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(54) **ADJUSTABLE HEIGHT ARTHROPLASTY PLATE**

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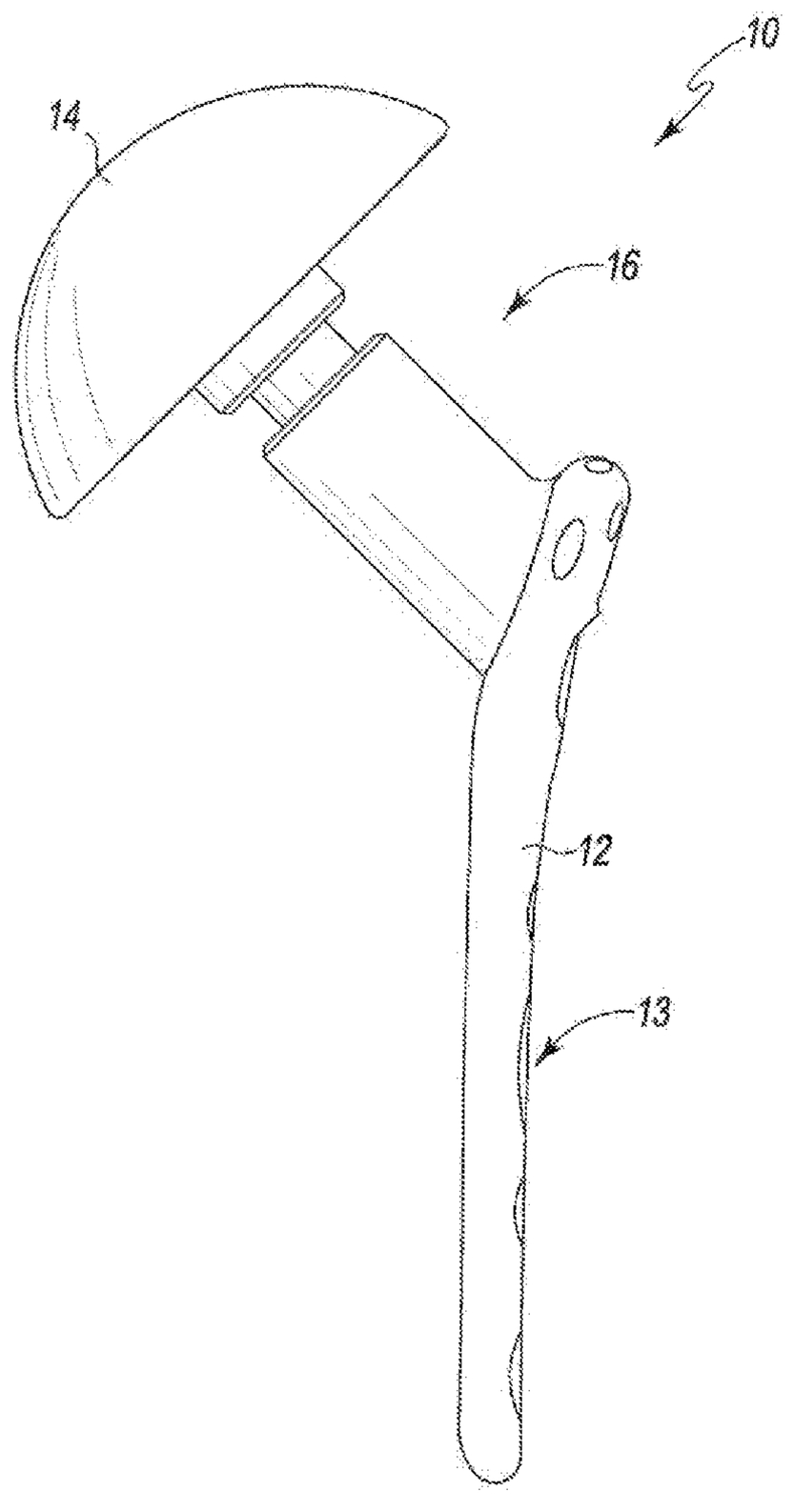
(57) **ABSTRACT**

An orthopaedic assembly. The orthopaedic assembly includes a first member adapted to be coupled to a bone and an adjustable connector assembly including an adjuster having a threaded end and a tapered end. The assembly also includes an articulation component including a bearing surface and adapted to be coupled to the tapered end of the adjustable connector assembly. The threaded end is adapted to engage the fixation plate.



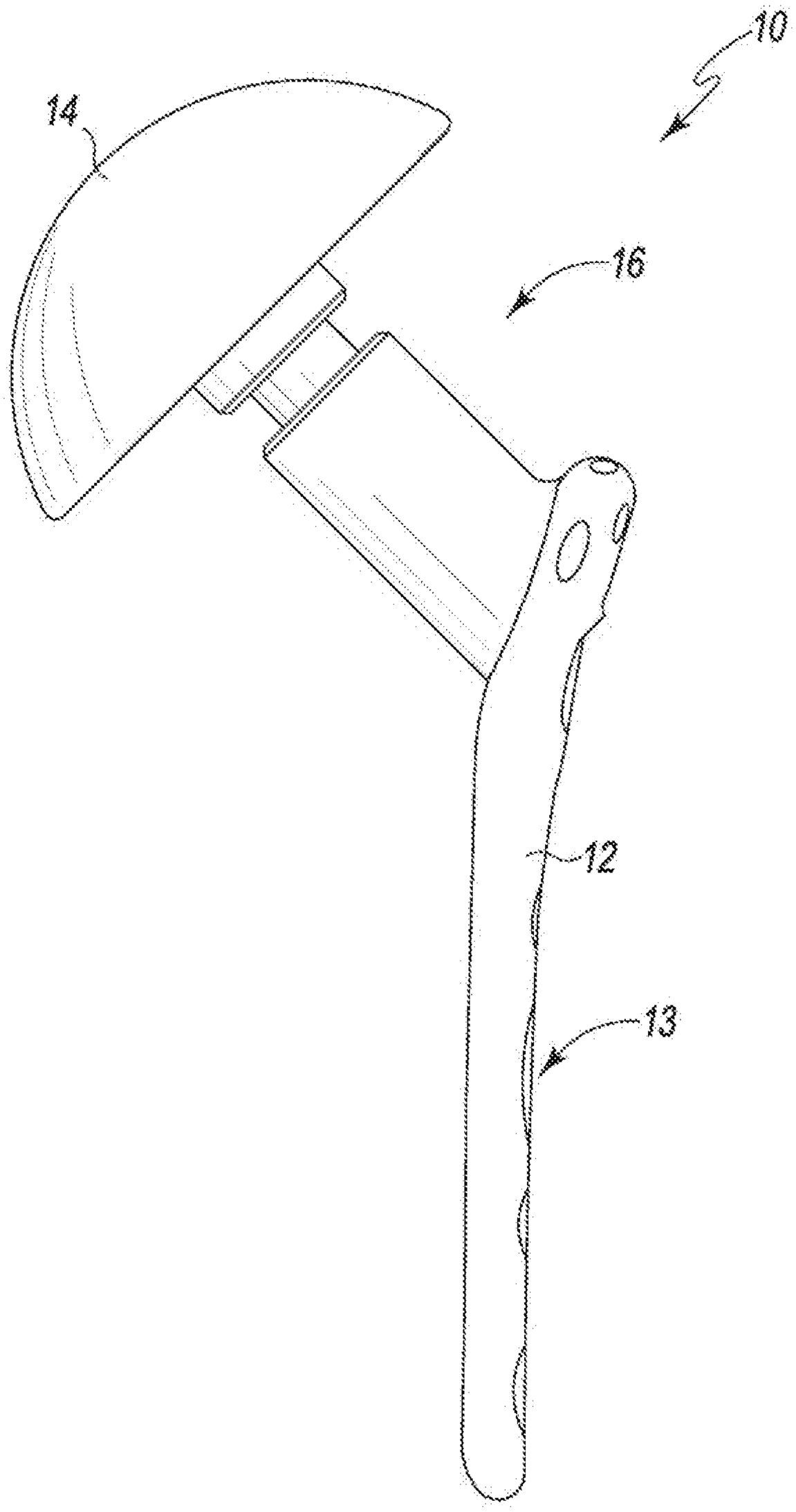


Fig. 1

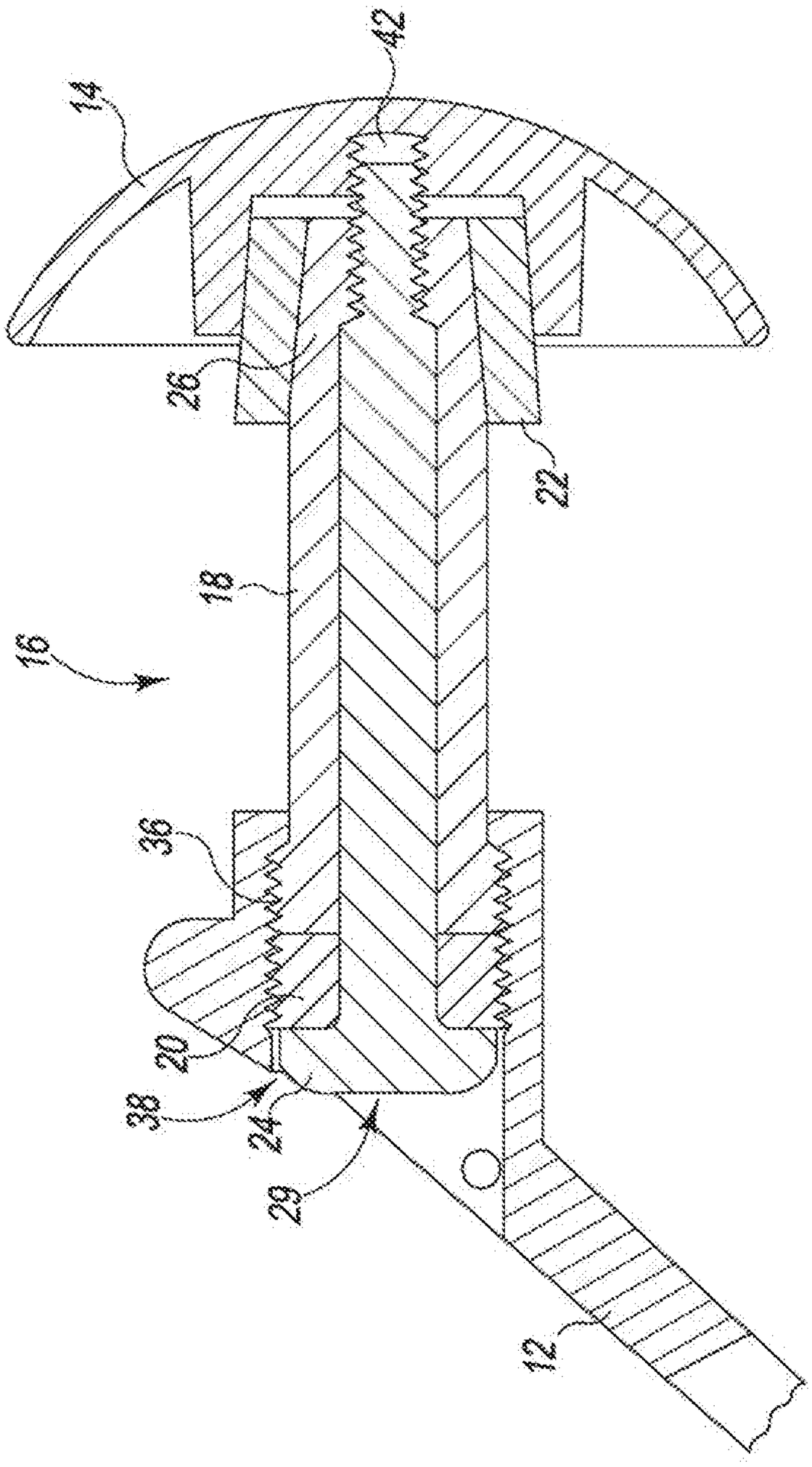


Fig. 2

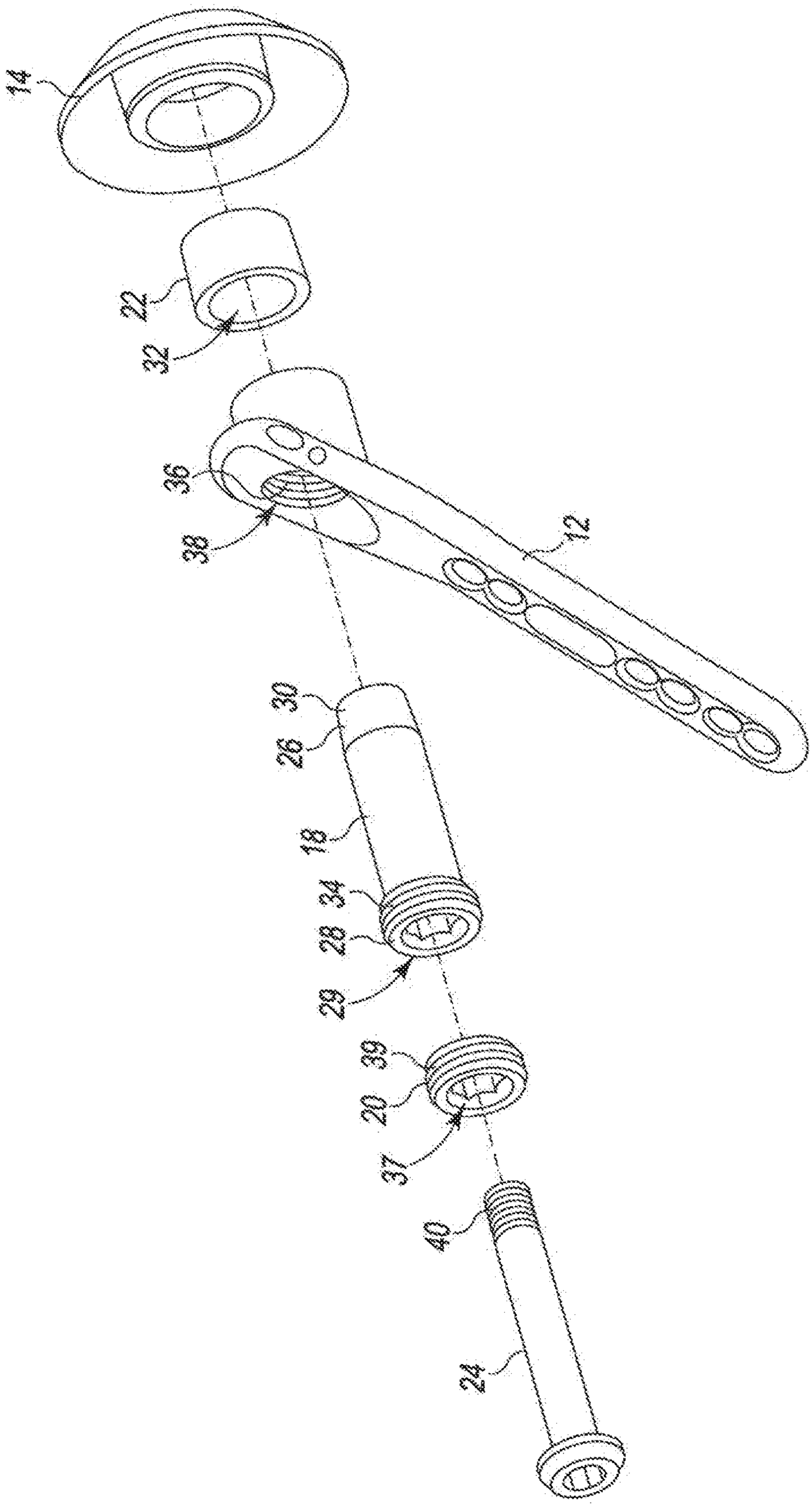


Fig. 3

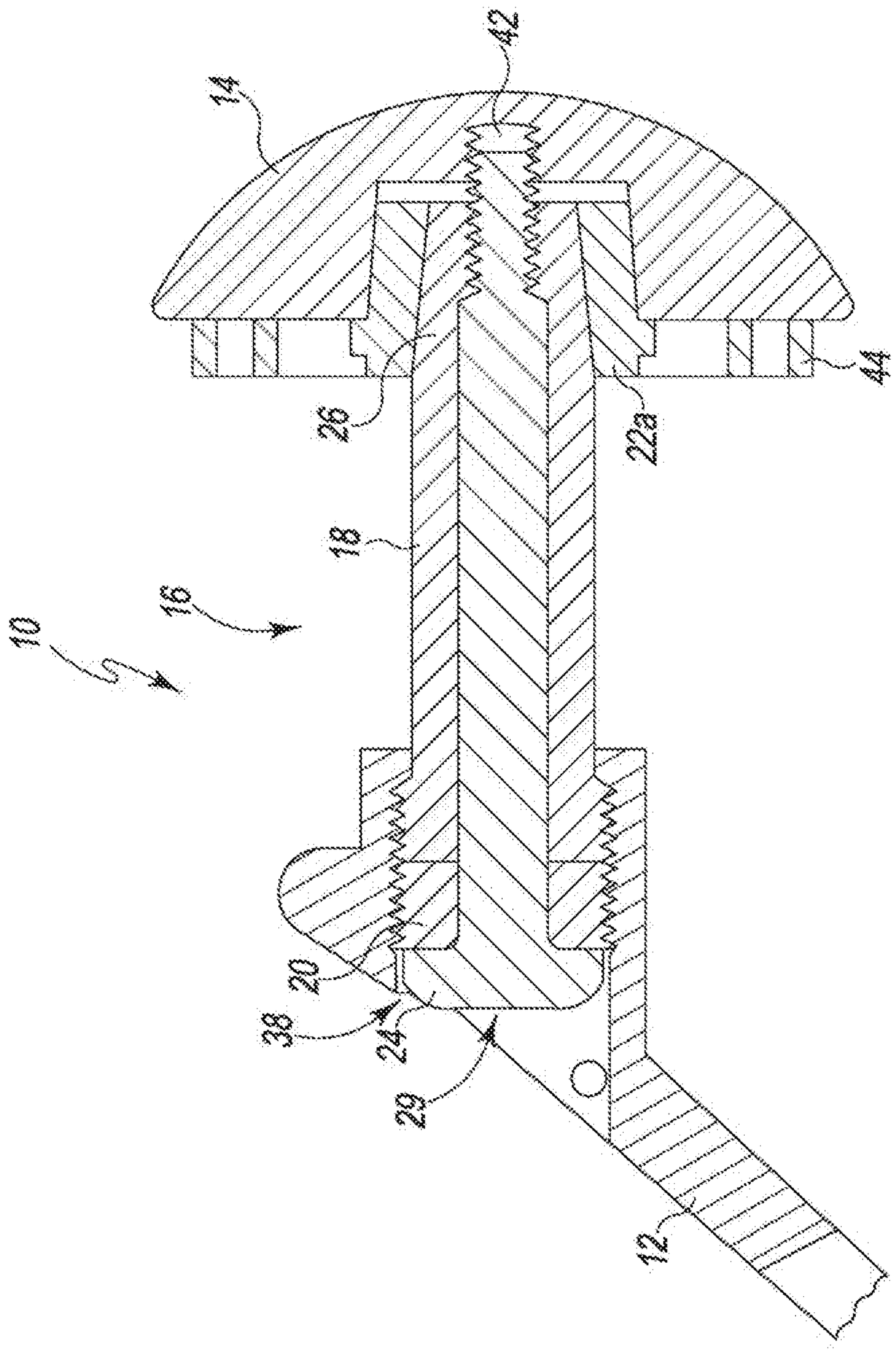


Fig. 4

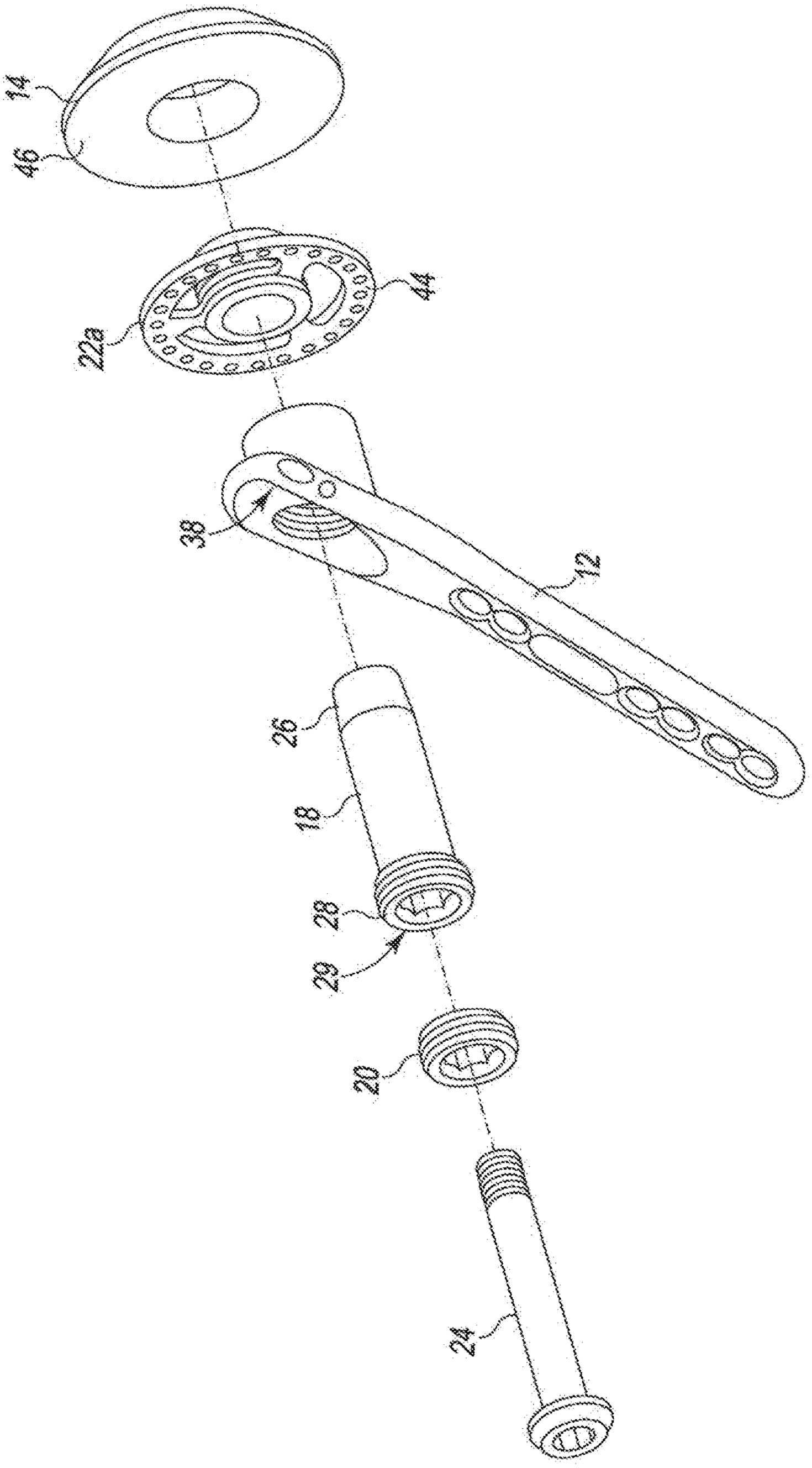


Fig. 5

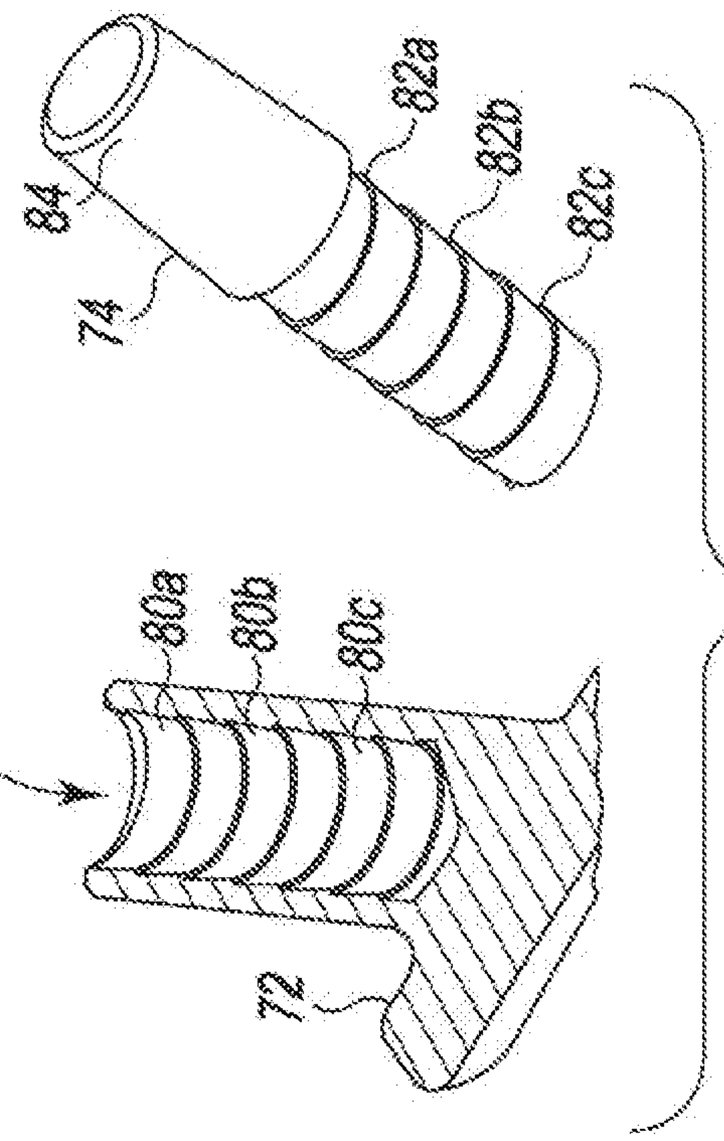


Fig. 7

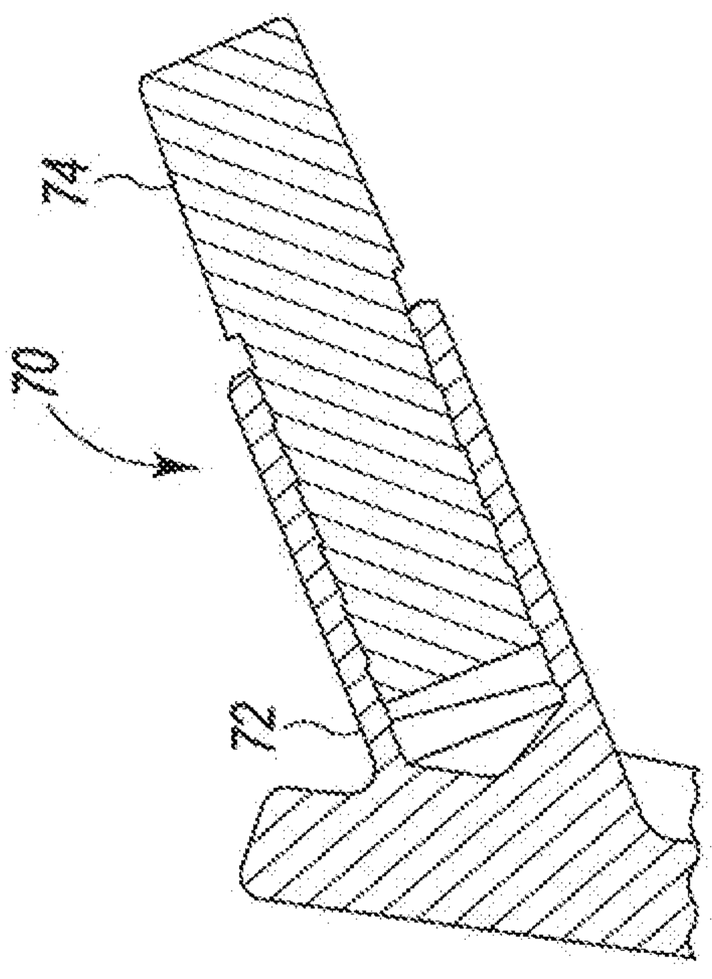


Fig. 8

ADJUSTABLE HEIGHT ARTHROPLASTY PLATE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to U.S. Prov. App. No. 61/706916 filed Sep. 28, 2012, entitled "Adjustable Height Arthroplasty Plate," which is incorporated by reference herein in its entirety.

TECHNICAL FIELD OF THE INVENTION

[0002] The present invention relates generally to the field of orthopedics, and, more particularly, to an arthroplasty plate for repairing fractures of an end of a long bone.

BACKGROUND

[0003] A natural shoulder joint may undergo degenerative changes for a variety of reasons, for instance arthritis. Alternatively, a shoulder joint may be fractured or otherwise damaged by an external force. When a shoulder joint is sufficiently degenerated or damaged it may be necessary to replace the natural joint with a prosthetic shoulder joint. Conventional shoulder prostheses comprise a humeral prosthesis, optionally with a glenoid prosthesis. For total or reverse arthroplasty a glenoid component is implanted, however for hemiarthroplasty the humeral component articulates against the natural glenoid cavity.

[0004] When the upper extremity of the humerus is fractured, the humerus generally breaks into several pieces, typically three or four. In particular, for a four part fracture, the humeral head splits off at the level of the anatomical neck, the greater and lesser tuberosities are separated from the humerus shaft below the tuberosities and the tuberosities are separated from one another along the bicipetal groove. As there is no longer a blood supply to the humeral head necrosis may begin. For repair of a three-part or four-part fracture, where the blood supply to the humeral head is damaged, the humeral head is replaced, and the greater and lesser tuberosities are reattached to the humeral shaft. Typically, the humeral component of a shoulder prosthesis comprises a stem for insertion into a bore extending into the intramedullary canal of the humerus, generally along the longitudinal axis of the bone, and an articulation component, which may be a convex bearing head in the case of total arthroplasty or a concave cup in the case of reverse arthroplasty. Typically, the articulation component is coupled to a neck portion of the stem, which extends from the intramedullary canal at an inclined angle relative to the longitudinal axis of a distal portion of the stem in order to recreate the anatomy of the natural joint. Commonly, humeral stem prostheses are secured in position within the intramedullary bore using bone cement. Alternatively, the stem may be coated with a material which encourages bone growth to hold the stem in position, such as Porocoat ® or hydroxyapatite. One such humeral stem prosthesis is commercially available from DePuy Orthopaedics, Inc under the trademark Global FX.

[0005] As an alternative to humeral stem implants, it is known to repair some types of proximal humeral fracture using an intramedullary nail extending along a bore formed within the intramedullary canal. Screws pass from outside of the humerus, through holes formed within the nail and into the humeral head and the tuberosities. This type of fixation also suffers from vascular damage in the intramedullary canal. Furthermore, a significant drawback is that because the humeral head is not replaced the nail must be inserted through a hole formed in the articular cartilage of the humeral head. A plug must be inserted into the hole to restore the bearing surface.

[0006] For the repair of fractures of the femoral neck it is known to provide a form of prosthesis generally known as a thrust plate prosthesis. One such form of thrust plate prosthesis is disclosed within PCT patent publication WO2007/024980-A2. The prosthesis comprises a plate portion to be attached to the lateral external surface of the proximal femur.

[0007] One issue in dealing with long-limb arthroplasty, is accommodating various anatomic sizes. This becomes even more of a challenge when the desired sizes of linking components that must engage and disengage and be mechanically stable. Also, surgeons desiring the ability to adjust intra-operatively creates additional issues as does the desire by surgeons to have infinite adjustability, not finite size offerings.

[0008] It is an object of embodiments of the present invention to obviate or mitigate one or more of the problems of the prior art, whether identified herein or elsewhere.

SUMMARY OF THE INVENTION

[0009] According to one embodiment of the present invention, an orthopaedic assembly is provided. The assembly includes a first member adapted to be coupled to a bone and an adjustable connector assembly including an adjuster having a threaded end and a tapered end. The assembly further includes an articulation component including a bearing surface and adapted to be coupled to the tapered end of the adjustable connector assembly. The threaded end is adapted to engage the fixation plate.

[0010] According to another embodiment of the present invention, an arthroplasty plate is provided. The arthroplasty plate includes a fixation plate adapted to be fixed to a surface of a bone, having a recess with a plurality of tapers and an adjustable connector assembly including an adjuster having a plurality of tapers on a first end a taper on a second end. An articulation component is also included and has a bearing surface and adapted to be coupled to the tapered second end of the adjustable connector assembly. The plurality of tapers are adapted to engage at least one of the plurality of tapers in the recess of the fixation plate.

[0011] According to yet another embodiment of the present invention, a method of repairing a fractured end of a bone includes removing fractured portions of an articulating bone surface at the end of a bone. The method further includes securing a fixation plate to a lateral surface of the fractured end of the bone. The fixation plate is coupled to adjustable connector assembly, which includes an adjuster having a threaded end and a tapered end. The adjuster is threaded into or out of a threaded bore of the fixation plate to adjust the length of the adjuster extending from the bore of the fixation plate. The position of the adjuster is locked within the threaded bore.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. **1** is a view in a frontal plane of an arthroplasty plate according to an embodiment of the present invention.

[0013] FIG. **2** is a cross-sectional view of the arthroplasty plate of FIG. **1**.

[0014] FIG. **3** is an exploded view of the arthroplasty plate according to FIG. **1**.

[0015] FIG. **4** is a cross-sectional view of an arthroplasty plate according to another embodiment of the present invention.

[0016] FIG. **5** is an exploded view of the arthroplasty plate of FIG. **4**.

[0017] FIG. **6** is a cross-sectional view of an arthroplasty plate according to another embodiment of the present invention.

[0018] FIG. **7** is an exploded view of the arthroplasty plate of FIG. **6**.

DETAILED DESCRIPTION

[0019] Like reference numerals refer to like parts throughout the following description and the accompanying drawings.

[0020] The below description will be given with respect to a humeral prosthesis, and more particularly, a hemiarthroplasty plate. However, it should be understood that the present invention may be used in other types of prosthesis and that the hemiarthroplasty plate is used as an example only. For example, instead of a fixation plate, a stem or other arthroplasty component could be used. And, any articulation member, not just humeral heads could be used as well.

[0021] Referring first to FIG. **1**, this is a view in a frontal plane of an assembled arthroplasty plate **10** for repair of a fractured proximal humerus in accordance with an embodiment of the present invention. The arthroplasty plate comprises a fixation plate (or first member of an orthopaedic assembly) **12** for attachment to a surface of the bone, in this case, a lateral external portion of a proximal humerus of a patient. To aid in the fixation to the bone, the fixation plate **12** may include a plurality of fixation holes **13** adapted to receive bone screws (not shown). An articulation component **14** replaces the natural humeral head. The articulation component **14** comprises a convex bearing surface and is sized and shaped to articulate with either the natural glenoid surface or an implanted glenoid prosthesis to reconstruct the shoulder joint. The articulation component **14** is coupled to the fixation plate **12** via a connector assembly **16** positioned in a bore formed in the proximal humerus.

[0022] Referring now to FIG. **2**, this illustrates a cross sectional view of the connector assembly of the arthroplasty plate of FIG. **1** to better illustrate details of the connector assembly **16**. In this embodiment, the connector assembly **16** is an adjustable assembly to allow the user to adjust the neck length of the arthroplasty plate **10**. The adjustable connector assembly **16** includes an adjuster **18**, a locking screw **20**, collar **22**, and assembly screw **24**. The collar **22** is used as a placeholder or substitute for the larger suture collar (FIG. **4**).

[0023] Referring to both FIGS. **2** and **3**, the various features of the adjustable connector assembly **16** will be further described. The adjuster **18** includes a first end **26** and a second end **28**. The first end **26** includes a connection feature **30** adapted to couple to a corresponding connection feature **32** of the collar **22**. In the illustrated embodiment, the connection feature **30** of the first end **26** is a male taper and the connection feature **32** of the collar **22** is a female taper. According to some embodiments, the male and female tapers are locking tapers, adapted to lock the adjuster **18** to the collar **22**. In some embodiments, the adjuster **18** may lock directly into the articulation component **14**. In those embodiments, the connection feature **30** of the first end **26** of the adjuster **18** is a male taper and is adapted to fit into a corresponding tapered recess in the articulation component **14**. The adjuster **18** also includes a through bore **29** extending between the first end **26** and the second end **28**.

[0024] The second end **28** of the adjuster **18** includes a connection feature **34** adapted to connect to a corresponding connection feature **36** in the fixation plate **12**. In the illustrated embodiments of FIGS. **2** and **3**, the connection feature **34** of the second end **28** is a thread and the connection feature **36** in the fixation plate **12** is a corresponding thread form. In use, the adjuster **18** is inserted into through bore **38** in the fixation plate **12**. As shown, the through bore **38** is threaded so as to engage the threads of the connection feature **34** of the second end **28**. Once the adjuster **18** is at the desired length, the locking screw **20** is screwed into the connection feature **36** of the fixation plate **12**, locking the adjuster **18** into place. In order to lock the adjuster **18** into place, the locking screw **20** includes a bore **37** and external threads **39**. The external threads **39** of the locking screw **20** engage the threaded through bore **38** of the fixation plate **12**, as shown in FIG. **2**. The adjuster **18** and the locking screw **20** are locked relative to each other and to the fixation plate **12** on the principal of a locking nut. The adjuster thread **34** is in contact with the top flank of the threads of feature **36** of the plate **12** and the locking screw thread **39** is in contact with the opposite or bottom flank of the threads of the plate **12**, making relative movement not possible. The collar **22** is then placed over the first end **26** of the adjuster **18**. The tapered connection feature **32** of the collar **22** is then locked into place with the tapered connection feature **30** of the first end **26** of the adjuster **18**. The articulation component **14** may then be placed onto the collar **22**.

[0025] The assembly screw **24** includes a threaded end **40** and the articulation component **14** includes a corresponding threaded opening **42** (shown in FIG. **2**). After the articulation component **14** is placed onto the collar **22**, the assembly screw **24** is inserted through the bores **37**, **29**, **38** of the locking screw **20**, adjuster **18**, and fixation plate, respectively. The threaded end **40** of the assembly screw **24** then threads into the threads of the threaded opening **42** of the articulation component **14**, locking all of the pieces together.

[0026] Turning now to FIGS. **4** and **5**, another embodiment of the present invention is illustrated. As shown, the arthroplasty plate assembly **10** includes a fixation plate **12**, articulation component **14**, an assembly screw **24**, a locking screw **20**, an adjuster **18**, and a collar **22***a*. In this embodiment, all the features are the same, with the exception that the collar **22***a* is a plate, having a flange **44** that extends outwardly and abuts an outwardly extending flange **46** (of FIG. **5**) of the articulation component **14**.

[0027] Turning now to FIGS. **6** and **7**, another embodiment of the present invention is illustrated. This embodiment is of an arthroplasty plate **70** having a fixation plate **72**, an adjustable connector **74**, and an articulation component **14** (of FIG. **1**). In this embodiment, the fixation plate **72** includes a through bore **78** that has a thread form that creates series of tapers **80***a*, **80***b*, **80***c*. As illustrated, the thread form is a continuous thread, but in other embodiments in can be discontinuous. In this embodiment, the adjustable connector **74** is the adjuster and includes a plurality of corresponding tapers **82***a*, **82***b*, **82***c*. The user would insert the adjustable

connector **74** into the through bore **78** of the fixation plate **72** and, once at the appropriate length, impacted to engage the tapers **80***a*, **82***a* to lock the adjuster **74** into place in the fixation plate **72**. In some embodiments, multiple tapers would engage at the appropriate length. At the other end of the adjuster is a male taper **84**. The male taper **84** is adapted to fit inside a female taper (not shown) of the articulation component **14** (of FIG. **1**). The articulation component **14** is then impacted onto the adjuster **74**, locking the tapers **84**. In some embodiments, an assembly screw can be used.

[0028] The foregoing description of the invention is illustrative only, and is not intended to limit the scope of the invention to the precise terms set forth. Further, although the invention has been described in detail with reference to certain illustrative embodiments, variations and modifications exist within the scope and spirit of the invention as described and defined in the following claims.

1 to **20**. (canceled)

21. A method of shoulder arthroplasty, the method comprising:

removing an end portion of a humerous;

securing a fixation plate to a lateral surface of the end portion of the humerous;

coupling an articulation component to the adjustable connector assembly;

adjusting the length of the adjustable connector assembly wherein to adjust a distance between the end portion of the humerous and the articulation component; and

locking the position of the adjustable connector assembly.

22. The method of claim **21**, further comprising coupling an articulation component to the tapered end of the adjuster.

23. The method of claim **22**, wherein the coupling an articulation component to the tapered end of the adjuster includes inserting a collar over the tapered end of the adjuster and inserting the articulation component onto an outer side of the collar.

24. The method of claim **21**, wherein locking the position of the adjuster within the threaded bore includes threading a locking screw into the threaded bore.

25. The method of claim **24**, further comprising inserting an assembly screw through the locking screw and the adjuster.

26. The method of claim **25**, wherein the inserting an assembly screw includes inserting a threaded end of the assembly screw through the locking screw and the adjuster.

27. The method of claim **26**, further comprising threading the threaded end of the assembly screw into a threaded recess of the articulation component.

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