



- (51) **International Patent Classification:**
A61C 8/00 (2006.01) *A61C 13/225* (2006.01)
- (21) **International Application Number:**
PCT/IL2020/050388
- (22) **International Filing Date:**
31 March 2020 (31.03.2020)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
266021 14 April 2019 (14.04.2019) IL
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- (81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.
- (84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,

(54) **Title:** DENTAL ABUTMENT AND ABUTTING SYSTEM

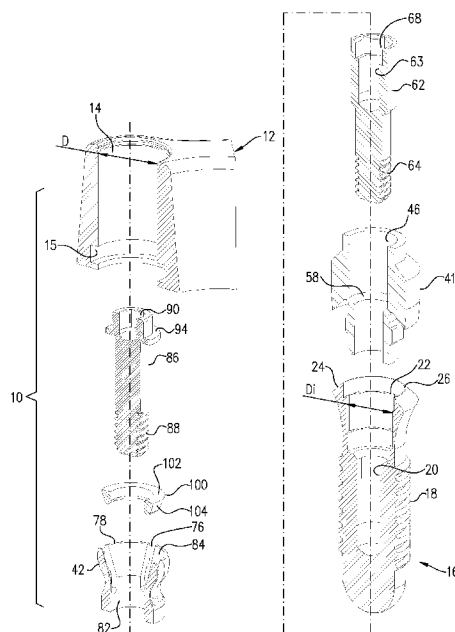


FIG. 1D

(57) **Abstract:** A dental abutment comprising a cylindrical abutment body and a tubular reconstruction element support; the abutment body is couplable to a dental implant and comprises a flat support end, the reconstruction element support has a proximal anchoring head portion configured with at least one slot, and a distal seat end bearing flush against the flat support end of the abutment body, said reconstruction element support is further configured with an axially extending through-going head bore, whereby the reconstruction element support is coupled to the abutment body by a manipulating fastener extending through the bore, and wherein axial fastening the fastener entails radial expansion of the anchoring head.



MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

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DENTAL ABUTMENT AND ABUTTING SYSTEM

TECHNOLOGICAL FIELD

The present disclosure is generally concerned with dental prosthetics and more particularly with an adjustable abutment system, an abutment therefor, and a method for fixing a dental prosthesis using such an abutment.

5 BACKGROUND ART

References considered to be relevant as background to the presently disclosed subject matter are listed below:

- US9,668,833
- KR101768410
- 10 - US6,227,860
- US9,603,679
- WO16139671

Acknowledgement of the above references herein is not to be inferred as meaning that these are in any way relevant to the patentability of the presently disclosed subject
15 matter.

BACKGROUND

US9,668,833 discloses an abutment, comprising: a ceramic part; and a metal adapter removably attachable to the ceramic part, wherein the metal adapter has a conical connection interface adapted to attach to a dental implant, wherein the metal adapter
20 comprises at least one flexible arm with a protrusion adapted to press against a side wall or snap into any corresponding recess of the ceramic part to secure the metal adapter to the ceramic part in the coronal-apical direction, wherein the metal adapter comprises at least one convex surface adapted to abut against at least one corresponding concave surface of the ceramic part to prevent rotation between the ceramic part and the metal

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adapter, wherein the metal adapter at its coronal end has a central protruding portion which is adapted to be received in a central apical recess of the ceramic part, and wherein said central protruding portion accommodates said at least one convex surface and said at least one flexible arm is housed within said central protruding portion

5 KR101768410 discloses a detachable locking link capable of compensating an upper prosthesis which, when a compensation of an upper prosthesis is required, is allowed to compensate the upper prosthesis on the basis of a structural characteristic which is easily detachably attached from the upper prosthesis, and is easily used and disassembled and assembled again during in use, and a method for assembling an upper
10 prosthesis using the same. The detachable locking link comprises: a coupling unit which is interposed by an upper prosthesis; an implant unit which is interposed by an implant; and an extension blade unit which is extended to the side direction at a border of the implant unit and the coupling unit. Accordingly, the locking link induces an implant and the upper prosthesis to be mutually coupled with each other. The coupling unit is coupled
15 by being forcibly inserted into the inside of an insertion hole of the upper prosthesis, wherein an upper end divided as two or more places is frictionally inserted and interposed with the insertion hole of the upper prosthesis.

US6,227,860 discloses a dental implant that includes a cylindrical body which can be positively secured against micromotion within a bore in a jawbone by a spindle-shaped
20 expansion mechanism and further secured against the contamination by microorganism through a gap in an internal channel of tubular portion by a compressive contact mechanism

US9,603,679 discloses a root canal abutment devices and methods which facilitate the adjustment or removal of an oral appliance, e.g., a crown or bridge, from a
25 reconfigurable abutment assembly are described. The adjustable abutment assembly may be secured within a pulp chamber of a pre-existing tooth. The abutment assembly has a projecting abutment portion with one or more shape memory alloy sleeves or plates or elements extending along the abutment. Each of the sleeves has a length with at least one curved or arcuate portion. Energy may be applied to the elements such that the arcuate
30 portion flattens to allow for the oral appliance to be placed thereupon while removal of the energy allows the elements to reconfigure into its curved configuration thereby

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locking the oral appliance to the abutment. Removal of the oral appliance may be effected by reapplication of energy to the elements.

WO16139671 discloses a dental abutment comprising first and second ends, each configured for being secured to an element of a dental reconstruction system, is provided.

- 5 The dental abutment comprises an abutment housing defining a first axis and comprising the first end, and a positioning element received therewithin, defining a second axis and comprising the second end. The dental abutment is configured to selectively permit free continuous three-dimensional rotation of the positioning element through a range of orientations within the abutment housing, and arrest the positioning element within the
- 10 abutment housing at any of the orientations. Further provided is an integrated dental implant comprising an implant portion with an abutment portion as provided.

GENERAL DESCRIPTION

- According to a first aspect of the present disclosure there is provided a dental
- 15 abutment configured for securing a dental reconstruction element to a dental implant, said dental implant configured for adjustably mounting a dental reconstruction element over a dental implant.

- Herein after in the specification and claims, the term "*dental reconstruction element*" is used in its broad sense and denotes any form, any full or partial, of a support
- 20 bar, mini support bar, full/partial denture, full or partial dental bridge, dental crown, or any other similar dental element constituting or supporting any type of dental prosthesis, either in full or partial.

- Other aspects of the disclosure are directed to a dental reconstruction set and system configured for securing a dental reconstruction element to a dental implant via a
- 25 dental abutment, and a method for performing same.

According to a particular aspect of the disclosure, the dental abutment provides adjustable mounting of a dental reconstruction element, at least about a longitudinal axis of the abutment.

- A first aspect of the disclosure is concerned with a dental abutment for screw
- 30 coupling to a dental implant, said abutment comprises a reconstruction element support

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configured for radial expansion anchorage within a bore of a dental reconstruction element.

According to an aspect of the disclosure there is a dental abutment comprising a cylindrical abutment body and a tubular reconstruction element support; the abutment
5 body is couplable to a dental implant and comprises a flat support end, the reconstruction element support has a proximal anchoring head portion configured with at least one slot, and a distal seat end bearing flush against the flat support end of the abutment body, said reconstruction element support is further configured with an axially extending through-going head bore, whereby the reconstruction element support is coupled to the abutment
10 body by a manipulating fastener extending through the bore, and wherein axial fastening the fastener entails radial expansion of the anchoring head.

The arrangement is such that radial expansion of the anchoring head portion results facilitates arresting against inside walls within a bore of a dental reconstruction element.

15 The arrangement is such that when at least the anchoring head portion of the dental abutment is received within a bore of a dental reconstruction element, axial force applied to the reconstruction element support entailing radially outward expansion of the anchoring head against an inside wall surface of said bore, thus anchoring the dental abutment within the dental reconstruction element so as to set at least longitudinal axial
20 positioning of the dental reconstruction element over the dental abutment,

The dental abutment and system disclosed herein is suitable for bearing and overcoming tolerances which may occur owing to measuring deviations, manufacturing deviations, etc. Such tolerances can extend axially, i.e. along the longitudinal axes of the dental system, or in planes intersecting said longitudinal axes.

25 It is noted that the disclosed arrangement facilitates for compensating positioning tolerances and inaccuracies that may reside between axes of the dental implant and the dental reconstruction element, where such tolerances can reside about a longitudinal axis ('Z axis') or about axes intersecting said longitudinal axis ('X axis' and 'Y axis'), giving rise to yaw, pitch and roll compensation.

30 The at least one slot of the reconstruction element support extends from the proximal towards the seat end, wherein the reconstruction element support arrests within the dental reconstruction element like a so-called 'slotted wall anchor'.

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According to a first embodiment of the disclosure, the abutment body is tubular and is configured with a through-going abutment bore extending between an implant end and the flat support end, said abutment bore configured with an inside fastener shoulder, whereby the abutment body is couplable to a dental implant by a implant fastener
5 extending through the abutment body.

According to this embodiment, the manipulating fastener is screw coupled within an internal threading configured within the implant fastener.

According to a second embodiment of the disclosure, the abutment body is a tubular body configured at an implant end thereof with an integral threaded fastener
10 couplable within a threaded bore of a dental implant, said abutment body is further configured at an opposite end thereof with a wrench engaging portion. According to this embodiment, the manipulating fastener is screw coupled within an internal threading configured within the abutment body.

According to yet another embodiment of the present disclosure, the abutment
15 body is configured with a first axis and a second axis; with a threaded bore extending along said first axis for screw coupling the tubular reconstruction element support, and wherein the abutment body is couplable to a dental implant along said second axis.

According to a particular configuration said first axis and said second axis intersect each other about an imaginary plane.

20 According to this embodiment the abutment body is configured with an implant end configured for bearing over an internal head portion of a dental implant, said implant end is configured as an external polygonal boss couplable at discrete angular increments within a polygonal socket of the dental implant, said polygonal boss coextends along said second axis.

25 According to a particular example the external polygonal boss of the abutment body is a 12 faced polygon and the polygonal socket of the dental implant is a 6 faced polygon, imparting the abutment body axial angular increments of 30° over the dental implant. However, other combinations of polygonal boss and polygonal socket can be adopted, e.g. 8 faced polygonal boss with an 8 faced polygonal socket, 8 faced polygonal
30 boss with a 16 faced polygonal socket, 6 faced polygonal boss with a 6 faced polygonal socket, etc.

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The angle between the first axis and the second axis is in the range of about 3° to 8°, and typically about 5°.

According to another aspect of the present disclosure there is a dental reconstruction element comprising a thorough going bore configured for snug receiving
5 at least a reconstruction element support of a dental abutment, said thorough going bore further configured for bearing radial engaging forces applied thereto by an anchoring head of the reconstruction element support which in turn is articulated to the dental abutment.

According to yet an aspect of the present disclosure there is a dental reconstruction set comprising one or more of each of a dental reconstruction element, a dental implant,
10 and a dental abutment comprising a dental abutment comprising a cylindrical abutment body and a tubular reconstruction element support; the abutment body is couplable to a dental implant and comprises a flat support end, the reconstruction element support has a proximal anchoring head portion configured with at least one slot, and a distal seat end bearing flush against the flat support end of the abutment body, said reconstruction
15 element support is further configured with an axially extending through-going head bore, whereby the reconstruction element support is coupled to the abutment body by a manipulating fastener extending through the bore, and wherein axial fastening the fastener entails radial expansion of the anchoring head.

It is noted that any polygonal boss or polygonal socket referred to herein can be
20 used with any suitable shaped tool, suitable for internal and corresponding external driving (i.e. screw manipulating) of the dental components, such as, Torx, Allen, fluted, slotted, etc.

Any one or more of the following features, designs and configurations can be applied to the dental abutment subject of the present disclosure, and other aspects of the
25 disclosure, independently or in combinations thereof:

- the abutment body can be coupled to a dental implant directly or indirectly, with an intermediate adapter seat member disposed therebetween, wherein the adapter seat member has a body with a thorough going bore extending between
30 abutment end mimicking an external head portion of a dental implant, and an implant end configured for bearing over an internal head portion of a dental implant;

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- the adapter seat member can be integral with or integrated with the abutment body;
- a dental implant end of the abutment body is configured for direct bearing over an external cylindrical head portion of a dental implant, or over an adapter seat member extending between the abutment body and the dental implant;
- a dental implant end of the abutment body can be cylindrical and configured for at least partially insertion into an open end of a dental implant;
- a portion of the abutment body can be configured at an external face thereof with a wrench gripping arrangement. According to one configuration, the wrench gripping arrangement is a polygonal shape. According to another configuration, the wrench gripping arrangement is a one or more recesses or depressions over an external surface of the abutment body;
- the at least one slot of the of the reconstruction element support can extend axially, parallel to the axis of the longitudinal head bore, imparting it a symmetrically segmented shape;
- the at least one slot of the of the reconstruction element support can extend helically;
- the anchoring head of the reconstruction element support can be configured with symmetrically disposed at least two slots;
- the reconstruction element support can be made of the same material as that of the abutment body, or of a different material, with different mechanical properties;
- the anchoring head portion of the reconstruction element support can be configured with a cylindrical external cross-section;
- the anchoring head portion of the reconstruction element support can be configured with an externally spherical or have a spherical portion, or rounded portion cross-section;
- at least the anchoring head portion of the reconstruction element support can be configured with surfacing for improved engagement with inside wall surface of the bore of the dental reconstruction element. Such surfacing can be, for example, serrations, knurling, axial/annular ridges, axial/annular grooves, roughened surfacing, etc.;

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- the wrench engaging portion of the abutment body can be a polygonal socket or a polygonal external surface;
- a distal end of the axially extending through-going head bore of the reconstruction element support can be configured with an inwardly tapering section, configured for engagement with a radial annular projection of the manipulating fastener;
- a distal end of the axially extending through-going head bore of the reconstruction element support can be configured with an inwardly tapering section, configured for engagement with a radial annular projection of the manipulating fastener;
- the radial annular projection of the manipulating fastener can be cylindrical;
- the radial annular projection of the manipulating fastener can be tapering in direction of tapering section of the reconstruction element support;
- a manipulating disc can be disposed between the tapering section of the reconstruction element support and the manipulating fastener, wherein said manipulating disc is configured with a tapering external surface corresponding with the tapering section of the reconstruction element support, and wherein the manipulating fastener applies substantially axial force to the manipulating disc which in turn gives rise to outwardly directed radial forces aimed applied to an inside face of the reconstruction element support;
- at an assembled position, the tubular reconstruction element support extends coaxially with abutment body;
- at an assembled position, the manipulating fastener extends coaxially with the tubular reconstruction element support;
- a distal portion of the abutment body can be configured with a tapering shoulder, which upon coupling to a dental implant can bear over a correspondingly tapering internal tapering portion of the dental implant;
- the bore of a dental reconstruction element can be configured a distal end thereof with an annular shoulder, which at an assembled position is configured for bearing over a cylindrical portion of the abutment body;

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- a resilient sealing member can be disposed between a distal end of the bore of the dental reconstruction element and an external surface of the abutment body. Such a resilient sealing member is suitable to eliminate or substantially reduce saliva and food from entering into a space extending between the bore of the dental reconstruction element and the external surface of the abutment body
- it is appreciated that any fastener can be used for articulating the dental reconstruction element to the abutment body and in turn for articulating the abutment body to a dental implant. Particularly, fasteners can be configured with internal or external polygonal heads/sockets;
- the abutment body can be mounted over any type of platform, e.g. a dental implant configured with an external polygonal head, a dental implant configured with an internal polygonal socket, a dental implant configured with a conical connection, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to better understand the subject matter that is disclosed herein and to exemplify how it may be carried out in practice, embodiments will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1A is a top perspective view of a dental set comprising a dental abutment according to a first embodiment of the present disclosure;

Fig. 1B is an exploded view of Fig. 1A;

Fig. 1C is a longitudinal section taken along line I – I in Fig. 1A;

Fig. 1D is an exploded view of Fig. 1C;

Fig. 1E is a top perspective view of a dental abutment used in the dental set of Fig. 1A;

Fig. 1F is an exploded view of Fig. 1E;

Fig. 1G is a longitudinal section of Fig. 1E;

Figs. 1H to 1K are directed to a modification of the dental set illustrated in Figs. 1A to 1G, wherein:

Fig. 1H is a top perspective view of the dental set;

Fig. 1I is an exploded view of Fig. 1H;

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Fig. 1J is a longitudinal section of Fig. 1H;

Fig. 1K is an exploded view of Fig. 1J;

Fig. 2A is a top perspective view of a dental set comprising a dental abutment according to a second embodiment of the present disclosure;

5 **Fig. 2B** is an exploded view of Fig. 2A;

Fig. 2C is a longitudinal section taken along line II – II in Fig. 2A;

Fig. 2D is an exploded view of Fig. 2C;

Fig. 2E is a top perspective view of a dental abutment used in the dental set of Fig. AA;

10 **Fig. 2F** is an exploded view of Fig. 2E;

Fig. 2G is a longitudinal section of Fig. 2E;

Fig. 3A is a top perspective view of a dental set comprising a dental abutment according to a modification of the second embodiment of the present disclosure;

Fig. 3B is an exploded view of Fig. 3A;

15 **Fig. 3C** is a longitudinal section taken along line III – III in Fig. 3A;

Fig. 3D is an exploded view of Fig. 3C;

Fig. 3E is a top perspective view of a dental abutment used in the dental set of Fig. 3A;

Fig. 3F is an exploded view of Fig. 3E;

20 **Fig. 3G** is a longitudinal section of Fig. 3E;

Figs. 3H and **3I** illustrate examples of the dental set of Fig. 3A, demonstrating tolerance rectifying;

Fig. 4A is a top perspective view of a dental set comprising a dental abutment according to a third embodiment of the present disclosure;

25 **Fig. 4B** is the same as Fig. 4A, however with a dental reconstruction element sectioned;

Fig. 4C is a longitudinal section taken along line IV – IV in Fig. 4A;

Fig. 4D is an enlargement of the portion marked IV in Fig. 4C;

Fig. 4E is a longitudinal section taken along line V – V in Fig. 4B;

30 **Fig. 4F** is a an exploded view of Fig. 4E;

Fig. 4G is a an exploded view of Fig. 4B;

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Fig. 4H is an enlarged planar sectioned view of the abutment used in the example illustrated in Fig. 4E;

Fig. 4I is a top perspective sectioned view of the abutment of Fig. 4H;

Fig. 4J illustrates the abutment of Fig. 4I with threaded fasteners articulated thereto;

Fig. 4K is a top perspective view of a dental abutment used in the dental set of Fig. 4A;

Fig. 4L is an exploded view of Fig. 4K;

Fig. 4M is a longitudinal section of Fig. 4K;

Fig. 5A is a top perspective view of a dental reconstruction set comprising support bar mounted over an array of abutments according to examples of the present disclosure; and

Fig. 5B is a planar view of Fig. 5A.

DETAILED DESCRIPTION OF EMBODIMENTS

Attention is first directed to Figs. 1A to 1G of the drawings, directed to a first embodiment of the disclosure. A dental set generally designated **10** comprises a schematically illustrated dental reconstruction element which in the illustrated example is part of a partial bridge **12**. It is however appreciated that the dental reconstruction element can assume any form, any full or partial, of a support bar, mini support bar, full/partial denture, full or partial dental bridge, dental crown, or any other similar dental element constituting or supporting any type of dental prosthesis, either in full or partial.

The dental reconstruction element **12** is configured with a bore **14** having a nominal diameter **D** (Figs. 1C and 1D) with an annular groove **15** at a bottom portion thereof, the purpose of which will become apparent herein after.

A dental implant **16**, of known structure is provided, said dental implant **16** comprising an external threading **18** for fitting into a cavity of a jaw bone (not shown) of an individual and an internal threading **20** at an abutment receiving bore **22**, having a nominal diameter **Di** configured at a top end of the dental implant, and further wherein the dental implant comprises a tapering top collar **24** with a smooth top edge **26**. Also, the dental abutment is configured with a polygonal (hexagonal in the illustrated example) head socket for fastening the dental implant within the jaw bone.

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An abutment assembly **40** according to a first embodiment of the disclosure is seen isolated in Figs. 1E to 1G. The abutment assembly **40** comprises an abutment body **41** and a tubular reconstruction element support **42**. The abutment body is tubular and is configured with a through-going abutment bore **46** extending between a top (proximal) flat support end **48**, and a bottom (distal) end configured with a boss **50** having an external diameter corresponding with **Di** of the abutment receiving bore **22**, and is further configured with polygonal shaped portion **52** and a downward facing skirt portion **56**. The arrangement is such that the boss **50** is shaped and sized for snug receiving within the abutment receiving bore **22**, with the skirt portion **56** resting over the tapering top collar **24** with abutting surfaces, thereby substantially eliminating movement between the elements.

The abutment bore **46** is further configured with an inside fastener shoulder **58** whereby the abutment body **41** can be couplable to the dental implant **16** by an implant fastener **62** configured with an external threaded portion **64** (corresponding with the internal threading **20** at the abutment receiving bore **22**) and a polygonal fastening socket **68**, whereby fastening the abutment body **41** with the dental implant **16** is sturdy and substantially motion-free. The implant fastener **62** is further configured at a top portion thereof with an internal thread **63**.

The tubular reconstruction element support **42** has a distal (bottom) flat seat end **70** bearing flush against the flat support end **48** of the abutment body **41**, and is configured with a proximal anchoring head portion **72** configured with four symmetrically disposed, axially extending, slots **76**, extending open from a top edge **78** of the reconstruction element support **42**. Whilst in the illustrated examples the slots are axially disposed, it is appreciated that the slots can be helically disposed about the longitudinal axis of the reconstruction element support **42**, and likewise, the reconstruction element support **42** can be configured with one or more slots. The reconstruction element support **42** is further configured with an axially extending through-going head bore **82** and inside tapering top section **84**. A manipulating fastener, namely bolt **86** has a threaded portion **88** corresponding with internal thread **63** of the implant fastener **62** and has a polygonal socket head **90** for fastening thereof, as well as a radially extending annular manipulating shoulder **94**.

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The abutment assembly further comprises a manipulating disc **100** configured with a top surface **102** and a tapering side wall **104**. At assembly, the manipulating disc **100** is disposed within the tapering section **84** of the reconstruction element support **42**, with the bottom face of the manipulating shoulder **94** of the manipulating fastener **86**
5 bearing flush against the top surface **102**. As a particular example, the top surface **102** of the manipulating disc **100** and the bottom face of the manipulating shoulder **94** are flat.

The arrangement is such that fastening the manipulating fastener **86** acts both to fasten the reconstruction element support **42** to the abutment body **41** (by coupling to implant fastener **62**), and to apply axially directed force to the manipulating disc **100**,
10 which in turn gives rise to outwardly directed radial forces, aimed to the inside surface **84** of the reconstruction element support, causing the anchoring head (i.e. the segments) of the reconstruction element support **42** to expand and tighten against inside wall surface of bore **14** of the dental reconstruction element **12**.

The arrangement disclosed hereinabove thus provides for compensating
15 positioning tolerances and inaccuracies residing between axes of the dental implant **16** and the dental reconstruction element **12**, where such tolerances can reside about a longitudinal axis ('Z axis') or about axes intersecting said longitudinal axis ('X axis' and 'Y axis'). Such tolerances which may occur owing to measuring deviations, manufacturing deviations, etc. Such tolerances can extend axially, i.e. along the longitudinal axes of the
20 dental system, or in planes intersecting said longitudinal axes.

It is noted that manipulating fastener **86** is finer than the implant fastener **62** and further that the reconstruction element support **42** can be made of the same material as that of the abutment body **41**, or of a different material, with different mechanical properties. In addition, it is appreciated that the external surface of the anchoring head
25 portion **72** of the reconstruction element support **42** can be smooth, as in the illustrated examples, or it can be surfaced for improved engagement with inside wall surface of the bore **14** of the dental reconstruction element **12**. Such surfacing can be, for example, serrations, knurling, axial/annular ridges, axial/annular grooves, roughened surfacing, etc. Such configurations can be applied to any of the examples and embodiments
30 disclosed herein.

Reverting to the assembled dental set **10**, a sealing ring (not shown), e.g. a resilient O-ring, or a stainless steel ring, or any other material ring, can be fitted into the annular

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groove **15** within the bore **14** of the dental reconstruction element **12**, such that at the assembled position the sealing ring is bears against an external surface of the abutment body **41**, suitable to eliminate or substantially reduce saliva and food from entering into a space extending between the bore of the dental reconstruction element and the external surface of the abutment body. However, at times a sealing ring can be obviated.

Referring to Figs. 1H to 1K there is illustrated a modification of the dental set **43** according to an aspect of the disclosure, wherein the significant difference resides in the shape of the abutment body **45** made suitable for mounting over a dental implant **47** which is configured with an external polygonal head.

The dental implant **47** is thus configured with an external polygonal head **49** projecting from a top surface **51** and configured with an internally threaded bore **53**. In turn, the abutment body **45** is configured with a through-going abutment bore **55** with an inside fastener shoulder **57** above a head receiving space **59** and a bottom surface **79**.

Other components of the dental set **43** are similar with those disclosed in connection with the example of Figs. 1A to 1G, wherein the abutment assembly **61** further comprises an implant fastener **67** for coupling the abutment body **45** to the dental implant **47**, through the abutment bore **55**, a tubular reconstruction element support **69** (substantially identical with tubular reconstruction element support **42**) and articulated to the abutment body **45** by a manipulating fastener bolt **71** via a manipulating disc **73**.

At the assembled position (Figs. 1H and 1J) abutment body **45** is fastened over the dental implant **47** with the bottom surface **79** baring flush against surface **51** and with the external polygonal head **49** of the dental implant **47** received within the head receiving space **59**. After tightening the implant fastener **67**, the reconstruction element support **69** is positioned over the abutment body **45** and once the dental reconstruction element (not shown) is placed thereover, the manipulating fastener bolt **71** is tightened, thereby setting the accurate, true position of the dental reconstruction element thereover.

In the two embodiment of Figs. 1A to 1K the abutment body **41**; **45** is couplable to the dental implant by a separate implant fastener **62**; **67**. However, turning now to the embodiment illustrated in Figs. 2A to 2G of the drawings, there is illustrated an example wherein the abutment body is couplable to the dental implant by an integral implant fastener. For sake of clarification, in the following example of Figs. 2A to 2G, like

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elements as in Figs 1A to 1G are designated with like reference numbers, however shifted by 100.

The dental set of Figs. 2 generally designated **110** comprises a schematically illustrated dental reconstruction element which in the illustrated example is part of a
5 partial bridge **112**.

The dental reconstruction element **112** is configured with a bore **114** having a nominal diameter **D** (Figs. 2C and 2D) with an annular groove **115** at a bottom portion thereof, the purpose of which being similar to the disclosure in connection with the previous example.

10 A dental implant **116**, of known structure is provided, said dental implant **116** comprising an external threading **118** for fitting into a cavity of a jaw bone (not shown) of an individual and an internal threading **120** at an abutment receiving bore **122**, having a nominal diameter configured at a top end of the dental implant, and further wherein the dental implant comprises a tapering top collar **124** with a smooth top edge **126**. The dental
15 abutment is configured with a polygonal head socket for fastening the dental implant within the jaw bone.

An abutment assembly **140** according to the second embodiment of the disclosure is seen isolated in Figs. 2E to 2G. The abutment assembly **140** comprises an abutment body **141** and a tubular reconstruction element support **142**. The abutment body **141** is
20 configured at a distal (bottom) end thereof with an integral, solid threaded stem **143** having an external nominal diameter corresponding with that the abutment receiving threaded bore **122**. Further, the dental body **141** is configured at its top side with an internally threaded bore **145** and having and a polygonal fastening socket **168**.

The implant body **141** has a top (proximal) flat support end **148**, and a bottom
25 (distal) end configured with a boss **150** having an external diameter corresponding with inside diameter of the abutment receiving bore **122**, and is optionally configured with tapering portion **156**. The arrangement is such that the boss **150** is shaped and sized for snug receiving within the abutment receiving bore **122**, with the tapering portion **156** resting over the tapering top collar **124** with abutting surfaces, thereby substantially
30 eliminating movement between the elements, once threaded stem **143** is fastened within the threaded receiving bore **122**, whereby fastening the abutment body **141** with the dental implant **116** is sturdy and substantially motion-free.

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The tubular reconstruction element support **142** has a distal (bottom) flat seat end **170** bearing flush against the flat support end **148** of the abutment body **141**, and is configured with a proximal anchoring head portion **172** configured with four symmetrically disposed, axially extending, slots **176**, extending open from a top edge **178** of the reconstruction element support **142**. Whilst in the illustrated examples the slots are axially disposed, it is appreciated that the slots can be helically disposed about the longitudinal axis of the reconstruction element support **142**, and likewise, the number of slots can vary.

The reconstruction element support **142** is further configured with an axially extending through-going head bore **182** and inside tapering top section **184**. A manipulating fastener, namely bolt **186** has an external threaded portion **188** corresponding with internal thread **145** of the abutment body **141** and has a polygonal socket head **190** for fastening thereof, as well as a radially extending annular manipulating shoulder **194** having a bottom face **195**.

The abutment assembly **140** further comprises a manipulating disc **101** configured with a top surface **103** and a tapering (bottom) side wall **105**. At assembly, the manipulating disc **101** is disposed within the tapering section **184** of the reconstruction element support **142**, with the bottom face **195** of the manipulating shoulder **194** of the manipulating fastener **186** bearing flush against the top surface **103**. In this particular example too, the top surface of the manipulating disc and the bottom face of the manipulating shoulder are flat.

The arrangement is such that fastening the manipulating fastener **186** acts both to fasten the reconstruction element support **142** to the abutment body **141**, and to apply axially directed force to the manipulating disc **101**, which in turn gives rise to outwardly directed radial forces, aimed to the inside surface **184** of the reconstruction element support, causing the anchoring head (i.e. the segments) of the reconstruction element support **142** to expand and tighten against inside wall surface of bore **114** of the dental reconstruction element **112**.

Similar to the previous example, the arrangement disclosed hereinabove thus provides for compensating positioning tolerances and inaccuracies residing between axes of the dental implant **116** and the dental reconstruction element **112**, where such tolerances can reside about a longitudinal axis ('Z axis') or about axes intersecting said

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longitudinal axis('X axis' and 'Y axis'). Such tolerances which may occur owing to measuring deviations, manufacturing deviations, etc. Such tolerances can extend axially, i.e. along the longitudinal axes of the dental system, or in planes intersecting said longitudinal axes.

5 Likewise, it is appreciated that the external surface of the anchoring head portion **172** of the reconstruction element support **142** can be smooth, as in the illustrated examples, or it can be surfaced for improved engagement with inside wall surface of the bore **114** of the dental reconstruction element **112**. Such surfacing can be, for example, serrations, knurling, axial/annular ridges, axial/annular grooves, roughened surfacing,
10 etc.

Further attention is now directed to Figs. 3A to 3G directed to a modification of the first embodiment illustrated in Figs. 1A to 1G. for sake of simplicity, like elements are designated with like reference numbers, with the addition of a ' indicator.

In fact, the dental set **10'** is similar to that disclosed in the example of Figs. 1A to
15 1G, however with different design concerning the abutment body **41'** and the dental implant **16'**, respectively. Accordingly, reference in the following example is emphasized on the different elements.

The dental set **10'** thus comprises a schematically illustrated dental reconstruction element which in the illustrated example is part of a partial bridge **12'** configured with a
20 bore **14'** having a nominal diameter.

A dental implant **16'** comprising an external threading **18'** for fitting into a cavity of a jaw bone (not shown) of an individual and an internal threading **20'** having a nominal diameter **Di** at an abutment receiving bore **22'**, configured at a top end of the dental implant, with a top head portion **123** with a smooth top edge **26'**.

25 An abutment assembly **40'** comprises an abutment body **41'** and a tubular reconstruction element support **42'**, the later being similar to reconstruction element support **42** of the example of Figs. 1A to 1G and reference is made back thereto.

The abutment body **41'** is tubular and is configured with a through-going abutment bore **46'** extending between a top (proximal) flat support end **48'**, and a bottom (distal)
30 end configured with a boss **50'** having an external diameter corresponding with **Di** of the abutment receiving bore **22'**, and is further configured with a gripping portion **52'** and a tapering portion **56'** configured for snug and fit receipt within the abutment receiving bore

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22' of the dental implant **16'**. The arrangement is such that the boss **50'** is shaped and sized for snug receiving within the abutment receiving bore **22'**, with the tapering portion **56'** abutting surfaces of the bore **22'**, thereby substantially eliminating movement between the elements.

5 The abutment bore **46'** of the abutment body **41'** is further configured with an inside fastener shoulder **58'** whereby the abutment body **41'** can be couplable to the dental implant **16'** by an implant fastener **62'** configured with an external threaded portion **64'** (corresponding with the internal threading **20'** at the abutment receiving bore **22'**) and a polygonal fastening socket **68'**, whereby fastening the abutment body **41'** with the dental
10 implant **16'** is sturdy and substantially motion-free. The implant fastener **62'** is further configured at a top portion thereof with an internal thread **63'**.

A manipulating fastener, namely bolt **86'** has a threaded portion **88'** corresponding with internal thread **63'** of the implant fastener **62'** and has a polygonal socket head **90'** for fastening thereof, as well as a radially extending annular manipulating shoulder **94'**.

15 The abutment assembly further comprises a manipulating disc **100'** configured with a top surface **102'** and a tapering side wall **104'**. At assembly, the manipulating disc **100'** is disposed within the tapering section **84'** of the reconstruction element support **42'**, with the bottom face of the manipulating shoulder **94'** of the manipulating fastener **86'** bearing flush against the top surface **102'**.

20 The arrangement is such that fastening the manipulating fastener **86'** acts both to fasten the reconstruction element support **42'** to the abutment body **41'** (by coupling to implant fastener **62'**), and to apply axially directed force to the manipulating disc **100'**, which in turn gives rise to outwardly directed radial forces, aimed to the inside surface **84'** of the reconstruction element support, causing the anchoring head (i.e. the segments)
25 of the reconstruction element support **42'** to expand and tighten against inside wall surface of bore **14'** of the dental reconstruction element **12'**.

The arrangement disclosed hereinabove thus provides for compensating positioning tolerances and inaccuracies residing between axes of the dental implant **16** and the dental reconstruction element **12'**, where such tolerances can reside about a
30 longitudinal axis ('Z axis') or about axes intersecting said longitudinal axis ('X axis' and 'Y axis'). Such tolerances which may occur owing to measuring deviations, manufacturing

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deviations, etc. Such tolerances can extend axially, i.e. along the longitudinal axes of the dental system, or in planes intersecting said longitudinal axes.

In addition, it is appreciated that the external surface of the anchoring head portion **72'** of the reconstruction element support **42'** can be smooth, as in the illustrated examples, or it can be surfaced for improved engagement with inside wall surface of the bore **14'** of the dental reconstruction element **12'**. Such surfacing can be, for example, serrations, knurling, axial/annular ridges, axial/annular grooves, roughened surfacing, etc. Such configurations can be applied to any of the examples and embodiments disclosed herein.

Likewise, a sealing ring (not shown) can be into annular groove **15'** of the dental reconstruction element **12**, such that at the assembled position the sealing ring is bears against an external surface of the abutment body **41'**, suitable to eliminate or substantially reduce saliva and food from entering into a space extending between the bore of the dental reconstruction element and the external surface of the abutment body.

In Fig. 3H there is illustrated a dental set as per the example of Figs 3A to 3G, wherein the dental implant **16''** and the associated abutment body **48''** and the reconstruction element support **42''** extend along a longitudinal axis **X''**, whilst the dental reconstruction element **12''** is disposed at an angle **Y''** thereabout, with an angle μ'' therebetween, and however is set in place by the reconstruction element support **42''** as discussed above.

Yet an example of rectifying tolerance issues is exemplified in Fig. 3I, demonstrating a dental set as per the example of Figs 3A to 3G, wherein the dental implant **16'''** and the associated abutment body **48'''** and the reconstruction element support **42'''** extend along a longitudinal axis **X'''**, whilst the dental reconstruction element **12'''** is disposed at an angle **Y'''** thereabout, with an angle μ''' therebetween, and further wherein the dental reconstruction element **12'''** is spaced at a distance **H** from the top end of polygonal socket head **90'''** of the implant fastener **62'''**, and however is set in place by the reconstruction element support **42'''** as discussed above.

Yet another embodiment is disclosed in Figs. 4A to 4L directed to an adjustable dental set generally designated **210**, and wherein for sake of clarification, in the following example like elements as in Figs 1A to 1G are designated with like reference numbers, however shifted by 200.

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The dental set **210** comprises a dental reconstruction element which in the illustrated example is part of a partial bridge **212**. It is however appreciated that the dental reconstruction element can assume any form, any full or partial, of a support bar, mini support bar, full/partial denture, full or partial dental bridge, dental crown, or any other
5 similar dental element constituting or supporting any type of dental prosthesis, either in full or partial.

The dental reconstruction element **212** is configured with a bore **214** having a nominal diameter **D** with an annular groove **215** at a bottom portion thereof, the purpose of which will become apparent herein after.

10 A dental implant **216**, of known structure is provided, said dental implant **216** comprising an external threading **218** for fitting into a cavity of a jaw bone (not shown) of an individual and an internal threading **220** at an abutment receiving bore **222**, having a nominal diameter, and further wherein the dental implant comprises a tapering top collar **224** with a smooth top edge **226**, and a polygonal head socket **223** for fastening the dental
15 implant **216** within the jaw bone.

An abutment assembly **240** according to a different embodiment of the disclosure is seen isolated in Figs. 4E and 4F. The abutment assembly **240** comprises an abutment body **241** and a tubular reconstruction element support **242**. The abutment body **241** is generally a tubular configured with a longitudinal second axis **X2** configured with a
20 through-going abutment bore **246** configured with at a distal (bottom) end with a polygonal boss **250**, said polygonal boss configured for receiving within the polygonal head socket **223** of the dental abutment **216**, at discrete angular increments, depending of course on the number of faces of the polygonal socket **223** and the number of faces of the a polygonal boss **250**.

25 According to a particular example the external polygonal boss **250** of the abutment body **241** is a 12 faced polygon and the polygonal socket **223** of the dental implant **216** is a 6 faced polygon, imparting the abutment body axial angular increments of 30° over the dental implant. However, other combinations of polygonal boss and polygonal socket can be adopted, e.g. an 8 faced polygonal boss with an 8 faced polygonal socket, 8 faced
30 polygonal boss with a 16 faced polygonal socket, a 6 faced polygonal boss with a 6 faced polygonal socket, etc.

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The abutment body **241** is further configured with a tapering portion facing skirt portion **256** such that the boss **250** is shaped and sized for snug receiving within the abutment receiving bore **222**, with the skirt portion **256** resting within a corresponding tapering portion within the top collar **224** of the dental implant **216**, thereby substantially
5 eliminating movement between the elements once coupled.

The abutment bore **246** is further configured with an inside fastener shoulder **258** whereby the abutment body **241** can be couplable to the dental implant **216** by an implant fastener **262** configured with an external threaded portion **264** (corresponding with the internal threading **220** at the abutment receiving bore **222**) and a polygonal fastening
10 socket **268**, whereby fastening the abutment body **241** with the dental implant **216** is sturdy and substantially motion-free. The implant fastener **262** is accessible for fastening through an opening **265** configured at a flat top surface of the abutment body **241**, whereby the abutment body **241** are coupled to one another about the longitudinal second axis **X2**.

15 The abutment body **241** is further configured with a tubular boss **271** upwardly projecting from the flat surface **267** and extending along a first axis **X1**, said tubular boss **271** configured with an internal thread **263**, and wherein according to the particular illustrated example said first axis **X1** and said second axis **X2** intersect each other about an imaginary plane, wherein the angle α between the first axis and the second axis is in
20 the range of about 3° to 8° , and typically about 5° .

The tubular reconstruction element support **242** has a distal (bottom) flat seat end **70** which at an assembled position bears flush against the flat surface **267** of the abutment body **241**, and is configured with a proximal anchoring head portion **272** configured with four symmetrically disposed, axially extending, slots **276**, extending open from a top edge
25 **278** of the reconstruction element support **242**. Whilst in the illustrated examples the slots are axially disposed, it is appreciated that the slots can be helically disposed about the longitudinal axis of the reconstruction element support **242**, and likewise, the number of slots can vary.

The reconstruction element support **42** is further configured with an axially
30 extending through-going head bore **282** and inside tapering top section **284**. A manipulating fastener, namely bolt **286** has a threaded portion **288** corresponding with

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internal thread **263** of the implant fastener **262** and has a polygonal socket head **290** for fastening thereof, as well as a radially extending annular manipulating shoulder **294**.

The abutment assembly **240** further comprises a manipulating disc **201** configured with a flat top surface **202** and a tapering side wall **204**. At assembly, the manipulating disc **201** is disposed within the tapering section **284** of the reconstruction element support **242**, with the bottom face of the manipulating shoulder **294** of the manipulating fastener **286** bearing flush against the flat top surface **202**.

The arrangement is such that fastening the manipulating fastener **286** acts both to fasten the reconstruction element support **242** to the abutment body **241** (by coupling to implant fastener **262**), and to apply axially directed force to the manipulating disc **201**, which in turn gives rise to outwardly directed radial forces, aimed to the inside surface **284** of the reconstruction element support, causing the anchoring head (i.e. the segments) of the reconstruction element support **242** to expand and tighten against inside wall surface of bore **214** of the dental reconstruction element **212**.

The arrangement disclosed hereinabove thus provides for compensating positioning tolerances and inaccuracies residing between axes of the dental implant **216** and the dental reconstruction element **212**, where such tolerances can reside about a longitudinal axis ('Z axis') or about axes intersecting said longitudinal axis ('X axis' and 'Y axis'). Such tolerances which may occur owing to measuring deviations, manufacturing deviations, etc. Such tolerances can extend axially, i.e. along the longitudinal axes of the dental system, or in planes intersecting said longitudinal axes.

The angular deviation α between the first axis **X1** and the second axis **X2**, together with the discrete, incremental angular positioning of the abutment assembly **240** with respect to the longitudinal axis of the dental abutment **216** offers a unique configuration providing support of a dental reconstruction element at a variety of setups, regardless of the preset axial alignment of the dental implant, yet at a sturdy manner and further with the ability to overcome three dimensional tolerances.

In addition, it is appreciated that the external surface of the anchoring head portion **272** of the reconstruction element support **242** is surfaced for improved engagement with inside wall surface of the bore **14** of the dental reconstruction element **12**. Such surfacing in the present example, comprises annular ridges. Though it can be, for example,

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serrations, knurling, axial/annular ridges, axial/annular grooves, roughened surfacing, etc.

Reverting to the assembled dental set **210**, a sealing ring (not shown), e.g. a resilient O-ring, or a metal ring, can be fitted into the annular groove **215** within the bore **214** of the dental reconstruction element **212**, such that at the assembled position the sealing ring is bears against an external surface of the abutment body **241**, suitable to eliminate or substantially reduce saliva and food from entering into a space extending between the bore of the dental reconstruction element and the external surface of the abutment body.

10 Figs 5A and 5B of the drawings illustrate a dental set **310** comprising a dental reconstruction element being a support bar **312** mounted over 5 dental implants **316_i** to **316_v**. It is noted that at least some of the dental implants **316_i** to **316_v** are not parallelly disposed, at times in more than one axis. For example, dental implant **316_i** is angularly offset at angles β_1 and β_2 with respect to dental implant **316_{ii}**, and dental implant **316_{iv}** is angularly offset at angles γ_1 and γ_2 with respect to dental implant **316_v**. Such angular disorders, as well as tolerances and inaccuracies residing between axes of the dental implants **316_i** to **316_v** and the dental reconstruction element **312** e.g. axial (elevation) gap **h** (Fig. 5B) can be overcome by dental abutments according to any of the herein disclosed embodiments, (such tolerances and inaccuracies may occur owing to
15
20 measuring deviations, manufacturing deviations, etc.).

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CLAIMS:

1. A dental abutment comprising a cylindrical abutment body and a tubular reconstruction element support; the abutment body is couplable to a dental implant and comprises a flat support end, the reconstruction element support has a proximal anchoring
5 head portion configured with at least one slot, and a distal seat end bearing flush against the flat support end of the abutment body, said reconstruction element support is further configured with an axially extending through-going head bore, whereby the reconstruction element support is coupled to the abutment body by a manipulating fastener extending through the bore, and wherein axial fastening the fastener entails radial
10 expansion of the anchoring head.
2. A dental abutment according to claim 1, wherein the abutment body is tubular and is configured with a through-going abutment bore extending between an implant end and the flat support end, said abutment bore configured with an inside fastener shoulder, whereby the abutment body is couplable to a dental implant by a implant fastener
15 extending through the abutment body.
3. A dental abutment according to claim 1, wherein the manipulating fastener is screw coupled within an internal threading configured within the implant fastener.
4. A dental abutment according to claim 1, wherein the abutment body is a tubular body configured at an implant end thereof with an integral threaded fastener couplable
20 within a threaded bore of a dental implant, said abutment body is further configured at an opposite end thereof with a wrench engaging portion.
5. A dental abutment according to claim 1, wherein the manipulating fastener is screw coupled within an internal threading configured within the abutment body.
6. A dental abutment according to claim 1, wherein the at least one slot of the
25 reconstruction element support extends from the proximal towards the seat end.
7. A dental abutment according to claim 1, wherein the abutment body is configured with a first axis and a second axis; with a threaded bore extending along said first axis for screw coupling the tubular reconstruction element support, and wherein the abutment body is couplable to a dental implant along said second axis.
- 30 8. A dental abutment according to claim 7, wherein the first axis and the second axis intersect each other about an imaginary plane.

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9. A dental abutment according to claim 7, wherein the abutment body is configured with an implant end configured for bearing over an internal head portion of a dental implant, said implant end is configured as an external polygonal boss couplable at discrete angular increments within a polygonal socket of the dental implant, said polygonal boss
5 coextends along said second axis.

10. A dental abutment according to claim 1, wherein the abutment body is couplable to a dental implant directly or indirectly, with an intermediate adapter seat member disposed therebetween, wherein the adapter seat member has a body with a thorough going bore extending between abutment end mimicking an external head portion of a
10 dental implant, and an implant end configured for bearing over an internal head portion of a dental implant.

11. A dental abutment according to claim 10, wherein the adapter seat member is integral with or integrated with the abutment body.

12. A dental abutment according to claim 1, wherein a dental implant end of the
15 abutment body is configured for direct bearing over an external cylindrical head portion of a dental implant, or over an adapter seat member extending between the abutment body and the dental implant.

13. A dental abutment according to claim 1, wherein a dental implant end of the abutment body is cylindrical and is configured for at least partially insertion into an open
20 end of a dental implant.

14. A dental abutment according to claim 1, wherein a portion of the abutment body is configured at an external face thereof with a wrench gripping arrangement.

15. A dental abutment according to claim 1, wherein the at least one slot of the of the reconstruction element support extends axially, parallel to an axis of the longitudinal head
25 bore, imparting it a symmetrically segmented shape.

16. A dental abutment according to claim 15, wherein the at least one slot of the of the reconstruction element support extends helically about the longitudinal axis of the reconstruction element support.

17. A dental abutment according to claim 1, wherein the anchoring head of the
30 reconstruction element support is configured with symmetrically disposed at least two slots.

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18. A dental abutment according to claim 1, wherein the anchoring head portion of the reconstruction element support is configured with a cylindrical external cross-section.

19. A dental abutment according to claim 1, wherein the anchoring head portion of the reconstruction element support is configured with a externally spherical or has a
5 spherical portion, or a rounded portion cross-section.

20. A dental abutment according to claim 1, wherein at least the anchoring head portion of the reconstruction element support is configured with surfacing for improved engagement with inside wall surface of the bore of a dental reconstruction element.

21. A dental abutment according to claim 1, wherein a distal end of the axially
10 extending through-going head bore of the reconstruction element support is configured with an inwardly tapering section, configured for engagement with a radial annular projection of the manipulating fastener.

22. A dental abutment according to claim 1, wherein a distal end of the axially extending through-going head bore of the reconstruction element support is configured
15 with an inwardly tapering section, configured for engagement with a radial annular projection of the manipulating fastener.

23. A dental abutment according to claim 1, wherein the radial annular projection of the manipulating fastener is cylindrical.

24. A dental abutment according to claim 1, wherein the radial annular projection of
20 the manipulating fastener is tapering in direction of tapering section of the reconstruction element support.

25. A dental abutment according to claim 1, wherein at an assembled position, the tubular reconstruction element support extends coaxially with abutment body.

26. A dental abutment according to claim 1, wherein at an assembled position, the
25 manipulating fastener extends coaxially with the tubular reconstruction element support.

27. A dental abutment according to claim 1, wherein a distal portion of the abutment body is configured with a tapering shoulder, which upon coupling to a dental implant bears over a correspondingly tapering internal tapering portion of the dental implant.

28. A dental abutment according to claim 1, wherein the bore of a dental
30 reconstruction element is configured at a distal end thereof with an annular shoulder, which at an assembled position is configured for bearing over a cylindrical portion of the abutment body.

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29. A dental abutment according to claim 1, wherein a resilient sealing member is disposed between a distal end of the bore of a dental reconstruction element mountable thereover, and an external surface of the abutment body.

30. A dental reconstruction element comprising a thorough going bore configured for snug receiving at least a reconstruction element support of a dental abutment, said thorough going bore further configured for bearing radial engaging forces applied thereto by an anchoring head of the reconstruction element support which in turn is articulated to the dental abutment.

31. A dental reconstruction set comprising one or more of each of a dental reconstruction element, a dental implant, and a dental abutment comprising a dental abutment comprising a cylindrical abutment body and a tubular reconstruction element support; the abutment body is couplable to a dental implant and comprises a flat support end, the reconstruction element support has a proximal anchoring head portion configured with at least one slot, and a distal seat end bearing flush against the flat support end of the abutment body, said reconstruction element support is further configured with an axially extending through-going head bore, whereby the reconstruction element support is coupled to the abutment body by a manipulating fastener extending through the bore, and wherein axial fastening the fastener entails radial expansion of the anchoring head.

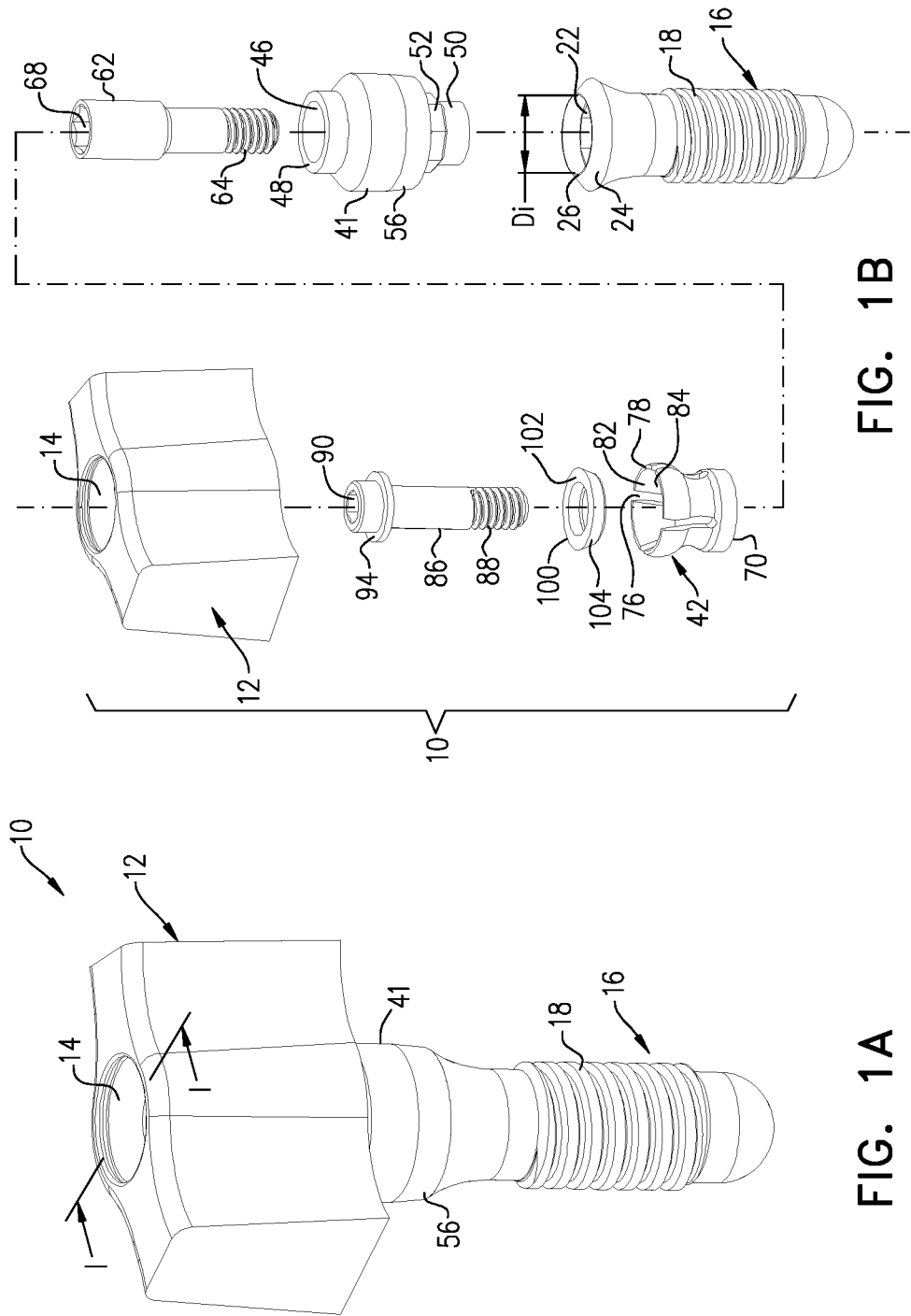


FIG. 1B

FIG. 1A

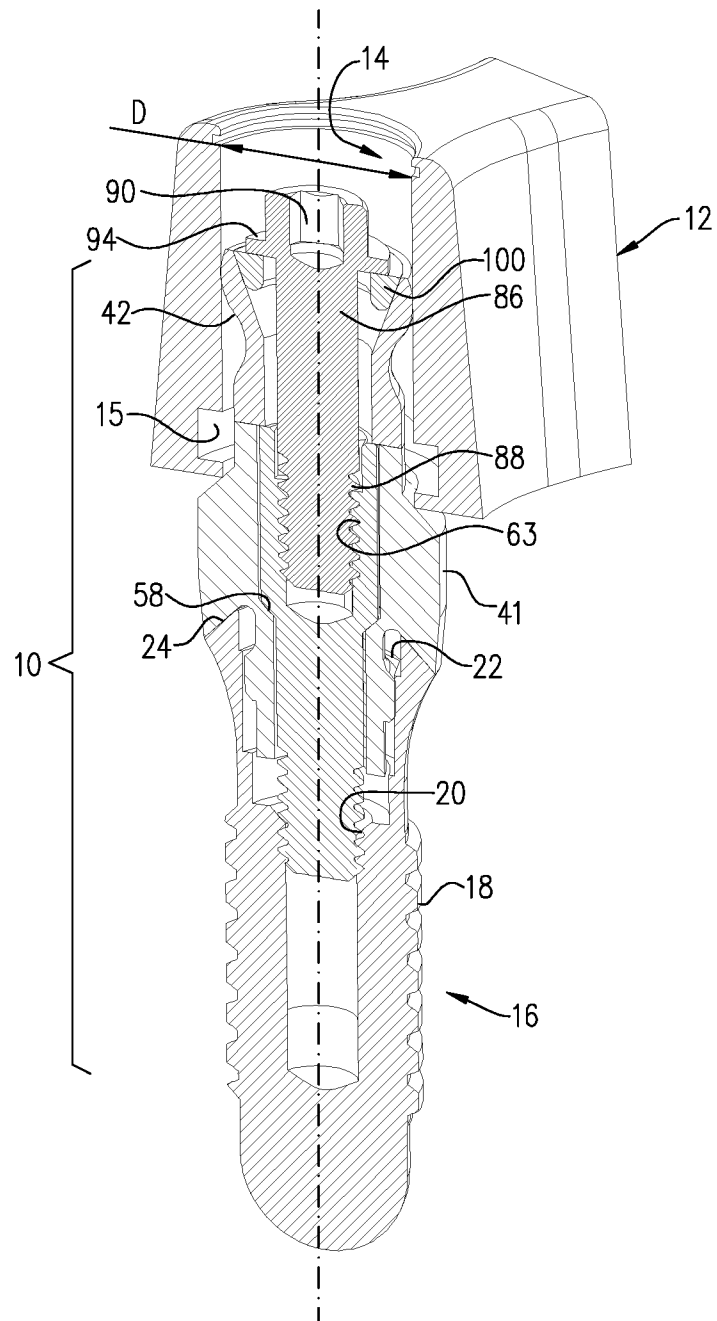


FIG. 1C

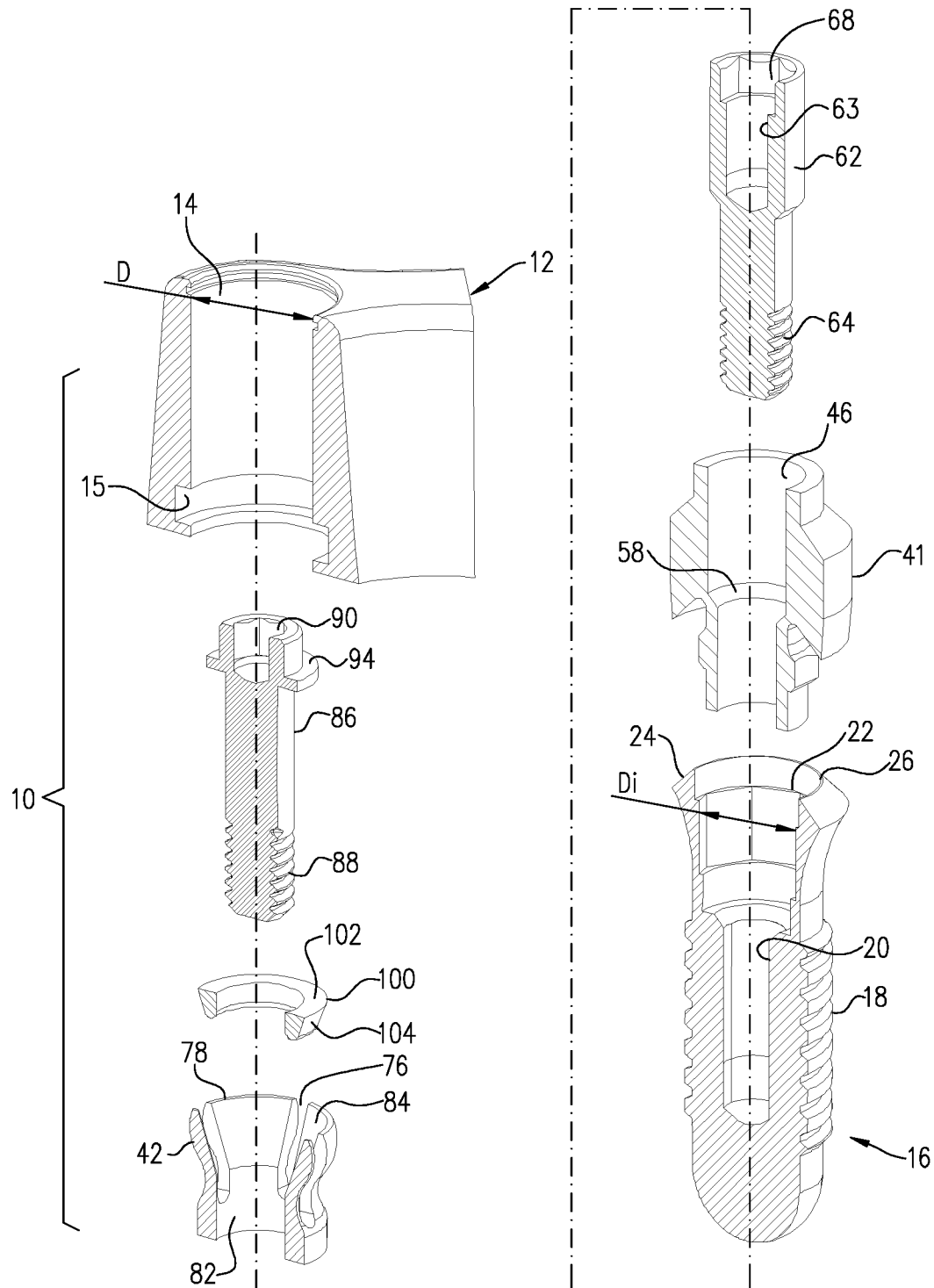


FIG. 1D

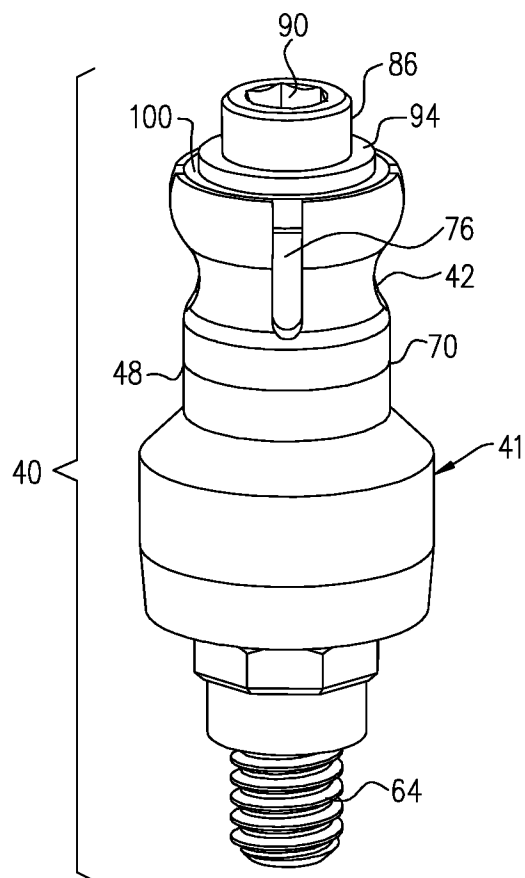


FIG. 1E

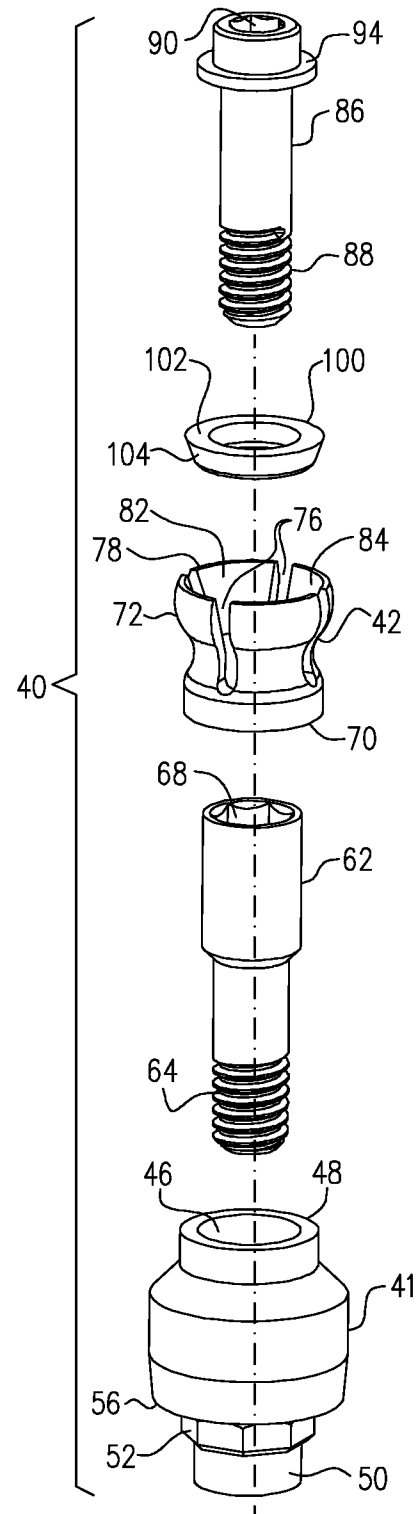


FIG. 1F

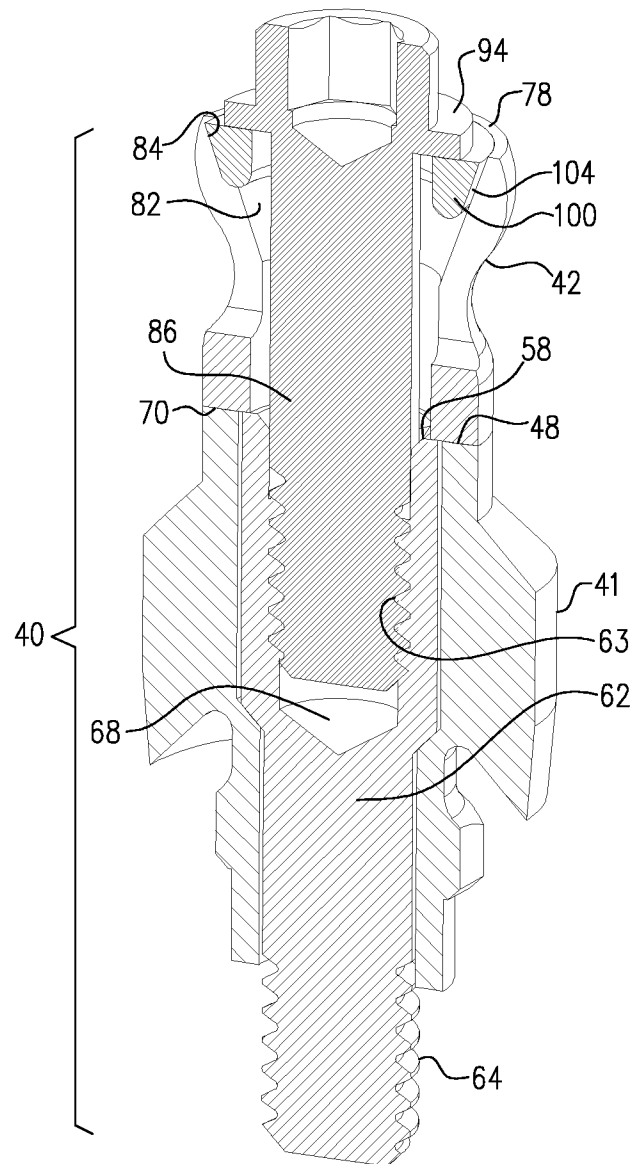


FIG. 1G

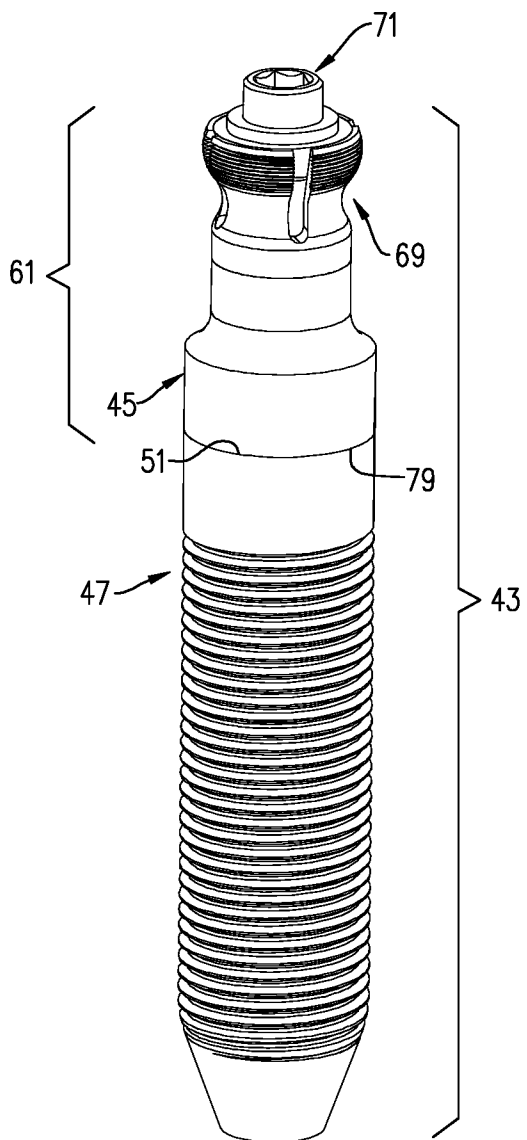


FIG. 1H

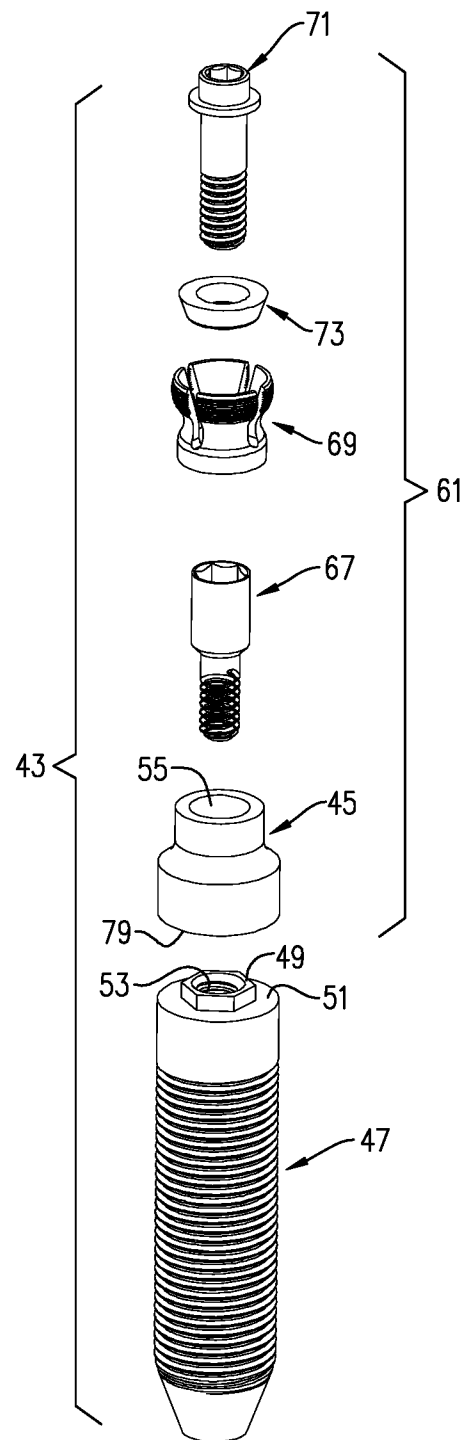


FIG. 1I

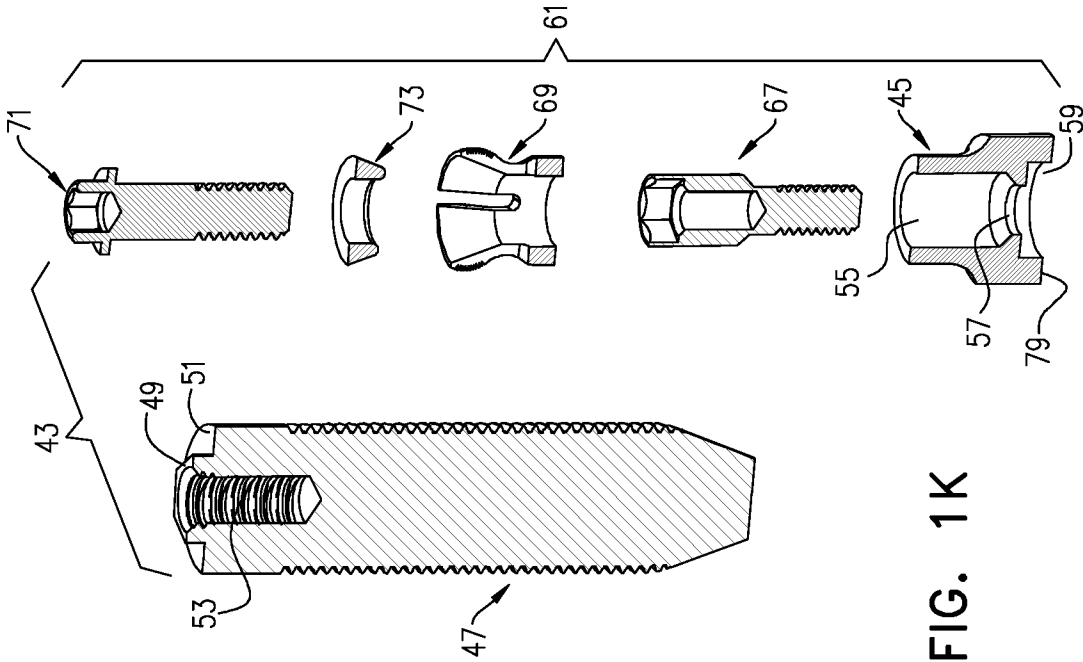


FIG. 1K

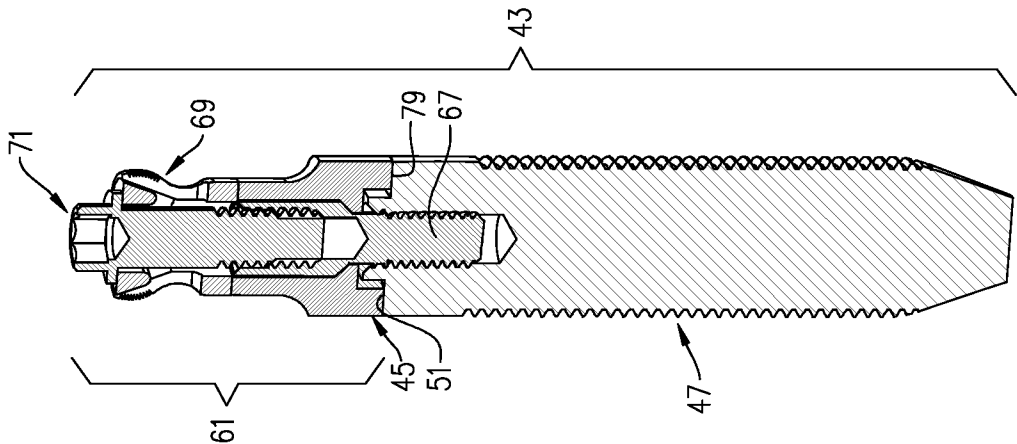


FIG. 1J

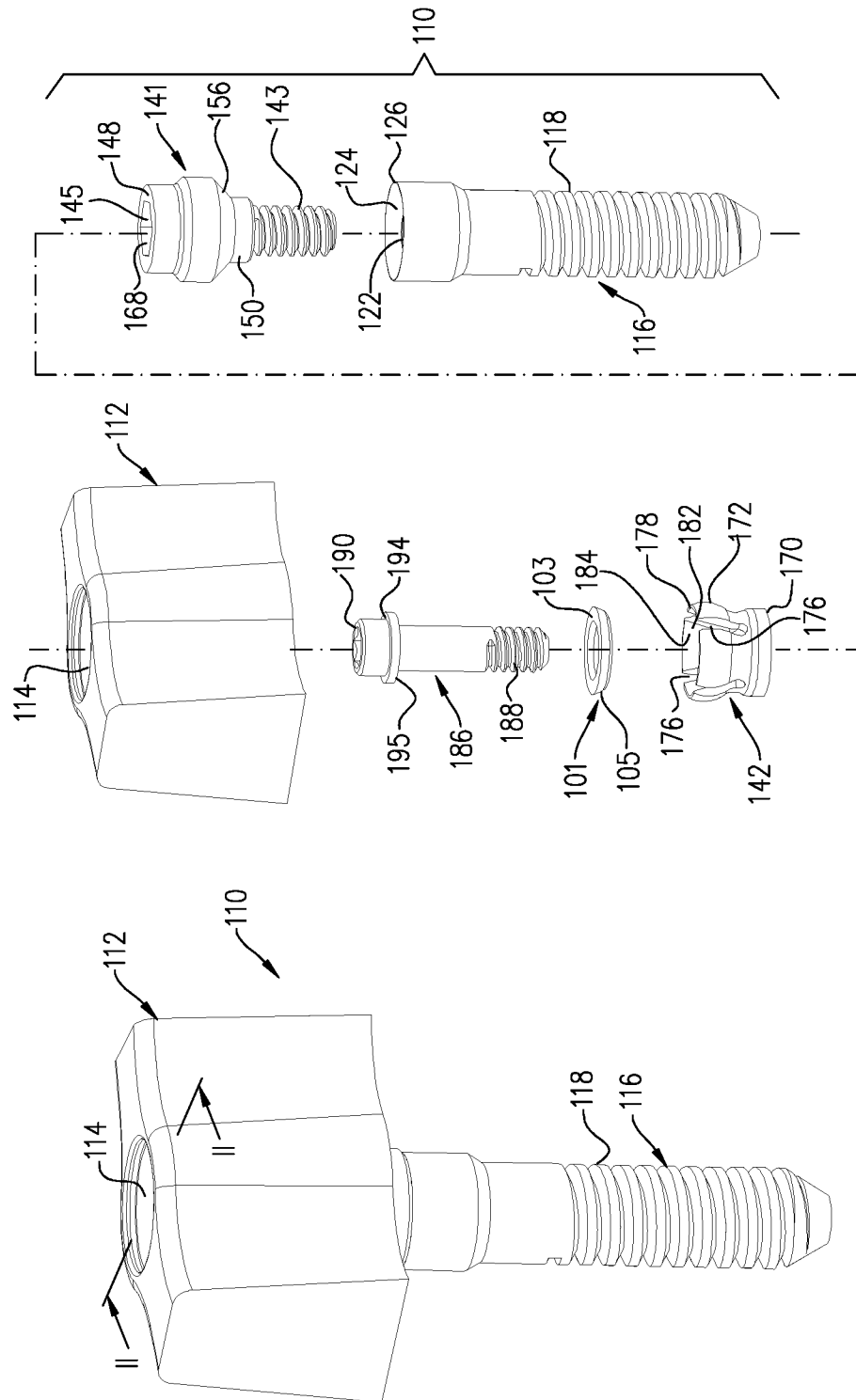


FIG. 2A

FIG. 2B

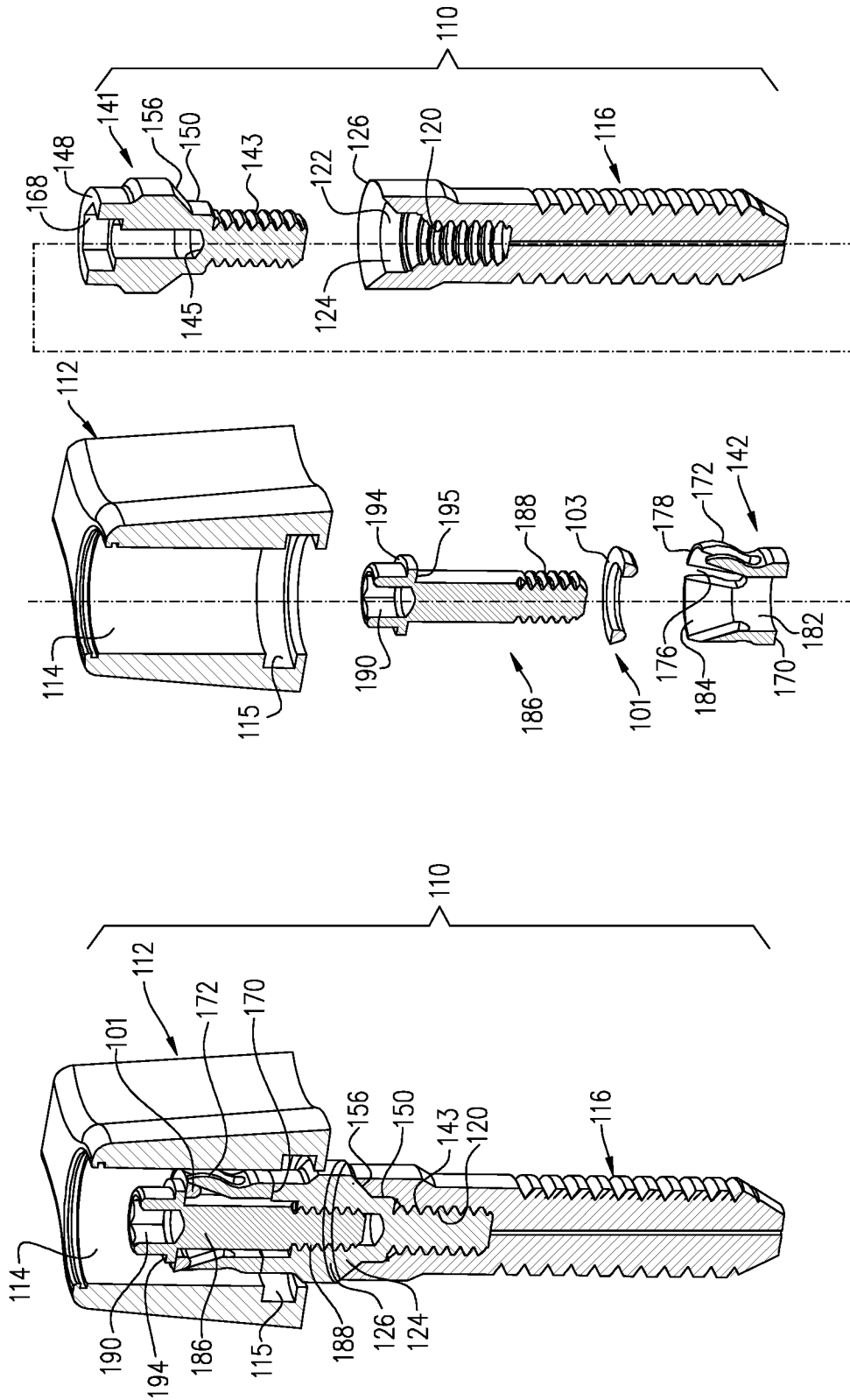
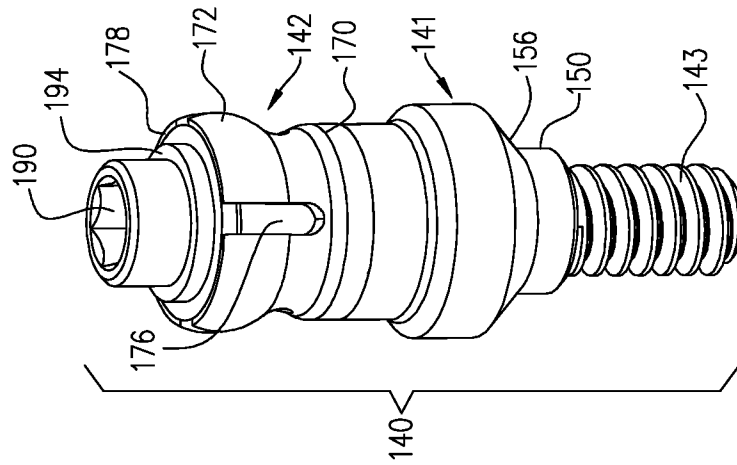
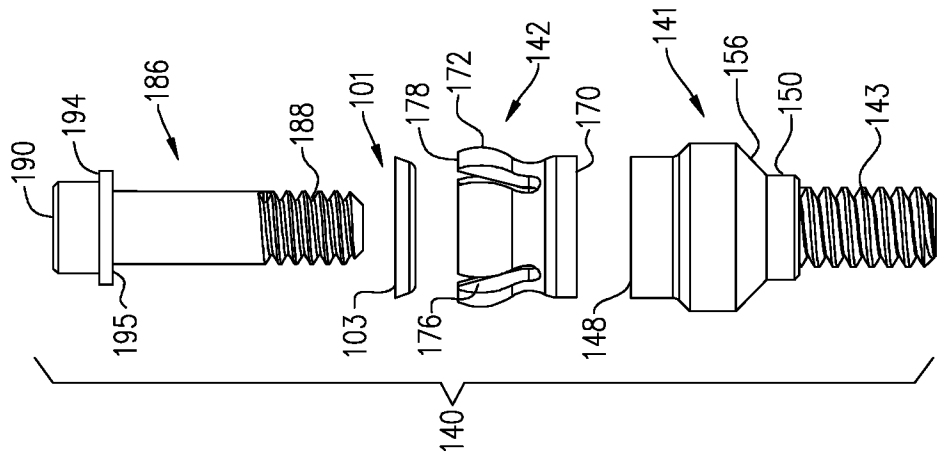
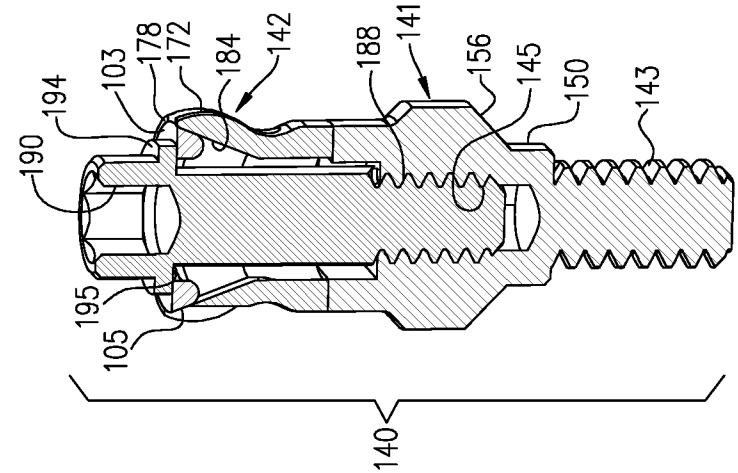


FIG. 2C

FIG. 2D



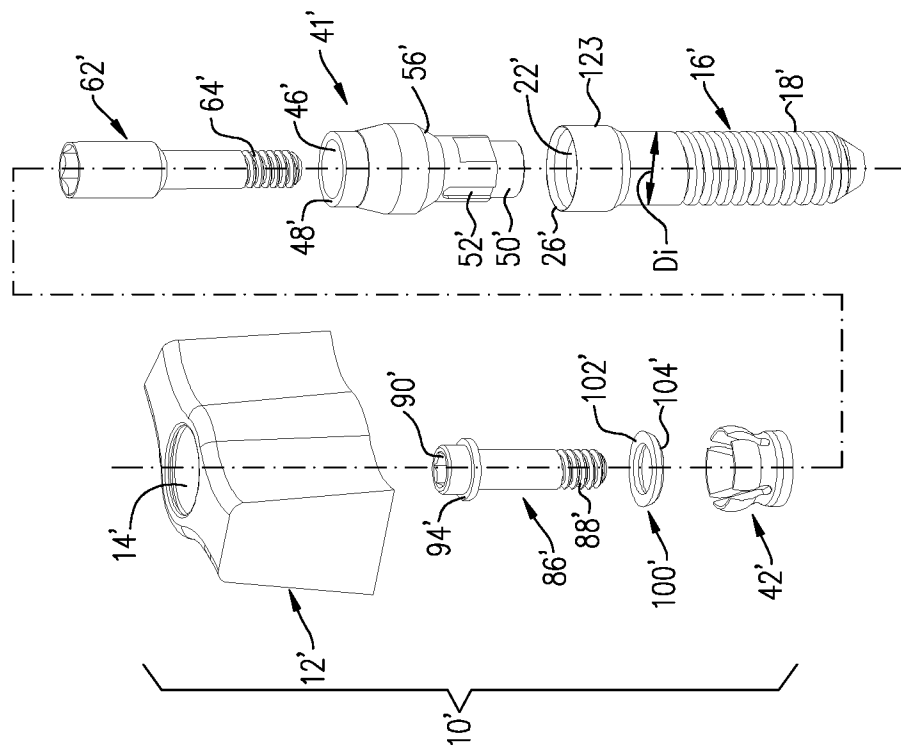


FIG. 3B

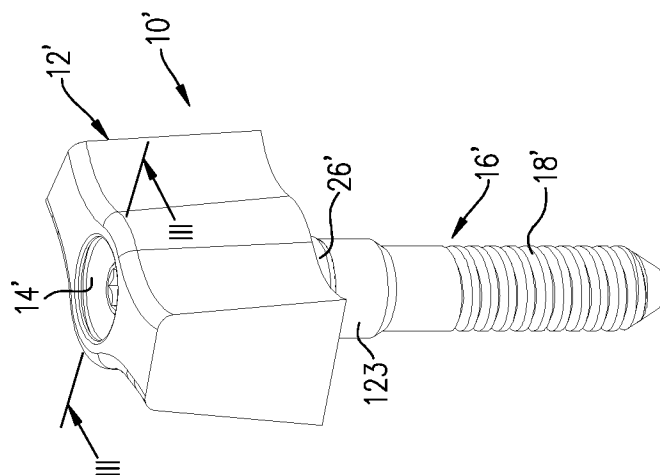


FIG. 3A

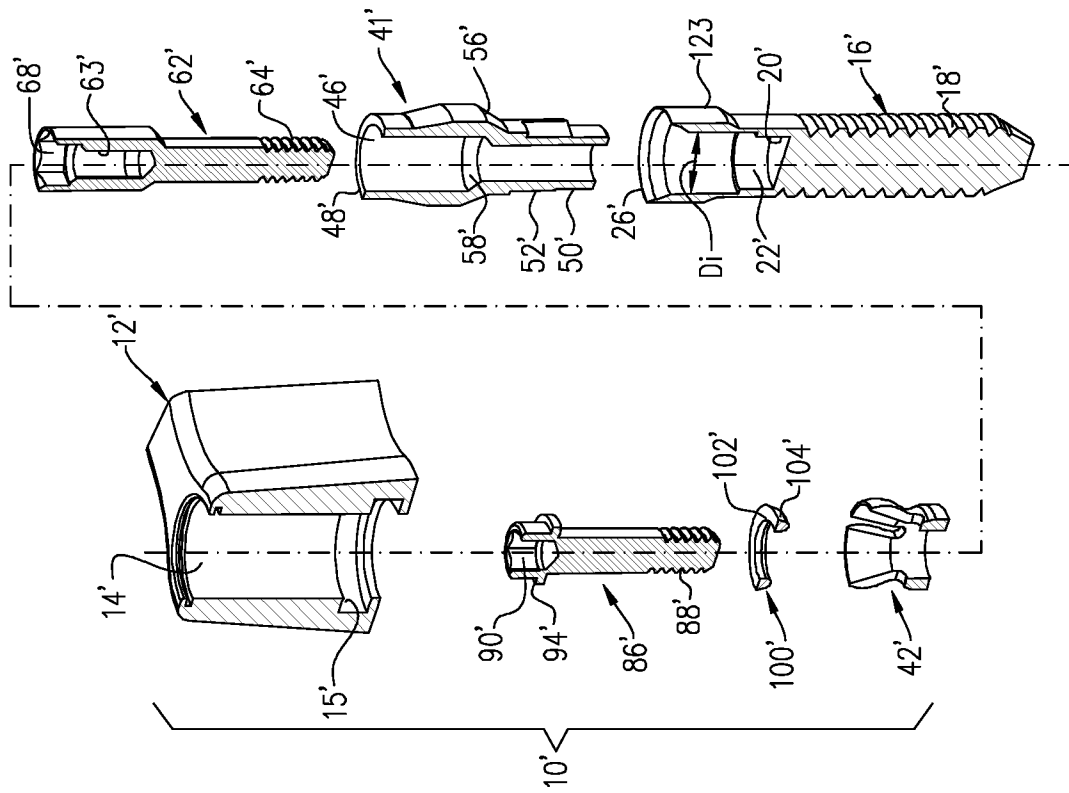


FIG. 3D

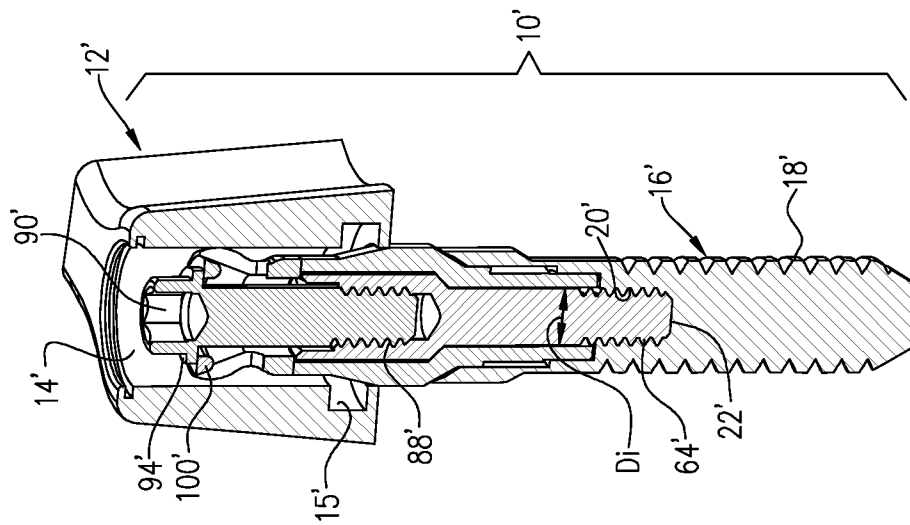


FIG. 3C

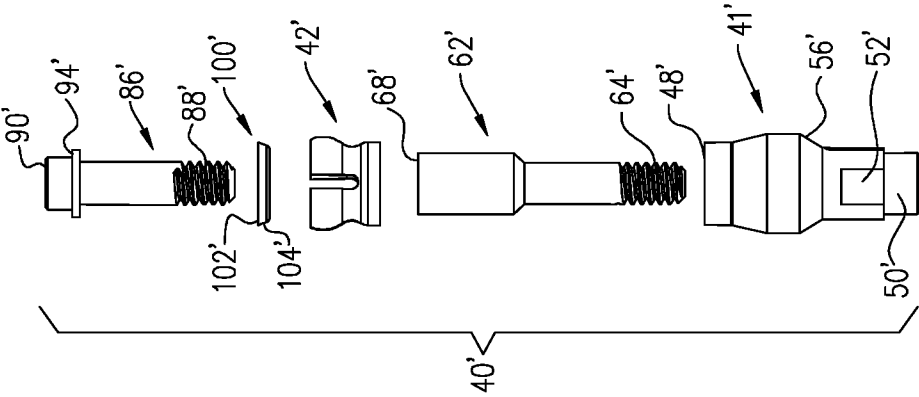


FIG. 3G

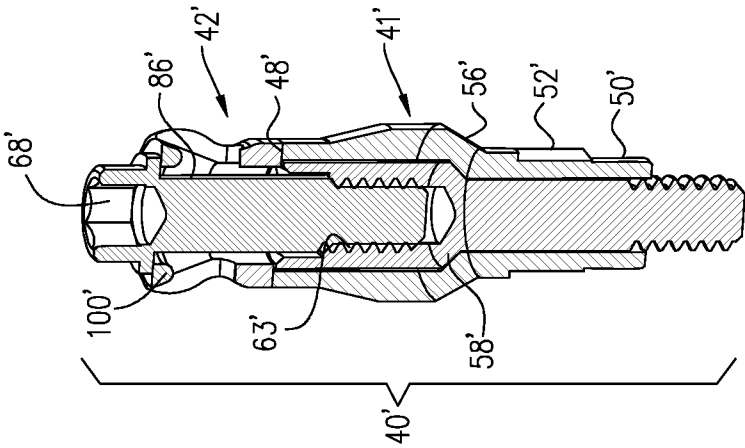


FIG. 3F

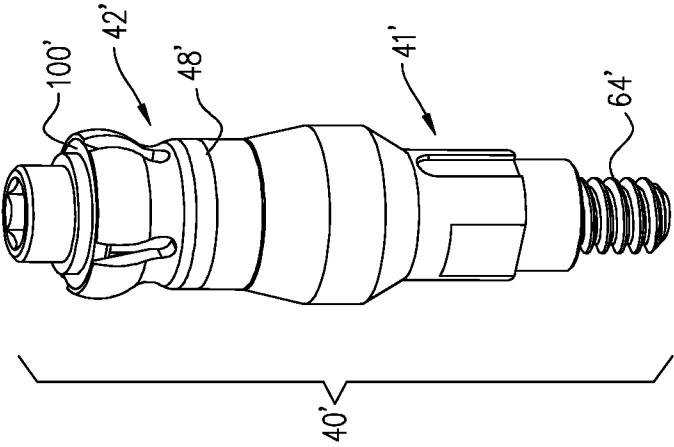


FIG. 3E

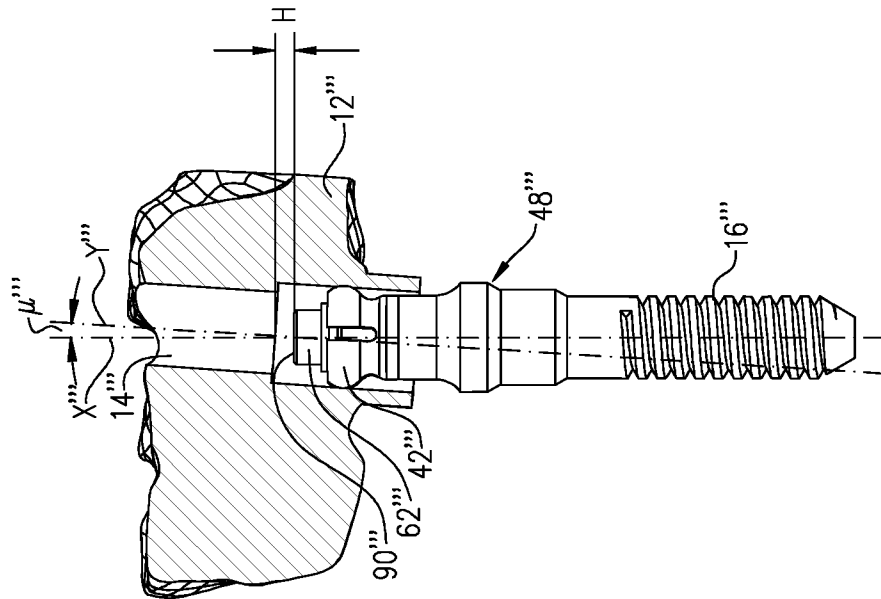


FIG. 31

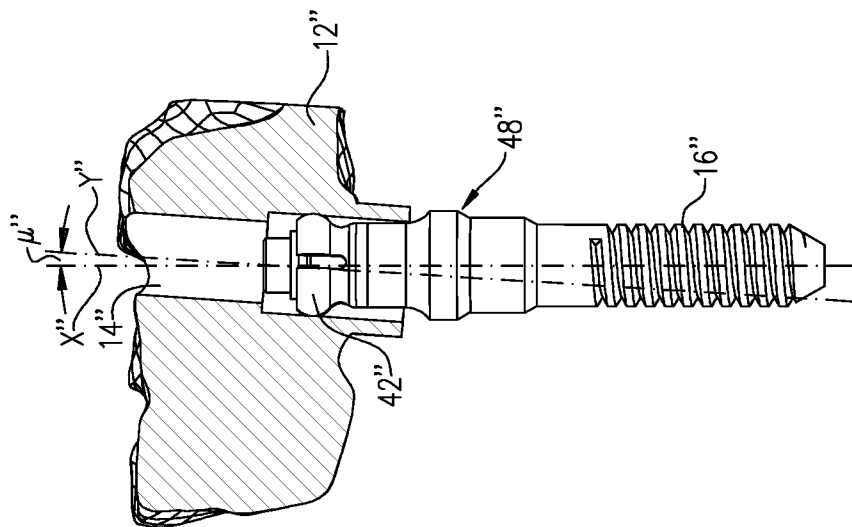


FIG. 3H

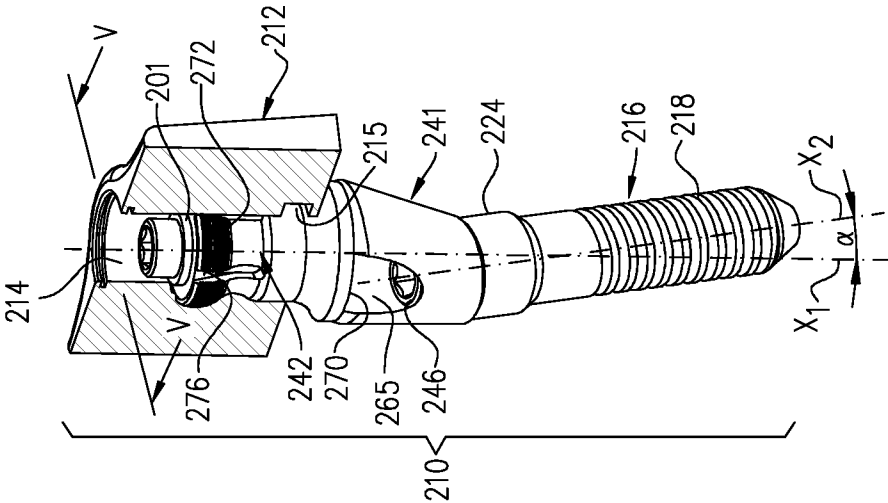


FIG. 4B

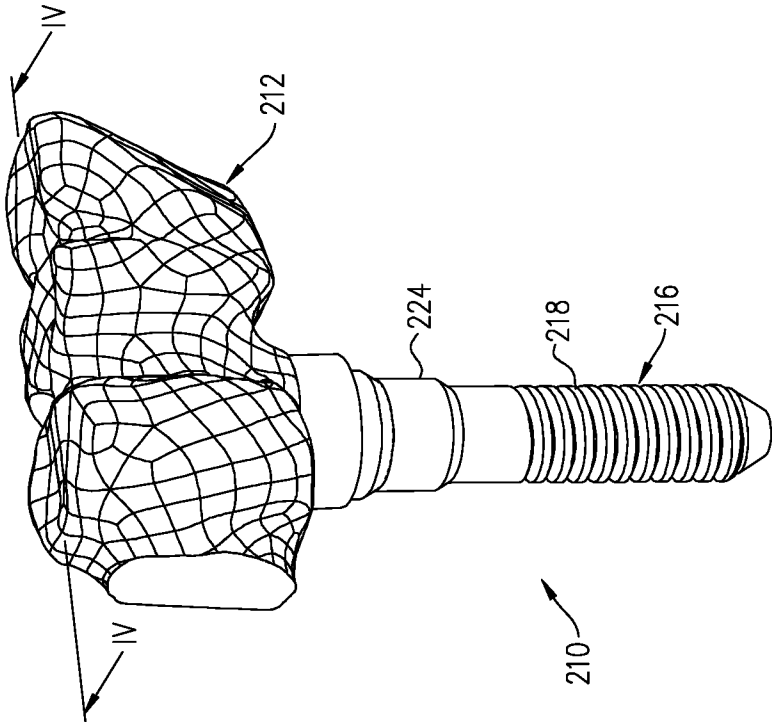
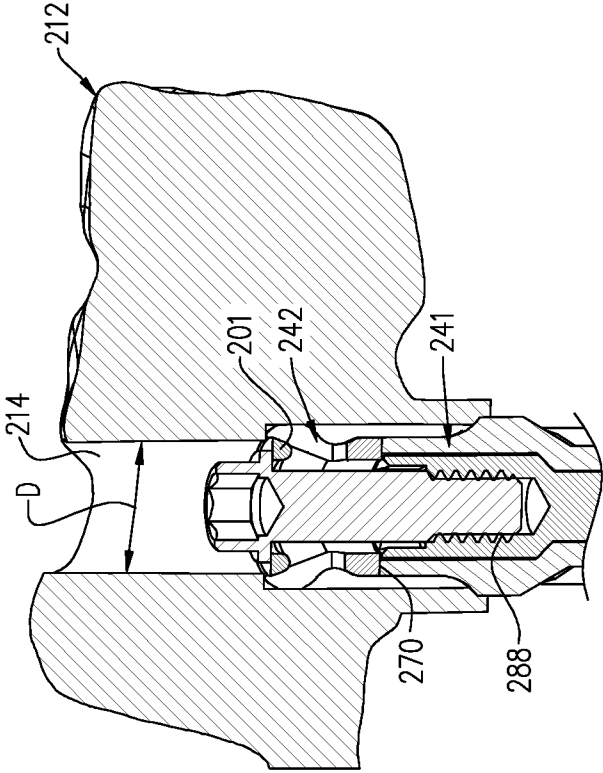
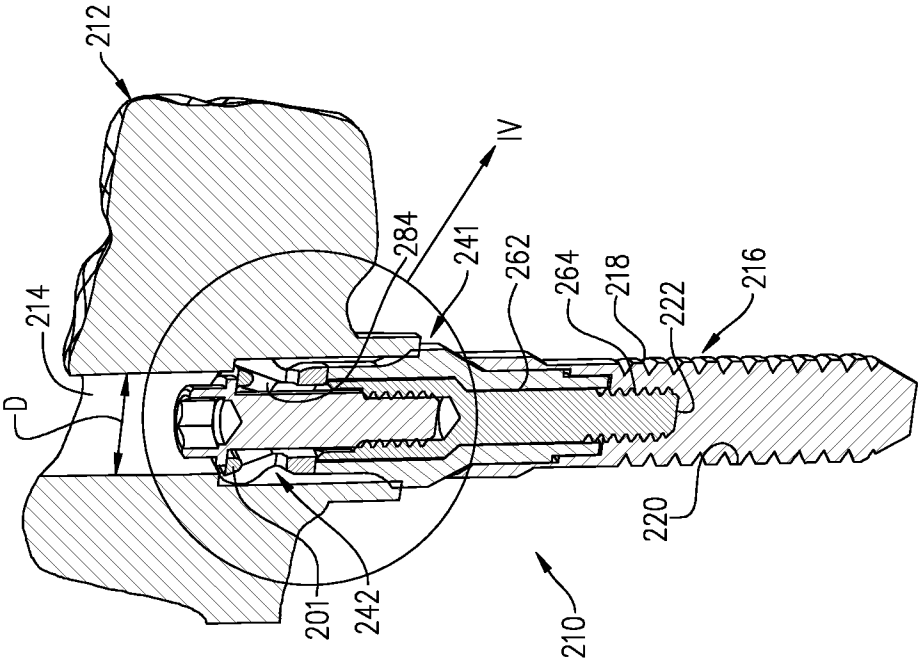


FIG. 4A



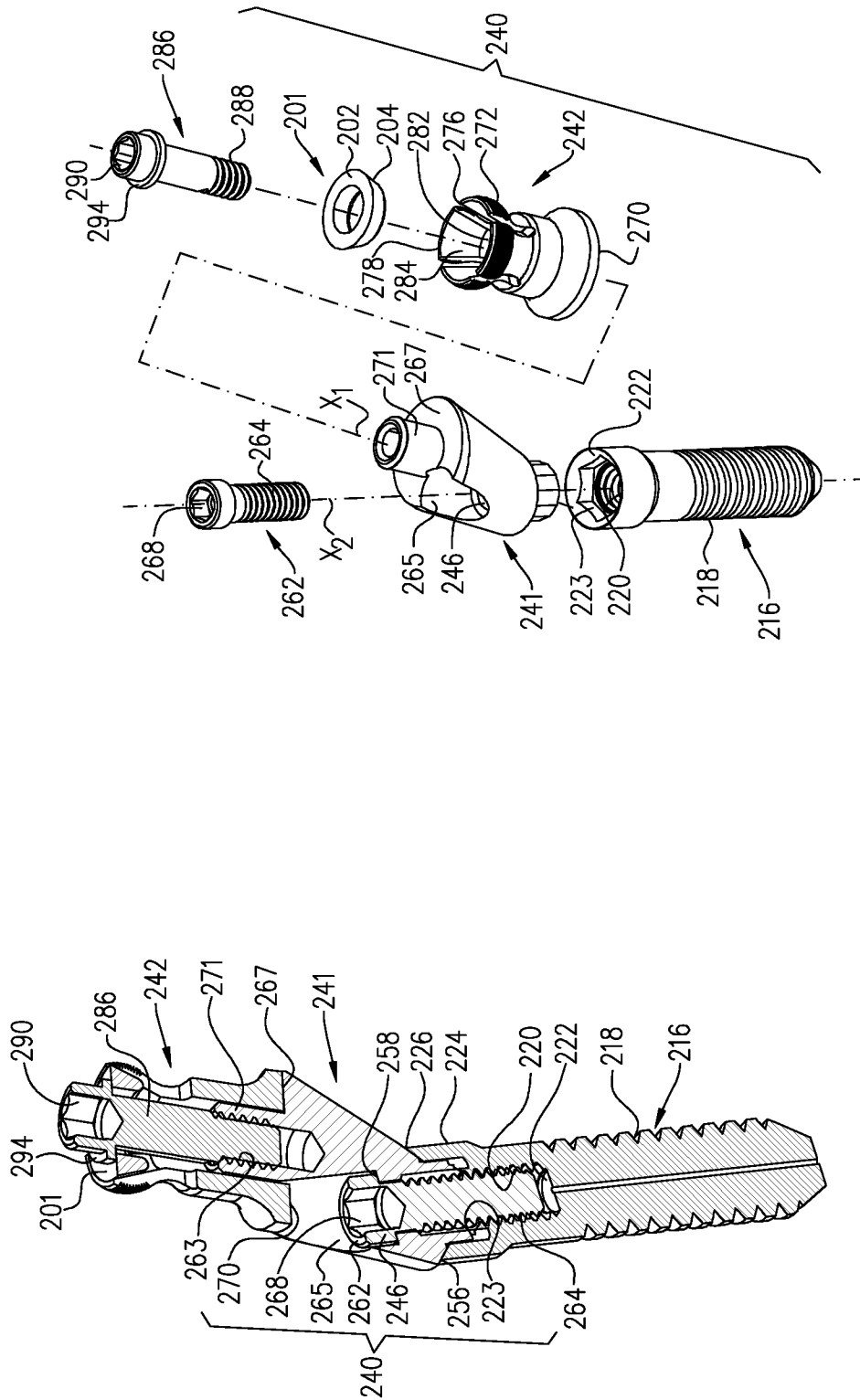


FIG. 4F

FIG. 4E

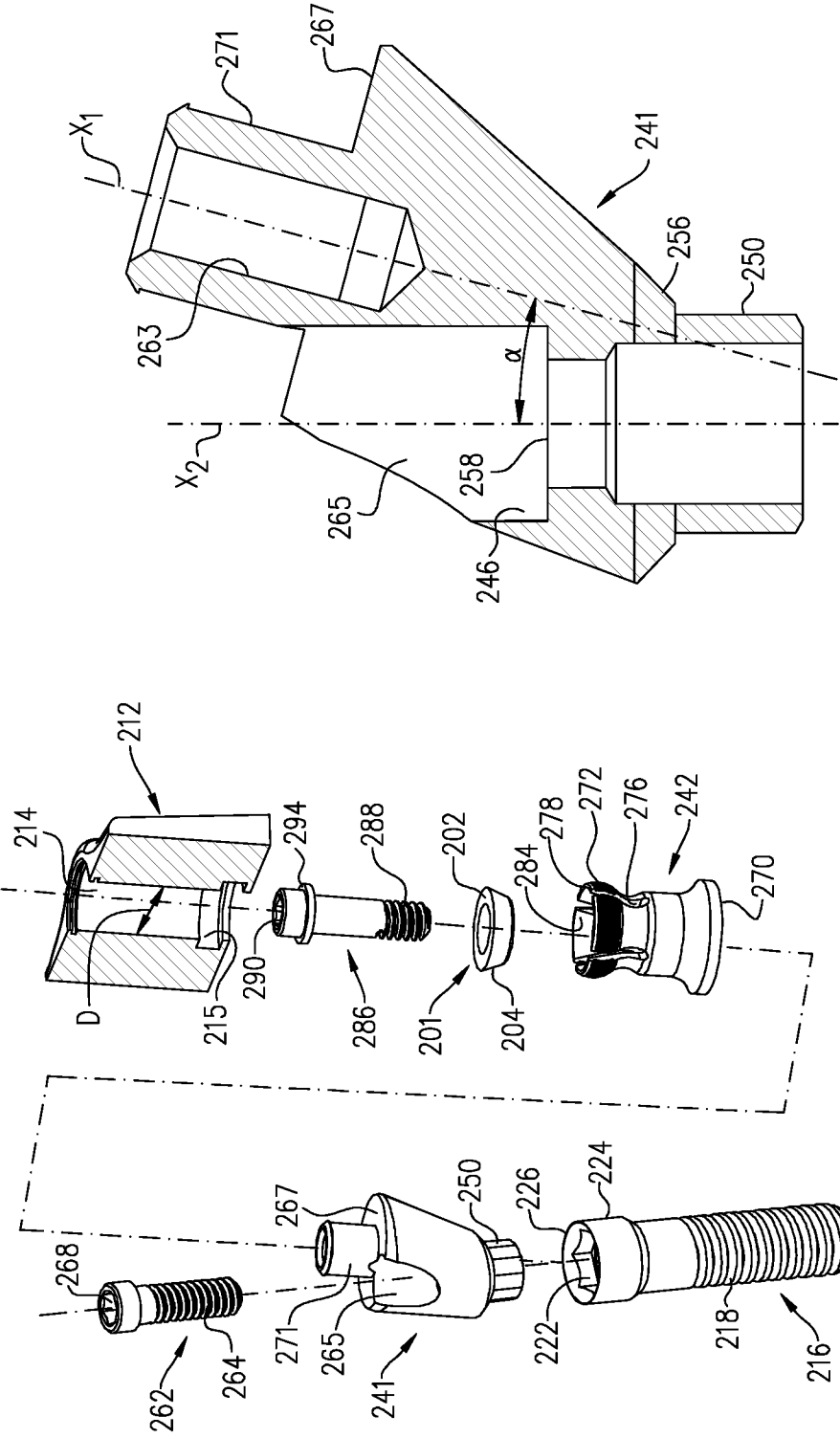


FIG. 4H

FIG. 4G

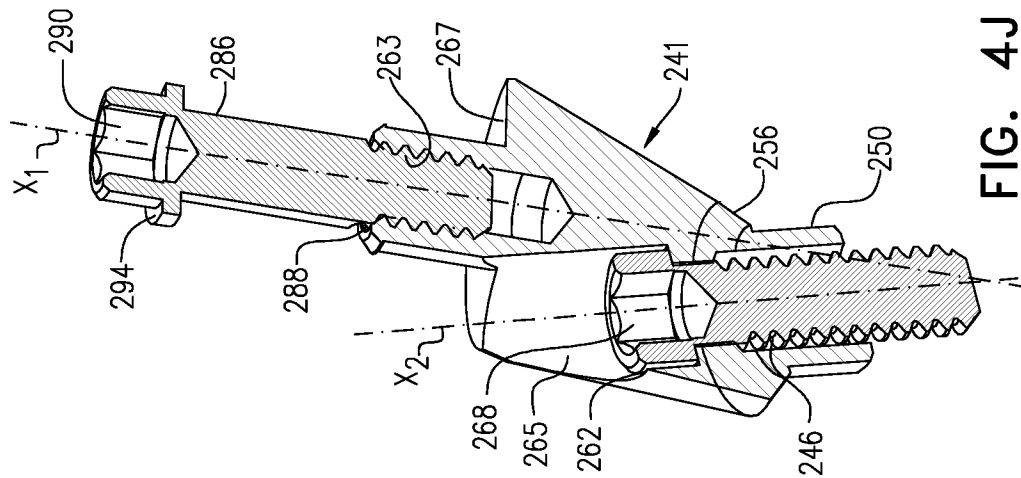


FIG. 4J

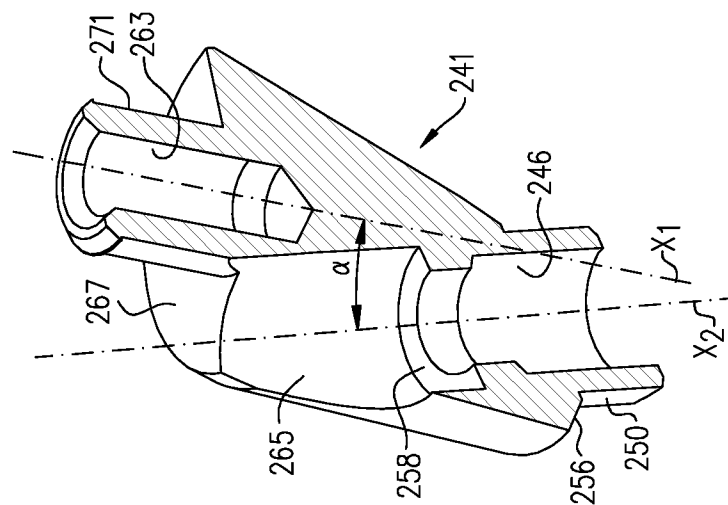


FIG. 4I

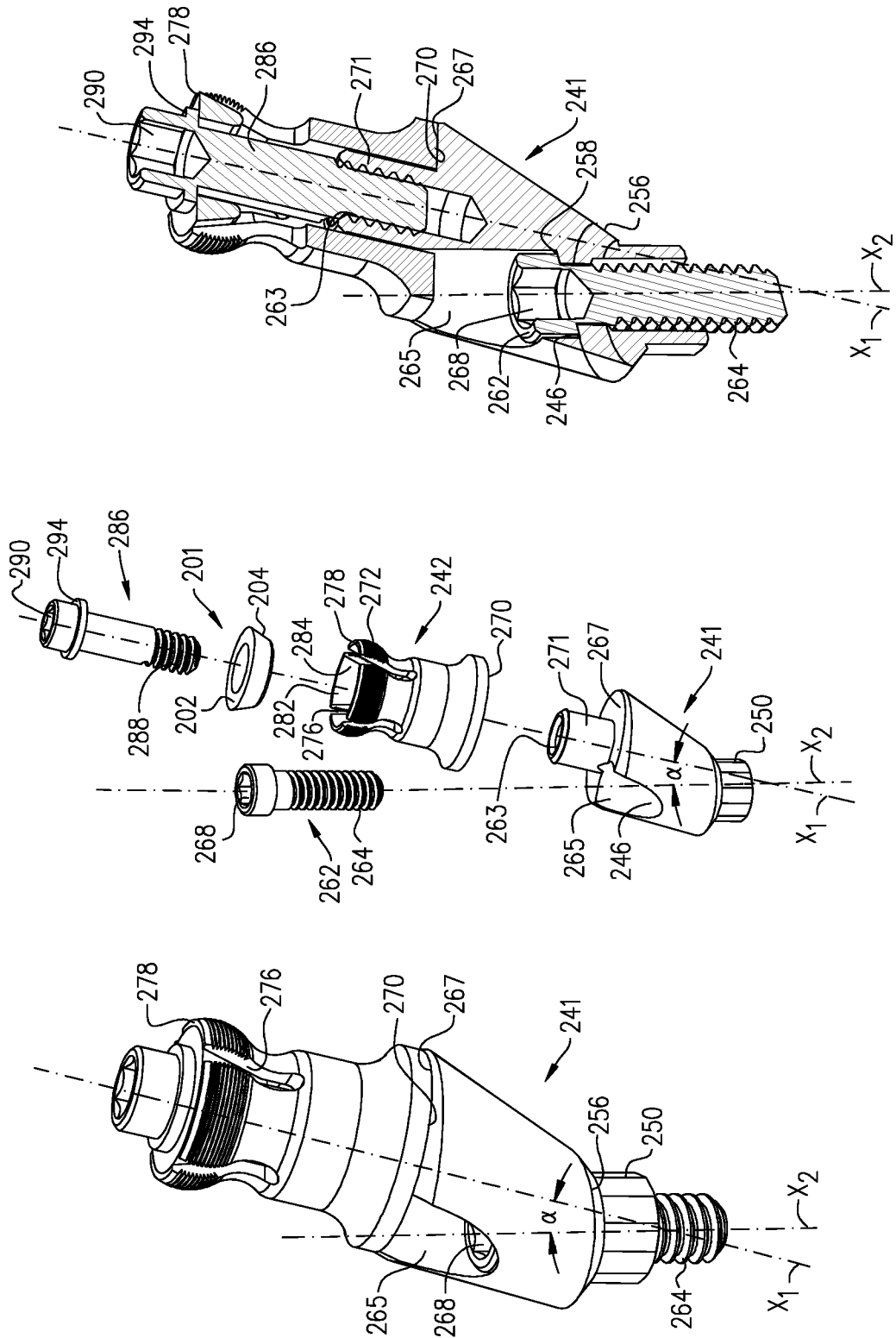


FIG. 4M

FIG. 4L

FIG. 4K

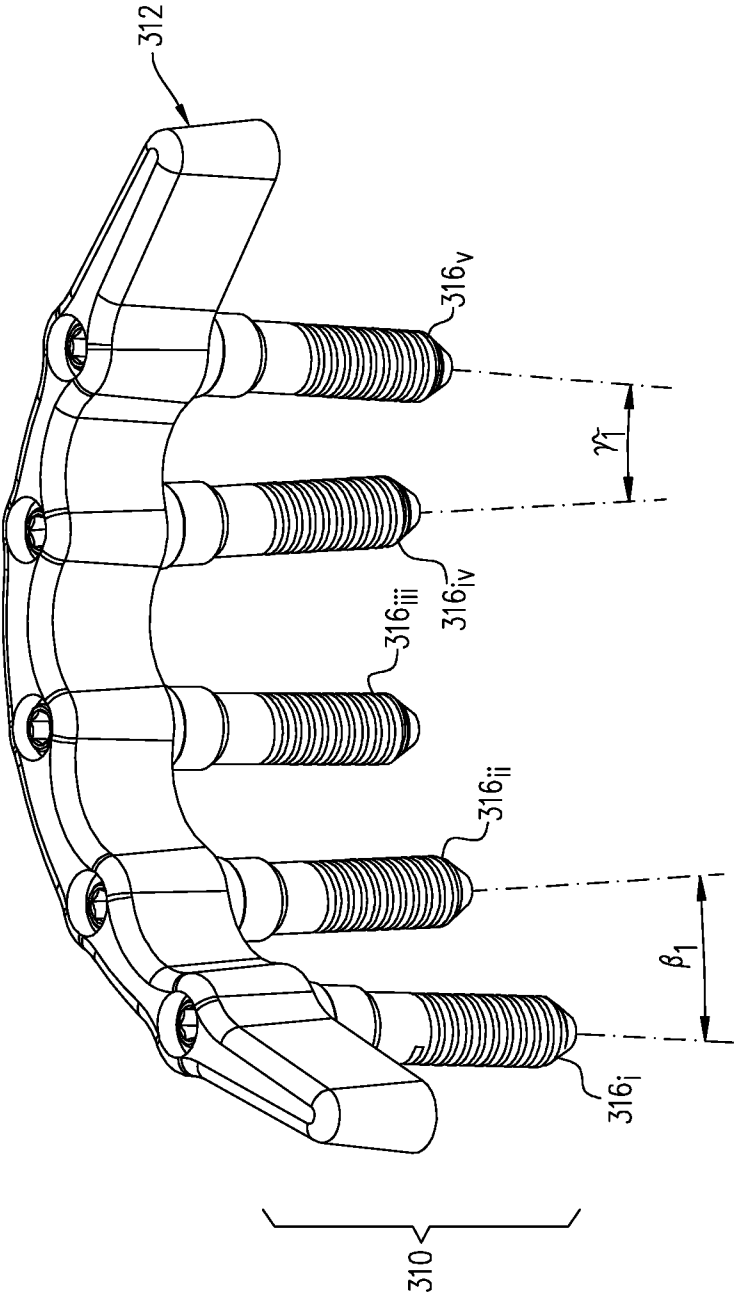


FIG. 5A

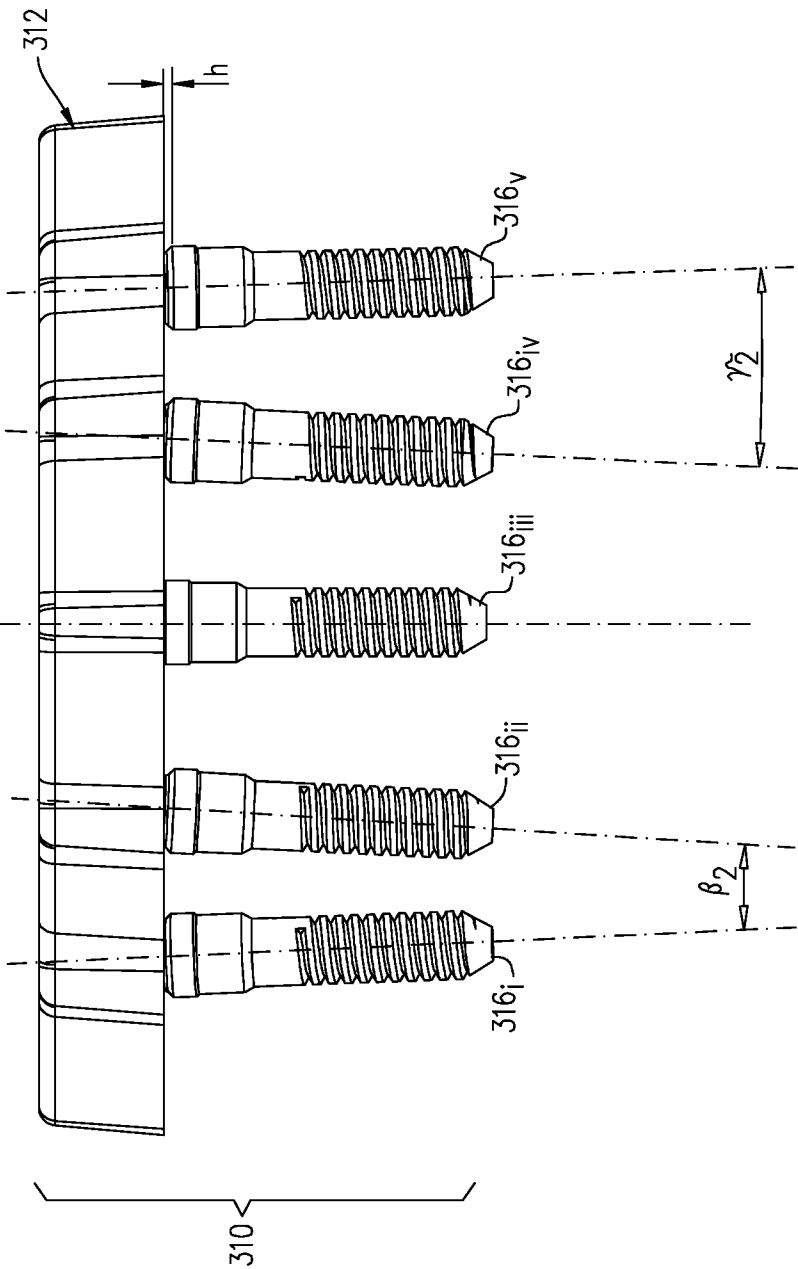


FIG. 5B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL2020/050388

A. CLASSIFICATION OF SUBJECT MATTER IPC (20200101) A61C 8/00, A61C 13/225 CPC (20130101) A61C 8/0048, A61C 8/0059, A61C 8/0065, A61C 8/0068, A61C 13/225 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) IPC (20200101) A61C 8/00, A61C 13/225 CPC (20130101) A61C 8/0048, A61C 8/0059, A61C 8/0065, A61C 8/0068, A61C 13/225 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 practicable, search terms used) Databases consulted: Google Patents, PatBase, Orbit, SIMILARI		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2018/060194 A1 (VALOC AG [CH]) 05 Apr 2018 (2018/04/05) paragraphs [0001], [0050], [0053]-[0056]; figures 1-7	1-31
X	US 2017/0224447 A1 (ANTHOGRYR [FR]) 10 Aug 2017 (2017/08/10) the whole document	30
A		1-29,31
A	US 2003/0224328 A1 (SAPIAN S. [US]) 04 Dec 2003 (2003/12/04) the whole document	1-31
A	US 2015/0118651 A1 (ANTHOGRYR [FR]) 30 Apr 2015 (2015/04/30) the whole document	1-31
☒ 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 05 Aug 2020		Date of mailing of the international search report 06 Aug 2020
Name and mailing address of the ISA: Israel Patent Office Technology Park, Bldg.5, Malcha, Jerusalem, 9695101, Israel Email address: pctoffice@justice.gov.il		Authorized officer SEGAL Liviu Telephone No. 972-73-3927134

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL2020/050388

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5135395 A (MARLIN ET AL. [US]) 04 Aug 1992 (1992/08/04) the whole document	1-31

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Information on patent family members

International application No.
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