(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 November 2007 (15.11.2007)

PCT

(10) International Publication Number
WO 2007/129955 A1

(51) International Patent Classification:
A61C 8/00 (2006.01) *A61B 17/86* (2006.01)

(21) International Application Number:
PCT/SE2007/000431

(22) International Filing Date: 4 May 2007 (04.05.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0600978-1 4 May 2006 (04.05.2006) SE
0600979-9 4 May 2006 (04.05.2006) SE

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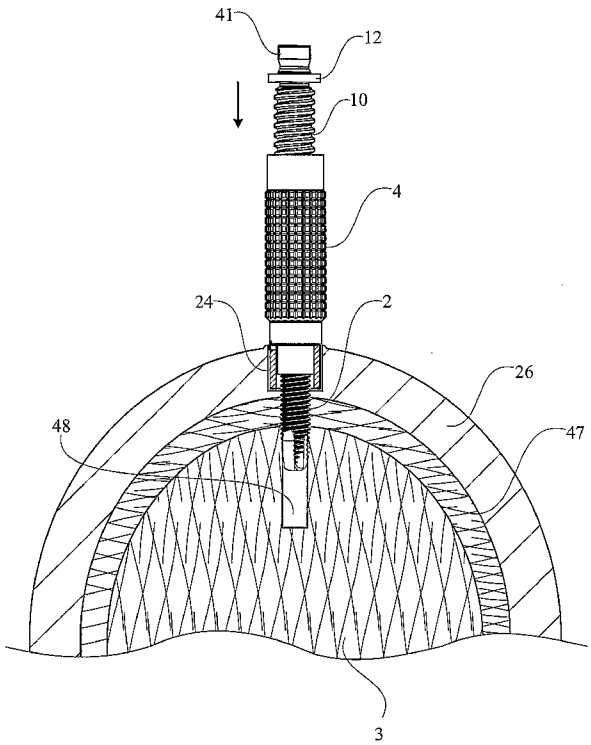
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** A DEVICE FOR SECURING A DENTAL IMPLANT IN BONE TISSUE, A METHOD FOR MAKING A SURGICAL TEMPLATE AND A METHOD OF SECURING A DENTAL IMPLANT IN BONE TISSUE



(57) **Abstract:** The application relates to a device and a method for securing a dental implant (2) in the bone tissue of a patient. The device comprises an internally threaded guide sleeve (4) with an interlock portion (7) that can engage an interlock portion (25) on a tubular mounting guide (24). A holder (10) comprises a screw (15) complementary to the thread of the guide sleeve (4). The holder (10) is arranged to secure an implant (2) at one end of the holder (10). The tubular mounting guide (24) is placed in a hole (27) in a surgical template (26) and cemented in the hole in a desired angular position. The template is placed in the mouth of the patient. Through the hole (27) in the template (26), a hole into the bone is drilled. The dental implant (2) is secured on the holder (10) and the guide sleeve placed in the hole (27) of the template (26) such that the respective interlock portions (7, 25) interlock. The holder (10) is screwed through the guide sleeve (4) until the implant is screwed into the bone. The application also relates to a method for making the surgical template (26).

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A DEVICE FOR SECURING A DENTAL IMPLANT IN BONE TISSUE, A METHOD FOR MAKING A SURGICAL TEMPLATE AND A METHOD OF SECURING A DENTAL IMPLANT IN BONE TISSUE

TECHNICAL FIELD

The present application relates to a device for securing a dental implant in bone tissue, for example the jawbone of a patient or the zygomatic bone of a patient. The application also relates to a method of making a surgical template and to a method of securing a dental implant in bone tissue.

BACKGROUND

In order to provide teeth for patients that lack one or several of their natural teeth, a dental implant may be secured to the bone tissue of the patient, for example to the jawbone. Such a dental implant is typically made of Titanium or some other bio-compatible material. When the dental implant has been secured to the jawbone, an abutment can be fixed to the implant and a suitable prosthesis cemented on the abutment. If the prosthesis is to be positioned correctly, the abutment should also be correctly positioned on the dental implant. The dental implant is normally formed with a special connection for the abutment. The orientation of the dental implant in the jawbone of the patient should then be such that the connection for the abutment is placed in a position where the abutment can be correctly positioned. It is an object of the present application to provide equipment and a method that makes it possible to give the implant a correct orientation when it is secured to bone tissue of a patient.

GENERAL DISCLOSURE

The present application relates to a device for securing a dental implant to the bone tissue of a patient. The device comprises a guide sleeve. The guide sleeve has a first end provided with an interlock portion. The guide sleeve also has an internal thread. The device further comprises a holder for the dental implant. The holder has dimensions that fit the guide sleeve such that the holder may be inserted into the guide sleeve. The holder comprises a screw that has an external thread that is complementary to the internal thread of the guide sleeve such that the screw (and thereby the holder) may cooperate with the guide sleeve.

The holder has a first end provided with a limit stop designed to cooperate with the guide sleeve such that the holder may be inserted a predetermined distance into the guide sleeve, i.e. the limit stop determines the maximal distance that the holder may travel into the guide sleeve. The holder also has a second end arranged to releasably secure a dental implant to be secured in the bone tissue of a patient.

A second end of the guide sleeve may be provided with at least one visible marking while the holder further also has at least one visible marking at its first end. The at least one visible marking on the holder can be brought to meet the at least one marking on the guide sleeve when the holder is placed in the guide sleeve. Thereby, an angular relationship between the guide sleeve and the holder can be indicated and/or verified.

In some embodiments, the second end of the guide sleeve and the first end of the holder may each have three visible markings or possibly more than three visible markings.

The holder may further comprise a separate fastening element for releasably securing a dental implant to the screw.

The screw may have a through-hole extending along a longitudinal axis of the screw and the separate fastening element may be an elongate fastening element that fits the dimensions of the through-hole in the screw such that the fastening element may be inserted into the screw. The elongate fastening element may then have a first end with a head adapted to cooperate with the screw when the fastening element is used to secure a dental implant to the holder. A second end of the elongate fastening element may be provided with a thread that can cooperate with an internal thread of a dental implant.

The device may further also comprise a tubular mounting guide having an interlock portion adapted to cooperate with the interlock portion of the guide sleeve such that the guide sleeve may be locked against rotation relative to the tubular mounting guide.

The device may further also comprise a surgical template with a hole through which a tool or a dental implant may be inserted. A tubular mounting guide is placed in the hole and secured against rotation. The tubular mounting guide has an interlock portion adapted to

cooperate with the interlock portion of the guide sleeve such that the guide sleeve may be locked against rotation relative to the tubular mounting guide.

The application also relates to a method of manufacturing a surgical template that is positionable in a mouth of a patient. The method of manufacturing a surgical template comprises providing a surgical template that has previously been formed based on the geometry of a patient's intra-oral anatomy. The surgical template is shaped to define a hole through which a dental implant may later be inserted. A tubular mounting guide is provided that has an interlock portion. The tubular mounting guide is placed in the hole in the surgical template in a position where the interlock portion may interact with a tool that is inserted into the tubular mounting guide. The tubular mounting guide is secured in the hole in this position such that it cannot rotate relative to the surgical template.

During manufacturing of the surgical template, a model of the patient's intra-oral anatomy may be used. In the model, a hole or recess is made at the location that corresponds to the position where it is planned to place a real implant in the patient's mouth. A replica of the dental implant that is to be secured in the patient's mouth is placed in the hole or recess in the model and the replica is positioned in the desired angular position (the angular position that is planned for the real implant when placed in the bone tissue of the patient) and secured in that position, e.g. cemented/glued in that position. The surgical template is placed over the model of the patient's intra-oral anatomy. The recess and the replica are then, of course, located under the hole in the surgical template. The correct angular position of the tubular mounting guide can then be determined based on the angular position of the replica. The tubular mounting guide is then rotated to its correct angular position and secured in the hole in this position. To secure the tubular mounting guide, it may be, for example, cemented in the hole.

There are some patients that have suffered regress of the jawbone to such an extent that it is no longer possible to place a dental implant in the jawbone. For such patients, a dental implant may be placed in other bone tissue than the bone tissue of the jawbone. Typically, the implant is then placed in the patient's zygomatic bone. The zygomatic bone is not the only alternative to the jawbone, there are also other options such as the pterygoid bone. However, the zygomatic bone is where implants are usually fastened in such cases. In the

following, reference will be made to the zygoma and to zygoma dental implants. It should be understood that this is done simply for convenience and that the term "zygoma dental implant" may refer to any dental implant that is placed in bone tissue outside the jawbone (for example dental implants placed in the pterygoid bone).

The method of manufacturing the surgical template may be designed to produce a surgical template suitable for the case where a zygoma dental implant is to be installed. To this end, the surgical template may be shaped with a second hole adjacent the hole through which the dental implant is to be inserted such that the surgical template can be used to install a zygoma dental implant. The method comprises providing a guide sleeve having a first end that is provided with an interlock portion that is fits the interlock portion of the tubular mounting guide. The guide sleeve has an internal thread. A holder is provided that has dimensions that fit the guide sleeve such that the holder may be inserted into the guide sleeve. The holder comprises a screw that has an external thread complementary in shape to the internal thread of the guide sleeve such that the screw may cooperate with the guide sleeve. The holder further has a first end provided with a limit stop designed to cooperate with the guide sleeve such that, maximally, the holder may be inserted a predetermined distance into the guide sleeve. A second end of the holder is arranged to releasably secure a dental implant which is later to be secured in the bone tissue of a patient. A replica is provided that corresponds to an end part of the zygoma dental implant to be secured in the bone tissue of the patient. The method further comprises providing a connection piece which has one end adapted to be connected to the holder and one end adapted to receive the replica and hold the replica such that the replica forms an angle with the longitudinal axis of the holder. The holder is inserted into the guide sleeve and screwed into the guide sleeve. The connection piece is secured to the second end of the holder. The guide sleeve is inserted into the tubular mounting guide such that the interlock portion of the guide sleeve) engages the interlock portion of the tubular mounting guide. The guide sleeve is then rotated together with the holder and the connection piece until the connection piece is in a position where a fastening member can be inserted through the second hole and brought against the connection piece. The replica is then brought against the connection piece and fastened to the connection piece by means of the fastening member. The tubular mounting guide is then secured in its hole such that it cannot rotate relative to the surgical template.

The application also relates to a method of securing a dental implant in the bone tissue of a patient. The method comprises providing a surgical template with a hole through which a dental implant may be inserted when the dental implant is to be secured in the patient's bone tissue. The hole in the surgical template has an interlock portion. The surgical template is secured in the mouth of the patient. A drill is inserted through the hole in the surgical template and a hole is drilled into the bone tissue of the patient. The method further comprises providing a guide sleeve that has an internal thread and an interlock portion that fits the interlock portion in the hole of the surgical template. The guide sleeve is inserted into the hole in the surgical template such that the respective interlock portions engage each other and lock the guide sleeve against rotation. A holder is provided that has dimensions that fit the guide sleeve such that the holder may be inserted into the guide sleeve. The holder comprises a screw that has an external thread that is complementary to the internal thread of the guide sleeve. The holder is also arranged to releasably secure a dental implant at one end of the holder. The dental implant is secured to the holder. The holder is inserted with the dental implant first into the guide sleeve such that the external thread of the holder's screw engages the internal thread of the guide sleeve. The holder is then screwed through the guide sleeve such that the dental implant is forced into the hole in the patient's bone tissue and screwed to the bone tissue of the patient.

The guide sleeve may optionally be designed such that it has a first end where the interlock portion is located and a second end provided with at least one visible marking. The holder may then be designed such that a first end of the holder has a limit stop and at least one visible marking that can be brought to meet the at least one visible marking on the guide sleeve to indicate/verify an angular relationship between the guide sleeve and the holder. When the dental implant has been screwed into the bone tissue of the patient until the limit stop on the holder has met the guide sleeve, it can be checked that the visible markings on the guide sleeve and the holder are aligned with each other. This should be the case when the holder has been screwed into the guide sleeve as far as possible and the limit stop has met the guide sleeve. If the visible markings are not aligned, this indicates that the holder has not been completely screwed into the guide sleeve. The angular position of the holder may then be adjusted such that the at least one visible marking on the holder meets the at least one visible marking at the second end of the guide sleeve.

When it has been established that the visible markings on the guide sleeve and the holder have met each other, the dental implant may be released from the holder.

The first end of the holder may have a limit stop designed to cooperate with the guide sleeve such that the maximal distance that the holder may be inserted into the guide sleeve is predetermined. When the holder is screwed into the guide sleeve, further movement of the holder into the guide sleeve will be prevented when the limit stop meets the guide sleeve. It can then be verified that the visible markings meet each other. If this is not the case, the angular position of the holder may be adjusted to make the visible markings meet each other.

The surgical template used in the method for securing a dental implant may have a tubular mounting guide placed in the hole. The interlock portion of the surgical template may then be a part of the tubular mounting guide. Alternatively, the interlock portion could be formed directly in the material of which the surgical template is made.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a dental implant being placed in the jawbone of a patient.

Figure 2 shows an abutment being connected to the dental implant.

Figure 3 indicates how a dental prosthesis is placed on an abutment.

Figures 4a, 4b and 4c show, in greater detail, how an abutment may be connected to a dental implant.

Figure 5 is a cross sectional view corresponding to Figure 4a.

Figure 6 is a cross sectional view of a zygoma dental implant placed in a patient.

Figure 7 is a side view of a device for securing a dental implant to the bone tissue of a patient.

Figure 8 is a cross sectional view corresponding to Figure 7.

Figure 9a is a side view of one component in the device showed in Figure 7 and Figure 9b is an end view of the guide sleeve as seen from the direction of the arrow A.

Figure 10 is a cross sectional view of the detail showed in Figure 9.

Figure 11 is a side view of another component in the device showed in Figure 7.

Figure 12 is a view from the direction of arrow A in Figure 11.

Figure 13 is a view from the direction of arrow B in Figure 11.

Figure 14a is a cross sectional view of the component showed in Figure 11 and Figure 14b shows an enlargement of the left part of Figure 14a.

Figure 15 shows, in perspective, yet another component in the device showed in Figure 7.

Figure 16 is a cross sectional view of the component showed in Figure 15.

Figure 17 is an enlargement of a detail showed in Figure 16.

Figure 18 is a side showing how two components have been put together to form a holder.

Figure 19 is a cross sectional view corresponding to Figure 18 and also showing a dental implant before the implant has been connected to the holder.

Figure 20 is a view corresponding to Figure 19 but with the dental implant secured to the holder.

Figure 21 is a view from above of a tubular mounting guide to be used

Figure 22 is a side view of the tubular mounting guide.

Figure 23 shows, in perspective, a surgical template.

Figure 24 is a side view showing the interaction between a guide sleeve and a tubular mounting guide.

Figure 25 is a cross sectional view of a model of a patient's intra-oral anatomy.

Figure 26 is a cross sectional view similar to Figure 25 but showing how a surgical template has been placed on the model together with a tubular mounting guide and a replica of a dental implant to be installed

Figure 27 is a view from above corresponding to Figure 26.

Figure 28 is a partially cross sectional view showing a step in a procedure where a dental implant is secured in the bone tissue of a patient.

Figure 29 is a view corresponding to Figure 28 and showing a following step in the procedure.

Figure 30 is a view corresponding to Figure 29 and showing a subsequent step in the procedure.

Figure 31 is a view corresponding to Figure 30 but showing a subsequent stage.

Figure 32 shows, in cross section, how the dental implant has been screwed completely into the bone tissue of the patient.

Figure 33 shows how the dental implant has been released from the holder.

Figure 34 shows how the device for securing a dental implant to bone tissue can be applied to a zygoma dental implant.

Figure 35 shows, in cross section, how a dental implant is secured to the zygomatic bone of a patient.

Figure 36 is a side view that shows how a replica of a dental implant has been secured the device for securing a dental implant to the bone tissue of a patient.

Figure 37 is a side view corresponding to Figure 36 but showing how the device is used in connection with a surgical template to be used for securing a dental implant to the zygomatic bone.

Figure 38 is a view from another perspective of the arrangement showed in Figure 37.

Figure 39 shows the same arrangement as in Figures 37 and 38 but from yet another perspective where the surgical template is seen from the side that is facing away in Figure 38.

Figure 40 is a perspective view of a surgical template for a zygoma dental implant.

Figure 41a and 41b is a side view and a cross sectional view of a zygoma dental implant.

DETAILED DESCRIPTION

As a further explanation of the background, a sequence for giving a patient a dental prosthesis is illustrated in Figures 1 – 3. With reference to Figure 1, it can be seen how a dental implant is screwed into the jawbone of the patient. Although not illustrated, it should be understood that a hole for the dental implant 2 has previously been drilled in the patient's jawbone. As showed in Figure 2, an abutment 32 can then be secured to the dental implant 2. The abutment 32 may be fastened to the implant 2 by means of a screw 33. When the abutment 32 has been fastened to the dental implant 2, a dental prosthesis 34 can be cemented to the abutment 32 as indicated in Figure 3. In order for the prosthesis 34 to be correctly oriented, the abutment 32 also needs to be correctly oriented. The reference numeral 31 refers to the natural teeth of the patient but could also be understood as representing already installed prostheses.

The fastening of the abutment 32 to the dental implant 2 is illustrated in greater detail in Figures 4a – 4c and in Figure 5. As showed in Figure 5, the abutment 32 may be secured to the dental implant 2 by means of a fastening screw 33 that engages an internal thread 23 in the dental implant 2. The fastening screw 33 has a head 45 that abuts a contact surface 49 inside the abutment 32 such that the fastening screw 33 may force the abutment 32 against the dental implant 2. A thread 46 on the fastening screw 33 may cooperate with an internal thread 23 of the dental implant 2. Figure 4a and 4c show two different embodiments of the dental implant 2. In Figure 4c, the dental implant has a top part 35 shaped in one piece with the rest of the dental implant 2. The top part 35 is shaped as a polygon, e.g. as a hexagon. In the embodiment of Figure 4a, the top of the dental implant 2 forms an internal polygon 39 that fits the outer polygon 38 of a separate top piece 37 that can be fitted to the dental implant 2. The top piece 37 is shaped as a polygon 35 at its upper end. For example, it may be shaped as a hexagon 35. The separate top piece 37 may be placed in the dental implant 2 such that the outer polygon 38 of the separate top piece 37 cooperates with the internal polygon 39 and locks the top piece 37 against rotation relative to the dental implant 2. As showed in Figure 4b, the lower end of the abutment 32 forms an internal female polygon 36 (e.g. a hexagon) that fits the polygon 35 at the top of the dental implant 2. When the abutment 32 has been fastened to the dental implant 2 by means of the fastening screw 33, the cooperating polygons 35, 36 will thus secure the abutment 32 against rotation relative to the dental implant 2. If the dental implant 2 is in an incorrect angular position when the abutment is secured to the dental implant, it will not be possible to place the abutment correctly in the mouth of the patient and the prosthesis will be somewhat twisted in relation to natural teeth 31 or other prostheses. For this reason, it is desirable that the dental implant can be secured to the bone tissue of the patient such that the dental implant is in a correct angular position, i.e. the angular position that has been previously planned for the dental implant.

Figure 6 shows yet another example of a case where the invention may be put to use. In Figure 6, the dental implant 2 is a zygoma implant that is secured to the bone tissue 3 of a patient's zygomatic bone. In this case, the end part 50 of the dental implant 2 must point in a correct direction if it should at all be possible to connect an abutment or a bridge to the dental implant 2. As showed in Figure 6, the end part 50 of the zygoma implant is pointing in a direction that forms an angle relative to the longitudinal axis of the dental implant 2. This angle is typically 45° or about 45° even though other angles are also conceivable.

When such a dental implant is screwed into the bone tissue of the patient, the end part 50 will follow the rotation of the dental implant but it is only in one angular position that the end part 50 is pointing in the correct direction for connection to an abutment, i.e. towards the opposite jaw. For this reason, it is important that the dental implant can be secured in the correct angular position.

The present invention relates to a device that is designed to secure a dental implant to the bone tissue of a patient. Figure 7 shows a device 1 for securing a dental implant 2 to the bone tissue of a patient. The device 1 comprises guide sleeve 4. The guide sleeve 4 is showed separately in Figure 9A and Figure 9B shows a side view of the sleeve 4. A cross sectional view of the sleeve 4 is showed in Figure 10. The guide sleeve 4 has a first end 6 provided with an interlock portion 7. The interlock portion 7 may be a protrusion, i.e. a male element such as a knob at the first end 6 of the guide sleeve 4 and in Figures 9A and 9B, the interlock portion 7 is shown as a knob. However, it should be understood that the interlock portion 7 may also take other forms, for example a groove in the guide sleeve 4 that can cooperate with a protrusion, e.g. a knob, in another detail. The interlock portion 7 could also take many other forms. For example, the first end 6 of the guide sleeve 4 could have a polygonal outer profile such that the guide sleeve 4 can be locked against rotation in a corresponding polygonal hole.

The sleeve 4 has a second end 8. Optionally, the second end 8 of the sleeve 4 may be provided with at least one visible marking 9. The visible marking 9 may be, for example, a marking 9 that has been painted on the guide sleeve 4. The visible marking 9 could also be a groove in the guide sleeve 4, possibly a painted grove. In Figure 9B, three visible markings 9 are indicated but it should be understood that there are also other possibilities. For example, there could be two visible markings 9 or four visible markings 9.

The device 1 also comprises a holder 10 for the dental implant 2. An embodiment of the holder 10 can be seen in Figures 18 – 20. The holder 10 has dimensions that fit the guide sleeve such that the holder 10 may be inserted into the guide sleeve 4 as indicated in Figure 8. The holder 10 has a first end 11 provided with a limit stop 12 designed to cooperate with the guide sleeve 4 such that the holder 10 may be inserted, at the most, only a predetermined distance into the guide sleeve 4. When it has been screwed the predetermined distance into the guide sleeve 4, correct angular positioning of the implant is

provided. The holder 10 has a second end 13 arranged to releasably secure a dental implant 2 to be secured in the bone tissue 3 of a patient.

As indicated in Figure 10, the guide sleeve 4 has an internal thread 5. The holder 10 comprises a screw 15 that has an external thread 16 that is complementary to the internal thread 5 of the guide sleeve 4 such that the screw 15 may cooperate with the guide sleeve 4 and be screwed into the guide sleeve 4. The holder 10 may further comprise a separate fastening element 18 for releasably securing a dental implant 2 to the screw 15.

In an embodiment showed in Figures 8, 14 and 19 – 20, the screw 15 has a through-hole 17 extending along a longitudinal axis of the screw 15. The separate fastening element 18 may then be an elongate fastening element 18 that fits the dimensions of the through-hole 17 in the screw 15 such that the fastening element 18 may be inserted into the screw 15. The separate fastening element 18 is showed separately in Figures 15 – 17. As showed in Figures 15 and 16, the separate fastening element 18 has a first end 19 with a head 20 adapted to cooperate with the screw 15 when the fastening element 18 is used to secure a dental implant 2 to the holder 10. The fastening element 18 further has a second end 21 provided with a thread 22 that can cooperate with an internal thread of a dental implant 2. As indicated in Figure 17, the head 20 of the separate fastening element 18 may have a slot or a hexagonal recess 51 that may receive a tool that engages the head of the fastening element 18.

In the embodiment showed in Figure 19, the top surface of the dental implant 2 (i.e. where the dental implant is secured to the holder10) is perpendicular to the longitudinal axis of the dental implant 2. When the dental implant 2 is secured to the holder 10, it will thus form an extension of the holder 10 and extend along the same axis as the holder 10.

As showed in Figures 13 and 14, an end of the screw 15 is shaped as a female polygon 52 (e.g. a hexagon) that can engage the male polygon 35 at the top of the dental implant 2. Alternatively, the end of the screw 15 could be shaped as a male polygon that engages a female polygon at the top of the dental implant 2. It should also be understood that other shapes than polygonal shapes may be considered for the end of the screw 15 and the top of the dental implant 2. For example half-cylindrical shapes may be considered as long as the

end of the screw 15 is able to engage the top of the dental implant 2 such that the dental implant can be locked against rotation relative to the screw 15.

The dental implant 2 can be releasably secured to the holder 10 in the following way. The separate fastening element 18 is inserted in the through-hole 17 of the screw 15 and pushed through the screw 15 such that the thread 22 on the second end of the separate fastening element 18 extends out of the screw 15. The holder 10 is brought into contact with the dental implant 2 such that the female polygon 52 at the end of the screw 15 engages the male polygon 35 at the top end of the dental implant 2. The separate fastening element 18 is then screwed to the dental implant 2. This can be done since the thread 22 on the separate fastening element 18 fits the internal thread 23 of the dental implant 2. To screw the separate fastening element 18 to the dental implant 2, a tool can be used that engages the recess 51 in the head 20 of the separate fastening element 18. When the separate fastening element 18 is screwed to the dental implant 2, the head 20 of the separate fastening element 18 will finally meet an end surface 54 on the screw 15 while the dental implant 2 is pressed against the screw 15 at the other end of the screw 15. The dental implant 2 will be pressed against a contact surface 53 at the end of the screw 15 (see Figure 14b). The dental implant 2 is now secured to the holder 10 but the dental implant can be released from the holder 10 if the separate fastening element is unscrewed. At this stage, the dental implant 2 is held by the holder 10, as showed in Figure 20.

As showed in Figures 11 and 12, the holder 10 may optionally have at least one visible marking 14 at its first end 11. When both the guide sleeve 4 and the holder 10 have visible markings 9, 14, the at least one visible marking 14 can be brought to meet the at least one marking 9 on the guide sleeve 4 to indicate an angular relationship between the guide sleeve 4 and the holder 10. The visible marking or markings 14 on the holder 10 may be, for example, painted markings 14 or the markings 14 could be formed by grooves. If grooves are used, the grooves may optionally be painted. In Figure 12, three visible markings 14 are indicated on the holder 10 but it should be understood that the number of markings 14 on the holder 10 may be something else than three.

The second end 8 of the guide sleeve 4 and the first end 11 of the holder 10 may each have three visible markings 9, 14.

When the guide sleeve 4 and the holder 10 have visible markings 9, 14 that can be brought to meet each other, the markings may confirm to a user of the equipment that the holder 10 is in a specific angular relationship relative to the guide sleeve 4. If the dental implant 2 is secured to the holder 10, this also means that the angular position of the dental implant can be confirmed. When the holder 10 is screwed into the guide sleeve 4, the user can observe whether the visible markings 9, 14 have met each other or not and thereby obtain a confirmation of the angular position of the dental implant 2. It should be noted, however, that embodiments are conceivable where the guide sleeve 4 and the holder 10 do not have such visible markings. The angular position of the holder (and the dental implant) may then be determined or verified by, for example, the number of revolutions of the holder 15 as it is screwed into the guide sleeve 4.

It should be understood that, normally, the visible markings 9, 14 on the guide sleeve 4 and the holder 10 should meet each other when the limit stop 12 has reached the guide sleeve 4. If the visible markings 9, 14 are aligned, this verifies that the limit stop 12 has met the guide sleeve 4.

With reference to Figures 21 and 22, the device 1 may further comprise a tubular mounting guide 24. The tubular mounting guide fits the first end 6 of the guide sleeve 4 such that the guide sleeve 4 may be inserted into the tubular mounting guide 24. The tubular mounting guide 24 has an interlock portion 25 adapted to cooperate with the interlock portion 7 of the guide sleeve 4 such that the guide sleeve 4 may be locked against rotation relative to the tubular mounting guide 24. The interlock portion 25 of the tubular mounting guide may be formed as a groove or indentation in the tubular mounting guide 24. The groove or indentation may then cooperate with the knob on the guide sleeve 4 showed in Figure 9A. Of course, the interlock portion 25 on the tubular mounting guide 24 could take many different forms. What is important is that it is shaped to cooperate with the corresponding interlock portion 7 on the guide sleeve 4. If the interlock portion 7 on the guide sleeve is a female interlock portion, e.g. a groove, the interlock portion 25 on the tubular mounting guide 24 would be a male interlock portion such as a knob. Other possible forms for the interlock portion 25 on the tubular mounting guide include, for example, polygonal forms.

With reference to Figure 23, a surgical template 26 is showed. The surgical template 26 is used when a dental implant 2 is to be secured to the bone tissue of a patient. The surgical

template 26 has one or several holes 27 through which a dental implant 2 may be inserted. A tubular mounting guide 24 may be placed in such a hole 27 and secured against rotation relative to the surgical template 26. This can be achieved by, for example, cementing the tubular mounting guide 24 in the hole 27. The tubular mounting guide 24 may have external grooves that facilitate the flow of a glue around the circumference of the tubular mounting guide. As previously explained, the tubular mounting guide 24 may have an interlock portion 25 (for example a groove or indentation) adapted to cooperate with the interlock portion 7 of the guide sleeve 4 such that the guide sleeve 4 may be locked against rotation relative to the tubular mounting guide 24 if the guide sleeve 4 is pressed into the tubular mounting guide 24. The surgical template 26 has tubular guides 43 with through-holes 44 through which anchor pins can be used to secure the surgical template 26 to a patient's bone tissue.

A method of manufacturing the surgical template 26 will now be explained with reference to Figures 25 – 27. Initially, a model 28 of a patient's intra-oral anatomy is made. In the model 28, a hole or recess 30 is made that can receive a dental implant 2 or a replica of a dental implant 2. A surgical template 26 is formed which is based on the geometry of a patient's intra-oral anatomy. The surgical template may be formed in a plastic material, i.e. a polymer material but other materials may also be considered. The surgical template 26 will thus correspond to the intra-oral anatomy of the patient such that it is positionable in the mouth of the patient. The surgical template 26 is formed with a hole 27 through which a dental implant 2 may later be inserted. A replica 29 of the real implant is placed in the hole or recess 30 and positioned in a desired angular position. The desired angular position is, of course, the planned angular position in which the real dental implant shall have. When it has been established that the replica 29 is in the desired angular position, the replica 29 may be secured in this position, for example by means of glue. Optionally, to verify that the replica 29 is really in the correct angular position, an abutment 32 may be placed on the replica and a dental prosthesis 34 placed on the abutment 32. As schematically indicated in Figures 26 and 27, the surgical template 26 is placed over the model 28 of the patient's intra-oral anatomy. It should be understood that, when the surgical template 26 is formed, it may optionally be formed on the model 28 when the replica 29 is secured (e.g. glued) in its position. However, it may also have been formed before the replica 29 is placed in the hole or recess 30. To ensure that the tubular mounting guide 24 is placed in the correct angular position, the following procedure may be used. With the replica 29 secured in the hole 30

and the surgical template 26 placed over the model 28, the holder 10 is placed in the guide sleeve 4 and screwed into the guide sleeve 4 until the limit stop 12 meets the guide sleeve 4. To verify that the holder 10 has really been inserted as far as possible, it may optionally be checked that the visible markings 9, 14 on the holder 10 and the guide sleeve 4 are in alignment with each other. The tubular mounting guide 24 is placed on the guide sleeve 4 such that the interlock portion 7 on the guide sleeve 4 engages the interlock portion 25 on the tubular mounting guide 24. The guide sleeve 4 together with the holder 10 and the tubular mounting guide 24 is then brought against the surgical template 26 such that the tubular mounting guide 24 is pressed into the hole 27 in the surgical template. Alternatively, the tubular mounting guide 24 may first be placed in the hole 27 after which the guide sleeve 4 is brought into engagement with the tubular mounting guide 24. The separate fastening element 18 is now inserted through the through-hole 17 in the screw 15 and brought into contact with the replica 29. The thread 22 on the separate fastening element 18 is used to screw the replica 29 to the holder 10 and the holder 10, together with the guide sleeve 4, is rotated until the holder 10 fits the replica 29. In practice, this may mean, for example, that an internal polygon 52 on the screw 15 can be fitted over a corresponding polygon 35 on the replica 29 (it should be understood that the top of the replica 29 may be shaped like the top of the dental implant 2 in Figure 4a or Figure 4c). When the replica 29 is held securely by the holder 10, the guide sleeve 4 and the tubular mounting guide 24 will be in the same position as they shall be when the real implant 2 is installed. The tubular mounting guide 24 is thus in the correct angular position._Until now, the tubular mounting guide 24 has been free to rotate in the hole 27. However, the tubular mounting guide 24 is now secured (e.g. cemented/glued) in the hole 27 in this position. Its position will thus be fixed. In this position, the interlock portion 25 of the tubular mounting guide 24 will be able to interact with a tool inserted into the tubular mounting guide 24. It should be understood that the guide sleeve 4 with its knob 7 forms such a tool that can interact with the tubular mounting guide 24.

It should be understood that the order in which the various components are put together need not necessarily be as indicated above and variations are perfectly possible. For example, the separate fastening element 18 may be inserted into the screw 15 before the guide sleeve 4 is brought into engagement with the tubular mounting guide 24.

As an alternative to the tubular mounting guide 24 that is rotated and cemented in the hole 27, a groove 25 could optionally be formed directly in the material that surrounds the hole 27. This would be done after it has been established that the dental implant (or the replica thereof) is in a correct angular position.

It should be understood that the hole 27 in the surgical template 26 may be shaped with a shoulder against which the tubular mounting guide 24 can abut when the tubular mounting guide 24 is placed in the hole 27. The surgical template 26 is made based on the geometry of the patient's intra-oral anatomy. When the geometry of the patient's intra-oral anatomy is made, the thickness of the soft tissue in the gum can be measured. It is then possible to know where the bone tissue begins. Consequently, the tubular mounting guide 24 can be placed at a predetermined distance from the bone tissue.

A method for securing a dental implant 2 in the bone tissue of a patient will now be explained with reference to Figures 28 – 33.

As showed in Figure 28, the surgical template 26 is placed over the patient's intra-oral anatomy. The surgical template may be a surgical template 26 manufactured according to the previously disclosed method. It will thus be understood that it has at least one hole 27 with an interlock portion 25 that may cooperate with a tool inserted into the hole 27. As previously described, the interlock portion may be, for example, a male or female element that can cooperate with a complementary element on a tool that is inserted into the hole 27. The surgical template 26 is showed placed on the soft tissue 47 of the gum. Beneath the gum 47, the bone tissue 3 can be seen. A hole 48 is drilled through the hole 27 and into the bone tissue 3. A drill 63 can be applied through the hole 27 in the surgical template as schematically indicated in Figure 28.

The next step is indicated in Figure 29. The guide sleeve 4 that has been previously described is fitted into the hole 27 in the surgical template such that the interlock portion 7 on the guide sleeve 4 engages the corresponding interlock 25 of the tubular mounting guide 24 that is cemented in the hole 27. When the components are shaped in the way showed in Figure 10 and Figure 22, this means that a knob on the tubular mounting guide enters a groove or indentation in the tubular mounting guide 24.

The following step can be seen in Figure 30. In Figure 30, the guide sleeve 4 has already been inserted into the hole 27. The interlock portion 7 (for example a knob) on the guide sleeve 4 cooperates with the corresponding interlock 25 (for example a groove or indentation) of the tubular mounting guide 24 such that the guide sleeve 4 is locked against rotation. The dental implant 2 is now secured to the holder 10 which is then ready to be inserted into the guide sleeve 4.

With reference to Figure 31, it can be seen how the holder 10 is screwed into the guide sleeve 4. As a consequence, the dental implant 2 will be screwed into the bone tissue 3 surrounding the hole 48. In Figure 30, the dental implant 2 has only reached half-way into its final position.

In Figure 32, it can be seen how the limit stop 12 of the holder 10 has met the end surface 54 of the guide sleeve 4 and the holder 10 cannot be screwed further into the guide sleeve 4. At this stage, it is checked whether the visible markings 9, 14 on the guide sleeve 4 and the holder 10 are aligned with each other. If the holder 10 is in the correct position relative to the guide sleeve 4, the visible markings 9, 14 should be aligned liked in Figure 24. If this is not the case, the angular position of the holder 10 is adjusted until the visible markings 9, 14 meet each other. The dental implant 2 which is securely held by the holder 10 and must follow the rotation of the holder 10 will now be in its correct angular position that was determined in the model of the patient's intra-oral anatomy when the surgical template 26 was manufactured.

Since the tubular mounting guide 24 may have been placed on a known distance from the bone tissue, it is also possible to know that the dental implant 2 has reached the correct depth, i.e. that it has been screwed into the bone tissue far enough.

The dental implant 2 can now be released from the holder 10. This can be made by unscrewing the separate fastening element 18 from the internal thread 23 of the dental implant 2. The holder 10 and the guide sleeve 4 can then be lifted away while the dental implant 2 remains in the patient's bone tissue 3 as indicated in Figure 33.

If it is desired to install a dental implant in the zygomatic bone tissue of the patient, the above described equipment and the above described procedure could be used if the zygoma

dental implant has a straight connection while the abutment that is designed to be connected to the dental implant is formed by an angle piece that has a through-hole with an axis which, when the abutment is connected to the zygoma dental implant, forms an angle with the longitudinal axis of the zygoma dental implant. The angle piece could be a 45° angle piece but the abutment could also have other angles, e.g. angles in the range of 45° - 50°. A simplified "Guided Surgery" can then be attained since it becomes possible to use a narrower implant mounting function. The implant and the abutment can be applied to a predetermined stop and it is not of decisive importance for the installation that an abutment surface of the implant must point in the right direction. Moreover, the abutment, which in that case is not fixed to the implant by an internal hexagon hole, can be adapted to the dental bridge while the adaptable abutment can be coupled and adjusted also in the axial direction. In this way, the possibilities of prefabricating a dental bridge according to "Zygoma in an Hour" are made simpler. It also becomes a possible, as an alternative; to shape the abutment with a beveled part that is angularly displaceable. Thereby, more material becomes available for the abutment. The implant may, as a starting point, be externally similar to "Nobel Speedy Replace" or "NOBEL Replace Tapered Groovy" with the "TiUnite" surface. The implant can then be pulled in with a so called "Stargrip" function after a hole has been drilled according to "Guided Surgery" and according to the planning program of "Procera® Software".

However, for the installation of a zygoma dental implant, another procedure may be followed that will now be explained with reference to Figures 34 and 35. As showed in Figure 34, a special connection piece 55 can be used to connect the holder 10 to the zygoma implant. The connection piece 55 has an internal thread 56 that may interact with the thread 22 on the separate fastening element 18 (see Figure 15). A screw 57 may be inserted in the through-hole 60 in the connection piece 55 and engage an internal thread 23 in the zygoma implant 2.

In Figure 35, it can be seen how a zygoma implant is secured. The surgical template is showed secured to the patient by one or several anchor pins 58. In the case of the zygoma implant, the surgical template has at least two holes. One hole 27 holds the tubular mounting guide 24 with the interlock portion 25 that cooperates with the interlock portion 7 on the guide sleeve 4. Through a second hole 59, it is possible to observe the connection piece 55 and the screw 57 that secures the connection piece 55 to the zygoma implant 2.

When the surgical template for the zygoma implant is made, the process for manufacturing the surgical template may be basically as described previously. The template 26 is placed over a model of a patient's intra-oral anatomy and the guide sleeve 4 with the holder 10 is rotated until the correct angular position has been attained. The tubular mounting guide 24 can then be cemented in its position.

As explained with reference to Figures 25 – 27, the position in which the tubular mounting guide 24 is to be secured in the surgical template 26 may be determined in a method where the surgical template 26 is placed on a model 28 of the patient's intra-oral anatomy. Such a model may also be used to shape the plastic material of the surgical template. However, methods are also possible where the plastic material of the surgical template is formed based exclusively on a computer model of the patient's intra-oral anatomy and the desired angular position of the tubular mounting guide may be determined without a physical model of the patient's intra-oral anatomy. This may be the case when, for example, the surgical template 26 is formed based on a computer model of the patient's intra-oral anatomy. To shape the surgical template, a scanning of the patient's intra-oral anatomy may be performed. The scanning may be, for example, a laser scanning or a computer tomographic scanning. The scanning may be performed either directly on the patient's oral anatomy or on a physical model of the patient's oral anatomy. The scanning is used to create a computer model of the patient's intra-oral anatomy. Based on the computer model, a plastic material may be formed into a template 26 that fits the patient's oral anatomy. Once the surgical template 26 has been shaped in the initial forming operation, the correct angular position for the tubular mounting guide 24 can be determined by a method which will now be described with reference to Figures 36 – 40. The method that is illustrated in Figures 36 – 40 relates to the case when a dental implant 2 is to be secured in the zygomatic bone of the patient.

Figure 36 shows a device which is adapted for a zygoma dental implant. The special connection piece 55 is used which may be shaped as indicated in Figure 34. In the arrangement showed in Figure 36, a replica 29 of a dental implant has been connected to the connection piece 55 by means of a fastening member 61 that may have a threaded end that fits an inner thread in the replica 29. The replica 29 does not have to be identical in shape to the real zygoma implant that is to be secured in the patient's zygomatic bone tissue. All that is needed is that the replica 29 can represent the end part 50 (see Figure 6) of

the real zygomatic implant 2. The fastening member 61 may be, for example, a tool or a screw.

As indicated in Figure 40, the surgical template 26 will have one hole 27 where the guide sleeve 4 may be placed when the dental implant 2 is to be secured in the zygomatic bone tissue. Next to the hole 27 for the guide sleeve 4, there is a second hole 59 which may serve as a separate prosthetics hole in which a sleeve 65 may optionally be placed. The second hole 59 or prosthetics hole will later be used to place an abutment 32 and a prosthesis 34 on the dental implant 2. In the case of the surgical template 26 for the zygoma implant procedure, there is thus a separate hole 27 for the equipment used for inserting and securing the dental implant 2 and a separate hole 59 for inserting and securing an abutment and a prosthesis.

Reference will now be made to Figure 37. Figure 37 illustrates a situation where the tubular mounting guide 24 has been placed in the hole 27 through which the zygoma implant 2 will later be inserted. The guide sleeve 4 has been placed in the hole 27 and the interlock 7 of the guide sleeve 4 has engaged the corresponding interlock 25 of the tubular mounting guide 24 such that the tubular mounting guide 24 is locked against rotation relative to the guide sleeve 4. If the guide sleeve 4 rotates around its longitudinal axis, the tubular mounting guide 24 will rotate together with the guide sleeve 4. The holder 10 has been connected to the special connection piece 55 (not visible in Figure 37 but arranged as in Figure 36) and the holder 10 has been screwed into the guide sleeve 4 until the limit stop 12 has met the guide sleeve 4. If the limit stop has actually met the guide sleeve 4, the at least one visible marking 14 on the holder 10 should be aligned with the at least one visible marking 14 on the holder 10 if the guide sleeve 4 and the holder 10 have such markings 9, 14. If the visible markings 9, 14 are not aligned, it may be so that the movement of the holder 10 has been stopped prematurely for some reason. The holder 10 may then be unscrewed by ½ - 1 turn and then again screwed into the guide sleeve 4 until the visible markings 9, 14 on the guide sleeve 4 and the holder 10 meet each other. The angular position of the holder 10 relative to the guide sleeve 4 can now be verified by the visible markings 9, 14. The guide sleeve 4, together with the holder 10 and the special connection piece 55, will now be rotated until the hole 60 in the special connection piece 55 is clearly visible through the prosthetic hole 59 in the surgical template 26. At this stage, the fastening member 61 may be inserted through the prosthetic hole 59 while the replica 29 is

brought against the special connection piece 55 from the other direction. The prosthetic hole 59 may then serve as a guide for the fastening member 61 such that the fastening member 61 is guided towards the position of the replica 29. Through the hole 60 in the special connection piece 55, the fastening member 61 can engage the replica 29 and secure the replica in its position. The replica 29, the fastening member 61 and the guide sleeve 4 will now be in the position showed in Figure 37. The same situation is illustrated in Figure 39 where the surgical template 26 is seen from the side where the replica 29 is protruding. Figure 38 offers a front view of the same situation. In this position, the replica 29 is pointing in the same direction as the end part 50 of the real dental implant 2 will point when it is correctly positioned. It follows that the holder 10 is holds the special connection piece in the desired angular position. The angular position of the holder 10 in the guide sleeve 4 can be accurately defined here. The angular position of the holder 10 in relation to the guide sleeve can be defined, for example, by visible markings 9, 14 on the guide sleeve 4 and the holder 10. Alternatively, the angular position of the holder 10 may also be defined by the number of revolutions that the holder 10 has made when it was screwed into the guide sleeve 4. Since the holder 10 is held in the guide sleeve 4 in a well defined position, it follows that the tubular mounting guide 24 must also be in the desired position. The tubular mounting guide can now be secured in its hole 27. A practical way of securing the tubular mounting guide 24 may be to cement it in its position.

Once the tubular mounting guide 24 has been secured (e.g. cemented) in its position, the fastening member 61 can be disconnected from the replica 29 and the special connection piece 55. The guide sleeve 4, together with the holder 10 and the special connection piece 55 may be removed from the hole 27.

When a dental implant 2 is to be secured to the zygomatic bone tissue of a patient, the procedure will be as follows. The "zygomatic" surgical template 26 will be placed in the mouth of a patient and secured to the patient's bone tissue 3 by means of anchor pins 58. Through the hole 27 where the tubular mounting guide 24 is placed, a drill 63 is inserted and a hole 48 for a dental implant 2 is drilled in the bone tissue 3 of the patient. Through the prosthetic hole 59, another hole is drilled that reaches into the area where it is planned that the special connection piece 55 shall hold the dental implant 2. The holder 10 is fastened to the special connection piece 55 which is secured to the zygomatic dental implant 2 by means of the screw 57 (see Figure 34). The guide sleeve 4 is inserted into the

hole 27 where the tubular mounting guide 24 has been secured. The interlock portion 7 of the guide sleeve 4 is brought into engagement with the interlock portion 25 of the tubular mounting guide 24. The guide sleeve 4 is now locked against rotation relative to the surgical template 26. The holder 10, with the dental implant 2 first, is inserted into the guide sleeve 4 such that the thread 16 of the screw 15 engages the internal thread 5 of the guide sleeve 4. The holder 10 is then screwed into the guide sleeve 4 until the limit stop 12 meets the guide sleeve 4. It can now be checked that the visible markings 9, 14 on the guide sleeve and the holder actually meet each other. If they are not aligned, the holder 10 may be unscrewed by about ½ revolution and then screwed into the guide sleeve again until the at least one visible marking 14 on the holder meets the at least one visible marking 9 on the guide sleeve. The holder 10 and the dental implant 2 have now reached the position that has been previously tried out with the replica 29 or that was pre-planned in a computer. The dental implant 2 is thus in the position that has been planned from the beginning. This can finally be verified by visual inspection through the prosthetic hole 59.

Concerning the procedure for securing a dental implant to the zygomatic bone tissue 3 of the patient, it should be noted that there may be cases where two zygomatic dental implants 2 are required. If two (or possibly more) dental implants 2 are to be secured to the bone tissue 3 of a patient, the sequence for securing the dental implants 2 may be such that one dental implant 2 is first secured. The dental implant 2 is released from the holder 10 and the holder 10 and the guide sleeve 4 are removed from the hole 27 in the surgical template 26. To help keeping the surgical template 26 in its desired position, a separate fixing device may be placed in the hole 27 through which a first zygomatic dental implant 2 has been inserted and secured to the bone tissue of the patient. Such a fixing device is showed in international patent publication WO 02/053055 (publication of PCT application PCT/SE01/02900).

If the two zygomatic dental implants 2 are to be placed close to each other, it may, in some cases, be difficult or even impossible to manufacture a surgical template 26 that has the necessary space for mounting two separate tubular mounting guides 24. It may then be necessary to manufacture two separate surgical templates 26, one for each dental implant 2.

With regard to the installation of a zygomatic dental implant 2, it should also be noted that the installation procedure has been described above in a manner that is somewhat

simplified. In practice, when the hole 48 is drilled into the bone tissue 3 of the patient, several drills 63 of different diameters may be used for drilling to different depths. For example, drilling may start with a drill having a smaller diameter whereafter one or several following drilling operations are performed with drills having a larger diameter. The different drills 63 may be provided with markings to indicate the depth to which each drill 63 penetrates into the bone tissue of the patient (not showed in the drawings). In this way, the hole 48 in the patient's bone tissue can be narrower as it reaches the zygomatic bone tissue and wider at the beginning of the hole 48 (i.e. in the jawbone). As an example, drilling may begin with a 2.9 mm drill to desired depth according to the markings on the drill. In a second stage, a 3.5 mm drill is used and finally a 4.2 mm drill. The zygomatic dental implant 2 will typically have a shape corresponding to such a hole 48 as indicated in Figure 41a and 41b where it can be seen that the diameter d_2 at the end of the dental implant 2 is smaller than the diameter d_1 at the beginning of the dental implant 2. For the drilling operation, drill guides (not showed in the drawings) may be placed in the tubular mounting guide 24.

In general terms, the method for securing a dental implant 2 to the bone tissue of the patient can be understood in terms of first determining the correct angular position of the implant in a model. A tubular guide 24 which will be used for guiding the tool used to secure the dental implant is then cemented in a position that is determined based on the position that the dental implant and the tool will have when the dental implant is in its correct angular position.

Concerning the fastening of the tubular mounting guide 24 in its hole 27, it should be noted that this operation does not necessarily require that the tubular mounting guide 24 is cemented in its hole 27. Alternative ways of securing the tubular mounting guide are also possible. An example of such an alternative method will now be explained with reference to Figure 21. As can be seen in Figure 21, the tubular mounting guide 24 may have an external profile that is not circular but instead comprises one or several planar surfaces. If the shape of the surgical template 26 and the position of the holder 10 and the guide sleeve 4 is accurately planned, the hole 27 in which the tubular mounting guide 24 is to be placed may be given a shape corresponding to the outer contour of the tubular mounting guide 24. The shape of the hole 27 and the shape of the tubular mounting guide 24 will then cooperate to lock the tubular mounting guide 24 against rotation.

The hole 27 in which the tubular mounting guide 24 is to be placed may have an internal shoulder that presents a surface against which the tubular mounting guide 24 may abut. When the geometry of the patient's intra-oral anatomy is known and the patient's bone tissue is known, the distance between the tubular mounting guide 24 and the bone tissue 3 of the patient can be accurately determined. In practice, this distance may be determined in advance when the shape of the surgical template 26 is planned. When surgical template 26 is later placed in the patient's mouth, the tubular mounting guide 24 may thus be located at a known distance from the patient's bone tissue 3. When the guide sleeve 4 is inserted into the tubular mounting guide 24, the guide sleeve will also be at a known distance from the patient's bone tissue 3. When the holder 10 is screwed into the guide sleeve 4 together with the dental implant 2, it is possible to know the exact depth to which the dental implant is finally screwed into the bone tissue 3. It will thus be possible not only to ensure that the dental implant 2 has the desired angular position but also to ensure that the dental implant 2 reaches a desired depth that has been planned in advance.

When the guide sleeve 4 and the holder 10 have more than one visible marking 9, 14, the markings 9, 14 meeting each other at one point around the circumference of the guide sleeve 4 can be seen even though an other pair of markings may be hidden from view when the equipment is placed in the mouth of a patient.

While the invention has been described above with reference to a device, a method for making a surgical template and a method for securing a dental implant in a patient's bone tissue, it should be understood that these categories only reflect different aspects of one and the same invention. It should thus be understood that the method for securing a dental implant in the bone tissue of a patient may include such steps that will be the natural consequence of using the device, regardless of whether such steps have been explicitly mentioned or not.

CLAIMS

1) A device (1) for securing a dental implant (2) to the bone tissue (3) of a patient, the device (1) comprising:
   a) a guide sleeve (4), the guide sleeve (4) having a first end (6) provided with an interlock portion (7), the guide sleeve (4) having an internal thread (5);
   b) a holder (10) for the dental implant (2), the holder (10) having dimensions that fit the guide sleeve such that the holder (10) may be inserted into the guide sleeve (4), the holder (10) comprising a screw (15) having an external thread (16) that is complementary in shape to the internal thread (5) of the guide sleeve such that the screw (15) may cooperate with the guide sleeve (4), and the holder (10) further having a first end (11) provided with a limit stop (12) designed to cooperate with the guide sleeve (4) such that the holder (10) may be inserted, at the most, a predetermined distance into the guide sleeve (4) and the holder (10) having a second end (13) arranged to releasably secure a dental implant (2) to be secured in the bone tissue (3) of the patient.

2) A device (1) according to claim 1, wherein the holder (10) further comprises a separate fastening element (18) for releasably securing a dental implant (2) to the screw (15).

3) A device according to claim 1, wherein the guide sleeve (4) has a second end (8) provided with at least one visible marking (9) and the holder (10) has at least one visible marking (14) at its first end (11) that can be brought to meet the at least one visible marking (9) on the guide sleeve (4) when the holder (10) is placed in the guide sleeve (4), thereby indicating an angular relationship between the guide sleeve (4) and the holder (10).

4) A device (1) according to claim 2, wherein the screw (15) has a through-hole (17) extending along a longitudinal axis of the screw (15) and wherein the separate fastening element (18) is an elongate fastening element fitting the dimensions of the through-hole (17) in the screw (15) such that the separate fastening element (18) may be inserted

into the screw (15), the separate fastening element (18) having a first end (19) with a head (20) adapted to cooperate with the screw (15) when the separate fastening element (18) is used to secure a dental implant (2) to the holder (10), the elongate fastening element (18) having a second end (21) provided with a thread (22) that can cooperate with an internal thread of a dental implant (2).

5) A device (1) according to any of claims 1 – 4, wherein the device further comprises a tubular mounting guide (24) having an interlock portion (25) adapted to cooperate with the interlock portion (7) of the guide sleeve (4) such that the guide sleeve (4) may be locked against rotation relative to the tubular mounting guide (24).

6) A device (1) according to any of claims 1 – 4, wherein the device further comprises a surgical template (26) with a hole (27) through which a dental implant (2) may be inserted, a tubular mounting guide (24) being placed in the hole (27) and secured against rotation, the tubular mounting guide (24) having structure (25) adapted to cooperate with the interlock portion (7) of the guide sleeve (4) such that the guide sleeve (4) may be locked against rotation relative to the tubular mounting guide (24).

7) A method of manufacturing a surgical template (26) that is positionable in a mouth of a patient, the method comprising: providing a surgical template (26) that has previously been formed based on the geometry of a patient's intra-oral anatomy, the surgical template (26) being shaped to define a hole (27) through which a dental implant (2) may later be inserted; providing a tubular mounting guide (24) with an interlock portion (25); placing the tubular mounting guide (24) in the hole (27) in a position where the interlock portion (25) may interact with a tool that is inserted into the tubular mounting guide (24); and securing the tubular mounting guide (24) in the hole (27) such that it cannot rotate relative to the surgical template (26).

8) A method according to claim 7, wherein a model (28) of the patient's intra-oral anatomy is provided; a replica (29) of a dental implant to be secured in the patient's bone tissue (3) is placed in a recess (30) in the model (28) and positioned in an angular position corresponding to the desired angular position of the real implant when placed in the bone tissue (3) of the patient; the surgical template (26) is placed over the model (28), the recess (30) and the replica (29) being located under the hole (27) in the

surgical template (26) and the replica (29); the correct angular position of the tubular mounting guide (24) is determined based on the angular position of the replica (29) and the tubular mounting guide (24) is rotated to its correct angular position and cemented in the hole (27) in this position.

9) A method according to claim 7, wherein the surgical template (26) has a second hole (59) adjacent the hole (27) through which the dental implant (2) is to be inserted such that the surgical template (26) can be used to install a zygoma dental implant (2) and wherein the method comprises: providing a guide sleeve (4) having a first end (6) that is provided with an interlock portion (7) that fits the interlock portion (25) of the tubular mounting guide (24), the guide sleeve (4) having an internal thread (5); providing a holder (10) having dimensions that fit the guide sleeve (4) such that the holder (10) may be inserted into the guide sleeve (4), the holder (10) comprising a screw (15) that has an external thread (16) complementary in shape to the internal thread (5) of the guide sleeve (4) such that the screw (15) may cooperate with the guide sleeve (4), the holder further having a first end (11) provided with a limit stop (12) designed to cooperate with the guide sleeve (4) such that the holder (10) may maximally be inserted a predetermined distance into the guide sleeve (4), the holder (10) having a second end (13) arranged to releasably secure a dental implant (2) to be secured in the bone tissue (3) of a patient; providing a replica corresponding to an end part (5) of the zygoma dental implant (2) to be secured in the bone tissue (3) of the patient; providing a connection piece (55) which has one end adapted to be connected to the holder (10) and one end adapted to receive the replica (29) and hold the replica (29) such that the replica (29) forms an angle with the longitudinal axis of the holder (10); inserting the holder (10) into the guide sleeve (4) and screwing the holder (10) into the guide sleeve (4); inserting the guide sleeve (4) into the tubular mounting guide (24) such that the interlock portion (7) of the guide sleeve (4) engages the interlock portion (25) of the tubular mounting guide (24); securing the connection piece (55) to the second end of the holder (10); rotating the guide sleeve (4) together with the holder (10) and the connection piece (55) until the connection piece (55) is in a position where a fastening member (61) can be inserted through the second hole (59) and brought against the connection piece (55); fastening the replica to the connection piece (55) by means of the fastening member (61); and subsequently securing the tubular mounting guide (24) in its hole (27) such that it cannot rotate relative to the surgical template (26).

10) A method of securing a dental implant in the bone tissue of a patient, the method comprising:

a) providing a surgical template (26) with a hole (27) through which a dental implant (2) may be inserted when the dental implant (2) is to be secured in the patient's bone tissue (3), the hole (27) being provided with an interlock portion (24, 25);

b) securing the surgical template (26) in the mouth of the patient;

c) inserting a drill (63) through the hole (27) in the surgical template (26) and drilling a hole (48) into the bone tissue (3) of the patient;

d) providing a guide sleeve (4) having an internal thread (5) and an interlock portion (7) that fits the interlock portion (24, 25) in the hole (27) of the surgical template (26);

e) inserting the guide sleeve (4) into the hole in the surgical template (26) such that the respective interlock portions (7, 24, 25) engage each other and lock the guide sleeve (4) against rotation;

f) providing a holder (10) that has dimensions that fit the guide sleeve (4) such that the holder may be inserted into the guide sleeve (4), the holder (10) comprising a screw (15) that has an external thread (16) that is complementary to the internal thread (5) of the guide sleeve (4) and the holder (10) being arranged to releasably secure a dental implant (2) at one end of the holder (10);

g) securing the dental implant (2) to the holder (10);

h) inserting the holder (10) with the dental implant (2) first into the guide sleeve (4) such that the external thread (16) of the holder's screw (15) engages the internal thread (5) of the guide sleeve (4); and

i) screwing the holder (10) through the guide sleeve (4) such that the dental implant (2) is forced into the hole (48) in the patient's bone tissue (3) and screwed to the bone tissue (3) of the patient.

11) A method according to claim 10, wherein the guide sleeve (4) has a first end (6) where the interlock portion (7) is located and a second end (8) that is provided with at least one visible marking (9), the holder (10) has a first end (11) where at least one visible marking (14) is placed that can be brought to meet the at least one visible marking (9) on the guide sleeve (4) and wherein the method comprises adjusting the angular

position of the holder (10) such that the visible markings (9, 14) on the guide sleeve (4) and the holder (10) meet each other.

12) A method according to claim 8 or 9, wherein the dental implant (2) is released from the holder (10) when it has been established that the visible markings (9, 14) on the guide sleeve (4) and the holder (10) have met each other.

Fig. 1

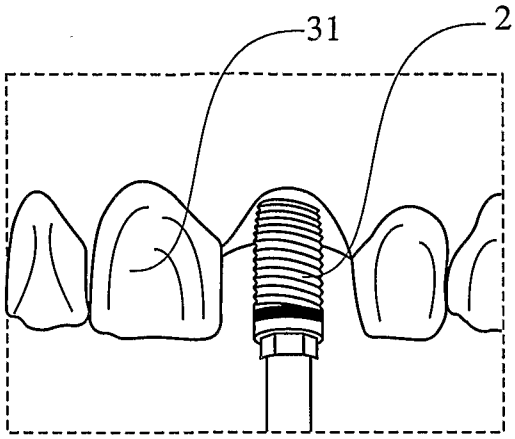


Fig. 2

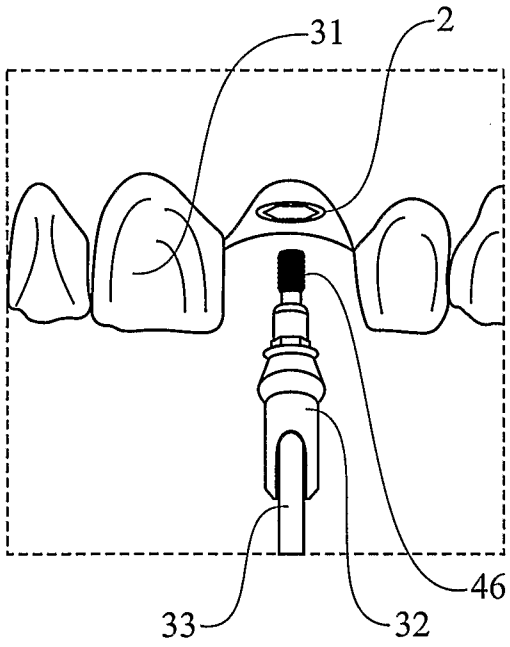


Fig. 3

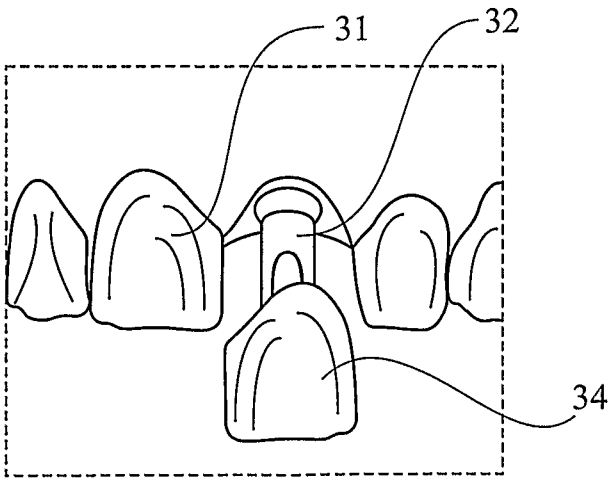


Fig. 4a

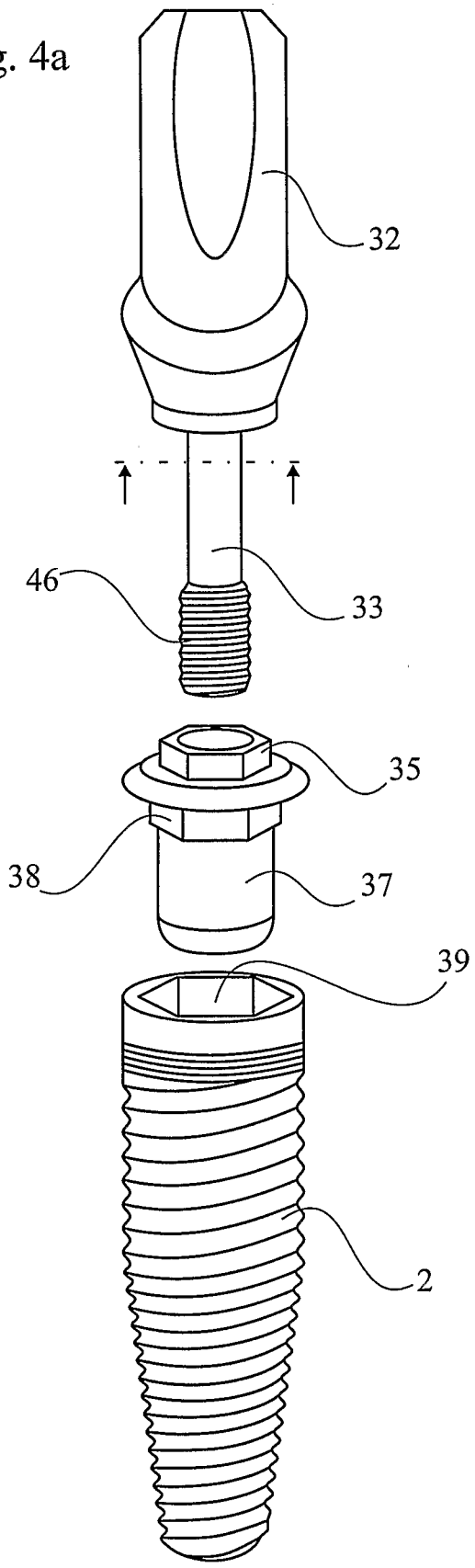


Fig. 4b

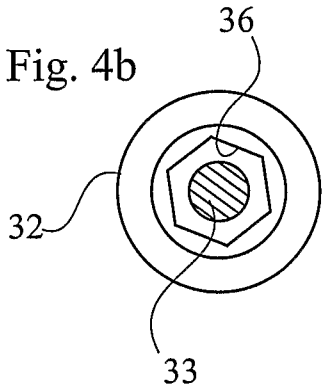


Fig. 4c

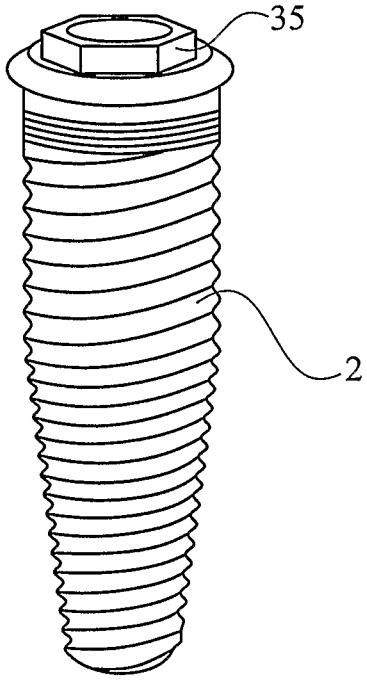


Fig. 5

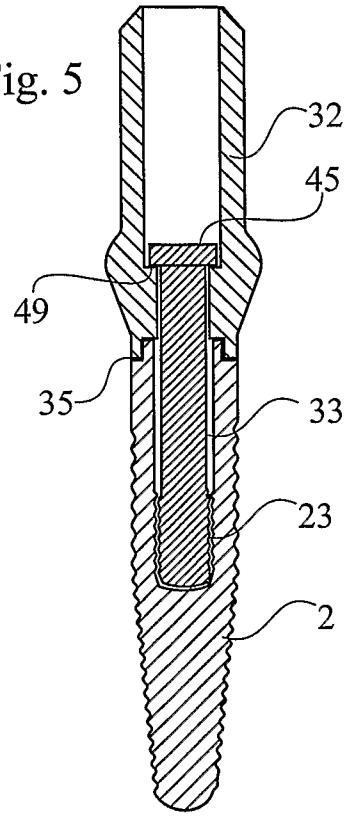
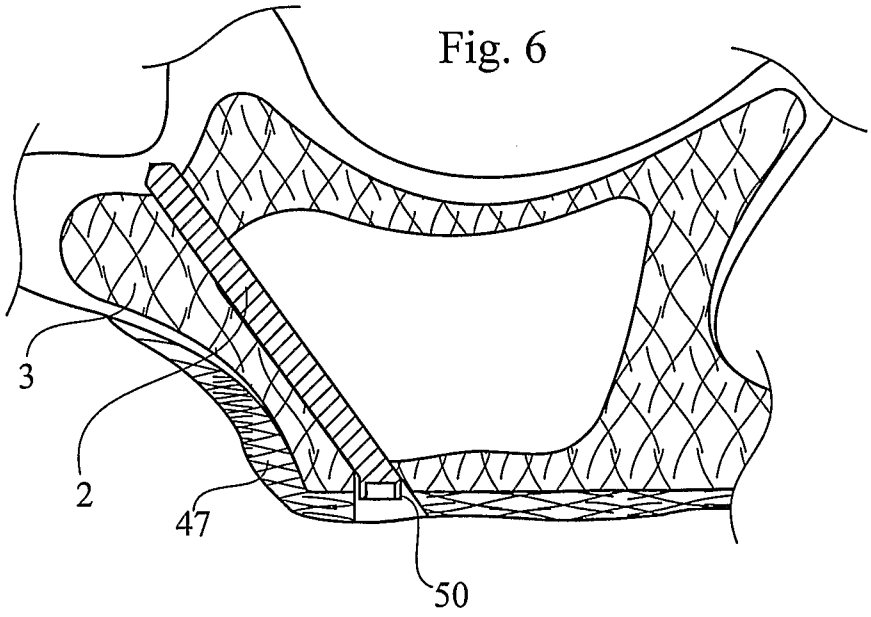


Fig. 6



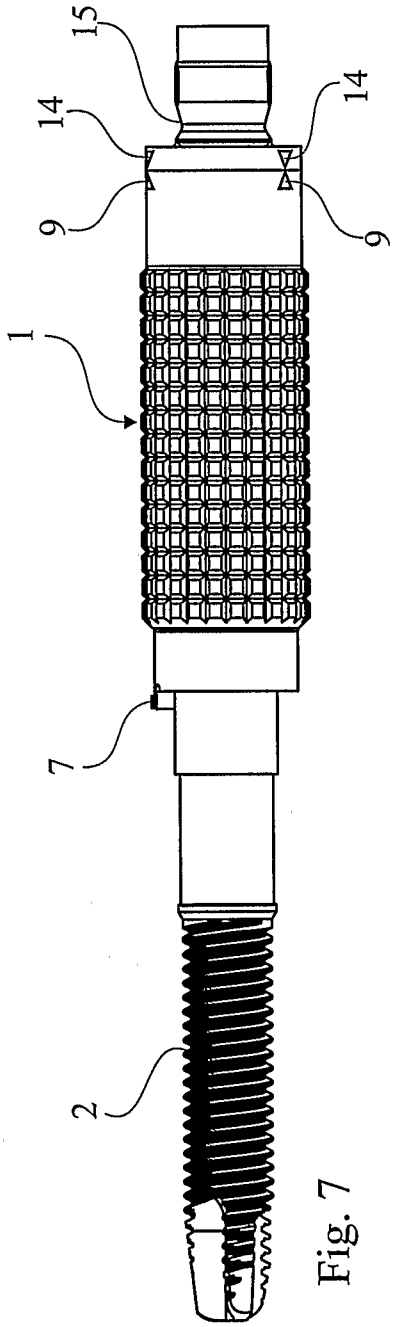


Fig. 7

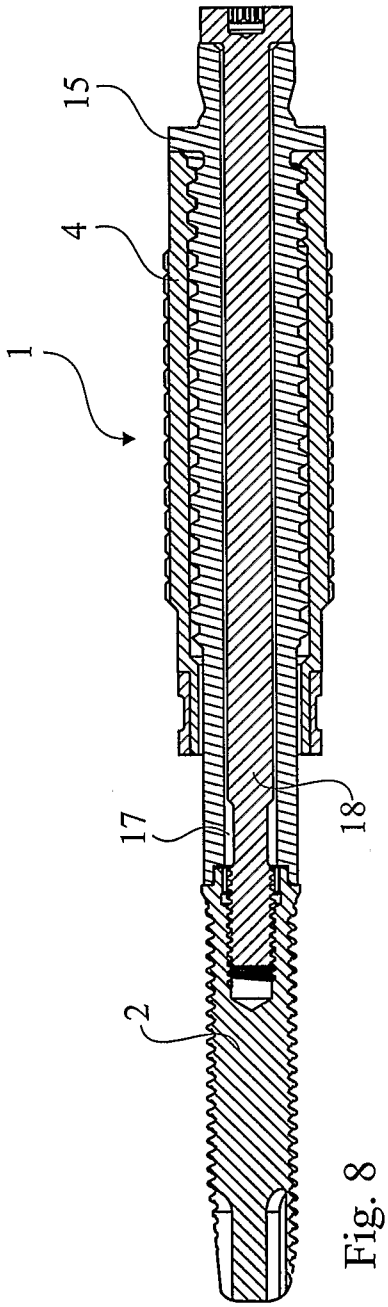


Fig. 8

Fig. 9a

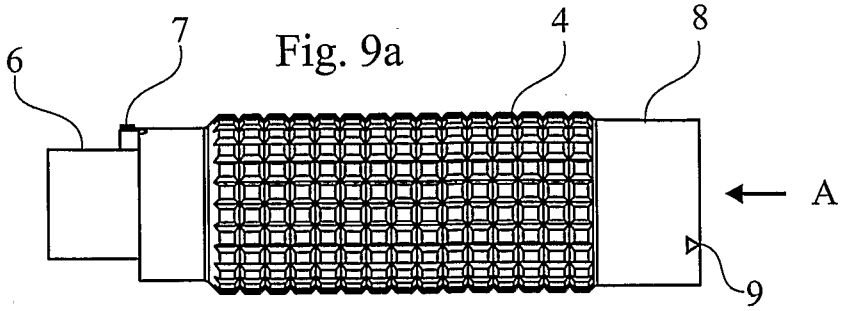


Fig. 9b

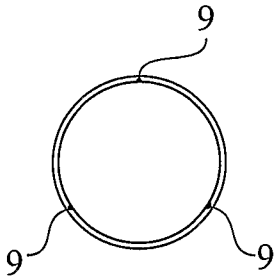


Fig. 10

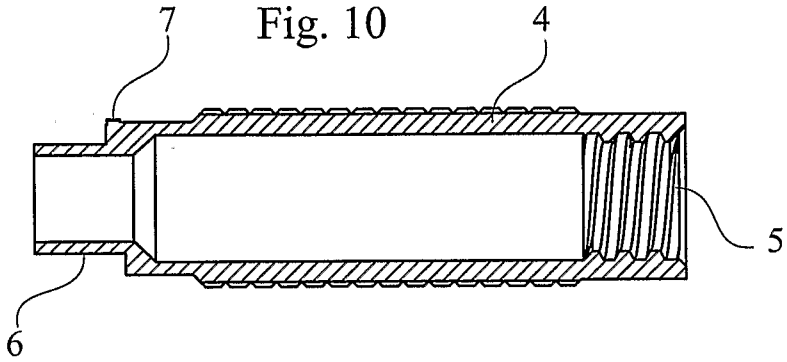
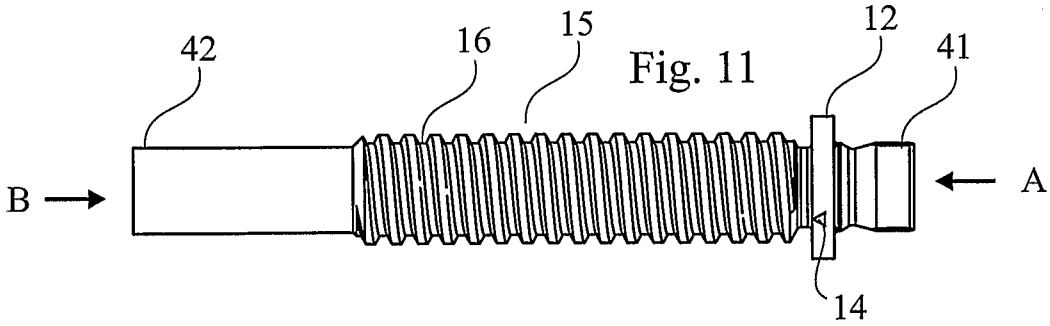


Fig. 11



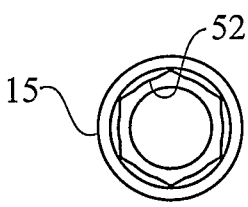


Fig. 13

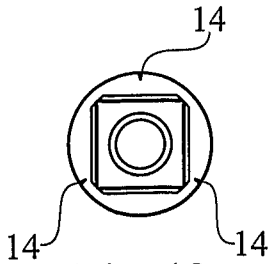
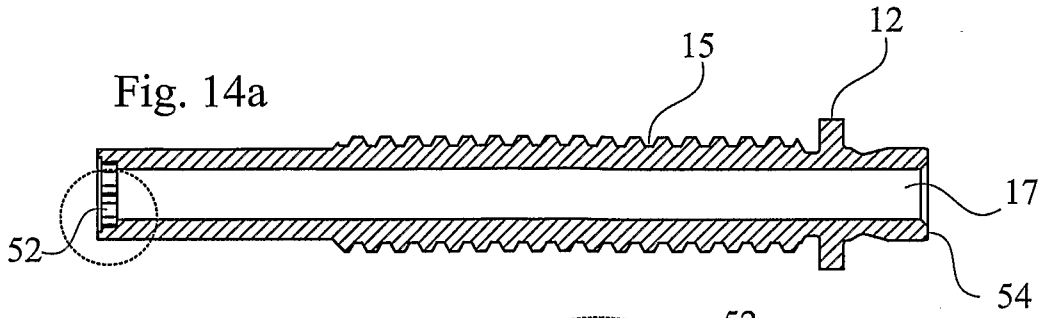


Fig. 12

Fig. 14a



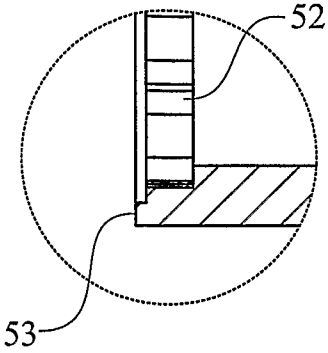


Fig. 14b

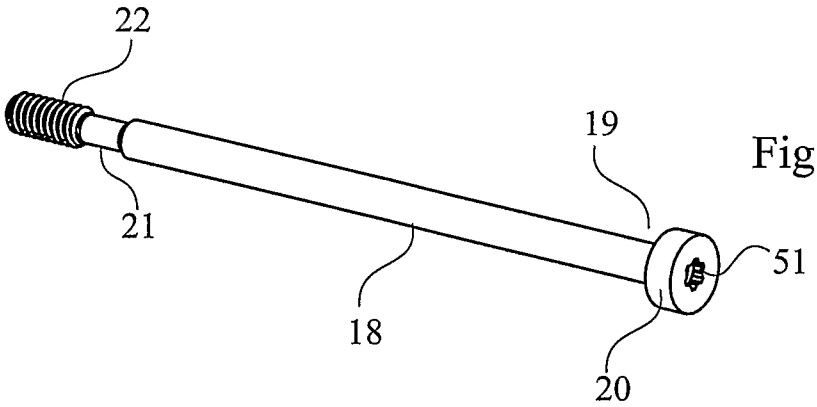


Fig. 15

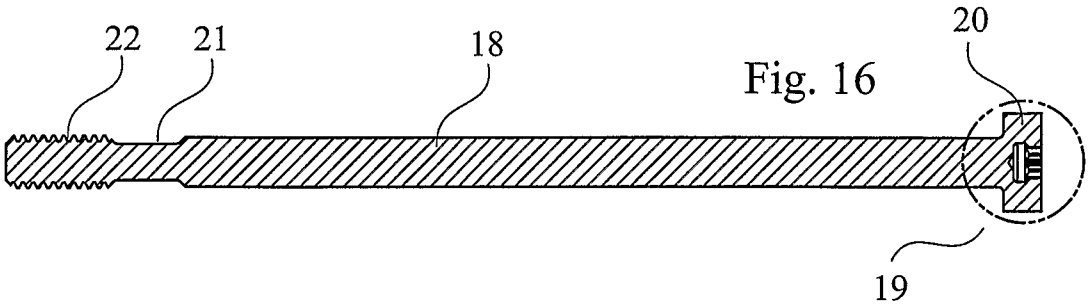
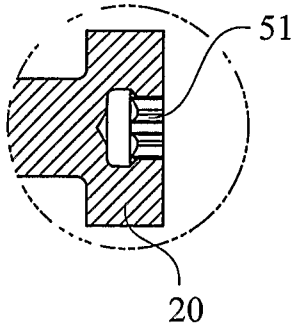


Fig. 16

Fig. 17



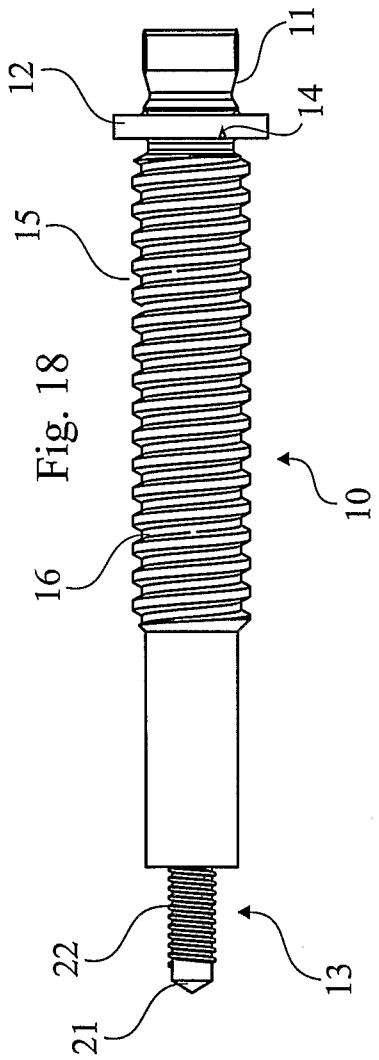


Fig. 18

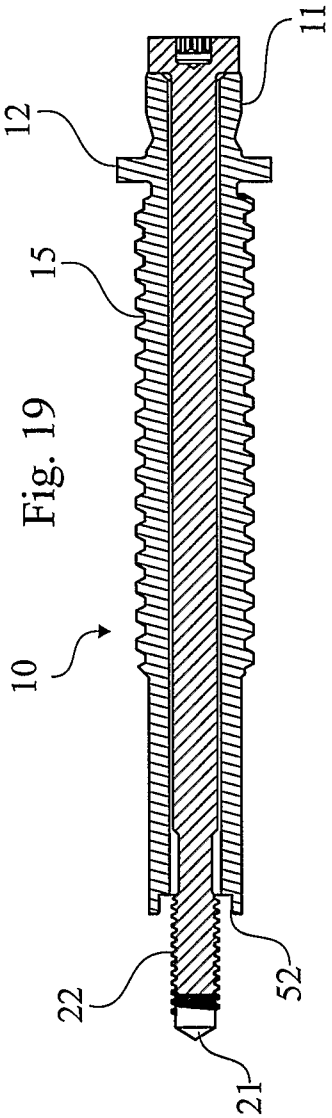


Fig. 19

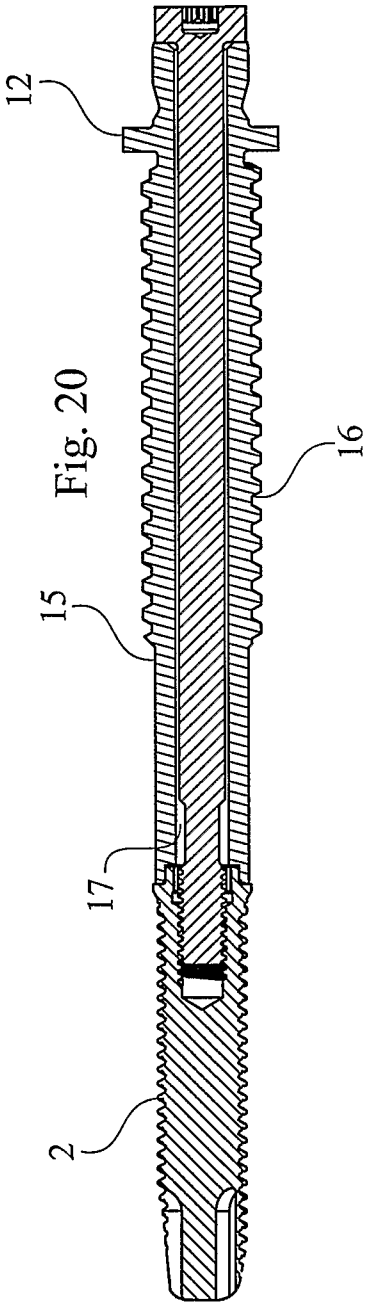


Fig. 20

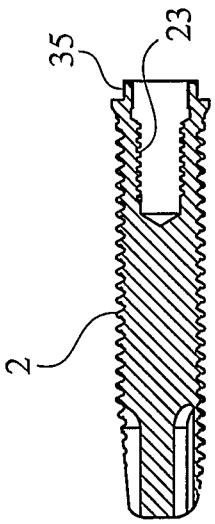


Fig. 21

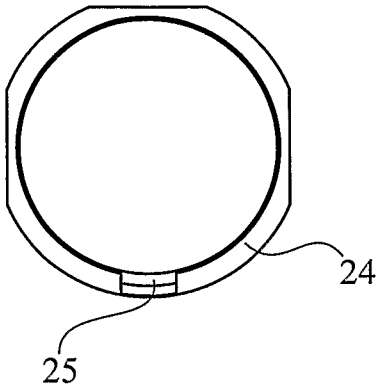


Fig. 22

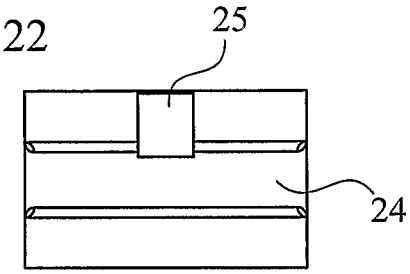
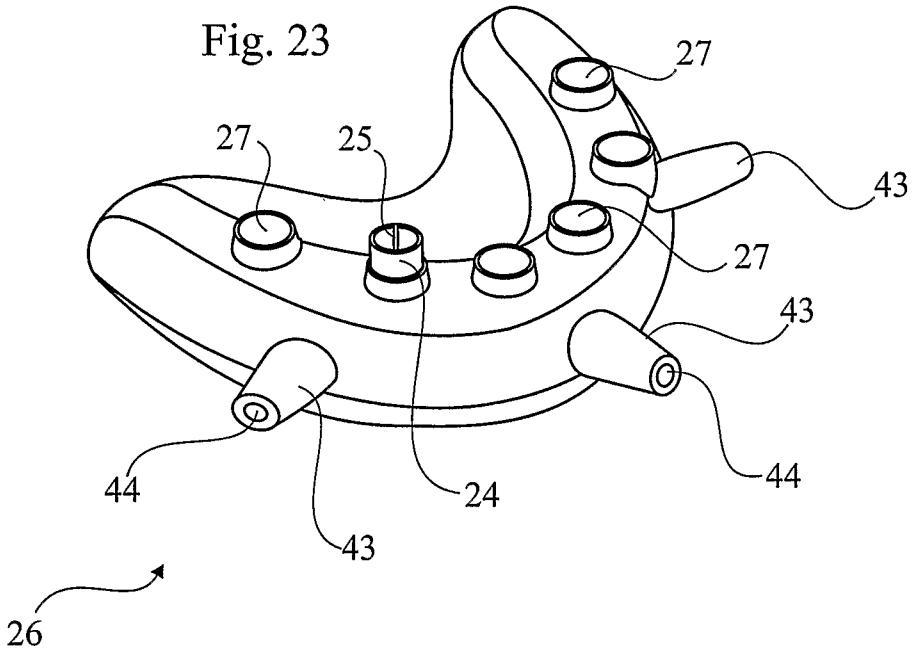


Fig. 23



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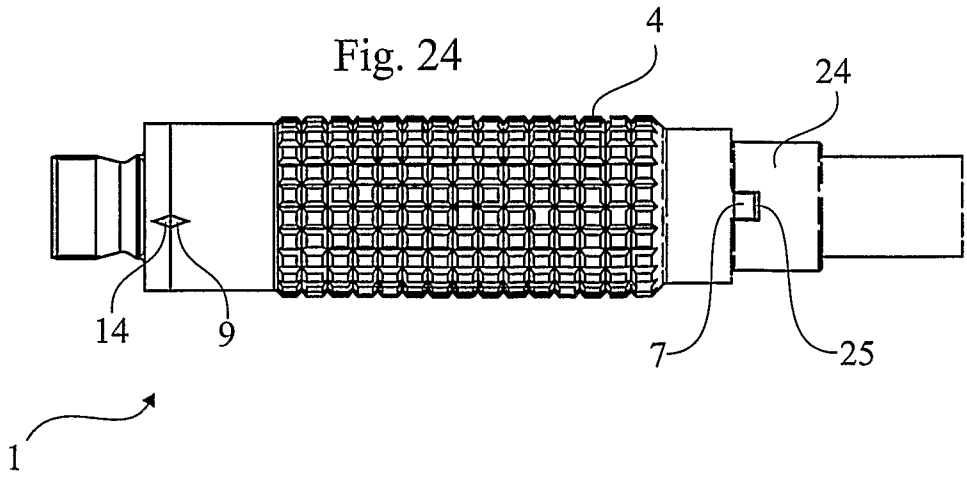


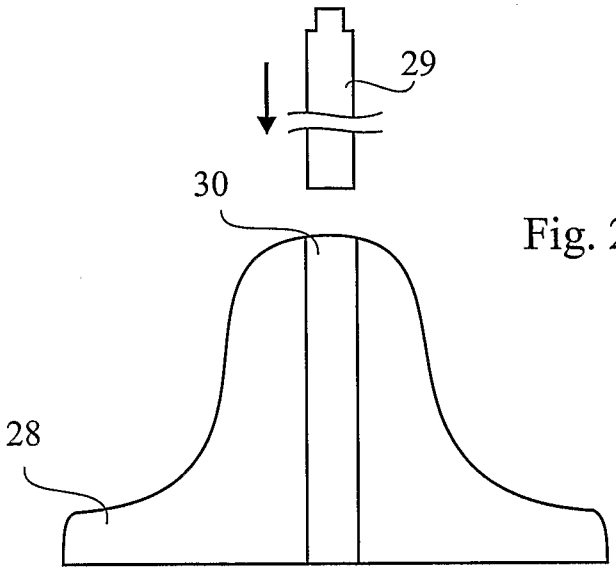


Fig. 25

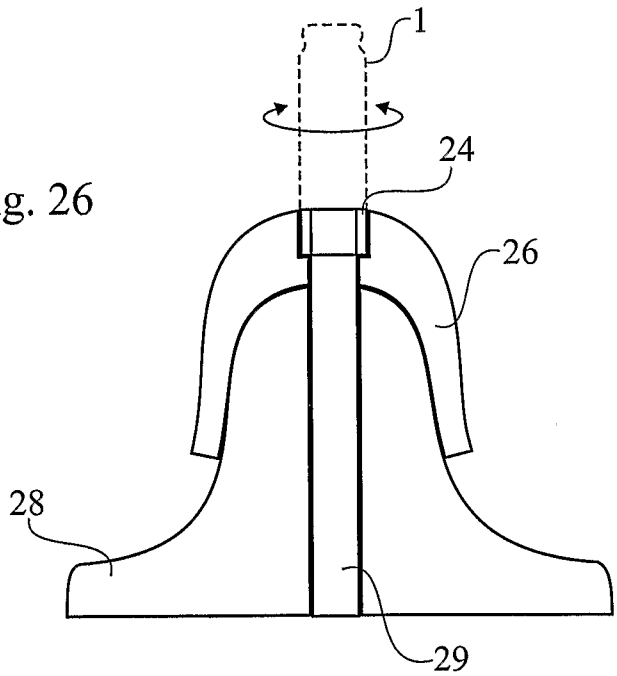


Fig. 26

Fig. 27

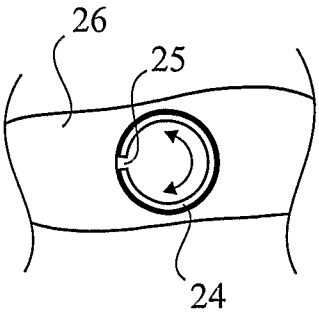


Fig. 28

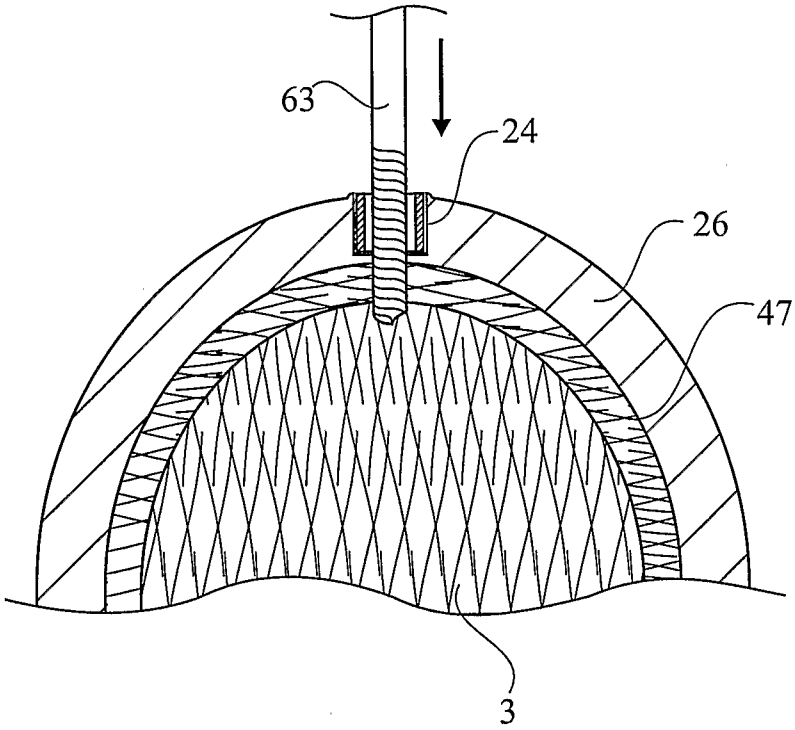
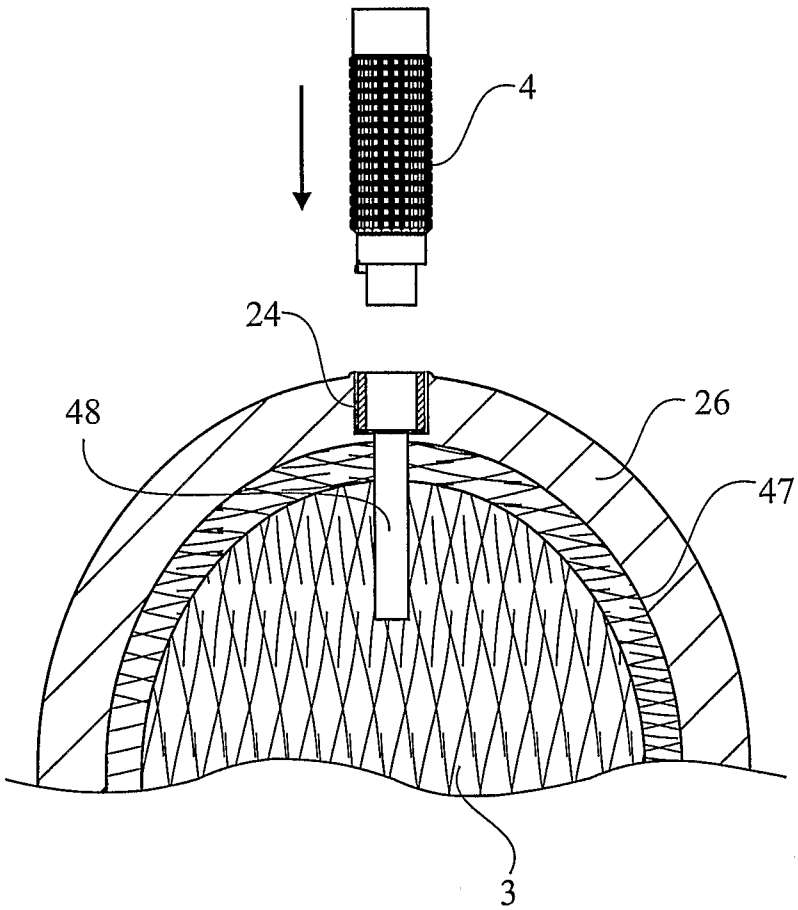


Fig. 29



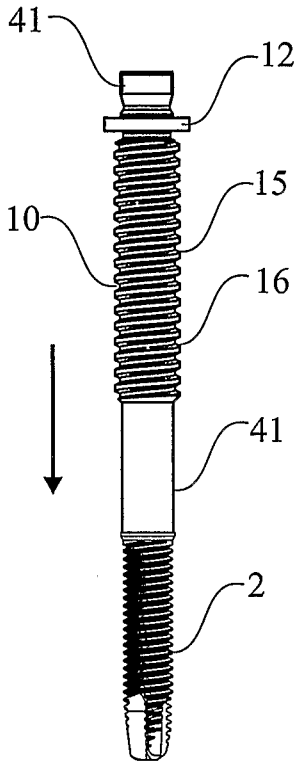


Fig. 30

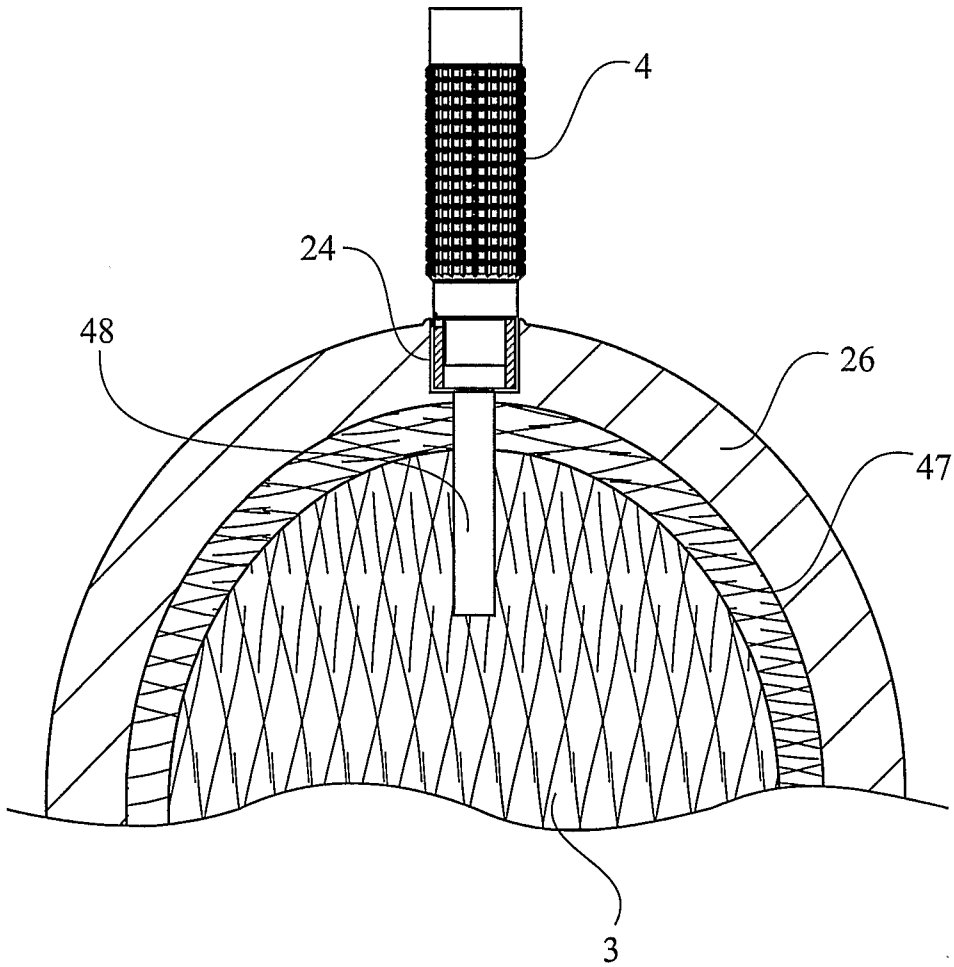


Fig. 31

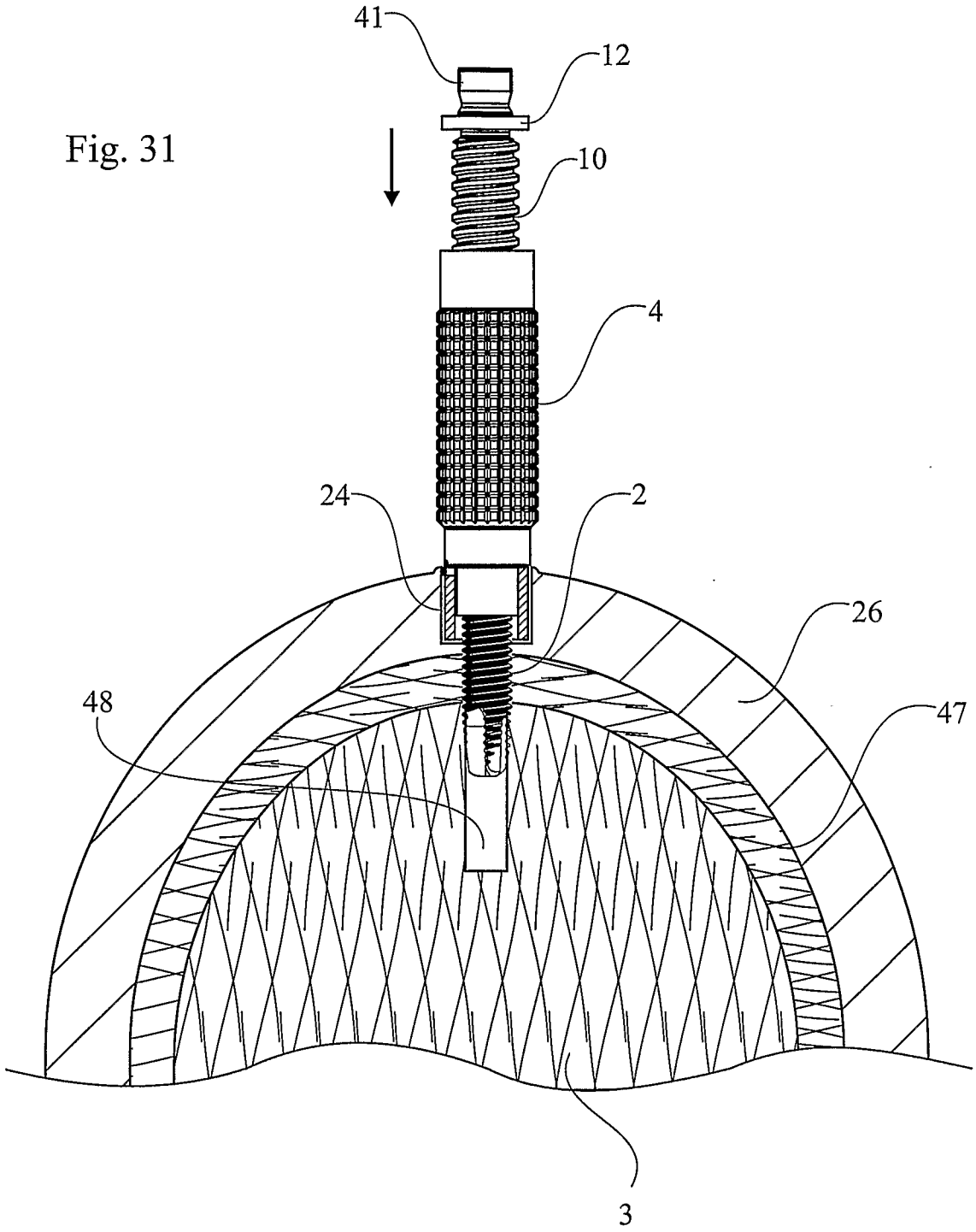


Fig. 32

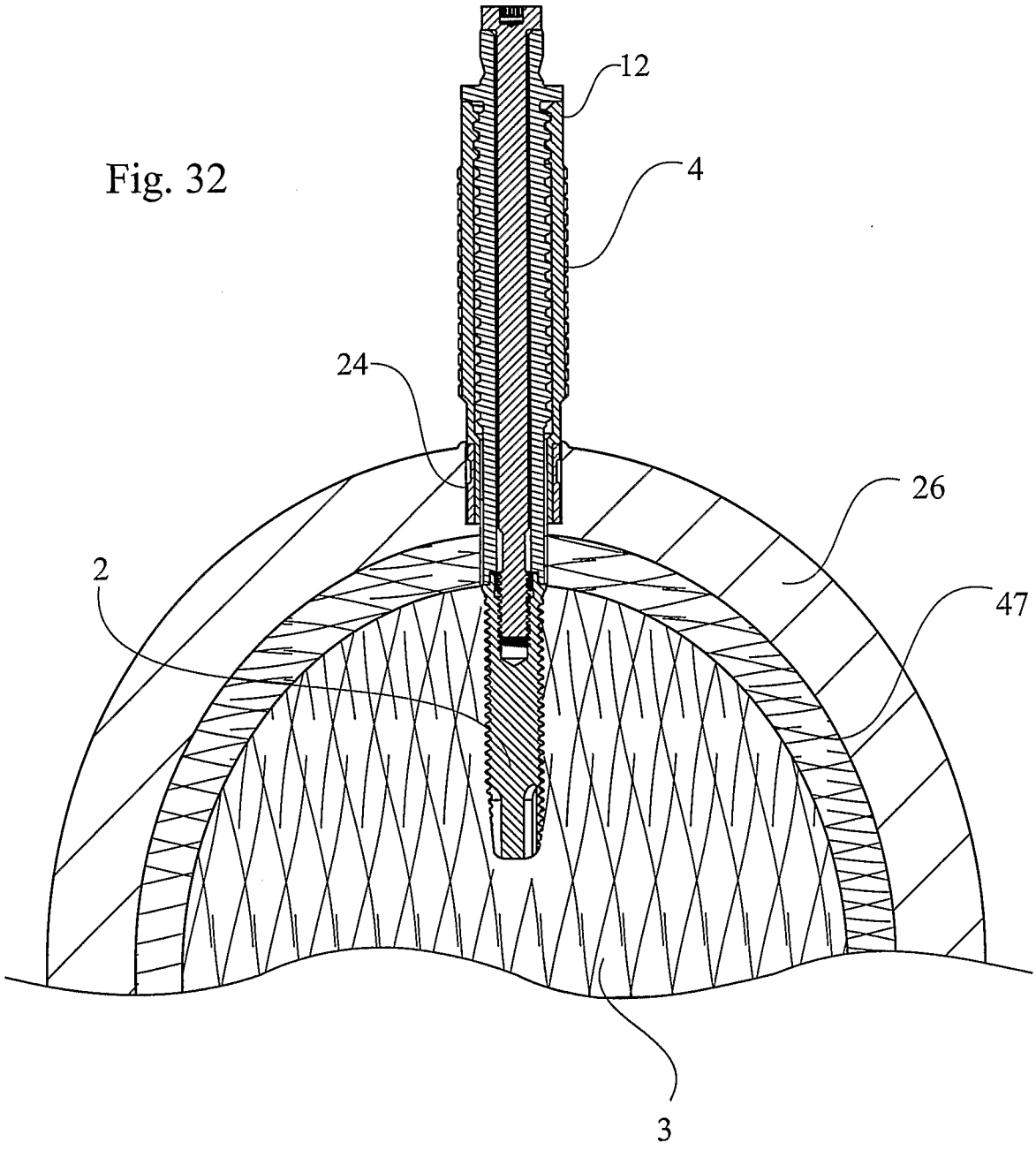
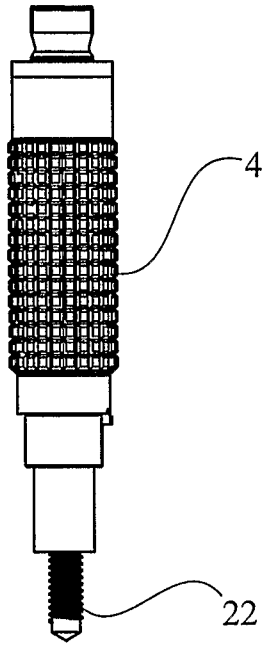
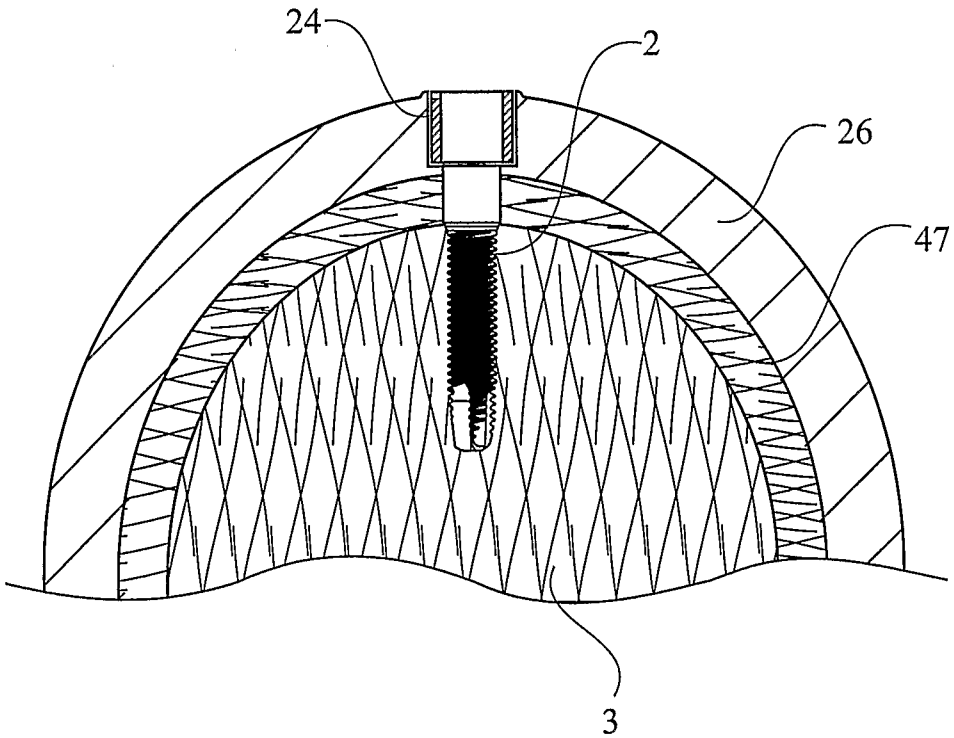


Fig. 33





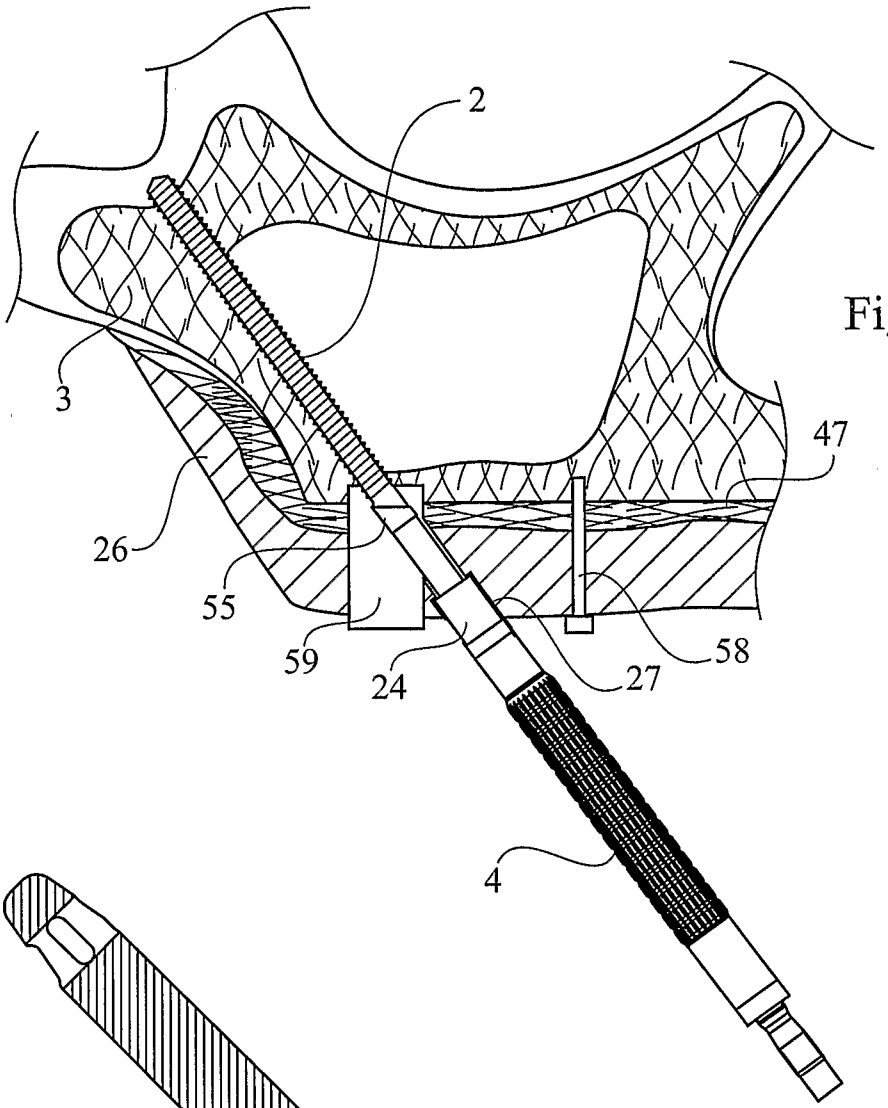


Fig. 35

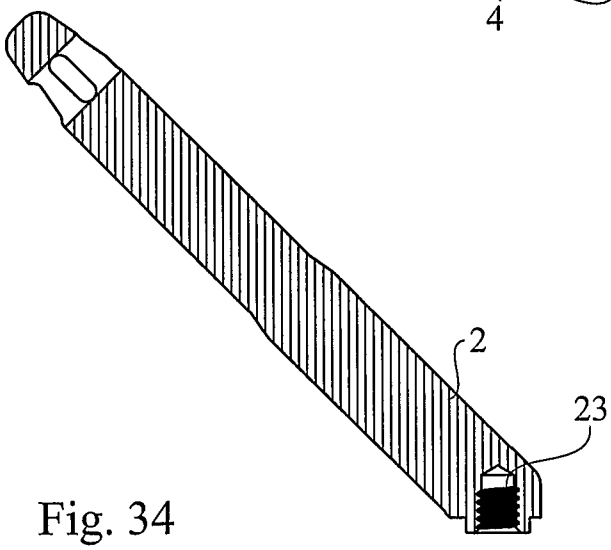


Fig. 34

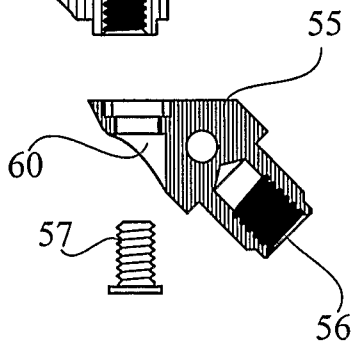


Fig. 36

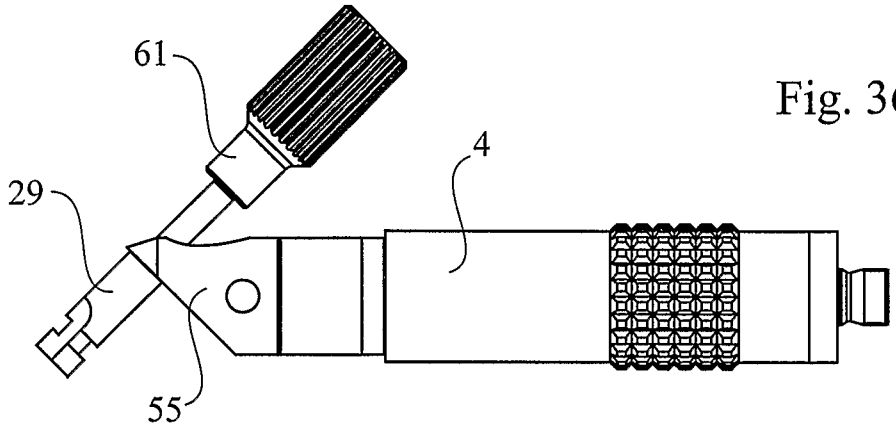


Fig. 37

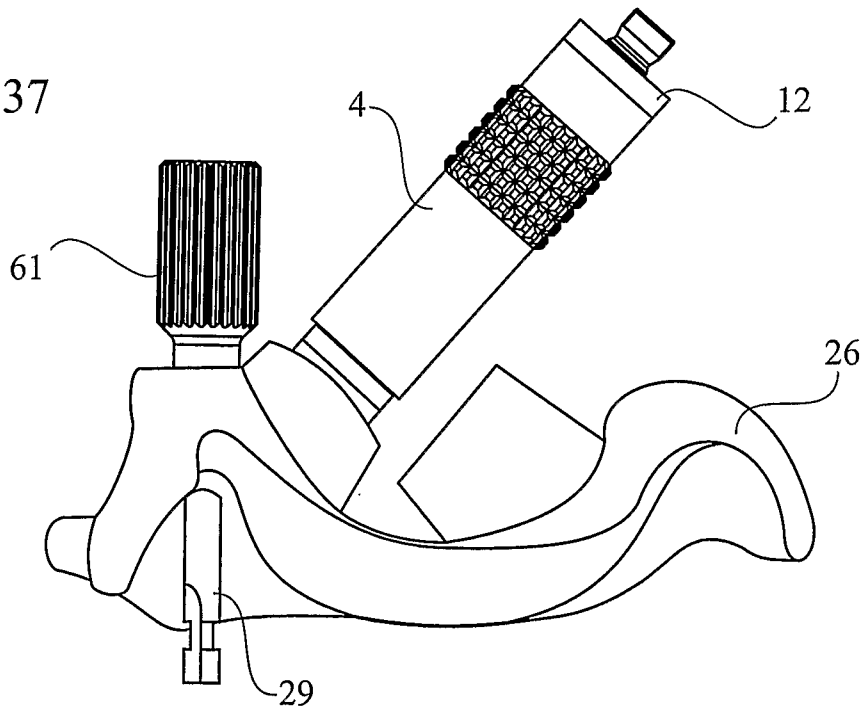


Fig. 38

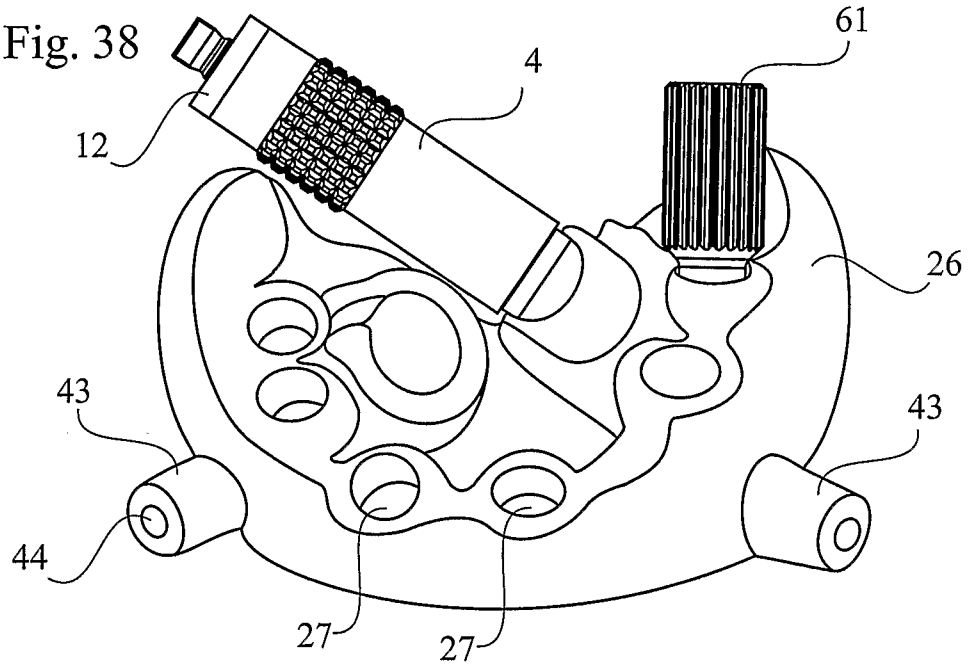
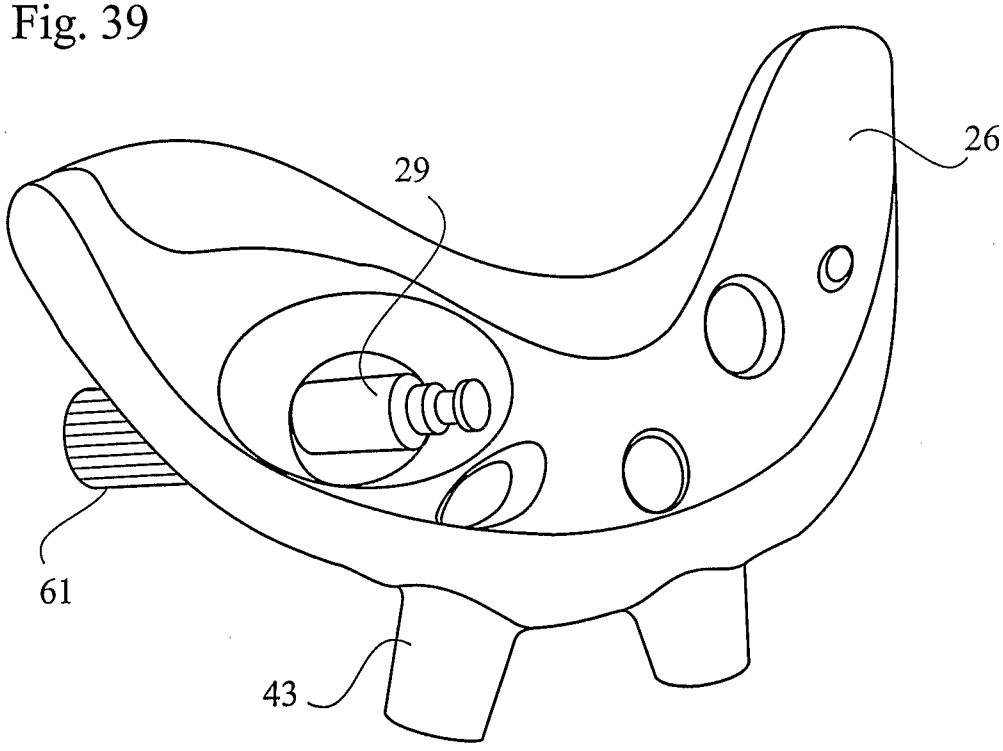


Fig. 39



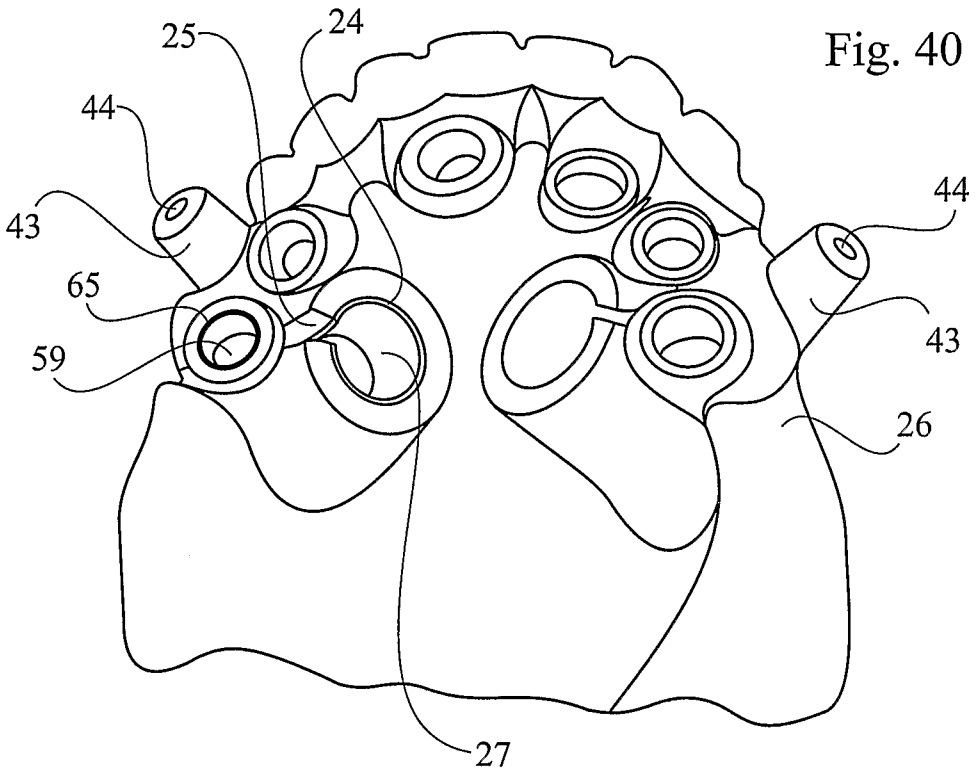


Fig. 40

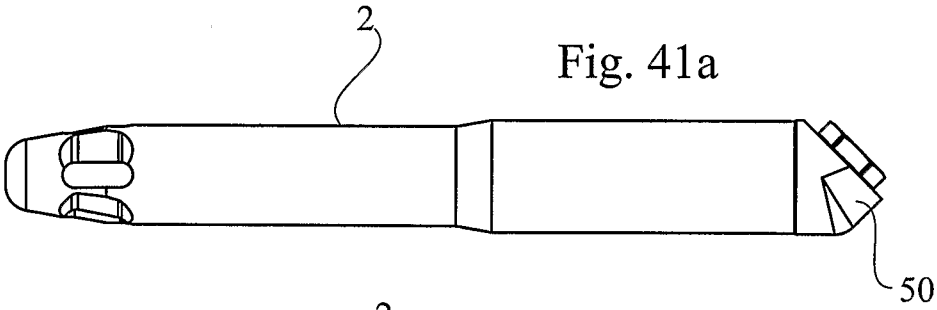


Fig. 41a

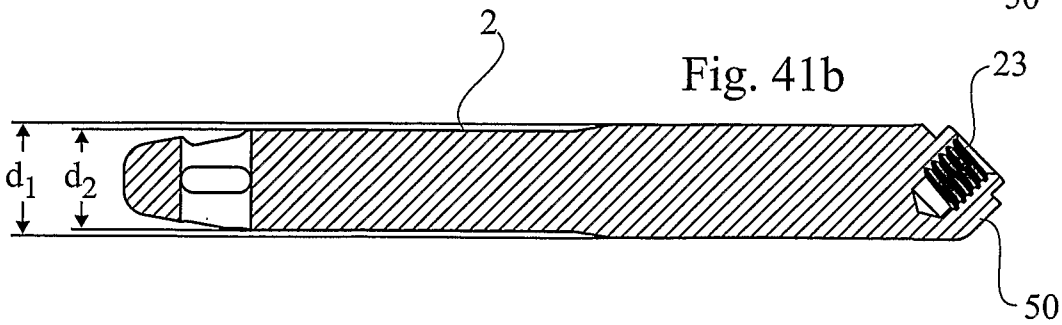


Fig. 41b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2007/000431

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.: 10-12
because they relate to subject matter not required to be searched by this Authority, namely:

Claims 10-12 relate to a method of treatment of the human or animal body by surgery or by therapy, as well as diagnostic methods /Rule 39.1(iv).

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 following separate inventions were identified:
1: Claims 1-6 and 10-12 directed to a device and a method for securing a dental implant to the bone tissue.
2: Claims 7-9 directed to a method of manufacturing a surgical template.

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 an additional fee, this Authority did not invite payment of any additional fee.

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.: 1-6 and 10-12

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/SE2007/000431

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
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: A61C

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

SE,DK,FI,NO classes as above

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 10009448 A1 (LAUX, ROBERT), 13 Sept 2001 (13.09.2001), figure 1	1-6
A	WO 9816163 A1 (CHIN, MARTIN), 23 April 1998 (23.04.1998), figures 11-14, abstract	1-6

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
3 Sept 2007	04 -09- 2007
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Leif Brander / MRo Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2007/000431

International patent classification (IPC)

A61C 8/00 (2006.01)
A61B 17/86 (2006.01)

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Cited literature, if any, will be enclosed in paper form.

DE	10009448	A1	13/09/2001	WO	0150977	A	19/07/2001
WO	9816163	A1	23/04/1998	AT	352260	T	15/02/2007
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				US	5810812	A	22/09/1998
				US	5976142	A	02/11/1999