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Lockable Implants

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US009393123B2

(12) **United States Patent**
Lucas et al.

(10) **Patent No.: US 9,393,123 B2**
(45) **Date of Patent: *Jul. 19, 2016**

(54) **LOCKABLE IMPLANTS**

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(72) Inventors: **Eric Montgomery Lucas**, Clemson, SC (US); **John David DesJardins**, Clemson, SC (US); **Kim John Chillag**, Columbia, SC (US); **Frank Richard Voss**, Columbia, SC (US)

(73) Assignees: **Clemson University Research Foundation**, Clemson, SC (US); **University of South Carolina**, Columbia, SC (US); **Kim John Chillag**, Columbia, SC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 22 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/944,606**

(22) Filed: **Jul. 17, 2013**

(65) **Prior Publication Data**

US 2014/0025172 A1 Jan. 23, 2014

Related U.S. Application Data

(60) Provisional application No. 61/672,352, filed on Jul. 17, 2012.

(51) **Int. Cl.**
A61F 2/30 (2006.01)
A61F 2/38 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***A61F 2/3845*** (2013.01); ***A61F 2/30*** (2013.01); ***A61F 2/32*** (2013.01); ***A61F 2/3804*** (2013.01); ***A61F 2/384*** (2013.01); ***A61F 2/3836*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC A61F 2002/30471; A61F 2002/30476; A61F 2002/30482; A61F 2002/30484; A61F 2002/30487; A61F 2002/3049; A61F 2002/30492; A61F 2002/30494; A61F 2002/30505; A61F 2002/30668; A61F 2002/4698; A61F 2002/30054; A61F 2002/30079; A61F 2/30476–2/30505; A61F 200/30476–200/305052
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,637,382	A	1/1987	Walker	
5,358,527	A	10/1994	Forte	
5,800,552	A	9/1998	Forte	
6,019,792	A *	2/2000	Cauthen	623/17.14
6,217,249	B1 *	4/2001	Merlo	403/90
7,572,292	B2	8/2009	Crabtree et al.	

(Continued)

FOREIGN PATENT DOCUMENTS

FR 2868691 A1 * 10/2005

OTHER PUBLICATIONS

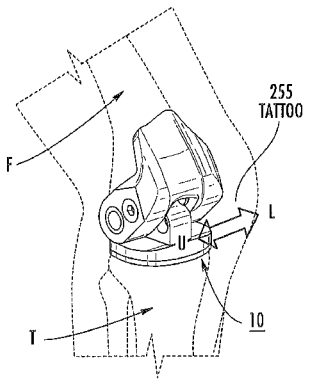
USPTO Notice of Allowance and Fee(s) due for related U.S. Appl. No. 13/944,161, date mailed Dec. 22, 2014, 13 pages.

Primary Examiner — Marcia Watkins
(74) *Attorney, Agent, or Firm* — Myers Bigel & Sibley, P.A.

(57) **ABSTRACT**

Total joint replacements for implants include a first member configured to attach to a first bone, a second member configured to reside in an adjacent second bone and a locking mechanism. The locking mechanism is configured to (i) lock the first and second members in alignment for full extension or other defined stabilized configuration and (ii) unlock to allow the first and second members to pivot relative to each other for flexion or bending.

23 Claims, 12 Drawing Sheets



(51) **Int. Cl.**

A61F 2/32	(2006.01)
A61F 2/40	(2006.01)
A61F 2/42	(2006.01)
A61F 2/48	(2006.01)

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

CPC .. *A61F 2/385* (2013.01); *A61F 2/40* (2013.01); *A61F 2/42* (2013.01); *A61F 2002/30079* (2013.01); *A61F 2002/30329* (2013.01); *A61F 2002/30492* (2013.01); *A61F 2002/30565* (2013.01); *A61F 2002/30607* (2013.01); *A61F 2002/30622* (2013.01); *A61F 2002/30632* (2013.01); *A61F 2002/30668* (2013.01); *A61F 2002/3813* (2013.01); *A61F 2002/482* (2013.01); *A61F 2250/0006* (2013.01); *A61F 2250/0008* (2013.01); *A61F 2250/0073* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,753,960	B2	7/2010	Cipolletti et al.	
7,799,084	B2	9/2010	Clemow et al.	
8,308,808	B2	11/2012	Hershbeger	
8,894,714	B2	11/2014	Makower et al.	
2003/0208276	A1*	11/2003	Berelsman et al.	623/20.11
2007/0276498	A1*	11/2007	Aebi et al.	623/17.16
2008/0133019	A1*	6/2008	Andrysek	A61F 2/68 623/20.14
2008/0275558	A1	11/2008	Clifford et al.	
2009/0171463	A1	7/2009	Brehm	
2010/0131070	A1	5/2010	Dees et al.	
2011/0130835	A1*	6/2011	Ashley et al.	623/17.11
2014/0025174	A1	1/2014	Lucas et al.	

* cited by examiner

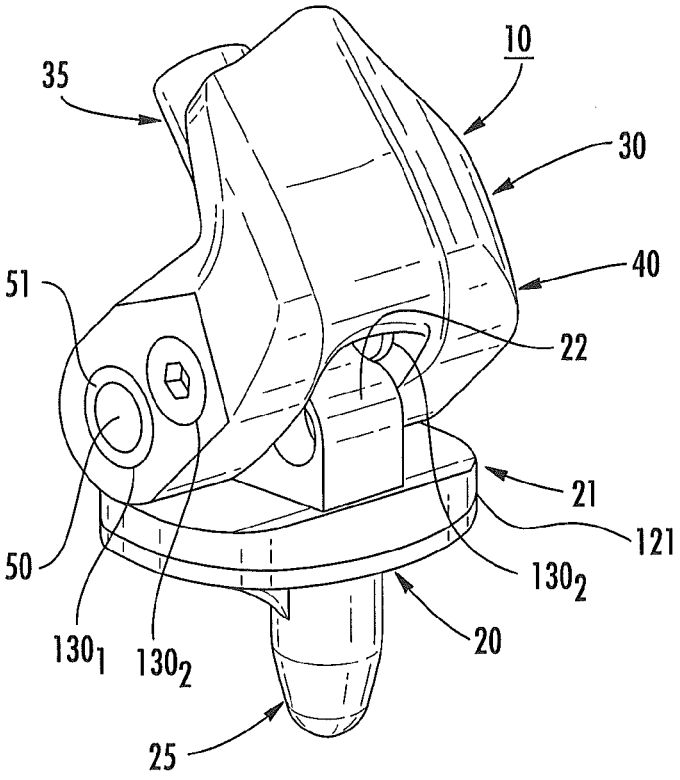

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FIG. 1

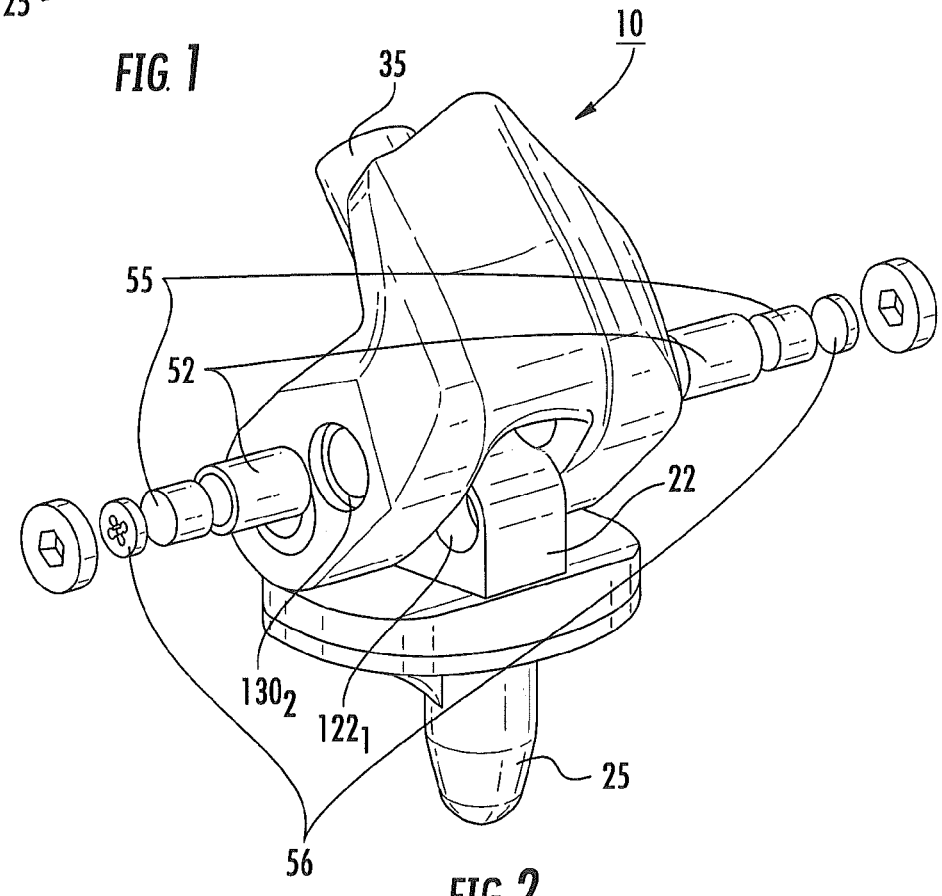
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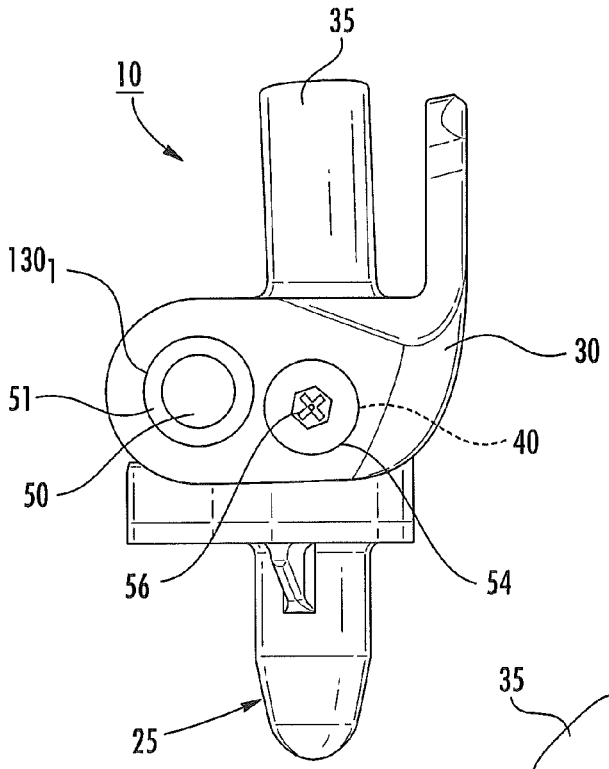
FIG. 2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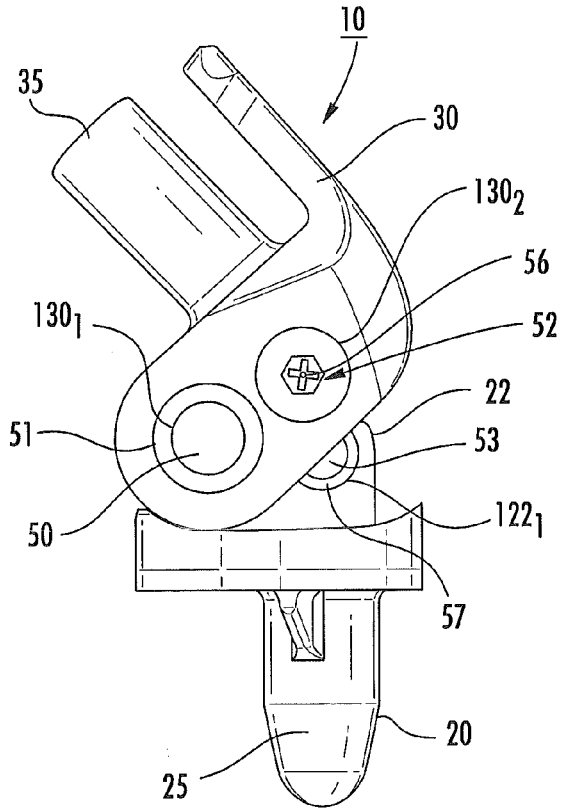
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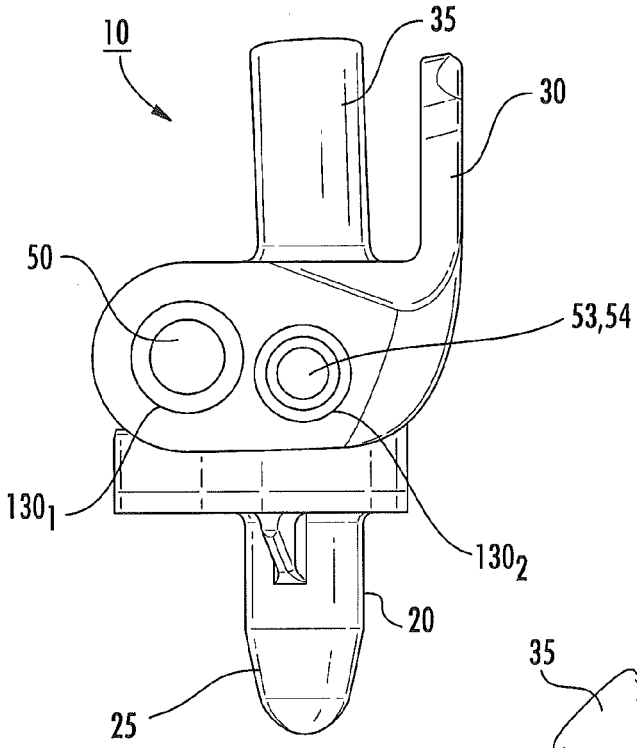
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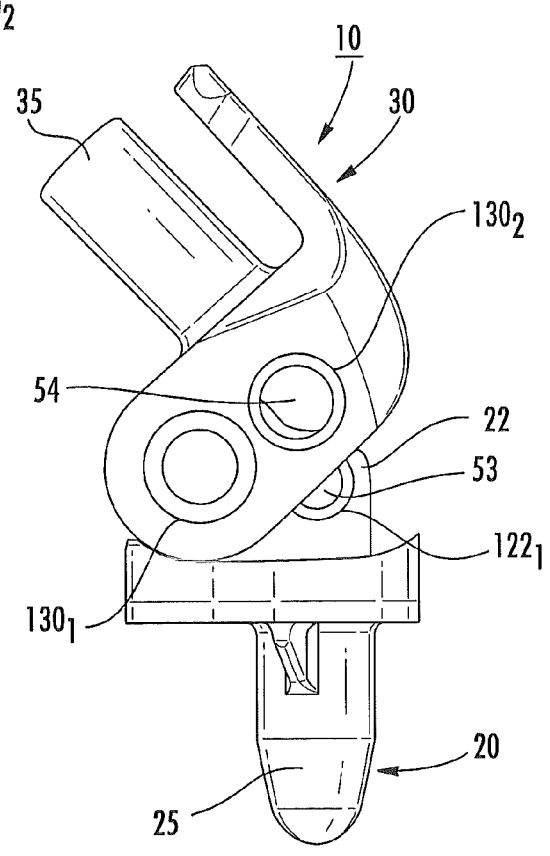
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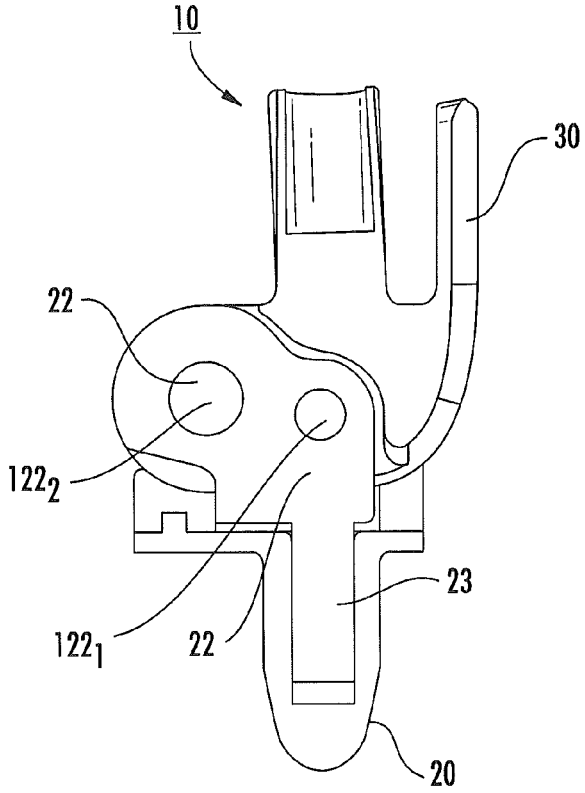
FIG. 6



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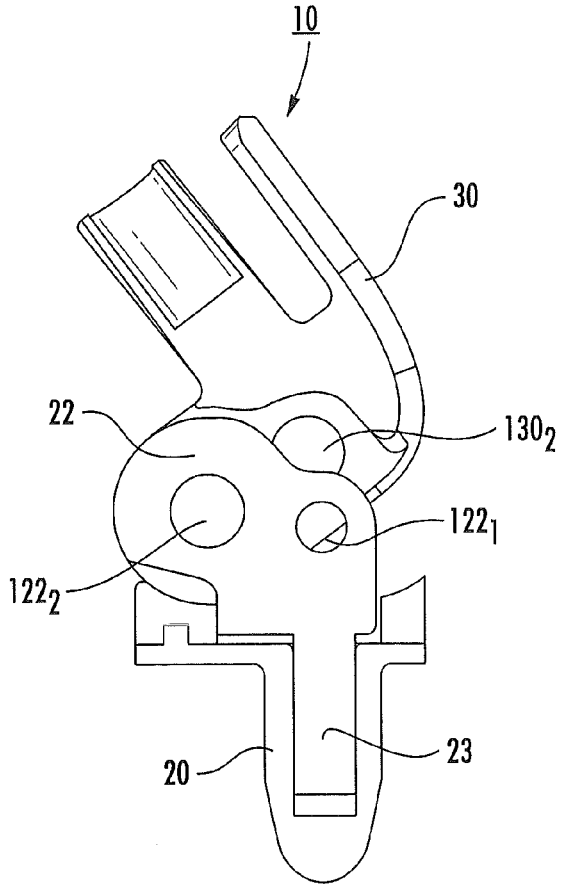

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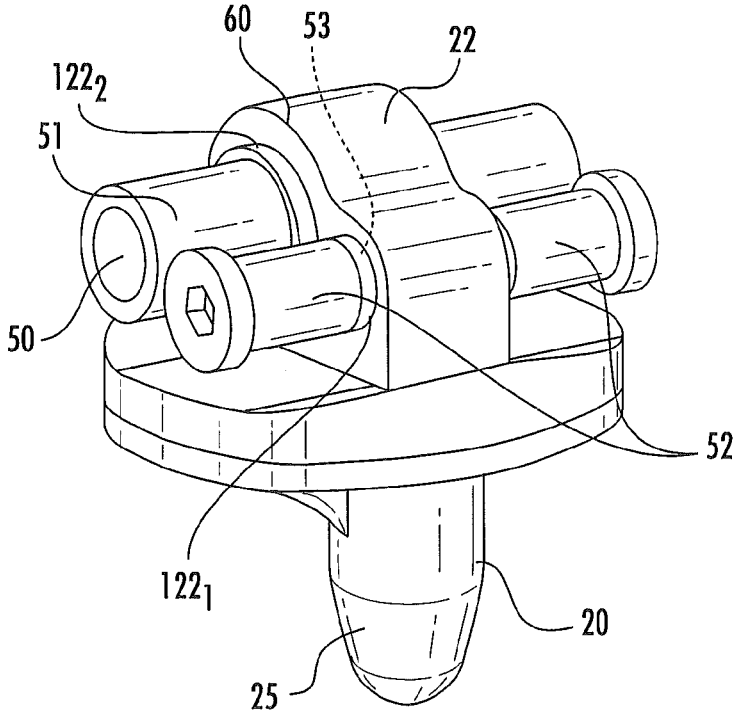

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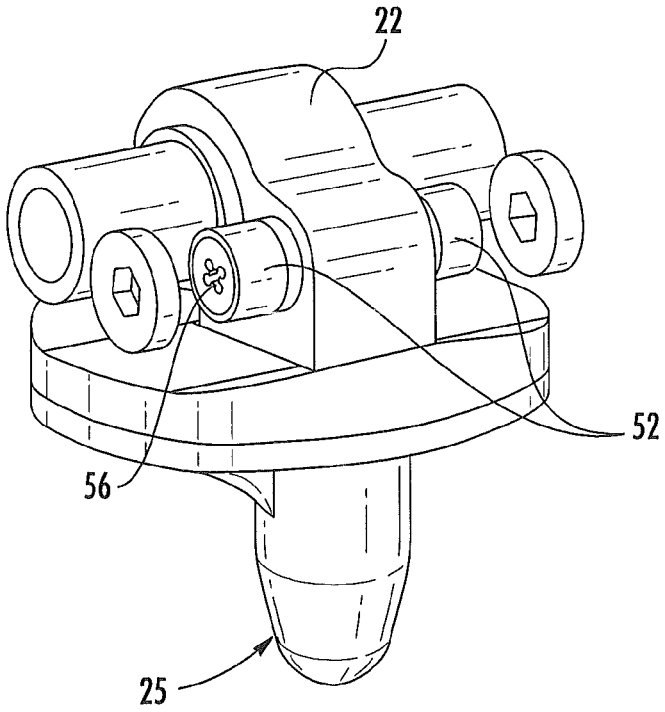

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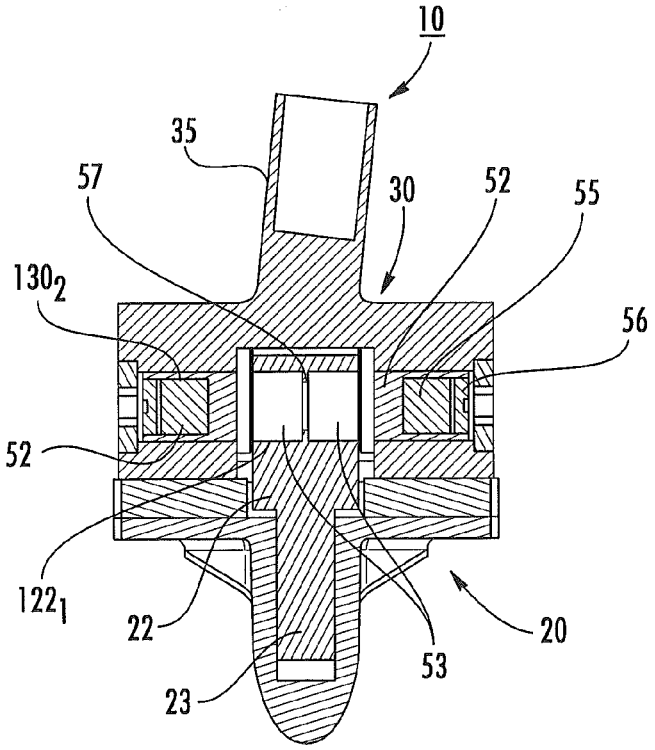
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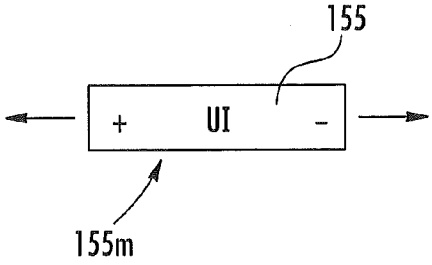
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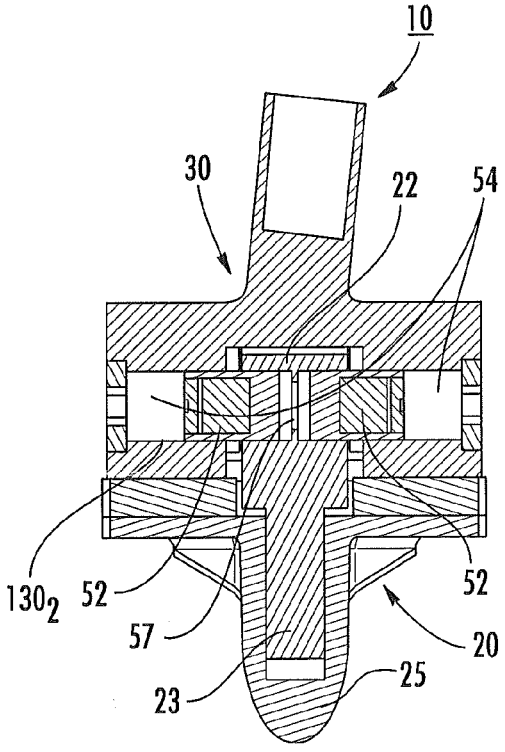
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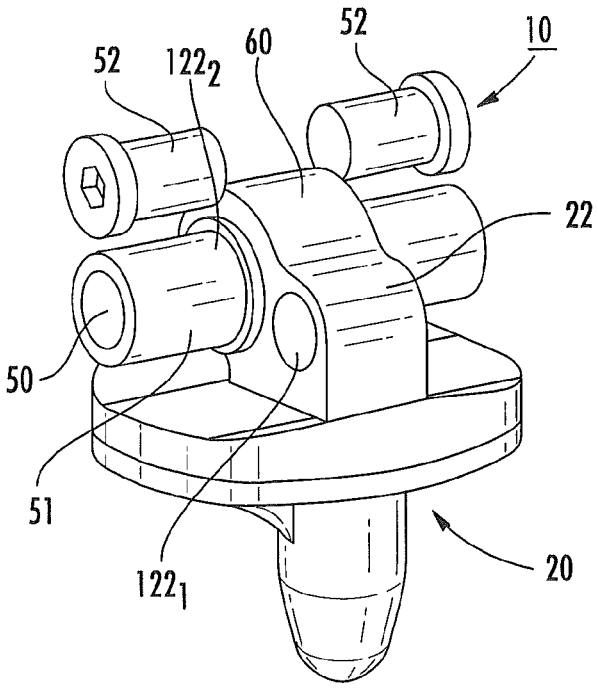
FIG. 12



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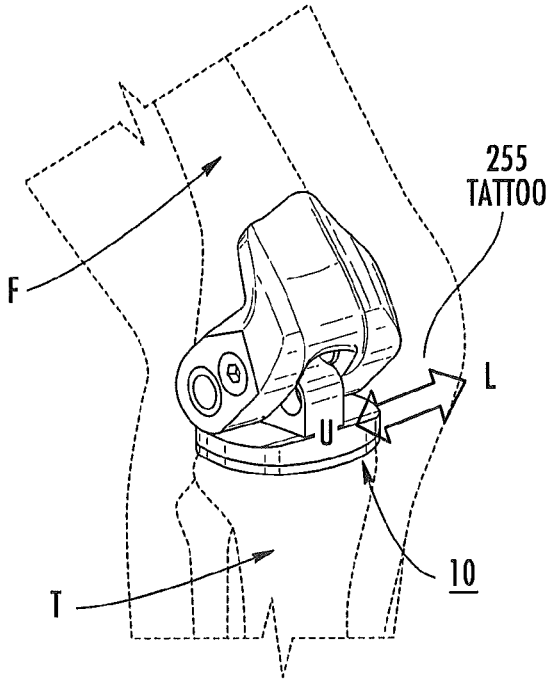
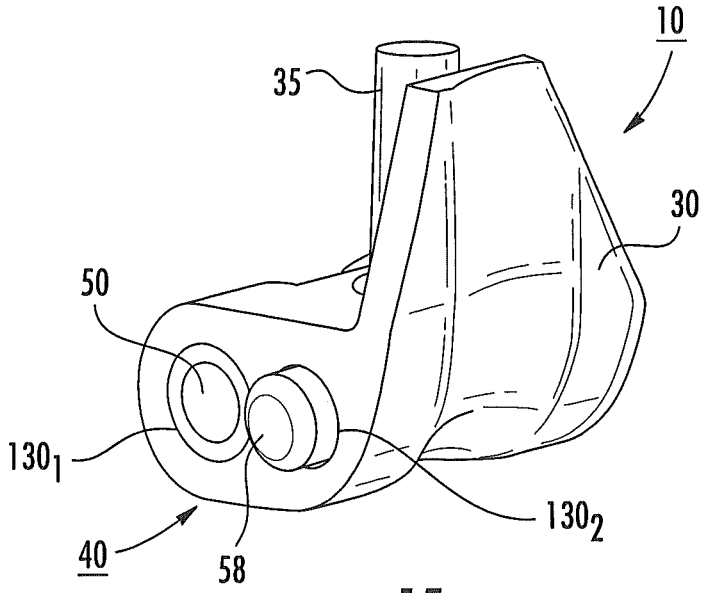


FIG. 14



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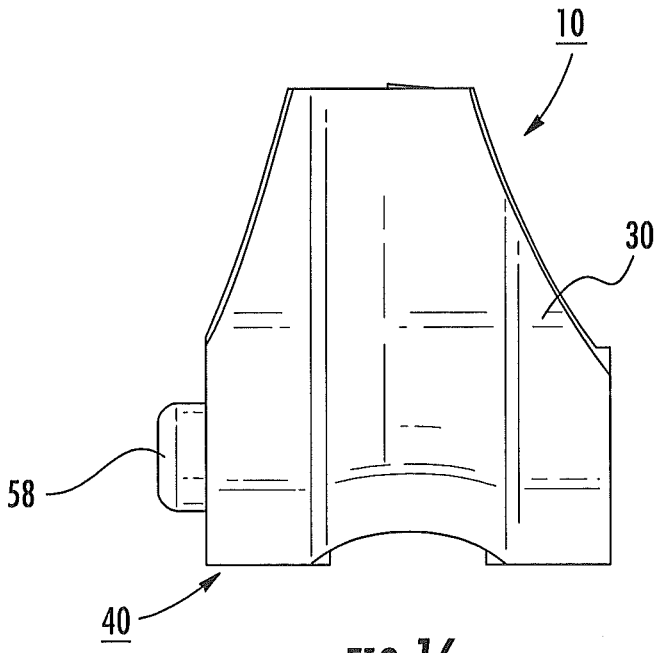

FIG. 16

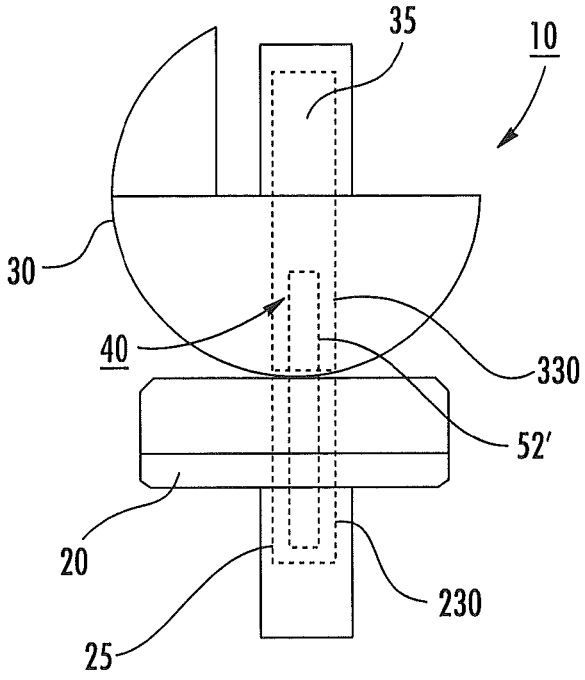

FIG. 17

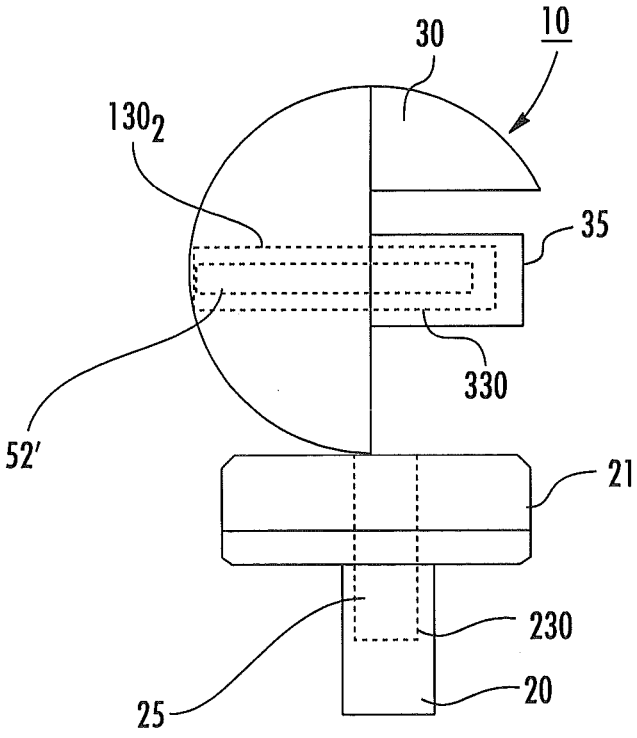

FIG. 18

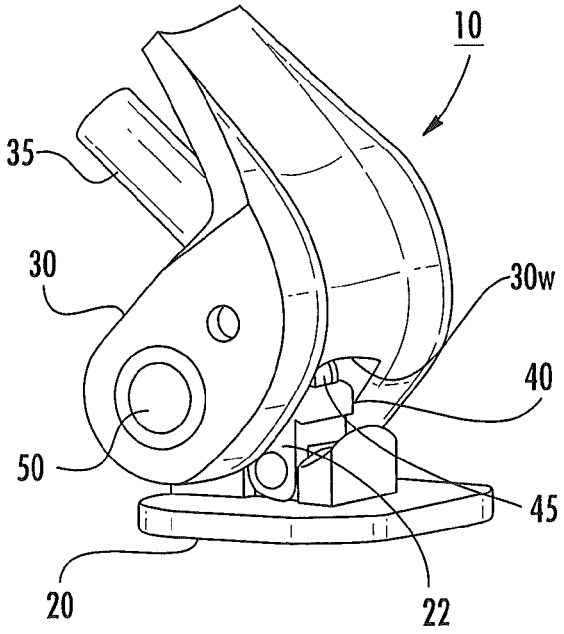

FIG. 19

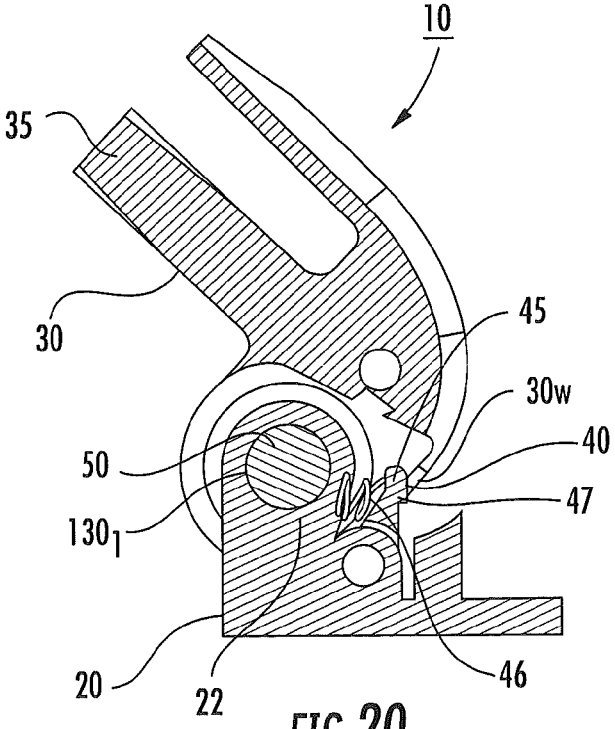

FIG. 20

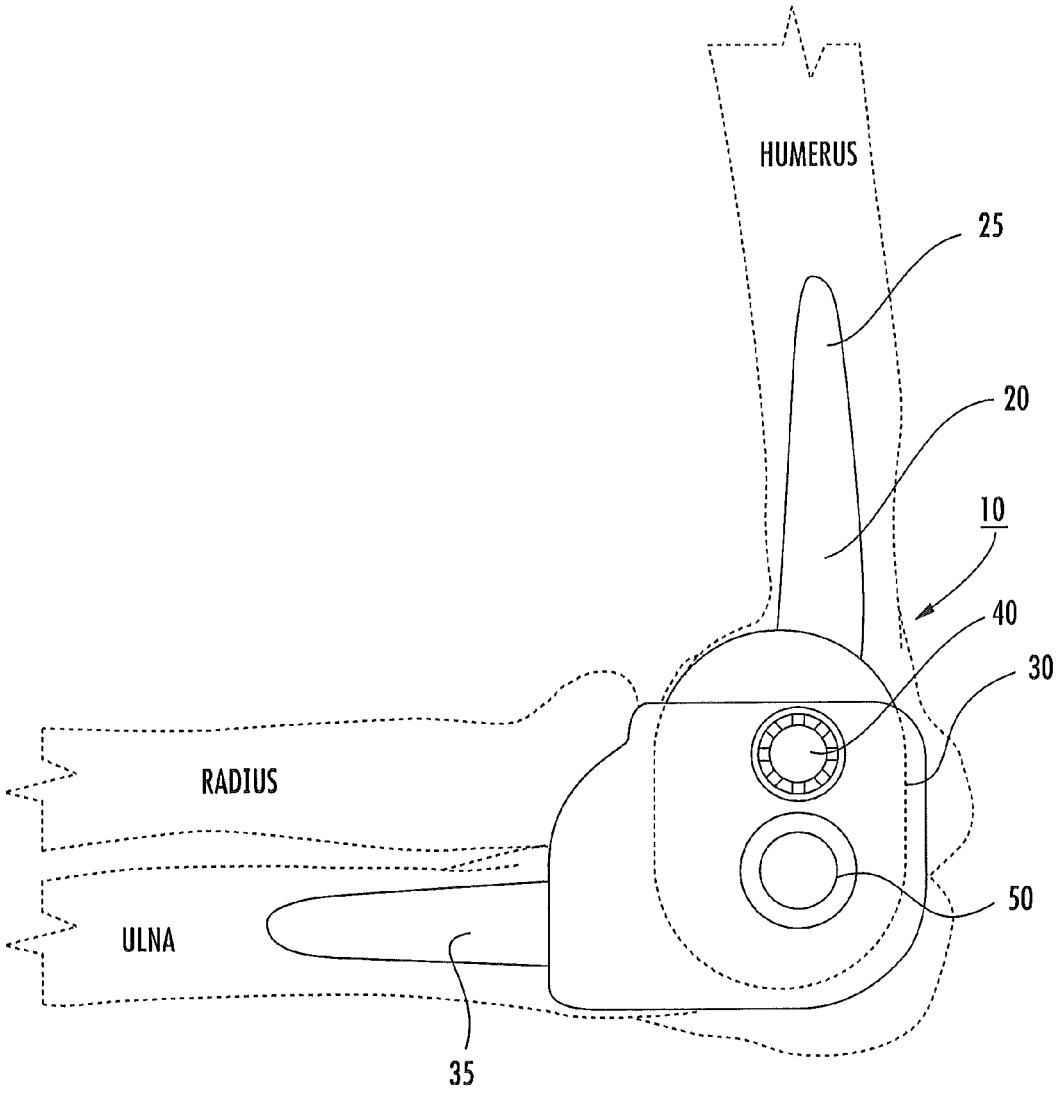

FIG. 21


Fig.12
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LOCKABLE IMPLANTS

RELATED APPLICATIONS

This application claims the benefit of and priority to U.S. Provisional Application Ser. No. 61/672,352, filed Jul. 17, 2012, the contents of which are hereby incorporated by reference as if recited in full herein.

FIELD OF THE INVENTION

The present invention relates to surgical implants and is particularly suitable for implants used in articulating joints and/or in the presence of muscular deficiency.

BACKGROUND

Knee arthrodesis, indicated in the presence of inadequate muscular control or soft tissue stability, allows for patients to successfully ambulate. This surgery results in a rigidly extended lower limb that cannot be flexed or reduced in length. The extended position requires greater muscular strength and endurance to control, even when not mobile, which can lead to secondary joint pain and muscular fatigue. The permanence of this rigid extension can also prevent patient participation in many normal daily living activities such as bathing, tying shoes, or sitting in close quarter spaces such as a cars, airplanes and theaters.

Total knee replacement (TKR) is a surgical procedure to relieve pain, correct deformity, and restore knee function using artificial materials to restore the load bearing and movement functions of the knee. If primary treatment fails, a revision procedure is required. As the number of knee replacement procedures increases, so does the incidence of revision surgeries. With each surgery more native anatomy is lost and the risk of secondary damage to musculature, nerves and bone increases. Multiple surgical interventions can compound these risks and negative complications, and can lead to terminal knee dysfunction.

Other joints that may be suitable for implants can have similar or other issues.

SUMMARY OF EMBODIMENTS OF THE INVENTION

Embodiments of the present invention provide lockable implants that allow for flexion when desired by the patient, and that lock into a fixed or semi-rigid configuration for structurally stable alternative configurations.

The lockable implants can be selectively locked and/or unlocked by a user.

The lockable implants can have mechanical or electromechanical locks to lock and unlock the implant, and thus the associated lower anatomical member, into a specific orientation.

The lockable implants can include a magnetically operated lock that cooperates with an externally applied magnetic field to lock and unlock the implant.

The lockable implants can be self-locking, responsive to applying a force at or above a defined force or load.

The lockable implants can include buttons, latches or flexible surfaces on the implant that are accessible by the user (through palpation or the like) either manually or with a tool, that can be used to activate the locking or unlocking ability of the implant.

Embodiments of the invention are directed to implants that include: (a) a first member configured to attach to a first bone;

(b) a second member in cooperating alignment with the first member configured to reside in a second adjacent bone; and (c) a lock mechanism in communication with the first and/or second members configured to (i) lock the first member to the second member for a stabilized configuration and (ii) unlock the first and second members to allow them to pivot relative to each other for flexion or bending.

The lock mechanism can be selectively actuated by a user to lock and unlock the implant.

The implant may include a hinge assembly having an axle configured to hingedly attach the first member to the second member. The hinge assembly can include a yoke with an axle channel that holds the axle and at least one spaced apart second channel. The lock mechanism can include at least one locking member that selectively slides in defined forward and reverse directions in the at least one second channel to respectively lock and unlock the first and second members.

The implant can include a hinge assembly having an axle configured to hingedly attach the first member to the second member. The hinge assembly can include a yoke that resides between the first and second members and has a laterally extending yoke axle channel and at least one spaced apart laterally extending second channel that is spaced apart from the axle channel. The second member can include outer laterally extending locking channels that reside on opposing ends of and can align with the at least one second laterally extending second channel. The lock mechanism can include at least one locking member that can slide, side-to-side, through the second member locking channels to enter and exit a defined interior space of the at least one second channel of the yoke to lock and unlock the implant.

The second member can include spaced apart laterally extending axle channels that reside on opposing ends of and can align with the laterally extending axle channel so that the axle resides in the second member axle channels and the yoke axle channel.

The first member can have a bearing surface defined by a polymer insert that holds the yoke and allows the second member to rotate in a flexion axis relative to the first member.

The lock mechanism can include a magnet that slides to lock and/or unlock in response to application of an external magnetic field.

The lock mechanism can be configured to be manually selectively actuated upon a contact force associated with a user physically pressing on an actuation member in communication with the lock mechanism that resides under skin of the patient with the implant.

The implant can include a hinge assembly that attaches the first and second members. The hinge assembly can include a yoke with a channel that receives first and second laterally spaced apart first and second magnets. The first or second member can include spaced apart open interior spaces that align with opposing sides of the yoke, one that receives a first magnet and one that receives the second magnet. The first and second magnets can slide out of the yoke channel into the respective first or second member interior spaces to unlock the lock mechanism and the magnets can slide into the yoke interior space to lock the implant.

The lock mechanism can be self-engaging in response to application of a load introduced by the patient when the first and second members are in a substantially aligned orientation.

The implant can be a total joint replacement implant.

The implant can be a total knee replacement implant.

The implant can be a total joint replacement implant of an elbow.

Other embodiments are directed to methods of operating an implant in a patient. The methods include: (a) selectively unlocking a lock of an implant having first and second members using an implantable lock onboard the implant; and (b) selectively locking the lock to lock the first member and the second member together in a fixed configuration for structural stability using the onboard lock.

The lock can include at least one magnet that slides and the selectively locking and unlocking can be carried out by passing an external magnetic field over the at least one magnet.

The selectively locking can be manually carried out by physically pressing on an actuation member in communication with the lock that resides under skin of the patient with the implant.

Other embodiments are directed to lockable implants. The implants include a first member configured to attach to a first bone; a second member in cooperating alignment with the first member configured to reside in a second adjacent bone; and a lock mechanism in communication with the first and second members configured to (i) lock the first member to the second member for a stabilized configuration and (ii) unlock the first and second members to allow them to pivot relative to each other for flexion or bending.

The lock mechanism can be selectively actuated by a user to lock and unlock the implant.

The lock mechanism can include at least one magnet that slides to lock and/or unlock in response to application of an external magnetic field.

The lock mechanism can be configured to be manually selectively actuated upon a contact force associated with a user physically pressing on an actuation member in communication with the lock mechanism that resides under skin of the patient with the implant.

The implant first and second members can have a cooperating ball and socket configuration and the lock mechanism can include at least one locking member that can slide through a locking channel to enter and exit a defined interior space of the first and/or second member to lock and unlock the implant.

The implant first and second members can be attached with a hinge having an axle in an axle channel.

The implant can be a total hip replacement implant.

The lock mechanism can be self-engaging in response to application of a load introduced by the patient when the first and second members are in a substantially aligned and/or defined orientation.

The implant can be a total knee replacement implant.

The implant can be a total joint replacement implant.

The implant can be a total joint replacement implant of a wrist.

The implant can be a total joint replacement implant of a hip.

The implant can be a total joint replacement implant of a shoulder.

The implant can be a total joint replacement implant of an elbow.

The implant can be a total joint replacement implant of an ankle.

The selectively locking can be manually carried out by physically pressing on an actuation member in communication with the lock that resides under skin of the patient with the implant.

It is noted that aspects of the invention described with respect to one embodiment, may be incorporated in a different embodiment although not specifically described relative thereto. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination. Applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to be able to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner. These and other objects and/or aspects of the present invention are explained in detail in the specification set forth below.

Other systems and/or methods according to embodiments of the invention will be or become apparent to one with skill in the art upon review of the following drawings and detailed description. It is intended that all such additional systems, methods, and/or devices be included within this description, be within the scope of the present invention, and be protected by the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features of the present invention will be more readily understood from the following detailed description of exemplary embodiments thereof when read in conjunction with the accompanying drawings.

FIG. **1** is an isometric perspective view of a knee implant according to embodiments of the present invention. The device is unlocked and partially flexed.

FIG. **2** is an exploded view of the device shown in FIG. **1**.

FIG. **3** is a side view of the device shown in FIG. **1**. The device may be locked in this position.

FIG. **4** is a side view of the device shown in FIG. **1** in a partially flexed orientation. The device is unlocked.

FIG. **5** is a side view of the device shown in FIG. **1** and FIG. **3**, with components of the locking mechanism removed.

FIG. **6** is a side view of the device shown in FIG. **1** and FIG. **4** in a partially flexed orientation, with components of the locking mechanism removed.

FIG. **7** is a sectioned midplane side view of the device shown in FIG. **1**. The device may be locked or unlocked in this position.

FIG. **8** is a sectioned midplane side view of the device shown in FIG. **1** in a partially flexed orientation. The device is unlocked.

FIG. **9** is an isometric view of the device shown in FIG. **1**, and aligned/rotated about its flexion axis as shown in FIG. **3**, FIG. **5**, and FIG. **7**. The device is in an unlocked state, and the femoral component is removed for visibility.

FIG. **10** is an isometric view of the device shown in FIG. **1**, and aligned/rotated about its flexion axis as shown in FIG. **3**, FIG. **5**, FIG. **7**, and FIG. **9**. The device is in a locked state, and the femoral component is removed for visibility.

FIG. **11** is a rear view of the device shown in FIG. **1**, sectioned in a frontal plane across the center of the locking mechanism. The device is in an unlocked state.

FIG. **12** is a rear view of the device shown in FIG. **1**, sectioned in a frontal plane across the center of the locking mechanism, as shown in FIG. **11**. The device is in a locked state.

FIG. **13** is an isometric view of the device shown in FIG. **1**, and rotated about its flexion axis as shown in FIG. **1**, FIG. **2**, FIG. **4**, FIG. **6**, and FIG. **8**. The femoral component is removed for visibility. The device is unlocked.

FIG. **14** is an example of a knee implant system in position relative to the femur "F" and tibia "T".

FIG. **15** an example of an embodiment of the device with a mechanical pushbutton for the locking mechanism according to embodiments of the present invention.

FIG. **16** is front view of the embodiment of the device seen in FIG. **15**.

FIG. **17** is an embodiment of the device where the lock can occur vertically through the stem of the femoral and tibial components according to embodiments of the present invention, shown in the locked position.

FIG. **18** is a view of the embodiment shown in FIG. **17**, in a flexed and unlocked position.

FIG. **19** is an embodiment of the device with another lock mechanism that is configured with a latch that engages when the device moved into full extension and/or a walking stable configuration according to yet other embodiments of the present invention.

FIG. **20** is a side section view of the embodiment in FIG. **19**.

FIG. **21** is a schematic illustration of an exemplary lockable implant in an elbow joint according to embodiments of the present invention.

FIG. **22** is a schematic illustration of an exemplary lockable total replacement hip implant according to embodiments of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The present invention now is described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

Like numbers refer to like elements throughout. In the figures, the thickness of certain lines, layers, components, elements or features may be exaggerated for clarity. Broken lines illustrate optional features or operations unless specified otherwise. One or more features shown and discussed with respect to one embodiment may be included in another embodiment even if not explicitly described or shown with another embodiment.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. As used herein, phrases such as "between X and Y" and "between about X and Y" should be interpreted to include X and Y. As used herein, phrases such as "between about X and Y" mean "between about X and about Y." As used herein, phrases such as "from about X to Y" mean "from about X to about Y."

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the specification and relevant art and should not be interpreted in an idealized or overly formal sense unless expressly so defined herein. Well-known functions or constructions may not be described in detail for brevity and/or clarity.

It will be understood that when an element is referred to as being "on", "attached" to, "connected" to, "coupled" with, "contacting", etc., another element, it can be directly on, attached to, connected to, coupled with or contacting the other element or intervening elements may also be present. In contrast, when an element is referred to as being, for example, "directly on", "directly attached" to, "directly connected" to, "directly coupled" with or "directly contacting" another element, there are no intervening elements present. It will also be appreciated by those of skill in the art that references to a structure or feature that is disposed "adjacent" another feature may have portions that overlap or underlie the adjacent feature.

Spatially relative terms, such as "under", "below", "lower", "over", "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is inverted, elements described as "under" or "beneath" other elements or features would then be oriented "over" the other elements or features. Thus, the exemplary term "under" can encompass both an orientation of over and under. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly. Similarly, the terms "upwardly", "downwardly", "vertical", "horizontal" and the like are used herein for the purpose of explanation only unless specifically indicated otherwise.

It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention. The sequence of operations (or steps) is not limited to the order presented in the claims or figures unless specifically indicated otherwise.

The term "about" means that the recited number or value can vary by +/−20%.

The term "sterile" means that the noted device or material meets or exceeds defined medical guidelines of cleanliness and is substantially (if not totally) without contaminants so as to be suitable for medical uses.

Turning now to the figures, FIG. **1** illustrates an example of a lockable implant **10** that is a total knee replacement (TKR) implant **10** according to embodiments of the present invention. Although primarily described as a TKR, the implant **10** can be used in other joints, particularly articulating joints such as, for example, ankles, hips, shoulders, elbows, wrists and the like (see, e.g., FIG. **21**). Although, the knee implant **10** can lock into place at about 0 and about 180 degrees, other implants can have other or additional locking orientations. For example, the elbow implant **10** (FIG. **21**) can be configured to "lock" in place at about 90 degrees.

Although the implant **10** is shown primarily herein as including a hinge to allow pivoting movement between two attached cooperating members **20**, **30**, other attachment con-

figurations for other movement of a particular joint can be used, such as a ball and socket type configuration (FIG. **22**).

As shown, the implant **10** includes a first member **20**, e.g., lower (tibial) member a second member **30**, e.g., upper (femoral) member **30** with a lock or locking mechanism **40** (also called a latch). The lower member **20** can be attached to the tibia ("T") and the upper member **30** can be attached to the femur ("F") via respective stems **25**, **35**. The lower and upper members **20**, **30** can be connected via a hinge yoke **22**. The locking mechanism **40** can be incorporated into the hinge that is attached to the rotating platform area using the hinge yoke **22**.

The hinge yoke **22** can include a laterally extending channel or aperture $\mathbf{122}_2$ that is aligned with channel $\mathbf{130}_1$ in the upper member **30** to hold an axle **50**, typically inside an axle bearing **51**, so as to allow the upper member **30** to pivot with respect to the lower member **20** via the axle **50**. The hinge yoke **22** can include a second channel or laterally extending aperture $\mathbf{122}_1$ that holds a moveable locking member **52**, shown as a pin or bolt, that can selectively slide to engage or disengage a channel $\mathbf{130}_2$ in the upper member **30** to (i) lock into a full stabilization walking configuration (e.g., full extension) to allow an arthrodesis gait without requiring normal muscular strength and/or control and (ii) unlock to allow the members **20**, **30** to pivot relative to each other for flexion or bending when not ambulating. FIG. **14** illustrates an exemplary implant **10** in position relative to the femur "F" and the tibia "T".

In some embodiments, the hinge yoke **22** can include first and second spaced apart, laterally extending apertures or channels $\mathbf{122}_1$, $\mathbf{122}_2$ (FIGS. **7**, **9**), one of which hold the axle **50** as discussed above and the other holding at least one slidable locking member **52**. As shown, the axle **50** may be larger than the locking member(s) **52**, but the reverse configuration may also be used. The axle **50** can reside behind the locking member(s) **52** as shown. In other embodiments, the axle **50** resides in front of the locking member(s) **52**.

In the embodiment shown, at least one slidable locking member **52** includes two locking members, one on each side of the implant **10**. The locking members **52** can slide inward and outward substantially in concert, or be separately deployable.

The hinge yoke locking member(s) channel $\mathbf{122}_1$ can be configured as a single channel with a constant diameter or with different diameters. Where more than one locking member **52** is used, the different locking members **52** can have different sizes (e.g., diameters) and/or configurations or may have the same configurations and sizes. In the embodiment shown, the hinge yoke **22** includes a forward channel $\mathbf{122}_1$ with a reduced diameter or inner extending lip **57** at a medial section thereof **57** (FIGS. **11**, **12**) or with two aligned laterally extending closed channels (not shown), one for each of the two locking members **52** (where two are used). Although shown as two locking members **52** a single locking member **52** or more than two may be used.

In some embodiments, the implant **10** can include a polymer insert **21** forming part of the hinge/rotating platform **121** as in conventional implants **10**. The locking mechanism **40** can be incorporated into conventional or novel hinge/rotating platform systems.

In some embodiments, the insert **21** and/or hinge yoke **22** can be provided in multiple configurations that can be selected by a doctor for a particular patient so that the doctor can choose one that locks the patient's leg 5-10 degrees short of "full extension" for a stable walking configuration.

The implants **10** can be modular, interfacing with other implantable components of a knee replacement system, allowing for adjustment of limb length and fixation angle. The implants **10** can be suitable for patients who could undergo revision, but are at risk of complications that could compromise its success. The implants **10** can be used for patients with poorly performing revision implants, but who do not desire permanent fusion (or amputation). The implants **10** can be used for patients that otherwise would require fusion or amputation. The implants **10** can be used with patients having existing fusions who can "take-down" to the lockable knee implant to provide them with increased mobility or quality of life. The implants **10** may also be used as a primary implant for a first TKR surgery irrespective of whether a patient may have the compromised tissue or bone structure as a precaution.

The implants **10** can have a hinge/rotating platform **121** and provide industry standard stability. The locking configurations can be configured to fit modular revision TKRs. The interfacing configurations of modular revision TKR implants can allow mix and match of components to custom fit to individual patients. The implant **10** can restore the knee joint function using a rotating hinge-like function with two axis of articulation, including articulating members **21**, **30**, which rotate about axle **50**, and articulating members **20** and **21**, **22** which rotate about the stem **23** (FIG. **7**) of the hinge yoke **22**, to allow the joint to function in a more normal fashion. In some embodiments, the implant **10** can include a mobile, bearing-type sliding component that supports the yoke **22** and may allow for some Anterior/Posterior (AP) motion (not shown). For descriptions of conventional TKR designs, including rotating, hinged designs, see, e.g., U.S. Pat. No. 5,358,527, U.S. Pat. No. 5,800,552, U.S. Pat. No. 7,572,292, U.S. Pat. No. 7,753,960, U.S. Pat. No. 7,799,084, and US PUB 2010/0131070, the contents of which are hereby incorporated by reference as if recited in full herein.

FIGS. **1** and **4** illustrate the implant **10** with the upper member **30** partially pivoted relative to the lower member **20** allowing flexion. FIG. **3** illustrates the implant **10** in a locked upright configuration for stable, weight-bearing walking.

The device **10** can be locked via mechanical or electromechanical locking mechanism **40** that engages the hinge comprising the hinge yoke **22**. The lock or locking mechanism **40** is typically unpowered, but may be passively powered (e.g., inductively powered) without requiring an on board power source. The lock can be selectively activated and/or deactivated by a user. The locking mechanism **40** can be manually or electronically activated and/or deactivated. The locking mechanism **40** can be manually actuated.

A user can activate and/or deactivate the locking mechanism from one state to the other. The device **10** can maintain its current status until the user intervenes.

The locking mechanism **40** may be self-activating in response to a large load, such as a load-bearing weight, being applied to the members **20**, **30**, when the members **20**, **30** are aligned in a substantially straight or other stable (walking) orientation (such that the pivot shaft of the two components **20**, **30**, e.g., femoral and tibial components, are substantially in-line so that the limb is substantially straight). This activation can be while a patient is prone on a bed or sofa by pushing against a foot board, for example, but is typically in response to standing upright. The activation can be induced by a jolt, small jump or other movement to cause the mechanical lock to move to the lock orientation.

When members **22** and **30** are aligned as shown in FIG. **3**, FIG. **5**, FIG. **7**, FIG. **9**, FIG. **10**, FIG. **11**, and FIG. **12**, each locking member **52** can translate axially within interior spaces **53**, **54** of channels $\mathbf{122}_1$ and $\mathbf{130}_2$ to lock and unlock the device **10**. The lock is disengaged, as shown in FIGS. **9**

and **11**, when the locking members **52** reside entirely within the respective internal space **54** of channel $\mathbf{130}_2$ of member **30**. The lock is engaged, as shown in FIGS. **10** and **12**, when one or both locking members **52** are in communication with the interior space **53** of channel $\mathbf{122}_1$ of hinge yoke **22**, blocking rotation of member **30** with respect to member **22**, and thus preventing flexion.

In some particular embodiments, an interruption **57** in the interior channel $\mathbf{122}_1$ that divides internal spaces **53** can take the form of a reduced diameter, and can keep locking members **52** from physically contacting either other, or from traveling beyond a pre-determined distance.

When the device **10** is rotated about axle **50**, interference geometry **60** of the hinge yoke **22** blocks access of channel $\mathbf{122}_1$ and can serve to keep locking members **52** from leaving interior space **54**.

In some embodiments, as shown for example in FIG. **2**, the locking mechanism **40** can include a magnetic material **55**, which can be a physical "permanent" magnet, that is embedded in, assembled, attached and/or connected to the locking member **52**. A cap **56** can be used to seal off the magnetic material **55** from bodily fluid. As shown in FIG. **2**, the locking member **52** includes a receiving space that holds the magnetic material **55** therein and cooperates with the cap **56** to seal the magnetic material therein.

With the use of an internal magnetic material **55**, attractive or repulsive axial (side-to-side relative to the implant body) force can be applied to the bolts **52** with a user interface device **155** which can apply an external magnetic field (physical or electrical magnet via a user probe, control or other user interface input device), causing the locking member(s) **52** to translate laterally with respect to the implant body **10**.

In some embodiments, the polar axis of magnetic material **55** can be in-line with the axis of the lock, and external magnets in the same polar axis can be passed over either side of the device **10**, pulling the bolts medially and into an unlocked configuration as shown in FIG. **10** and FIG. **12**. By reversing the external magnets to the opposite polar direction, the user can pass the external magnets **155***m* over either side of the device **10** to move the locking members **52** medially to unlock the device **10** as shown in FIG. **9** and FIG. **11**.

FIG. **14** illustrates that a tattoo or other externally visible marker **255** can be applied to the skin of a patient over the locking mechanism **10** to provide alignment information for directional reference for "lock" and "unlock" actions (which can be icons or other suitable visible indicia).

In some particular embodiments, the magnetic material **55** can be a rare earth magnet, which is typically much stronger than ferrous magnets. There are two conventional types of rare earth magnets, neodymium magnets (e.g., neodymium-iron-boron) and samarium-cobalt magnets.

In some embodiments, the polar magnetic axis of magnetic material **55** within locking members **52** can be aligned in such a way that the natural state of the implant is to remain locked until user intervention.

Magnetic material can be extremely brittle and can also be vulnerable to corrosion (such as from the digestive acids in the body). The magnetic material can be sealed within the locking member **52** and cap **56**. The magnetic material **55** can be alternatively or additionally plated or coated with a biocompatible material such as polyethylene to protect them from breaking, chipping and/or for corrosion resistance. Particular examples of rare earth magnets include $Nd_2Fe_{14}B$, $SmCo_5$ and Sm(Co,Fe,Cu,Zr).

The magnetic material **55** can include a material that moves or changes viscosity in response to exposure to a magnetic field such as a magnetorheological fluid (also known as an MR fluid, available from Lord Corporation, Erie, Pa.) or a ferrofluid. The fluids change viscosity when subjected to a magnetic field.

The lock **40** can also or alternatively be a mechanical lock **58**, as seen in FIG. **15**, that can be manually pushed by a user to engage and/or disengage the locking members **52**. For example, a user can push against skin on one side of the implant **10** to slide a pin in a defined direction, e.g., inward or up or down, a distance sufficient to disengage a lock feature that engages or disengages the locking members **52**. FIGS. **15** and **16** illustrate an exemplary manually deployable push button **58** that a user can use to engage or disengage the locking mechanism **40**, e.g., to slide locking members **52**.

In some embodiments, the hinge yoke **22** can include a set of stacked dome or belleview washers, springs or other biasing members that can bias the movement in one direction (to the unlocked or locked position).

The locking mechanism **40** can be self-activating in response to application of load bearing weights as noted above.

The locking mechanism **40** can be a mechanical assembly that includes a set of stacked dome or belleview washers, springs or other biasing members that compress when a defined load is applied and allow a locking member to translate in a defined direction, e.g., sideways or up or down to engage a mechanical lock retention feature associated with the hinge yoke **22**.

As shown in FIGS. **17** and **18**, the locking mechanism **40** can be configured so that locking can occur with a vertical lock member **52'**, which resides in a channel **330** within the femoral component **30**. When the user moves the leg into full extension, locking member **52'** can slide down into an aligned channel **230** of tibial component **20**. When locking member **52'** is in simultaneous communication with both channels **230**, **330** flexion cannot occur and the device **10** is thus locked, allowing for ambulation. When the user wishes to unlock the device, the user can lift the leg so that the tibial member is above the femoral member, and the locking member **52'** will return entirely to the shaft **330** of femoral member **30**, thus unlocking the device and allowing for flexion.

In some embodiments of the device **10**, the locking mechanism **40** is configured so that locking can occur in response to when the device is moved into full extension, as shown in FIG. **19** and FIG. **20**. The lock or locking mechanism **40** can include an upwardly projecting member **45** that is in communication with a spring or other resilient member **46** to bias the member in one position, e.g., the member **45** can be spring-loaded. The upper femoral component **30** includes an interior wall **30***w*. The upwardly projecting member **45** has a lip **47** or other shaped feature with a geometry shaped to interface with and secure with a defined depression in the femoral component **30** interior wall **30***w*. In this embodiment, the locking mechanism **40** can be disengaged through the previously described method of magnetic operation and/or a mechanical push actuation, e.g., via a push button a or other input.

In other embodiments, the locking mechanism can be activated using an inductively powered circuit/switch based on an externally applied inductive power source.

FIG. **21** shows the implant **10** can be for an elbow that can lock into place at about 60-120 degrees, e.g., about 90 degrees, from the long or substantially axially aligned configuration of the stem members **25**, **35**.

FIG. **22** shows an alternate implant **10'** with a lock mechanism **40** that can lock a ball and socket configuration as the two cooperating members **20'**, **30'** of a total replacement hip joint. The lock mechanism **40** can include at least one locking member **52** (e.g., a magnet or other configuration such as one

or more of the components/configurations described above) that slides into an interior cavity **10***c* of the first or second member **20**, **30** to latch or lock the two members together in a defined stable configuration. The at least one locking member **52** can also slide further in the same direction or in an opposing direction to unlatch or unlock the implant (the two members **20**, **30**) and allow bending and/or flexion.

While the foregoing written description of the invention enables one of ordinary skill to make and use what is considered presently to be the best mode thereof, those of ordinary skill will understand and appreciate the existence of variations, combinations, and equivalents of the specific embodiment, method, and examples herein. The invention should therefore not be limited by the above described embodiment, method, and examples, but by all embodiments and methods within the scope and spirit of the invention as claimed.

That which is claimed:

1. An implant, comprising:

a first member configured to attach to a first bone;

a second member in cooperating alignment with the first member and configured to reside in a second adjacent bone; and

an internal lock mechanism in communication with the first member and the second member and configured to selectively and reversibly, based on patient-user interaction with the internal lock mechanism after implantation, (i) lock the first member to the second member for a stabilized configuration to prevent them from pivoting relative to each other and (ii) unlock the first and second members to allow them to pivot relative to each other for at least one of flexion or bending, wherein the lock mechanism comprises at least one locking member that either (a) slides in defined directions in interior spaces of the first and second members or (b) slides in defined directions in interior spaces of the second member and a yoke held by the first member to lock and unlock the first and second members, and wherein the lock mechanism, the first member, and the second member are sized and configured as implantable components that are adapted to reside under skin of a patient's body.

2. The implant of claim **1**, wherein the lock mechanism has the configuration of (b) and is selectively actuated by a respective patient-user to lock and unlock the implant using an external magnet for the user interaction, wherein the magnet is configured to apply a magnetic field onto the internal lock mechanism to lock and unlock the first and second members.

3. The implant of claim **1**, wherein the lock mechanism is configured to be manually selectively actuated upon a contact force associated with a user physically pressing on an actuation member in communication with the lock mechanism, and wherein the actuation member also resides under the skin of the patient's body with the implant.

4. The implant of claim **1**, wherein the implant is a total joint replacement implant.

5. A lockable implant, comprising:

a first member configured to attach to a first bone;

a second member in cooperating alignment with the first member and configured to reside in a second adjacent bone; and

a lock mechanism in communication with the first and second members and configured to (i) lock the first member to the second member for a stabilized configuration to prevent them from pivoting relative to each other and (ii) unlock the first and second members to allow them to pivot relative to each other for at least one of flexion or bending,

wherein the lock mechanism, the first member and the second member, are all adapted to reside under skin of a patient, wherein the lock mechanism comprises at least one locking member that can slide in defined opposing directions in interior spaces of the first and second members to lock and unlock, respectively, the first and second members based on external user interaction with the lock mechanism after implantation.

6. The implant of claim **5**, wherein the lock mechanism is selectively actuated by a patient/user to lock and unlock the implant.

7. The implant of claim **5**, wherein the first member includes a yoke, and wherein the lock mechanism is configured to be manually selectively actuated upon a contact force associated with a user physically pressing on an actuation member in communication with the lock mechanism that resides under skin of the patient with the implant.

8. An implant, comprising:

a first member configured to attach to a first bone;

a second member in cooperating alignment with the first member and configured to reside in a second adjacent bone;

an internal lock mechanism in communication with the first member and the second member and comprises at least one locking member, wherein the internal lock mechanism is configured to selectively and reversibly (i) lock the first member to the second member for a stabilized configuration that prevents at least one of flexion or bending and (ii) unlock the first and second members to allow them to pivot relative to each other for at least one of flexion or bending; and a hinge and

assembly having an axle configured to hingedly attach the first member to the second member, wherein the hinge assembly comprises a yoke held by the first member and comprising an axle channel that holds the axle and a spaced apart lock channel, wherein the spaced apart lock channel of the yoke is an open channel that extends across the yoke, wherein the at least one locking member comprises first and second locking members that selectively slide in defined directions in the lock channel of the yoke to respectively lock and unlock the first and second members, and wherein, when locked, the first and second locking members extend into opposing ends of the lock channel of the yoke, and

wherein the lock mechanism, the hinge assembly, the first member, and the second member are sized and configured as implantable components that are adapted to reside under skin of a patient's body.

9. The implant of claim **8**, wherein the first member has a bearing surface defined by a polymer insert that holds the yoke and allows the second member to rotate about a flexion axis relative to the first member.

10. An implant, comprising:

a first member configured to attach to a first bone;

a second member in cooperating alignment with the first member and configured to reside in a second adjacent bone;

a hinge assembly having an axle configured to hingedly attach the first member to the second member, wherein the hinge assembly comprises a yoke that resides between the first and second members is held by the first member and has a laterally extending yoke axle channel and a laterally extending lock channel that is spaced apart from the yoke axle channel, wherein the second member comprises a lock channel with outer laterally

extending interior spaces that reside on opposing ends of and can align with the laterally extending lock channel of the yoke; and

a lock mechanism in communication with the first member and the second member and configured to (i) lock the first member to the second member for a stabilized configuration that prevents at least one of flexion or bending and (ii) unlock the first and second members to allow them to pivot relative to each other for at least one of flexion or bending,

wherein the lock mechanism comprises first and second locking members that can slide in the interior spaces of the second member locking channel to enter and exit the laterally extending lock channel of the yoke to lock and unlock the implant.

11. The implant of claim **10**, wherein the second member comprises spaced apart and aligned laterally extending axle channels that reside on opposing ends of and can align with the laterally extending yoke axle channel so that the axle resides in the second member axle channels and the yoke axle channel.

12. An implant, comprising:

a first member configured to attach to a first bone;

a second member in cooperating alignment with the first member and configured to reside in a second adjacent bone; and

a lock mechanism in communication with the first member and the second member and configured to (i) lock the first member to the second member and (ii) unlock the first and second members to allow them to pivot relative to each other for at least one of flexion or bending,

wherein the lock mechanism comprises a magnet that slides to look and/or unlock in response to application of an external magnetic field.

13. An implant, comprising:

a first member configured to attach to a first bone;

a second member in cooperating alignment with the first member and configured to reside in a second adjacent bone;

a lock mechanism in communication with the first member and the second member and configured to (i) lock the first member to the second member for a stabilized configuration that prevents at least one of flexion or bending and (ii) unlock the first and second members to allow them to pivot relative to each other for at least one of flexion or bending; and

a hinge assembly that attaches the first and second members, wherein the hinge assembly comprises a yoke with a channel including an interior space that receives laterally spaced apart first and second magnets, the yoke held by the first member, and wherein the second member comprises spaced apart open interior spaces that can align with opposing sides of the yoke channel, one that receives the first magnet and one that receives the second magnet, and wherein the first and second magnets slide out of the yoke channel into respective interior spaces of the second member to unlock the lock mechanism and the magnets slide into the yoke channel interior space to lock the implant.

14. An implant, comprising:

a first member including a yoke and configured to attach to a first bone;

a second member in cooperating alignment with the first member and configured to reside in a second adjacent bone;

an internal lock mechanism in communication with the first member and the second member and configured to selectively and reversibly (i) lock the first member to the second member for a stabilized configuration that prevents at least one of flexion or bending and (ii) unlock the first and second members to allow them to pivot relative to each other for at least one of flexion or bending, wherein the lock mechanism comprises at least one locking member that slides in defined directions in interior spaces of the first and second members to lock and unlock the first and second members, and wherein the lock mechanism, the first member, and the second member are sized and configured as implantable components that are adapted to reside under skin of a patient's body; and

an axle extending through the first and second members, wherein the defined interior spaces of the first and second members comprise elongate horizontal channels that are offset from the axle, and wherein the implant is a total knee replacement implant.

15. An implant, comprising:

a first member including a yoke and configured to attach to a first bone;

a second member in cooperating alignment with the first member and configured to reside in a second adjacent bone;

an internal lock mechanism in communication with the first member and the second member and configured to selectively and reversibly (i) lock the first member to the second member for a stabilized configuration that prevents at least one of flexion or bending and (ii) unlock the first and second members to allow them to pivot relative to each other for at least one of flexion or bending, wherein the lock mechanism comprises at least one locking member that slides in defined directions in interior spaces of the first and second members to lock and unlock the first and second members, and wherein the lock mechanism, the first member, and the second member are sized and configured as implantable components that are adapted to reside under skin of a patient's body; and

an axle extending through the first and second members, wherein the defined interior spaces of the first and second members comprise elongate horizontal channels that are offset from the axle, and wherein the implant is a total joint replacement implant of an elbow.

16. A lockable implant, comprising:

a first member including a yoke and configured to attach to a first bone;

a second member in cooperating alignment with the first member and configured to reside in a second adjacent bone; and

a lock mechanism in communication with the first and second members and configured to (i) lock the first member to the second member for a stabilized configuration to prevent them from pivoting relative to each other and (ii) unlock the first and second members to allow them to pivot relative to each other for at least one of flexion or bending,

wherein the lock mechanism comprises at least one locking member that can slide in defined opposing directions in interior spaces of the first and second members to lock and unlock, respectively, the first and second members, and

wherein the at least one lock member of the lock mechanism comprises at least one magnet that slides to lock and/or unlock in response to application of an external magnetic field.

17. A lockable implant, comprising:

a first implant member configured to attach to a first bone;

a second implant member in cooperating alignment with the first implant member and configured to reside in a second adjacent bone; and

a lock mechanism in communication with the first and second implant members and configured to (i) lock the first member to the second member for a stabilized configuration that prevents at least one of flexion or bending and (ii) unlock the first and second members to allow them to pivot relative to each other for at least one of flexion or bending,

wherein the lock mechanism comprises at least one locking member that can slide in defined opposing directions in interior spaces of the second implant member to lock and unlock, respectively, the first and second implant members, wherein the first and second implant members are attached with a hinge having an axle in an axle channel, wherein the interior spaces of the second implant member are elongate channels that cooperate with an open yoke lock channel in a yoke, wherein the yoke is held by the first implant member, and wherein the yoke also comprises a spaced apart axle channel, and wherein, when locked, the at least one locking member resides in the yoke lock channel and at least partially in the elongate channels of the second implant member.

18. An implant, comprising:

a first implant member with a stem configured to reside in a first bone;

a second implant member in cooperating alignment with the first implant member, the second implant member comprising a stem configured to reside in a second adjacent bone;

a lock mechanism with at least one slidable lock member in communication with the first implant member and the second implant member and configured to (i) lock the first implant member to the second implant member for a stabilized configuration that prevents at least one of flexion or bending and (ii) unlock the first and second implant members to allow the first and second implant members to pivot relative to each other for at least one of flexion or bending; and

a hinge assembly attached to the first and second implant members, wherein the hinge assembly comprises a yoke with an axle channel and a spaced apart lock channel, with an axle extending through the yoke axle channel, and wherein the at least one slidable lock member is configured to slide in first and second opposing directions in the lock channel to selectively and reversibly lock and unlock the first and second implant members,

wherein the first implant member comprises a rotatable platform attached to the stem, and wherein the yoke is fixedly attached with the rotatable platform.

19. The implant of claim 18, wherein the at least one slidable lock member comprises first and second lock members, wherein the second implant member comprises at least one axle channel that holds the axle in cooperation with the yoke axle channel, and wherein the second implant member comprises a lock channel with open interior spaces, one that resides adjacent one end of the yoke lock channel and one that resides adjacent an opposing end of the yoke lock channel, wherein, the first and second lock members slidably travel (a) into the yoke lock channel to lock the first and second implant members and (b) out of the yoke lock channel into the interior spaces of the second implant member to unlock the first and second implant members.

20. The implant of claim 18, wherein the at least one slidable lock member includes first and second slidable lock members, each comprising a magnet, wherein the second implant member comprises at least one axle channel that holds the axle in cooperation with the yoke axle channel, and wherein the second implant member comprises a lock channel with first and second spaced apart open interior spaces that reside on opposing ends of the yoke lock channel.

21. The implant of claim 20, wherein, in operation the first and second lock members slidably travel into and out of the yoke lock channel, wherein, in a lock position, the first and second lock members extend partially out of respective first and second open interior spaces of the second implant member into opposing end portions of the yoke lock channel, and wherein in an unlock position, the first and second lock members reside in the open interior spaces of the second implant member outside the yoke lock channel.

22. An implant, comprising:

a first implant member with a stem configured to reside in a first bone;

a second implant member in cooperating alignment with the first implant member, the second implant member comprising a stem configured to reside in a second adjacent bone;

a lock mechanism with at least one slidable lock member in communication with the first implant member and the second implant member and configured to (i) lock the first implant member to the second implant member for a stabilized configuration that prevents at least one of flexion or bending and (ii) unlock the first and second implant members to allow the first and second implant members to pivot relative to each other for at least one of flexion or bending; and

a hinge assembly attached to the first and second implant members, the hinge assembly including a yoke that is held by the first implant member, wherein the hinge assembly comprises an axle and a spaced apart lock channel, and wherein the at least one slidable lock member is configured to slide in first and second opposing directions in the lock channel to selectively and reversibly lock and unlock the first and second implant members,

wherein the at least one lock member comprises first and second lock members, and wherein the second implant member comprises a body with a lock channel comprising first and second laterally opposing and spaced apart first and second interior spaces, one on each side of the yoke lock channel and cooperating therewith, and wherein the first lock member slidably resides in the first interior space of the second implant member and the second lock member slidably resides in the second interior space of the second implant member.

23. An implant, comprising:

a first implant member with a stem configured to reside in a first bone;

a second implant member in cooperating alignment with the first implant member, the second implant member comprising a stem configured to reside in a second adjacent bone;

a lock mechanism with at least one slidable lock member in communication with the first implant member and the second implant member and configured to (i) lock the first implant member to the second implant member for a stabilized configuration that prevents at least one of flexion or bending and (ii) unlock the first and second

implant members to allow the first and second implant members to pivot relative to each other for at least one of flexion Or bending; and

a hinge assembly attached to the first and second implant members, wherein the hinge assembly comprises a yoke including an axle channel and a spaced apart lock channel, the yoke held by the first implant member, and wherein the at least one slidable lock member is configured to slide in first and second opposing directions in the lock channel to selectively and reversibly lock and unlock the first and second implant members,

wherein the lock channel and the axle channel are parallel, elongate channels residing in the yoke between outer body portions of the second implant member.

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