



(51) International Patent Classification:
H04R 25/00 (2006.01)

(21) International Application Number:
PCT/EP2010/064284

(22) International Filing Date:
27 September 2010 (27.09.2010)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO,

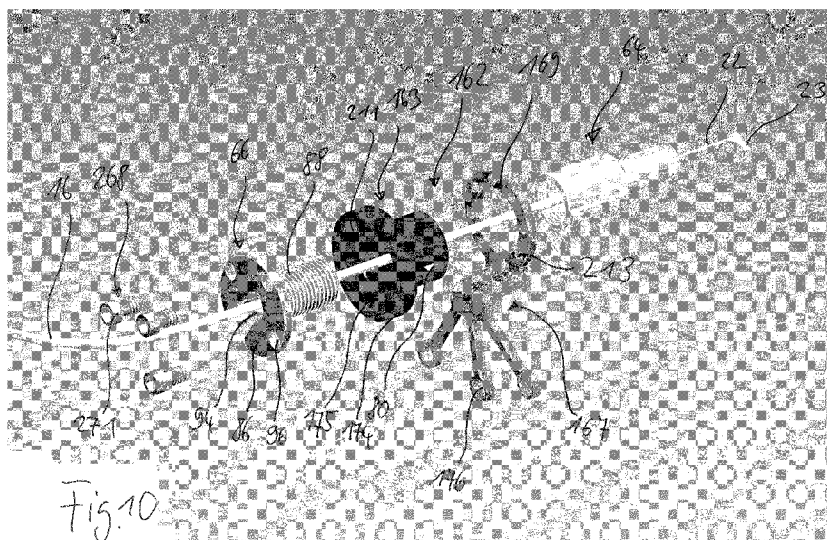
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, 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, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- upon request of the applicant, before the expiration of the time limit referred to in Article 21(2)(a)
- without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) Title: **IMPLANTABLE HEARING INSTRUMENT**



(57) Abstract: The invention relates to a hearing instrument, comprising an audio signal source (28), an audio signal processing unit (34) for processing the audio signals provided by the audio signal source, and an implantable stimulation assembly (18) for stimulating a middle ear or inner ear component of the hearing of a patient, wherein the stimulation assembly comprises: an actuator (20) to be coupled to said hearing component for vibrating said hearing component according to the processed audio signals, a non-variable first support member (62, 162) to be directly fixed at the patient's skull, a second support member (64) at which the actuator is fixed and which is guided by the first support member for axial movement with regard to the first support member, an adjustment member (66) engaging with the first support member and the second support member for manually adjusting the axial position of the second support member with regard to the first support member during implantation, and means (68, 268) for locking the adjustment member so as to lock the axial position of the second support member with regard to the first support member once a desired position has been reached.

Implantable hearing instrument

The invention relates to an at least partially implantable hearing instrument comprising an audio signal source (usually a microphone arrangement), an audio signal processing unit for processing the audio signals provided by the audio signal source and an implantable
5 stimulation assembly for stimulating a middle ear or inner ear component of the hearing of a patient via an actuator to be coupled to that hearing component for vibrating that hearing component according to the processed audio signals.

In order to impart such vibrations in a well-defined manner to the hearing component of the patient, the stimulation assembly, and in particular the actuator, has to be somehow fixed at
10 the patient's skull.

US 6,325,755 B1 relates to an actuator fixation system allowing for adjustment in three dimensions and comprising a cylindrical hanger which is to be fixed at the mastoid by a mounting flange and which receives a ball-shaped end of a sleeve having a sleeve bore mating with a threaded spinner of a transducer assembly which also includes an adjustable slight post,
15 a transducer support and a transducer. The spinner can be moved through the sleeve bore in order to adjust the overall length of the sleeve and the transducer assembly.

US 2007/0142697 A1 relates to an implantable hearing aid transducer which is fixed by a positioning system via a bone anchor in the mastoid; the transducer is connected via a connection to an ossicle which comprises a thread for making the connection detachable.

20 US 2001/0031908 A1 relates to an implantable hearing aid which comprises a transducer touching the malleus for taking up vibrations of the malleus; the transducer may be a piezotransducer and is supported by a transducer mount comprising a member which is axially adjustable via a screw with regard to an element which is fixed at the skull by screws.

US 2002/0038072 A1 relates to an implantable hearing aid comprising a fixation system for
25 an electromechanical transducer comprising a carriage which can be moved along a guide rail by rotating a threaded spindle. The fixation system also comprises a ball-and-socket joint for lateral adjustment of the transducer.

WO 2005/101903 A2 relates to an implantable hearing aid comprising a transducer which is integrated within a ball received in a transducer housing which is fixed to the skull via flanges.

It is an object of the invention to provide for an at least partially implantable hearing instrument comprising an actuator fixation system which allows for easy implantation of the fixation system, for convenient and reliable adjustment of the actuator position and for convenient maintenance or revisions of the system after implantation. It is a further object of the invention to provide for a method of implanting a stimulation assembly of such hearing instrument.

10 According to the invention, these objects are achieved by a hearing instrument as defined in claim 1 and a method as defined in claim 30, respectively.

The invention is beneficial in that, by providing the stimulation assembly with a non-variable first support member to be directly fixed at the patient's skull, a second support member at which the actuator is fixed and which is guided by the first support member for axial movement with regard to the first support member, an adjustment member engaging with the first support member and the second support member for manually adjusting the axial position of the second support member with regard to the first support member during implantation and means for locking the adjustment member so as to lock the axial position of the second support member with regard to the first support member once a desired position has been reached, a stimulation assembly having a relatively simple structure is obtained which can be implanted in a relatively simple manner without the need for removal of a large amount of bone, which can be adjusted in a reliable and convenient manner without the need of manipulation of the actuator with fingers and without the need of using several different tools, and which allows for relatively easy revision after implantation in case that, for example, the actuator has to be replaced, etc.

Since the stimulation assembly of the present invention allows for adjustment of the actuator position along one axis only, precise drilling of the implantation cavity is necessary. Preferably, a drilling method using a customized jig as described in WO 2010/061006 A2 is used.

Preferred embodiments of the invention are defined in the dependent claims.

Hereinafter, examples of the invention will be illustrated by reference to the attached drawings, wherein:

- Fig. 1 is a schematic cross-sectional view of an example of the hearing instrument according to the invention after implantation;
- Fig. 2 is a block diagram of the hearing instrument of Fig. 1;
- Fig. 3 is a perspective view of a first example of a stimulation assembly of a hearing instrument according to the invention prior to implantation;
- Fig. 4 is a perspective view of the stimulation assembly of Fig. 3 seen from a different direction;
- Fig. 5 is a perspective view of the adjustment member and the actuator support member of the stimulation assembly of Figs. 3 and 4;
- Fig. 6 is a perspective view of the actuator support of the stimulation assembly of Figs. 3 and 4;
- Fig. 7 is a perspective view of the distal end of a tool to be used for adjusting the stimulation assembly of Figs. 3 and 4;
- Figs. 8 and 9 are perspective views of a second example of a stimulation assembly according to the invention prior to implantation seen from two different directions and shown in the locked state;
- Fig. 10 is an explosion view of third example of a stimulation assembly according to the invention prior to implantation; and
- Fig. 11 is a perspective view of the stimulation assembly of Fig. 10, shown in the locked state.

Fig. 1 shows a cross-sectional view of the mastoid region, the middle ear and the inner ear of a patient after implantation of an example of a hearing instrument according to the invention, wherein the hearing instrument is shown only schematically. The hearing instrument comprises an external unit 10 which is worn outside the patient's body at the patient's head, typically close to the ear, and an implantable unit 12 which is implanted under the patient's skin 14, usually in an artificial cavity created in the user's mastoid. The implantable unit 12 is connected, via a cable assembly 16, to a stimulation assembly 18 comprising an electromechanical actuator 20 for stimulating a middle ear or inner ear component of the hearing of the patient, such as an ossicle, the stapes footplate, the oval window or the round window of the cochlea 26 via a coupling rod 22 (in the example shown in Fig. 1, the rod 22 is coupled to the stapes footplate 24 via a coupling element 23 provided at the distal end of the coupling rod 22).

The external unit 10 is fixed at the patient's skin 14 in a position opposite to the implantable unit 12, for example, by magnetic forces created between at least one fixation magnet provided in the external unit 10 and at least one co-operating fixation magnet provided in the implantable unit 12 (the magnets are not shown in Fig. 1).

An example of a block diagram of the system of Fig. 1 is shown in Fig. 2. The external unit 10 includes a microphone arrangement 28, which typically comprises at least two spaced-apart microphones 30 and 32 for capturing audio signals from ambient sound, which audio signals are supplied to an audio signal processing unit 34, wherein they undergo, for example, acoustic beam forming. The processed audio signals are supplied to a transmission unit 36 connected to a transmission antenna 38 in order to enable transcutaneous transmission of the processed audio signals via an inductive link 40 to the implantable unit 12 which comprises a receiver antenna 42 connected to a receiver unit 44 for receiving the transmitted audio signals. The received audio signals are supplied to a driver unit 48 which drives the actuator 20.

The external unit 10 also comprises a power supply 50 which may be a replaceable or rechargeable battery, a power transmission unit 52 and a power transmission antenna 54 for transmitting power to the implantable unit 12 via a wireless power link 56. The implantable unit 12 comprises a power receiving antenna 58 and a power receiving unit 60 for powering the implanted electronic components with power received via the power link 56.

Preferably, the audio signal antennas 38, 42 are separated from the power antennas 54, 58 in order to optimize both the audio signal link 40 and the power link 56. However, if a particularly simple design is desired, the antennas 38 and 54 and the antennas 42 and 58 could be physically formed by a single antenna, respectively.

5 According to the embodiment shown in Figs. 3 to 7, the stimulation assembly 18 comprises a non-variable first support member 62 (which hereinafter will be referred to as "cradle") which is to be directly fixed at the patient's skull, a second support member 64 (hereinafter referred to as "actuator support member") at which the actuator 20 is to be fixed and which is guided by the cradle 62 for axial movement with regard to the cradle 62, an adjustment member 66
10 (which forms a "lift screw") which engages with the cradle 62 and the actuator support member 64 for manually adjusting the axial position of the actuator support member 64 with regard to the cradle 62 during implantation, and a locker element 68 which serves to lock the axial position of the actuator support member 64 with regard to the cradle 62 once a desired position has been reached.

15 The cradle 62 is a "non-variable" element in the sense that it has a fixed structure which cannot be changed, i.e. it has no parts which can be moved or adjusted with regard to each other. Preferably, the cradle 62 is made of a single piece, preferably made of titanium. The cradle 62 comprises a distal hollow cylindrical portion 70 in which a distal cylindrical portion 72 of the actuator support member 64 is axially guided in a manner preventing rotation of the
20 actuator support member 64 with regard to the cradle 62 (hereinafter, "distal" designates directions towards the hearing component to be stimulated, and "proximal" designates directions away from the hearing component to be stimulated towards the skin). The cradle 62 also comprises a proximal flange 74 which is provided with openings 76 for receiving bone screws (not shown) used for fixing the cradle 62 at the patient's skull.

25 As shown in Figs. 5 and 6, the outer peripheral surface of the proximal cylindrical portion 72 of the actuator support member 64 comprises a radially projecting element 78, such as a nose or a rib, which is axially slidably guided within an axially extending slot 80 (or a corresponding recess) in the wall of the distal cylindrical portion 70 of the cradle 62, with the projecting element 78 preventing rotation of the actuator support member 64 with regard to
30 the cradle 62. The slot 80 is limited in the distal direction by a ring structure 82 of the distal

cylindrical portion 70 of the cradle 62, which ring structure 82 acts as a distal stop for a nose 84 provided at the proximal end of the projecting rib 78 of the actuator support member 64, thereby limiting the axial travelling distance of the actuator support member 64 relative to the cradle 62.

- 5 The actuator 20 is fixed at the distal end of the actuator support member 64 and extends distally beyond the proximal cylindrical portion 72.

The adjustment member 66 comprises a proximal flange portion 86 and a distal cylindrical portion 88. The outer peripheral surface of the cylindrical portion 88 is provided with an outer thread 90 which engages with an inner thread 91 provided in the hollow interior of the proximal cylindrical portion 72 of the actuator support member 64. The adjustment member 66 is provided with a central bore 92 and a lateral axially extending slot 94 communicating with the bore 92, with the bore 92 and the slot 94 extending axially over the entire length of the adjustment member 66. The bore 92 and the slot 94 serve to receive the cable assembly 16 which connects the proximal end of the actuator 22 to the implantable unit 12.

- 15 The distal side of the flange portion 86 of the adjustment member 66 abuts the proximal side of the proximal flange 74 of the cradle 62, so that, upon rotation of the adjustment member 66 relative both with regard to the cradle 62 and the actuator support member 64, the axial position of the actuator support member 64 with regard to the adjustment member 66 and with regard to the cradle 62 can be adjusted.

- 20 In the example shown in Figs. 3 to 7 the flange portion 86 of the adjustment member 66 is provided with two holes 96 which are provided for being engaged by a mating structure, namely two pins 98, provided at the distal end of a tool 100 (see Fig. 7) which has a substantially C-shaped cross section for receiving the cable assembly 16 in its central axially extending bore 102. For adjusting the adjustment member 66 the pins 98 of the tool 100 are moved into the holes 96 of the adjustment member 66, and the adjustment member 66 is rotated accordingly. Thereby the tool 100 and the adjustment member 66 are rotated around the cable assembly 16.

It is to be understood that prior to adjustment of the adjustment member 66 the cradle 62 is fixed within the artificial cavity prepared by the surgeon by fixing the flange portion 74 of the cradle 62 at the patient's skull by using bone screws. Once the desired final position of the actuator 20 has been reached by appropriate adjustment of the adjustment member 66, the adjustment member 66 is fixed in this position by using the locker element 68. In the example shown in Figs. 3 to 6, the locker element 68 comprises two pins 104 which correspond to the pins 98 of the tool 100 and which are inserted into the holes 96 of the adjustment member 66. The locker element 68 then is fixed at the patient's skull by screwing bone screws (not shown) into corresponding holes 106 provided at the locker element 68. Due to the engagement of the pins 104 of the locker element 68 with the holes 96 of the adjustment member 66, the adjustment member 66 is prevented from rotation, thereby fixing the axial position of the actuator 20.

An alternative embodiment of the stimulation assembly 18 is shown in Figs. 8 and 9, wherein the locker element is significantly simplified compared to the embodiment shown in Figs. 3 to 6. In the embodiment of Figs. 8 and 9 the flange portion 74 of the cradle 62 is provided with a plurality of circumferentially spaced-apart locking holes 211 which are provided with an inner thread. The flange portion 86 of the adjustment member 66 is provided only with one hole 96, rather than with two holes 96 as shown in the embodiment of Figs. 3 to 6. The single hole 96 is located opposite to the lateral slot 94 of the adjustment member 66. Although only one of the holes 96 is provided, the same tool, namely the tool shown in Fig. 7, can be used due to the specific location of the hole 96 opposite to the slot 94. One of the pins 98 of the tool 100 then engages with the hole 96, and the other pin 98 engages with the slot 94.

The locker element is formed by a screw 268 comprising a threaded shaft 269 adapted to be screwed into one of the holes 211 of the flange portion 74 of the cradle 62 and a head 271 for abutting the proximal side of the flange portion 86 of the adjustment member 66.

Once the final desired position of the adjustment member (i.e. the desired position of the actuator 20) has been reached, the position of the adjustment member 66 is fixed by inserting the locker screw 268 into the hole 96 of the adjustment member 66 and by screwing the threaded shaft portion 269 into the respective one of the locking holes 211 of the flange portion 74 of the cradle 62.

In Figs. 10 and 11 a modification of the embodiment of Figs. 8 and 9 is shown, wherein three locker screws 268 are provided, wherein the proximal flange portion 86 of the adjustment member 66 is provided accordingly with three holes 96. Also, the cradle 162 is provided in two parts, namely a proximal part 167 and a distal part 163 comprising the distal hollow cylindrical portion 70 and a proximal flange portion 174 corresponding to a part of the proximal flange portion 74 of the cradle 62 of Figs. 8 and 9; the bone screw openings 76 of the proximal flange portion 74 of the cradle 62 are replaced by a lateral flange, which comprises bone screw openings 176 for being fixed at the patient's skull by bone screws (not shown). The proximal part 167 also comprises a ring-like portion 169 which receives the distal cylindrical portion 70 of distal part 163 of the cradle 162 and which abuts the distal side of the flange portion 174 of the distal part 163 of the cradle 162. The ring-like portion 169 is fixed to the flange portion 174 of the distal part 163 of the cradle 162 via the locker screws 268 which are screwed into threaded holes 213 provided in the ring-like portion 169 in the same manner as the holes 211 in the flange portion 174 of the distal part 163 of the cradle 162 (in the embodiment of Figs. 10 and 11, the holes 211 are not threaded). Thereby rotation of the proximal part 167 relative to the distal part 163 is prevented. The flange portion 174 is provided, at its proximal side, with a recess 175 for receiving the proximal flange portion 86 of the adjustment member 66 in manner that the proximal flange portion 86 of the adjustment member 66 is surrounded by the flange portion 174 of the of the distal part 163 of the cradle 162; thereby the surgeon is enabled to prevent the cradle 162 from rotation when screwing the adjustment member 66 into the actuator support member 64 (by seizing the peripheral surface of the flange portion 174).

As can be seen in the Figures, the actuator 20 preferably extends axially beyond the distal end of the cradle 62.

As already mentioned above, the stimulation assembly 18 may be implanted in the following manner:

A cavity is drilled into the patient's head, the stimulation assembly 18 is inserted into the cavity, the cradle 62 is fixed at the patient's skull (either directly via the holes 76 or via the fixation member 167), the axial position of the actuator support member 64 is manually adjusted with regard to the cradle 62 by acting on the proximal end of the adjustment member

66, namely by inserting the structure 98 at the distal end of the tool 100 into the corresponding mating structures 96 provided at the proximal end of the adjustment member 66, whereby the actuator, namely the coupling rod 22 and the coupling element 23, is coupled to the hearing component of the patient, and locking the adjustment member 66 by using the locker element 5 68/268 so as to lock the axial position of the actuator support member 64 with regard to the cradle 62, namely by locking the rotational position of the adjustment member 66, once a desired actuator position has been reached.

Preferably, the drilling process is prepared in the following manner which is explained in more detail in WO 2010/061006 A2: a print of the patient's upper teeth is captured by 10 solidifying an elastic material; a jig having a lateral beam and navigation benchmarks is connected to the teeth print; the jig is positioned at the patient's head by using the teeth print; a three-dimensional image of the patient's head and the benchmarks is captured, with the jig being in place; a minimal invasive drilling axis is determined for the hearing instrument implantation based on the three-dimensional image; a customized jig is manufactured by 15 providing the lateral beam of the jig with a drilling guide opening for guiding the drilling tool, wherein the position and orientation of the drilling guide opening are selected so as to guide the drilling tool along the determined minimal invasive drilling axis when the jig is positioned at the patient's head by using the teeth print; and the customized jig is positioned at the patient's teeth by using the teeth print, with the drilling guide opening in the jig being used for 20 guiding the drilling tool. Thereby a particularly precise oriented drilling axis is achieved, which eliminates the need for three-dimensional adjustment of the fixation system of the stimulation assembly. Rather, it is sufficient to provide for an axial adjustment as proposed by the present invention.

A drilling system suitable to be used with the present invention is described in PCT- 25 application PCT/EP2010/056749.

Claims

1. A hearing instrument, comprising an audio signal source (28), an audio signal processing unit (34) for processing the audio signals provided by the audio signal source, and an implantable stimulation assembly (18) for stimulating a middle ear or inner ear component of the hearing of a patient, wherein the stimulation assembly comprises:

an actuator (20) to be coupled to said hearing component for vibrating said hearing component according to the processed audio signals,

a non-variable first support member (62, 162) to be directly fixed at the patient's skull,

a second support member (64) at which the actuator is fixed and which is guided by the first support member for axial movement with regard to the first support member,

an adjustment member (66) engaging with the first support member and the second support member for manually adjusting the axial position of the second support member with regard to the first support member during implantation, and

means (68, 268) for locking the adjustment member so as to lock the axial position of the second support member with regard to the first support member once a desired position has been reached.
2. The hearing instrument of claim 1, wherein the first support member (62, 162) comprises a distal hollow cylindrical portion (70) in which a proximal cylindrical portion (72) of the second support member (64) is axially guided in a manner preventing rotation of the second support member with regard to the first support member.
3. The hearing instrument of claim 2, wherein the outer peripheral surface of the proximal cylindrical portion (72) of the second support member (64) comprises a radially projecting element (78, 84) which is axially slideably guided within an axially extending slot (80) or recess in the wall of the first support member (62, 162), with the projecting element preventing rotation of the second support member with regard to the first support member.

4. The hearing instrument of claim 3, wherein the projecting element (78, 84) is formed by a nose or a rib.
5. The hearing instrument of one of claims 2 and 3, wherein the adjustment member (66) comprises a central bore (92) and a lateral, axially extending slot (94) communicating with the bore, with the bore and the slot being designed for receiving a cable assembly (16) connected to the proximal end of the actuator (20), and with the bore and the slot extending axially over the entire length of the adjustment member.
6. The hearing instrument of claim 5, wherein the adjustment member (66) comprises a thread (90) engaging with a thread (91) provided at the second support member (64), wherein adjustment of the axial position of the second support member is achieved by rotation of the adjustment member relative to the second support member.
7. The hearing instrument of claim 6, wherein the thread (90) of the adjustment member (66) is an outer thread at a distal cylindrical portion (88) of the adjustment member, and the thread (91) of the second support member (64) is provided as an inner thread in the proximal cylindrical portion (72) of the second support member.
8. The hearing instrument of one of the preceding claims, wherein the adjustment member (66) comprises a proximal flange portion (86) abutting a proximal flange portion (74, 174) of the first support member (62, 162).
9. The hearing instrument of one of the preceding claims, wherein the first support member (62, 162) is to be fixed at the patient's skull by bone screws.
10. The hearing instrument of claim 9, wherein the first support member (62) comprises a proximal flange portion (74) provided with openings (76) for receiving bone screws.
11. The hearing instrument of one of the preceding claims, wherein the first support member (62) is made of a single piece.
12. The hearing instrument of one of claims 2 to 7, wherein the first support member (162) comprises a proximal part (167) and a distal part (163), wherein the distal part is fixed at the proximal part, wherein the proximal part comprises a flange portion provided with

provided with openings (176) for receiving bone screws, and wherein the distal part comprises said distal hollow cylindrical portion (70).

13. The hearing instrument of claims 8 and 12, wherein the distal part (163) of the first support member (162) comprises said proximal flange portion (174).
14. The hearing instrument of claim 13, wherein the proximal part (167) of the first support member (162) comprises a ring-like portion (169) for receiving said distal hollow cylindrical portion (70) of the distal part (163) and for abutting the distal side of said proximal flange portion (174) of the distal part.
15. The hearing instrument of one of the preceding claims, wherein the first support member (62, 162) is made of titanium.
16. The hearing instrument of one of the preceding claims, wherein the adjustment member (66) is for being rotated by a tool (100) having a substantially C-shaped cross-section for receiving a cable assembly (16) connected to the actuator (20) and for being rotated around the cable assembly.
17. The hearing instrument of claim 16, wherein the proximal end (86) of the adjustment member (66) comprises at least one hole (96) for being engaged by a mating structure (98) at the distal end of the tool (100).
18. The hearing instrument of one of the preceding claims, wherein the first support member (62, 162) forms a cradle.
19. The hearing instrument of one of the preceding claims, wherein the actuator (20) extends axially beyond the distal end of the first support member (62, 162).
20. The hearing instrument of one of the preceding claims, wherein the locking means (68, 268) is designed to prevent rotation of the adjustment element (66) and the first support member (62, 162) relative to each other.
21. The hearing instrument of claim 20, wherein the locking means is formed by a locker element (268) comprising a structure (269, 271) for engaging with mating structures (96, 211, 213) provided at the proximal ends (74, 86, 174) of the adjustment member

- (66) and the first support member (62, 162), respectively, in a manner so as to prevent rotation of the adjustment element and the first support element relative to each other.
22. The hearing instrument of claim 21, wherein the distal end (86) of the adjustment member (66) comprises at least one hole (96), wherein the proximal end (74) of the first support member (62) comprises a plurality of circumferentially spaced apart holes (211) comprising an inner thread, and wherein the locker element is formed by a screw (268) for passing through the at least one hole of the adjustment member and for being screwed into one of the holes of the first support member.
 23. The hearing instrument of claims 14 and 21, wherein the distal end (86) of the adjustment member (66) comprises at least one hole (96), wherein the proximal end (174) of the distal part (163) of the first support member (162) comprises a plurality of circumferentially spaced apart holes (211), wherein the ring-like portion (169) of the proximal part (167) of the first support member comprises a plurality of circumferentially spaced apart holes (213) comprising an inner thread, and wherein the locker element is formed by at least one screw (268) for passing through the at least one hole of the adjustment member and one of the holes of the distal part of the first support member and for being screwed into one of the holes of the ring-like portion of the proximal part of the first support member.
 24. The hearing instrument of claim 22, wherein the at least one hole (96) of the adjustment member (66) is designed to engage with a mating structure (98) of a tool (100) to be used for rotating the adjustment member.
 25. The hearing instrument of claims 5, 16 and 24, wherein the tool (100) is designed to simultaneously engage both with the at least one hole (96) of the adjustment member (66) and with the lateral, axially extending slot (94) of the adjustment member for rotating the adjustment member.
 26. The hearing instrument of claim 21, wherein the locking means is formed by a locker element (68) comprising a structure (104) for engaging with a mating structure (96) provided at the distal end (86) of the adjustment member (66) in manner so as to prevent rotation of the adjustment member, and wherein the locker element comprises means (106) for being fixed at the patients skull.

27. The hearing instrument of claims 16 and 26, wherein the engaging structure (104) of the locker element (68) equals a structure (98) of the tool (100) for engaging with the adjustment member (66) for rotating the adjustment member.
28. The hearing instrument of one of the preceding claims, wherein the audio signal source is formed by a microphone arrangement (28) for capturing audio signals from ambient sound.
29. The hearing instrument of claim 28, wherein the microphone arrangement (28) and the audio signal processing unit (36) form part of an external unit (10) to be fixed at the patient's head and comprising means (36, 38) for transmitting the processed audio signals via a wireless subcutaneous link (40) to the stimulation assembly (18).
30. A method of implanting a stimulation assembly (18) for stimulating a middle ear or inner ear component of the hearing of a patient of a hearing instrument comprising an audio signal source (28) and an audio signal processing unit (34) for processing the audio signals provided by the audio signal source, wherein the stimulation assembly comprises a non-variable first support member (62, 162), a second support member (64) at which an actuator (20) is fixed and which is guided by the first support member for axial movement with regard to the first support element, and an adjustment member, the method comprising:
 - drilling a cavity for implantation of the stimulation assembly into a patient's head and inserting the stimulation assembly into the cavity;
 - fixing the first support member at the patient's skull;
 - manually adjusting the axial position of the second support member with regard to the first support member by acting on the proximal end of the adjustment member, thereby coupling the actuator to said hearing component; and
 - locking the adjustment member so as to lock the axial position of the second support member with regard to the first support member once a desired position has been reached.
31. The method of claim 30, comprising the following steps prior to drilling the cavity:

capturing a print of the patient's upper teeth by solidifying an elastic material;

connecting a jig having a lateral beam and navigation benchmarks to the teeth print;

positioning the jig at the patient's head by using the teeth print;

capturing a three-dimensional image of the patient's head and the benchmarks with the jig in place;

determining a minimal invasive drilling axis for the hearing instrument implantation based on the three-dimensional image;

manufacturing a customized jig by providing the lateral beam of the jig with a drilling guide opening for guiding a drilling tool, wherein the position and orientation of the drilling guide opening are selected so as to guide the drilling tool along determined minimal invasive drilling axis when the jig is positioned at the patient's head by using the teeth print; and

positioning the customized jig at the patient's teeth by using the teeth print;

wherein the drilling guide opening in the jig is used for guiding the drilling tool.

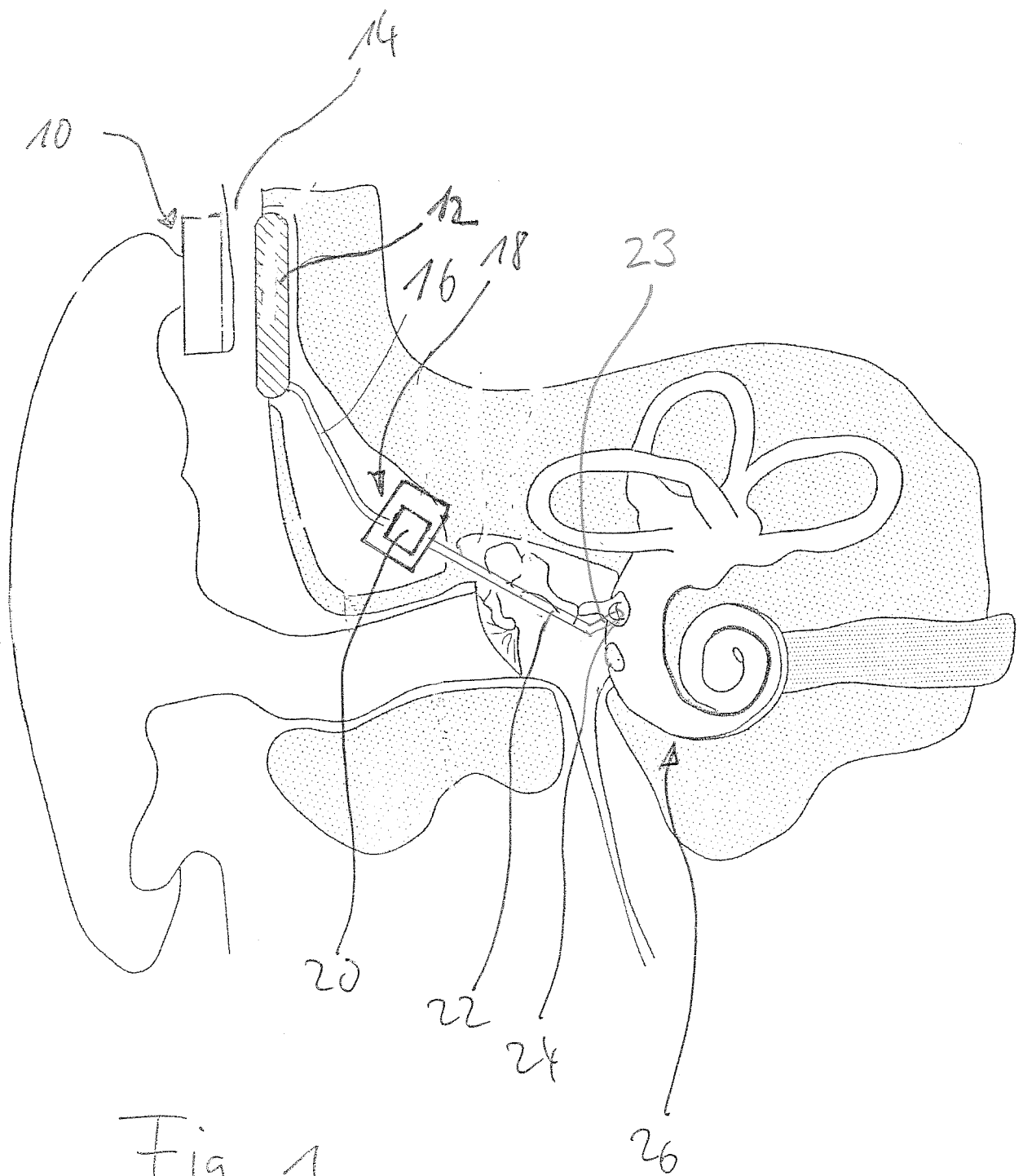


Fig. 1

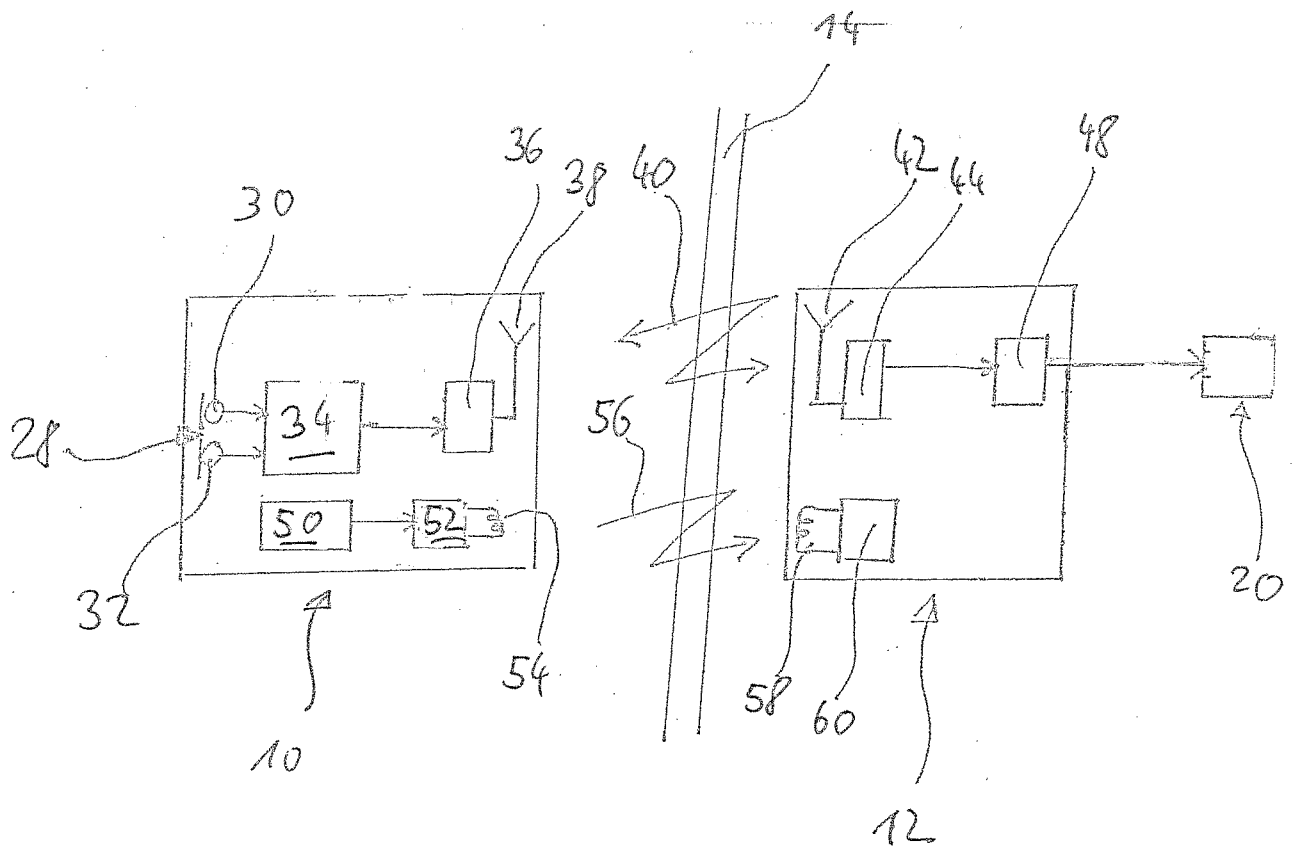
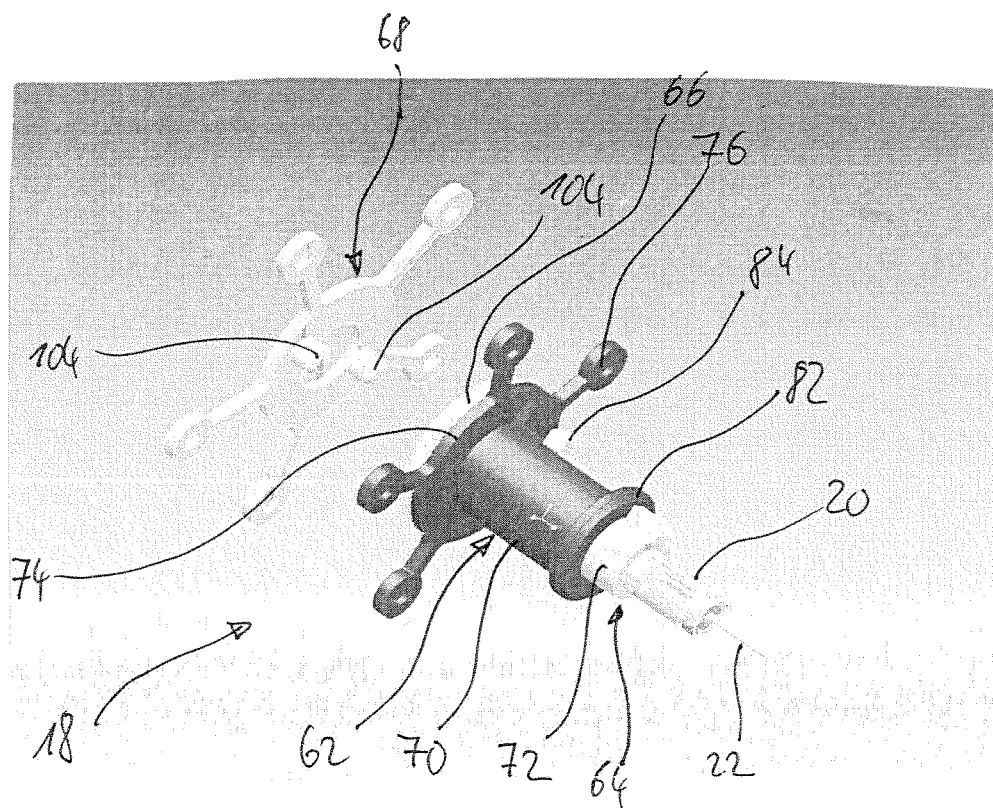
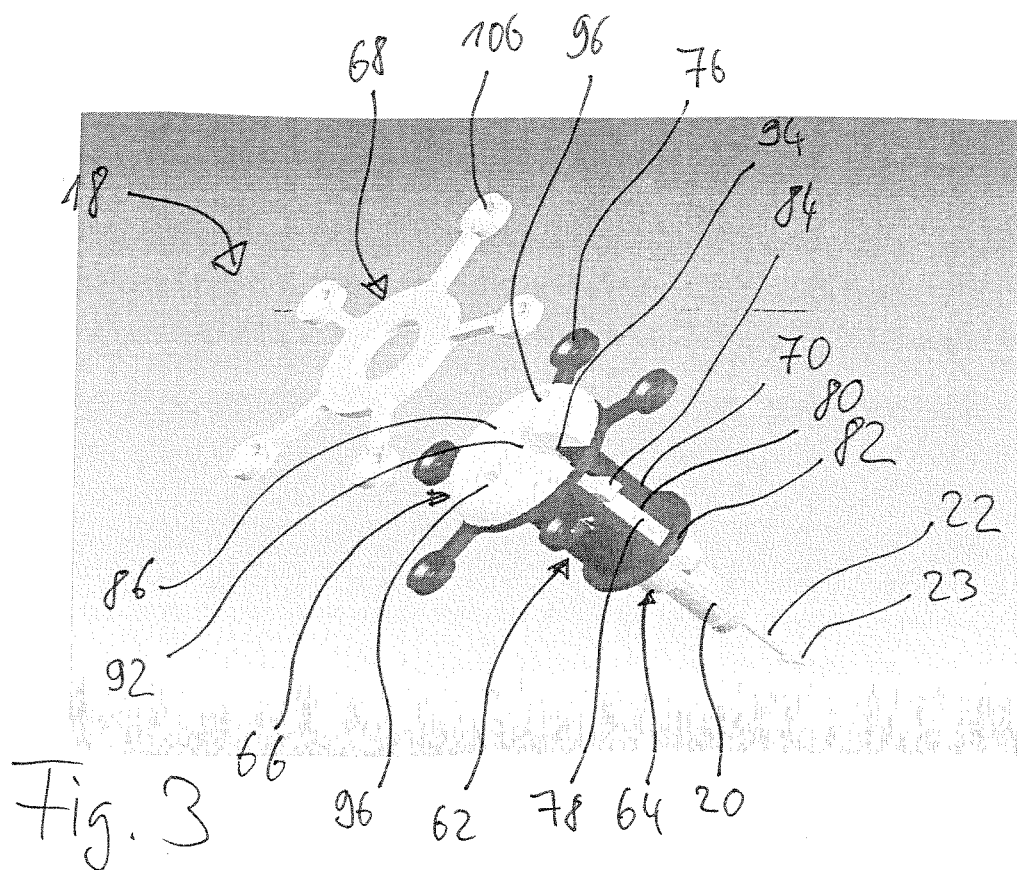


Fig. 2



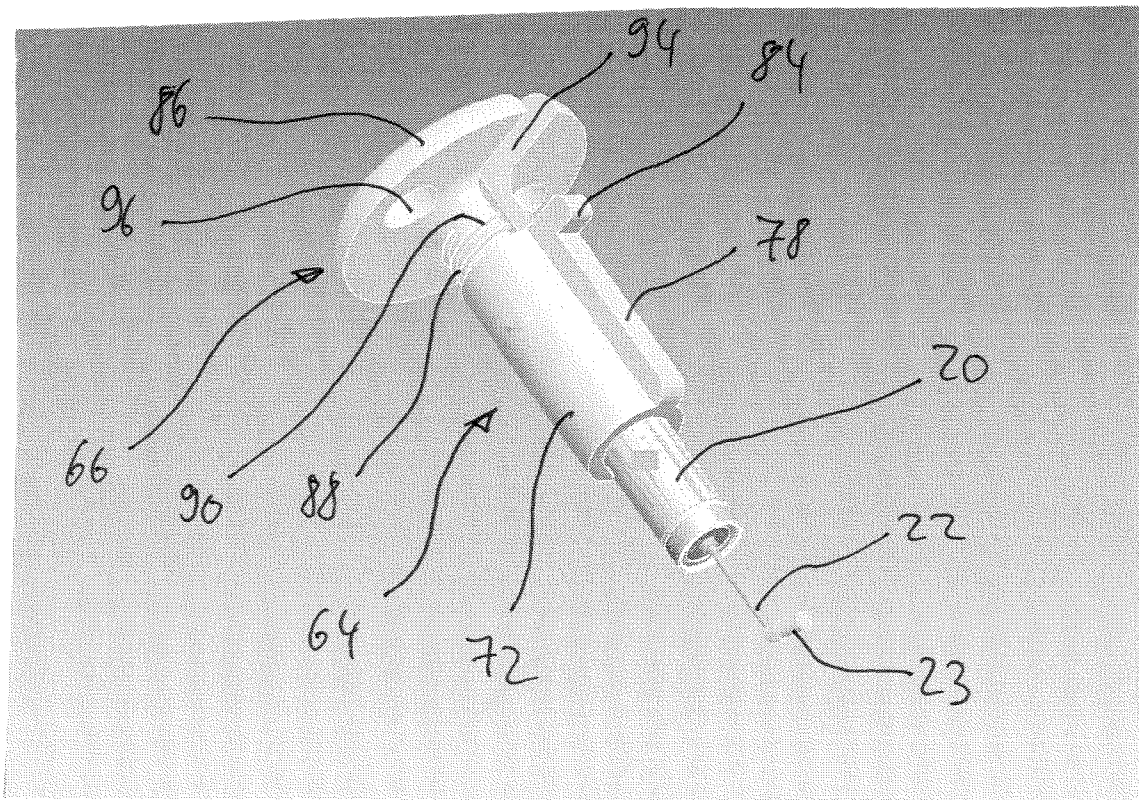


Fig. 5

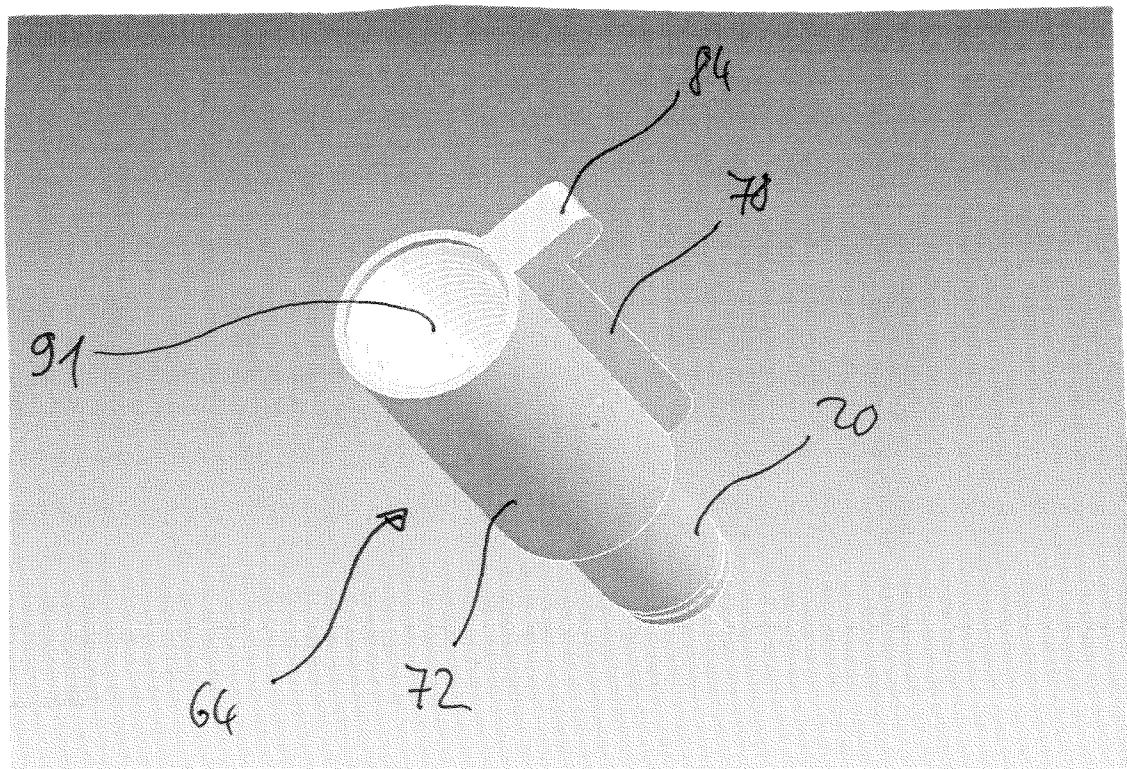


Fig. 6

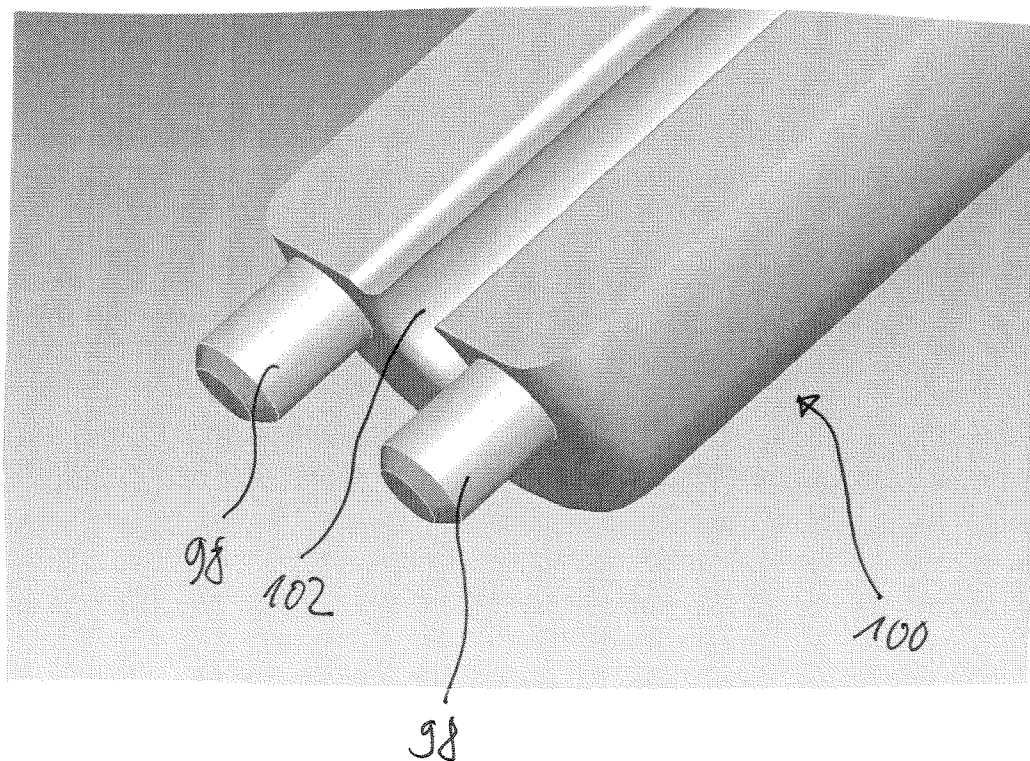


Fig. 7

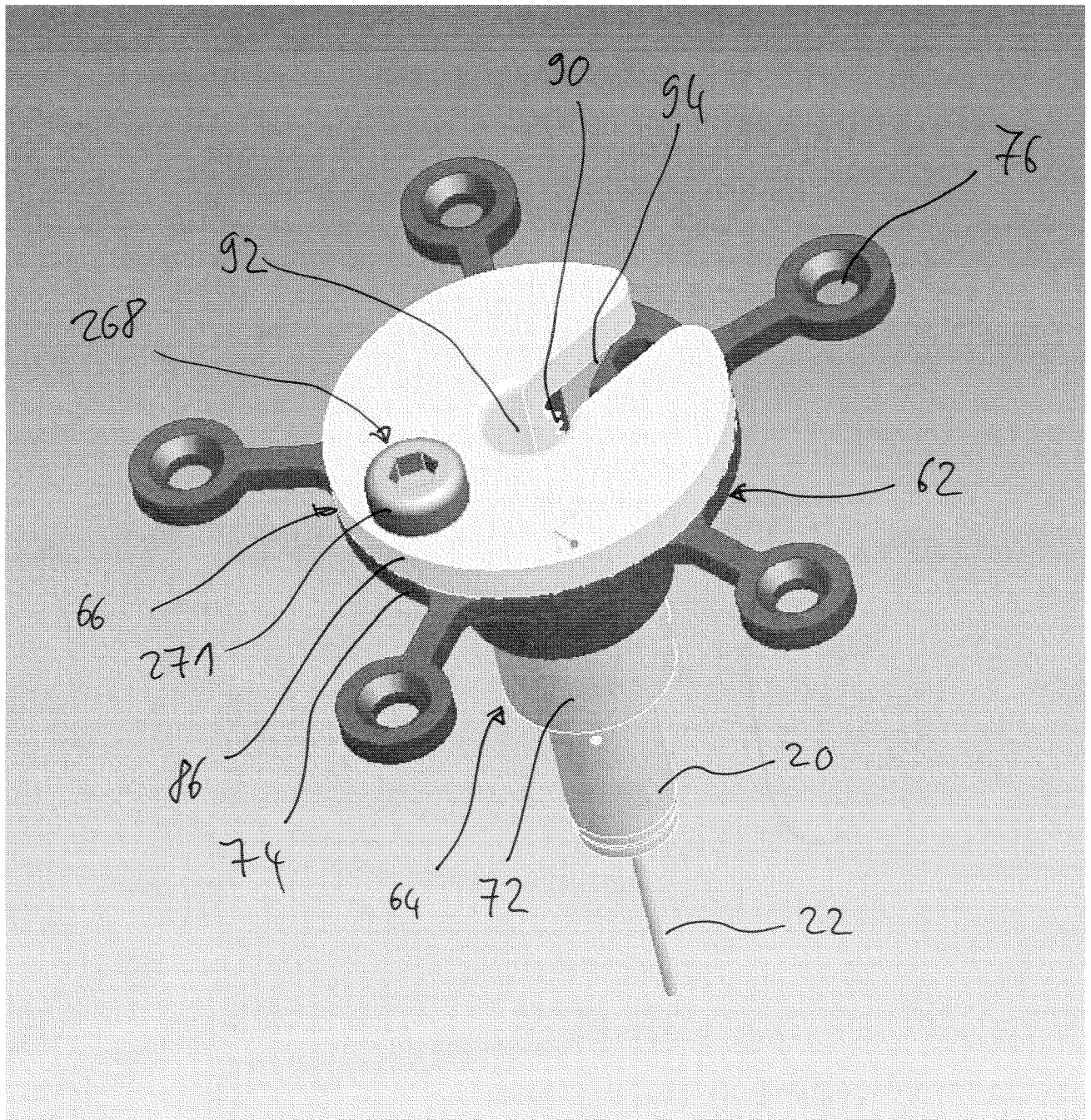


Fig. 8

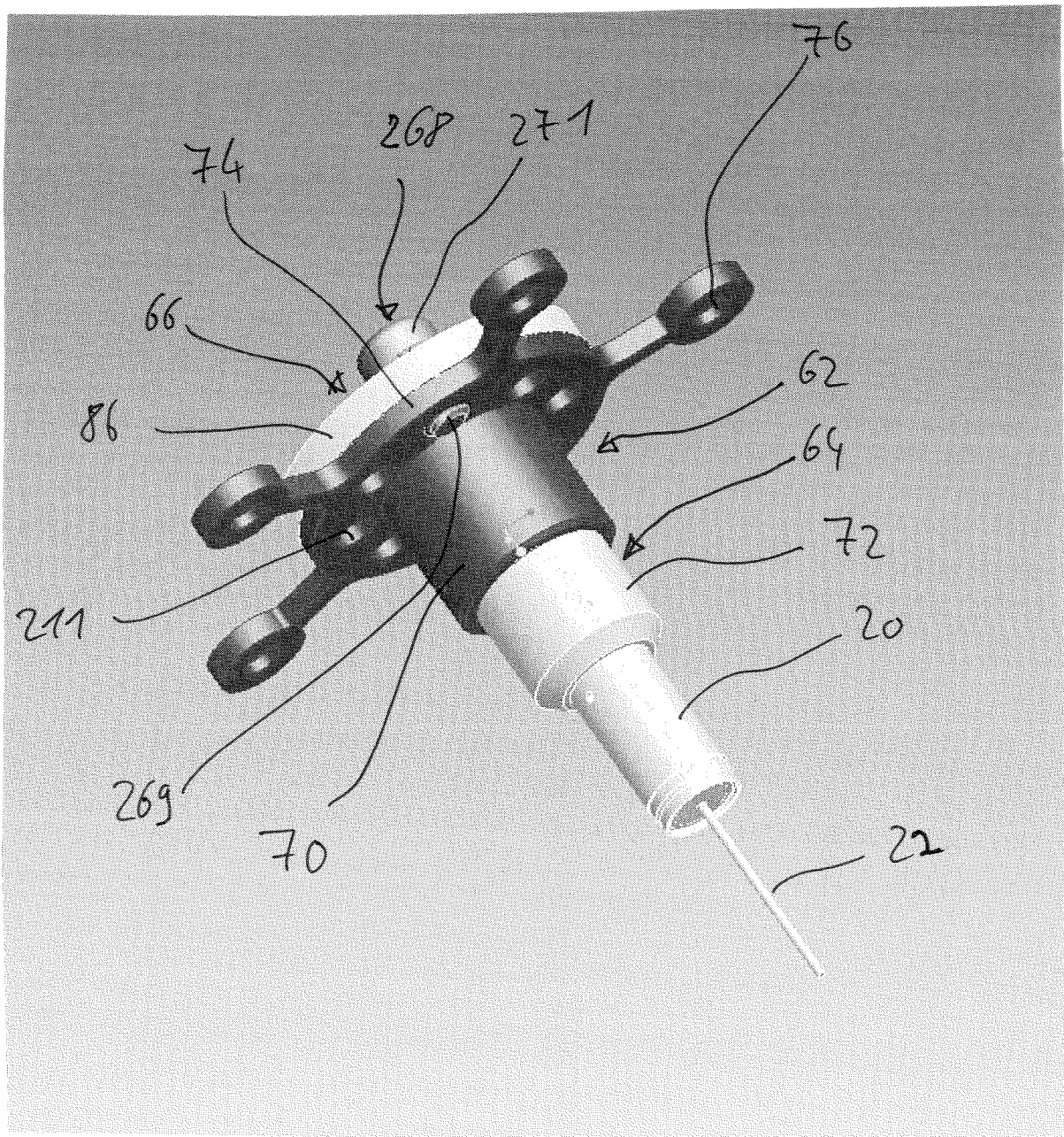


Fig. 9

Fig. 10

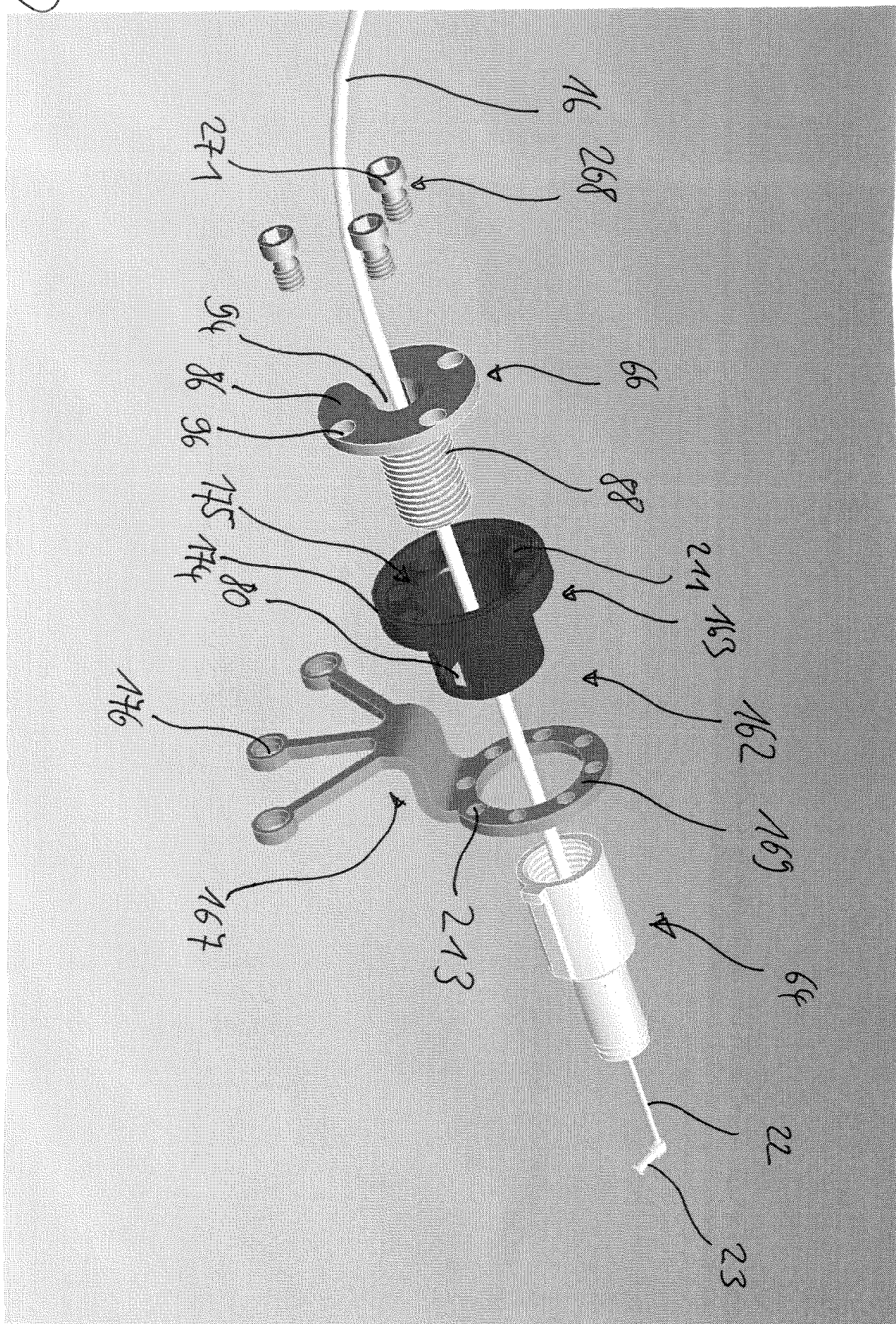


Fig. 11

