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(71) Applicant (for all designated States except US):
BIOMET MANUFACTURING CORP. [US/US]; 56 E. Bell Drive, Warsaw, Indiana 46582 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **WHITE, John R.** [US/US]; 7 Stone Camp Trail, Winona Lake, Indiana 46590 (US). **SCHMIDT, Kurt** [US/US]; 1705 Willow Lane, Warsaw, Indiana 46580 (US). **HERSHBERGER, Troy W.** [US/US]; 2655 E. Liberty Drive, Winona Lake, Indiana 46590 (US). **RAISH, Thomas C.** [US/US]; 66 S. Hunters Ridge, Warsaw, Indiana 46582 (US). **SCHOENEFELD, Ryan J.** [US/US]; 10425 Lake Tahoe Drive, Fort Wayne, Indiana 46804 (US). **HAMMAN, William J.** [US/US]; 2601 Westwood Road, Winona

Lake, Indiana 46590 (US). **MERIDEW, Jason D.** [US/US]; 2211 Laurelwood Drive, Warsaw, Indiana 46580 (US). **WITT, Tyler D.** [US/US]; W3929 Empire Lane, Fond du Lac, Wisconsin 54937 (US).

(74) Agents: **WARNER, Richard W.** et al.; **HARNESS, DICKEY & PIERCE, P.L.C.**, P.O. Box 828, Bloomfield Hills, Michigan 48303 (US).

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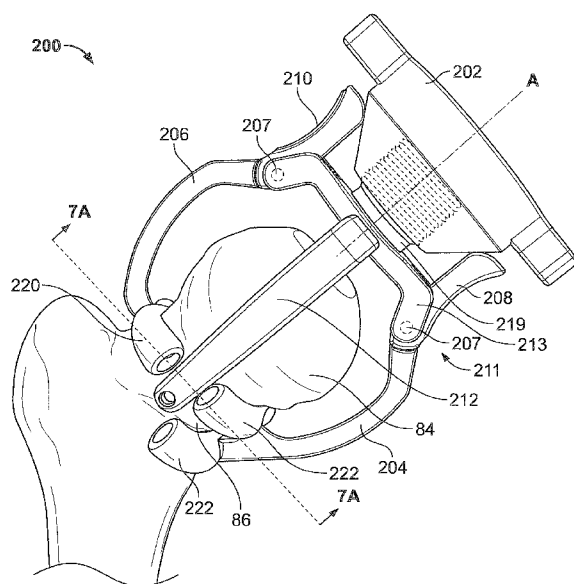


FIG. 7

(57) Abstract: An orthopedic apparatus includes an alignment guide attachable to one of a femoral joint surface of a femur of a patient. The alignment guide has a patient-specific three-dimensional engagement surface, and at least one guiding portion defining a guiding passage. The engagement surface anatomically matches a corresponding portion of the femoral joint surface.



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PATIENT SPECIFIC ALIGNMENT GUIDE

CROSS-REFERENCE TO RELATED APPLICATIONS

5 **[0001]** This application claims priority to U.S. Application 12/486,992, filed on June 18, 2009, which is a continuation-in part of U.S. Application No. 12/039,839, filed on February 29, 2008, which claims the benefit of provisional application 60/892,349, filed March 1, 2007, and which is a continuation-in part of U.S. Application No. 11/756,057, filed on May 31, 2007, which claims the benefit of U.S. Provisional Application No. 60/812,694, filed on June 9, 2006.

10 **[0002]** This application is also a continuation-in-part of U.S. Application No. 12/025,414, filed on February 4, 2008, which claims the benefit of U.S. Provisional Application No. 60/953,637, filed on August 2, 2007.

15 **[0003]** The disclosures of the above applications are incorporated herein by reference.

INTRODUCTION

20 **[0004]** Various custom made, patient-specific orthopedic implants and associated templates and alignment guides are known in the art. Such implants and guides can be developed using commercially available software. Custom implant guides are used to accurately place pins, guide bone cuts, and insert implants during orthopedic procedures. The guides can be made from a pre-operative plan formed from MRI or CT scans of the patient and rely on matching a subcutaneous anatomic feature for correct positioning.

25 **[0005]** The present teachings provide a patient-specific alignment guide for a femoral resurfacing or replacement procedure.

SUMMARY

30 **[0006]** The present teachings provide an orthopedic apparatus including an alignment guide attachable to a femoral joint surface of a femur of a patient. The alignment guide has a patient-specific three-dimensional engagement surface, and at least one guiding portion defining a guiding

passage. The engagement surface anatomically matches a corresponding portion of the femoral joint surface.

5 **[0007]** The present teachings provide an orthopedic apparatus including a frame including a body and a longitudinal post extending from the body, a securing member threadably couplable to the post; and a plurality of arms coupled to the body and movable between an open configuration and a closed configuration. The plurality of arms can be engaged to a femoral joint surface of a patient in the closed configuration. Each arm has a clamping portion with a patient-specific three-dimensional engagement surface. The engagement surface anatomically matches a corresponding portion of the femoral joint surface.

10 **[0008]** In various embodiments, the present teachings provide an orthopedic apparatus including a reusable frame having a body and a plurality of arms coupled the body. The plurality of arms can be engaged to a femoral joint surface of a patient. The apparatus also includes a plurality of disposable clamping portions. Each clamping portion can be removably coupled to a corresponding arm, and each clamping portion can include a patient-specific three-dimensional engagement surface. The engagement surface anatomically matches a corresponding portion of the femoral joint surface of the patient.

20 **[0009]** Further areas of applicability of the present invention will become apparent from the description provided hereinafter. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the invention.

25

BRIEF DESCRIPTION OF THE DRAWINGS

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

30 **[0011]** FIG. 1 is a flowchart of an exemplary method of preparing patient specific alignment guides according to the present teachings;

[0012] FIG. 2 is an environmental view of a patient-specific guide according to the present teachings;

[0013] FIG. 3 is an environmental view of a patient-specific guide according to the present teachings;

[0014] FIG. 3A is a sectional view of FIG. 3 taken along axis 3A;

[0015] FIG. 4 is an environmental view of a patient-specific guide
5 according to the present teachings;

[0016] FIG. 4A is a sectional view of FIG. 4 taken along axis 4A;

[0017] FIG. 5 is an environmental view of a patient-specific guide according to the present teachings;

[0018] FIG. 5A is a sectional view of FIG. 5 taken along axis 5A;

10 **[0019]** FIG. 6 is an environmental view of a patient-specific guide according to the present teachings;

[0020] FIG. 6A is an exploded view of an exemplary connection for patient-specific guide of FIG. 6;

[0021] FIG. 6B is an exploded view of an exemplary connection for
15 patient-specific guide of FIG. 6;

[0022] FIG. 7 is an environmental view of a patient-specific guide according to the present teachings;

[0023] FIG. 7A is a sectional view of FIG. 7 taken along axis 7A;

[0024] FIG. 7B is an exploded view of an exemplary modular
20 component of the patient-specific guide of FIG. 7;

[0025] FIG. 7C is an exploded view of an exemplary modular component of the patient-specific guide of FIG. 7;

[0026] FIG. 7D is an exploded view of an exemplary component of the patient-specific guide of FIG. 7;

25 **[0027]** FIG. 8 is a perspective view of a patient-specific guide according to the present teachings;

[0028] FIG. 8A is a plan view of patient-specific guide of FIG. 8;

[0029] FIG. 8B is an environmental sectional view of a patient-specific component of a guide according to the present teachings;

30 **[0030]** FIG. 8C is an environmental sectional view of a patient-specific component of a guide according to the present teachings, the sectional view taken along a plane perpendicular to the axis of a femoral neck of a patient;

[0031] FIG. 8D is an environmental perspective view of a patient-specific guide according to the present teachings;

[0032] FIG. 8E is a sectional view of FIG. 8D taken along axis 8E; and

[0033] FIG. 9 is a perspective environmental view of a patient-specific
5 guide according to the present teachings.

DESCRIPTION OF VARIOUS EMBODIMENTS

[0034] The following description is merely exemplary in nature and is
in no way intended to limit the scope of the present teachings, applications, or
10 uses. For example, although the present teachings are illustrated for alignment
guides in knee surgery, the present teachings can be used for other guides,
templates, jigs, drills, rasps or other instruments used in various orthopedic
procedures.

[0035] The present teachings provide a method for preparing patient-
15 specific alignment guides for use in orthopedic surgery for a joint, such as, for
example, the knee joint. Conventional, not patient-specific, prosthesis
components available in different sizes can be used with the alignment guides,
although patient-specific femoral and tibial prosthesis components prepared with
computer-assisted image methods can also be used. Computer modeling for
20 obtaining three dimensional images of the relevant patient's anatomy, patient-
specific prosthesis components, and the alignment guides and templates can be
provided by various CAD programs and/or software available from various
vendors or developers, such as, for example, from Materialise USA, Ann Arbor,
Michigan.

[0036] Referring to FIG. 1, in preoperative planning, imaging data can
25 be obtained of an entire leg including a joint to be reconstructed at a medical
facility or doctor's office, at aspect 10. The imaging data can include a detailed
scan of a hip, knee and ankle. The imaging data can be obtained using MRI,
CT, X-Ray, ultrasound or any other imaging system. In some cases, the scan
30 may be performed with the patient wearing an unloader brace to stress the
ligaments. The scan data obtained can be sent to a manufacturer, at aspect 20.
The scan data can be used by the manufacturer to construct a three-dimensional

image of the joint and prepare an initial implant fitting and alignment protocol detailing the fit of the implant. The fitting and alignment protocol can be stored in any computer storage medium, in a computer file form or any other computer or digital representation. The initial implant fitting and alignment protocol can be
5 obtained using standard alignment methods or using alignment methods provided by or based on the preferences of individual surgeons.

[0037] As discussed above, in the preoperative planning stage of a surgical procedure, multiple image scans of portions of the patient's anatomy related to the procedure are obtained. Image markers visible in the scan can be
10 placed on the patient's anatomy to allow image scaling and orientation. The obtained scans of the desired anatomy can be correlated to one another to reconstruct an image of the patient's specific anatomy in three-dimensions.

[0038] The outcome of the initial fitting is an initial surgical plan that can be printed or represented in electronic form with corresponding viewing
15 software. The initial surgical plan can be surgeon-specific, when using surgeon-specific alignment protocols. The initial surgical plan, in a computer file form associated with interactive software, can be sent to the surgeon, or other medical practitioner, for review, at 30. Using the interactive software, the surgeon can manipulate the position of images of various implant components
20 relative to an image of the joint. The surgeon can modify the plan and send it to the manufacturer with recommendations or changes. The interactive review process can be repeated until a final, approved plan is sent to the manufacturer, at 40.

[0039] Various methods of sending the initial and final surgeon-
25 approved surgical plans can be used. The surgical plans can be, for example, transferred to an electronic storage medium, such as CD, DVD, flash memory, which can then be mailed using regular posting methods. In various embodiments, the surgical plan can be e-mailed in electronic form or transmitted through the internet or other web-based service.

[0040] After the surgical plan is approved by the surgeon, patient-
30 specific alignment guides for the femur and tibia can be developed using a CAD program or other three-dimensional modeling software, such as the software

provided by Materialise, for example, according to the surgical plan, at 50. Computer instructions of tool paths for machining the patient-specific alignment guides can be generated and stored in a tool path data file, at 60. The tool path can be provided as input to a CNC mill or other automated machining system, and the alignment guides can be machined from polymer, ceramic, metal or other suitable material, and sterilized, at 70. The sterilized alignment guides can be shipped to the surgeon or medical facility, at 75 for use during the surgical procedure. Patient-specific components or portions are defined as those constructed by a surgical plan approved by the doctor using three-dimensional images of the specific patient's anatomy and made to closely conform and mate substantially as a negative mold of corresponding portions of the patient's anatomy, including bone surfaces with or without associated soft tissue, such as articular cartilage, for example.

[0041] Images of the knee joint anatomy can include images of the joint surfaces of the distal femur and proximal tibial with or without the associated soft tissues, such as articular cartilage, on the respective bone surfaces. The alignment procedure can make use of the mechanical, anatomic, transepicondylar and cylindrical axes in various degrees. Multiple alignment procedures can be provided to accommodate the experience and preference of individual surgeons. For example, the alignment procedure can be based on the anatomic and mechanical axes, or can be substantially based on the cylindrical axis. Further, the alignment procedure can be deformity-specific, such that the procedure is adapted, for example, to a valgus or varus deformity.

[0042] Similarly, images of the hip joint anatomy of the joint surface of the proximal femur with or without the associated soft tissues, such as articular cartilage, on the respective bone surfaces can be used in the alignment procedure. The alignment procedure can include, for example, the selection of an anteversion angle, a femoral neck angle and other orientations for positioning a femoral implant, such as a resurfacing component, without notching or impinging on the femoral neck.

[0043] Referring to FIG. 2, an exemplary multiple-component femoral alignment guide 100 that can be manufactured using the method of FIG. 1 is

illustrated. In this exemplary embodiment, the alignment guide 100 is shown with first and second adjacent components 102 and 104, although more than two components can be similarly included in the alignment guide 100. The first and second components 102, 104 can be movably and/or removably connected to one another with a coupling mechanism referenced at 120. The coupling mechanism 120 can be selected from a variety of mechanisms that provide easy intra-operative assembly. In various embodiments, for example, the coupling mechanism 120 can be a snap-on connection between the two components. In various embodiments, the coupling mechanism 120 can be an interlocking mechanism, such as a keyway-and-key mechanism, a dovetail mechanism, a puzzle-like interlocking mechanism, or any other interlocking mechanism. In various embodiments, the coupling mechanism 120 can include a permanent or temporary hinge or other pivotable structure that allows relative motion between the adjacent components, such that one component can be rotated relative to the other component for ease of positioning on the patient. The components can be permanently pivotably coupled with the hinge or can be detachable.

[0044] The exemplary alignment guide 100 can be configured as patient-specific for the femoral neck 86 of a proximal femur, as illustrated in FIG. 2. The alignment guide 100, when assembled, can wrap around and mate in three dimensions with the femoral neck 84 for assisting in the placement of an alignment pin for femoral head resurfacing. The first component 102 can include a guiding portion or formation 108 and a portion 112 having a first three-dimensional inner bone engagement surface 113 that can anatomically match or mate with a portion of the femoral neck 86 in three dimensions. The guiding formation 108 can be in the form of a sleeve including a guiding passage 109, a bore, a hole, or other opening through which an alignment pin or drill bit or other stool or fastener can be inserted. The second component 104 can be coupled to the first component 102 by the coupling mechanism 120. The second component 104 can include a second three-dimensional inner bone engagement surface 105 that can anatomically match and mate with substantially the remaining portion of the femoral neck 86 in three dimensions, without requiring other supports to retain the guide 100 on the proximal femur.

[0045] FIGS. 3-5 illustrate various exemplary patient-specific, unitary or single-component alignment guides 100 for the patient's proximal femur. Same reference numbers are used to refer to similar parts or features throughout various embodiments. New or additional elements are identified with new
5 reference numbers.

[0046] Referring to FIGS. 3 and 3A, a patient-specific alignment guide 100 according to the various embodiments can be constructed as a one-piece integral or monolithic component that has a three-dimensional inner patient-specific engagement surface 113 conforming to the corresponding anatomy of a
10 specific patient, including subchondral bone with or without soft tissue. The alignment guide 100 can include first and second arms 130 that are patient-specific, curved and substantially concave toward the femoral neck 86 and extend anteriorly and posteriorly around the femoral neck 86 without, however, fully encircling the femoral neck 86. The alignment guide 100 can be generally
15 saddle-shaped and can include a first portion 131 conforming to a portion of the femoral head 84. The first portion 131 can be patient-specific, curved and substantially concave toward the femoral head 84. A guiding portion 108 with an internal passage 109 can extend from the first portion 131 for guiding a pin, a drill bit or other tool. The alignment guide 100 can also include a second portion
20 132 extending from the first portion 131 along the femoral neck 86 and abutting the greater trochanter 76. The second portion 132 can be patient-specific, conforming to the anatomy of the femoral neck 86, such that the second portion 132 can be, for example, convex where the anatomy of the femoral neck 86 is concave. The first portion 131, the second portion 132 and the first and second
25 arms 130 form the saddle shape of the alignment guide 100, as shown in FIG. 3. The engagement surface 113 includes the inner surfaces of the first portion 131, the second portion 132 and the first and second arms 130. The first and second arms 130 can be oriented substantially perpendicularly to the first and second portions 131, 132. The alignment guide 100 can be positioned superiorly relative
30 to the femur, as shown in FIG. 3.

[0047] Referring to FIGS. 4 and 4A, an alignment guide 100 according to the various embodiments can include a second portion 132 that can abut the

lesser trochanter 78 of the patient's femur. In the embodiment illustrated in FIG. 4, the alignment guide 100 can be positioned anteriorly or posteriorly relative to the femur and the first and second arms 130 can extend superiorly and inferiorly relative to the femur. The alignment guide 100 shown in FIG. 4 can be substantially saddle-shaped and patient-specific in three dimensions. The first portion 131 is patient-specific, curved and substantially concave inward and toward the femoral head 84. The second portion 132 is patient-specific, curved and substantially convex inward and toward the neck, and the first and second arms 130 are patient-specific, curved and substantially concave inward and toward the femoral neck 86. The engagement surface 113 includes the inner surfaces of the first portion 131, the second portion 132 and the first and second arms 130. The first and second arms 130 can be oriented substantially perpendicularly to the first and second portions 131, 132.

[0048] Referring to FIGS. 5 and 5A, an alignment guide 100 according to various embodiments can be positioned inferiorly relative to the femur and the first and second arms 130 can extend around the femoral neck 86 posteriorly and anteriorly relative to the femur. The alignment guide 100 shown in FIG. 5 is also saddle-shaped and patient-specific in three dimensions, with the first portion 131 being patient-specific, curved and substantially concave inward and toward the femoral head 84, the second portion 132 being patient-specific, curved and substantially convex inward and toward the neck, and the first and second arms 130 being curved and concave inward and toward the femoral neck 86. The engagement surface 113 includes the inner surfaces of the first portion 131, the second portion 132 and the first and second arms 130. The first and second arms 130 can be oriented substantially perpendicularly to the first and second portions 131, 132.

[0049] The alignment guides 100 shown in FIGS. 3A-5A can be made of biocompatible polymer or other material such that the first and second arms 130 that can flex to allow the alignment guide 100 to be snap on and held around the femoral neck 86 without any other temporary fixation. The alignment guide 100 can be also supported on the femur with removable fixators, such as pins.

[0050] In various embodiments, and referring to FIGS. 6, 6A and 6B, the alignment guide 100 can be in the form of a complete or partial shell encompassing the femoral head 84 and having a patient-specific three-dimensional inner engagement surface 113. The alignment guide 100 can include first and second members 102, 104 coupled with first and second connecting portions 140, 142 at a connection 141. In various embodiments, the first and second members 102, 104 can be flexible such that the alignment guide 100 can be mounted by opening up the connecting portions 140, 142 at one or more connections 141. In various embodiments, the first and second members 102, 104 can also include a hinge or a split connection (not shown) opposite to the connection 141. The first and second members 102, 104 can be patient-specific and curved, as shown in FIG. 6, with the inner surface 113 closely conforming to the substantially convex surface of the head 84 and to the substantially concave surface of the neck 86. The first and second connecting portions 140, 142 can form a tongue and groove connection (142a, 140a) or a other clasp or snap-on connection (142b, 140b), as shown in the exemplary illustrations of FIGS. 6A and 6B.

[0051] It will be appreciated that other single or multiple-component guides can be similarly constructed for guiding and preparing other bone joints for receiving prosthetic components. Patient-specific guides can be, for example, constructed for the knee, the hip, the shoulder, etc, and can include two or more relatively movable and interconnected components. When more than two components are used, the same or different coupling mechanisms can be provided along the interfaces of the adjacent components. Each of the components can match a corresponding anatomic portion in three dimensions and can be configured for surgical placement on the patient and can include a guiding formation that is related to an axis associated with the anatomic portion. Such axes can be tangential or perpendicular or at other specified angle relative to the anatomic portion and relative to various anatomic axes of the joint, such as, for example, the mechanical axis, the epicondylar axis or other anatomic axis.

[0052] Referring to FIGS. 7-9, a patient-specific alignment guide 200 according to various embodiments is illustrated. The alignment guide 200 can include a frame 211 including a nut or other securing member 202, a body 213, a removable target member 212, and first and second arms 204, 206 movable
5 between an open (non-engaging) and closed (engaging or clamping) configuration and pivotably coupled to the body 213 with pins or other pivots 207. The securing member 202 can be threadably connected to a threaded portion of a post 219 extending from the body 213. First and second tabs or extensions 208, 210 can extend from the corresponding first and second arms
10 204, 206 in the direction of the post 219. When the securing member 202 is fully threaded to the post 219, the securing member 202 pushes against the first and second extensions 208, 210 forcing and securing the first and second arms 204, 206 to the closed/clamping configuration around the patient's anatomy, as shown in FIG. 7. The post 219 can include a plurality of longitudinal passages
15 201 (shown in FIG. 8A) having different orientations relative to and converging toward a longitudinal axis A of the post 219, as shown in FIGS. 7, 8A and 9. The passages 201 can be arranged to form a tool guide and can be used for passing guide wires, fixation pins, drills or other tools. The first and second arms 204, 206 can include patient-specific clamping portions 220, 222, as described below.

[0053] The frame 211 (excluding the patient-specific portions discussed below) can be any instrument guiding frame for femoral resurfacing procedures, such as, for example, the RECAP[®] KS Alignment Device, commercially available from Biomet, Inc. of Warsaw, Indiana. Further details of a related frame can be found in WIPO publication WO 2008/040961, the
20 disclosure of which is incorporated herein by reference. Other embodiments of a frame 211 according to the present teachings are discussed below.

[0054] Referring to FIGS. 7A and 7B, in various embodiments according to the present teachings, each clamping portion 220, 222 can be made to be patient-specific using the methods described above and can conform
30 to the three-dimensional anatomy of the femoral neck 86 or a femoral head 84 of a specific patient, as shown in FIGS. 7A and 8E, for example. The clamping portions 220, 222 can be integral to the corresponding arms 206, 208 and made

of the same material, such as a biocompatible metal. As illustrated in FIG. 7, the second arm 204 can include a pair of spaced-apart clamping portions 222 that are coupled to one another. It should be noted that one or both of the first and second arms 204, 206, can utilize this dual clamping configuration,

5 **[0055]** Referring to FIGS. 7B and 7C, in various embodiments according to the present teachings, the first and second arms 204, 206 can be modular, such that the corresponding patient-specific clamping portions 220, 222 can be removably coupled to the first and second arms 204, 206. The modular connection can be a groove-and-tab connection, as illustrated in FIG. 7B, which
10 shows an exemplary groove/slot 230 and tab 231 in arm 206 and a corresponding tab/extension/hook 233 and groove/slot 232 associated with clamping portion 220. The tab 231 can be received in slot 232 while the tab 233 can be received in slot 230. It will be appreciated that the relative locations of the groove and tab can be reversed. Different types of removable connections
15 can be used, including snap-on, dovetail, or other quick-coupling and decoupling connections. The modular clamping portions 220, 222 can be of single-use, while the frame 211 can be sterilizable and reusable. In various embodiments, the modular clamping portions 220, 222 can be non patient-specific and provided in different sizes and/or in a kit form. Different
20 biocompatible materials can be used for the modular clamping portions 220, 222 and the frame 211, such as metallic materials for the frame 211 and plastic materials for the modular clamping portions 220, 222, although other materials biocompatible materials can also be used.

[0056] Referring to FIG. 7D the clamping portions 220, 222 can be
25 generic metallic portions, which can be fitted with patient-specific clamping covers 240. Each patient-specific cover 240 can include a three-dimensional patient specific surface 242. The patient-specific surface can be constructed from three-dimensional image data of the patient, as described above, and can closely match or conform, for example as negative mold, to a corresponding
30 surface of the specific patient's femoral anatomy, such as the femoral neck 86, as shown in FIG. 7A or the femoral head 84, as shown in FIG. 8E. The patient specific cover 240 can include a groove or slot or opening 244 for fitting the

cover 240 onto the corresponding clamping portion 220, 222. The covers 240 can be made of a compliant, soft and flexible material, such as a plastic, for easy fitting onto the clamping portions 220, 222 and can be single use or disposable covers that can be used with a sterilizable and reusable frame 211, such as a
5 metallic frame. The covers 240 can also be provided in different sizes for non patient-specific uses.

[0057] Referring to FIGS. 8-8D, the patient-specific alignment guide 200 can be provided with more than two arms, such as first, second and third arms 204, 206, 205 with corresponding clamping portions 220. The first, second
10 and third arms 204, 206, 205 can be arranged circumferentially at 120 degrees apart relative to the body 113. The clamping portions 220 can be patient specific for direct and full contact with the three-dimensional anatomy of the femoral neck 86, as shown in FIG. 8B and 8C, or the three-dimensional anatomy of the femoral head 84, as shown in FIG. 8E, correspondingly providing curved surface
15 contact with the femoral neck or femoral head. The clamping portions 220 can be modular, snap-on patient-specific components, such as those illustrated in FIG. 7B, or can be provided patient-specific disposable covers 240, such as those illustrated in FIG. 7D. In various embodiments, the clamping portions 220 can include pointed tips 221 for point-contact at relative distances determined for
20 a specific patient, as shown in FIG. 8C. Instead of point tips 221, line edges can be used for patient-specific line contact in three dimensions.

[0058] In various embodiments, and referring to FIG. 9, the various clamping portions 220, 222 and patient-specific covers described above can be selectively used with a frame 211 in which the first and second arms 204, 206
25 can be spring-loaded at the pivot pins 207 and biased in the closed or clamping position around the femoral neck 86 or femoral head 84. The first and second arms 204, 206 can be released from the clamping position by applying pressure on corresponding first and second extensions 208, 210 in the direction of the arrows B shown in FIG. 9.

[0059] The foregoing discussion discloses and describes merely
30 exemplary arrangements of the present teachings. Furthermore, the mixing and matching of features, elements and/or functions between various embodiments is

expressly contemplated herein, so that one of ordinary skill in the art would appreciate from this disclosure that features, elements and/or functions of one embodiment may be incorporated into another embodiment as appropriate, unless described otherwise above. Moreover, many modifications may be made to adapt
5 a particular situation or material to the present teachings without departing from the essential scope thereof. One skilled in the art will readily recognize from such discussion, and from the accompanying drawings, that various changes, modifications and variations can be made therein without departing from the spirit and scope of the present teachings.

CLAIMS

What is claimed is:

1. An orthopedic apparatus comprising:
a frame including a body and a longitudinal post extending from the
5 body;
a securing member threadably couplable to the post; and
a plurality of arms pivotably coupled to the body and movable
between an open configuration and a closed configuration, the plurality of arms
engageable to a femoral joint surface of a patient in the closed configuration,
10 each arm having a clamping portion with a patient-specific three-dimensional
engagement surface, the engagement surface anatomically matching a
corresponding portion of the femoral joint surface.
2. The orthopedic apparatus of claim 1, wherein each engagement
15 surface anatomically matching a corresponding portion of a femoral neck surface
of the patient.
3. The orthopedic apparatus of claim 1, wherein each engagement
surface anatomically matching a corresponding portion of a femoral head
20 surface of the patient.
4. The orthopedic apparatus of claim 1, wherein each clamping
portion is modularly coupled to a correspond arm of the frame.
- 25 5. The orthopedic apparatus of claim 4, wherein each clamping
portion is made of biocompatible flexible plastic material and is disposable.
6. The orthopedic apparatus of claim 1, wherein each clamping
portion is a patient-specific cover coupled to a non-patient specific portion of a
30 corresponding arm.

7. The orthopedic apparatus of claim 6, wherein the patient-specific cover is disposable and made of a flexible biocompatible plastic material.

5 8. The orthopedic apparatus of claim 1, wherein the post comprises a tool guide with at least one guiding aperture extending along a longitudinal axis of the post.

9. The orthopedic apparatus of claim 1, wherein the plurality of arms includes at least three arms.
10

10. An orthopedic apparatus comprising:
a reusable frame having a body and a plurality of arms pivotably coupled to the body, the plurality of arms engageable to a femoral joint surface of a patient;
15 a plurality of disposable clamping portions, each clamping portion removably coupled to a corresponding arm, each clamping portion including a patient-specific three-dimensional engagement surface, the engagement surface anatomically matching a corresponding portion of the femoral joint surface of the patient.
20

11. The orthopedic device of claim 10, wherein each clamping portion is modularly connected to a corresponding arm by a snap-on connection.

12. The orthopedic device of claim 10, wherein each clamping portion
25 comprises a cover fitted over a distal portion of a corresponding arm.

13. The orthopedic device of claim 10, wherein the arms are spring-loaded and biased in a closed position for clamping around the femoral joint surface.

14. An orthopedic apparatus comprising:

a saddle-shaped alignment guide attachable to one of a femoral joint surface of a femur of a patient, the alignment guide being monolithic and having a patient-specific three-dimensional engagement surface, the engagement surface anatomically matching a corresponding portion of the femoral joint surface, the alignment guide including at least one guiding portion defining a guiding passage.

15. The orthopedic apparatus of claim 14, wherein the engagement surface includes an inner surface of a first portion engageable with one of a superior and inferior portion of the femoral joint surface and inner surfaces of first and second arms engageable with anterior and posterior portions of a femoral neck of the femoral joint surface, wherein the inner surface of the first portion is patient-specific, curved and substantially concave toward a femoral head of the femoral joint surface and the inner surfaces of first and second arms are patient-specific, curved and substantially concave toward the femoral neck.

16. The orthopedic apparatus of claim 15, wherein the engagement surface includes an inner surface of second portion abutting the greater trochanter of the femur, wherein the inner surface of the second portion has a patient-specific, curved and substantially convex toward the femoral joint surface.

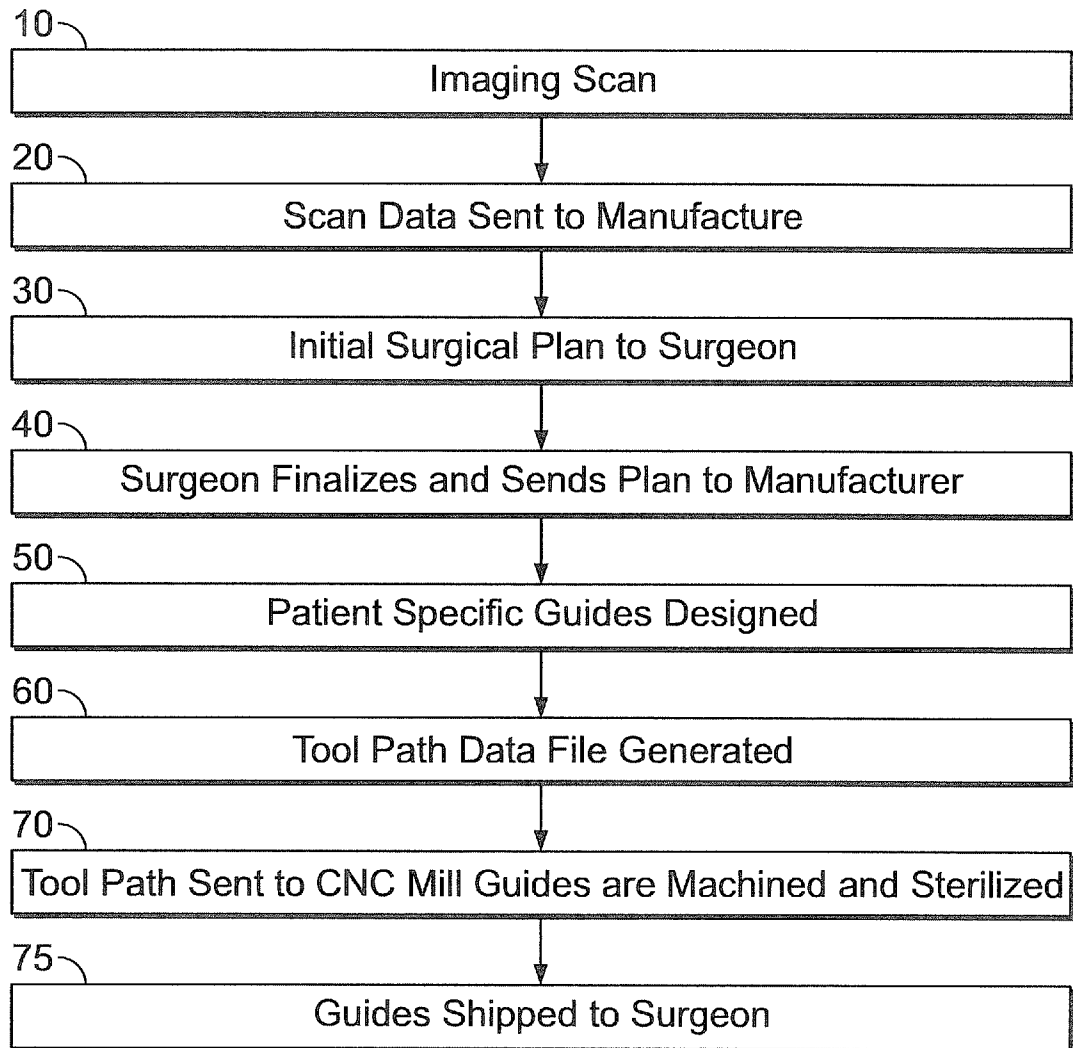
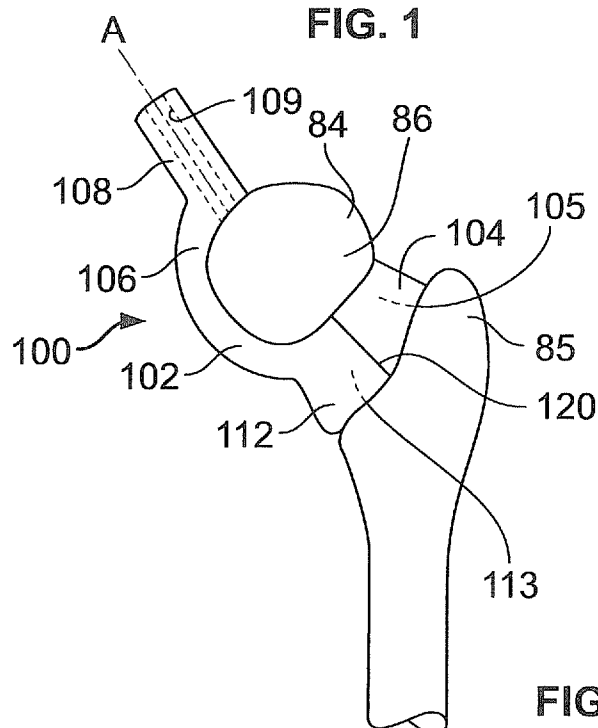
17. The orthopedic apparatus of claim 14, wherein the engagement surface includes an inner surface of a first portion engageable with one of an anterior and posterior portion of the femoral joint surface and inner surfaces of first and second arms engageable with superior and inferior portions of a femoral neck of the femoral joint surface, wherein the inner surface of the first portion is patient-specific, curved and substantially concave toward the femoral joint surface, and the inner surfaces of the first and second arms are patient-specific, curved and substantially concave toward the femoral neck.

18. The orthopedic apparatus of claim 17, wherein the engagement surface includes an inner surface of a second portion abutting the lesser trochanter of the femur, wherein the inner surface of the second portion is patient-specific, curved and substantially convex toward the femoral joint surface.

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19. The orthopedic apparatus of claim 14, wherein the patient specific engagement surface includes portions oriented along first and second substantially orthogonal planes of the femoral joint.

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**FIG. 1****FIG. 2**

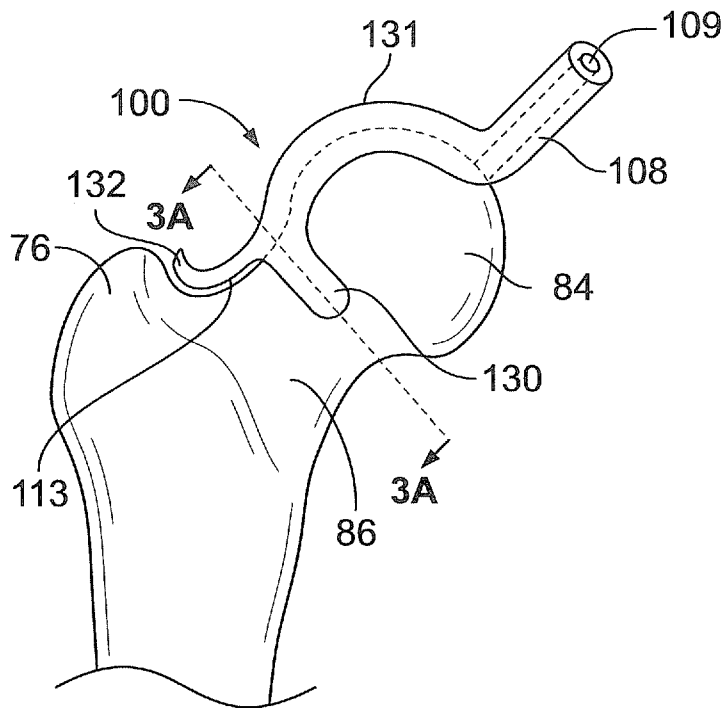


FIG. 3

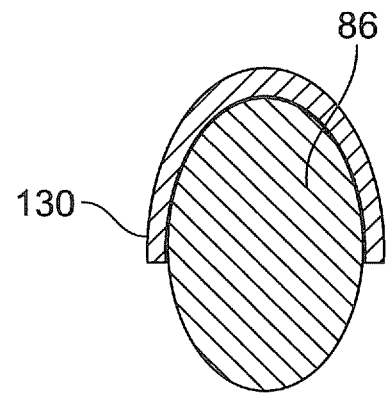


FIG. 3A

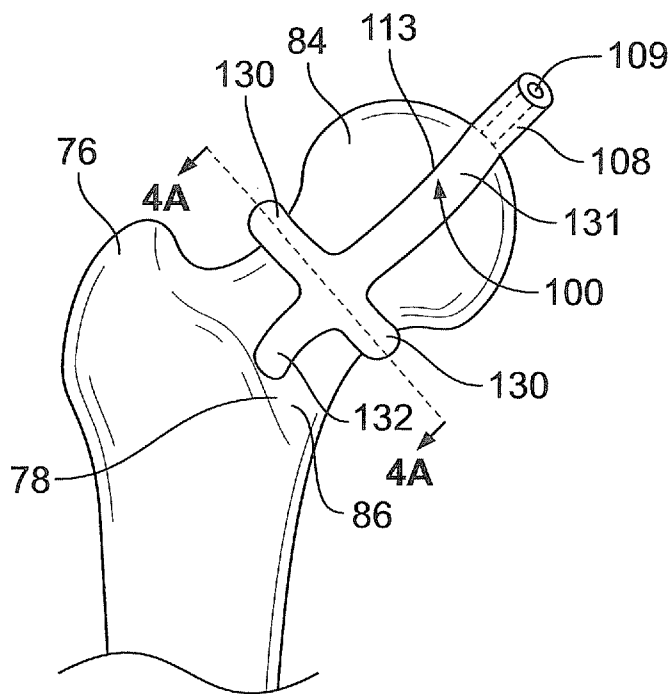


FIG. 4

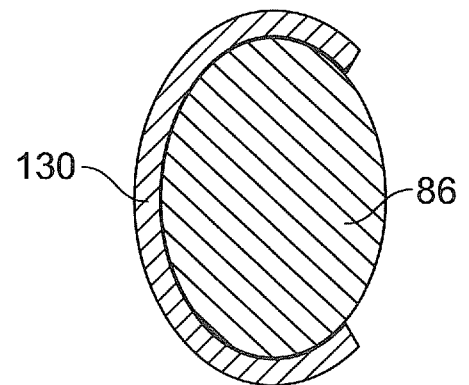


FIG. 4A

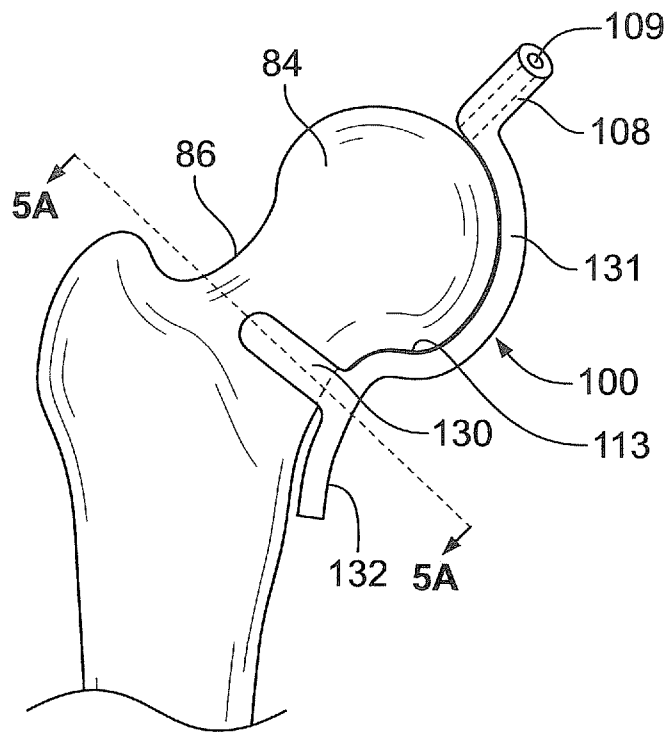


FIG. 5

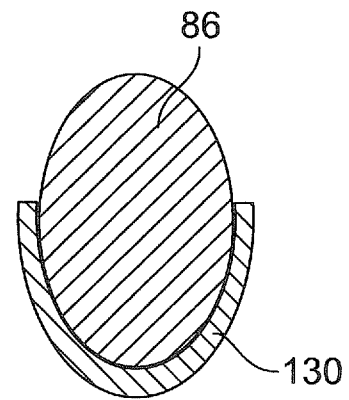


FIG. 5A

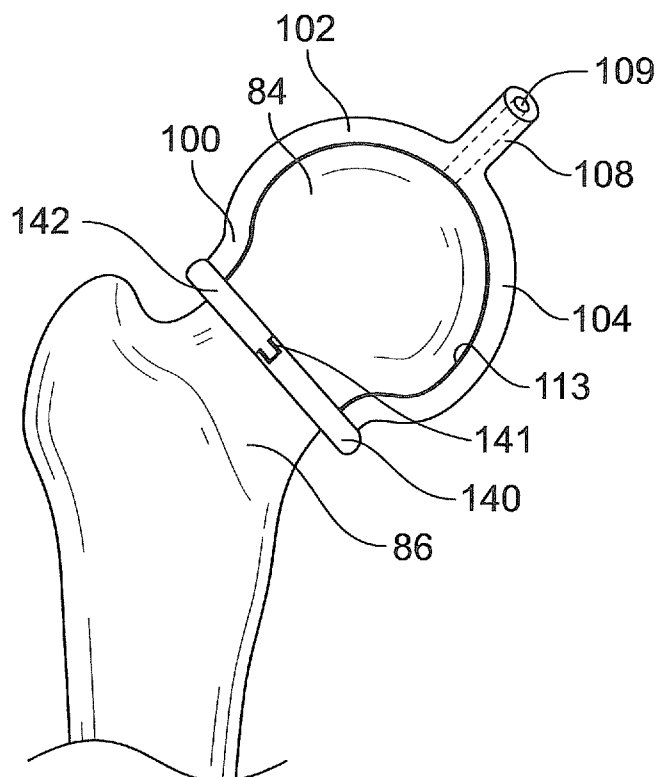


FIG. 6

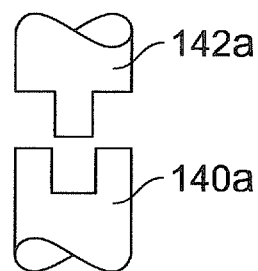


FIG. 6A

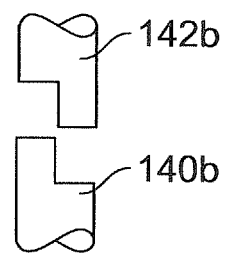


FIG. 6B

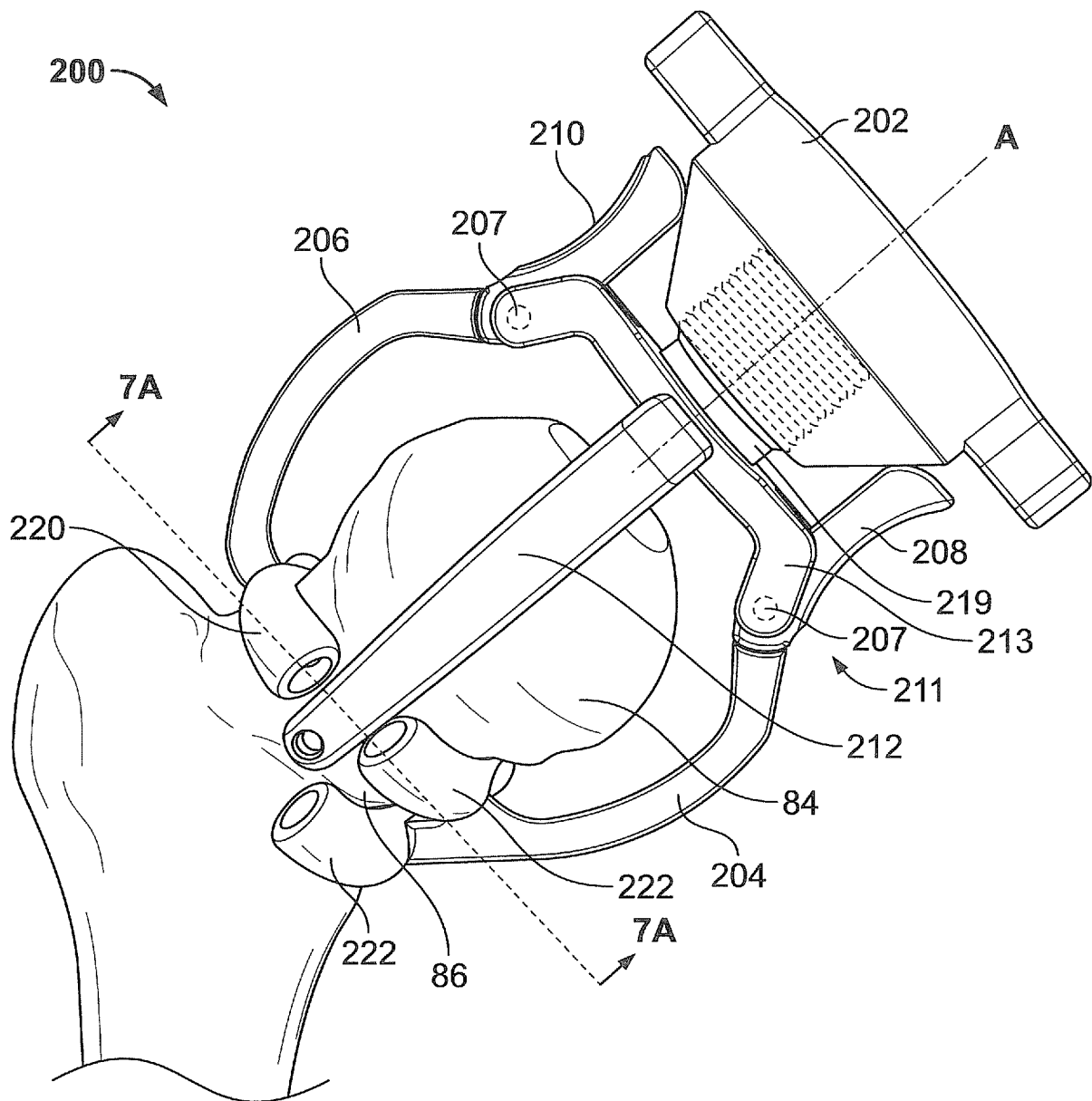


FIG. 7

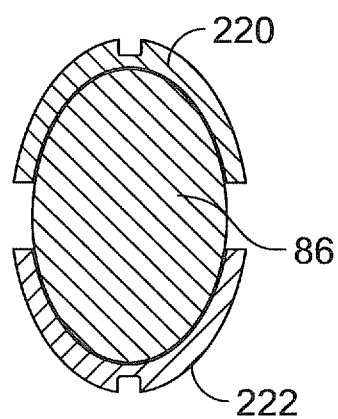


FIG. 7A

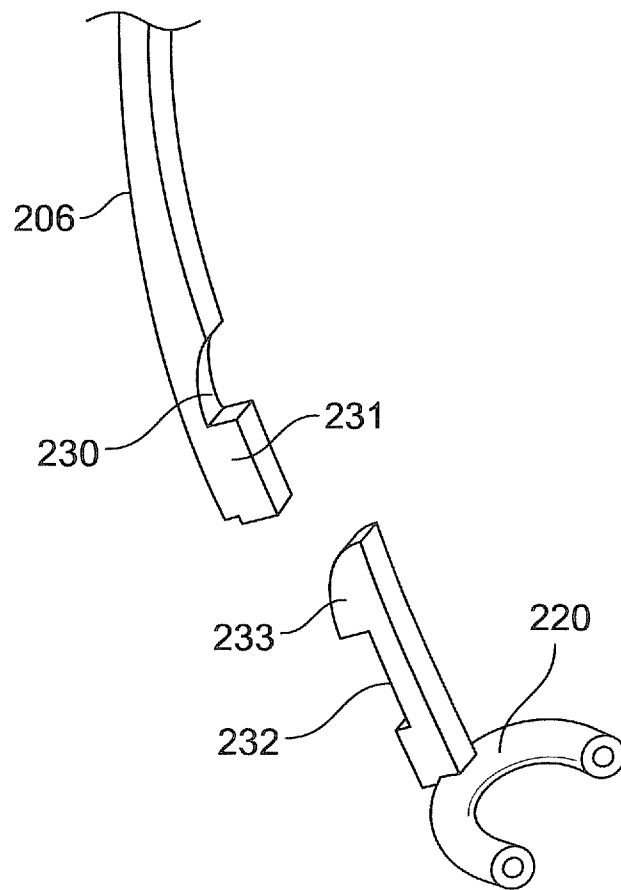


FIG. 7B

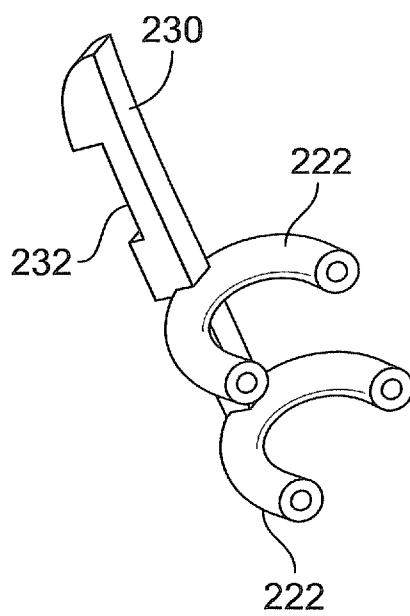


FIG. 7C

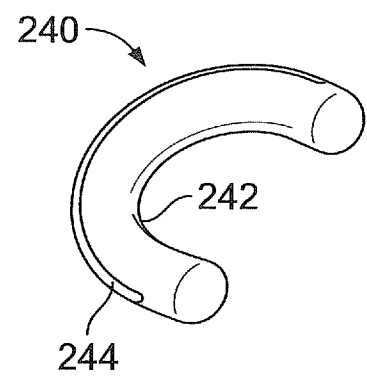


FIG. 7D

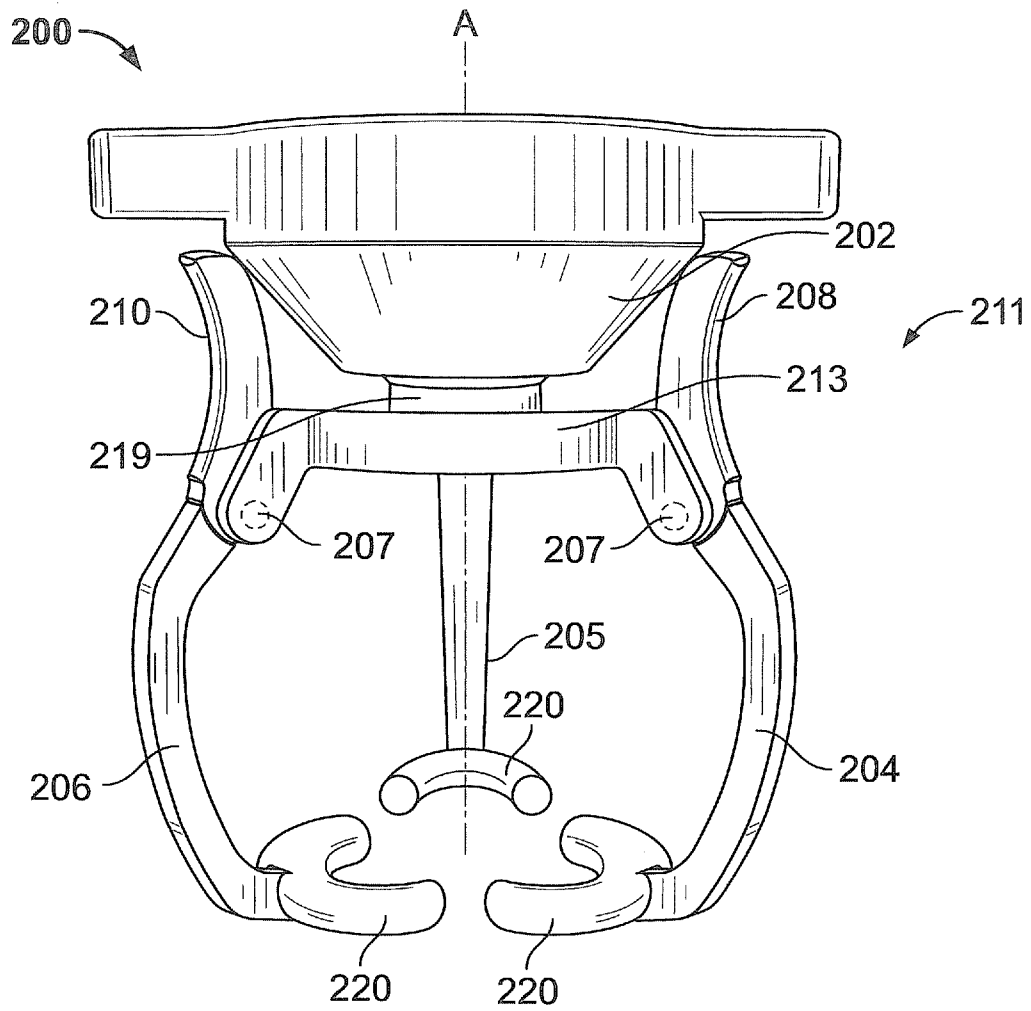


FIG. 8

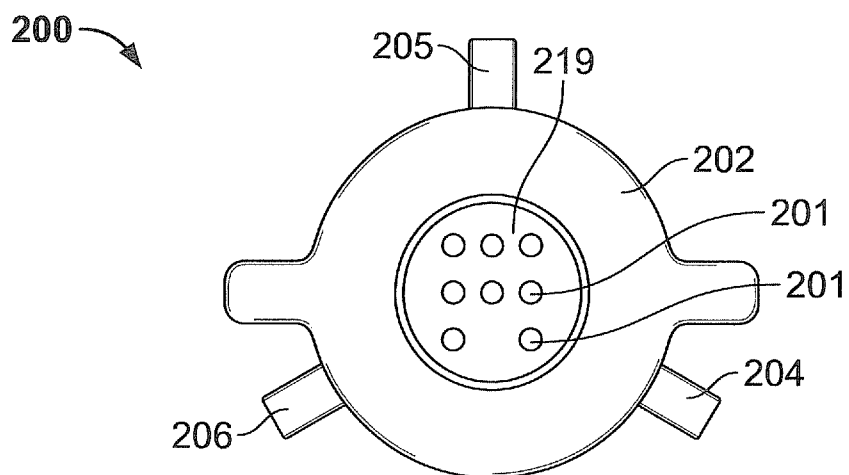


FIG. 8A

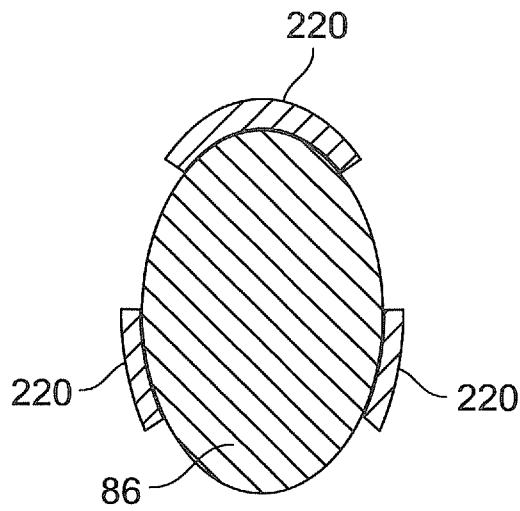


FIG. 8B

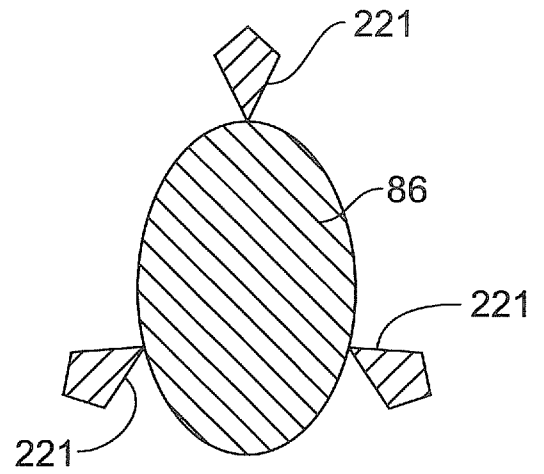


FIG. 8C

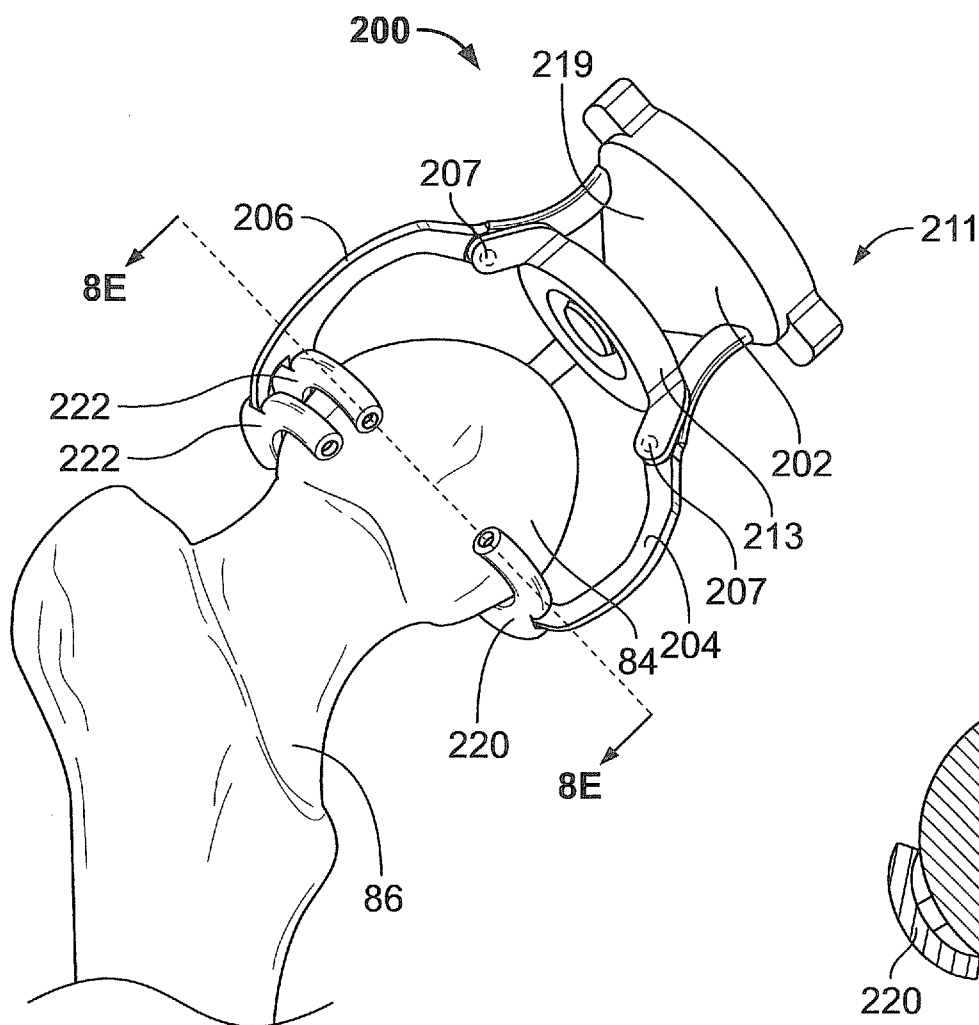


FIG. 8D

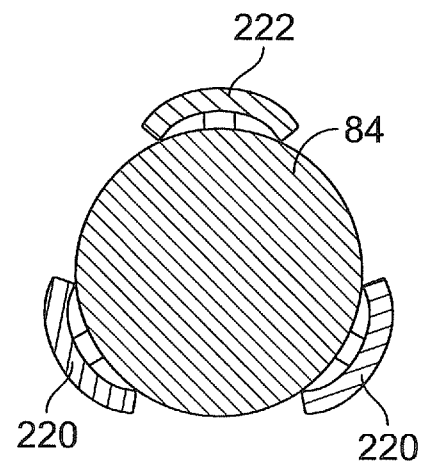


FIG. 8E

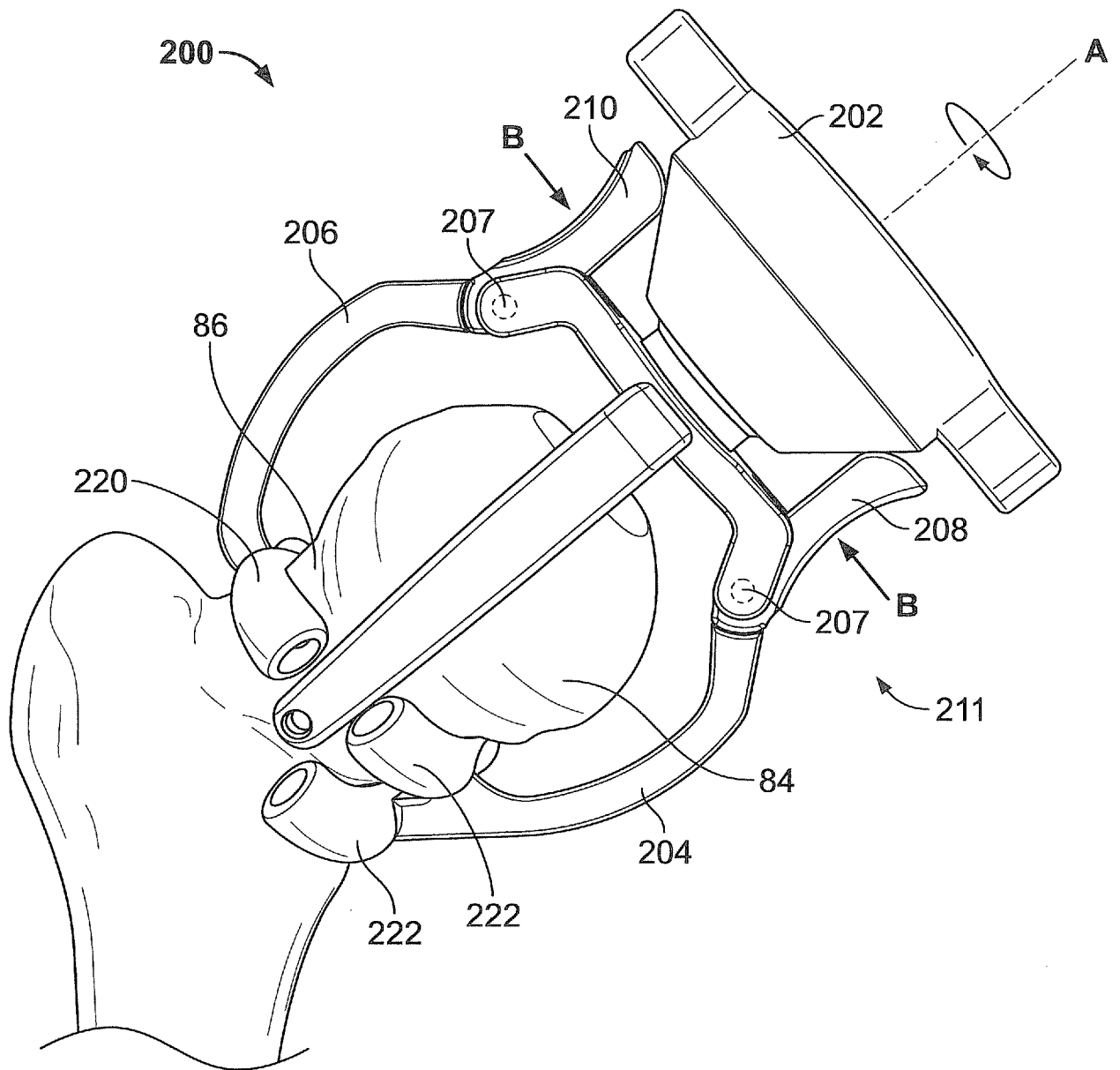


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/038845

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61B17/17
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2008/014618 A1 (ORTHOSOFT INC [CA]; AMIOT LOUIS-PHILIPPE [CA]; MALETTE LOUIS [CA]; SZM) 7 February 2008 (2008-02-07) figure 5 page 15, line 30 - line 34 page 18, line 17 - line 33 page 23, line 9 - page 24, line 13	1-19
Y	GB 2 442 441 A (BIOMET UK LTD [GB]) 9 April 2008 (2008-04-09) figures 1-3 page 4, line 25 - page 5, line 17 page 6, line 1 - line 9	1-13
Y	US 2009/118736 A1 (KREUZER STEFAN [US]) 7 May 2009 (2009-05-07) figures 2,3 paragraphs [0028], [0029]	14-19
	-/--	

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

22 September 2010

Date of mailing of the international search report

05/10/2010

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Tel. (+31-70) 340-2040,
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Authorized officer

Fourcade, Olivier

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2010/038845

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2007/137327 A1 (ELLYSIAN LTD; LYE ROBERT [AU]) 6 December 2007 (2007-12-06) figures 1-3 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2010/038845

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			EP	2077770 A1		15-07-2009
			WO	2008040961 A1		10-04-2008
			JP	2010505488 T		25-02-2010
US 2009118736	A1	07-05-2009	WO	2009061792 A2		14-05-2009
WO 2007137327	A1	06-12-2007	NONE			