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(54) Title: SCREW-RETAINED ABUTMENT WITH OFF-AXIS FEATURE AND METHODS OF MAKING AND USING SAME

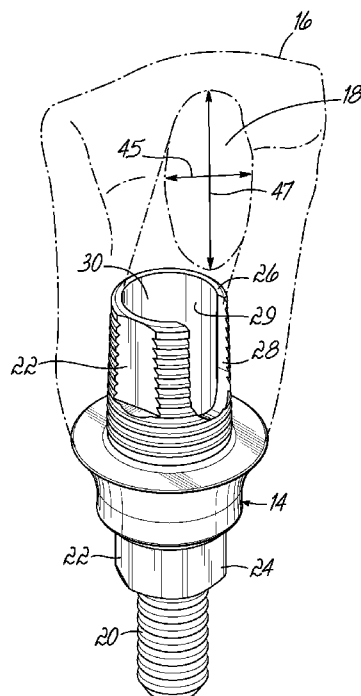


FIG. 1

(57) Abstract: An abutment (14) is provided with a cavity (30) and a slot (28) in its sidewall (29) adapted to allow a driver (36) to access a screw (20) in the cavity (30) at an angle Θ relative to a longitudinal axis of the screw (20). The abutment (14) may include a screw seat (52) and may be connected to an implant (12) via a screw (20) in the screw seat (52). A prosthesis (16), which may include a driver access channel (18) that has a diameter less than the outer diameter of the drive portion or head (50) of the screw (20), may be placed over the abutment (14). Methods of making a dental prosthesis and methods of attaching and removing the dental prosthesis from the implant are also disclosed.



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SCREW-RETAINED ABUTMENT WITH OFF-AXIS FEATURE AND METHODS OF MAKING AND USING SAME

Cross-Reference to Related Application

[0001] This application claims priority to U.S. Provisional Patent Application No. 62/235,079, filed September 30, 2015, the entire content of which is incorporated herein by reference.

Technical Field

[0002] The present invention relates generally to screw-retained abutments, and more particularly to screw-retained abutments with an off-axis feature, as well as methods of making and using the same.

Background

[0003] Edentulism, the condition of being toothless to some extent, may be treated by the implantation of a dental assembly. These assemblies require certain components to rest comfortably and securely in the patient's oral cavity. The implant fixture, also known as the dental implant or simply the implant, is the part of the dental assembly that becomes fused with the patient's jaw bone. The implant is available in both cylinder and screw-type varieties and is typically made from titanium or a titanium alloy. Implant abutments are screwed onto the implant and are positioned at and above the patient's gum line. Finally, a dental prosthesis is placed over the abutment and is designed to look and function like a natural tooth.

[0004] Alternatively, the prosthesis may be formed over the abutment outside of the patient's mouth, and the combined prosthesis and abutment may then be affixed to the implant with a fixation screw. To install the abutment and prosthesis onto the implant and to access the fixation screw during repair and maintenance of the dental assembly, the prosthesis must contain a screw access channel. In known dental assemblies, this screw access channel can often reside at the labial side of the tooth or on the biting surface, which is not desired as a matter of strength and aesthetics. Additionally, in known dental assemblies, this screw access channel must be of large enough diameter to allow the screw to traverse the channel. However, as the diameter of the channel increases, the strength of the prosthesis

becomes more compromised. Also, a fixation screw that may pass through the screw access channel of the prosthesis increases the risk that the screw may become dislodged and lead to swallowing the prosthesis and/or the fixation screw.

[0005] Solutions to the problem of labial access to the fixation screw have been proposed. In one such dental assembly, the screw access channel resides on the lingual side of the prosthesis and is angled relative to the longitudinal axis of the implant. However, the screw access channel still requires a large enough diameter to allow the fixation screw to pass through the prosthesis. Additionally, this dental assembly contains a ceramic abutment affixed to a titanium implant, increasing the likelihood of crack propagation in the ceramic abutment during tightening of the fixation screw, which seats against the ceramic abutment.

[0006] Therefore, there is a need for a dental assembly that addresses the present challenges and characteristics discussed above in regard to the screw access channel placement and the interface between the abutment and dental implant.

Summary of Invention

[0007] To these ends, an abutment is provided with a screw access hole and a slot in its sidewall adapted to allow a driver to access a screw in the screw access hole at an angle relative to a longitudinal axis of the screw. The abutment may include a screw seat and may be connected to an implant via a screw in the screw seat.

[0008] In another aspect of the invention, a dental assembly may include the abutment and a screw within the screw access hole of the abutment. Additionally, the dental assembly may include an implant adapted for connection to the abutment via the screw. A prosthesis, which may include a driver access channel that has a diameter less than the outer diameter of the drive portion of the screw, may be placed over the abutment.

[0009] In another embodiment, a process for making a dental assembly includes designing the dental assembly to include a screw access hole and the slot in the sidewall of an abutment of the dental assembly and manufacturing the dental assembly.

[0010] In another embodiment, a method of attaching a prosthesis to a dental implant is provided. The method includes assembling a fixation screw through a

screw access hole of an abutment and then fabricating the prosthesis, which includes a driver access channel, over the abutment. The abutment may be aligned with the dental implant and a driver may be passed through the driver access channel and rotated to drive the fixation screw.

[0011] In another embodiment, a method of detaching a prosthesis from a dental implant is provided. The method includes inserting a driver into a driver access channel of the prosthesis, which is affixed to an abutment, and rotating the driver to disengage a fixation screw from the dental implant. The abutment and prosthesis are then removed from the dental implant.

Brief Description of the Drawings

[0012] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given above, and the detailed description given below serve to explain various aspects of the invention.

[0013] FIG. 1 is a diagrammatic view of a prosthesis affixed to an abutment with a fixation screw inserted therein.

[0014] FIG. 2 is a detailed view of an abutment.

[0015] FIG. 3 is a diagrammatic cross-sectional view of a dental assembly with a driver engaged.

[0016] FIG. 4 is a diagrammatic view of a driver.

[0017] FIG. 5 is a diagrammatic view of a driver access channel analog.

[0018] FIG. 6A is a diagrammatic view of an abutment and fixation screw assembly with a coping affixed.

[0019] FIG. 6B is a diagrammatic view of an abutment, fixation screw, and coping assembly affixed to an implant analog.

[0020] FIG. 6C is a diagrammatic view of an abutment, fixation screw, coping, and implant analog assembly with a driver access channel analog included therewith.

[0021] FIG. 6D is a diagrammatic cross-sectional view of an abutment, fixation screw, and coping assembly.

[0022] FIG. 7 is a diagrammatic view of a computer model of an implant, abutment, and prosthesis blank.

[0023] FIG. 8A is a diagrammatic cross-sectional view of a dental assembly.

[0024] FIG. 8B is a diagrammatic cross-sectional view of a dental assembly implanted in a patient's jaw.

[0025] FIG. 8C is a diagrammatic cross-sectional view of a dental assembly with a driver engaged.

[0026] FIG. 8D is a diagrammatic cross-sectional view of a dental assembly with a driver engaged.

Detailed Description

[0027] Although the invention will be described next in connection with certain embodiments, the invention is not limited to practice in any one specific type of dental assembly. The description of the embodiments of the invention is intended to cover all alternatives, modifications, and equivalent arrangements as may be included within the spirit and scope of the invention as defined by the appended claims. In particular, those skilled in the art will recognize that the components of the embodiments of the invention described herein could be arranged in multiple different ways.

[0028] With reference now to the FIGS., a dental assembly 10 is shown with an implant 12, an abutment 14, and a prosthesis 16. In FIG. 1, prosthesis 16 is shown with driver access channel 18 at an angle θ off the longitudinal access of fixation screw 20 and implant 12, as best shown in FIGS. 3 and 8B. A detailed view of the abutment 14 is shown in FIG. 2. In the embodiment shown, the abutment may include an optional anti-rotation feature 22 at the apical region 24 of abutment 14 that interfaces with engaging features of the implant at its coronal end (not shown) to position the abutment 14 radially. Similarly, coronal region 26 of abutment 14 may include an optional anti-rotation feature 22 that interfaces with engaging features (not shown) of the prosthesis 16. Also, in the embodiment shown, the coronal region 26 of the abutment 14 may include grooves to improve securing, e.g. cementing, of the prosthesis 16 to the abutment 14.

[0029] Slot 28 in the sidewall 29 of abutment 14 allows a driver to access the fixation screw 20 at an angle. Such angular access allows for the placement of the driver access channel 18 on the lingual side of the prosthesis.

[0030] Abutment 14 also includes cavity 30 with a height 32 corresponding to the height 34 of the screw 20. In this way, the screw 20 may move upwardly when being disengaged from the implant 12 while the prosthesis 16 remains attached to

the abutment 14. Therefore, the screw 20 need not ever be completely removed through the prosthesis 16, and the risk of inadvertent swallowing of the screw 20 during removal of the prosthesis 16 is decreased. Stated differently, the screw 20 may disengage the implant 12, but may also be contained within the cavity 30 of abutment 14.

[0031] Referring still to FIG. 2, the abutment 14 may be dual colored. The abutment 14 has an apical portion 24 configured to be positioned within a gingival region of a patient's mouth, and a coronal portion 26 configured to support the prosthesis 16. The apical portion 24 may be a first color, generally gingival-colored, and the coronal portion 26 may be a second color different from the first color, generally tooth-colored. Such a dual-colored abutment allows for a more aesthetically pleasing installation. However, such dual coloring is optional.

[0032] Although the embodiments discussed herein are drawn toward single-unit dental assemblies, it is also possible to adapt the present invention to multi-unit bridge dental assemblies. In such an embodiment, the anti-rotational features 22 of the abutment 14 are not engaged by the implant 12. However, the cavity 30 of the coronal portion 26 of the abutment 14 is configured similarly to the cavity 30 of the single-unit dental assemblies.

[0033] As shown in FIGS. 3 and 4, a conventional ball-point hex driver 36 may be used to drive fixation screw 20 through the abutment 14 and into the implant 12. The driver 36 passes through driver access channel 18, which may be sized such that driver 36 fits therethrough but screw 20 does not. Through the use of a ball-point hex driver 36, the user may change the angle θ of the driver 36 as driver 36 is rotated to insert or remove the screw 20. Alternatively, the user may hold the angle θ steady throughout the insertion and removal procedure. However, in applications where it is desirable to make the screw 20 removable, the radius 37 of driver access channel 18 may be widened to allow the screw 20 to pass fully therethrough.

[0034] The dental assembly may be made through two main steps. First, conventional or digital processes may be used to design the dental assembly, which will be unique to each patient and application. Then, the dental assembly may be manufactured either via conventional manufacturing techniques modified to include the driver access channel 18 or through computer-aided manufacturing techniques.

[0035] Turning now to FIGS. 5-6D, the prosthesis 16 may be formed by a modification to conventional methods. First, the dental professional makes an

impression of the patient's oral cavity using conventional transfer techniques. Then, a stone model of the patient's jaw bone is created, including an implant analog 38 replicating the exact implant 12 orientation and height. Then the dental professional assembles abutment 14 onto implant analog 38 with screw 20, ensuring that slot 28 in the sidewall 29 of abutment 14 is oriented at the desired position. A coping 40 is placed onto abutment 14, again ensuring alignment of coping slot 42 in the sidewall 43 with abutment slot 28. An access-channel plug 44 may be placed into slots 28, 42 at the desired off-axis angle θ . The access-channel plug 44 will represent the driver access channel 18 within the completed prosthesis 16. Acrylic wax may then be placed around the coping 40 and access channel plug 44, and the plastic coping 40 may be modified as needed to create the desired prosthetic shape. Standard laboratory processes may be used to fabricate the prosthesis from the wax inverse negative thus formed. As a result, the formed prosthesis will contain a driver access channel 18 of the same diameter as the shaft 46 of access-channel plug 44, and screw 20 will be contained within abutment 14 in such a manner that it may not pass through the driver access channel 18 and is contained within the cavity 30 of abutment 14. Driver access channel 18 may thus have a generally elliptical shape with a long axis 45 and a short axis 47, as best shown in FIG. 1. The long axis 45 is configured to allow the driver 36 to move along the driver access channel 18 to contact the screw continuously during rotation of the driver 36.

[0036] Alternatively, prosthesis 16 may be formed using a digital workflow procedure. First, the dental professional conducts an intra-oral or impression scan using digital impression techniques. The data thus generated are imported into software that determines implant or abutment height as well as the required orientation of the engaging features. This or other software may then be used to determine the correct linear, axial, and rotational location of the dental assembly components, including the desired location and orientation of the slot 28 of abutment 14. Software also designs the prosthesis with an appropriate off-axis drive access channel. Finally, the prosthesis is fabricated following computer-aided manufacturing procedures.

[0037] An exemplary computer-aided manufacturing process using a 3SHAPE® CAD/CAM system is provided for further illustration. First, data obtained from either an intra-oral or impression scan of the patient's oral cavity are imported into the CAD system. Then, a computer model of the implant 12 and abutment 14,

the abutment 14 having a slot 28 in its sidewall 29, is combined with a computer model of a prosthesis blank 49 *in silico*. The prosthesis blank 49 includes a scan adapter flat 51 that is aligned with the slot 28 in the sidewall 29 of the abutment 14. See FIG. 7. The implant 12, abutment 14, and prosthesis blank 49 are placed within a visual depiction of the patient's oral cavity in the appropriate location, with the scan adapter flat 51 aligned in the desired direction of the off-axis driver access channel 18. The angle of this off-axis driver access channel 18 may be modified, as desired, *in silico*. The design software can then be used to transform the prosthesis blank 49 into an appropriate prosthesis 16 that includes the off-axis driver access channel 18.

[0038] Once the design of the dental assembly 10 is complete, the actual prosthesis 16 may be formed from a milling process using the data obtained from the CAD software. The milled prosthesis 16 may then be attached to an abutment 14 and implant 12 using cement, for example. It may be beneficial to insert an access channel plug 44 into the off-axis driver access channel 18 during the attachment of the prosthesis 16 to the abutment 14 to protect the screw 20 from the cement. Indeed, the access channel plug 44 may be used to align the prosthesis 16 by inserting the access channel plug 44 into the head 50 of the screw 20 and then passing the prosthesis 16 over the access channel plug 44 and onto the abutment 14. Once the prosthesis 16 is formed and attached to the abutment 14 and implant 12, the resulting dental assembly 10 may then be placed inside the patient's oral cavity.

[0039] Turning now to FIGS. 8A-8D, dental assembly 10 may be assembled as follows. Implant 12 may be installed in the patient's jaw 48 using conventional procedures. Pre-assembled abutment 14 and prosthesis 16, which contains fixation screw 20, may be aligned with implant 12. Driver 36 may be used to drive fixation screw 20 through abutment 14 and into implant 12. Conveniently, head 50 of screw 20 may rest in screw seat 52 of abutment 14. Screw seat 52 may be formed from titanium or some other similarly strong metal, thus reducing the risk of deformation or cracking during the screw tightening procedure. Removal of the prosthesis may then be accomplished by the reverse of the installation procedure detailed above.

[0040] While the present invention has been illustrated by the description of one or more embodiments thereof, and while the embodiments have been described in considerable detail, they are not intended to restrict or in any way limit the scope of the appended claims to such detail. The various features shown and described

herein may be used alone or in any combination. Additional advantages and modifications will readily appear to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and method and illustrative examples shown and described. Accordingly, departures may be from such details without departing from the scope of the general inventive concept.

WHAT IS CLAIMED IS:

1. An abutment with a longitudinal axis and a sidewall, the abutment comprising a cavity along the longitudinal axis and a slot in the sidewall adapted to allow a driver to access a screw in the screw access hole at an angle relative to the longitudinal axis.
2. The abutment of claim 1, further comprising at least one anti-rotational feature.
3. The abutment of claim 1, further comprising an apical portion and a coronal portion, wherein the apical portion is a first color and the coronal portion is a second color different from the first color.
4. The abutment of claim 1, further comprising at least one implant engaging feature.
5. The abutment of claim 1, wherein the angle relative to the longitudinal axis is 0° to 35°.
6. A dental assembly comprising the abutment of claim 1; and a screw within the cavity of the abutment.
7. The dental assembly of claim 6, further comprising an implant adapted for connection to the abutment via the screw.
8. The dental assembly of claim 6, further comprising a coping having a sidewall and a slot in the sidewall, the coping placed over the abutment such that the slot in the sidewall of the coping and the slot in the sidewall of the abutment overlap.

9. The dental assembly of claim 8, further comprising
an access-channel plug configured to fit into the slot in the sidewall of the coping.
10. The dental assembly of claim 6, further comprising
a prosthesis having a driver access channel, the driver access channel having an opening on at least one surface of the prosthesis, the prosthesis placed over the abutment such that the driver access channel of the prosthesis and the slot in the sidewall of the abutment overlap.
11. The dental assembly of claim 10, wherein the opening of the driver access channel is an elliptical shape having a long axis and a short axis, the long axis configured to allow the driver to move along the driver access channel to contact the screw continuously during rotation of the driver.
12. A dental assembly comprising
the abutment of claim 5; and
a screw within the cavity of the abutment.
13. The dental assembly of claim 12, further comprising
an implant adapted for connection to the abutment via the screw.
14. The dental assembly of claim 12, further comprising
a coping having a sidewall and a slot in the sidewall, the coping placed over the abutment such that the slot in the sidewall of the coping and the slot in the sidewall of the abutment overlap.
15. The dental assembly of claim 14, further comprising
an access-channel plug configured to fit into the slot in the sidewall of the coping.

16. The dental assembly of claim 12, further comprising
a prosthesis having a driver access channel, the driver access channel having an opening on at least one surface of the prosthesis, the prosthesis placed over the abutment such that the driver access channel of the prosthesis and the slot in the sidewall of the abutment overlap.
17. The dental assembly of claim 16, wherein the opening of the driver access channel is an elliptical shape having a long axis and a short axis, the long axis configured to allow the driver to move along the driver access channel to contact the screw continuously during rotation of the driver.
18. A process for making the dental assembly of claim 6 comprising:
designing the dental assembly to include the screw access hole and the slot in the sidewall of the abutment; and
manufacturing the dental assembly.
19. The process of claim 18, wherein the designing the dental assembly includes intraoral scanning of an oral cavity and computer aided placement of the screw access hole and the slot in the sidewall to produce a computer model of the dental assembly.
20. The process of claim 18, wherein the designing the dental assembly includes taking an impression of an oral cavity.
21. The process of claim 20, further comprising making a stone model of the oral impression.
22. The process of claim 19, wherein the manufacturing the dental assembly includes milling the dental assembly in accordance with the computer model of the dental assembly.
23. The process of claim 20, wherein the impression of the oral cavity is used to prepare a computer model of the dental assembly.

24. The process of claim 23, wherein the manufacturing the dental assembly includes milling the dental assembly in accordance with the computer model of the dental assembly.
25. The process of claim 21, further comprising
- attaching the abutment to the stone model in a treatment location;
 - applying a coping having a sidewall and a slot in the sidewall, the coping placed over the abutment such that the slot in the sidewall of the coping and the slot in the sidewall of the abutment overlap;
 - inserting an access-channel plug configured to fit into the slot in the sidewall of the coping and into the slot in the sidewall of the abutment at an off-axis angle;
 - applying wax around the coping and the access channel plug to create a tooth-shaped wax inverse negative;
 - removing the access channel plug from the wax inverse negative;
 - converting the wax inverse negative to a prosthesis having a driver access channel, the driver access channel having an opening on at least one surface of the prosthesis, the prosthesis placed over the abutment such that the driver access channel of the prosthesis and the slot in the sidewall of the abutment overlap;
 - inserting the screw into the cavity; and
 - attaching the prosthesis to the abutment.

26. A process for attaching a prosthesis to a dental implant, the process comprising

- assembling a fixation screw into an abutment;
- fabricating the prosthesis, the prosthesis including a driver access channel;
- attaching the prosthesis to the abutment;
- aligning the abutment to the dental implant;
- inserting a driver into the driver access channel; and
- driving the driver to rotate the fixation screw, thereby attaching the prosthesis

to the dental implant.

27. A process for detaching a prosthesis from a dental implant, the process comprising

- inserting a driver into a driver access channel in the prosthesis, the prosthesis affixed to an abutment, the abutment comprising a screw access hole;

- engaging the driver with a screw through the driver access channel of the prosthesis and the cavity of the abutment;

- rotating the driver to disengage the screw from the dental implant; and
- removing the abutment and the prosthesis from the dental implant.

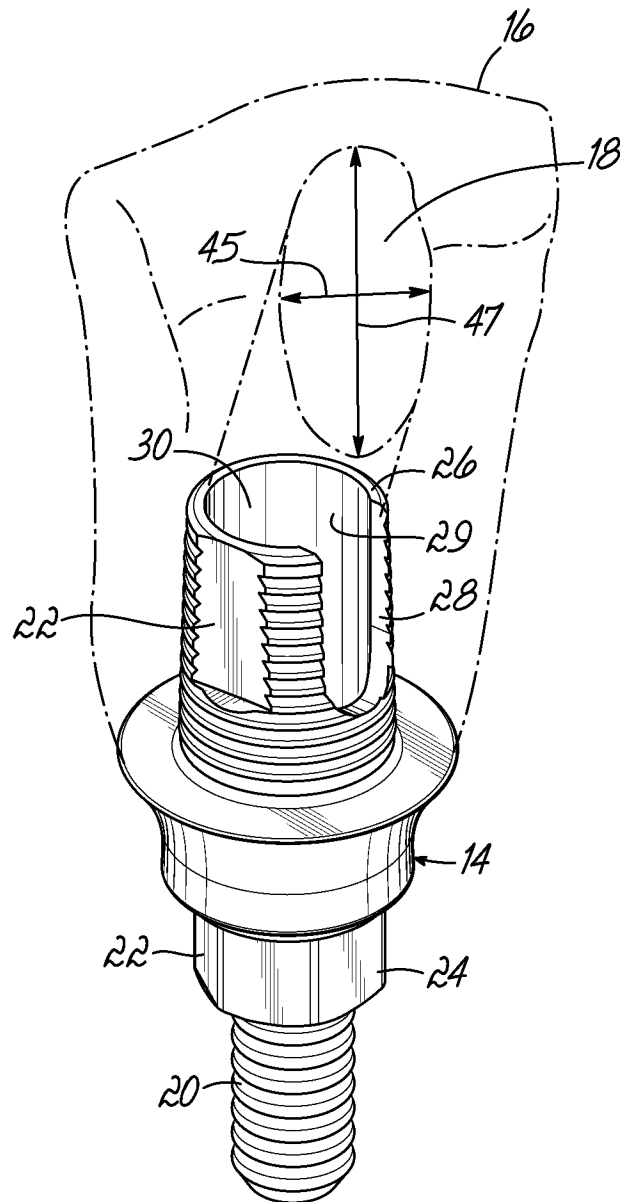


FIG. 1

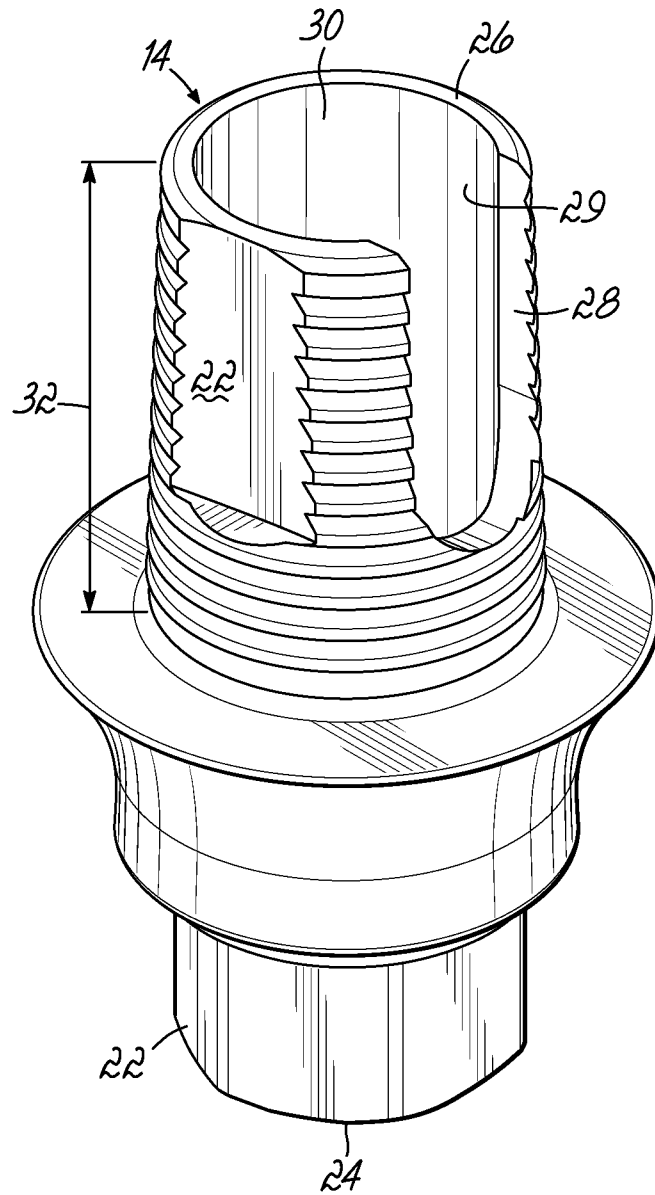


FIG. 2

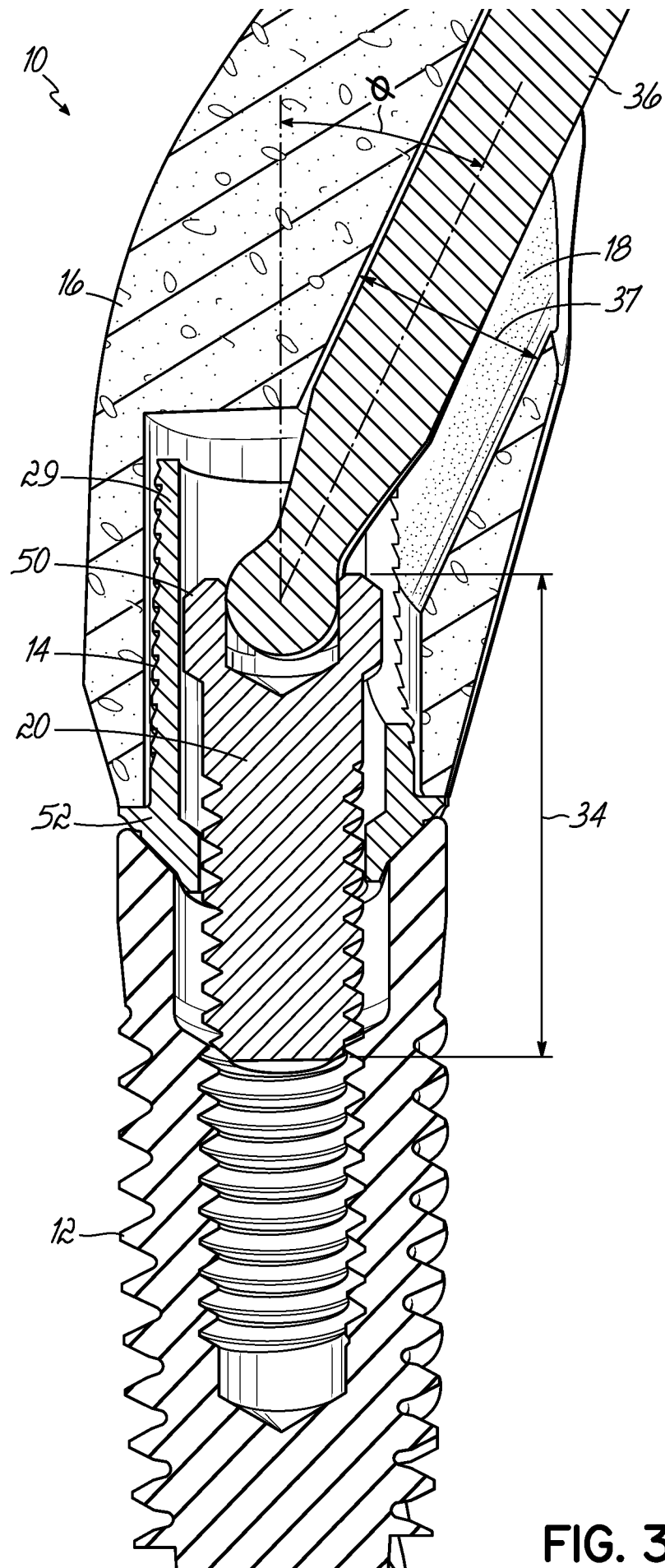


FIG. 3

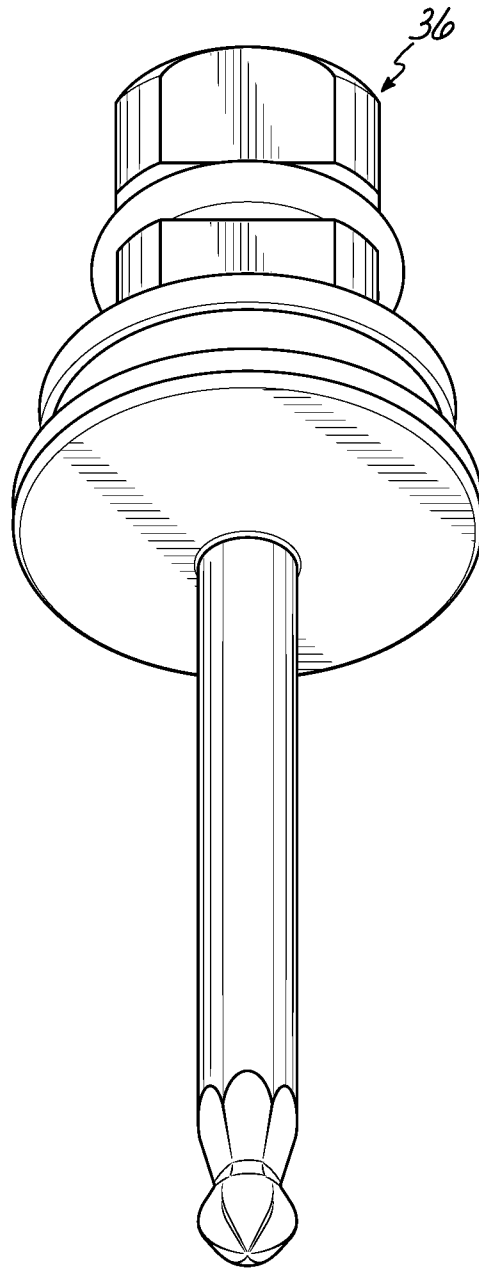


FIG. 4

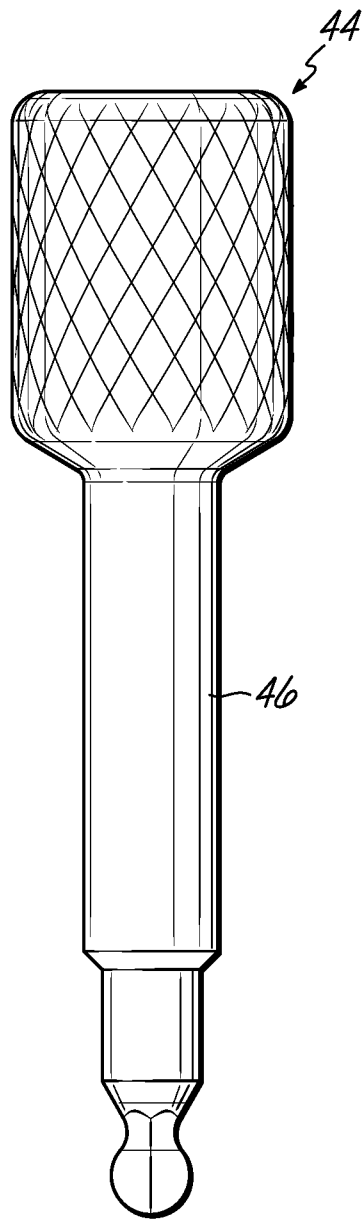


FIG. 5

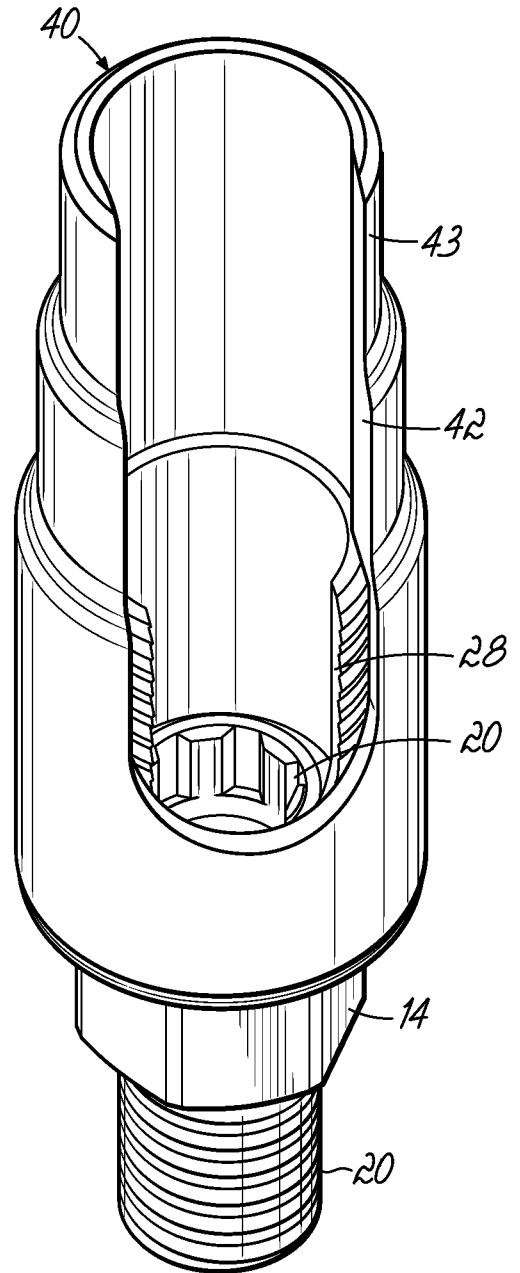


FIG. 6A

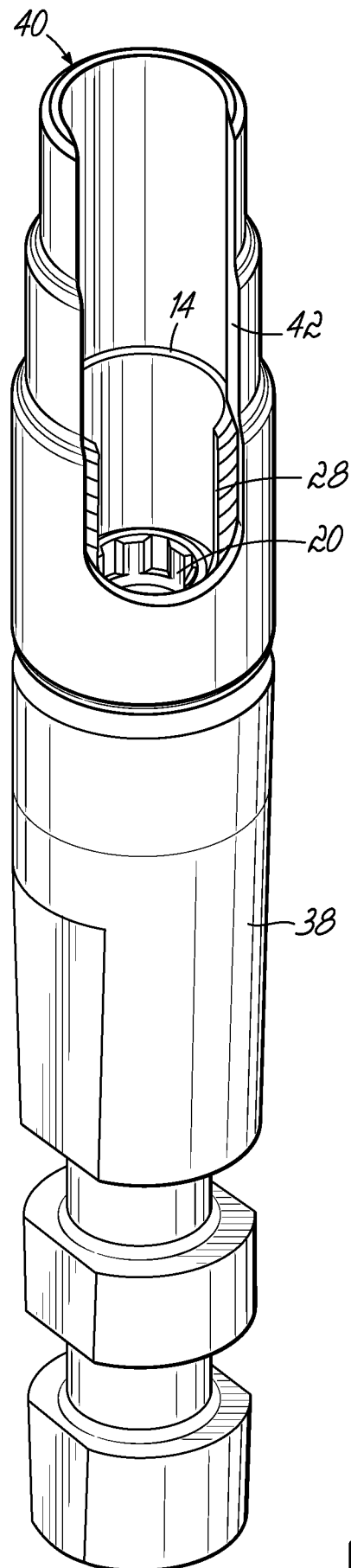


FIG. 6B

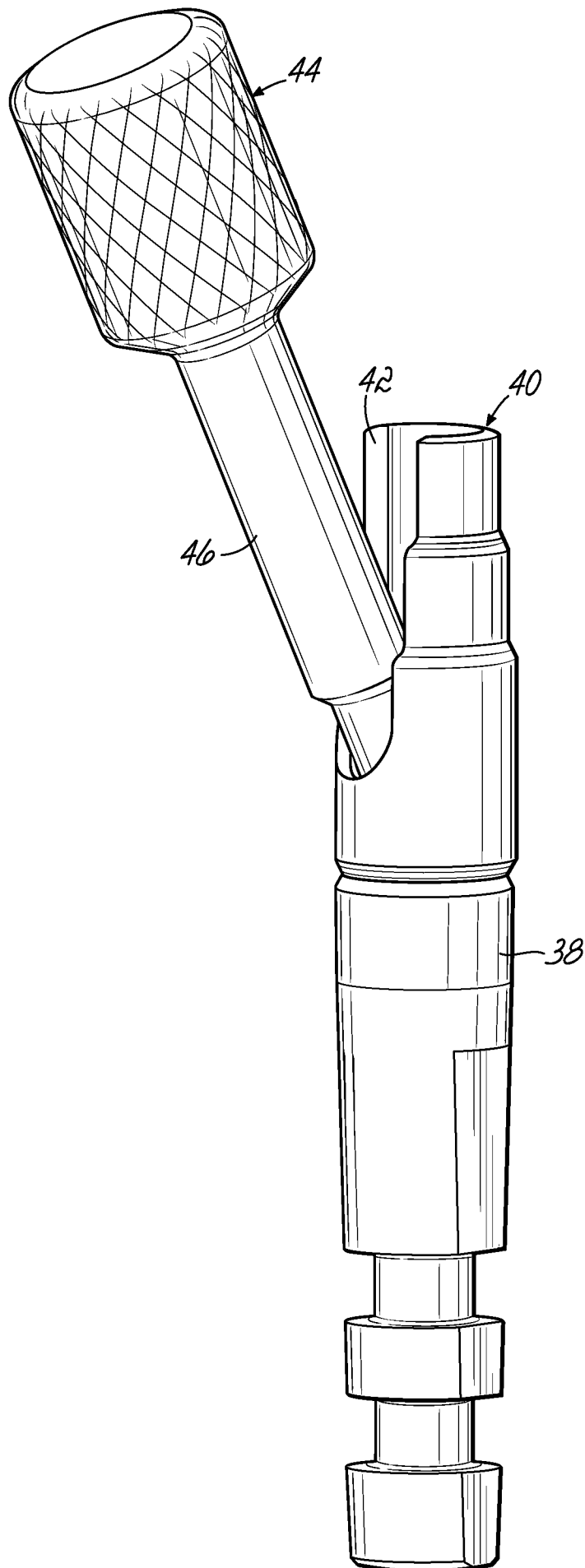


FIG. 6C

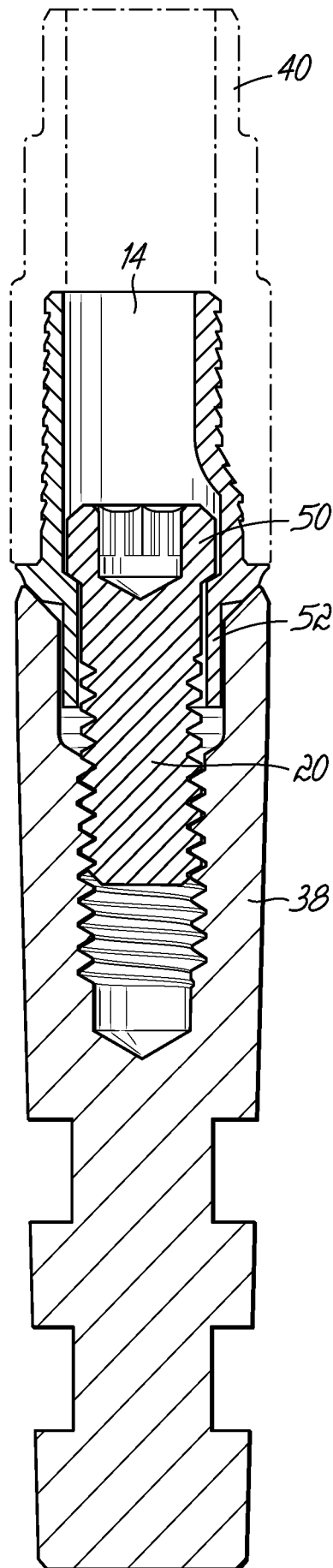


FIG. 6D

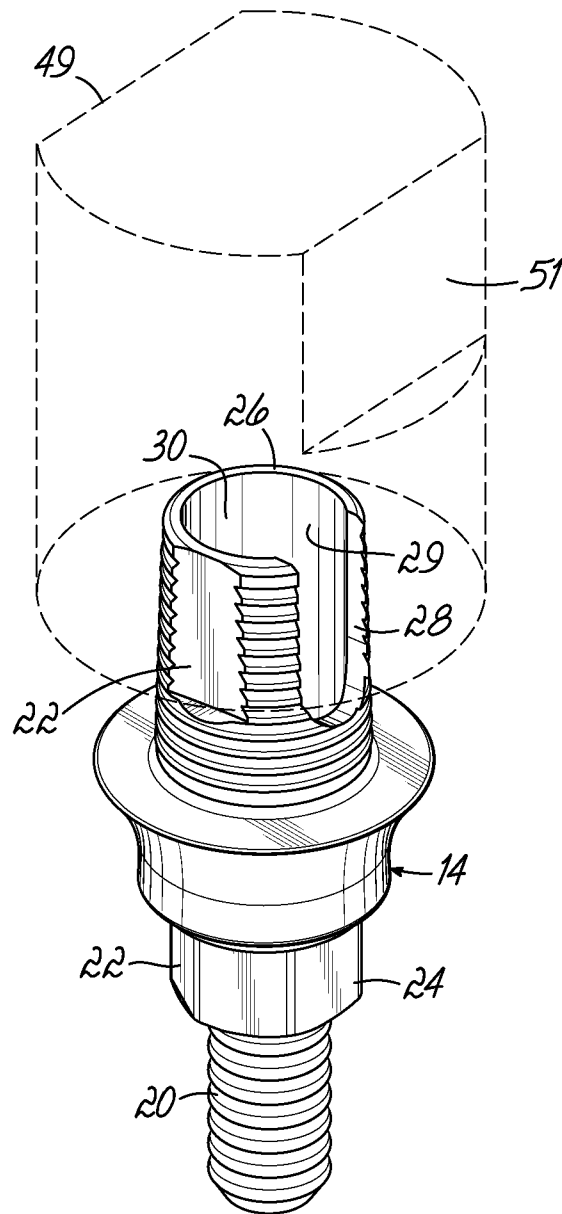


FIG. 7

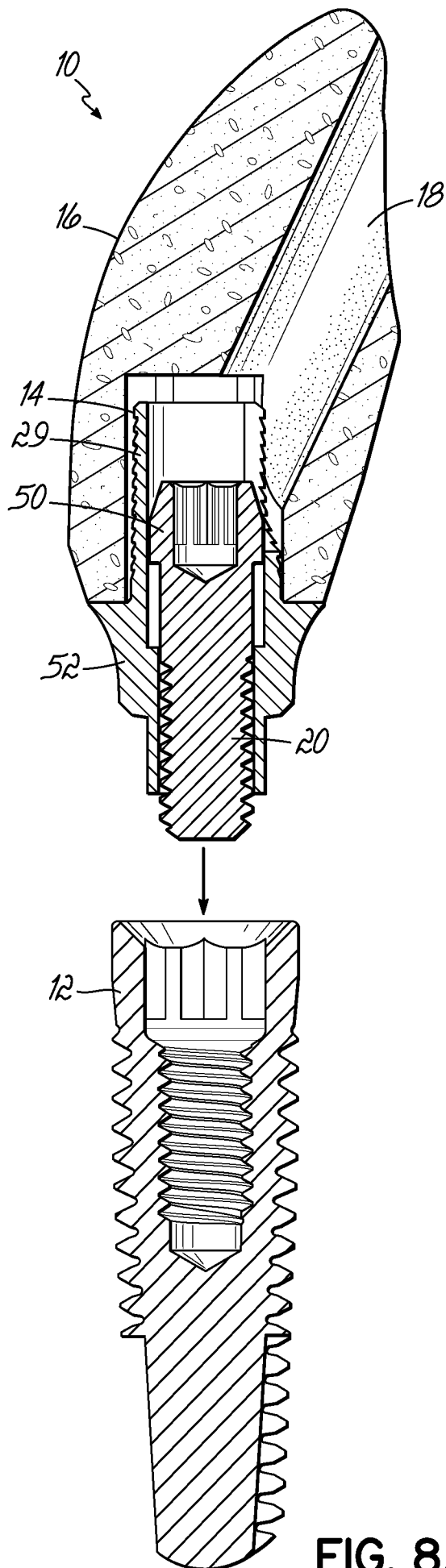


FIG. 8A

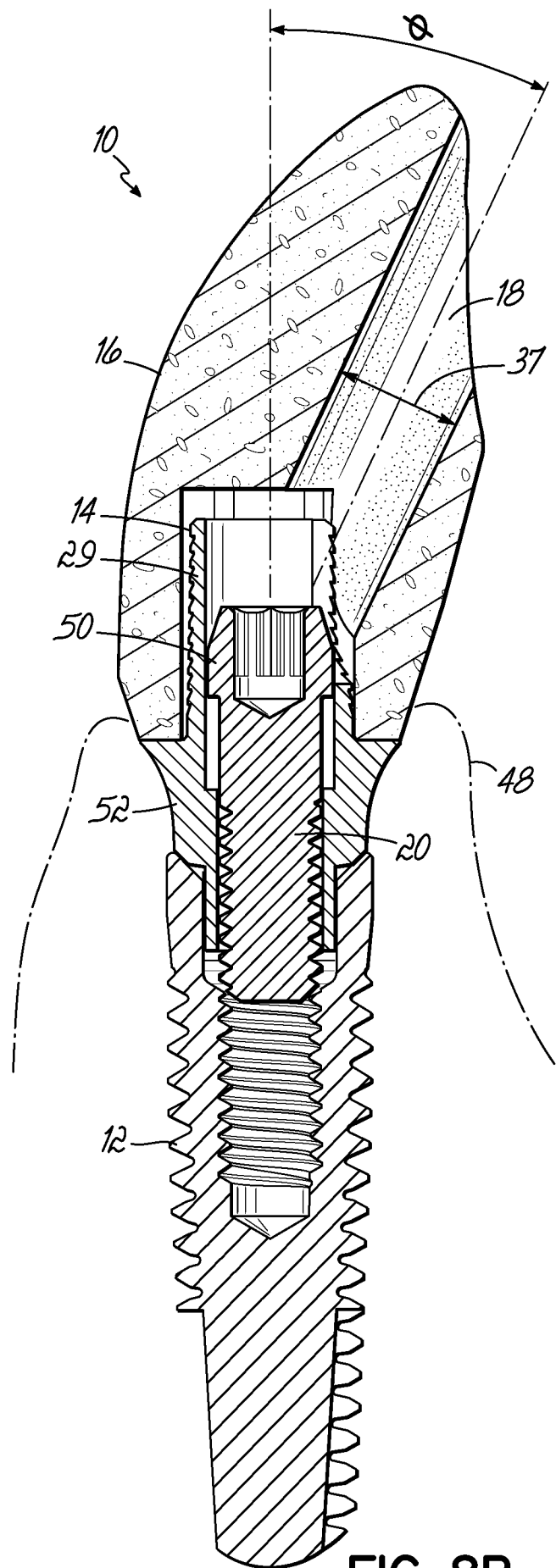


FIG. 8B

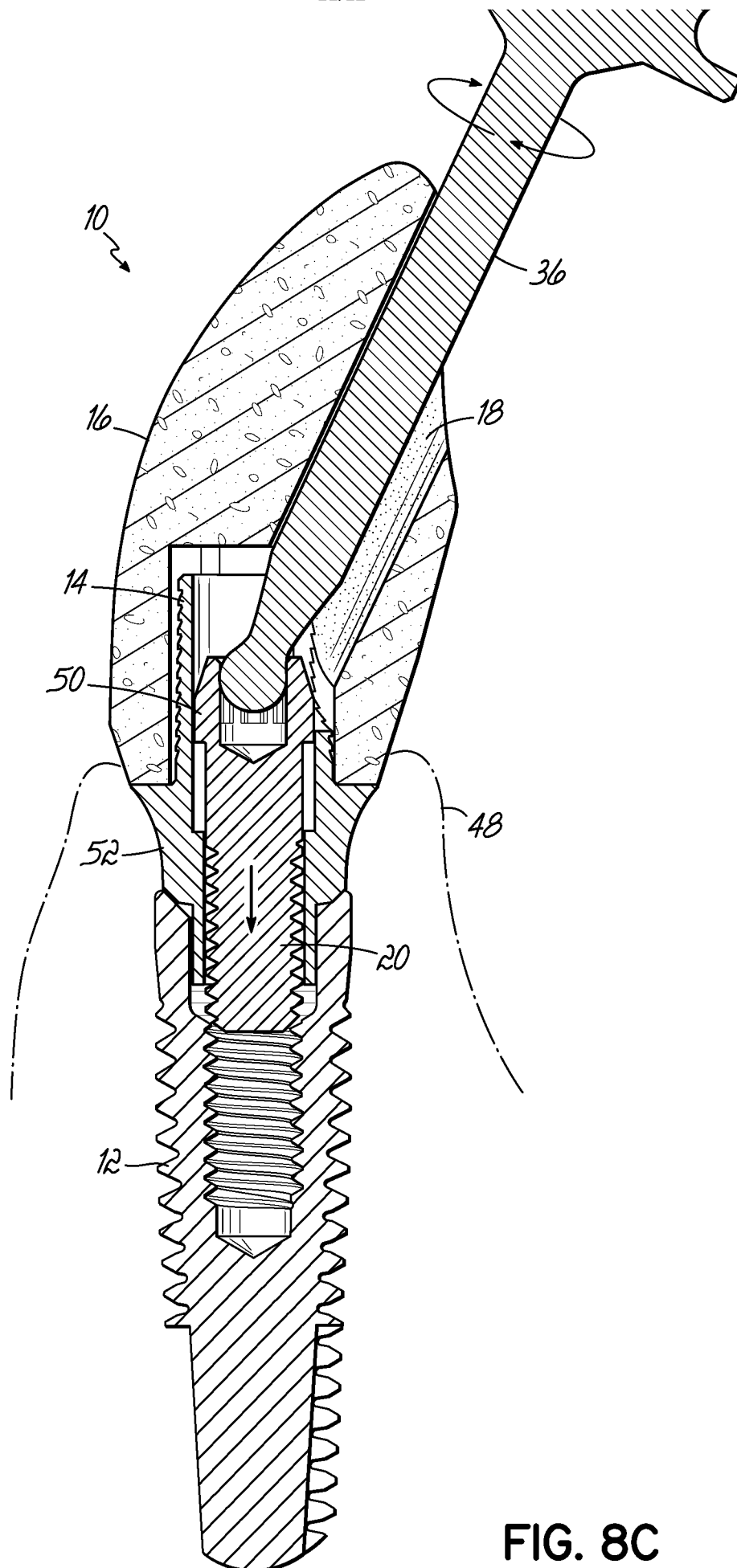


FIG. 8C

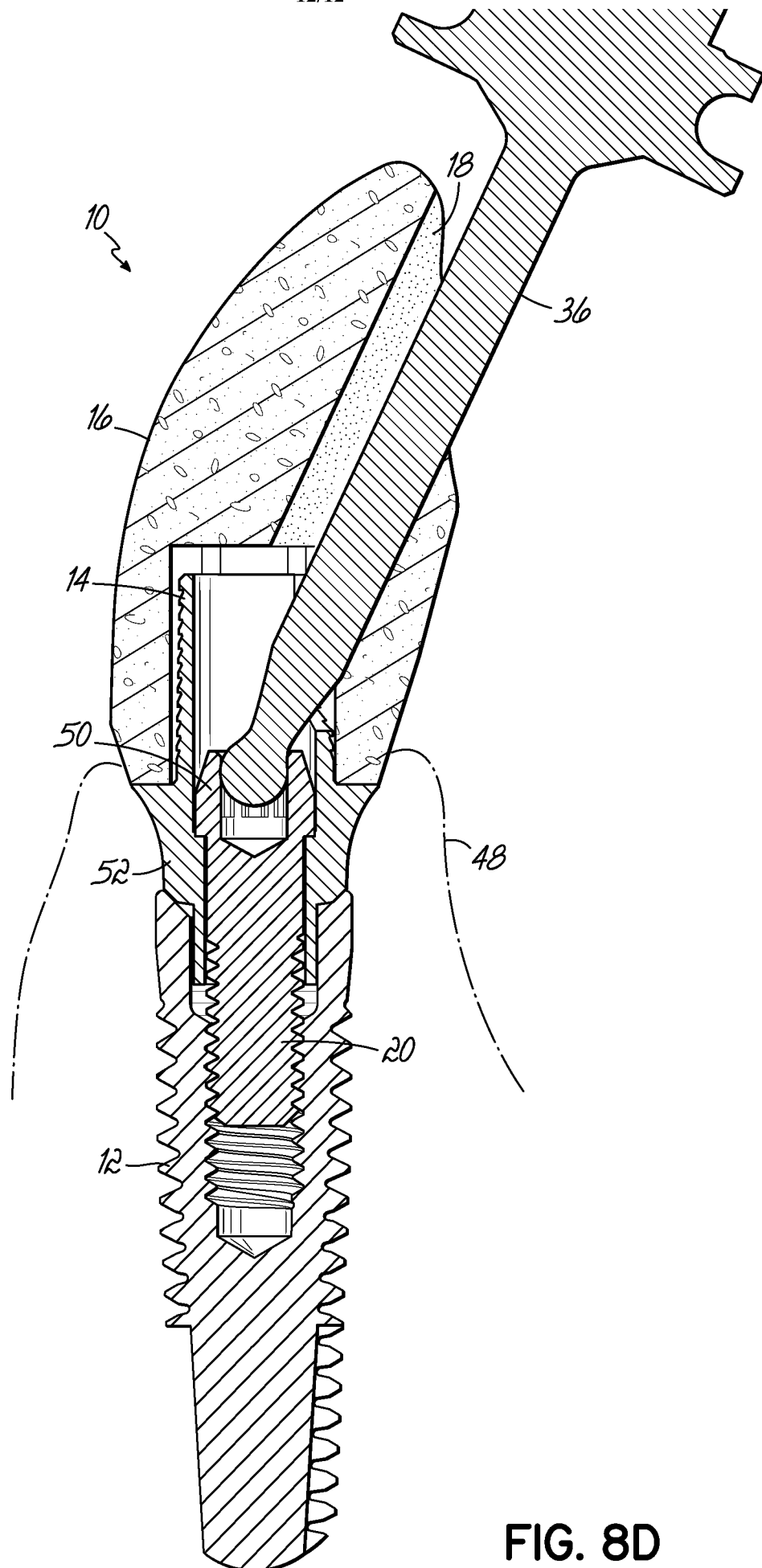


FIG. 8D

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US16/54719

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-25 are directed towards an abutment with a longitudinal axis and a sidewall, the abutment comprising a cavity along the longitudinal axis and a slot in the sidewall adapted to allow a driver to access a screw in the screw access hole at an angle relative to the longitudinal axis.

Group II: Claim 26-27 are directed towards aligning the abutment to the dental implant; inserting a driver into the driver access channel, and driving the driver to rotate the fixation screw, thereby attaching the prosthesis to the dental implant; or inserting a driver into a driver access channel in the prosthesis, the prosthesis affixed to an abutment.

The inventions listed as Groups I and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features.

****See Supplemental Page****

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-25

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US16/54719

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61C8/00, A61C13/225, A61C13/34 (2016.01)

CPC - A61C8/005, A61C8/0068, A61C13/0004, A61C13/0022, A61C13/225, A61C13/34

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(8) Classifications: A61C8/00, A61C13/225, A61C13/34 (2016.01)

CPC Classifications: A61C8/005, A61C8/0068, A61C13/0004, A61C13/0022, A61C13/225, A61C13/34

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)

PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); Google Scholar, Pubmed, EBSCO

Abutment, cavity, hole, depression, hollow, slot, recess, cut, opening, sidewall, wall, angle, axis, off axis, angular, screw, thread, dental, teeth, tooth, prosthesis, implant, model, tool, driver, screwdriver, access, entrance, channel, coping, plug, attach, detach, fixation, design

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CA 2920441 A1 (XAM-MAR MANGRANE, E) March 26, 2015; figures 1, 11; page 2 lines 33-34, page 5 lines 32-35, page 6 lines 2-5, 12-21	1-2, 4-7, 12, 13
Y		3, 8-11, 14-24
Y	WO 2014/173539 A1 (STRAUMANN HOLDING AG) October 20, 2014; page 7 lines 10-30, page 9 lines 30-31, page 10 lines 1-3; page 17 line 10-11	3
Y	WO 2013/004387 A1 (NOBEL BIO CARE SERVICES AG) January 10, 2013; figures 2, 5A; page 5 paragraph, page 6 paragraph 2, page 8 paragraph 3, page 9 paragraph 1	10-11, 16-17
A		25
Y	US 6,159,010 A (ROGERS, DP, et al.) December 12, 2000; figure 1; column 2 lines 36-40, 50-55; claim 27	8, 14
A		25
Y	WADHWANI, C, et al. An Esthetic Solution to the Screw-Retained Implant Restoration: Introduction to the Implant Crown Adhesive Plug: Clinical Report. Journal of Esthetic and Restorative Dentistry. Vol. 23, No. 3; June 2011 [online]. [retrieved on 19 November 2016]. <URL: http://onlinelibrary.wiley.com/doi/10.1111/j.1708-8240.2011.00423.x/full >; page 139 paragraph 4	9, 15
Y	US 6,126,445 A (WILLOUGHBY, AJM) October 3, 2000; figure 4; column 3 line 65, column 4 lines 55-57, column 20 lines 10-15, column 51 lines 6-11, 21-23	18-24
A		25
A	US 2007/0154864 A1 (DEER, DJ, et al.) July 5, 2007; paragraphs [0004], [0008], [0010], [0027], [0030]	25



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

28 November 2016 (28.11.2016)

Date of mailing of the international search report

31 JAN 2017

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INTERNATIONAL SEARCH REPORT

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2014/200404 A1 (BRANEMARK INTEGRATION AB) December 18, 2014; entire document	1-25
A	WO 2014/064558 A2 (MEDICAL CORPORATION IT) May 1, 2014; entire document	1-25
A	WO 2008/157137 A1 (SOUTHERN IMPLANTS, INC.) December 24, 2008; entire document	1-25
A	US 2013/0209958 A1 (BENZ, R, et al.) August 15, 2013; entire document	1-25

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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.-***-Continued from Box III: Lack of Unity of Invention-***-

Group I has at least an abutment with a longitudinal axis and a sidewall, the abutment comprising a cavity along the longitudinal axis and a slot in the sidewall adapted to allow a driver to access a screw in the screw access hole at an angle relative to the longitudinal axis that Group II does not have.

Group II has at least aligning the abutment to the dental implant; inserting a driver into the driver access channel, and driving the driver to rotate the fixation screw, thereby attaching the prosthesis to the dental implant; or inserting a driver into a driver access channel in the prosthesis, the prosthesis affixed to an abutment, the abutment comprising a screw access hole, engaging the driver with a screw through the driver access channel of the prosthesis and the cavity of the abutment, rotating the driver to disengage the screw from the dental implant, and removing the abutment and the prosthesis from the dental implant that Group I does not have.

The common technical features of Groups I and II are assembling a fixation screw into an abutment, a driver access channel, inserting a driver into the driver access channel and a cavity of the abutment.

These common features are disclosed by WO 2014/200404 A1 to Branemark Integration AB (hereinafter 'Brankemark'). Brankemark discloses assembling a fixation screw into an abutment (interface abutments are mounted and fixed using the prosthetic screws; page 6 lines 11-13), a driver access channel (screw channel 9, figure 1, page 5, lines 1-5), inserting a driver into the driver access channel (screwdriver 24 inserted into screw channel 9, figure 1, page 4 lines 24-25), and a cavity of the abutment (cavity in abutment 12 for insertion of screw 4, figure 1, column 4, lines 15-21).

Since the common technical features are previously disclosed by the Branemark reference, these common features are not special and so Groups I and II lack unity.