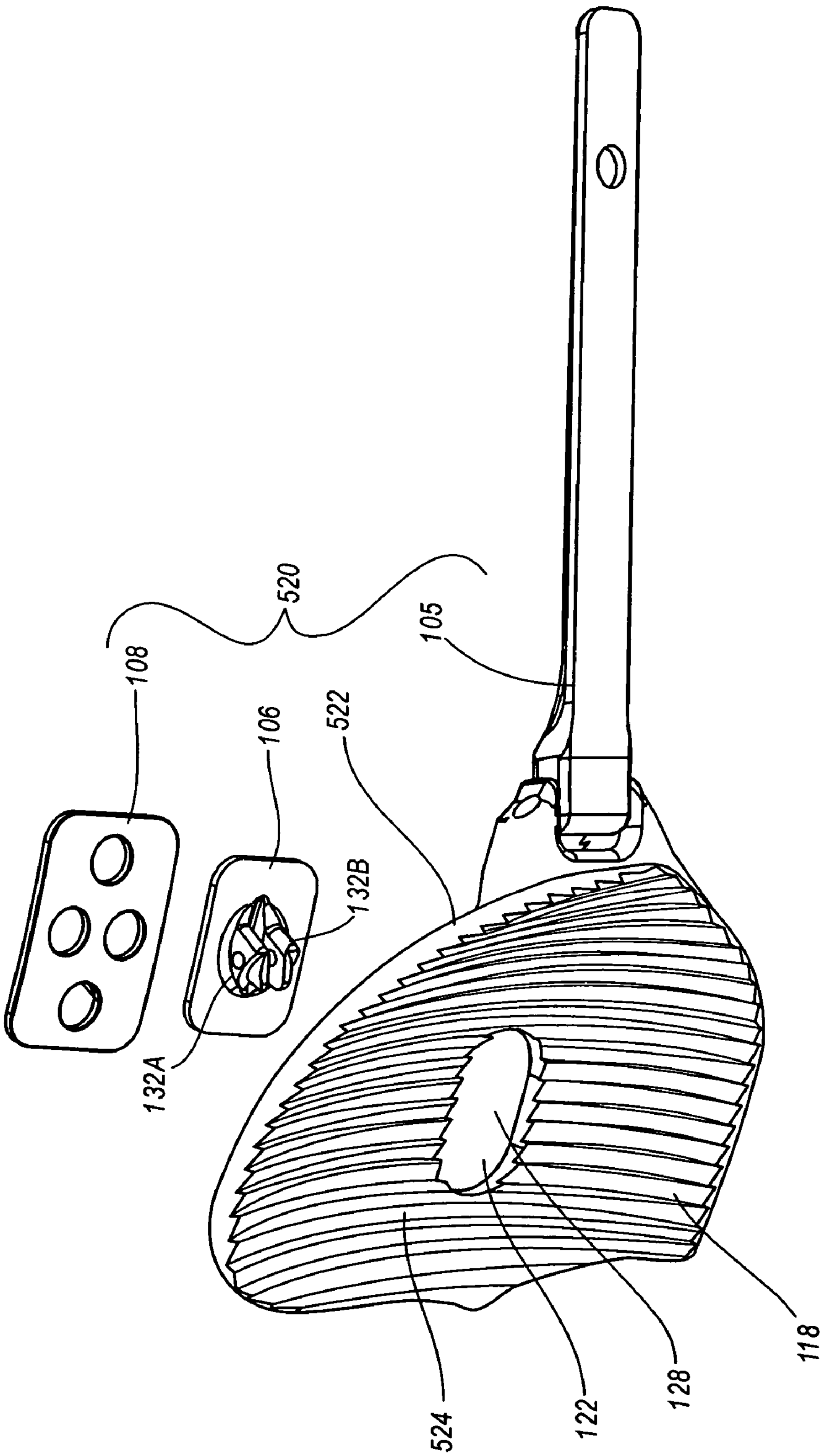

Fig. 29

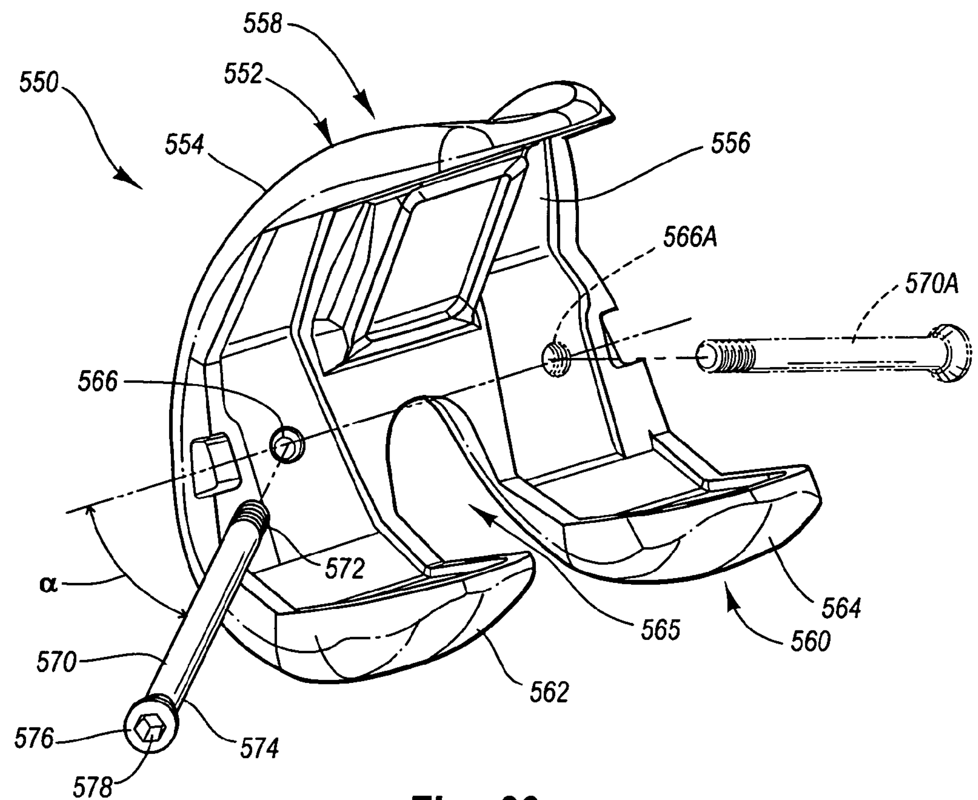
558
552
550
554
556
566A
570A
566
α
572
565
564
560
570
562
576
574
578

Fig. 30

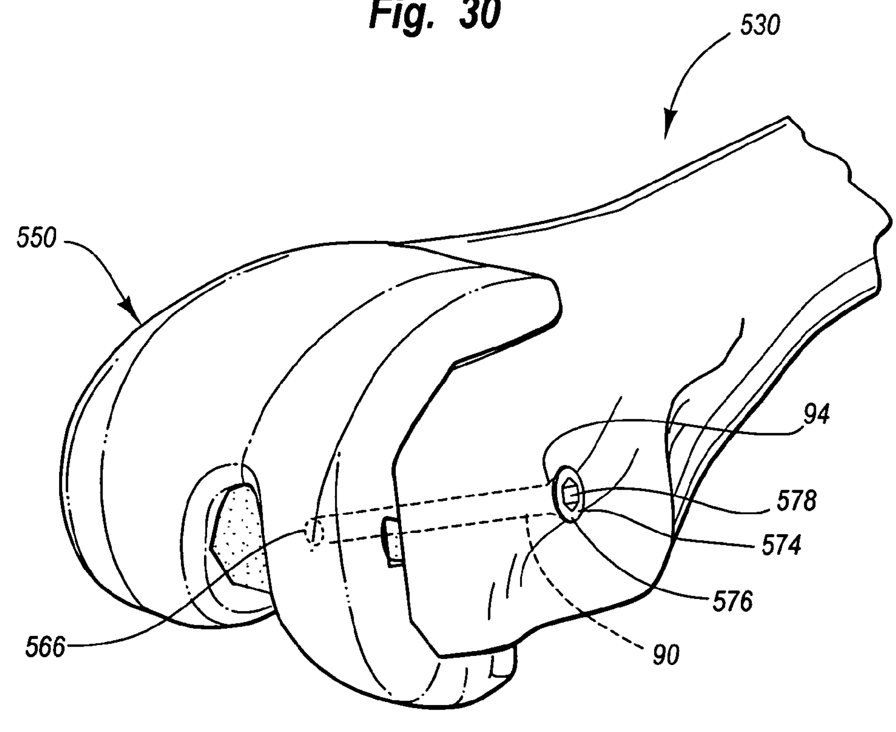
530
550
94
578
574
576
566
90

Fig. 31

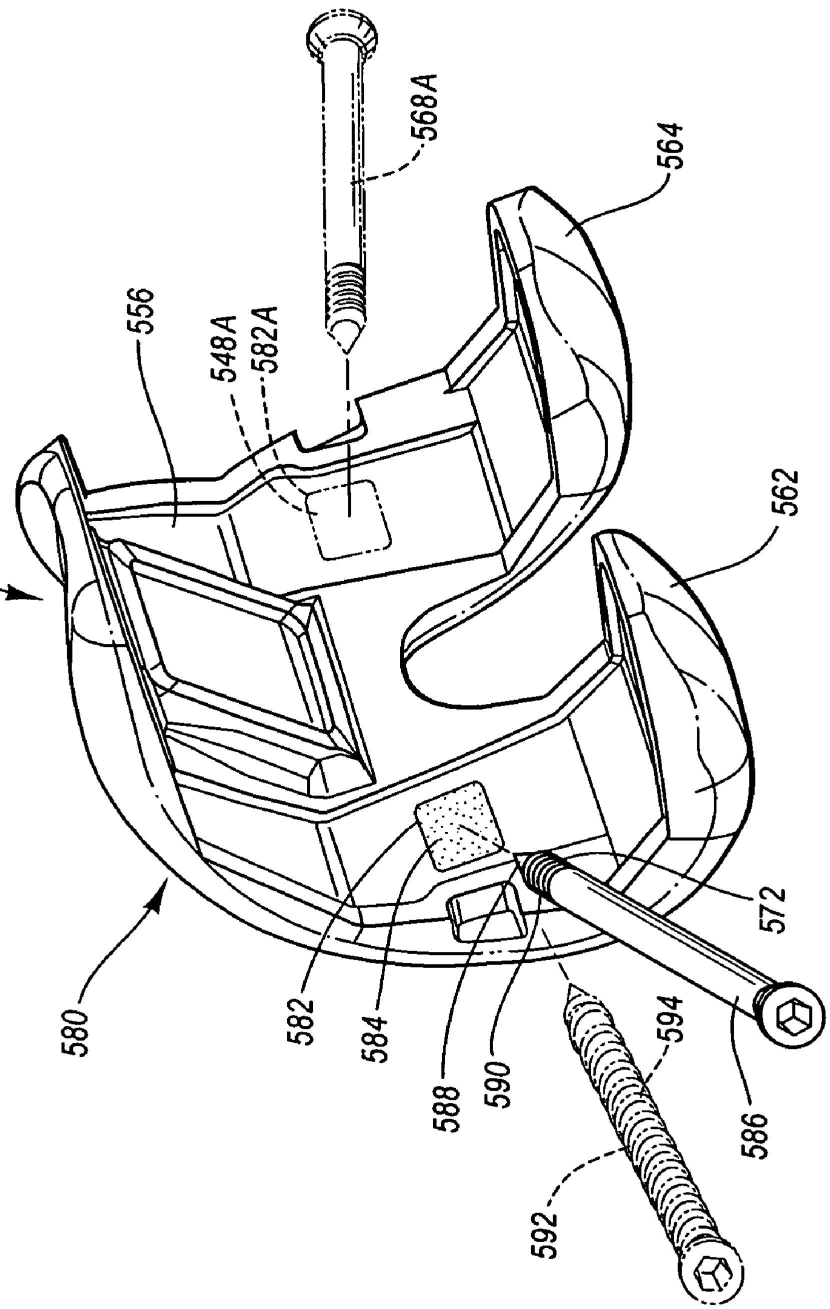
558
556
548A
582A
568A
564
562
580
582
584
588
590
586
572
594
592

Fig. 32

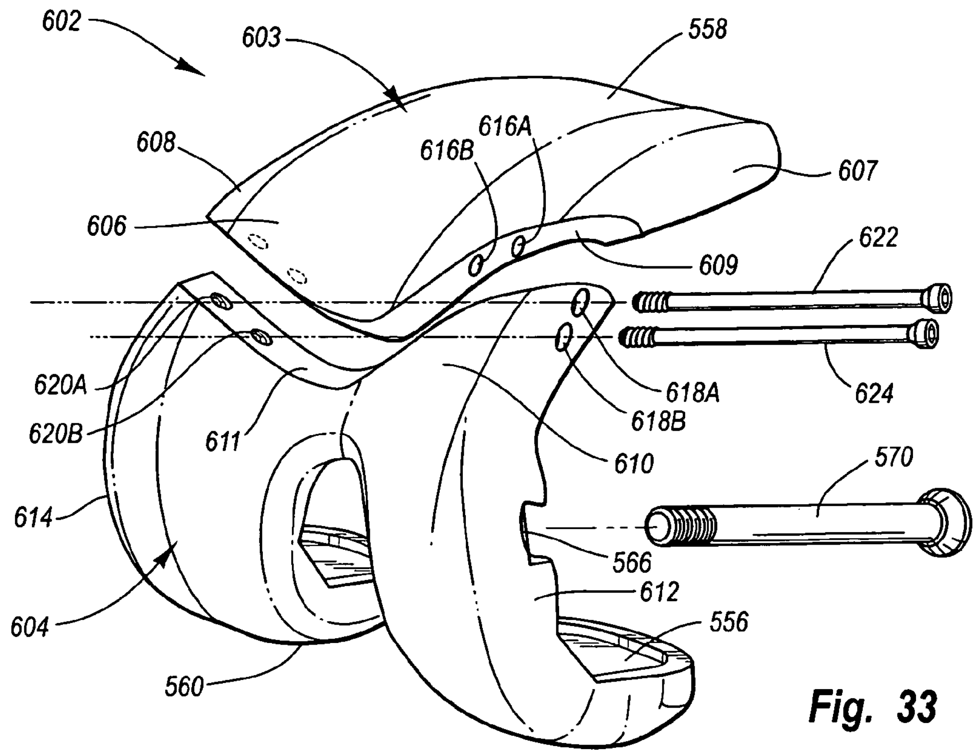
602
603
558
608
616A
616B
607
606
609
622
620A
620B
618A
624
611
618B
610
570
614
566
612
604
556
560

Fig. 33

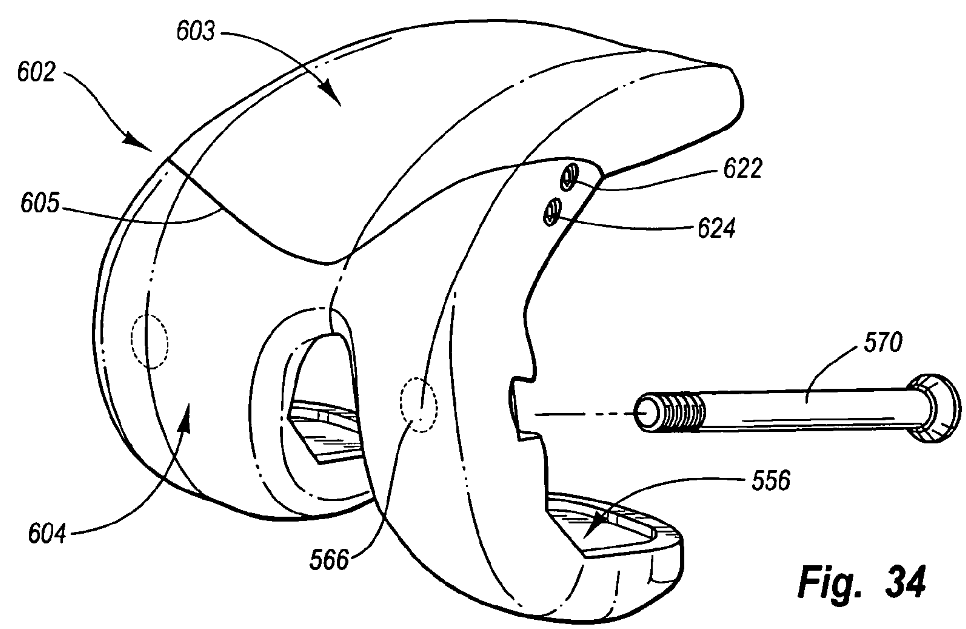
603
602
622
605
624
570
556
604
566

Fig. 34

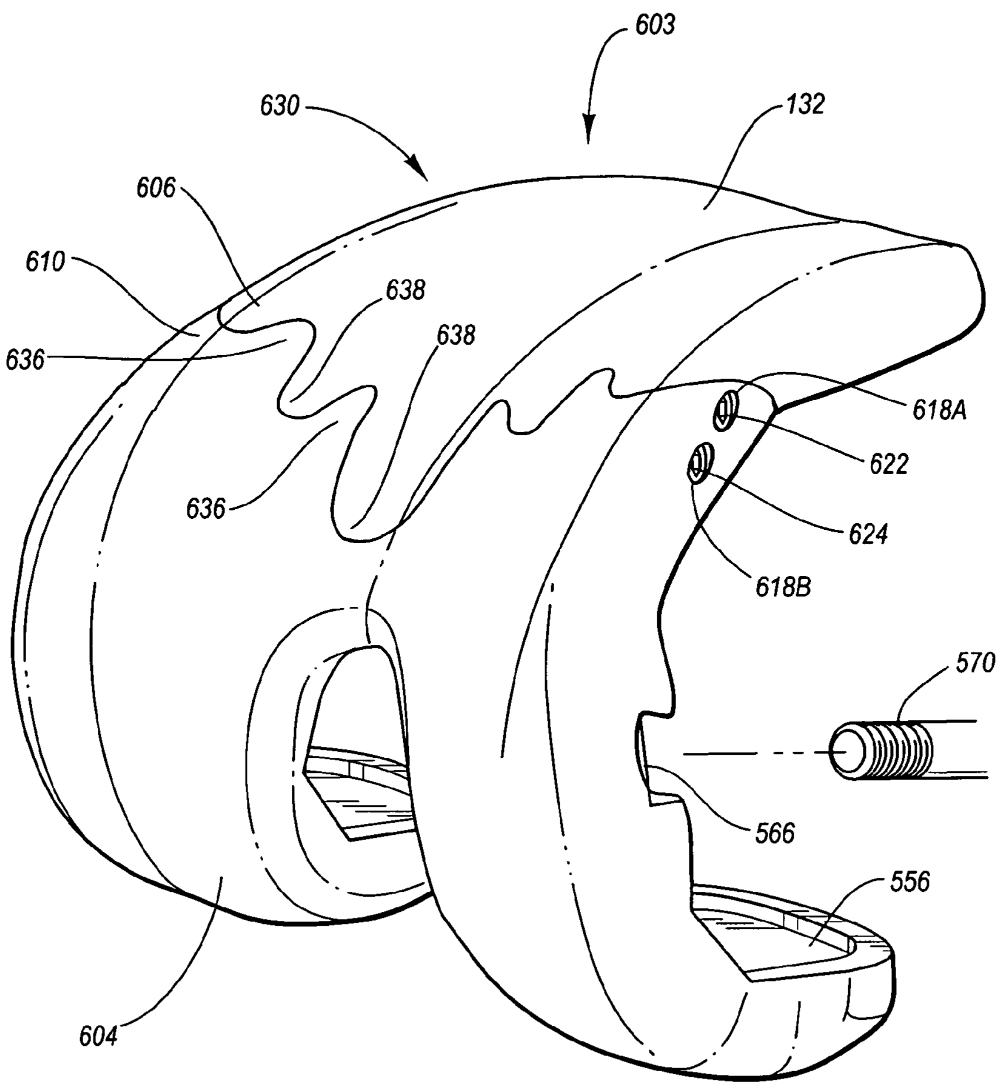
603
630
132
606
610
638
638
636
618A
622
636
624
618B
570
566
556
604

Fig. 35

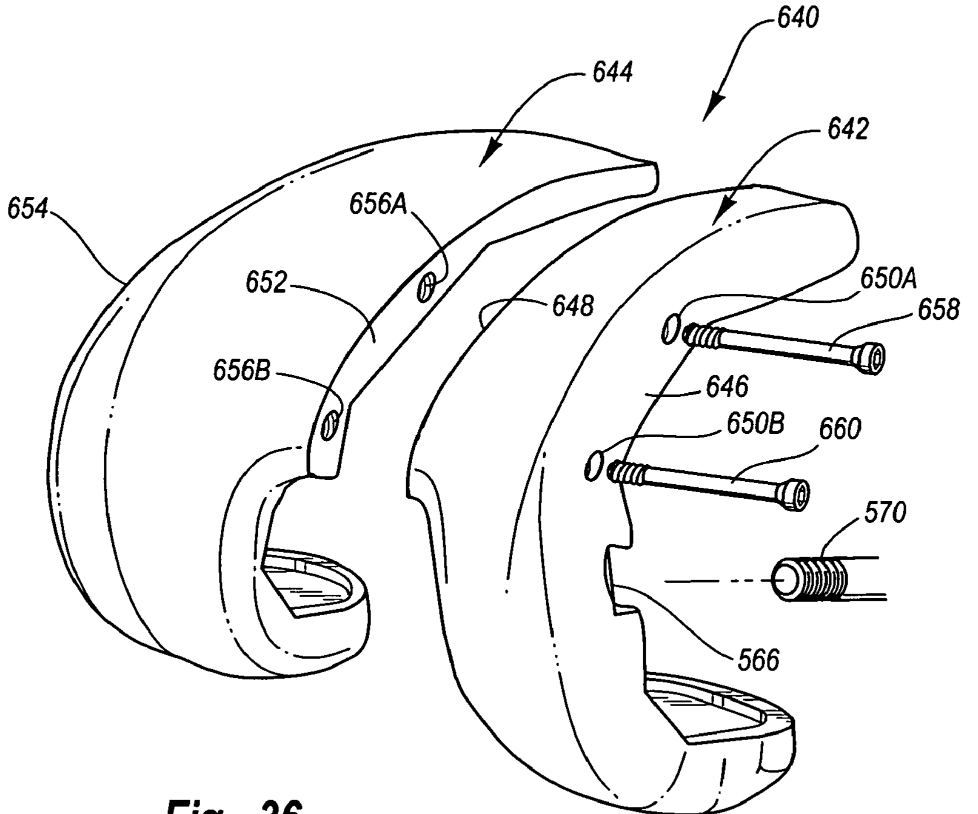
640
644
642
654
656A
652
648
650A
658
656B
646
650B
660
570
566

Fig. 36

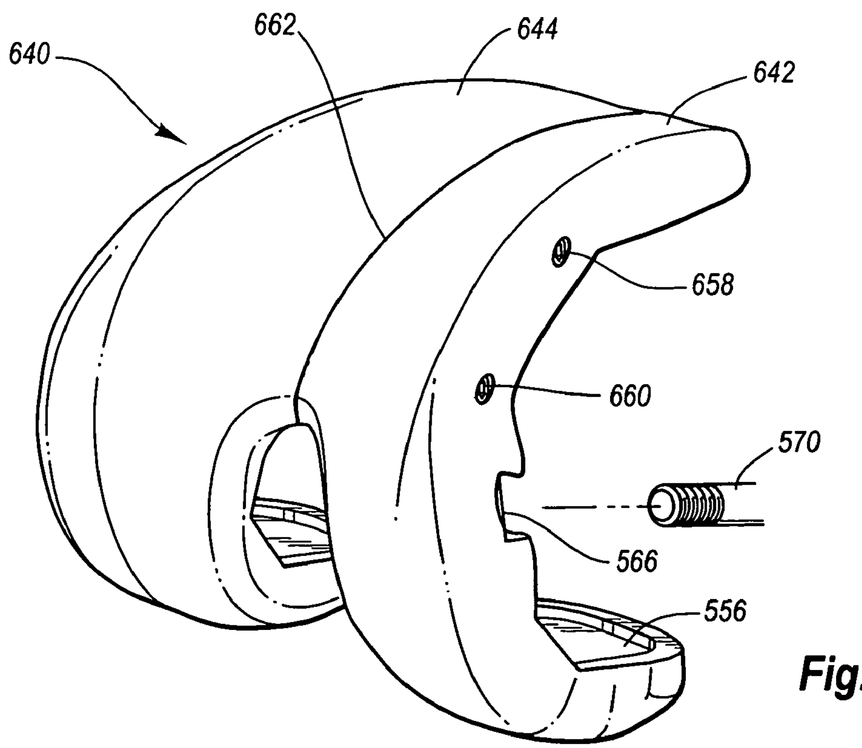
640
662
644
642
658
660
570
566
556

Fig. 37

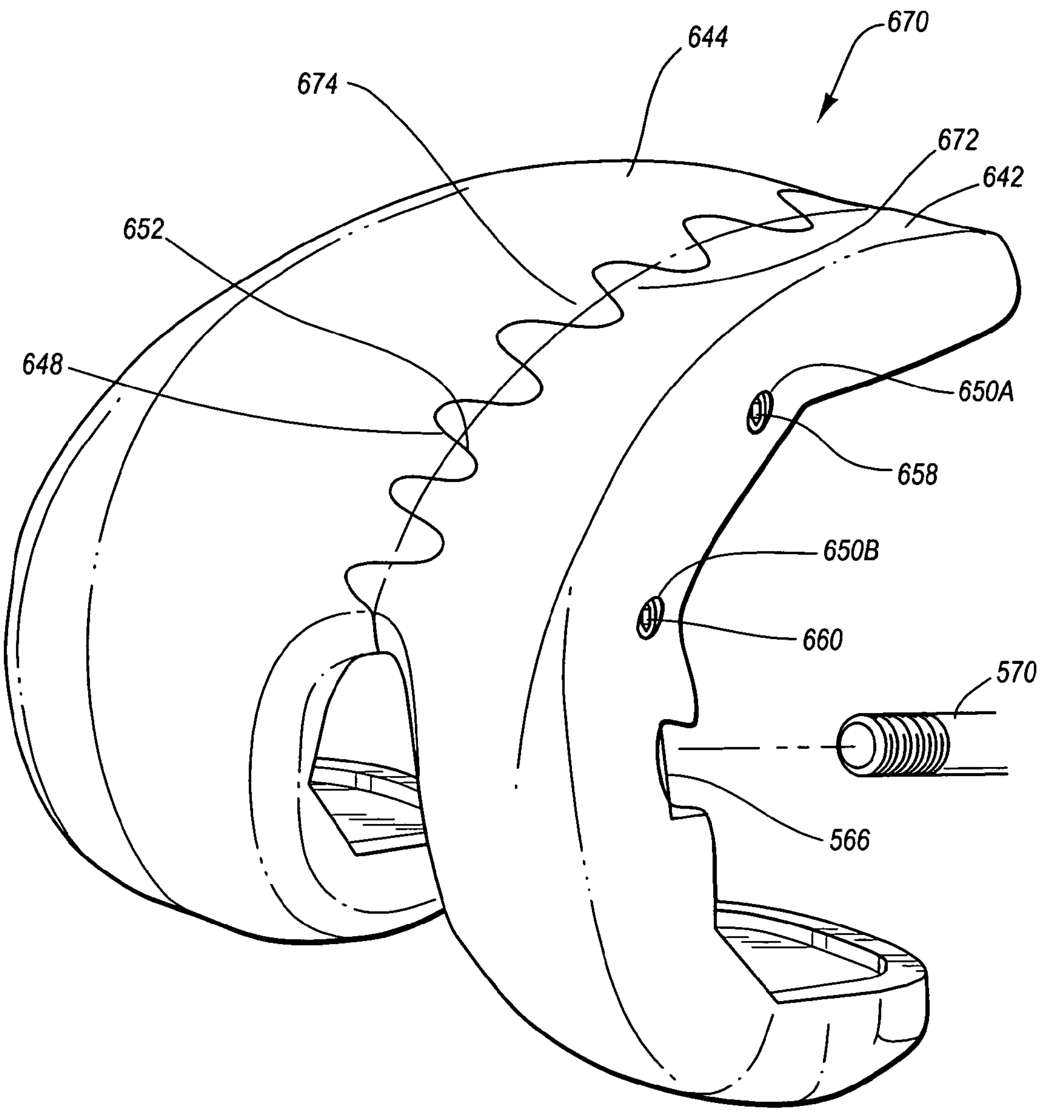

Fig. 38

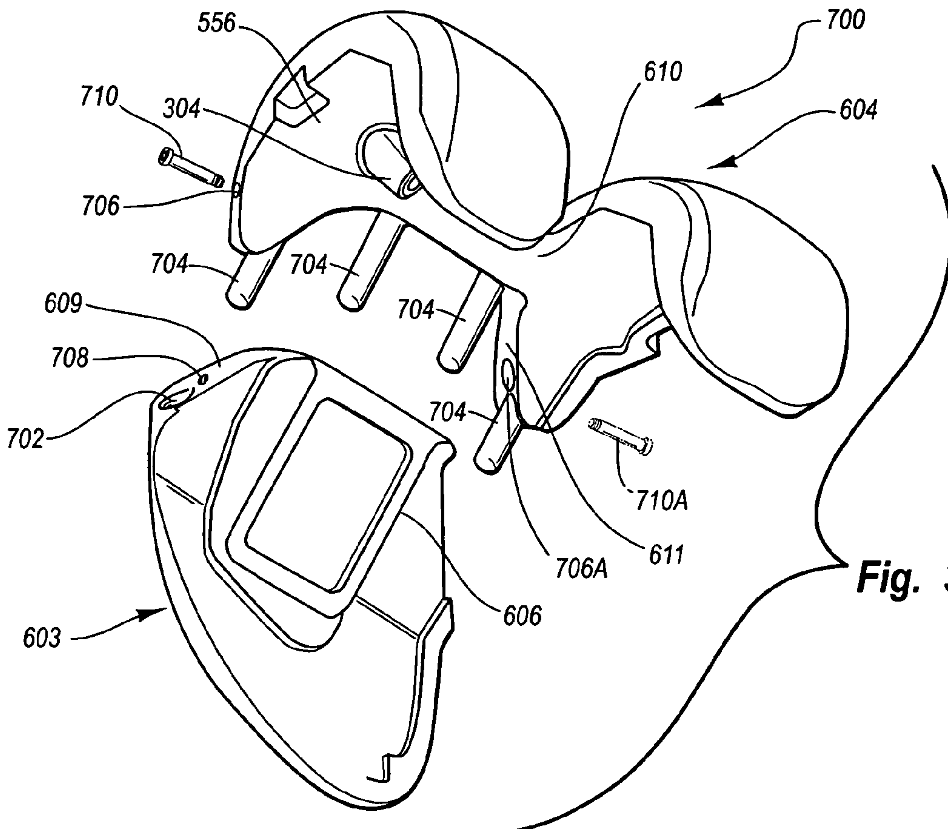

Fig. 39A

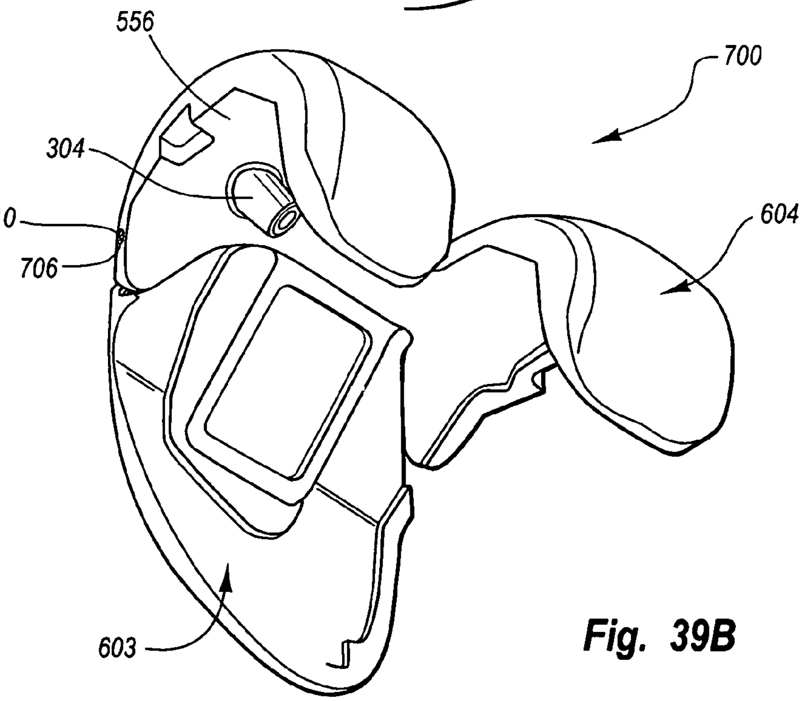

Fig. 39B

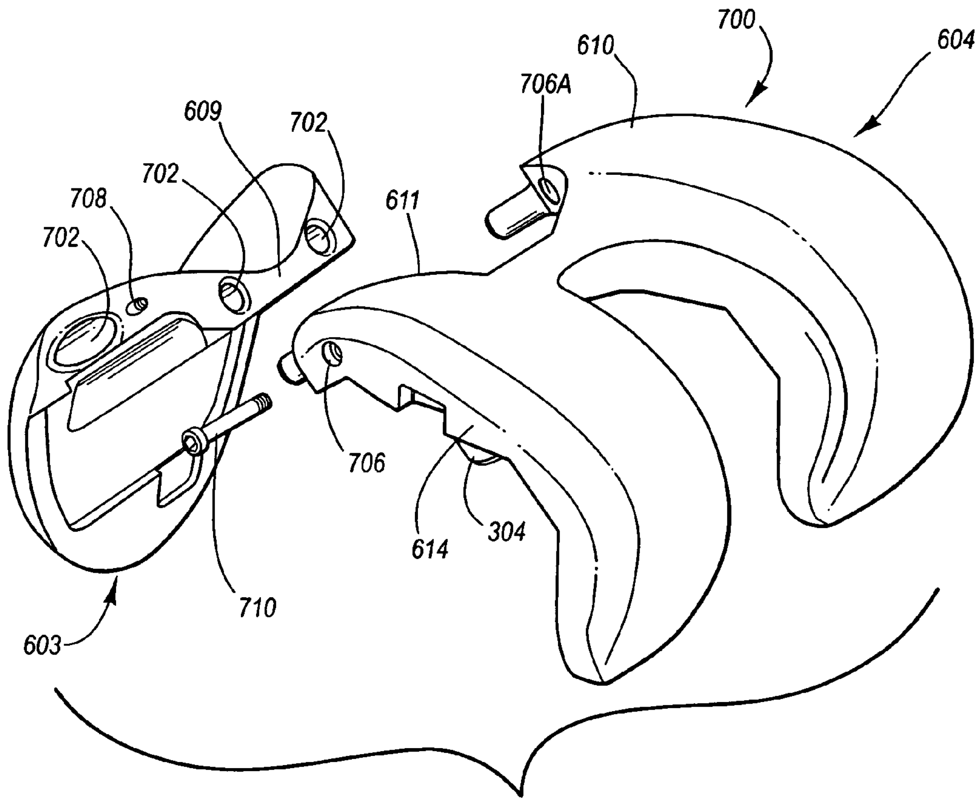

Fig. 39C

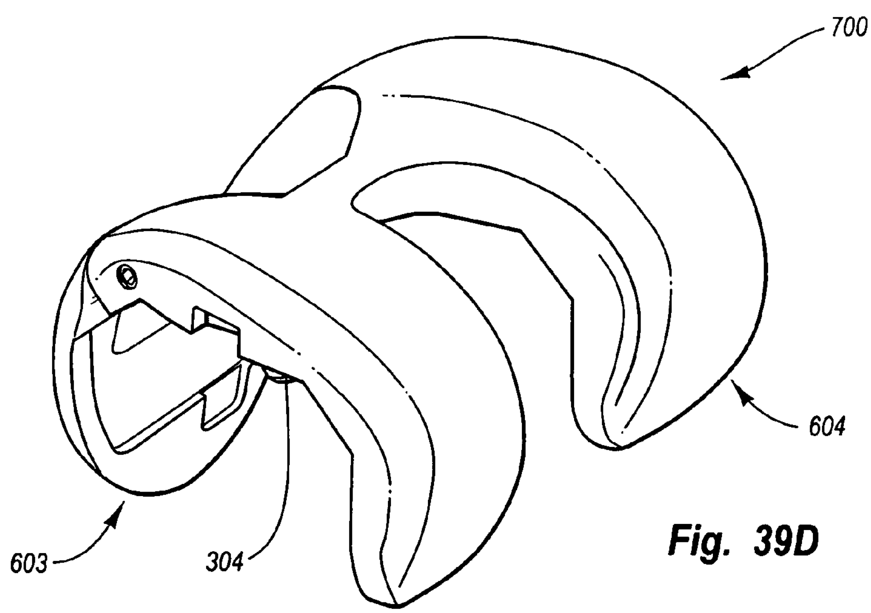

Fig. 39D

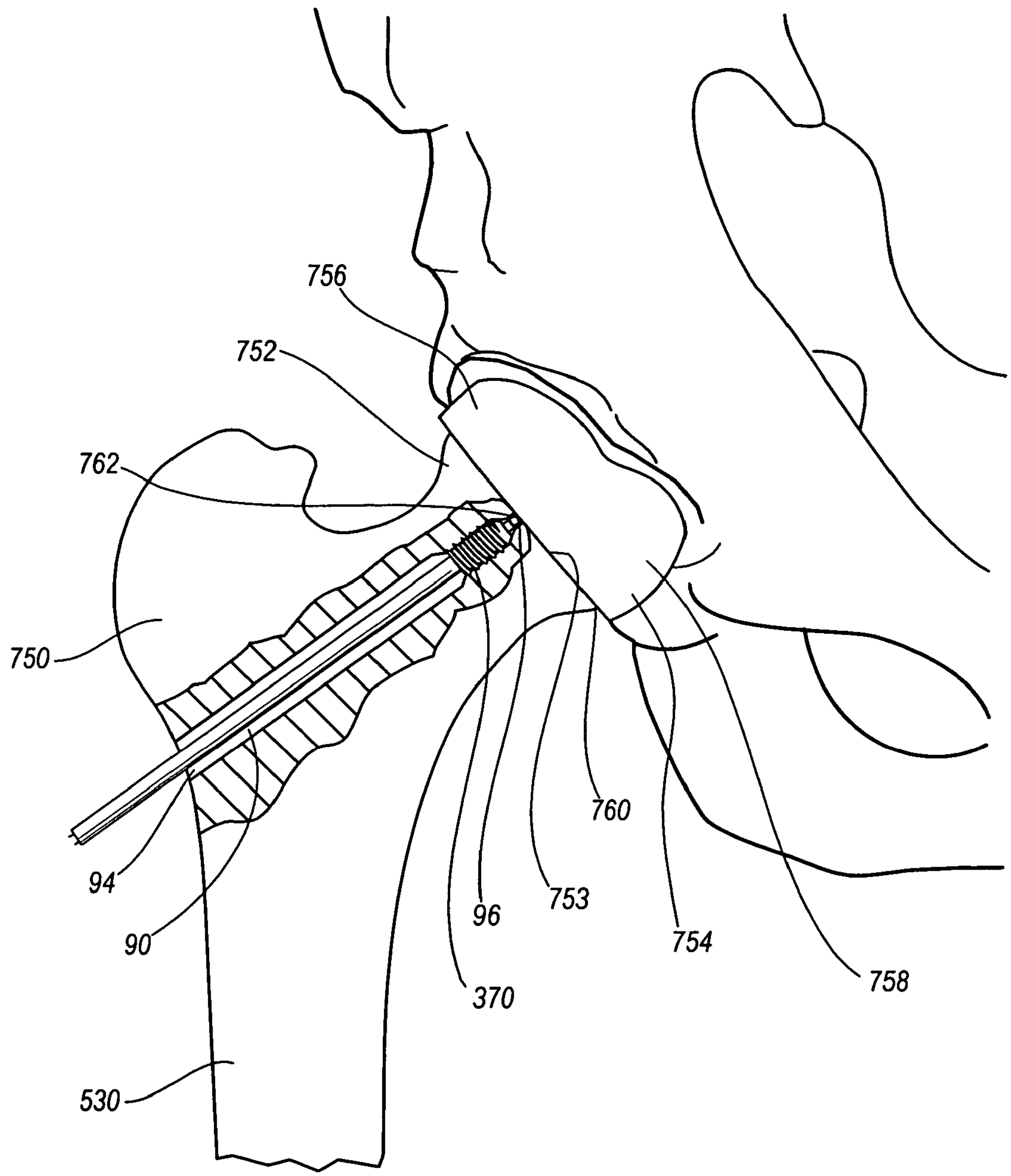

Fig. 40

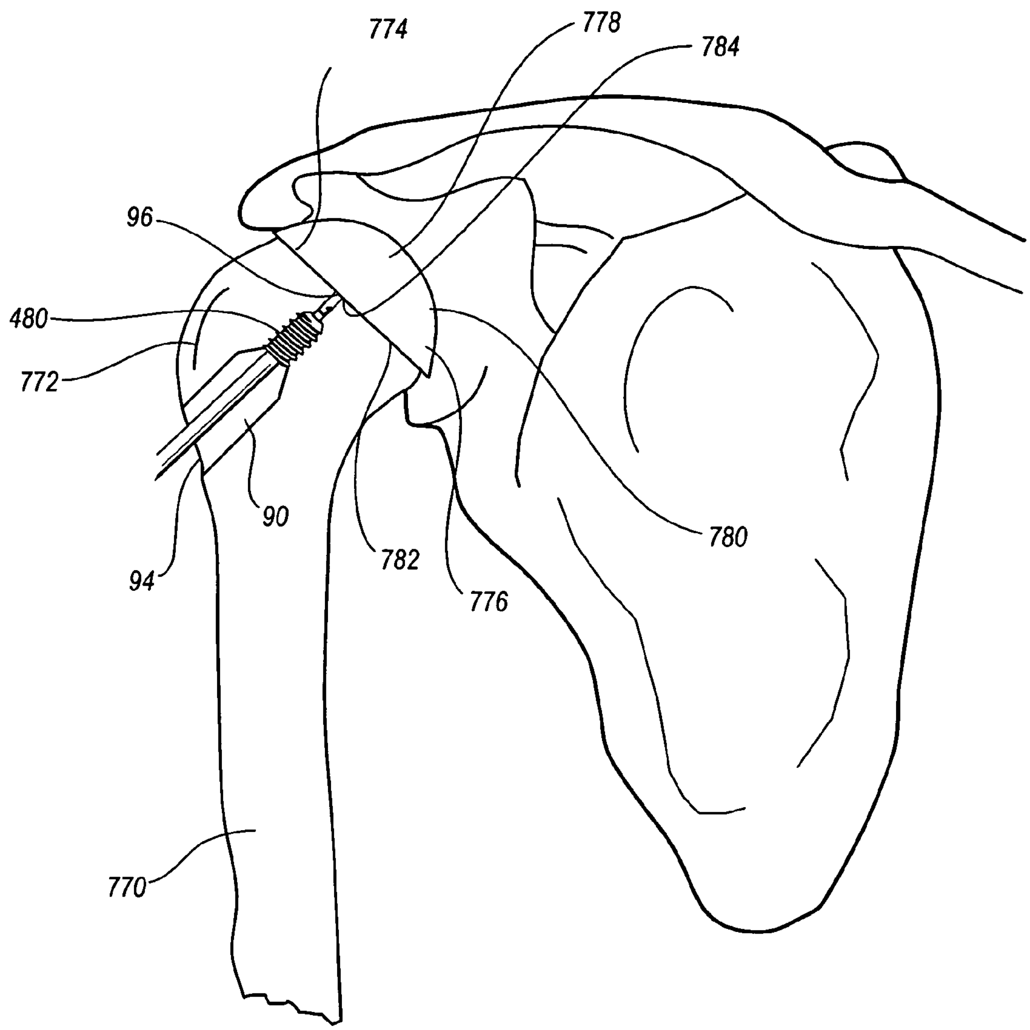

Fig. 41

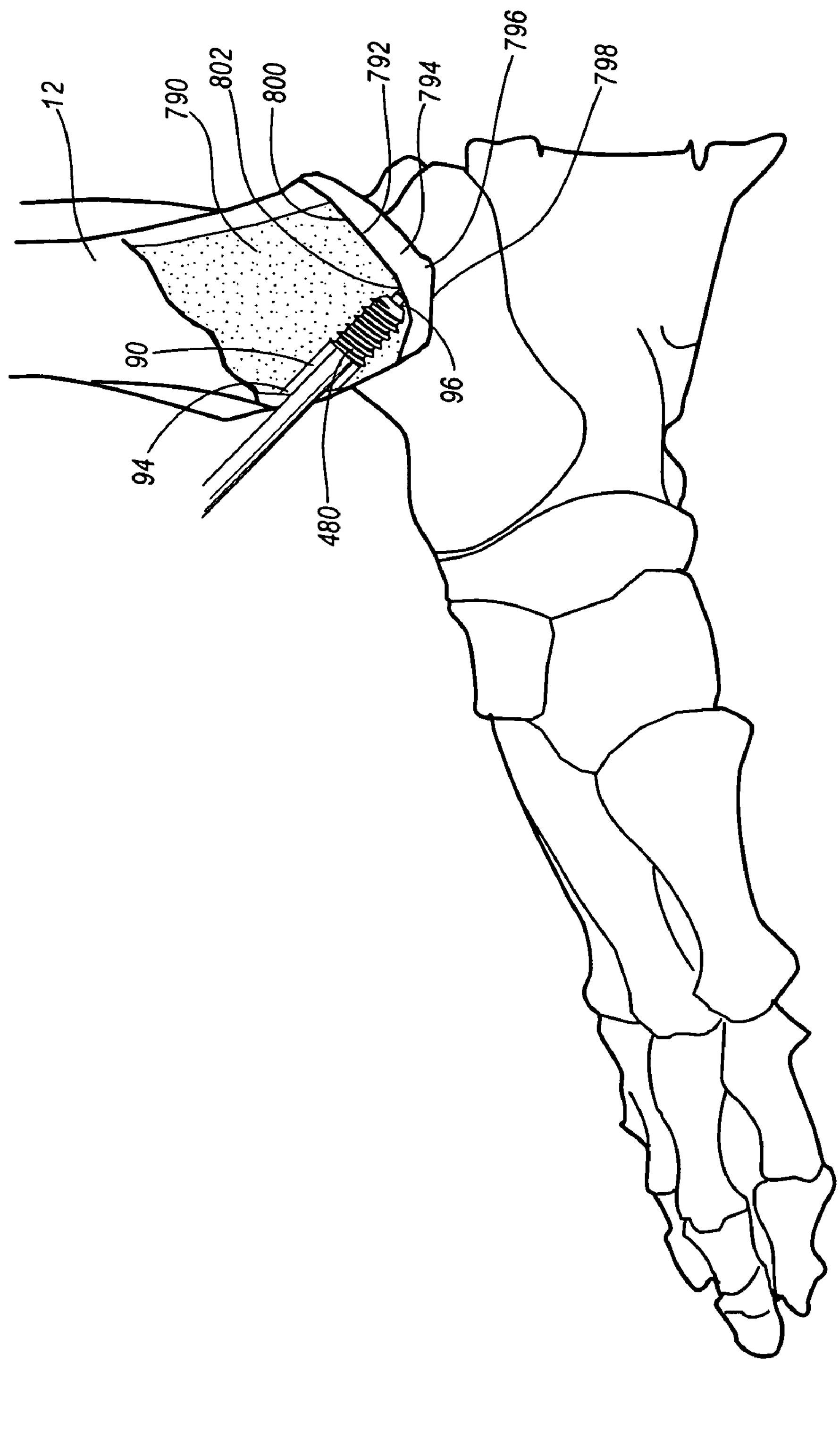

Fig. 42

IMPLANTS AND RELATED METHODS AND APPARATUS FOR SECURING AN IMPLANT ON AN ARTICULATING SURFACE OF AN ORTHOPEDIC JOINT

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-in-part of U.S. patent application Ser. No. 10/749,346, filed Dec. 30, 2003, now U.S. Pat. No. 7,771,483, and is a continuation-in-part of U.S. patent application Ser. No. 10/444,927, filed May 23, 2003, now U.S. Pat. No. 7,615,081, which claims priority to U.S. Provisional Application Ser. No. 60/383,348, filed May 24, 2002, which applications are incorporated herein by specific reference.

BACKGROUND OF THE INVENTION

1. The Field of the Invention

The present invention relates to implants and related methods and apparatus for mounting such implants on an articulating surface of an orthopedic joint of a patient.

2. The Relevant Technology

The human body has a variety of movable orthopedic joints such as the knee joint, hip joint, shoulder joint, and the like. These joints are formed by the intersection of two bones. The intersecting end of each bone has smooth articular surface that is comprised of cartilage. As a result of injury, wear, arthritis, disease or other causes, it is occasionally necessary to replace all or part of an orthopedic joint with an artificial implant. This procedure is referred to as a joint replacement or arthroplasty. For example, a total knee arthroplasty comprises cutting off or resecting the articular surfaces at both the distal end of the femur and the proximal end of the tibia. Complementary artificial implants are then mounted on the distal end of the femur and the proximal end of the tibia. Where only a portion of a joint is damaged, a partial joint arthroplasty can be performed. In this procedure, one or more artificial implants replace only a portion of a joint.

Although joint replacement is now a common procedure that has met with popular success, conventional implants and related mounting techniques have significant shortcomings. One significant drawback to many joint replacements is the extended and painful patient recovery. For example, a traditional knee replacement requires an open procedure wherein a relatively large incision is made which severs a portion of the muscle bounding the femur. The large incision is made so as to fully expose the respective ends of the femur and tibia.

This exposure is necessary when using conventional techniques to resect the femur and tibia and to mount the implants. For example, some conventional tibial implants are screwed directly into the resected end face of the tibia. Mounting such screws requires exposure of the resected end face. In yet other embodiments, the implants are formed with posts projecting therefrom. The posts are received within sockets formed on the resected end face of the tibia and femur. Again, forming of the sockets and inserting the posts into the sockets requires substantially full expose of the resected end face of the tibia and femur.

In general, the more invasive the surgery, the more painful, difficult, and time consuming the patient recovery. This is largely due to the significant amount of scar tissue produced the by incision and resection of various soft tissues. Furthermore, such open and invasive surgeries have a greater risk of infection.

Another problem with conventional joint implants and related techniques for mounting is that it can be difficult to fit, adjust, and/or exchange different implants during the fitting stage. That is, implants come in a variety of different sizes, shapes, and configurations. During the joint replacement procedure, the surgeon may often test a variety of different sized implants to determine the best fit and alignment. As conventional implants are screwed into or pounded onto the bone during placement, the fitting, adjustment, and/or replacement of different conventional implants can be difficult and potentially damaging to the bone. Likewise, it can often be difficult to replace worn or damaged implants.

Accordingly, what is needed are implants and related methods and systems for preparing an articular surface of a joint and mounting an implant thereat which minimizes the length of incision, the amount of bone resection, and/or the impact on soft tissue. What is also needed are implants and related methods and systems which enable easier fitting, alignment, testing, and/or replacement of implants.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of the present invention will now be discussed with reference to the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope.

FIG. **1** is a perspective view of the proximal end of a tibia;

FIG. **2** is a perspective view of a guide assembly for forming a tunnel on the proximal end of the tibia shown in FIG. **1**;

FIG. **2**A is a perspective view of an alternative template used with the guide assembly shown in FIG. **2**;

FIG. **3** is a perspective view showing the guide assembly in FIG. **2** mounted on the tibia of FIG. **1**;

FIG. **4** is a perspective view of the tibia shown in FIG. **1** having a tunnel formed thereon;

FIG. **5** is a perspective view of a rasp assembly resecting the tibia of FIG. **4**;

FIG. **6** is a top perspective view of the raps assembly shown in FIG. **5**;

FIG. **7** is a bottom perspective view of the rasp assembly shown in FIG. **6**;

FIG. **8** is an exploded perspective view of the retention rod shown in FIG. **5**;

FIGS. **9**A and **9**B are perspective views of the retention rod shown in FIG. **8** being mounted to the rasp assembly shown in FIG. **5**;

FIG. **10** is a perspective view of the tibia shown in FIG. **4** having a recess formed thereon;

FIG. **11** is a perspective view of a cutting template being mounted on the tibia shown in FIG. **4**;

FIG. **12**A is a top perspective view of a condylar implant;

FIG. **12**B is a bottom perspective view of the condylar implant shown in FIG. **12**A;

FIG. **12**C is an exploded perspective view of the condylar implant shown in FIG. **12**B;

FIG. **13** is a perspective view of an alternative embodiment of a condylar implant;

FIG. **14** is a perspective view of another alternative embodiment of a condylar implant;

FIG. **15**A is a top exploded perspective view of the condylar implant shown in FIG. **14**;

FIG. **15**B is bottom exploded perspective view of the condylar implant shown in FIG. **15**A;

FIG. **16**A is a top exploded perspective view of an alternative condylar implant;

FIG. **16**B is bottom exploded perspective view of the condylar implant shown in FIG. **16**A;

FIG. **17** is an exploded view of an anchor assembly for securing a condylar implant to the tibia shown in FIG. **10**;

FIG. **18** is a side view of the fastener of the anchor assembly shown in FIG. **17** being secured to the condylar implant positioned on the tibia;

FIG. **19** is a cross sectional perspective view of the bone anchor of the anchor assembly shown in FIG. **17**;

FIG. **20** is a side view of the bone anchor shown in FIG. **19** being mounted to the tibia shown in FIG. **18**;

FIG. **21** is a side view of a crown nut of the anchor assembly shown in FIG. **17** being mounted to the fastener shown in FIG. **18**;

FIG. **22** is a cross sectional side view of the assembled anchor assembly shown in FIG. **17** securing the condylar implant to the tibia;

FIG. **23** is a perspective view of an alternative embodiment of the fastener shown in FIG. **17**;

FIG. **24** is an alternative embodiment of an anchor assembly;

FIG. **25** is a cross section side view of the anchor assembly shown in FIG. **24** securing a condylar implant to a tibia;

FIG. **26** is an exploded perspective view of an inventive full tibia implant for mounting on the proximal end of a tibia;

FIG. **27** is a perspective view of an inventive femoral implant for mounting on the distal end of a resected femur;

FIG. **28** is a perspective view of a femoral rasp assembly for resecting the distal end of a femur;

FIG. **29** is a perspective view of an alternative embodiment of a femoral rasp assembly for resecting the distal end of a femur;

FIG. **30** is an inside perspective view of the femoral implant shown in FIG. **27**;

FIG. **31** is a perspective view of the femoral implant shown in FIGS. **27** and **30** mounted to the femur shown in FIG. **27**;

FIG. **32** is a perspective view of an alternative embodiment of the femoral implant shown in FIG. **30**;

FIG. **33** is a perspective view of a laterally bisected, two-piece femoral implant in a disassemble state;

FIG. **34** is a perspective view of the implant shown in FIG. **33** in an assembled state;

FIG. **35** is a perspective view of an alternative embodiment of the implant shown in FIGS. **33** and **34**;

FIG. **36** is a perspective view of a longitudinally bisected, two-piece femoral implant in a disassemble state;

FIG. **37** is a perspective view of the implant shown in FIG. **36** in an assembled state;

FIG. **38** is a perspective view of an alternative embodiment of the implant shown in FIGS. **36** and **37**;

FIGS. **39**A-D are perspective views of another alternative embodiment of a laterally bisected, two-piece femoral implant;

FIG. **40** is a partial cross sectional side view of an inventive implant mounted on the proximal end of a femur;

FIG. **41** is a partial cross sectional side view of an inventive implant mounted on the proximal end of a humerus; and

FIG. **42** is a partial cross sectional side view of an inventive implant mounted on the distal end of a tibia.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to methods and apparatus for preparing an articulating surface of an orthopedic joint to receive an implant, implants for mounting at an articulating surface of an orthopedic joint, anchoring systems for securing an implant at an articulating surface of an orthopedic joint, and related methods and instruments. As used in the specification and appended claims, the terms "articulating surface" and "natural articulating surface" are broadly intended to include all natural articular surfaces of a bone forming a portion of an orthopedic joint and all articulating wear surfaces of a bone forming a portion of an orthopedic joint which are produced as a result of ware, trauma, disease, or other causes which remove all or a portion of the natural articular surface.

The implants, anchoring systems, instruments, and methods of the present invention can be used in combination to mount an inventive implant or can be used separately or in combinations with other conventional implants, anchoring systems, instruments and/or methods. It is appreciated that the implants, anchoring systems, instruments, and methods of the present invention can be used for mounting an implant on virtually any articulating surface of any orthopedic joint in a human or other mammal. By way of example and not by limitation, the implants, anchoring systems, instruments, and methods of the present invention can be used in association with resurfacing an articulating surface of a knee joint, ankle joint, hip joint, shoulder joint, elbow joint, wrist joint, interphalangeal joint, or other joints. As such, the implants can be mounted on the proximal end and distal end of the femur, tibia, humerus, radius, and ulna, and on the articular surfaces of the scapula, pelvis, bones within the foot and hand, and other bone articular surfaces. Likewise, the implants, anchoring systems, instruments, and methods of the present invention can be used in facilitating a partial joint arthroplasty or a total joint arthroplasty.

In one embodiment, the implants, anchoring systems, instruments, and/or methods of the present invention are designed so that an articulating surface of a joint can be prepared and an implant mounted thereon using procedures that are minimally invasive. As a result, recovery time is significantly improved while the damage to soft tissue if decreased and the risk of infection minimized. Also in one embodiment of the present invention, the implants, anchoring systems, instruments, and/or methods are designed so that the implant can be selectively adjusted, tightened, and/or loosened after the implant is positioned on the articulating surface. This ability allows for greater ease in adjustment and fitting of an implant at the time of initial placement and for greater easy in replacement of an implant.

Set forth below are several embodiments of the present invention used in association with preparing an articulating surface at a proximal end of a tibia and mounting a condylar implant at the proximal end of the tibia. It is again noted that these embodiments are only given by way of example and that one skilled in the art based on the teaching provided herein would be able to use corresponding implants, methods, and instruments to prepare and/or mount an implant on other joint articulating surfaces.

Depicted in FIG. **1** is a proximal end **10** of a tibia **12**. Proximal end **10** has a lateral side **14** and a medial side **16** which each extend between an anterior side **18** and a posterior side **19**. Proximal end **10** further comprises a lateral condyle **20** and a medial condyle **21**. Lateral condyle **20** terminates proximally at a lateral facet **22** of a superior articular surface of tibia **12** while medial condyle **21** terminates proximally at medial facet **24** of a superior articular surface of tibia **12**.

Although tibia **12** shown in FIG. **1** is from a left leg, it is appreciated that the tibia of the right leg has a complimentary configuration and that the methods and apparatus of this specific example are equally applicable thereto. Furthermore, the methods and apparatus of this example are primarily illustrated in association with medial condyle **21** of tibia **12**. It is also appreciated that the methods and apparatus can be used in association with lateral condyle **20**.

In one embodiment, to facilitate mounting of a condylar implant on medial condyle **21**, conventional arthroscopic procedures are used to resect the posterior portion of the medial meniscus. Once the posterior portion of the medial meniscus is removed, a vertical or horizontal incision, generally in a range between about 2 cm to about 6 cm, is formed over the anterior side of the medial meniscus. Following retraction of the surrounding tissue, the anterior side of the medial meniscus is resected. A coarse rasp is then inserted between the medial condyle of the femur and medial condyle **21** of tibia **12**. The rasp is used to remove approximately 1-2 mm of articular cartilage on medial facet **24** of tibia **12**. Removal of the meniscus and the articular cartilage provides increased access to medial facet **24** of tibia **12**.

Depicted in FIG. **2** is one embodiment of a guide assembly **30** which is now used for forming a tunnel through a portion of tibia **12**. As discussed below in greater detail, the tunnel can be used for preparing tibia **12** for a condylar implant and/or securing a condylar implant to tibia **12**. In general, guide assembly **30** includes a substantially U-shaped guide brace **32** having a template **34** and a tubular guide sleeve **36** mounted on opposing ends thereof. More specifically, guide brace **32** has a first end **38** and an opposing second end **40**. Recessed in first end **38** is a socket **42**.

Template **34** comprises a low profile base plate **44** having a top surface **46** and an opposing bottom surface **48** which each extend between a first end **50** and an opposing second end **52**. Although not required, in one embodiment bottom surface **48** has a configuration generally complementary to medial facet **24** of the superior auricular surface of tibia **12**. Base plate **44** typically has a maximum thickness extending between surfaces **46** and **48** in a range between about 1 mm to about 4 mm. Projecting from second **52** of base plate **44** is a stem **54**. Stem **54** is configured to be slidably received within socket **42** of guide brace **32**. A projection **56** downwardly extends from bottom surface **48** of base plate **44** at first end **50**. As depicted, projection **56** has the configuration of a narrow finger. In other embodiments, projection **56** can comprise an elongated ridge or other configurations.

Formed on second end **40** of guide brace **32** is an enlarged housing **60** having a passage **62** extending therethrough. A resiliently flexible clamp arm **64** is mounted to housing **60**. An aperture **66** extends through clamp arm **64** in general alignment with passage **62**.

Tubular guide sleeve **36** slidably extends through passage **62** and aperture **66**. Guide sleeve **36** has a proximal end **68** and an opposing distal end **70**. A plurality of sharpened teeth **72** are formed at distal end **70**. By pressing clamp arm **64** toward housing **60**, passage **62** and aperture **66** are aligned allowing guide sleeve **36** to freely slide within passage **62** and aperture **66** to a desired location. As clamp arm **56** is released, clamp arm **56** resiliently biases away from housing **60** so as to bind guide sleeve **36**, thereby securing guide sleeve **36** in the desired location. In alternative embodiments, it is appreciated that clamp arm **64** can be replaced with a set screw, clamp, or a variety of other types of fasteners that can be used to selectively secure guide sleeve **36** to second end **40** of guide brace **32**.

During use, as depicted in FIG. **3**, template **34** is slid over medial facet **24** of tibia **12**, i.e., the articulating surface, so that projection finger **56** catches on posterior side **19** of tibia **12**. Projection finger **56** thus facilitates proper positioning of template **34** and also helps to retain template **34** on medial facet **24**. It is appreciated that the size and shape of the lateral and medial facets of the superior articular surfaces of the tibia varies between different patients. As such, the present invention comprises a plurality of alternative templates **34** which are configured for placement on one of the lateral and medial facet and which each have a different configuration. As such a number of the alternative templates **34** can be initially test fitted to determine one that has a best fit for a particular patient.

For example, depicted in FIG. **2**A is one alternative template **34**A that is smaller than template **34**. Like elements between templates **34** and **34**A are identified by like reference characters. In further contrast to template **34**, template **34**A has a projection **56**A downwardly extending from second end **52** of base plate **44**. Projection **56**A thus biases against anterior side **18** or medial side **16** of tibia **12** to help properly position template **34**A. In yet other embodiments, in contrast to positioning the projection on one of the opposing ends of base plate **44**, the projection can be positioned along one of the opposing sides of base plate **44** so as to bias against lateral side **14** (when used on lateral facet **22**) or bias against medial side **16** of tibia **12**.

Once template **34** is selected and properly positioned on medial facet **24**, tubular guide sleeve **36** is advanced within housing **60** so that teeth **72** at distal end **70** bias against medial side **16** of proximal end **10** of tibia **12**. As such, tubular guide sleeve **36** biases against tibia **12** at a location spaced apart from the articulating surface of medial facet **24**. Guide sleeve **36** is then secured in place by releasing clamp arm **64**. By securing guide sleeve **36** against tibia **12**, guide assembly **30** is clamped onto tibia **12**. In one alternative embodiment, guide sleeve **36** can be biased against anterior side **18** of tibia **12**.

Next, a tubular drill sleeve **76** is inserted into tubular guide sleeve **60**. Positioned within drill sleeve **76** is a guide wire **78**. Using drill sleeve **76** as a guide, guide wire **78** is drilled through tibia **12** until guide wire **78** reaches template **34**, thereby forming a guide tunnel. In part, template **34** functions as a shield to prevent guide wire **78** and/or other drill tools from accidentally contacting and damaging the femur. In other embodiments, a hole or recess is formed on template **34**. Guide wire **78** can passed through or into the hole or recess to ensure complete formation of the tunnel on medial facet **24**.

Once the guide tunnel is formed, guide wire **78** and drill sleeve **76** are removed from guide sleeve **60**. A larger drill tool, not show, such as a larger guide wire, drill bit, or the like is then passed through guide sleeve **60** and drilled through tibia **12** along the guide tunnel to form a final tunnel **90** (FIG. **4**) through tibia **12**. It is appreciated that any number of progressively larger drill tools can be used. In alternative embodiments guide wire **78** and drill sleeve **76** can be eliminated. A single larger drill tool can then be used to form tunnel **90** in a single pass. Using a sequence of larger drill tools, however, helps ensure proper placement of tunnel **90** and facilitates forming the opening of the tunnel adjacent to template **34**.

As discussed below in greater detail, the angular orientation of tunnel **90** is typically held constant and is based on the configuration of the implant. However, depending on the amount of bone needed to be resected for mounting the condylar implant, it may be necessary to shift the position of tunnel **90** posterior or anterior. Shifting the position of tunnel **90** posterior-anterior is accomplished by selectively moving stem **54** of template **34** further into or further out of socket **42** of guide brace **32**. Once template **34** and guide brace **32** are positioned at their relative positions, a set screw **80** is tightened so as to secure template **34** and guide brace **32** together.

Predefined markings **82** are formed on stem **54** to help define the relative positioning between template **34** and guide brace **32**.

Once tunnel **90** is formed, guide assembly **30** is removed so as to produce tibia **12** shown in FIG. **4**. As depicted, tunnel **90** has an interior surface **92** that extends from a first end **94** to an opposing end second end **96**. First end **94** is formed on medial side **16** of proximal end **10** of tibia **12**. Second end **96** is formed on medial facet **24** of tibia **12**. Expressed in other terms, second end **96** of tunnel **90** is formed on a section of an articulating surface, i.e., medial facet **24**, while first end **94** is at a location on tibia **12** that is spaced apart from the articulating surface. Although tunnel **90** can be any desired size, in one embodiment tunnel **90** has a diameter in a range between about 5 mm to about 10 mm.

Using the above discussed methods and instruments, tunnel **90** is formed by procedures that are minimally invasive to the patient. As discussed below in greater detail, once tunnel **90** is formed, tunnel **90** can then be used to assist in the resection of medial fact **24** and/or the mounting of a condylar implant on the resected medial facet **24**. Furthermore, by using tunnel **90** the resection of medial facet **24** and the mounting of the condylar implant can also be performed using procedures that are minimally invasive.

Although not required, in one embodiment as mentioned above tunnel **90** is used in the resection of tibia **12** for preparing tibia **12** to receive a condylar implant. The resection of tibia **12** can be accomplished using a number of different procedures. For example, as depicted in FIG. **5**, is one embodiment of a rasp assembly **100** is used in association with a retention rod **102** to facilitate resection of tibia **12**.

As depicted in FIG. **6**, rasp assembly **100** comprises a rasp body **104** having a pivot arm **105** mounted thereon, a rasp guide **106**, and a cover plate **108**. More specifically, as depicted in FIGS. **6** and **7**, rasp body **104** has a top surface **110** and an opposing bottom surface **112** that each extend between a proximal end **114** and an opposing distal end **116**. Transversely extending across bottom surface **112** are a plurality of ridges **118** that each terminate at a sharpened cutting edge **120**. It is appreciated that ridges **118** and cutting edges **120** can be at any desired orientation or combination of different orientation that facilitate cutting. Bottom surface **112** is configured such that reciprocating movement of bottom surface **112** on tibia **12** produces a recess on tibia **12** that can receive a desired implant. Recessed on top surface **110** of rasp body **104** is a guide slot **122**. Guide slot **122** is bounded by a floor **124** and a sidewall **126** upstanding from floor **124**. Extending through floor **124** to bottom surface **112** is an opening **128**.

Rasp guide **106** comprises a slide plate **130** having a top surface **131** and an opposing bottom surface **133**. Downwardly projecting from bottom surface **133** are a pair of spaced apart forks **132**A and **132**B with a pin **134** extending therebetween. Forks **132**A and B have facing interior surfaces **136** which bound a gap **137** and have opposing exterior surfaces **138**. Forks **132**A and B terminate at a free terminus **140**. Exterior surface **138** of each fork **132**A and B is recessed at terminus **140** such that a sloping shoulder **142** is formed on each fork **132**A and B.

Rasp guide **106** is received within guide slot **122** so that forks **132**A and B project through opening **128**. Rasp guide **106** is slightly smaller than guide slot **122** such that forks **132**A and B are free to reciprocate within opening **128** as slide plate **130** reciprocates within guide slot **122**. As shown in FIG. **5**, cover plate **108** is secured within guide slot **122** so as to retain rasp guide **106** within guide slot **122**. Cover plate **108** can be mounted using conventional techniques such as welding, press fit, and the like. Holes **144** are formed through cover plate **108** to prevent unwanted build-up of resected bone particles within guide slot **122**.

As depicted in FIG. **6**, pivot arm **105** has a proximal end **146** and an opposing distal end **148**. A set hole **149** extends through pivot arm **105** toward proximal end **146**. Distal end **148** of arm **105** is hingedly mounted to proximal end **114** of rasp body **104** by a pin **150**.

In one embodiment, an insertion handle **160** is used to place rasp body **104** over medial facet **24** of tibia **12**. Insertion handle **160** has a proximal end **162** and an opposing distal end **164**. A post **165** is formed a proximal end **162**. Post **165** is adapted to receive an extension handle if desired. A pair of spaced apart lips **166**A and B project from distal end **164** and bound a slot **163**. A channel **168** (FIG. **5**) longitudinally extends through insertion handle **160** so as to communicate with slot **163**. Channel **168** is configured to receive pivot arm **105** when rasp body **104** is received within slot **163**.

During use, pivot arm **105** is slid into channel **165** from between lips **166**A and B. Lips **166**A and B are then advanced to extend above and below proximal end **114** of rasp body **104**. A set screw **168** (FIG. **7**) is then advanced into insertion handle **160** so as to extend through set hole **149** on pivot arm **105**. In this configuration insertion handle **160** rigidly supports rasp body **104** so as to prevent hinged movement of rasp body **104** during insertion.

Turning to FIG. **8**, retention rod **102** comprises a tubular set rod **172** bounding a channel **174** extending from a proximal end **176** to an opposing distal end **178**. Distal end **178** terminates at a distal end face **179**. A handle **180** outwardly projects from proximal end **176** to facilitating grasping retention rod **102**.

Retention rod **102** further comprises a hook rod **182**. Hook rod **182** has a proximal end **184** and an opposing distal end **186**. Projecting from distal end **186** is a hook **188**. Threads **190** are formed on proximal end **184**. A knob **192** is also provided having a threaded port **193**. Threads **190** on hook rod **182** are configured to mate with threaded port **193** of knob **192**. Hook rod **182** is received within channel **174** of set rod **172** such that knob **192** biases against handle **180** and hook **188** extends beyond distal end face **179**. In this configuration, rotation of knob **192** relative to hook rod **182** causes hook **188** to extend or retract relative to set rod **172**.

During operation, as depicted in FIG. **5**, rasp assembly **100** is mounted on medial facet **24** of tibia **12**. Rasp assembly **100** is positioned using the rigidly mounted insertion handle **160**, as discussed above, such that forks **132**A and B (FIG. **7**) are aligned with the second end **96** of tunnel **90**. Once rasp assembly **100** is positioned, retention rod **102** is advance within tunnel **90** from first end **94**. As depicted in FIG. **9**A, knob **192** is rotated so that hook **188** extends beyond set rod **172**. With hook **188** freely exposed, hook **188** is hooked over pin **134** extending between forks **132**A and B.

As depicted in FIG. **9**B, once hook **188** has captured pin **134**, knob **192** is rotated so as to advance set rod **172** toward hook **188**. Set rod **172** is advanced until distal end face **179** of set rod **172** biases against shoulders **142** of forks **132**A and B. Shoulders **142** are sloped such that end face **179** can sit flush against shoulder **142** while set rod **172** retains its orientation within tunnel **90**. In this configuration, retention rod **102** is securely fixed to rasp guide **106**.

Once retention rod **102** is secured to rasp assembly **100**, insertion handle **160** is removed from pivot arm **105**. A reciprocal driver, such as a reciprocal saw, not shown, is then connected pivot arm **105**. While holding rasp guide **106** substantially stationary by holding onto retention rod **102**, the reciprocal driver rapidly reciprocates rasp body **104** so that cutting edges **120** resect medial facet **24** of tibia **12**. In one embodiment, rasp body **104** reciprocates along a length in a range between about 1 mm to about 4 mm. Other dimensions can also be used.

In one embodiment bottom surface **112** of rasp body **104** slightly arched so as to be convex. By having pivot arm **105** hingedly attached to rasp body **104**, rasp body **104** is free to reciprocate along the arched path. The hinged attachment also helps to minimize binding of rasp body **104**. In alternative embodiments, arm **105** can be rigidly attached to rasp body **104**.

In one embodiment of the present invention means are provided for removably engaging retention rod **102** with rasp body **104** such that rasp body **104** can be selectively reciprocated without substantial movement of retention rod **102**. By way of example and not by limitation, one embodiment of the means comprises rasp guide **106** slidably mounted on rasp body **104** and hook **188** mounted on retention rod **102**. In alternative embodiments it is appreciated that a variety of different structures can accomplish the same function. For example, pin **134** and hook **188** can be replaced with a threaded connection, bayonet connection, or any number of other conventional connections which allows retention rod **102** to engage with rasp guide **106**.

It is also appreciated that rasp guide **106** can be mounted on rasp body **104** in a variety of different ways. For example, opening **128** can extend through rasp body **104** without the formation of guide slot **122**. In this embodiment slide plate **130** can be positioned directly on top surface **110** of rasp body **104** while forks **132**A and B extend through opening **128**. In yet another alternative, guide slot **122** can be formed on bottom surface **112** of rasp body **104**. Cover plate **108** can be formed having opening **128** extending therethrough and cutting edges **120** formed on a bottom surface thereof. Slide plate **130** can be positioned within the guide slot **122** so that when cover plate **108** is secured over guide slot **122**, forks **132**A and B extend through opening **128** formed on cover plate **108**.

It is also appreciated that retention rod **102** can have a variety of different configurations. For example, in alternative embodiments set rod **172** can be eliminated. As such, retention rod **102** can simply comprise hook rod **182**. Furthermore, as discussed above, hook **188** can be replaced with a variety of different types of connectors.

Once medial facet **24** has been sufficiently resected by rasp body **104**, rasp assembly **100** and retention rod **102** are removed. The resected bone particles are removed by conventional flushing and suction. As depicted in FIG. **10**, tibia **12** now has a resected recess **194** formed on medial facet **24**.

It is appreciated that the resection of tibia **12** can be accomplished using a variety of different techniques. For example, in one alternative depicted in FIG. **11**, the resection of tibia **12** is accomplished by cutting through an area bounded by a cutting template **200**. Cutting template **200** comprises a plate **202** having a top surface **204** and an opposing bottom surface **206**. In the embodiment depicted cutting template **200** is configured to rest on lateral facet **22** of tibia **12**. Of course, cutting template **200** can also be designed for resting on medial facet **24**.

Extending between opposing surfaces **204** and **206** are a plurality of guide spaces **208**. Guide spaces **208** are formed so that when cutting template **200** is positioned, guide spaces **208** are positioned over at least a portion of the facet to be resected. In the embodiment depicted, guide spaces **208** have the configuration of an elongated channel. As will be discussed below in greater detail, the channels facilitate guided receipt of a cutting burr **210** which is used to selectively remove the unwanted bone. In alternative embodiments, depending on the type and size of tool used to remove the bone, guide spaces **208** can come in a variety of different sizes, shapes, and orientations.

In one embodiment, although not required or shown, a second cutting template is provided having guide spaces extending therethrough. In the second cutting template, the guide spaces are aligned so as to bound the area of the facet to be resected which was blocked by plate **202** of cutting template **200**. As a result, by sequentially using both cutting templates, all or at least a greater proportion of the bone can be removed by cutting burr **210**. Additional cutting templates can also be used.

Cutting template **200** is used in association with retention rod **102** as previously discussed. In the embodiment depicted, handle **180** has a different configuration. During use, cutting template **200** is position over lateral facet **22**. Distal end **178** of set rod **172** is advanced through tunnel **90** so that hook **188** of hook rod **182** projects out of set rod **172**. Hook **188** is passed though a guide space **208** and then pulled back onto top surface **204** of plate **202**. A rib **212** upwardly projects from plate **202** adjacent to guide space **208**. Hook **188** is hooked over rib **212** so as to improve the engagement between hook **188** and cutting template **200**.

Once hook **188** is engaged to cutting template **200**, knob **192** is rotated so as to bias set rod **172** against bottom surface **206** of template **200**. As a result, retention rod **102** is securely clamped to cutting template **200**. Accordingly, by pulling retention rod **102**, cutting template **200** is securely held in place on lateral facet **22**. Cutting burr **210** or some other form of drill bit is then advanced into and along each of guide spaces **208** so as to resect the portion of the bone directly below guide space **208**. As previously discussed, in one embodiment cutting template **200** can be removed and replaced with a second template. Burr **100** can then be passed through guide spaces of the second template to remove further bone that was covered by cutting template **200**.

In other alternatives, it is appreciated that once cutting template **200** is removed, the remaining bone portion can be removed by sight and feel without the use of a template. In yet other embodiments, depending on the type and amount of bone needed to be resected, a single template can be rotated or shifted on lateral facet **22** so that the single template is used to remove the desired bone.

In one embodiment of the present invention, means are provided for removably engaging retention rod **102** to cutting template **200** so that retention rod **102** secures cutting template **200** to the lateral or medial facet of tibia **12** when retention rod **102** is received within tunnel **90** of tibia **12**. By way of example and not by limitation, one embodiment of such means comprises hook **188** and guide space **208** which enables hook **188** to engage with cutting template **200**.

The present invention also envisions that there are a variety of other structures that can accomplish the same function. For example, the same structures and techniques as discussed above for securing retention rod **102** to rasp assembly **100** can also be used with cutting template **200**. That is, in one alternative forks **132**A and B with pin **134** can be mounted on bottom surface **206** of plate **202**. Other connections such as threaded connection, bayonet connections, and the like can also be used.

By using the above discussed instruments and methods, the lateral and medial facets of tibia **12** can be selectively resected by procedures that are minimally invasive.

Depicted in FIGS. **12A-12C** is one embodiment of a condylar implant **300** incorporating features of the present invention. The term "condylar implant" is broadly intended to include implants that can replace all or a portion of a condyle of a tibia. The condylar implant can also replace all or a portion of the articular surface of the condyle. Accordingly, while the depicted embodiments show one conventional size and configuration for a condylar implant, in alternative embodiments the condylar implant can be larger to replace more of the tibia or can be smaller to replace only a section of a condyle of a tibia. In such alternatives, the condylar implant can have a variety of different configurations.

In general, condylar implant **300** comprises a body **301** having a top articular surface **306** and an opposing bone apposition surface **303**. In one embodiment, top articular surface **306** is contoured to mate with a corresponding femoral condyle. A stem **304** projects from bone apposition surface **303**. Body **301** comprises a bearing plate **302** having top articular surface **306** and an opposing bottom surface **308**. A pocket **316** is recess on bottom surface **308**. Pocket **316** is bounded by a floor **317** and a sidewall **318** upstanding around the perimeter thereof. As discussed below in greater detail, an inlay **320** is disposed within pocket **316**.

Stem **304** projects from bottom surface **308** of bearing plate **302** and terminates at a distal terminus **310**. Recessed within distal terminus is a threaded socket **312**. Bearing plate **302** and stem **304** are typically comprised of a metal such as chromium, cobalt, titanium, or the like and alloys thereof but can also be made of ceramics or plastics. Bearing plate **302** and/or stem **304** can also be comprised of layers or sections of different materials. In one embodiment, bearing plate **302** has a maximum thickness typically in a range between about 2 mm to about 10 mm. Other dimensions can also be used depending on the amount that the tibial condyle is resected or worn away.

In one embodiment of the present invention, means are provided for connecting a fastener to stem **304**. One example of such means comprises threaded socket **312** as discussed above. In alternative embodiments, the threads within the socket on stem **304** could be replaced with bayonet slots, bayonet posts, ribs which are configured to mate with barbs or other forms of connectors. The socket can also be filled with an adhesive. In still other embodiments, the socket can be eliminated and threads, bayonet posts, barbs or other forms of connections can be formed on the exterior of stem **304**.

Secured within pocket **316** so as to encircle stem **304** is inlay **320**. Inlay **320** is comprised of a porous bone ingrowth material such as porous tantalum. Other conventional porous bone ingrowth materials can also be used. Inlay **320** is secured within pocket **316** using conventional techniques such as press fit, welding, adhesive, and the like. Inlay **320** has an exposed bottom surface **322** that can be substantially flat, arched, or can have any other desired configuration. In this embodiment, bottom surface **322** of inlay **320** comprises substantially all of bone apposition surface **303** of base plate **301**.

Centrally extending through stem **304** is a central longitudinal axis **314**. In one embodiment, stem **304** projects from floor **317** so as to form an angle θ between central longitudinal axis **314** and inlay **320** in a range between about 30° to about 60°. Other angles can also be used. Stem **304** typically has a length in a range between about 2 mm to about 10 mm. Other dimensions can also be used.

It is appreciated that condylar implant **300** can have a variety of alternative configurations. For example, stem **304** is primarily formed to provide sufficient room for socket **312** when bearing plate **302** has a relative small thickness. As the thickness of bearing plate **302** increases, stem **304** can be increasingly shortened as more of socket **312** can be formed directly into bearing plate **302**. As such, in some embodiments stem **304** can be eliminated in that all of socket **312** can be formed directly on bearing plate **302**.

Furthermore, in the depicted condylar implant **300**, pocket **316** is formed to receive inlay **320**. In alternative embodiments pocket **316** can be eliminated and a section of the porous bone ingrowth material can be mounted on the bottom surface of bearing plate **302** using other conventional fastening techniques such as adhesives, screws, alternative press fits, and the like. Furthermore, in contrast to one pocket **316**, a plurality of spaced apart pockets can be formed on bottom surface **308** with each pocket receiving a separate inlay **320**. Here it is noted that spikes, fins, or other forms of projections can also be formed projecting from bottom surface **308** of bearing plate **302**. These projections can penetrate into the tibia or be received within slots formed on the tibia to help prevent movement of bearing plate **302**.

In still other embodiments, it is appreciated that inlay **320** or other forms of the porous bone ingrowth material can be eliminated. In this embodiment, the condylar implant can comprise a single integral member. For example, depicted in FIG. **13** is an alternative embodiment of a condylar implant **300**A. Implant **300**A is formed as a single integral body **301**A having top articular surface **306** and bone apposition surface **303**. Implant **300**A can also be characterized as comprising a bearing plate that is free to pockets or inlays. The bottom surface of the bearing plate comprises bone apposition surface **303**. Because of the increased thickness of implant **300**A, stem **304** is eliminated. Threaded socket **312** is formed directly on bone appositions surface **303**. Projections **309** extend from surface **303**.

In yet another alternative embodiment, depicted in FIG. **14** is a condylar implant **326**. Like elements between condylar implants **300** and **326** are identified by like reference characters. In contrast to condylar implant **300** which is fixed and rigid, condylar implant **326** is mobile. Specifically, condylar implant **326** comprises a lower bearing plate **328** from which stem **304** projects and an upper bearing plate **330** that is slidably mounted on lower bearing plate **328**.

As depicted in FIGS. **15**A and B, lower bearing plate **328** has a top surface **332** and an opposing bottom surface **334** with a perimeter edge **335** extending therebetween. Pocket **316** is formed on bottom surface **334** to receive inlay **320**. Top surface **332** is substantially flat or inwardly arched and extends between an anterior end **336** and a posterior end **338**. A track **340** is recessed on top surface **332**. Track **340** has an open mouth extending through perimeter edge **335** at anterior end **336** and longitudinally extends toward posterior end **338**. Track **340** is bounded by a substantially flat floor **343** having a sidewall **344** upstanding therefrom. Sidewall **344** comprises a recess groove **345** which extends along floor **343** and an outwardly projecting lip **346** which projects along top surface **332**. As such, the opposing sidewalls **344** of track **340** form a mortis.

Upper bearing plate **330** comprises top articular surface **306** and a bottom surface **348** which each extend between an anterior end **350** and an opposing posterior end **352**. Bottom surface **348** has a configuration substantially congruent to top surface **332** of lower bearing plate **328**. Projecting from bottom surface **348** is an elongated key **354** which extends from toward anterior end **350** to toward posterior end **352**. Key **354** has a sidewall **356** that is substantially complementary to sidewall **344** of tack **340** such that key **354** forms a tenon that can slide into track **340** from mouth **342**. In this position key **354** can freely slide along track **340** but is prevented from vertically separating from track **340**.

During use, upper bearing plate **330** can slide posterior-anterior on lower bearing plate **328** as the femoral condyle rotates on top articular surface **306**. This ability of upper bearing plate **330** to slide minimizes high stress points between the femoral condyle and upper bearing plate, thereby minimizing wear. Furthermore, because bearing plates **328** and **330** slide against each other on congruent surfaces, both of bearing plates **328** and **330** can be comprised of metal without producing undue wear. In other embodiments, bearing plates **328** and **330** can be comprised of plastics, ceramics, or composites of different materials. In addition, bearing plates **328** and **330** can be made of the same or different materials.

Although key **354** and track **340** are shown as being linear, in alternative embodiments they can be congruently curved to more naturally correspond to the bending movement of the knee. For example, depicted in FIGS. **16**A and B is another alternative embodiment of a condylar implant **360** which includes an upper bearing plate **361** and a lower bearing plate **362**. In this embodiment, lower bearing plate **362** includes a track **363** that is curved along the length thereof. Upper bearing plate **361** includes an elongated key **364** having a curve complementary to track **363** such that key **364** can freely slide within track **363**. As previously discussed, key **364** and track **363** can also be arched or curved in a vertical plane.

Depicted in FIG. **17** is one embodiment of an anchor assembly **370** used to secure condylar implant **300** to tibia **12**. Anchor assembly **370** comprises a fastener **372**, a bone anchor **374**, and a crown nut **376**. Fastener **372** comprises an elongated shaft **380** having an exterior surface **381** extending between a proximal end **382** and an opposing distal end **384**. In one embodiment, fastener **372** has a length greater than 8 mm and more commonly greater 15 mm. Other dimensions can also be used.

Formed at distal end **384** of shaft **380** are threads **386** that are configured to threadedly mate with threaded socket **312** of stem **304**. Outwardly projecting proximal of threads **386** is an annular flange **388** which functions as a stop when fastener **372** is threaded into stem **304**. Recessed into proximal end **382** is a socket **390**. A pair of opposing bayonet slots **392** longitudinally extend through the sidewall bounding socket **390**. Finally, encircling and radially outwardly projecting from exterior surface **381** between proximal end **382** and flange **388** are engagement threads **394**.

As depicted in FIG. **18**, condylar implant **300** is mounted within recess **194** such that stem **304** is received within second end **96** of tunnel **90**. Here it is noted that because condylar implant **300** has a relatively low profile, condylar implant **300** can be easily passed through the relatively small incision that was originally formed over the medial meniscus. This is in contrast to other conventional procedures where larger incisions must be made to either allow placement of an implant having a large stem that is embedded within the bone for securing or to provide access room to enable securing of the implant by passing screws down through the top of at least a portion of the implant.

Once implant **300** is positioned, a fastener driver **400** has a distal head **402** (FIG. **17**) that is configured to be received within socket **390** of fastener **372**. A pair of opposing bayonet prongs **404** project from head **402** and are configured to mate within bayonet slots **392**. With fastener driver **400** secured to proximal end **382** of fastener **372**, fastener driver **400** is used to advance distal end **384** into tunnel **90** through first end **94**. Fastener **372** is advanced through tunnel **90** so that threads **386** are received within socket **312** of stem **304**. Fastener driver **400** is then rotated so that fastener **372** is threaded into stem **304**.

Next, bone anchor **374** is secured within tunnel **90**. In one embodiment, a tap, not shown, is used to initially thread interior surface **92** of tunnel **90**. This can be accomplished before or after positioning of fastener **372**. Alternatively, bone anchor **374** can be self-tapping.

As depicted in FIG. **17**, bone anchor **374** comprises a tubular body **410** having a substantially cylindrical configuration. Body **410** includes an interior surface **412** and an exterior surface **414** that each extend between a proximal end **416** and an opposing distal end **418**. Distal end **418** includes a tapered nose **420**. Encircling and radially outwardly projecting from exterior surface **414** are one or more helical threads **422**. As mentioned above, the threads can be conventional or self-taping. In alternative embodiments, threads **422** can be replaced by ridges, barbs, or other bone engaging structures used in conventional bone anchors. Bone anchor **374** can be formed of a biocompatible metal, a bioabsorbable polymer, a bioactive ceramic, or any other desired material.

As depicted in FIG. **19**, interior surface **412** bounds a channel **424** longitudinally extending through bone anchor **374**. Interior surface **412** comprises a first sidewall **426** extending from proximal end **416**, a second sidewall **430** extending from distal end **418**, and an annular shoulder **432** extending between first sidewall **426** and second sidewall **430**. First sidewall **426** has a maximum diameter that is greater than the maximum diameter of second sidewall **430**. As such, shoulder **432** is tapered so as to constrict from first sidewall **426** to second sidewall **430**. First sidewall **426** bounds a socket **430** which is configured to receive a tool for rotation of bone anchor **374**. As such, first sidewall **426** has a non-circular transverse cross section. In typical embodiments, first sidewall **426** has a polygonal transverse cross section.

Turning to FIG. **20**, a distal end **435** of a tubular anchor driver **436** is received within engagement socket **438** of bone anchor **374**. Distal end **435** has a polygonal configuration complementary to socket **438** such that rotation of anchor driver **436** rotates bone anchor **364**. Bone anchor **374** and anchor driver **436** are passed over the proximal end of fastener driver **400** and advanced to first end **94** of tunnel **90**. By rotating anchor driver **436**, bone anchor **374** is screwed into tunnel **90** using fastener driver **400** as a guide. Bone anchor **374** is sized so that threads **422** engage with interior surface **92** of tunnel **90**, thereby securing bone anchor **374** to tibia **12** within tunnel **90**. Bone anchor **374** is advanced so that bone anchor **374** encircles engagement threads **394** of fastener **372**. Using fastener driver **400** as a guide for bone anchor **374** helps to concentrically dispose bone anchor **374** around fastener **372**.

Once bone anchor **374** is positioned, anchor driver **436** is removed and crown nut **376** is positioned. As depicted in FIG. **17**, crown nut **376** comprises a rounded head **440** having a threaded bore **442** extending therethrough. Projecting from head **440** are a plurality of spaced apart prongs **444** having notches **446** formed therebetween. Crown nut **376** is configured to mate with a nut driver **450**. Nut driver **450** comprises a tubular shaft **452** that terminates at a distal end **454**. Projecting from distal end **454** are a plurality of spaced apart prongs **456**. Prongs **456** are configured to mate with crown nut **376** by being received within notches **446**. In this mated configuration, rotation of nut driver **450** facilitates rotation of crown nut **376**.

Turning to FIG. **21**, with crown nut **376** mounted on nut driver **450**, crown nut **376** and nut driver **450** are passed over the proximal end of fastener driver **400**. Nut driver **450** is used to advance crown nut along fastener driver **400**, into tunnel **90**, and over fastener **372**. Threaded bore **442** of crown nut **376** is configured to threadedly mate with engagement threads **394** on fastener **372**. Accordingly, once crown nut **376** is advanced over fastener **372** to engagement threads **394**, nut driver **450** is rotated causing crown nut **376** to threadedly engage with engagement threads **394**.

As depicted in FIG. **22**, socket **428** of bone anchor **374** is larger than head of crown nut **376** such that crown nut **376** can freely pass therethrough. Shoulder **432**, however, constricts to a diameter smaller than the diameter of head **440** of crown nut **376**. Accordingly, crown nut **376** is advanced along fastener **372** by engaging with threads **394** until head **440** of crown nut **376** biases against shoulder **432** of bone anchor **374**. Tightening crown nut **376** against shoulder **432** produces tension on fastener **376** which tightly secures condylar implant **300** against tibia **12**.

In one embodiment, engagement threads **394** on fastener **372** rotate in a direction opposite threads **422** on bone anchor **374**. For example, engagement threads **394** can be right-hand threads while threads **422** are left-hand threads. As a result, rotation of crown nut **376** against bone anchor **374** does not cause bone anchor **364** to rotate concurrently. Furthermore, once crown nut **376** is initially positioned, nut driver **450** is removed. Anchor driver **436** can then be repositioned over fastener driver **400** so as to engage with bone anchor **374**. Anchor driver **436** can then be used to back bone anchor **374** a distance back toward first end **94** of tunnel **90**. In so doing, fastener **372** is further tensioned so as to increase the force securing condylar implant **300** on tibia **12**. Again, because threads **394** and threads **422** rotate in opposite directions, backing bone anchor **374** does not cause crown nut **376** to unscrew.

Finally, once crown nut **376** and bone anchor **374** are positioned in their final state, fastener driver **400** is removed from fastener **372**. Closing procedures for the tissue are then performed. In one alternative embodiment, bone anchor **374** can be eliminated. In this embodiment, crown nut **376** can be sized to bias directly against the bone so as to tension fastener **372**. For example, crown nut **376** can be tapered to bias against the bone surrounding the opening at first end **94** of tunnel **90**. In yet other embodiments, tunnel **90** can be counter bored so as to form a constricting shoulder within tunnel **90**. Crown nut **376** can be configured to bias against the constricting shoulder of tunnel **90**.

In still other embodiments, bone anchor **374** can be replaced with an insert that is fitted within tunnel and provides a hard bearing surface against which crown nut **376** can bear. For example, the insert can comprise a tubular member having a tapered exterior surface that biases against the bone and a tapered interior surface against which crown nut **376** can bias. In view of the foregoing, it is appreciated that crown nut **376** can have any desired configuration. Likewise, any type of attachment mechanism can be used to secure crown nut **367** to fastener **372**.

As discussed above, fastener driver **400** is useful as a guide in directing placement of bone anchor **374** and crown nut **376**. In contrast to being separately connected to fastener **372**, in one alternative embodiment the fastener driver can be integrally formed with fastener **372**. For example, depicted in FIG. **23** is a fastener system **460**. Fastener system **460** includes a fastener **462** and an elongated drive rod **464** integrally formed with fastener **462**. Like elements between fasteners **372** and **462** are identified by like reference characters. As with fastener **372**, fastener **462** includes flange **388** and threads **386** and **394**. Formed proximal of threads **394** is a mating region **468**. Mating region has a polygonal or other non-circular transverse cross section. As such removal or further tightening of fastener **462** can be accomplished by passing a tubular driver over fastener **462** so as to engage with mating region **468**.

In contrast to socket **390** of fastener **372**, fastener **462** is integrally formed with drive rod **464**. To facilitate separation of drive rod **464** from fastener **462**, a plurality of annular breaking grooves **466** encircle fastener system **460** at spaced apart locations along the junction between fastener **462** and drive rod **464**.

Fastener system **460** is used in substantially the same manner as fastener **372** and fastener driver **400**. However, once bone anchor **374** and crown nut **376** are finally positioned, fastener **462** and drive rod **464** are separated by breaking fastener system **460** at a annular breaking grooves **466** located adjacent to first end **94** of tunnel **90**.

It is appreciated that the anchor assembly for condylar implant **300** can have a variety of different configurations. For example, depicted in FIG. **24** is an alternative embodiment of an anchor assembly **480**. Anchor assembly **480** includes bone anchor **374**, as discussed above, and a fastener **482**. Like elements between fasteners **372** and **482** are identified by like reference characters. Fastener **482** includes a shaft **483** having a proximal end **484** and an opposing distal end **486**. Mounted at or toward distal end **486** are threads **386** and flange **388** as discussed above. Mounted at proximal end **484** is an enlarged rounded head **488** that terminates at an end face **490**. Recessed within end face **490** is a socket having a polygonal or other non-circular configuration. It is noted that head **488** has a maximum diameter that is smaller than the diameter of socket **424** of bone anchor **374** but larger than the minimum diameter of shoulder **432** of bone anchor **374**. As such, head **488** seats against shoulder **432** when passed through bone anchor **374**.

Turning to FIG. **25**, in contrast to anchor assembly **370** where fastener **372** is initially positioned, in anchor assembly **480** bone anchor **374** is initially secured within tunnel **90** using anchor driver **436**. Again, tunnel **90** can be pre-tapped or threads **422** on bone anchor **374** can be self-tapping. Once bone anchor **374** is positioned, a driver, not shown, is inserted within socket **492** of fastener **482**. The driver is then used to advance distal end **486** of fastener **482** into tunnel **90**, through channel **424** of bone anchor **374**, and into socket **312** of condylar implant **300**. The driver is then used to rotate fastener **482** so that threads **386** threadedly engage with socket **312**. Fastener **482** is advanced into socket **312** until flange **388** contacts the end face of stem **304**. The driver for fastener **482** is then removed.

Next, anchor driver **436** is inserted back into socket **428** of bone anchor **374**. This can be accomplished by passing anchor driver **436** over the driver for fastener **482** or by first removing the driver for fastener **482**. Anchor driver **436** is then used to back bone anchor **374** a distance toward first end **94** of tunnel **90**. In so doing, shoulder **432** of bone anchor **374** biases against head **488** of fastener **482**, thereby tensioning fastener **482** so as to securely bias condylar implant **300** against tibia **12**. It is appreciated that threads **386** of fastener **482** and threads **422** of bone anchor **374** rotate in opposite directions so that the backing of bone anchor **374** does not unscrew fastener **482** from condylar implant **300**.

It is appreciated that in alternative embodiments the various threaded connections used in association with the anchor assemblies can be replaced with bayonet connections, expanding collets, press fit barb connections, and other conventional connections commonly used in place of thread connections.

In one embodiment of the present invention means are provided for securing a fastener to the bone apposition side of an implant after the bone apposition surface of the implant is biased against the natural or resected articulating surface of the bone such that applying increased tension to the fasten increases the force at which the bone apposition surface biases against the natural or resected articulating surface of the bone. Examples of such means, which can be formed on implant **300** or any other implant within the scope of the present invention, include stem **304** which projects from the bone apposition surface. Stem **304** can include threaded socket **312** or the other alternatives to threaded socket **312**, as discussed above, which enable the connection of a fastener. Other examples of such means comprise the formation of threaded socket **312** directly on bone apposition surface as depicted in FIG. **13**. In other alternatives, the threads of socket **312** can be replaced with barbs, bayonet connectors, adhesive, or other alternative forms of connectors. Other examples of such means are discussed with other embodiment disclosed below.

By using the above discussed implants and anchor assemblies with the corresponding methods and instruments, it is appreciated that the implants can be securely mounted to tibia **12** using procedures that are minimally invasive. Furthermore, because the implants are only secured in place after they are positioned on the proximal end of the tibia, the surgeon can easily switch out different sizes of implants when trying to determine an appropriate fit. Likewise, because the anchoring assemblies are operated through the first end of the tunnel which is remote from the implant, the inventive anchoring assemblies enable the surgeon to easily adjust the placement of the implant during initial positioning and to subsequently remove the implant should a replacement be required at a later date.

Because the inventive implants, anchor assemblies, tissue preparation instruments, and corresponding methods each produce independently unique benefits, it is appreciated that theses various features can be used independently with other conventional apparatus and techniques. For example, in one embodiment a larger incisions can be made at the knee of a patient and the proximal end of tibia **12** resected using conventional resection techniques. In this embodiment, tunnel **90** can be formed either before or after the resection of tibia **12**. Once the tibia is resected and tunnel **94** formed, the above procedure can then be used to secure condylar implant **300**. In another alternative, tunnel **94** can be formed and tibia **12** resected as discussed above. However, once tibia **12** is resected, a conventional implant can be mounted on tibia **12** using conventional techniques.

In one alternative, distal end **384** of fastener **372** can initially be mounted on or integrally formed with condylar implant **300** (FIG. **17**) before implant **300** is positioned on the resected articulating surface. Proximal end **382** of fastener **372** can then be advanced into tunnel **90** from second end **96** (as opposed to first end **94**) as implant **300** is being positioned on the resected articulating surface. As discussed above, the bone anchor and crown nut can then be used to secure fastener **372** within tunnel **90**.

The above discussed embodiments relate to mounting a condylar implant on tibia **12**. As previously mentioned, however, the present invention can also be used to mount other types of implants on other articulating surface so as to achieve one or more of the same benefits. For example, depicted in FIG. **26** is a full tibial implant **500**. Tibial implant **500** comprises body **501** which includes a tray **502** and a bearing plate **504**. Tray **502** has a top surface **506** and an opposing bone apposition surface **509**. Top surface **506** bounds a pocket **508** which is configured to receive and lock bearing plate **504**. Bearing plate **504** has a top articular surface **510** and a bottom surface **512** which is selectively snap fit within pocket **508** of tray **502**.

In one embodiment, tray **502** is comprised of metal while bearing plate **504** is comprised of a polymeric material. It is noted that bearing plate **504** and tray **502**, as discussed above, are well known in the art and can be replaced with a variety of other conventional bearing plates **504** and trays **502** used in full tibial implants. The distinction over the prior art, however, is that tray **502** has been modified so that stem **304**, as previously discussed, projects from bone apposition surface **509**.

As also depicted in FIG. **26**, proximal end **10** of tibia **12** has been uniformly resected so as to form a resected articulating surface in the form of a tibial plateau **514**. Tunnel **90** includes second end **96** formed on tibial plateau **514** and first end **94** spaced apart from tibial plateau **514**. Tibia **12** can be resected to form tibial plateau **514** by using conventional techniques or by using a larger rasp assembly **100** in conjunction with retention rod **102** being disposed within tunnel **90**. Depending on the method used, tunnel **90** can be formed before or after resection of tibia **12**.

Once tibia **12** is resected, tray **502** is positioned on tibial plateau **514** so that stem **304** aligns with second end **96** of tunnel **90**. One of the above discussed anchor assemblies is then used to secure tray **502** to tibia **12**. Bearing plate **504** can be secured to tray **502** either before or after securing tray **502** to tibia **12**.

In one alternative, by increasing the thickness of tray **502**, stem **304** can be eliminated and replaced with socket **312** as discussed with regard to FIG. **13**. Furthermore, one or more pockets can be formed on bone apposition surface **509** of tray **502** so as to receive one or more inlays of bone growth material.

Features of the present invention can also be used for mounting a femoral implant on the distal end of a femur. Like elements between different embodiments are identified by like reference characters. For example, depicted in FIG. **27** is a distal end **532** of a femur **530**. Femur **530** has a posterior side **536** and an anterior side **538** that each extend between a medial side **540** and a lateral side **542**. The articulating surface at distal end **532**, notably the femoral medial condyle and lateral condyle, have been resected so as to form a resected articulating surface **534**.

Tunnel **90** is formed on femur **530**. Second end **96** of tunnel **90** extends through resected articulating surface **534** while first end **94** of tunnel **90** is formed on medial side **540** at a location spaced apart from resected articulating surface **534**. Tunnel **90** can be bored through femur **530** at an oblique angle α, as reflected in FIG. **30**. In one embodiment the angle α is in a range between about 15° to about 50° with about 20° to about 40° being more common. Other angles can also be used. Tunnel **90** can be bored by making an incision in the skin adjacent femur **530**, properly orienting a tubular alignment guide, then boring tunnel **90** with a drill through the alignment guide. In one embodiment tunnel **90** can be formed using a modified guide assembly similar to guide assembly **30** as previously discussed.

Resected articulating surface **534** can be formed using the present invention or other conventional resecting techniques. For example, depicted in FIG. **28** is a femoral rasp assembly **515** which has components similar to rasp assembly **100** previously discussed with regard to FIGS. **6-9**. Femoral rasp assembly **515** comprises a substantially U-shaped rasp body **516**, pivot arm **105**, rasp guide **106**, and cover plate **108**.

Insertion handle **160** is show removably disposed over pivot arm **105** and, if desired, can be used to initially place rasp assembly **515** on femur **530**. Rasp body **516** has a substantially concave cutting surface **517** having a plurality of ridges **118** formed thereon. Ridges **118** each terminate at sharpened cutting edge **120**. It is appreciated that ridges **118** and cutting edges **120** can be at any desired orientation or combination of different orientations that facilitate cutting.

As with rasp assembly **100**, extending through rasp body **516** is guide slot **122** and opening **128**. Rasp guide **106** is received within guide slot **122** so that forks **132**A-B pass through opening **128**. Cover plate **108** secures rasp guide **106** within guide slot **122**.

During operation, rasp assembly **515** is mounted on the distal end of femur **530** such that forks **132**A and B of rasp guide **106** are aligned with second end **96** of tunnel **90**. Once rasp assembly **515** is positioned, retention rod **102** (FIGS. **8** and **9**) is advance within tunnel **90** from first end **94** and connected to rasp guide **106** as previously discussed.

Once retention rod **102** is secured to rasp assembly **515**, insertion handle **160** is removed and a reciprocal driver, such as a reciprocal saw, is connected pivot arm **105**. While holding rasp guide **106** substantially stationary by holding onto retention rod **102**, the reciprocal driver rapidly reciprocates rasp body **516** so that cutting edges **120** resects the distal end of femur **530**. In the embodiment depicted, rasp body **516** is only designed to resect the medial side of the distal end of femur **530**. A complementary rasp assembly can then be used to resect the lateral side of the distal end of femur **530** using a second tunnel **90** extending through lateral side **542** of femur **530**, thereby forming resected articulating surface **534**.

In yet other embodiments, it is appreciated that multiple different rasp assemblies with one or more different tunnels can be used to resect femur **530** or a single rasp assembly can be configured to simultaneously resect the entire distal end of femur **530**. For example, depicted in FIG. **29** is another embodiment of a femoral rasp assembly **520**. Rasp assembly **520** comprises an arched rasp body **522**, pivot arm **105**, rasp guide **106**, and cover plate **108**. Rasp body **522** has a substantially concave cutting surface **524** having a plurality of ridges **118** formed thereon. As with rasp body **516**, extending through rasp body **522** is guide slot **122** and opening **128**. Rasp guide **106** is received within guide slot **122** so that forks **132**A-B pass through opening **128**. Cover plate **108** secures rasp guide **106** within guide slot **122**.

Rasp body **522** is configured to primarily resect the anterior surface at the distal end of femur **530**. As such, a corresponding tunnel **90** is need on femur **530** to ensure proper placement of rasp body **522** during resection. A complementary rasp body is then be used to resect the remainder of the distal end of femur **530**. For example, depicted in FIGS. **33-39** are alternative embodiments of two piece femoral implants. Corresponding two piece rasp bodies can be formed to resect the corresponding surfaces that receive the pieces of the femoral implants.

Furthermore, it is also appreciated that although resected articulating surface **534** is shown having a plurality of planar faces, in alternative embodiments the one or more rasp assemblies can be configured so as to produce resected articulating surface **534** having a continuous smooth arched surface or combinations of different surfaces.

In one embodiment of the present invention, a femoral implant **550** is provided incorporating features of the present invention. As depicted in FIGS. **27** and **30**, femoral implant **550** comprises a substantially U-shaped body **552** having an articular surface **554** and an opposing bone apposition surface **556** which each extend between an anterior end **558** and a posterior end **560**. Articular surface **554** is configured to mate with a tibia or tibial implant while bone apposition surface **556** is configured to mate with resected articulating surface **534** of femur **530**.

More specifically, body **552** of femoral implant **550** comprises a substantially U-shaped medial condyle **562** and a substantially U-shaped lateral condyle **564**. Condyles **562** and **564** are connected together at anterior end **558** but are spaced apart at posterior end **560** so that an elongated slot **565** is formed thereat. In an alternative embodiment, the femoral implant can comprise a unicondylar femoral implant which independently comprises medial condyle **562** or lateral condyle **564**. It is appreciated that where only one of medial condyle **562** or lateral condyle **564** is being implanted, it is necessary only to resect one of the medial condyle or lateral condyle at the distal end of femur **530**.

Formed on bone apposition surface **556** of medial condyle **562** is a threaded socket **566**. In alternative embodiments, socket **556** can be replaced with outwardly projecting stem **304** as previously discussed with regard to FIG. **12**. Stem **304** can have external threads or a socket with internal threads. In turn, the threads can be replaced with bayonet connectors or other alternatives as previously discussed.

As also depicted in FIG. **30**, a fastener **570** is provided. Fastener **570** has a distal end **572** with threads formed thereat and an opposing proximal end **574**. An enlarged head **576** is formed at proximal end **574** and has a polygonal socket **578** to receive a drive rod. Distal end **572** is configured to mate with socket **566**. In alternative embodiments, distal end **572** can be modified to mate with the above discussed alternatives that can replace socket **566**.

During use femoral implant **550** is positioned on resected articulating surface **534** so that socket **566** is aligned with second end **96** of tunnel **90**. Here it is appreciated that because there are no posts projecting from bone apposition surface **556**, femoral implant **550** can be slide on to resected articulating surface **534** lateral to medial or medial to lateral through a medial or lateral incision on the knee of the patent. As a result, it is not necessary to openly expose distal end **532** of femur **530** during placement of femoral implant **550**. As depicted in FIG. **31**, once tunnel **90** and socket **566** are aligned, distal end **572** of fastener **574** is placed in first end **94** of tunnel **90** and advanced through tunnel **90**. By inserting a driver into socket **578**, fastener **570** is selectively rotated so that first end **572** threaded into socket **566**. Enlarged head **576** biases against femur **530** so as to securely bias femoral implant **550** against femur **530**.

In one alternative embodiment, enlarged head **576** can be threaded or otherwise mounted on proximal end **574** such that screwing head **576** onto the shaft of fastener **570** causes head **576** to bias against the bone and thereby tension fastener **570**. In this embodiment head **576** would function as a crown nut.

In contrast to using fastener **574**, it is appreciated that anchor assembly **370** or **480**, as previously discussed with regard to FIGS. **17** and **24**, or their discussed alternatives can be used to secure femoral implant **550** to femur **530**. Furthermore, as depicted in FIG. **30**, in one alternative embodiment a second socket **566**A can be formed on bone apposition surface **556** of lateral condyle **564**. A second fastener **570**A can be passed through a second tunnel on the lateral side of femur **530** to couple with second socket **566**A, thereby further securing femoral implant **550** to femur **530**. Alternatively, second fastener **570**A can be used instead of first fastener **570**.

Depicted in FIG. **32** is an alternative embodiment of a femoral implant **580** incorporating features of the present invention. Again, like elements of different embodiments are identified by like reference characters. In contrast to threaded sockets **566** of femoral implant **558**, femoral implant **580** comprises an enlarged socket **582** filled with a curable adhesive **584** such as polymethylmethacrylate or the like. In yet other embodiments, socket **582** can be filled with a polymer such as Delrin, polyetheretherketone, or the like that is capable of receiving and deforming to the shape of a fastener received therein.

A fastener **586** is also depicted in FIG. **32**. Distal end **572** of fastener **586** terminates at a pointed nose **588**. Threads or ribs **590** are disposed adjacent to pointed nose **588**. In this embodiment, because of pointed nose **588**, fastener **586** can simply be driven through femur **530**, such as by being impacted with a hammer or other tool, without the prior formation of tunnel **90**. As ribs **590** are received within socket **582**, the material therein cures or deforms around threads or ribs **590** so as to secure fastener **586** to femoral implant **580**, thereby securing femoral implant **580** to femur **530**. Alternatively, fastener **586** can also be used in association with tunnel **90**. In yet another alternative embodiment, fastener **586** can be replaced with a fastener **592**. Fastener **592** has a helical screw thread **594** extending along the length thereof. As such, fastener **592** can be screwed into femur **530** so as to engage with femoral implant **580** with or without prior formation of tunnel **90**.

In one embodiment, in addition to the use of a fastener to attach the femoral implant to the femur **530**, a bone cement can be employed to further enhance the adhesion of the femoral implant to resected femur **530**. The bone cement can be applied before and/or during mounting of the femoral implant. For example, the femoral implant can be partially attached and then a syringe or other form of delivery tube used to inject bone cement between the femoral implant and femur **530**. In addition, a porous or fibrous material, such as a wire mesh, may be attached to bone apposition surface **556** of the femoral implant to thereby foster bone growth between the femoral implant and resected femur **530** and/or to provide surface area for attaching the bone cement between the femoral implant and resected femur **530**. In one embodiment, one more pockets can be formed on bone apposition surface **556**. An inlay of porous bone ingrowth, such as previously discussed with regard to inlay **320**, can be secured within the pockets.

Depicted in FIGS. **33**-**39** are connectible two-piece femoral implants incorporating features of the present invention. The implants can be used in knee arthroplasty wherein the two parts are independently slid in from the medial or lateral side of the knee through an incision and then connected and mounted onto resected articulating surface **534** of femur **530**. A coupling member, such as a bolt, screw, pin, or the like, can be used to attach one part of the femoral implant to the other. Optionally, one part may be mounted on resected articulating surface **534** followed by the other part being connected thereto. A fastener is passed through femur **530**, as discussed above, to connect the femoral implant to femur **530**. Because the smaller parts of the two-piece femoral implant can be sequentially inserted through an incision, the required incision can be smaller than required for unitary implants.

FIG. **33** is a perspective view of a two-piece femoral implant **602** in a divided state while FIG. **34** is a perspective view of femoral implant **602** shown in an assembled state. In one embodiment, femoral implant **602** can be designated as “end use” in that the entire structure is configured to be permanently mounted onto the resected articulating surface during a resurfacing procedure and is designed for permanent daily use by a patient.

Femoral implant **602** is centrally divided lateral to medial and comprises a patellar condyle **603**, which includes anterior end **558**, and a tibial condyle **604**, which includes posterior end **560**. Patellar condyle **603** includes at a substantially V-shaped posterior end **606**. Posterior end **606** terminates at an end face **609** that extends between a medial side **607** and a lateral side **608** of patellar condyle **603**. A pair of spaced apart linear passageways **616**A-B transversely extend through posterior end **606** of patellar condyle **603** so as to enter and exit through end face **609**.

Tibial condyle **604** terminates at a V-notched anterior end **610** that is complementary to V-shaped posterior end **606** of patellar condyle **603**. Anterior end **610** terminates at an end face **611** that also extends between a medial side **612** and lateral side **614** of tibial condyle **604**. A pair of spaced apart passageways **618**A-B transversely extend through anterior end **610** of tibial condyle **604** between medial side **612** and end face **611**. A pair of threaded sockets **620**A-B are formed on end face **611** toward lateral side **614** in alignment with passageways **618**A-B.

When patellar condyle **603** and tibial condyle **604** are mated, a joint line **605** is formed at the intersection. In one embodiment, joint line **605** is positioned so that it corresponds to the location of the sulcus of femur **530** when femoral implant **602** is mounted on femur **530**. In the mated position, passageways **616**A-B, passageways **618**A-B, and sockets **620**A-B are aligned. As a results, bolts **622** and **624** having threaded ends can be passed through passageways **616**A-B, **618**A-B and screwed into sockets **620**A-B so as to securely connect patellar condyle **603** and tibial condyle **604**. It is appreciated that bolts **622** and **624** can be replaced with a variety of other structures to connect patellar condyle **603** and tibial condyle **604**.

Femoral implant **602** further comprises socket **566** formed on bone apposition surface **556** of tibial condyle **604**. As a result, fasteners **570** or anchor assemblies **370** or **480** can secure femoral implant **602** to femur **530** as discussed in the above embodiments.

Depicted in FIG. **35** is a femoral implant **630** that is substantially the same as femoral implant **602**. The only difference is that interlocking teeth **636** and **638** are formed along posterior end **606** of patellar condyle **603** and anterior end **610** of tibial condyle **604**, respectively. Interlocking teeth **636** and **638** provide greater engagement and stability between patellar condyle **603** and tibial condyle **604**.

Depicted in FIGS. **36** and **37** is another alternative embodiment a two-piece femoral implant **640**. Femoral implant **640** is centrally divided anterior to posterior so as to comprise a substantially U-shaped medial condyle **642** a substantially U-shaped lateral condyle **644**. Medial condyle **642** has a medial side face **646** and a lateral side face **648**. A pair of spaced apart passageways **650**A-B transversely extend through medial condyle **642** between side faces **646** and **648**.

Lateral condyle **644** also has a medial side face **652** and a lateral side face **654**. A pair of spaced apart threaded sockets **656**A-B are formed on medial face **652** of lateral condyle **644**. When condyles **642** and **644** are mated, a joint line **662** is formed at the intersection. In one embodiment, joint line **662** is positioned so that it corresponds to the location of the trochlear groove of femur **530** when femoral implant **640** is mounted on femur **530**. In the mated position, passageways **650**A-B are aligned with threaded sockets **656**A-B. As a result, fasteners **658** and **660** each having a threaded end can be selectively passed through passageways **650**A-B and screwed into sockets **656**A-B so as to secure condyles **642** and **644** together.

Depicted in FIG. **38** is a femoral implant **670** that is substantially the same as femoral implant **640**. The only difference is that a plurality of interlocking teeth **672** and **674** are formed along lateral side face **648** of medial condyle **642** and medial side face **652** of lateral condyle **644**, respectively.

Interlocking teeth **672** and **674** provide greater engagement and stability between medial condyle **642** and lateral condyle **644**.

Depicted in FIGS. **39**A-D is another embodiment of a two-piece femoral implant **700** incorporating features of the present invention. Femoral implant **700** is substantially similar to implant **602** discussed above with regard to FIGS. **33** and **34**. As such, like elements are identified by like reference characters. In contrast to implant **602**, a plurality of spaced apart holes **702** are formed on end face **609** of posterior end **606** of patellar condyle **603**. A plurality of spaced apart pegs **704** project from end face **611** of anterior end **610** of tibial condyle **604**. Pegs **704** are formed complementary to holes **702** such that when patellar condyle **603** and tibial condyle **604** are mated together, pegs **704** are received within holes **702** so as to rigidly hold condyles **603** and **604** together.

In contrast to having a pair of bolts transversely extending across patellar condyle **603** in femoral implant **602**, femoral implant **700** comprises a passageway **706** that extends from lateral side **614** of tibial condyle **604** to end face **611** at anterior end **610** of tibial condyle **604**. A threaded socket **708** is formed on end face **609** of posterior end **606** of patellar condyle **603**. When condyles **603** and **604** are mated, passageway **706** and socket **708** are aligned. A bolt **710** having a threaded end is passed through passageway **706** and screwed into socket **708** so as to secure condyles **603** and **604** together. In one alternative, a complementary passageway **706**A and socket **708**A can also be formed on the medial side of condyles **603** and **604** to provide further engagement by a bolt **710**A.

Finally in contrast to have socket **566** to receive fastener **570**, tubular stem **304** is formed on bone apposition surface **556** of tibial condyle **604**. Stem **304** is designed to mate to fastener **570** or the other anchor assemblies as previously discussed. Alternatively, stem **304** can be replaced with socket **566**.

Depicted in FIGS. **40-42** are still other examples of inventive implants mounted on resected articulating surfaces of other orthopedic joints. For example, depicted in FIG. **40** is femur **530** having a proximal end **750** that would normally terminate at a femoral head **752** having an articulating surface. In the depicted drawing, femoral head **752** has been resected to from a resected articulating surface **753**. In each of the embodiments depicted in FIGS. **40-42**, it is appreciated that the resected articulating surface can be formed using conventional techniques or by using a modified rasp assembly of the present invention in combination with tunnel **90**.

A proximal femoral implant **754** is shown mounted on resected articulating surface **753**. Implant **754** comprises a body **756** having an articular surface **758** and an opposing bone apposition surface **760**. Articular surface **758** engages with the acetabular socket while bone apposition surface **760** biases against resected articulating surface **753**.

Tunnel **90** is formed on femur **530**. Second end **96** of tunnel **90** is formed on resected articulating surface **753** while first end **94** of tunnel **90** is formed on the shaft of femur **530** at a location spaced apart from resected articulating surface **753**. A threaded socket **762** is formed on bone apposition surface **760** of implant **754**. Socket **762** can be replaced with stem **304** or other alternatives as discussed herein. Socket **762** is aligned with second end **96** of tunnel **90**. Anchor assembly **370** is disposed within tunnel **90** and is coupled with implant **754** through socket **762** so as to secure implant **754** to femur **530**.

Depicted in FIG. **41** is a humerus **770** having a proximal end **772** that would normally terminate at a humerus head having an articulating surface. In the depicted drawing, the humerus head has been resected to form a resected articulating surface **774**. A proximal humerus implant **776** is shown mounted on resected articulating surface **774**. Implant **776** comprises a body **778** having an articular surface **780** and an opposing bone apposition surface **782**. Articular surface **780** engages with the scapula while bone apposition surface **782** biases against resected articulating surface **774**.

Tunnel **90** is formed on humerus **770**. Second end **96** of tunnel **90** is formed on resected articulating surface **774** while first end **94** of tunnel **90** is formed on the shaft of humerus **770** at a location spaced apart from resected articulating surface **774**. A threaded socket **784** is formed on bone apposition surface **782** of implant **776**. Socket **784** is aligned with second end **96** of tunnel **90**. Anchor assembly **480** is disposed within tunnel **90** and is coupled with implant **776** through socket **784** so as to secure implant **776** to humerus **770**.

Depicted in FIG. **42** is tibia **12** having a distal end **790** that would normally terminate at an articulating surface such as the inferior articular surface and the malleolar articular surface. In the depicted drawing, distal end **790** of tibia **12** has been resected to form a resected articulating surface **792**. A distal tibial implant **794** is shown mounted to resected articulating surface **792**. Implant **794** comprises a body **796** having an articular surface **798** and an opposing bone apposition surface **800**. Articular surface **798** engages with the talus or an implant thereat while bone apposition surface **800** biases against resected articulating surface **792**.

Tunnel **90** is formed on tibia **12**. Second end **96** of tunnel **90** is formed on resected articulating surface **798** while first end **94** of tunnel **90** is formed on tibia **12** at a location proximally spaced apart from resected articulating surface **792**. A threaded socket **802** is formed on bone apposition surface **800** of implant **794**. Socket **802** is aligned with second end **96** of tunnel **90**. Anchor assembly **480** is disposed within tunnel **90** and is coupled with implant **794** through socket **802** so as to secure implant **794** to tibia **12**.

Set forth above are several different embodiments of the present invention. It is appreciated that the different features of the different embodiments can be mixed and matched to produce a variety of other embodiments within the scope of the present invention. By way of example and not by limitation, each of the different implants can be made with or without an inlay of porous bone ingrowth material on the bone apposition surface; each different implant can be made with a projecting stem or flush socket to receive a fastener; each different implant can be configured to mate with one or more different fasteners; and each different implant can be made as an integral body or two or more separate parts. For example, each implant can comprise a metal tray that is mounted to the bone and a plastic bearing plate that is mounted to the tray. It is likewise appreciated that the different methods steps for the different embodiments can also be mixed and matched and used with other techniques. Finally, it is again noted that the implants described herein are only by way of example and not by limitation. The present invention can also be used in association with resurfacing articulating surfaces of other orthopedic joints.

Finally, the above embodiments primarily discuss mounting implants on resected articulating surfaces. On occasion, however, a sufficient portion of a natural articulating surface has been worn down or otherwise removed by events other than surgical resection so that it is not necessary to resect the wear surface which is still functioning as a natural articulating surface. On these occasions, it is envisioned that the implant can be mounted directly on the worn natural articulating surface with minimal or no surgical resection of the articulating surface.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. An implant system for resurfacing at least a portion of an articulating surface of a bone, the system comprising:
- an implant having a top articular surface and an opposing bone apposition surface, the implant comprising:
  - a lower bearing plate; and
  - an upper bearing plate having the top articular surface formed thereon, one of the lower bearing plate and upper bearing plate having a track formed thereon while the other has a key that slidably rides within the track;
- an elongated fastener configured to rigidly mount to the implant so as to outwardly project from the bone apposition surface and prevent pivoting movement of the implant with respect to the fastener; and
- a tubular bone anchor adapted to encircle at least a portion of the fastener, the bone anchor comprising one or more threads or barbs formed on an exterior surface thereof.

2. An implant system as recited in claim **1**, wherein the implant further comprises a stem projecting from the bone apposition surface, the stem being threaded to mate with the fastener.

3. An implant system as recited in claim **1**, wherein the implant has a socket formed on the bone apposition surface, the socket being threaded to mate with the fastener.

4. An implant system as recited in claim **1**, wherein the
- bearing plate has a bottom surface disposed opposite said top articular surface, a pocket being formed on the bottom surface of the bearing plate,
- an inlay of porous bone ingrowth material secured within the pocket.

5. An implant system as recited in claim **1**, wherein the fastener comprises an elongated shaft having a length in a range between about 5 mm to about 15 mm.

6. An implant system as recited in claim **1**, wherein the fastener comprises an elongated shaft having an enlarged head integrally formed thereon.

7. An implant system as recited in claim **1**, further comprising an enlarged crown nut removably mountable to the fastener.

8. An implant system as recited in claim **7**, wherein the crown nut is rotatable relative to the bone anchor.

9. An implant system as recited in claim **7**, further comprising means for attaching an attachment tool to the crown nut.

10. An implant system as recited in claim **9**, wherein the means for attaching the attachment tool comprises a plurality of prongs formed on the crown nut.

11. An implant system as recited in claim **1**, wherein the fastener has at least one helical thread that engages with the implant and the bone anchor has at least one external helical thread, the helical thread of the bone anchor rotating in a direction opposite of the helical thread of the fastener.

12. An implant system as recited in claim **1**, wherein the bone anchor has an interior surface bounding a channel extending between a first end and an opposing second end, the first end terminating at a first end face, the channel comprising a first channel portion extending from the first end, a second channel portion extending from the second end, and a radially inwardly projecting shoulder disposed between the first channel portion and the second channel portion.

13. An implant system as recited in claim **12**, wherein the fastener comprises a shaft having an enlarged head integrally formed thereon, the head being biased against the shoulder of the bone anchor.

14. An implant system as recited in claim **12**, further comprising an enlarged crown nut removably mounted on the fastener and biased against the shoulder of the bone anchor.

15. An implant system as recited in claim **1**, further comprising a drive rod integrally formed with the fastener, a plurality of spaced apart annular breaking grooves being formed at the intersection between the fastener and the drive rod.

16. An implant system as recited in claim **1**, wherein the fastener is configured to rigidly mount to the implant by threadedly engaging with the implant.

17. An implant system as recited in claim **1**, wherein the fastener has at least one helical thread that engages with the implant.

18. An implant system as recited in claim **1**, wherein the fastener has a proximal end and an opposing distal end, the distal end being mounted to the implant and the proximal end projecting away from the bone apposition surface of the implant, and wherein the implant system further comprises means for attaching a fastener driver to the proximal end of the fastener.

19. An implant system as recited in claim **18**, wherein the means for attaching a fastener driver comprises a blind socket formed in the proximal end of the fastener.

20. An implant system as recited in claim **1**, wherein the fastener has a first helical thread and the implant has a second helical thread and the fastener is rigidly mounted to the implant by threaded connection between the first and second helical threads.

21. An implant system for resurfacing at least a portion of an articulating surface of a bone, the system comprising:
- an implant having a top articular surface and an opposing bone apposition surface, the implant comprising:
  - a tray having the bone apposition surface; and
  - a bearing plate mounted on the tray, the bearing plate being comprised of a polymeric material and having the top articular surface;
- an elongated fastener configured to rigidly mount to the implant so as to outwardly project from the bone apposition surface and prevent pivoting movement of the implant with respect to the fastener; and
- a tubular bone anchor adapted to encircle at least a portion of the fastener, the bone anchor comprising one or more threads or barbs formed on an exterior surface thereof.

22. An implant system as recited in claim **21**, wherein the implant further comprises a stem projecting from the bone apposition surface, the stem being threaded to mate with the fastener.

23. An implant system as recited in claim **21**, wherein the implant has a socket formed on the bone apposition surface, the socket being threaded to mate with the fastener.

24. An implant system as recited in claim **21**, wherein the
- bearing plate has a bottom surface disposed opposite said top articular surface, a pocket being formed on the bottom surface of the bearing plate,
- an inlay of porous bone ingrowth material secured within the pocket.

25. An implant system as recited in claim **21**, wherein the fastener comprises an elongated shaft having a length in a range between about 5 mm to about 15 mm.

26. An implant system as recited in claim **21**, wherein the fastener comprises an elongated shaft having an enlarged head integrally formed thereon.

27. An implant system as recited in claim **21**, further comprising an enlarged crown nut removably mountable to the fastener.

28. An implant system as recited in claim **27**, wherein the crown nut is rotatable relative to the bone anchor.

29. An implant system as recited in claim **27**, further comprising means for attaching an attachment tool to the crown nut.

30. An implant system as recited in claim **29**, wherein the means for attaching the attachment tool comprises a plurality of prongs formed on the crown nut.

31. An implant system as recited in claim **21**, wherein the fastener has at least one helical thread that engages with the implant and the bone anchor has at least one external helical thread, the helical thread of the bone anchor rotating in a direction opposite of the helical thread of the fastener.

32. An implant system as recited in claim **21**, wherein the bone anchor has an interior surface bounding a channel extending between a first end and an opposing second end, the first end terminating at a first end face, the channel comprising a first channel portion extending from the first end, a second channel portion extending from the second end, and a radially inwardly projecting shoulder disposed between the first channel portion and the second channel portion.

33. An implant system as recited in claim **32**, wherein the fastener comprises a shaft having an enlarged head integrally formed thereon, the head being biased against the shoulder of the bone anchor.

34. An implant system as recited in claim **32**, further comprising an enlarged crown nut removably mounted on the fastener and biased against the shoulder of the bone anchor.

35. An implant system as recited in claim **21**, further comprising a drive rod integrally formed with the fastener, a plurality of spaced apart annular breaking grooves being formed at the intersection between the fastener and the drive rod.

36. An implant system as recited in claim **21**, wherein the fastener is configured to rigidly mount to the implant by threadedly engaging with the implant.

37. An implant system as recited in claim **21**, wherein the fastener has at least one helical thread that engages with the implant.

38. An implant system as recited in claim **21**, wherein the fastener has a proximal end and an opposing distal end, the distal end being mounted to the implant and the proximal end projecting away from the bone apposition surface of the implant, and wherein the implant system further comprises means for attaching a fastener driver to the proximal end of the fastener.

39. An implant system as recited in claim **38**, wherein the means for attaching a fastener driver comprises a blind socket formed in the proximal end of the fastener.

40. An implant system as recited in claim **21**, wherein the tray further comprises a top surface opposite the bone apposition surface and the means for securing the fastener is configured so as to be inaccessible from the top surface of the tray.

41. An implant system as recited in claim **21**, wherein the fastener has a first helical thread and the implant has a second helical thread and the fastener is rigidly mounted to the implant by threaded connection between the first and second helical threads.

42. An implant for resurfacing at least a portion of an articulating surface of a bone, the implant comprising:

a body having a first side with a top articular surface and an opposing second side with a bone apposition surface, the bone apposition surface being adapted to bias against a natural or resected articulating surface of a bone, the body comprising:

a tray having the bone apposition surface; and

a bearing plate mounted on the tray, the bearing plate being comprised of a polymeric material and having the top articular surface; and

means for securing a fastener to the second side of the body after the bone apposition surface is biased against the natural or resected articulating surface such that the fastener is rigidly fixed to the body so as to prevent pivoting movement of the body with respect to the fastener and such that applying increased tension to the fastener increases a force at which the bone apposition surface biases against the natural or resected articulating surface.

43. An implant as recited in claim **42**, wherein the tray further comprises a top surface opposite the bone apposition surface and the means for securing the fastener is configured so as to be inaccessible from the top surface of the tray.

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