

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
13 September 2007 (13.09.2007)

PCT

(10) International Publication Number
WO 2007/103826 A2

(51) International Patent Classification:
A61F 2/24 (2006.01)

(21) International Application Number:
PCT/US2007/063233

(22) International Filing Date: 2 March 2007 (02.03.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/779,307 2 March 2006 (02.03.2006) US

(71) Applicant (for all designated States except US): **TALUS MEDICAL, INC.** [US/US]; 3239 Oak Knoll Drive, Redwood City, California 94062 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **CHOI, George Yoseung** [US/US]; 3239 Oak Knoll Drive, Redwood City, California 94062 (US). **WARNE, Brian** [US/US]; 133 Potomac Drive, Los Gatos, California 95032 (US).

(74) Agent: **LEVINE, David A**; Levine Bagade Han LLP, 2483 East Bayshore Road, Suite 100, Palo Alto, California 94303 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

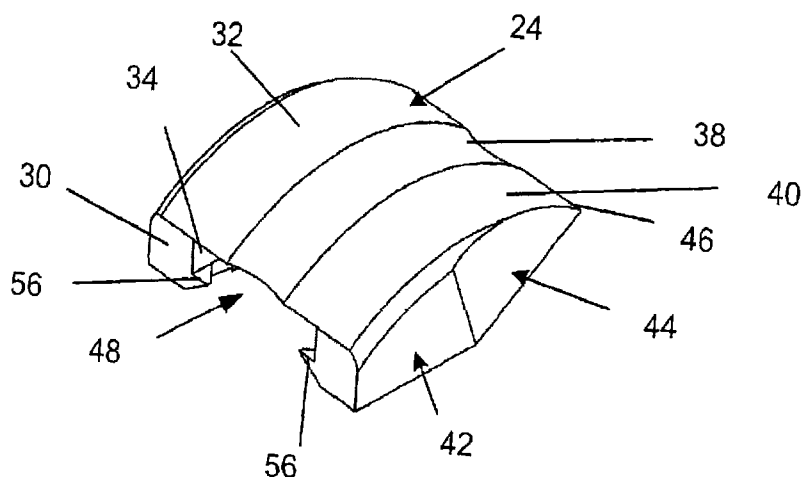
— of inventorship (Rule 4.17(iv))

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: BONE PROSTHESIS



(57) Abstract: A partial bone prosthesis and methods of using the same are disclosed herein. The partial bone prosthesis can be configured for use, for example, on the superior side of the talus or an end of a long bone, such as the tibia. The partial bone prosthesis can anchor to the perimeter of the contact patch between the bone and the prosthesis. For example, the prosthesis can be attached to the talus without drilling holes through the talus, preserving structural integrity and blood flow within the talus.

WO 2007/103826 A2

1 TITLE OF THE INVENTION

2 BONE PROSTHESIS

3
4 George Yoseung Choi

5 James Brian Warne

6
7 FIELD OF THE INVENTION8 [0001] This invention relates to a bone prosthesis and methods of using the same. More
9 specifically, the bone prosthesis can be anchored perimetricly.
10

11 BACKGROUND OF THE INVENTION

12 [0002] Osteoarthritis or trauma can result in ankle pathology of uneven wear on, and/or
13 direct trauma to, the surface of the talus. This commonly leads to cartilage erosion and
14 subsequent break down of subchondral bone. Osteoarthritis and certain trauma on the talus
15 are often treated by fusing the talus to the tibia. This fusion procedure results in loss of
16 mobility of the ankle, and the expected complications resulting from a loss of mobility
17 including gait changes, further stress-related injuries, and a reduction of the patient's overall
18 mobility.19 [0003] A secondary treatment for osteoarthritis in the talus - and in other bones - is to
20 replace part of the damaged bone with a partial bone prosthesis. The partial bone prostheses,
21 such as those for the talus or the long bones (e.g., femur, tibia, humerus, ulna), typically
22 anchor into the remainder of the bone. This anchoring occurs through a radial center with
23 respect to the longitudinal axis of the long bone, or roughly with respect to the vertical in the
24 case of the talus.

[0004] Figures 1 and 2 illustrate anterior and lateral views of the tibia 6, talus 12 and fibula 2 (not shown in Figure 2). A vertical axis 8 and an original talus thickness 10 is shown. The original talus thickness 10 is dependent on individual anatomical factors and the amount of pathological bone degradation.

[0005] Figures 3 and 4 illustrate that when the talus 12 is prepared for a typical prosthesis 20 implantation, tissue, such as a superior surface and adjacent bone, of the talus 12 is removed. The remaining portion of the talus 12 has a new superior surface (i.e., contact patch 16 for the prosthesis 20) substantially perpendicular to the vertical axis 8. The minimum talus height after tissue removal (i.e., minimum cut-down thickness 14) is substantially less than the minimum tissue height of the original talus 12, as shown in Figures 1 and 2.

[0006] Figures 5 and 6 illustrate that the typical partial bone prosthesis is attached to the contact patch 16. The prostheses 20 often have central anchors 22 that protrude into and/or through the center of the talus 12 along or near the vertical axis 8. With the prosthesis 20 implanted, the post-implant talus minimum thickness 18 is very small and increases the fragility of the talus 12 during and after the implantation of the prosthesis 20. The damage done by the central anchors 22 can also impair blood flow to and within the talus 12.

[0007] Therefore, a need exists for a partial bone prosthesis that does not substantially impact the minimum bone thickness or minimum longitudinal or vertical thickness after implanting in a bone. There also exists a need for a partial bone prosthesis that does not anchor centrally to the prosthesis.

SUMMARY OF THE INVENTION

[0008] A partial bone prosthesis is disclosed herein. The partial bone prosthesis can be used to treat a long bone, talus, knee, hip, shoulder, elbow, or vertebra.

1 [0009] The prosthesis can have a prosthesis body having a central axis. The prosthesis
2 body can have a perimeter anchor. The perimeter anchor can be radially distal to the central
3 axis. The perimeter anchor can be substantially thicker than the remainder of the prosthesis
4 body.

5 [0010] The perimeter anchor can form a complete perimeter around the central axis or the
6 perimeter anchor can form an incomplete perimeter around the central axis. The prosthesis
7 body can have a branch. The branch can have all or part of the perimeter anchor.

8 [0011] The perimeter anchor can have an ingrowth matrix. The perimeter anchor can have
9 a first ridge. The perimeter anchor can have a second ridge. The perimeter anchor can have a
10 supplemental anchor port. The prosthesis body can be made from a titanium alloy, a cobalt
11 chromium alloy, or combinations thereof.

12 [0012] A method for implanting a partial bone prosthesis to a bone end of a bone having a
13 central axis is also disclosed. The method includes removing tissue from the bone end.
14 Removing tissue includes removing substantially thicker tissue distally from the central axis
15 than proximally to the central axis. Removing tissue also includes exposing a contact patch
16 on the bone. The method includes deploying the partial bone prosthesis to the contact patch.

17 [0013] Deploying can include applying a bone morphogenic protein to the bone and/or the
18 prosthesis. Deploying can include inserting a supplemental anchor through the partial bone
19 prosthesis and into the bone. Inserting can include inserting the supplemental anchor through
20 the perimeter anchor.

21 BRIEF DESCRIPTION OF THE DRAWINGS

22
23 [0014] Figure 1 is not the invention and illustrates an anterior view of the bones of the
24 upper ankle.

25 [0015] Figure 2 is not the invention and illustrates a lateral view of Figure 1 sans fibula.

1 [0016] Figure 3 is not the invention and illustrates the bones of Figure 1 after typical tissue
2 removal in preparation for implanting a partial talus prosthesis.

3 [0017] Figure 4 is not the invention and illustrates the bones of Figure 2 after typical tissue
4 removal in preparation for implanting a partial talus prosthesis.

5 [0018] Figure 5 is not the invention and illustrates Figure 3 after implanting a known partial
6 talus prosthesis.

7 [0019] Figure 6 is not the invention and illustrates Figure 4 after implanting a known partial
8 talus prosthesis.

9 [0020] Figures 7 through 9 are perspective views of variations of the talus bone prosthesis.

10 [0021] Figures 10a and 11a illustrate cross-sections A-A and B-B, respectively, of a
11 variation of the bone prosthesis.

12 [0022] Figures 10b and 11b illustrate cross-sections A-A and B-B, respectively, of a
13 variation of the partial bone prosthesis.

14 [0023] Figures 12 and 13 illustrate cross-sections A-A and B-B, respectively, of a variation
15 of the partial bone prosthesis.

16 [0024] Figures 14 and 15 illustrate cross-sections A-A and B-B, respectively, of a variation
17 of the partial bone prosthesis.

18 [0025] Figures 16 and 17 illustrate cross-sections A-A and B-B, respectively, of a variation
19 of the partial bone prosthesis.

20 [0026] Figures 18 and 19 illustrate cross-sections A-A and B-B, respectively, of a variation
21 of the partial bone prosthesis.

22 [0027] Figures 20 and 21 illustrate cross-sections A-A and B-B, respectively, of a variation
23 of the partial bone prosthesis.

24 [0028] Figure 22a is a front view of the variation of the bone prosthesis of Figure 9.

25 [0029] Figure 22b is a bottom view of the variation of the bone prosthesis of Figure 9.

- 1 [0030] Figure 22c is a side view of the variation of the bone prosthesis of Figure 9.
- 2 [0031] Figure 23 illustrates a variation of a prosthesis floating component.
- 3 [0032] Figure 24a is a top view of the prosthesis floating component of Figure 23.
- 4 [0033] Figure 24b is a side view of the prosthesis floating component of Figure 23.
- 5 [0034] Figure 24c illustrates a variation of section C-C of Figure 24b.
- 6 [0035] Figure 25 illustrates a variation of the prosthesis tibia component.
- 7 [0036] Figure 26a is a side view of the prosthesis tibia component of Figure 25.
- 8 [0037] Figure 26b is a front view of the prosthesis tibia component of Figure 25.
- 9 [0038] Figure 27 is an anterior view of a variation of a method for removing tissue for
- 10 preparing the bones of Figure 1 for implanting a variation of the partial bone prosthesis.
- 11 [0039] Figure 28 is a lateral view of the variation of the method shown in Figure 27 for
- 12 removing tissue for preparing the bones of Figure 2 for implanting a variation of the partial
- 13 bone prosthesis.
- 14 [0040] Figure 29 is an anterior view of a variation of a method for implanting the partial
- 15 bone prosthesis.
- 16 [0041] Figure 30 is a lateral view of the variation of the method shown in Figure 29 for
- 17 implanting the partial bone prosthesis.
- 18 [0042] Figure 31 is an anterior view of a variation of a method for implanting the partial
- 19 bone prosthesis with ridges.
- 20 [0043] Figure 32 is a lateral view of the variation of the method shown in Figure 31 for
- 21 implanting the partial bone prosthesis.
- 22 [0044] Figure 33 is an anterior view of a variation of a method for implanting the partial
- 23 bone prosthesis with supplemental anchors.
- 24 [0045] Figure 34 is a lateral view of the variation of the method shown in Figure 33 for
- 25 implanting the partial bone prosthesis.

[0046] Figures 35 and 36 are anterior views of various variations of methods for implanting a multi-component variation of the partial bone prosthesis.

[0047] Figure 37 is a lateral view of the variations of the method shown in Figures 35 and 36 for implanting the partial bone prosthesis.

[0048] Figures 38 and 39 are anterior views of various variations of methods for implanting a multi-component variation of the partial bone prosthesis.

[0049] Figure 40 is a lateral view of the variations of the method shown in Figures 38 and 39 for implanting the partial bone prosthesis.

[0050] Figure 41 illustrates a variation of a method of implanting a multi-component variation of the partial bone prosthesis in a knee.

[0051] Figure 42 is an exploded view of a variation of a method of implanting a multi-component variation of the partial bone prosthesis in a hip.

[0052] Figure 43 illustrates a variation of a method of implanting a multi-component variation of the partial bone prosthesis in a shoulder.

DETAILED DESCRIPTION

[0053] Figure 7 illustrates that the partial bone prosthesis can have a prosthesis body 24.

The prosthesis body 24 can have a central axis 26. During use in a long bone, the central axis

26 can be substantially parallel and/or aligned with a longitudinal axis of the long bone.

During use in the talus 12 or in a vertebra, the central axis 26 can be substantially parallel

and/or aligned with a vertical axis 8.

[0054] The prosthesis body 24 can have a central portion 28. The central axis 26 can pass

through the central portion 28. The prosthesis body 24 can have a perimeter anchor 30. The

perimeter anchor 30 can be radially distal to the central axis 26. The perimeter anchor 30 can

partially or completely surround the central portion 28.

1 [0055] The prosthesis can have a distal prosthesis surface 32. The distal prosthesis surface
2 32 can be configured to substantially match the exterior of the portion of the bone being
3 replaced by the prosthesis. The proximal and distal prosthesis surfaces 32 are proximal and
4 distal, respectively, to the remainder of the bone which is being partially replaced.

5 [0056] Figure 8 illustrates that the prosthesis body 24 can have one or more branches 36.
6 The branches 36 can extend radially from the central axis 26. The branches 36 can extend
7 substantially parallel, or not substantially parallel, to the central axis 26 at a radius from the
8 central axis 26.

9 [0057] The prosthesis can have a proximal prosthesis surface 34. The proximal prosthesis
10 surface 34 can be configured to attach to the bone.

11 [0058] Figure 9 illustrates that the prosthesis body 24 can have one or more grooves 38
12 extending along a fore-aft (i.e., front-back or anterior-posterior) axis on the distal prosthesis
13 surface 32. The groove 38 can be laterally centered on the prosthesis body 24. The groove
14 38 can be configured to align with a tongue in an adjacent implant or a protrusion in an
15 adjacent bone to the groove. The groove 38 can be configured to minimize or otherwise
16 restrict lateral movement of the implant with respect to the adjacent implant or adjacent bone
17 to the groove.

18 [0059] The distal prosthesis surface 32 can have one or more shoulders 40 on each side of
19 the groove 38 and between grooves 38. The shoulders 40 can be flat and/or curved surfaces.
20 The shoulders 40 and/or the grooves 38 can have low-friction coating, for example made
21 from PTFE (e.g., Teflon ® from E.I. du Pont de Nemours and Company of Wilmington, DE).

22 [0060] The prosthesis body 24 can have a prosthesis flat 42 and a prosthesis rise 44. The
23 prosthesis rise 44 can extend at an angle from the prosthesis flat 42 with measured parallel
24 the up-down (i.e., dorsal-plantar or dorsal-palmar) axis.

1 [0061] The prosthesis body 24 can have a sharp edge 46 at the front and/or back of the
2 prosthesis body 24. The prosthesis body 24 can have a flat, blunt face at the front and/or
3 back of the prosthesis body 24.

4 [0062] The prosthesis body 24 can have a body channel 48. The bone channel 48 can pass
5 through the prosthesis body 24 from the front to the back or from a first lateral side (i.e., left)
6 to a second lateral side (i.e., right). The surface of the bone channel 48 can be formed by the
7 proximal prosthesis surface 34. The perimeter anchor 30 can extend along two opposite sides
8 of the bone channel 48. The perimeter anchor 30 can be vacant at the front port and/or back
9 port of the bone channel 48.

10 [0063] Figures 10a and 11a illustrates that the perimeter anchor 30 can have a maximum
11 anchor thickness 50. The central portion 28 (i.e., not the perimeter anchor 30) can have a
12 maximum central portion thickness 52. The maximum anchor thickness 50 can be
13 substantially larger than the maximum central portion thickness 52.

14 [0064] The proximal prosthesis surface 34 at the central portion 28 can form an angle with
15 the proximal prosthesis surface 34 at the perimeter anchor 30. The distal prosthesis surface
16 32 can be substantially or entirely curved. The central portion 28 can have a substantial
17 radius from the central axis 26.

18 [0065] The perimeter anchor 30 can have a maximum anchor thickness 50. The central
19 portion 28 can have a maximum central portion thickness 52. The maximum anchor
20 thickness 50 can be substantially greater than the maximum central portion thickness 52.

21 [0066] Figures 10b and 11b illustrate that the perimeter anchor 30 can substantially
22 converge at the central axis 26. The proximal prosthesis surface 34 can peak and/or form an
23 angle at the central axis 26. The central portion 28 can have a nominal or insubstantial radius
24 from the central axis 26.

[0067] Figures 12 and 13 illustrate that the prosthesis can have an ingrowth matrix **54** integrated with or attached to the perimeter anchor **30**. The ingrowth matrix **54** can form the proximal prosthesis surface **34**. The central portion **28** can have or be absent of (as shown) ingrowth matrix **54**.

[0068] Figures 14 and 15 illustrate that the distal prosthesis surface **32** can have an attacher. The attacher can be a ridge **56** (as shown), spine, prominence, rise, fin, skeg, or combinations thereof. The ridge **56** can be at the radial end away from the central axis **26**. The ridge **56** can have a v-shaped configuration. The ridge **56** can be oriented radially inward toward the central axis **26**. The ridge **56** can be configured to provide additional resistance in one direction (e.g., when pulling downward, as shown).

[0069] Figures 16 and 17 illustrate that the ridge **26** can have a t-shaped configuration.

Figures 18 and 19 illustrate that the perimeter anchor can have first **58**, second **60** and third ridges **62**. The ridges **56** can be located progressively radially closer to the central axis **26**.

[0070] Figures 20 and 21 illustrate that the perimeter anchor **30** can have one or more (e.g., two or four) supplemental anchor ports **64**. The supplemental anchor ports **64** can be between the distal prosthesis surface **32** and the proximal prosthesis surface **34**. The supplemental anchor ports **64** can be threaded (shown in Figures 33 and 34). The supplemental anchor port **64** can be located at substantially the thickest portion of the perimeter anchor **30**. The supplemental anchor port **64** can be configured perpendicularly to the proximal prosthesis surface **34**.

[0071] Figure 22a illustrates that the shoulders **40** can have shoulder widths **66**. The shoulder width **66** can be from about 6.4 mm (0.25 in.) to about 19 mm (0.75 in.), for example about 12.7 mm (0.500 in.). The shoulders **40** can have a rounded transition to the sides of the prosthesis body **24** having a distal chamfer radius **68**. The distal chamfer radius

1 68 can be from about 0.08 mm (0.03 in.) to about 3.0 mm (0.12 in.), for example about 2 mm
2 (0.06 in.).

3 [0072] The groove 38 can have a groove radius 70 (of curvature). The groove radius 70 can
4 be from about 10 mm (0.4 in.) to about 41 mm (1.6 in.), for example about 20.7 mm (0.813
5 in.).

6 [0073] The ridge 56 can have a ridge height 72 and a ridge angle 74. The ridge height 72
7 can be from about 1.3 mm (0.05 in.) to about 5 mm (0.2 in.), for example about 2.54 mm
8 (0.100 in.). The ridge angle 74 can be from about 17° to about 70°, for example about 35°.

9 [0074] The bone channel 48 can have a bone channel width 76. The bone channel width 76
10 can be from about 10 mm (0.4 in.) to about 41 mm (1.6 in.), for example about 20.7 mm
11 (0.813 in.).

12 [0075] The perimeter anchor 30 can have a perimeter anchor height 78 and a perimeter
13 anchor width 80. The perimeter anchor height 78 can be from about 3.3 mm (0.13 in.) to
14 about 14 mm (0.55 in.), for example about 6.99 mm (0.275 in.). The perimeter anchor width
15 80 can be from about 3.6 mm (0.14 in.) to about 14 mm (0.56 in.), for example about 7.14
16 mm (0.281 in.).

17 [0076] The prosthesis body 24 can have a prosthesis body width 82 from about 17 mm
18 (0.68 in.) to about 69.9 mm (2.75 in.), for example about 34.9 mm (1.375 in.), also for
19 example about 38 mm (1.5 in.).

20 [0077] Figure 22b illustrates that the ridge 56 can have one, two, three, four or more teeth
21 84. The teeth 84 can be sharpened. The teeth 84 can have a tooth angle 86 with respect to
22 the face of closer end of the prosthesis body 24. The tooth angle 86 can be from about 20° to
23 about 80°, for example about 45°. The teeth 84 can be separated from each other by a tooth
24 gap 88. The tooth gap 88 can be from about 2 mm (0.08 in.) to about 12 mm (0.5 in.), for
25 example about 3.96 mm (0.156 in.), also for example about 6.35 mm (0.250 in.). The teeth

1 **84** can have a tooth slot **90** between the teeth **84**. The tooth slot **90** can have a tooth slot
2 diameter **92** from about 12 mm (0.5 in.) to about 53 mm (2.1 in.), for example about 28 mm
3 (1.1 in.).

4 **[0078]** The sides of the prosthesis rise **44** can taper at a rise taper angle **94** inward as it
5 approaches the end of the prosthesis body **24**. The rise taper angle **94** can be from about 0° to
6 about 45°, more narrowly from about 4° to about 20°, for example about 9°.

7 **[0079]** The bone channel **48** can taper at a bone channel angle **96**. The bone channel angle
8 **96** can be from about 0° to about 10°, for example about 2.4°.

9 **[0080]** Figure 22c illustrates that the distal surface **98** can have a distal surface radius **100**
10 (of curvature). The distal surface radius **100** can be from about 15 mm (0.6 in.) to about 64
11 mm (2.5 in.), for example about 31.50 mm (1.240 in.).

12 **[0081]** The prosthesis flat **42** can have a prosthesis flat length **102**. The prosthesis flat
13 length **102** can be from about 8 mm (0.3 in.) to about 80 mm (3 in.), for example about 19.1
14 mm (0.750 in.). The prosthesis body **24** can have a prosthesis body length **104** from about 19
15 mm (0.75 in.) to about 80 mm (3 in.), for example about 38.10 mm (1.500 in.). The length of
16 the prosthesis rise **44** can be the difference between the prosthesis flat length **102** and the
17 prosthesis body length **104**: about 0 mm (0 in.) to about 69 mm (2.7 in.), for example about
18 38 mm (1.5 in.).

19 **[0082]** The prosthesis rise **44** can have a rise lift angle **106** with respect to the bottom of the
20 prosthesis flat **42**. The rise lift angle **106** can be from about 0° to about 45°, more narrowly
21 from about 10° to about 40°, for example about 20.2°.

22 **[0083]** Figure 23 illustrates that the prosthesis floating component **108** can have a
23 substantially square or rectangular transverse section. The prosthesis floating section **108** can
24 have a tibia-side surface **110** opposite of a talus-side surface **112**. A tibia tongue **114** can
25 extend from the tibia-side surface **110**. The tibia tongue **114** can be configured to act as a

1 slidable guide within the groove on the tibia prosthesis. A talus tongue **116** can extend from
2 the talus-side surface **112**. The talus tongue **116** can be configured to act as a slidable guide
3 within the groove on the talus prosthesis.

4 **[0084]** Figure 24a illustrates that the prosthesis floating component **108** can have a floating
5 component width **118** and a floating component length **120**. The floating component width
6 **118** can be from about 18 mm (0.7in.) to about 71 mm (2.8 in.), for example about 34.93 in.
7 (1.375 in.). The floating component length **120** can be from about 18 mm (0.7 in.) to about
8 71 mm (2.8 in.), for example about 36 mm (1.4 in.).

9 **[0085]** The one or more shoulders **40** on the prosthesis floating component **108** can each
10 have a shoulder width **66** from about 6.4 mm (0.25 in.) to about 25 mm (1.0 in.). The tibia
11 **114** and talus tongues **116** can have the about same widths as the corresponding grooves **38** in
12 the respective prosthesis components.

13 **[0086]** Figure 24b illustrates that the shoulders **40** on the tibia-side surface **110** can be
14 substantially flat. The talus tongue **116** and the shoulders **40** on the talus-side surface **112**
15 can have a talus-side radius **122** (of curvature). The talus-side radius **122** can be from about
16 15 mm (0.6 in.) to about 64 mm (2.5 in.), for example about 32.13 mm (1.265 in.).

17 **[0087]** The talus-side surface **112** can be flat. The tibia-side surface **110** can be rounded.

18 **[0088]** The tongues **114**, **116** can have a tongue height **124**. The tongue height **124** can be
19 from about 0.3 mm (0.01 in.) to about 1.3 mm (0.05 in.), for example about 5.6 mm (0.022
20 in.).

21 **[0089]** The floating component **108** can have a floating component height **126**. The
22 floating component height **126** without the tongues **114**, **116** can be a tongueless height **128**.
23 The floating component height **126** can be from about 1.5 mm (0.06 in.) to about 17 mm
24 (0.68 in.), for example about 8.43 mm (0.332 in.).

[0090] Figure 24c illustrates that the prosthesis can have a minimum tongueless height **130**, and a maximum tongueless height **132**. The minimum tongueless height **130** can be about at the mid-point from front to back of the prosthesis floating component **108**. The minimum tongueless height **130** can be from about 1 mm (0.04 in.) to about 4.1 mm (0.16 in.), for example about 2.0 mm (0.079 in.). The maximum tongueless height **132** can be about at the front and/or back ends of the prosthesis floating component **108**. The maximum tongueless height **132** can be from about 3.6 mm (0.14 in.) to about 15 mm (0.58 in.), for example about 7.32 mm (0.288 in.).

[0091] The tongues **114**, **116** can have the same or different tongue radii **133**. The tongue radii **133** can be from about 10 mm (0.4 in.) to about 41 mm (1.6 in.), for example about 20.7 mm (0.813 in.). The tongue radii **133** can be about equal to the groove radii on the adjacent prosthesis component. For example, the groove radius **70** for the prosthesis tibia component **134** can be about the same as the tongue radius **133** for the tongue tibia-side surface **110** of the prosthesis floating component **108**. The groove radius **70** for the prosthesis talus component can be about the same as the tongue radius **133** for the tongue talus-side surface **110** of the prosthesis floating component **108**.

[0092] Figure 25 illustrates a prosthesis tibia component **134** that can have a perimeter anchor **30** that extends from a base **136** along a single side of the base **136**. The perimeter anchor **30** can extend at a right, obtuse, or acute angle from the base **136**. The perimeter anchor **30** can extend from one, two, three, four or more sides of the base **136**. The perimeter anchor **30** can have a first supplemental anchor port **138** and a second supplemental anchor port **140**. The anchor ports **138**, **140** can be straight or tapered. The anchor ports **138**, **140** can be threaded or unthreaded. The prosthesis tibia component **134** can have a groove **38** configured to slidably engage the tibia tongue **114** on the prosthesis floating component **108**. The prosthesis tibia component **134** can have a tongue **114**, **116** configured to slidably engage

the groove **38** on the prosthesis talus component **158**, for example when in use without the prosthesis floating component **108**.

[0093] The tongues **114**, **116** on the prosthesis floating component **108** can either or both be grooves **38**, and the grooves **38** on the prosthesis tibia component **134** and the prosthesis talus component **158** can either or both be tongues **114**, **116** to engagably match the corresponding structure on the prosthesis floating component **108**.

[0094] Figure 26a illustrates that the prosthesis tibia component **134** can have a tibia component length **142** and a tibia component height **144**. The tibia component length **142** can be from about 17 mm (0.65 in.) to about 69 mm (2.7 in.), for example about 34.93 mm (1.375 in.). The tibia component height **144** can be from about 7.9 mm (0.31 in.) to about 31.8 mm (1.25 in.), for example about 15.9 mm (0.625 in.).

[0095] The anchor ports **138**, **140** can have an anchor port inner radius **146** and an anchor port outer radius **148**, for example if the anchor port is tapered or threaded. The anchor port inner radius **146** can be from about 1.5 mm (0.06 in.) to about 3.3 mm (0.13 in.), for example about 1.7 mm (0.065 in.). The anchor port outer radius **148** can be from about 1.5 mm (0.06 in.) to about 5.8 mm (0.23 in.), for example about 2.87 mm (0.113 in.).

[0096] The groove radius **70** of the prosthesis tibia component **134** can be about equal to the groove radius **70** for the prosthesis talus component **158**.

[0097] Figure 26b illustrates that the perimeter anchor **30** can have a perimeter anchor width **80**. The perimeter anchor width **80** can be from about 2 mm (0.07 in.) to about 8 mm (0.3 in.), for example about 3.81 mm (0.150 in.).

[0098] The base **136** can have a base height **150**. The base height **150** can be from about 2 mm (0.07 in.) to about 8 mm (0.3 in.), for example about 3.81 mm (0.150 in.).

1 [0099] The prosthesis tibia component 134 can have a tibia component width 151. The
2 tibia component width 151 can be from about 17 mm (0.7 in.) to about 71 mm (2.8 in.), for
3 example about 35.56 mm (1.400 in.).

4 [00100] Any or all elements of the prosthesis and/or other devices or apparatuses described
5 herein, including the prosthesis body 24 of the talus prosthesis, prosthesis floating component
6 108, and/or tibial prosthesis, or any other prosthesis, can have a surface finish to about 1.6
7 μm (63 $\mu\text{in.}$) or less.

8 [00101] Any or all elements of the prosthesis and/or other devices or apparatuses described
9 herein, including the prosthesis body 24 of the talus prosthesis, prosthesis floating component
10 108, and/or tibial prosthesis, or any other prosthesis, can be made from, for example, a single
11 or multiple stainless steel alloys, nickel titanium alloys (e.g., Nitinol), other titanium alloys,
12 cobalt-chrome alloys (e.g., ELGILOY® from Elgin Specialty Metals, Elgin, IL;
13 CONICHROME® from Carpenter Metals Corp., Wyomissing, PA), aluminum and aluminum
14 alloys (e.g., 6060-T6 aluminum, 6061-T6 aluminum), nickel-cobalt alloys (e.g., MP35N®
15 from Magellan Industrial Trading Company, Inc., Westport, CT), molybdenum alloys (e.g.,
16 molybdenum TZM alloy, for example as disclosed in International Pub. No. WO 03/082363
17 A2, published 9 October 2003, which is herein incorporated by reference in its entirety),
18 tungsten-rhenium alloys, for example, as disclosed in International Pub. No. WO 03/082363,
19 polymers such as polyethylene terephthalate (PET)/polyester (e.g., DACRON® from E. I.
20 Du Pont de Nemours and Company, Wilmington, DE), polypropylene, (PET),
21 polytetrafluoroethylene (PTFE), expanded PTFE (ePTFE), polyether ether ketone (PEEK),
22 nylon, polyether-block co-polyamide polymers (e.g., PEBAX® from ATOFINA, Paris,
23 France), aliphatic polyether polyurethanes (e.g., TECOFLEX® from Thermedics Polymer
24 Products, Wilmington, MA), polyvinyl chloride (PVC), polyurethane, thermoplastic,
25 fluorinated ethylene propylene (FEP), absorbable or resorbable polymers such as

polyglycolic acid (PGA), polylactic acid (PLA), polycaprolactone (PCL), polyethyl acrylate (PEA), polydioxanone (PDS), and pseudo-polyamino tyrosine-based acids, extruded collagen, silicone, zinc, echogenic, radioactive, radiopaque materials, a biomaterial (e.g., cadaver tissue, collagen, allograft, autograft, xenograft, bone cement, morselized bone, bone morphogenic protein (BMP), osteogenic powder, beads of bone) any of the other materials listed herein or combinations thereof. Examples of radiopaque materials are barium sulfate, zinc oxide, titanium, stainless steel, nickel-titanium alloys, tantalum and gold.

[0100] Any or all elements of the prosthesis and/or other devices or apparatuses described herein can be or have a matrix for cell ingrowth **54** (e.g., as described supra) or used with a fabric, for example a covering (not shown) that acts as a matrix for cell ingrowth **54**. The matrix and/or fabric can be, for example, polyester (e.g., DACRON® from E. I. Du Pont de Nemours and Company, Wilmington, DE), polypropylene, PTFE, ePTFE, nylon, extruded collagen, a cobalt-chrome alloy matrix, silicone or combinations thereof.

[0101] The elements of the prosthesis and/or other devices or apparatuses described herein and/or the fabric can be filled and/or coated with an agent delivery matrix known to one having ordinary skill in the art and/or a therapeutic and/or diagnostic agent. The agents within these matrices can include radioactive materials; radiopaque materials; cytogenic agents; cytotoxic agents; cytostatic agents; thrombogenic agents, for example polyurethane, cellulose acetate polymer mixed with bismuth trioxide, and ethylene vinyl alcohol; lubricious, hydrophilic materials; phosphor cholene; anti-inflammatory agents, for example non-steroidal anti-inflammatories (NSAIDs) such as cyclooxygenase-1 (COX-1) inhibitors (e.g., acetylsalicylic acid, for example ASPIRIN® from Bayer AG, Leverkusen, Germany; ibuprofen, for example ADVIL® from Wyeth, Collegeville, PA; indomethacin; mefenamic acid), COX-2 inhibitors (e.g., VIOXX® from Merck & Co., Inc., Whitehouse Station, NJ; CELEBREX® from Pharmacia Corp., Peapack, NJ; COX-1 inhibitors); immunosuppressive

agents, for example Sirolimus (RAPAMUNE®, from Wyeth, Collegeville, PA), or matrix metalloproteinase (MMP) inhibitors (e.g., tetracycline and tetracycline derivatives) that act early within the pathways of an inflammatory response. Any or all parts of the prosthesis or other elements, tools, bones or other parts of the implant site can be coated with hydroxyapatite. Examples of other agents are provided in Walton et al, Inhibition of Prostaglandin E₂ Synthesis in Abdominal Aortic Aneurysms, *Circulation*, July 6, 1999, 48-54; Tambiah et al, Provocation of Experimental Aortic Inflammation Mediators and Chlamydia Pneumoniae, *Brit. J. Surgery* 88 (7), 935-940; Franklin et al, Uptake of Tetracycline by Aortic Aneurysm Wall and Its Effect on Inflammation and Proteolysis, *Brit. J. Surgery* 86 (6), 771-775; Xu et al, Sp1 Increases Expression of Cyclooxygenase-2 in Hypoxic Vascular Endothelium, *J. Biological Chemistry* 275 (32) 24583-24589; and Pyo et al, Targeted Gene Disruption of Matrix Metalloproteinase-9 (Gelatinase B) Suppresses Development of Experimental Abdominal Aortic Aneurysms, *J. Clinical Investigation* 105 (11), 1641-1649 which are all incorporated by reference in their entireties.

METHOD OF USE

[0102] The prosthesis 20 can be used at the end of long bones. The prosthesis 20 can be used on the superior side of the talus 12. The prosthesis 20 can be used on vertebra.

[0103] Figures 27 and 28 illustrate the superior surface of the talus 12 – or bone end of a long bone (not shown) – can have tissue removed to prepare for the implantation of the prosthesis 20. More tissue can be removed from the superior surface of the bone radially distal from the central axis 26 than radially proximal to the central axis 26.

[0104] The talus 12 can have a minimum cut-down thickness 16. The minimum cut-down thickness 16 can be substantially equivalent to the original talus thickness 10 shown in

Figures 1 and 2. The minimum cut-down thickness **16** can be substantially larger than the minimum cut-down thickness **16** shown in Figures 3 and 4.

[0105] All or part of the remaining superior surface can be a contact patch **16**, for example, for the prosthesis **20** to attach to in whole or part. BMP known to those having ordinary skill in the art can be applied to the contact patch **16** and/or to the surface (e.g., the surface that will contact the contact patch **16**) of the prosthesis **20**, for example the perimeter anchor **30**, before or after the prosthesis **20** is attached to the talus **12**.

[0106] Figures 29 and 30 illustrate that the prosthesis **20** can be attached to all or part of the superior surface of the talus **12**. The perimeter anchor **30** can attach to the talus **12**. A post-implant talus minimum thickness **18** can be substantially equivalent to the minimum cut-down thickness **14** of Figures 27 and 28.

[0107] Figures 31 and 32 illustrates that the ridge **56** can attach to the talus **12**. The talus **12** can have tissue removed in a configuration to mate the ridge **56**. The talus **12** can have no tissue removed to mate the ridge **56**, for example, and the ridge **56** can deform the talus **12** and/or the prosthesis **20**.

[0108] Figures 33 and 34 illustrate that one or more supplemental anchors **152** can be deployed through the prosthesis **20** and into or through the talus **12**. The supplemental anchor **152** can be deployed through the perimeter anchor **30** and/or through the central portion **28**. The supplemental anchors **152** can be screws, pins, brads, sutures, or combinations thereof.

[0109] The supplemental anchor **152** can have a supplement anchor head **154**. The end of the supplemental anchor port **64** adjacent to the distal prosthesis surface **32** can be sunken to receive the supplemental anchor head **154** in a configuration flush with the distal prosthesis surface **32**.

[0110] The supplemental anchor **152** can have supplemental anchor thread **154**. The supplemental anchor thread **154** can be received by a thread in the supplemental anchor port **64**. The supplemental anchor thread **154** can be configured to fixedly or removably attach to the talus **12**.

[0111] Figures 35 through 36 illustrate a method of implanting the prosthesis **20** that can have multiple components. The prosthesis **20** can have a prosthesis talus component **158** and a prosthesis tibia component. The prosthesis talus component **158** can, for example, be substantially equivalent to any of the prostheses **20** shown in Figures 7-22c and 29-34. The prosthesis tibia component **134** can have the perimeter anchor **30**. The perimeter anchor **30** of the prosthesis tibia component **134** can ascend superiorly along the lateral, anterior and posterior perimeter of the tibia **6**, as shown in Figures 35 through 37. The perimeter anchor **30** of the prosthesis tibia component **134** can descend inferiorly and/or terminate along the medial malleolus articular facet **160**, as shown in Figure 35. The perimeter anchor **30** of the prosthesis tibia component **134** can ascend superiorly along the medial perimeter of the tibia **6**, as shown in Figure 36. The perimeter anchor **30** of the prosthesis tibia component **134** can replace the medial malleolus **162**, as shown in Figure 36.

[0112] The medial malleolus **162** can be completely or partially preserved or completely or partially removed. For example, the prosthesis tibia component **134** can bolster the medial malleolus **162**, as shown in Figure 35. The prosthesis tibia component **134** can replace the medial malleolus **162**, as shown in Figure 36. The prosthesis tibia component **134** can be preserved, for example, with the use of a properly sized prosthesis tibia component **134** as shown in Figure 25.

[0113] The prosthesis tibia component **134** can be configured to approximate the fibular notch **164**, as shown in Figures 35 and 36.

[0114] Figures 38 through 40 illustrate that the prostheses 20 can have a prosthesis floating component 108. The prosthesis floating component 108 can be separate from the prosthesis talus component 158 and the prosthesis tibia component 134. The prosthesis floating component 108 can be implanted between the prosthesis talus component 158 and the prosthesis tibia component 134. The prosthesis floating component 108 can be configured to slidably contact the prosthesis talus component 158 and the prosthesis tibia component 134.

The prosthesis floating component 108, the prosthesis tibia component 134, and the prosthesis talus component 158 can be made from the same and/or different materials.

[0115] Figure 41 illustrates that the prosthesis 20 can be implanted in a knee 166. The prosthesis 20 can have a prosthesis femur component 168, a prosthesis tibia component 134, a prosthesis floating component 108, or combinations thereof. The prosthesis femur component 168 can be configured to replace, and extend superiorly to and/or beyond, the adductor tubercle 170 and lateral epicondyle 172 around part of or substantially or completely the entire perimeter of the femur 174. The prosthesis tibia component 134 can be configured to replace, and extend inferiorly beyond, the Gerdy's tubercle around part of or substantially or completely the entire perimeter of the tibia 12.

[0116] Figure 42 illustrates that the prosthesis 20 can be implanted in a hip 176, notably in the femur and pelvis 177. The prosthesis 20 can have a prosthesis femur component 168, a prosthesis pelvis component 176, a prosthesis floating component 108, or combinations thereof. The prosthesis femur component 168 can be configured to replace, and extend inferiorly to and/or beyond, the greater trochanter 178 and lesser trochanter 180 around part of or substantially or completely the entire perimeter of the femur 174. The prosthesis femur component 168 can be configured to approximate or otherwise mimic the anatomical features including the greater trochanter 178, lesser trochanter 180, femur head 179 and femur neck 181.

[0117] The prosthesis pelvis component 176 can be configured to replace, and extend radially beyond, the acetabular notch 182. The prosthesis pelvis component 176 can be configured to approximate or otherwise mimic or transition smoothly into the anatomic features including the acetabulum 183, and superior pubis ramus 185.

[0118] Figure 43 illustrates that the prosthesis 20 can be implanted in a shoulder 40. The prosthesis 20 can have a prosthesis humerus component 184, a prosthesis scapula component 186, a prosthesis floating component 108, or combinations thereof. The prosthesis humerus component 184 can be configured to replace, and extend superiorly to and/or beyond, the greater tubercle 188 and/or lesser tubercle around part of or substantially or completely the entire perimeter of the humerus 190. The prosthesis scapula component 186 can be configured to replace, and extend inferiorly beyond, the supraglenoid tubercle 192, infraglenoid tubercle 194, the neck of the scapula 196, and/or the triceps brachii attachment 198 around part of or substantially or completely the entire perimeter of the scapula 200.

[0119] During use of the implant in weight bearing joints (e.g., ankle, knee, hip, vertebrae), the patient can walk to force the prosthesis against the bone to which the prosthesis is implanted.

[0120] The prosthesis can be sized so that during preparation (e.g., as shown in Figures 27 and 28) of the talus and implantation and attachment of the prosthesis that the removal or other loss of existing talus be minimal, for example less than about 35% of the talus volume, more narrowly less than about 20% of talus volume, yet more narrowly less than 10% of the talus volume. The prosthesis can be sized to cause no or minimal damage to the cancellous bone, for example minimizing or preventing impairment of blood flow to, from and within the bone and blood cell generation by the bone.

[0121] The prosthesis can be attached to the talus, without creating a hole substantially completely through the talus with substantially opposite ends of the hole in the direction of

1 the dorsal-plantar axis of the talus and/or completely surrounded by the bone except for the
2 exit and entry port of the hole.

3 [0122] It is apparent to one skilled in the art that various changes and modifications can be
4 made to this disclosure, and equivalents employed, without departing from the spirit and
5 scope of the invention. Elements shown with any variation are exemplary for the specific
6 variation and can be used in combination with, or otherwise on or in, other variations within
7 this disclosure. An example of combination would be a prosthesis that can have the ridges of
8 the prosthesis shown in Figures 18 and 19 and the ingrowth matrix shown of the prosthesis
9 shown in Figures 12 and 13. The ingrowth matrix can extend down the prosthesis to some,
10 all, or none of the ridges.

11 [0123] Any or all surfaces or portions of surfaces of the prosthesis can be configured to allow
12 ingrowth and/or supplemental anchoring of soft tissue (e.g., ligament, tendon, membrane).

13 [0124] Anatomical representations in the figures have been simplified for the purpose of
14 illustration. One having ordinary skill in the art can identify the anatomical details implied
15 but not explicitly shown and extrapolate and interpolate therefrom to understand and enable
16 the disclosure herein. For example, though the trochlea, various facets and asymmetry are
17 not shown, one having ordinary skill in the art understands that the prosthesis fits and mimics
18 the configurations of the trochlea, various facets and asymmetry where appropriate.

CLAIMS

1. A partial bone prosthesis device comprising:

a prosthesis body having a central axis, a central portion and a perimeter anchor,
wherein the central axis passes through the central portion, and wherein the perimeter anchor
is radially distal to the central axis.

2. The device of Claim 1, wherein the perimeter anchor is substantially thicker than the
central portion.

3. The device of Claim 1, wherein the perimeter anchor forms a complete perimeter around
the central portion.

4. The device of Claim 1, wherein the perimeter anchor forms an incomplete perimeter
around the central portion.

5. The device of Claim 4, wherein the prosthesis body comprises a branch.

6. The device of Claim 5, wherein the branch comprises the perimeter anchor.

7. The device of Claim 1, wherein the perimeter anchor comprises an ingrowth matrix.

8. The device of Claim 1, wherein the perimeter anchor comprises a first ridge.

9. The device of Claim 8, wherein the perimeter anchor comprises a second ridge.

1 10. The device of Claim 1, wherein the perimeter anchor comprises a supplemental anchor
2 port.

4 11. The device of Claim 1, wherein the prosthesis body comprises titanium

6 12. The device of Claim 1, wherein the prosthesis body comprises cobalt chromium.

8 13. The device of Claim 1, wherein the prosthesis body comprises bone morphogenic
9 protein.

11 14. A method for implanting a partial bone prosthesis to a bone end of a bone having a
12 central axis, comprising:

13 removing tissue from the bone end, wherein removing tissue comprises removing
14 substantially thicker tissue distally from the central axis than proximally to the central axis,
15 and wherein removing tissue comprises exposing a contact patch; and

16 deploying the partial bone prosthesis to the contact patch.

18 15. The method of Claim 14, wherein deploying comprises applying bone morphogenic
19 protein.

21 16. The method of Claim 15, wherein deploying comprises inserting a supplemental anchor
22 through the partial bone prosthesis and into the bone.

24 17. The method of Claim 16, wherein inserting comprises inserting the supplemental anchor
25 through the anchor perimeter.

1

2 18. A method for implanting a partial bone prosthesis to a talus, comprising:

3 attaching the prosthesis to the talus, wherein the attaching does not include creating a
4 hole substantially completely through the talus in the direction of the dorsal-plantar axis of
5 the talus.

6

7 19. The method of Claim 18, wherein the hole is completely surrounded by the bone except
8 for two substantially opposite ends of the hole.

9

10 20. A method for implanting a partial bone prosthesis to a talus, comprising:

11 removing a portion of the talus, and

12 attaching the prosthesis to the talus,

13 wherein the amount of talus removed by the removal of the portion of the talus and the
14 attaching the prosthesis to the talus is less than 35% of the talus.

15

16 21. The method of Claim 20, wherein the amount of talus removed by the removal of the
17 portion of the talus and the attaching the prosthesis to the talus is less than 20% of the talus.

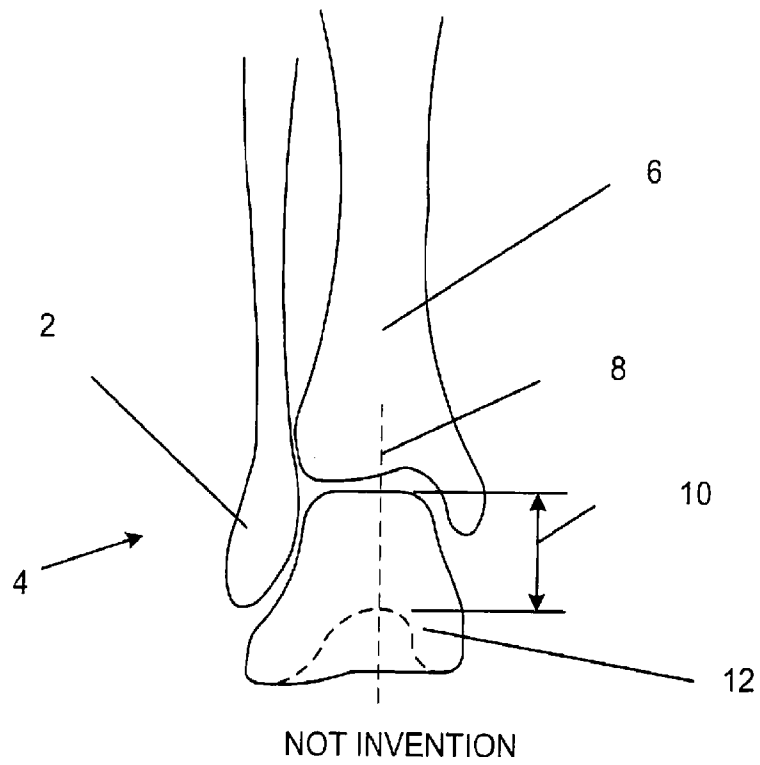


Fig. 1

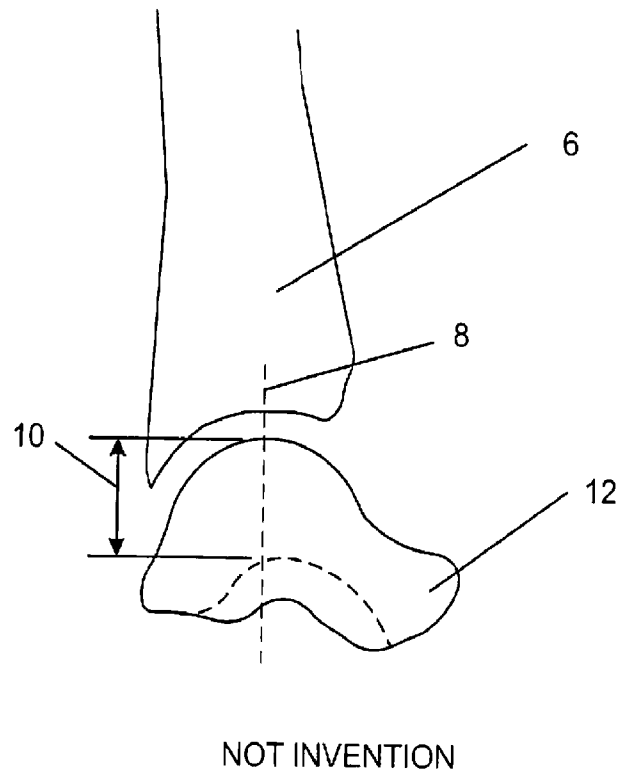


Fig. 2

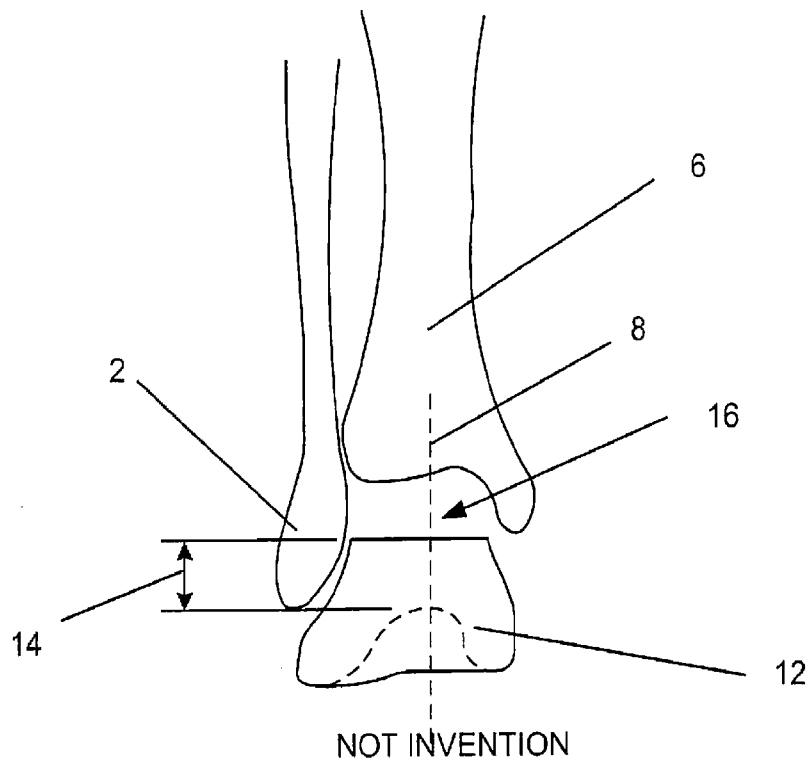


Fig. 3

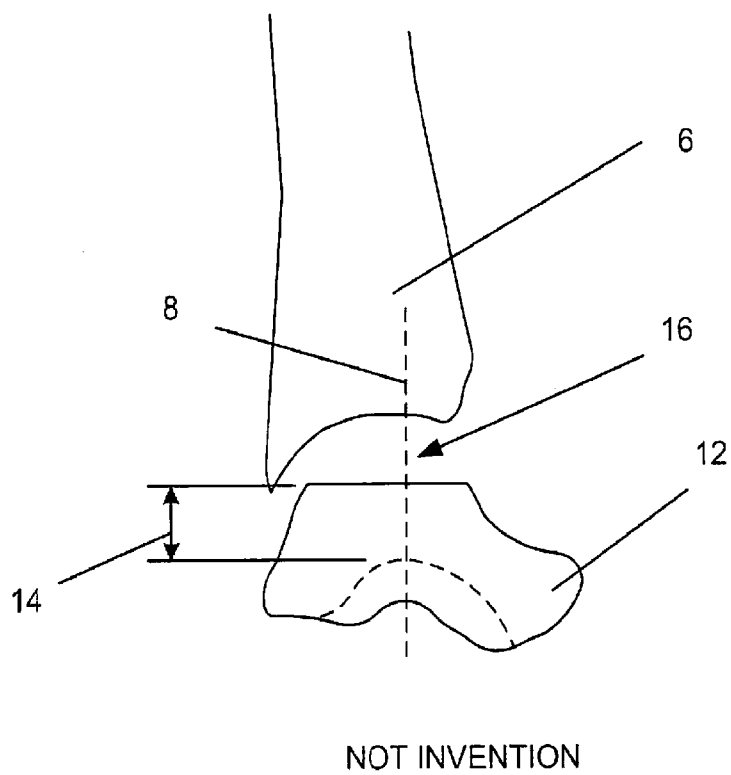


Fig. 4

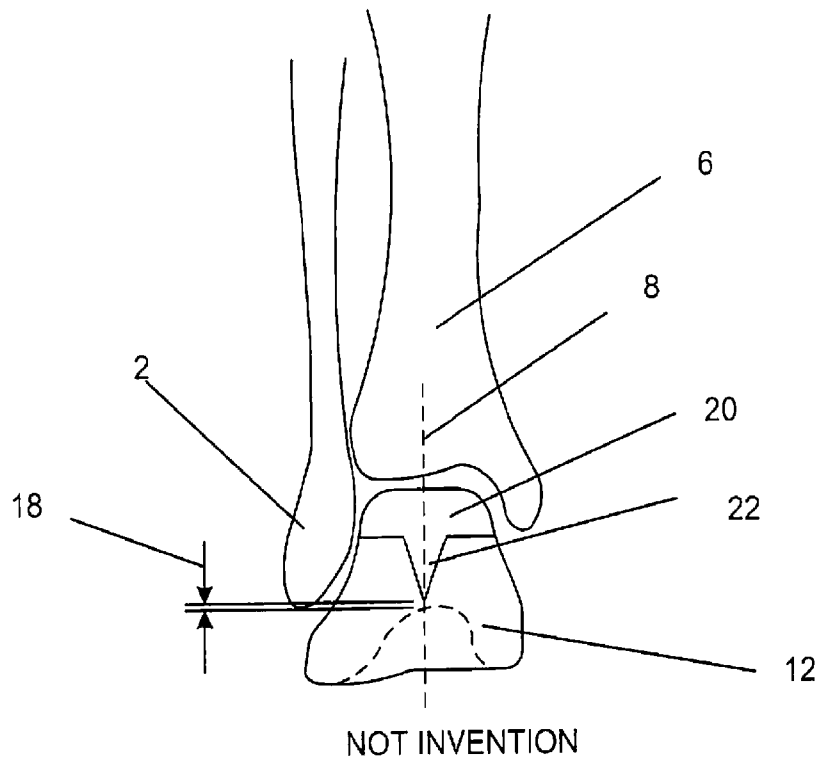


Fig. 5

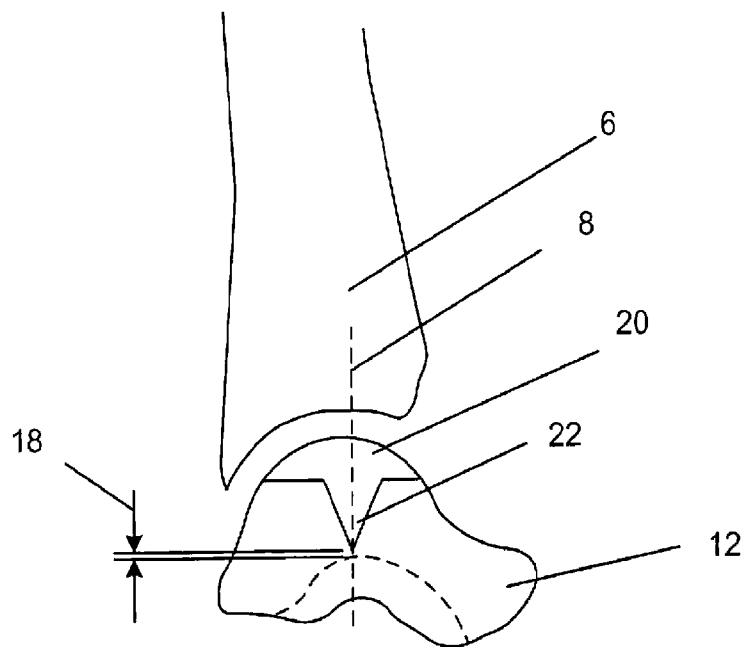
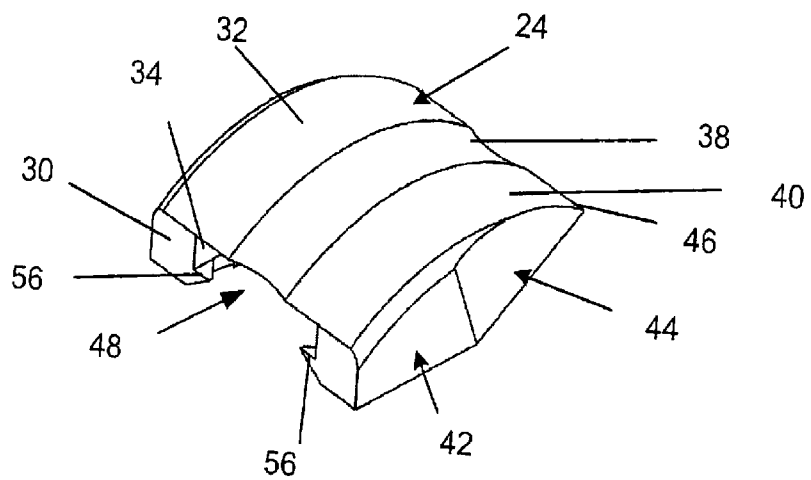
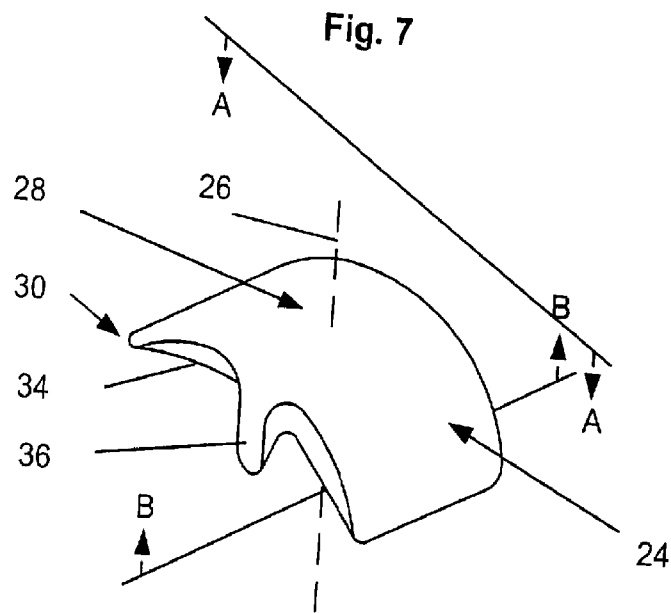
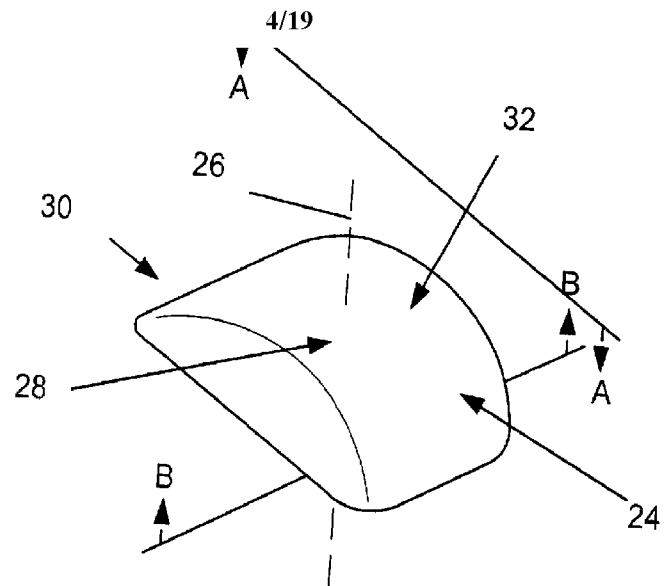


Fig. 6



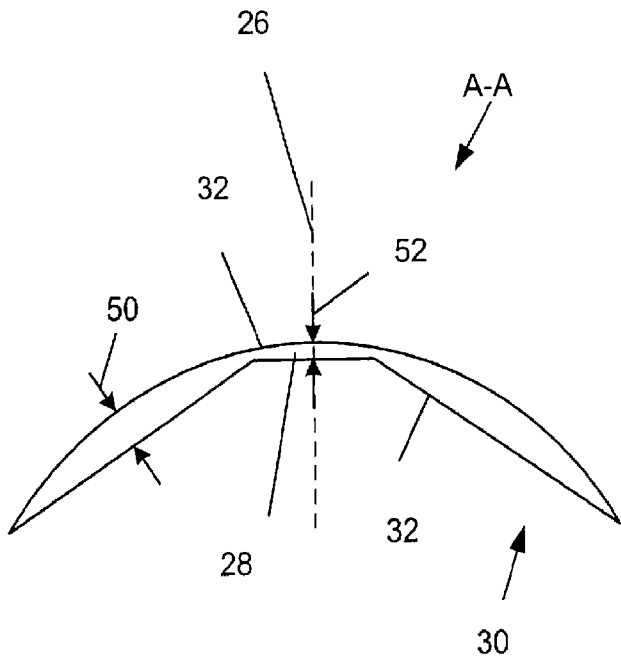


Fig. 10a

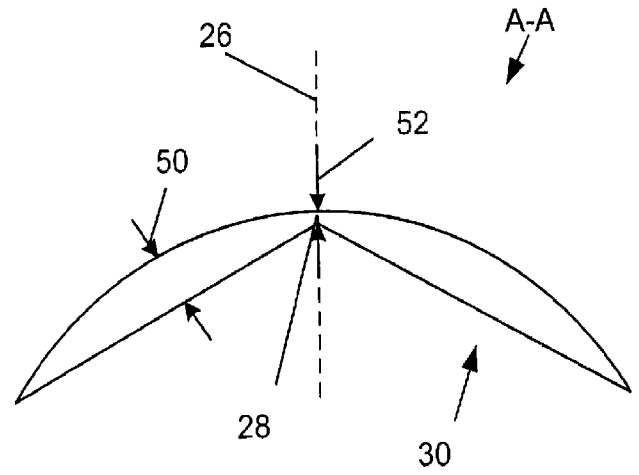


Fig. 10b

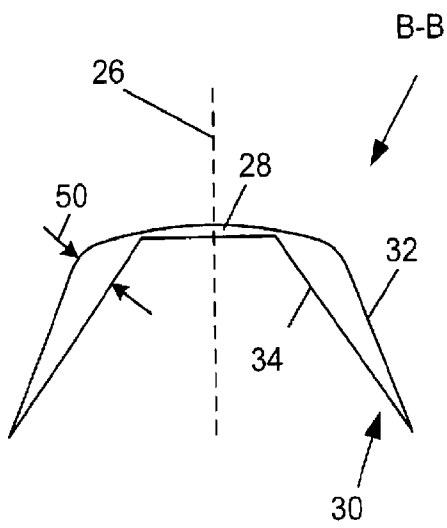


Fig. 11a

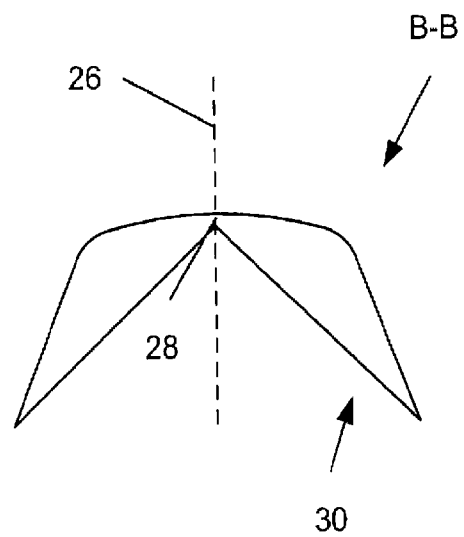


Fig. 11b

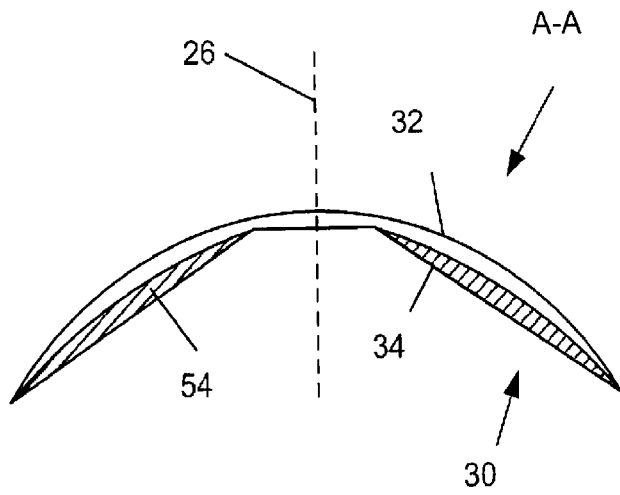


Fig. 12

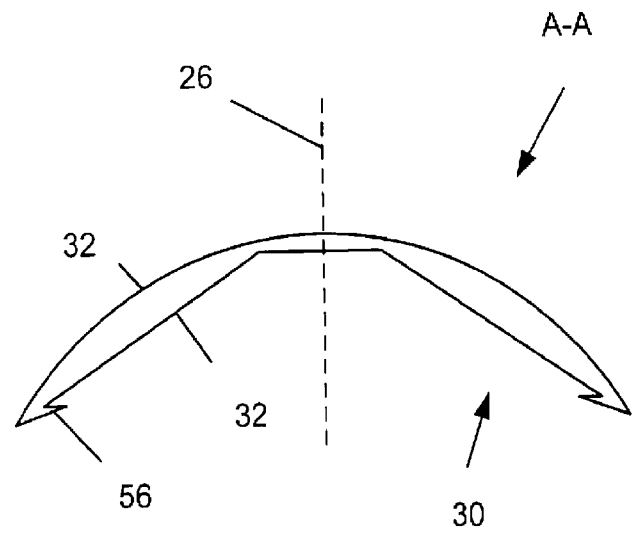


Fig. 14

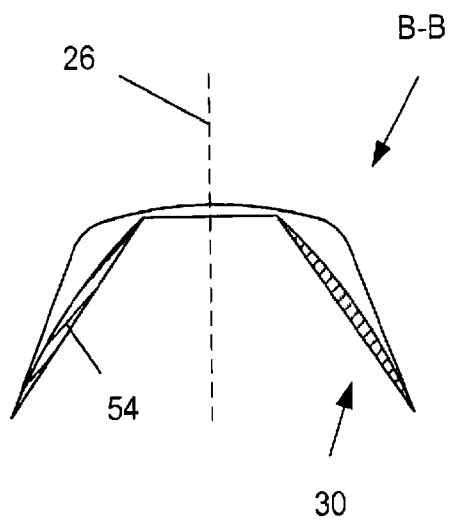


Fig. 13

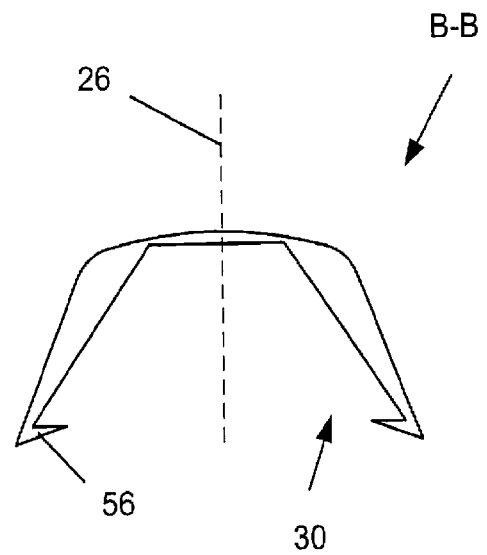


Fig. 15

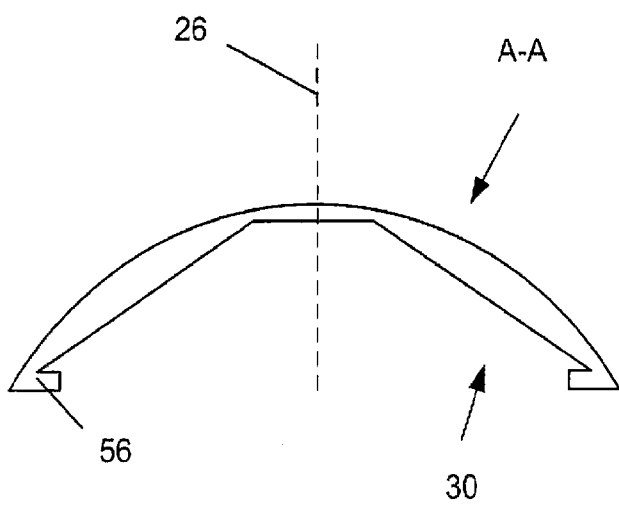


Fig. 16

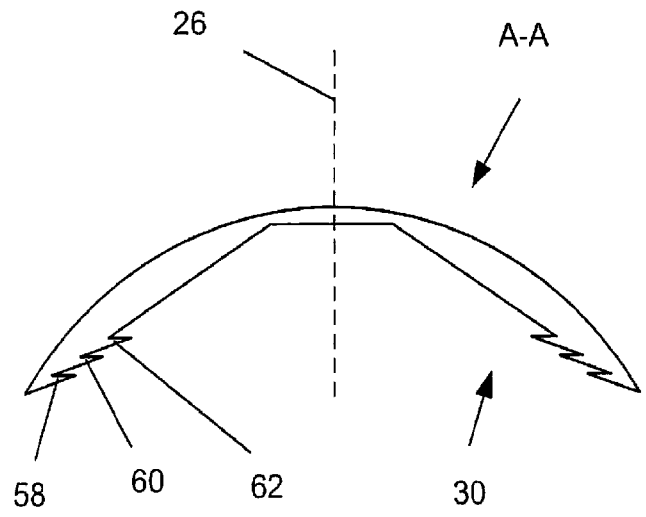


Fig. 18

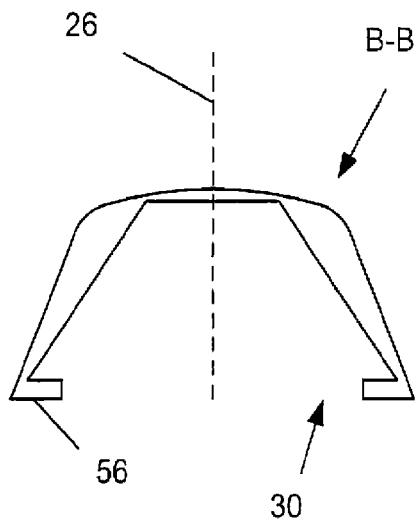


Fig. 17

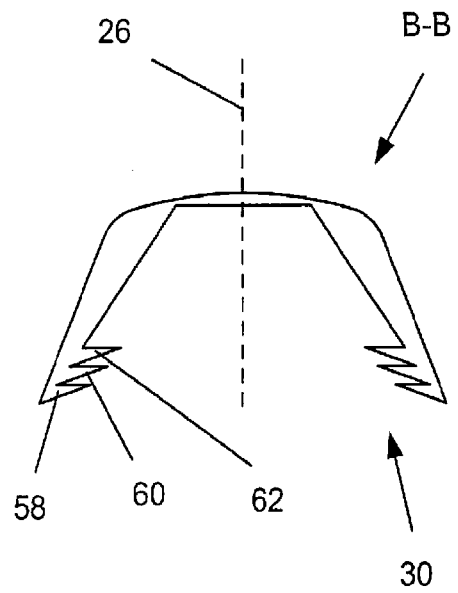


Fig. 19

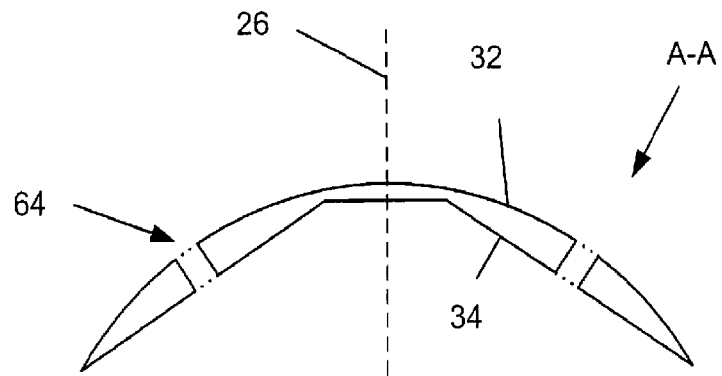


Fig. 20

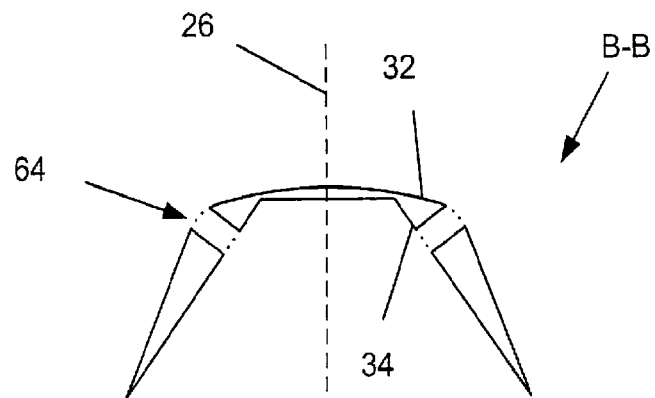


Fig. 21

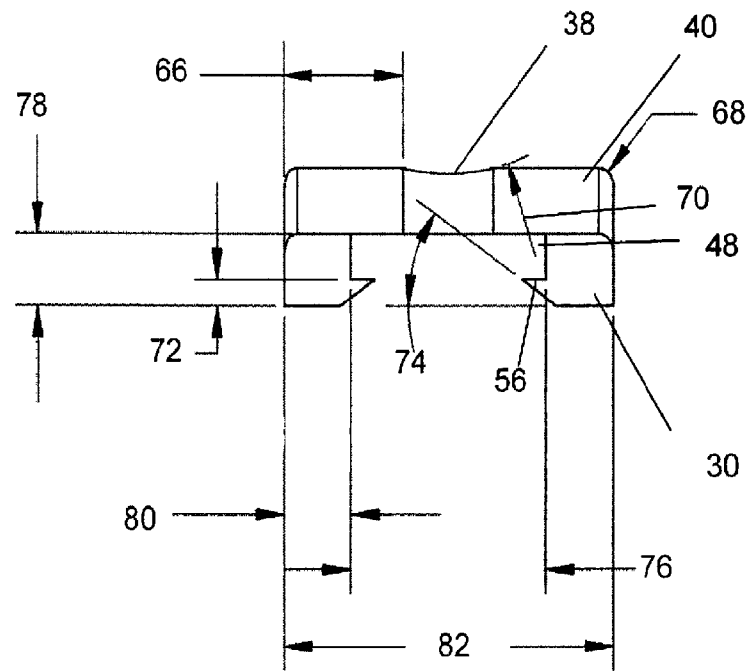


Fig. 22a

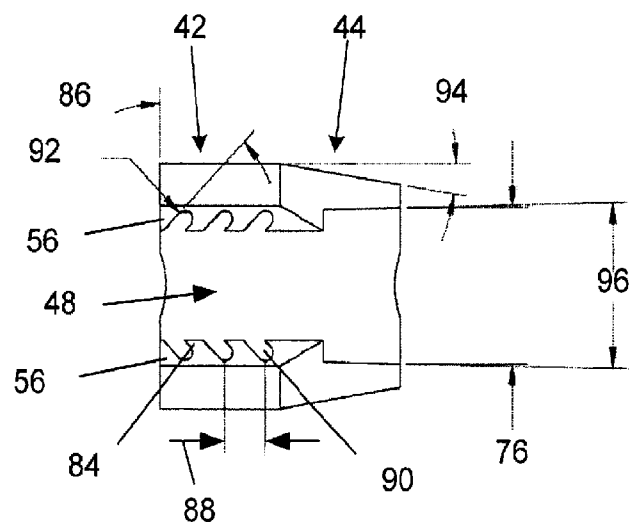


Fig. 22b

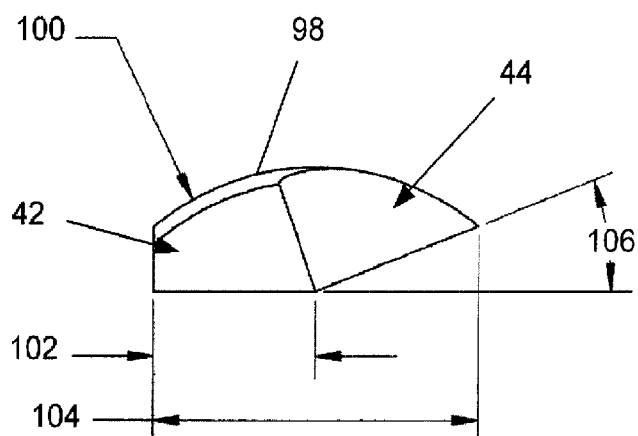
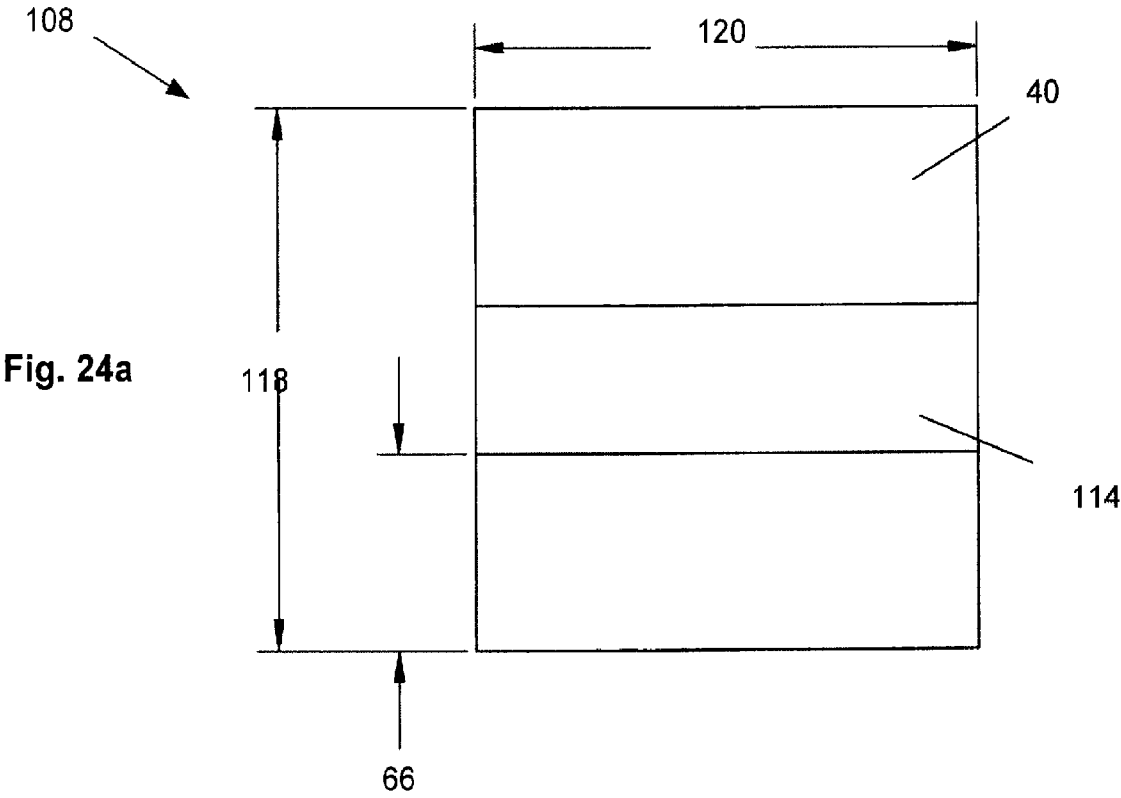
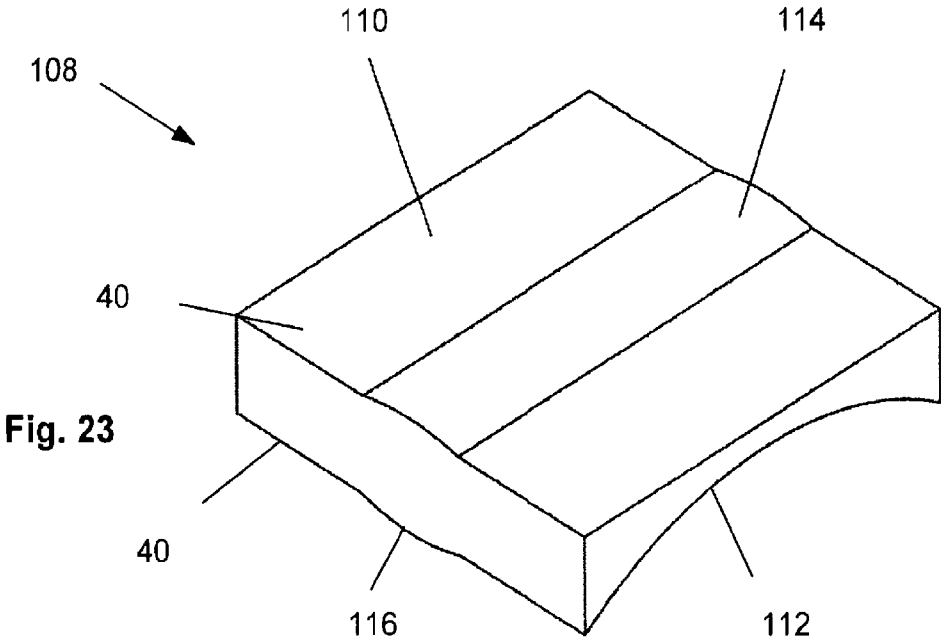


Fig. 22c



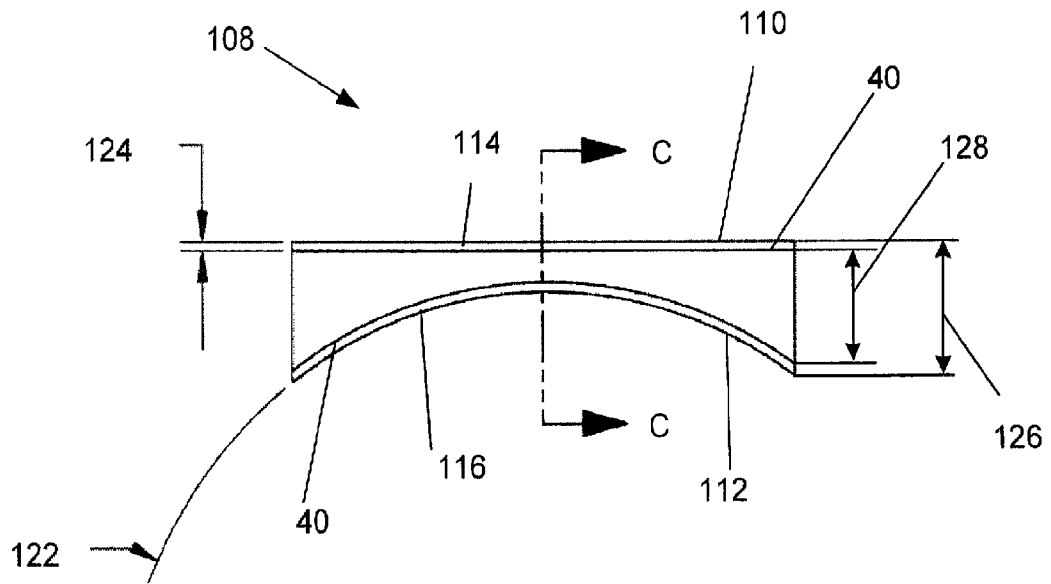


Fig. 24b

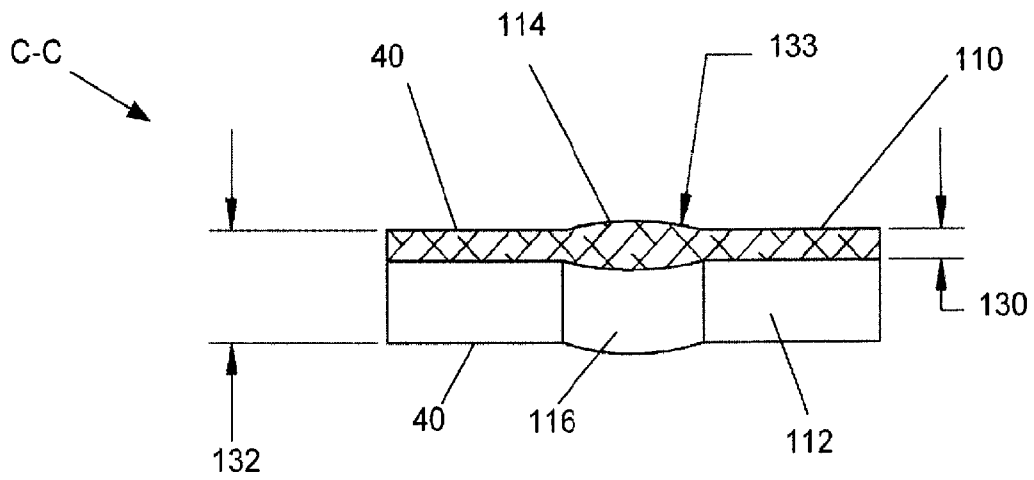


Fig. 24c

Fig. 25

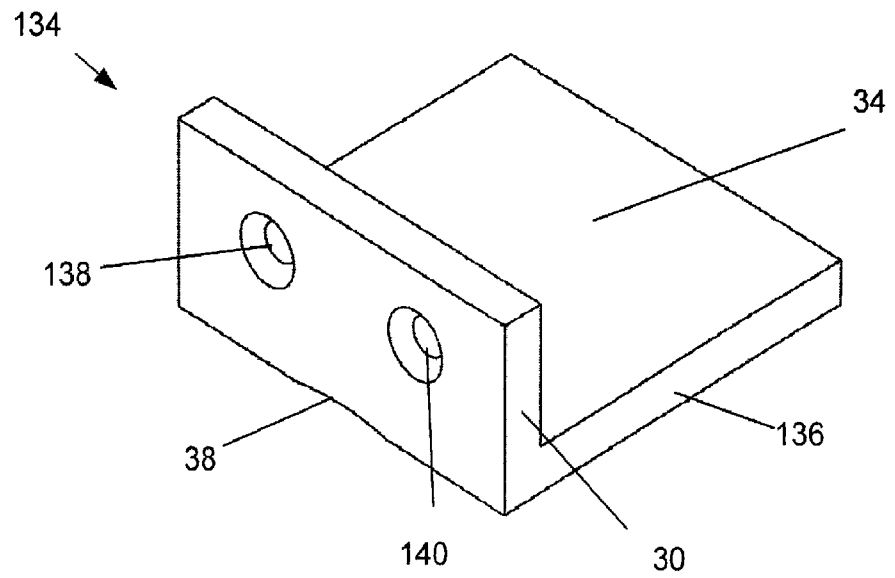


Fig. 26a

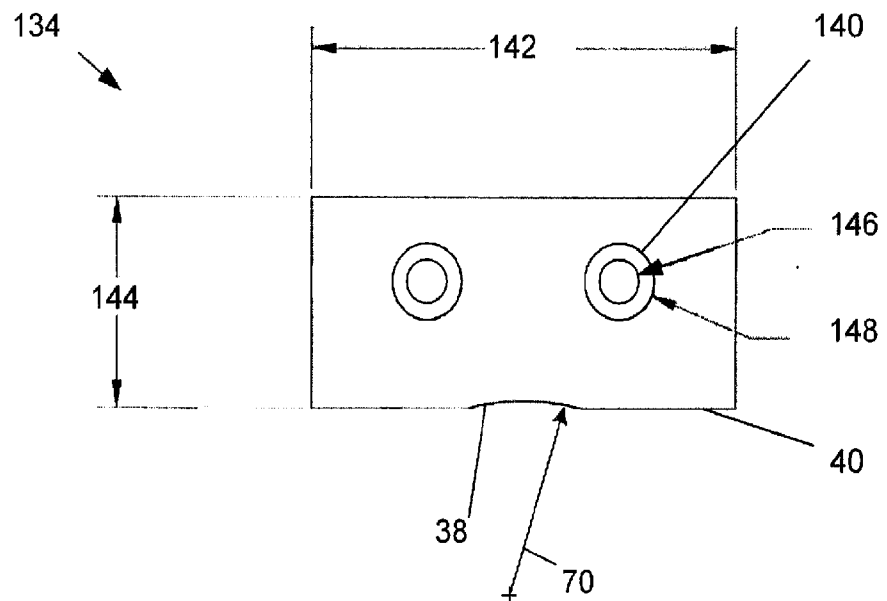
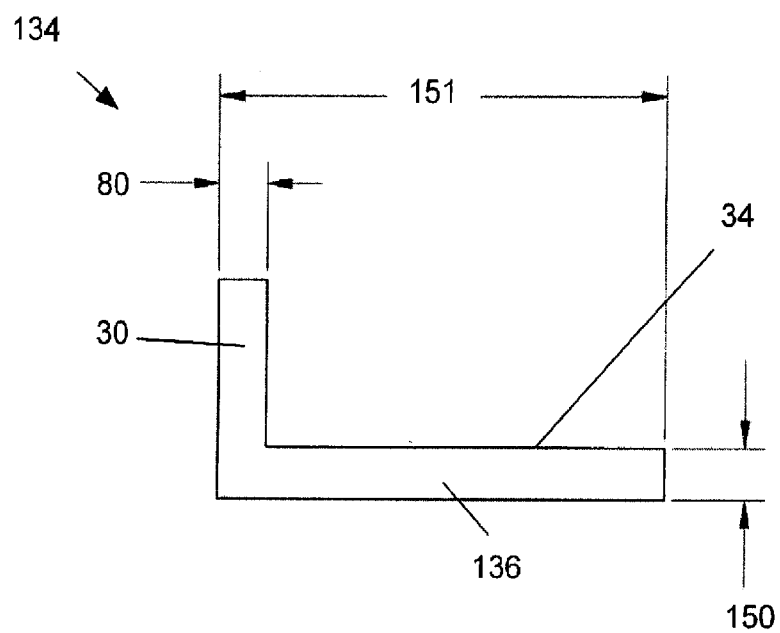


Fig. 26b



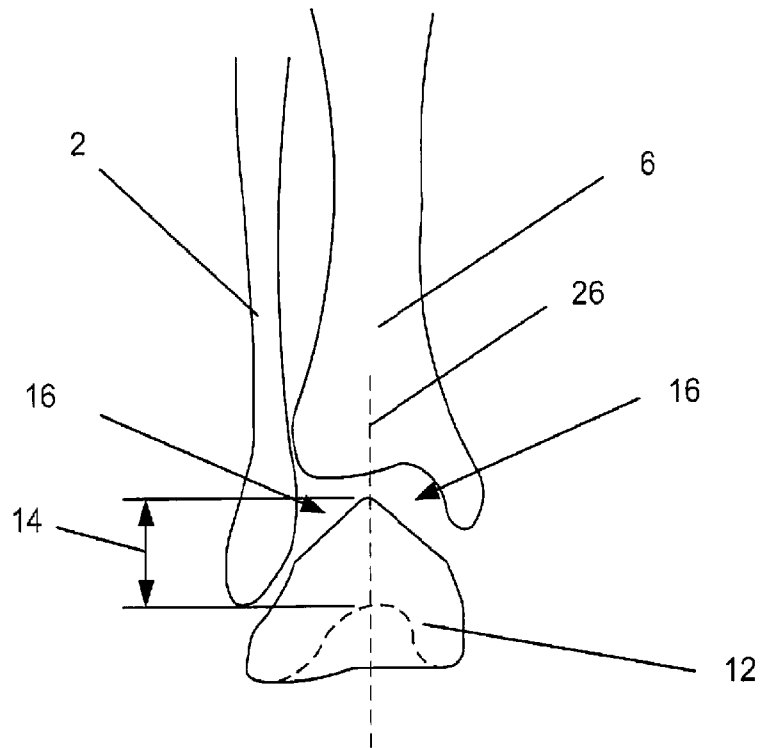


Fig. 27

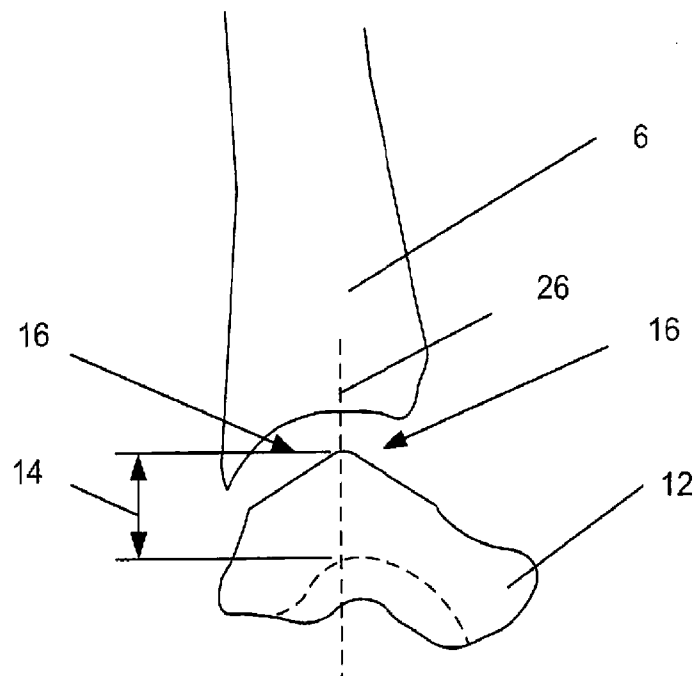


Fig. 28

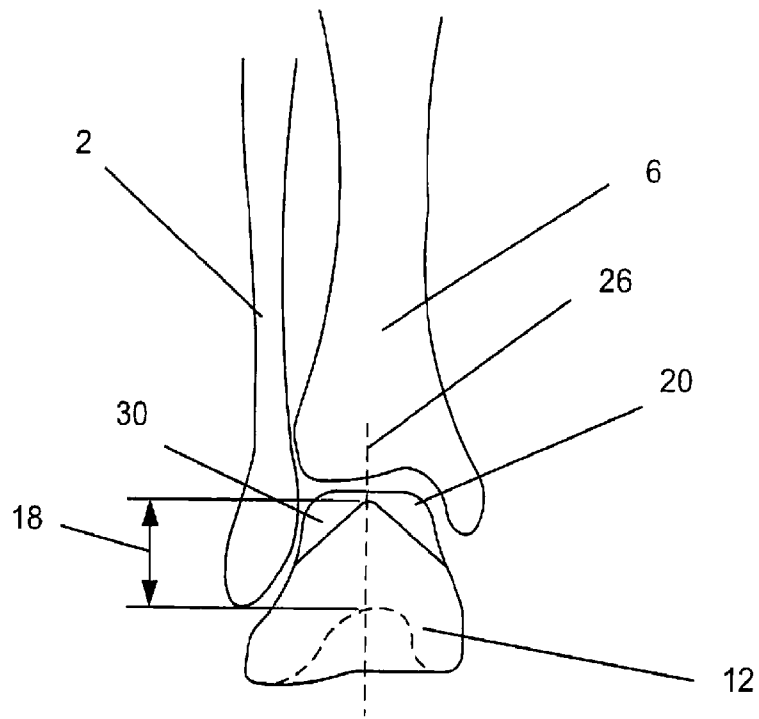


Fig. 29

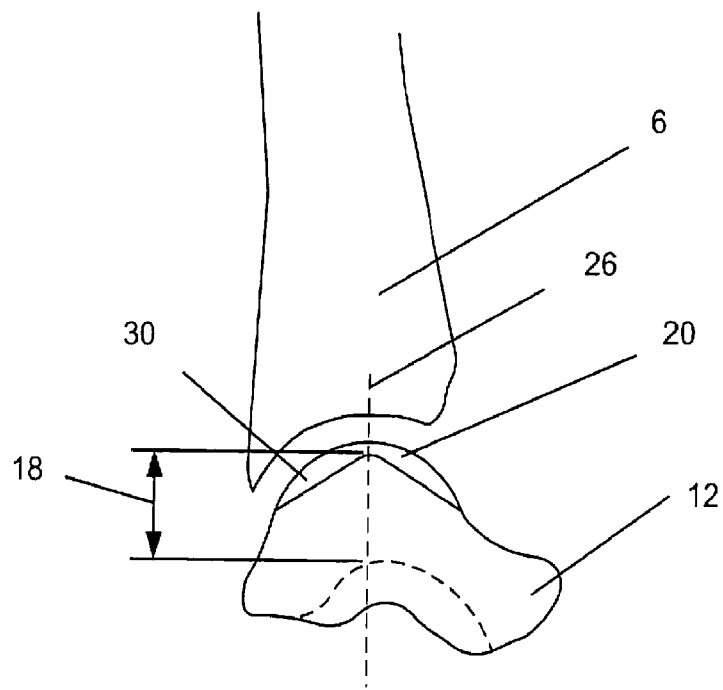


Fig. 30

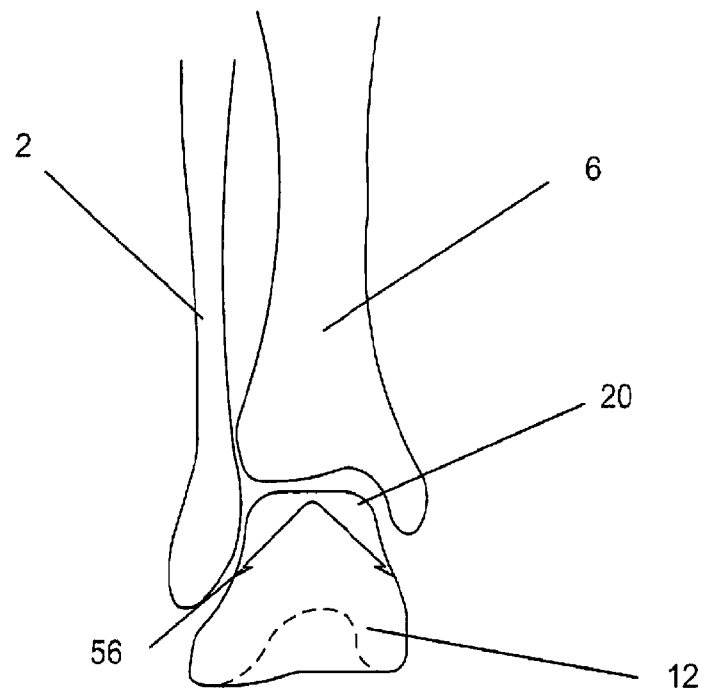


Fig. 31

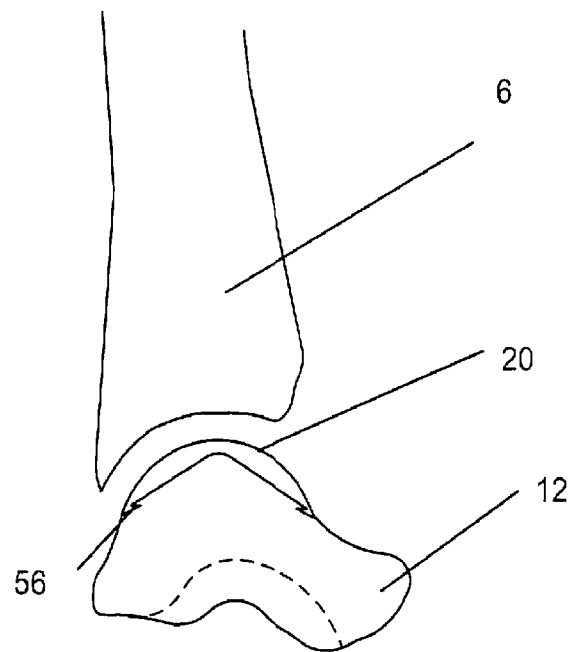


Fig. 32

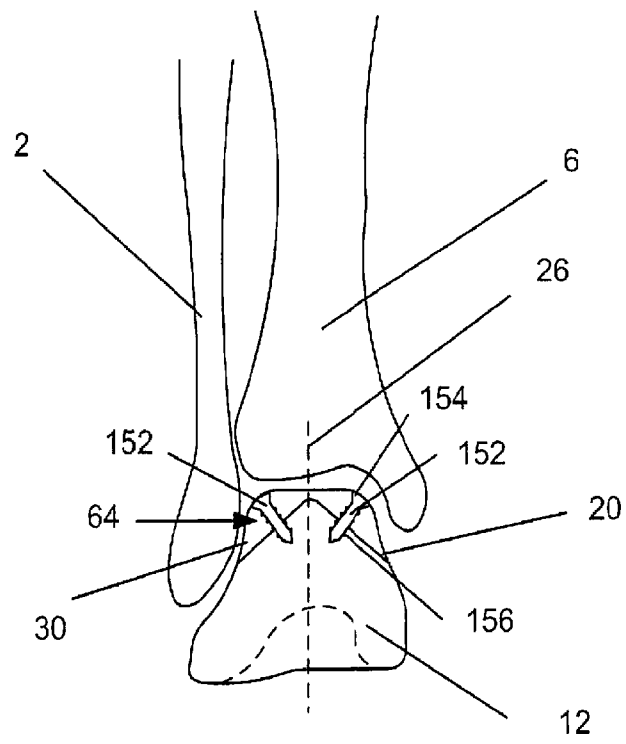


Fig. 33

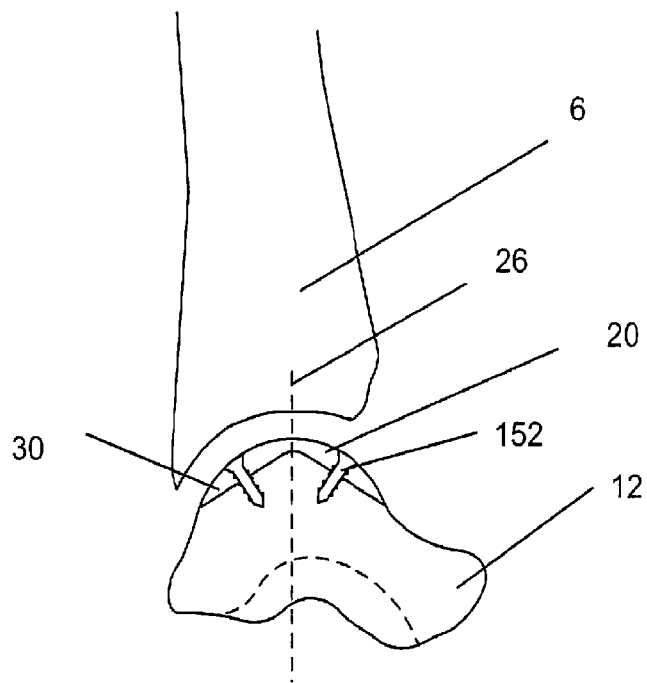


Fig. 34

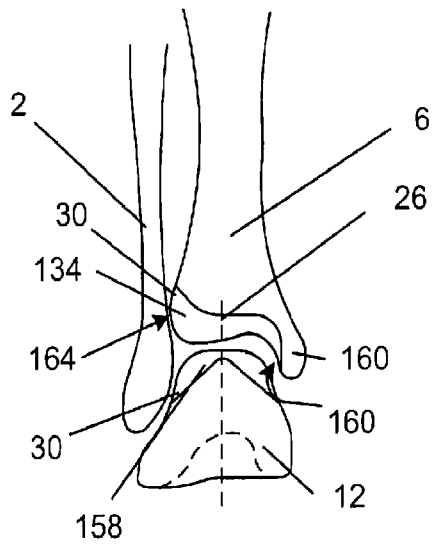


Fig. 35

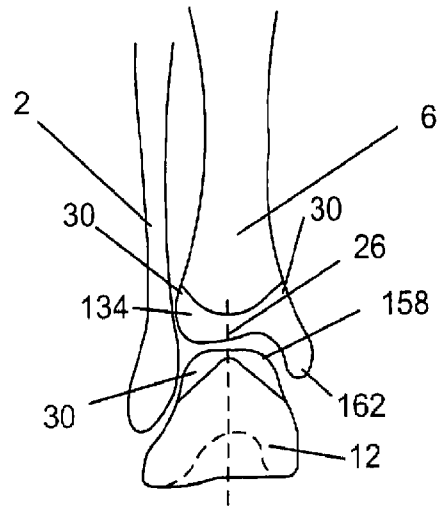


Fig. 36

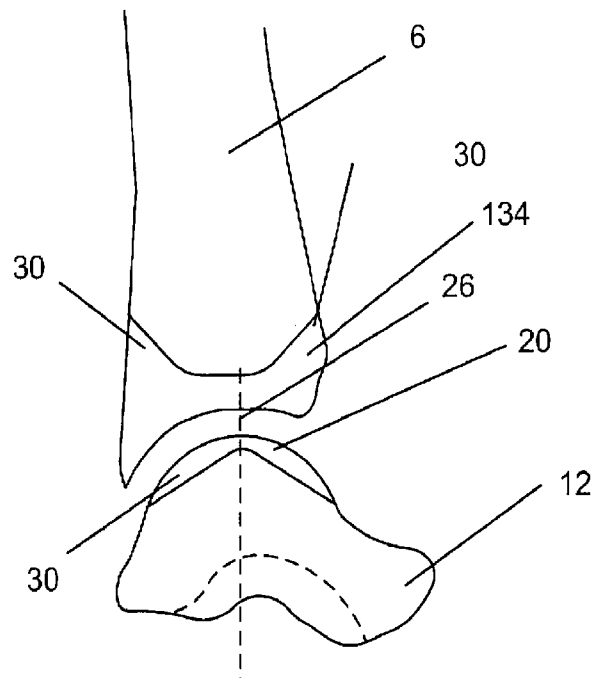


Fig. 37

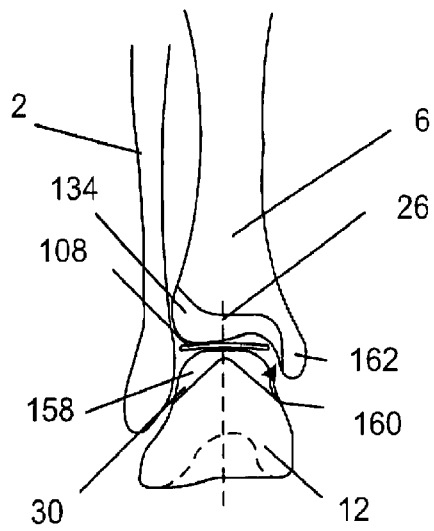


Fig. 38

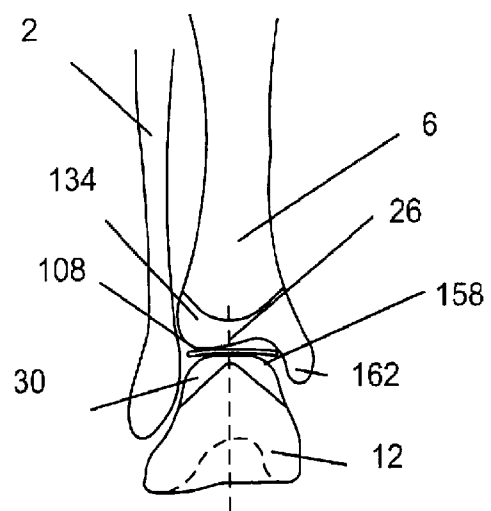


Fig. 39

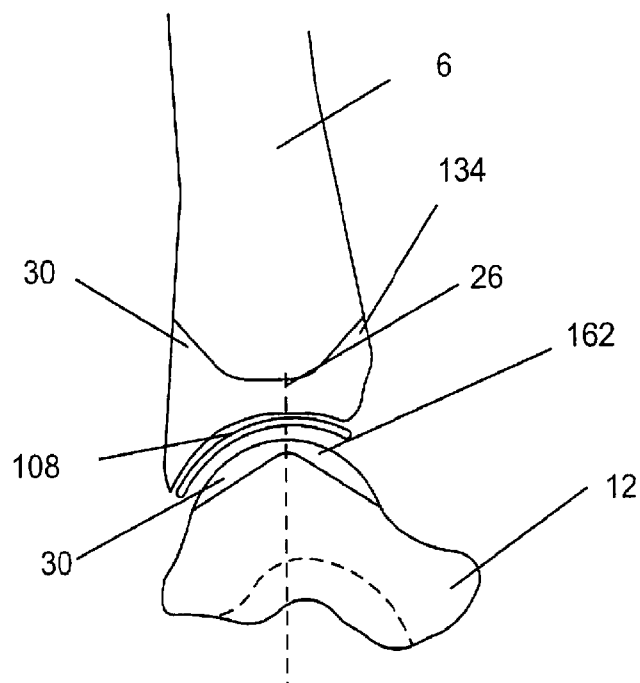


Fig. 40

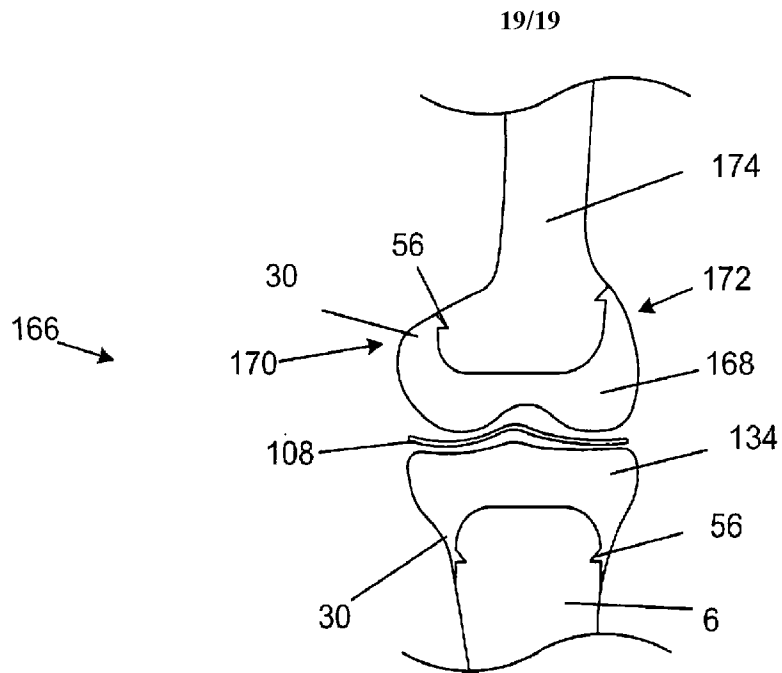


Fig. 41

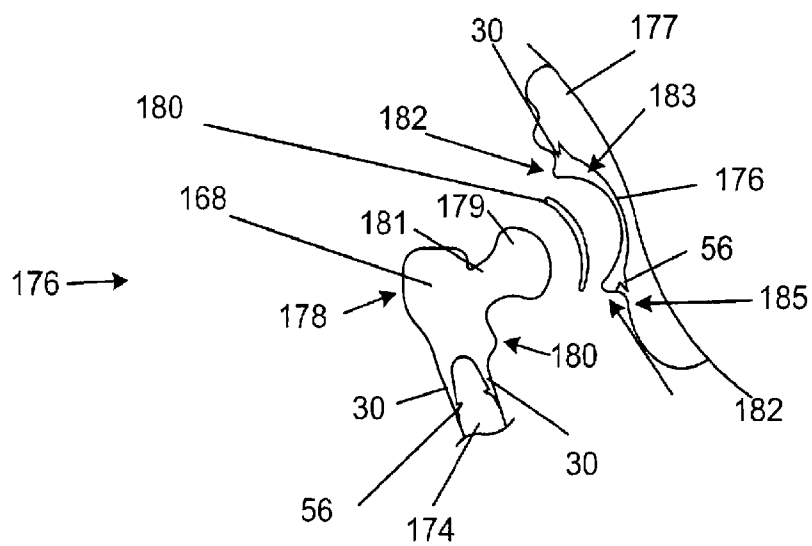


Fig. 42

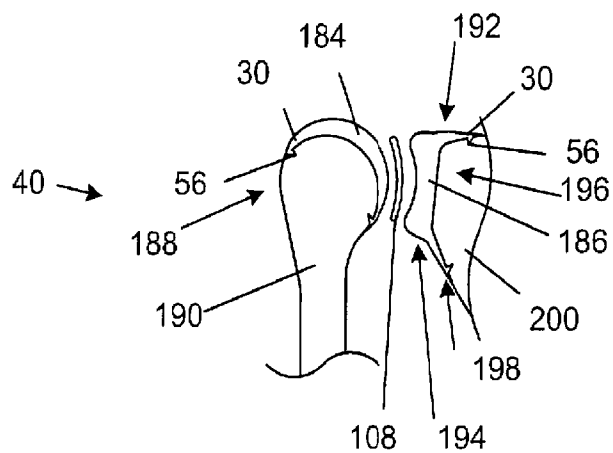


Fig. 43