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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 November 2003 (06.11.2003)

PCT

(10) International Publication Number
WO 03/092326 A1

(51) International Patent Classification[7]: H04R 25/00

(21) International Application Number: PCT/AU03/00464

(22) International Filing Date: 17 April 2003 (17.04.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PS 1922 23 April 2002 (23.04.2002) AU

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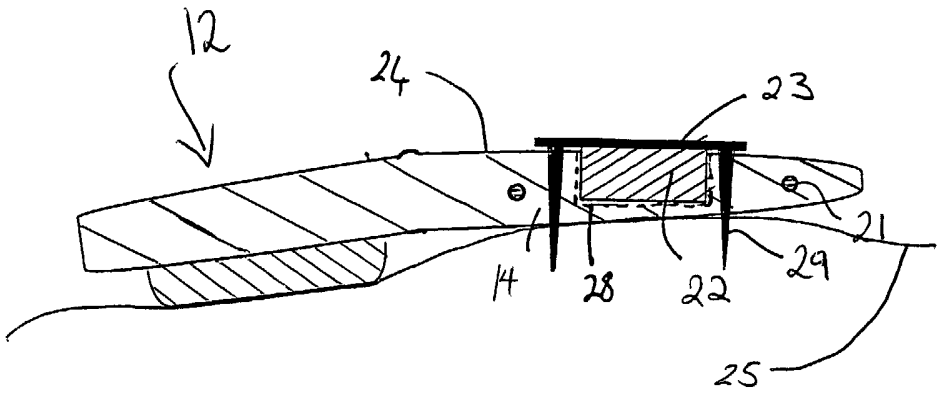
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

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

Published:
— *with international search report*

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: MRI-COMPATIBLE COCHLEAR IMPLANT



(57) Abstract: A magnetic alignment system (10) for a transcutaneous transmitter/receiver system. The magnetic alignment system (10) comprises an external transmitter unit (11) and an implantable receiver component (12) with both the external transmiter unit and the implantable receiver component having a magnet (13a, 22) to allow transcutaneous alignment of the external transmitter unit (11) and the implantable receiver component (12). The system (10) further comprises an anchor member (23) for anchoring the magnet (22) of the implantable receiver component (12) to a part of the body of a recipient, so allowing the recipient to undergo an MRI without the need to remove the magnet (22).

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MRI-COMPATIBLE COCHLEAR IMPLANT

Field of the Invention

The present invention relates to a cochlear implant and in particular an MRI-compatible cochlear implant.

Background Art

In many people who are profoundly deaf, the reason for deafness is absence of, or destruction of, the hair cells in the cochlea which transduce acoustic signals into nerve impulses. These people are unable to derive suitable benefit from conventional hearing aid systems, no matter how loud the acoustic stimulus is made, because there is damage to or absence of the mechanism for nerve impulses to be generated from sound in the normal manner.

It is for this purpose that cochlear implant systems have been developed. Such systems bypass the hair cells in the cochlea and directly deliver electrical stimulation to the auditory nerve fibres, thereby allowing the brain to perceive a hearing sensation resembling the natural hearing sensation normally delivered to the auditory nerve.

Cochlear implant systems have typically consisted of essentially two components, an external component commonly referred to as a processor unit and an internal implanted component commonly referred to as a receiver/stimulator unit. Traditionally, both of these components have cooperated together to provide the sound sensation to a recipient.

The external component has traditionally consisted of a microphone for detecting sounds, such as speech and environmental sounds, a speech processor that converts the detected sounds, particularly speech, into a coded signal, a power source such as a battery, and an external transmitter antenna coil.

The coded signal output by the speech processor is transmitted transcutaneously to the implanted receiver/stimulator unit situated within a recess of the temporal bone of the recipient. This transcutaneous transmission occurs via the external transmitter

antenna coil which is positioned to communicate with an implanted receiver antenna coil provided with the receiver/stimulator unit.

This communication serves two essential purposes, firstly to transcutaneously transmit the coded sound signal and secondly to provide power to the implanted receiver/stimulator unit. Conventionally, this link has been in the form of a radio frequency (RF) link, but other such links have been proposed and implemented with varying degrees of success.

The implanted receiver/stimulator unit traditionally includes a receiver antenna coil that receives the coded signal and power from the external processor component, and a stimulator that processes the coded signal and outputs a stimulation signal to an intracochlear electrode assembly which applies the electrical stimulation directly to the auditory nerve producing a hearing sensation corresponding to the original detected sound.

The commonly accepted method of providing the implanted stimulator with power and information is to transmit RF-power via an inductively coupled coil system. In such a system, the external transmitter antenna coil is usually positioned on the side of a recipient's head directly facing the antenna coil of the implanted receiver/stimulator unit to allow for the transmission of the coded sound signal and power from the speech processor to the implanted unit. Such transmitters usually have a coil formed by a small number of turns of a single or multi-strand wire and a magnet at the hub of the coil. The magnet holds the transmitter antenna coil in place due to magnetic attraction with a magnet of the implanted unit.

Unfortunately, the implanted magnet poses problems for cochlear implant recipients requiring MRI. In this regard, although studies indicate that MRI presents no major risk to such recipients, dislodgment of the implanted magnet may occur during an MRI procedure.

The applicant has developed a cochlear implant having a magnet that can be cut from the implant to allow for MRI scanning. In this regard, a small incision may be made over the implant site and the magnet removed using a suitable instrument. Once the magnet has been removed, the incision is covered by a sterile bandage and the MRI procedure completed. The magnet is then replaced and the incision is closed.

While this implant enables an MRI procedure without risk of dislodgment of the magnet, it may not be desirable for individuals requiring multiple MRI images over extended periods.

The present invention aims to provide an implant which addresses the problems of the prior art.

In providing the above description of the prior art, the present applicant is not conceding that any or all of the above description is part of the present common general knowledge of a person skilled in the art of the present invention in Australia.

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

Summary of the Invention

According to a first aspect, the present application is directed to a first invention comprising a magnetic alignment system for a transcutaneous transmitter/receiver system, said magnetic alignment system comprising an external transmitter unit and an implantable receiver component, both the external transmitter unit and the implantable receiver component having a magnet to allow transcutaneous alignment of said external transmitter unit and said implantable receiver component, the system being characterised in that it further comprises an anchor member for anchoring the magnet of the implantable receiver component to a part of the body of a recipient.

The magnetic alignment system of the first aspect is preferably part of a cochlear implant system wherein the external transmitter unit is positioned on the side of the recipient's head and wherein the implantable receiver component is positioned subcutaneously and in alignment with the external transmitter unit.

The external transmitter unit may comprise a transmitter antenna coil which is preferably adapted to provide in combination with the implantable receiver component,

a transcutaneous radio (RF) frequency link between the external componentry of the cochlear implant and the implanted componentry thereof.

The implantable receiver component of the system preferably comprises a receiver antenna, preferably an antenna coil, and a housing for a stimulator device. The receiver antenna typically comprises a wire antenna coil. The antenna coil may be comprised of at least one and preferably two turns of electrically insulated platinum or gold wire.

The electrical insulation of the receiver antenna may be provided by a flexible silicone moulding and/or silicone or polyurethane tubing.

The housing of the stimulator device is preferably implantable in a recess of the temporal bone adjacent the ear of a recipient. The housing is preferably formed from a biocompatible material or has a biocompatible coating and may be coated with a layer of silicone or parylene.

The receiver antenna coil is preferably external of the housing. Electrical connection between the antenna coil and the implantable componentry within the housing may be provided by one or two hermetic and electrically insulated feedthroughs.

The antenna coil of the implantable component preferably acts as part of the radio frequency (RF) link to allow transcutaneous bidirectional data transfer between the implantable component and external components of the system. The radio frequency signals can comprise frequency modulated (FM) signals. While described as a receiver coil, the receiver coil may transmit signals to the external transmitter coil which receives the signals.

The magnet of the implantable receiver component is preferably positioned within the insulation material of the antenna coil, for example within the silicone of the antenna coil and preferably centrally of the antenna coil. The magnet can also be positioned within an appropriately dimensioned and/or shaped recess in the insulation material.

The at least one anchor member of the magnet may comprise at least one plate member and at least one fixing or fastening member. The at least one plate member is configured to have at least one hole therein to receive said fixing member. The plate member can be an integral component of the magnet or be part of a casing around the magnet.

In one embodiment, the plate member may be integral with the magnet and extend outwardly and away from one end of the magnet to form a flange like member. Alternately, the plate member may be connected to said one end the magnet.

The plate member may be any shape but preferably forms a relatively flat surface across one end of the magnet. In this embodiment, the magnet may be positioned within the insulation of the antenna coil and the plate member positioned along a surface of the insulation material of the antenna coil without substantially increasing the bulk of the implantable receiver component.

As mentioned above, the implantable receiver component, in use, is preferably positioned, together with the housing, subcutaneously within a recess in the temporal bone of a recipient.

The insulation material for the antenna coil may include a recess along its length to accommodate the magnet. The recess of the insulation material may be positioned either on a side adjacent the skin of a recipient or, alternatively, on a side adjacent the temporal bone of a recipient.

In the embodiment wherein the recess of the insulation material is on a side of the material adjacent the skin of the recipient, it is preferred that the plate member of the magnet extends substantially over said recess and preferably beyond the boundary of said recess. In this embodiment, the area of the plate member which extends beyond the boundary of the recess typically includes at least one hole to receive a screw or other fixing or fastening member. In use, the screw may be introduced through the at least one hole and through the insulation material of the antenna coil until it screws into the bone of the temporal region, thereby fixing the magnet in place relative to the skull.

In the embodiment wherein the recess of the insulation material is on a side of the insulation material adjacent the temporal bone, the plate member of the magnet can

lie flush with the bone of the temporal region. In this embodiment, a screw of the anchor member need not extend through the insulation material of the antenna coil and therefore, the magnet only may be fixed to the skull rather than both the magnet and the insulation of the antenna coil being fixed to the skull.

The plate member may be made from a material such as a biocompatible, non-magnetic metal or alloy such as Titanium or Nitinol™. It may also be made from a non-metal material, however, to minimise interference to use of an MRI system and to the RF link. Examples of such a material include but are not limited to carbon fibre, Teflon or polytetrafluoroethylene (PTFE), or polyurethane. The plate member of the magnet may be coated with a material to prevent tissue erosion due to direct contact of the tissue to the plate member. In this regard, the plate member may be sprayed or coated with a silicone layer.

In another embodiment, the plate member may be adapted to substantially fit within the recess of the insulation material. Preferably, part of the plate member extends beyond the boundary of the recess said part typically including at least one hole to receive a screw or other fixing or fastening member. In this embodiment, during implantation of the implantable receiver component, the magnet may be positioned within the recess of the insulation material which has the plate member substantially fitted therein. The implantable receiver component is moved towards the skull of a recipient until the magnet is substantially aligned with the bone of the skull. At least one screw may be introduced through the hole of the plate member to fix the plate member to the skull. In this way, the magnet is substantially encased between the plate member and the skull of said recipient although the magnet is not connected to nor integral with the plate member.

In the embodiment of the invention wherein the magnetic alignment system forms part of a cochlear implant, a first electrode assembly, adapted to be inserted in the cochlea of recipient, preferably extends outwardly from the housing of the stimulator device of the implantable receiver component.

The first electrode assembly preferably comprises a carrier member having a leading end that is insertable into a cochlea of a recipient and a trailing end distal the leading end. The elongate carrier member preferably has a plurality of electrodes mounted thereon. In one embodiment, the electrodes are mounted in a longitudinal

array. Each of the electrodes have at least one wire, and preferably at least two, extending from each electrode back towards the trailing end of the carrier member.

The carrier may have 22 electrodes. In another embodiment, the carrier member may have 30 electrodes. Other numbers of electrodes can be envisaged, including less than 20 or greater than 30 electrodes. The electrodes are preferably formed from a biocompatible electrically conducting material, such as platinum.

In a preferred embodiment, a second electrode assembly also extends outwardly from the housing of the stimulator device. While it can be envisaged that the second electrode assembly could also be insertable in the cochlea, it is preferred that the second electrode assembly has one or more electrodes thereon and is adapted to be implantable external of the internal passages, such as the scala tympani, of the cochlea.

According to a second aspect, the present application is directed to a second invention comprising a magnet holding device adapted for use with a magnetic alignment system for a transcutaneous transmitter/receiver system, said magnetic alignment system comprising an external transmitter unit and an implantable receiver component, both the external transmitter unit and the implantable receiver component having a magnet to allow transcutaneous alignment of said external transmitter unit and said implantable receiver component, the magnet holding device being engageable with the implantable receiver component such that the magnet of the implantable receiver component is prevented from dislodging or being dislodged from the implantable receiver component.

Again, the magnetic alignment system of the second aspect is preferably part of a cochlear implant system wherein the external transmitter unit is positioned on the side of the recipient's head and wherein the implantable receiver component is positioned subcutaneously and in alignment with the external transmitter unit. The magnet holding system is preferably adapted to ensure that the magnet does not move, at least substantially, relative to the structure of the implantable component, when a recipient of the implant undergoes an MRI. In this regard, it is to be understood that the implantable component may be engaged with the skull of the recipient, such as by sutures or the like to prevent the implantable component moving, at least substantially, relative to the skull of the recipient.

The magnet holding device of the second aspect may be brought into engagement with the implantable receiver component during the implantation of the receiver component or, alternatively, at a later stage and as a separate procedure to the implantation of the receiver component. The latter embodiment has the advantage that the magnet holding device may be applied to existing implants in the body of a recipient.

As mentioned above, the implantable receiver component of the system preferably comprises a receiver antenna and a housing for a stimulator device. The receiver coil typically comprises a wire antenna coil. The antenna coil may be comprised of at least one and preferably two turns of electrically insulated platinum or gold wire.

The electrical insulation of the antenna coil may be provided by a flexible silicone moulding and/or silicone or polyurethane tubing. The magnet typically sits within a recess of the insulation material.

The housing and the antenna coil are preferably implanted in a recess of the temporal bone adjacent the ear of an recipient.

The magnet of the implantable receiver component is preferably positioned within the insulation material for the antenna coil, for example within the silicone of the antenna coil and preferably centrally of the antenna coil.

As mentioned above, the implantable receiver component, in use, is preferably positioned, together with the housing, subcutaneously within a recess in the temporal bone of a recipient.

The magnet holding device of the second aspect preferably comprises a plate member adapted to extend substantially over the recess of the insulation material of the antenna coil and therefore substantially over the magnet. Typically, the plate member extends beyond the boundary of the recess in the insulation material.

The magnet holding device may further include at least one anchor member adapted to engage the insulation material of the antenna coil and fix the plate member to the insulation material.

The at least one anchor member may include a number of screws or a relatively shallow cup member along one side of the plate member. Preferably, the material of the at least one anchor member is of sufficient strength to impress into the insulation material and thereby fix the plate member over the magnet. Alternatively, a series of holes or a rim may be made in the insulation material to receive the at least one anchor member.

The plate member and/or the at least one anchor member may be made from a material such as a biocompatible, non-magnetic metal or alloy such as Titanium or Nitinol™. They may also be made from a non-metal material, however, to minimise interference to an MRI system and to the RF link. Examples of such a material include but are not limited to carbon fibre, PTFE or polyurethane. The plate member may further be coated with a material to prevent tissue erosion due to direct contact of the plate member with surrounding tissue. In this regard, the plate member may be sprayed or coated with a silicone.

The present invention thereby provides a magnetic alignment system which enables a recipient to undergo an MRI procedure without removing the magnet of a cochlear implant. Such a system is useful for those recipients requiring regular MRI scans.

As used herein, magnet includes magnetised material or material attracted or repelled by a magnet.

Brief Description of the Drawings

By way of example only, preferred embodiments of the invention are now described with reference to the accompanying drawings, in which:

Figure 1 is a pictorial representation of a cochlear implant system using a magnetic alignment system;

Figure 2 is a perspective view of a magnet according to the present invention;

Figure 3 is a top plan view of the magnet of Fig. 2 installed in an implantable component of a cochlear implant;

Figure 4 is a sectional view of the magnet and system of Fig. 3;

Figure 5 is a sectional view of a further embodiment of the present invention;

Figure 6 depicts a series of alternative magnet casing arrangements;

Figure 7 is a sectional view of a further embodiments of the present invention; and

Figure 8 is a sectional view of a further aspect of the invention.

Preferred Mode of Carrying out the Invention

The magnetic alignment system of the present invention is generally depicted as 10 in the accompanying drawings. In this embodiment, the magnetic alignment system 10 is shown as part of a cochlear implant system. It is to be understood that the magnetic alignment system could be used in association with other transcutaneous transmitter/receiver systems.

The magnetic alignment system 10 comprises an external transmitter unit 11 and an implantable receiver component 12.

The external transmitter unit 11 comprises a speech processor 5 having a microphone 6 and a transmitter antenna coil 13 which transmits electrical signals to the implantable receiver component 12 via a radio frequency (RF) link.

The implantable receiver component 12 of the system comprises a receiver antenna 14 for receiving power and data from the transmitter coil 13 and a stimulator unit 15 within a housing 16. A cable 17 extends from the stimulator unit 15 to the cochlea 7 which then terminates in an electrode array 18 that is positionable within the scala tympani of the cochlea 7. The signals received are applied by the array 18 to the basilar membrane 19 thereby stimulating the auditory nerve 20.

The receiver antenna 14 typically comprises a wire antenna coil 21 (eg. see Fig. 4) comprised of at least one and preferably two turns of electrically insulated platinum or gold wire.

The implantable receiver component 12 has a magnet 22 to allow transcutaneous alignment of the implantable receiver coil 14 with the magnet 13a of the external transmitter antenna coil 13.

In the embodiments of the present invention depicted in Figs. 2-5 and 8, the magnet 22 is held in position in or on the bone of the skull of the recipient in a manner so as to ensure that the magnet 22 is not dislodged if the recipient undergoes MRI.

As depicted in Figs. 2-5, the magnet 22 of the implantable receiver component 12 has an anchor member 23 comprising a plate member 26 to facilitate anchoring of the magnet 22 to the component 12 and the skull of the recipient.

The electrical insulation of the antenna coil 21 is provided by a flexible silicone moulding 24.

In use, the implantable receiver component 12 is positioned on or in a recess of the temporal bone 25 adjacent the ear of a recipient.

The magnet 22 of the implantable receiver component is positioned within the silicone 24 of the antenna 14 with the plate member 26 having orifices 27 that can each receive screws 29 or other suitable fastening members.

The plate member 26 as depicted is preferably a relatively flat structure such that it may be positioned along a surface of the silicone 24 of the antenna 14 without increasing the bulk of the implantable receiver component 12.

The silicone 24 of the antenna coil 14 includes a recess 28 along its length to accommodate the magnet 22. The recess 28 may be positioned either on a side of the silicone 24 adjacent the skin of a recipient (see Figure 4) or, alternatively, on an opposite side of the silicone 24 adjacent the temporal bone of a recipient (see Figure 5).

The plate member 26 extends substantially over recess 28 and preferably beyond the boundary of said recess 28.

As mentioned, the plate member 26 is fixed in position by the screws 29. The screws 29 are introduced through holes 27 in the plate member 26 and screwed through the silicone 24 and into the temporal bone 25 thereby fixing the magnet 22 in place relative to the temporal bone 25.

As depicted in Figure 5, where the recess 28 of the silicone 24 is on a side of the silicone 24 adjacent the temporal bone 25, the screws 29 need not extend through the thickness of the silicone 24 of the antenna 14.

Fig. 6 depicts alternatives flange 26 and screw 29 arrangements that could be utilised to anchor the magnet 22 in a desired position.

An alternative arrangement for holding the magnet in place is depicted generally as 40 in Fig. 7. In this embodiment, the magnet 22 is held in place within the implantable component only.

The depicted magnet holding device 40 of Fig. 7 may be brought into engagement with the implantable receiver component 12 during the implantation of the receiver component 12 or, alternatively, at a later stage and as a separate procedure to the implantation of the receiver component 12.

The magnet holding device 40 comprises a plate member 41 that is adapted to extend substantially over the magnet 22. The magnet holding device 40 further includes an anchor member 42 adapted to engage the silicone 24 of the antenna coil 14 and fix the plate member 41 to the silicone 24.

The depicted anchor member 42 comprises a shallow cup-like member 43 that is pressed into the silicone 28 and thereby secures the magnet 22 within the silicone 28.

Another embodiment of the invention is depicted in Figure 8. In this embodiment, a plate member 42 is at least partially fitted within the recess 28 of the silicone 24. Peripheral portions 45 of the plate member 42 extend beyond the boundary of the recess 28 and have orifices therein that each receive a screw 46.

In this embodiment, during implantation of the implantable receiver component, the magnet 22 is positioned within the recess 28 of the insulation material which has the plate member substantially fitted therein. The implantable receiver component 12 is then moved towards the skull of a recipient until the magnet is substantially aligned with the bone 25 of the skull. The screws 46 are then introduced through the respective holes of plate member 42 to fix the plate member 42 to the temporal bone 25. In this way, the magnet 22 is substantially encased between the plate member 42 and the temporal bone 25 although the magnet is not connected to nor integral with the plate member 42.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

CLAIMS

1. A magnetic alignment system for a transcutaneous transmitter/receiver system, said magnetic alignment system comprising an external transmitter unit and an implantable receiver component, both the external transmitter unit and the implantable receiver component having a magnet to allow transcutaneous alignment of said external transmitter unit and said implantable receiver component, the system further comprising an anchor member for anchoring the magnet of the implantable receiver component to a part of the body of a recipient.

2. The magnetic alignment system of claim 1 wherein the system is part of a cochlear implant system wherein the external transmitter unit is positionable on the side of the recipient's head and wherein the implantable receiver component is positionable subcutaneously and in alignment with the external transmitter unit.

3. The magnetic alignment system of claim 2 wherein the external transmitter unit comprises a transmitter antenna coil which is adapted to provide in combination with the implantable receiver component, a transcutaneous radio (RF) frequency link.

4. The magnetic alignment system of claim 3 wherein the implantable receiver component of the system comprises a receiver antenna coil.

5. The magnetic alignment system of claim 4 wherein the magnet of the implantable receiver component is positioned within an insulation material surrounding the antenna coil.

6. The magnetic alignment system of claim 4 wherein the magnet of the implantable receiver component is positioned within an appropriately dimensioned and/or shaped recess in an insulation material of the receiver antenna coil.

7. The magnetic alignment system of claim 1 wherein the anchor member comprises at least one plate member and at least one fixing member.

8. The magnetic alignment system of claim 7 wherein the plate member has at least one hole therein to receive said fixing member.

9. The magnetic alignment system of claim 7 wherein the plate member is an integral component of the magnet.

10. The magnetic alignment system of claim 8 wherein the plate member of the magnet extends over and beyond the boundary of said recess.

11. The magnetic alignment system of claim 10 wherein the area of the plate member which extends beyond the boundary of the recess includes said at least one hole.

12. The magnetic alignment system of claim 11 wherein, when the recess of the insulation material is adjacent the skin of the recipient, the fixing member is introduced through the at least one hole and through the insulation material of the antenna until it engages in the bone of the recipient.

13. The magnetic alignment system of claim 11 wherein, when the recess of the insulation material is on a side of the insulation material adjacent the temporal bone, the plate member lies flush with the bone of the temporal region such that the fixing member passes through the plate member and into the bone of the recipient..

14. The magnetic alignment system of claim 7 wherein, when the recess of the insulation material is on a side of the insulation material adjacent the temporal bone, the plate member is non-planar and extends between the recess and the magnet that is positionable therein.

15. The magnetic alignment system of claim 14 wherein the plate member can be fastened to the bone of the recipient with one or more fixing members.

16. A magnet holding device for use with a magnetic alignment system for a transcutaneous transmitter/receiver system, said magnetic alignment system comprising an external transmitter unit and an implantable receiver component, both the external transmitter unit and the implantable receiver component having a magnet to allow transcutaneous alignment of said external transmitter unit and said implantable receiver component, the magnet holding device being engageable with the implantable receiver component such that the magnet of the implantable receiver component is prevented from dislodging or being dislodged from the implantable receiver component.

17. The magnet holding device of claim 16 wherein the magnetic alignment system is part of a cochlear implant system and wherein the external transmitter unit is positionable on the side of the recipient's head and wherein the implantable receiver component is positionable subcutaneously and in alignment with the external transmitter unit.

18. The magnet holding device of claim 17 wherein the implantable receiver component of the system comprises a receiver antenna and a housing for a stimulator device.

19. The magnet holding device of claim 18 wherein the magnet of the implantable receiver component is positioned within an insulation material surrounding a coil comprising the receiver antenna.

20. The magnet holding device of claim 19 wherein the magnet holding device comprises a plate member adapted to extend substantially over a recess formed in the insulation material of the antenna coil and over the magnet positionable therein.

21. The magnet holding device of claim 20 wherein the plate member extends beyond the boundary of the recess in the insulation material.

22. The magnet holding device of claim 21 wherein the device further comprises at least one anchor member adapted to engage the insulation material of the receiver antenna and fix the plate member to the insulation material.

23. The magnet holding device of claim 22 wherein the at least one anchor member comprises a relatively shallow cup-like member along one side of the plate member that is impressible into the insulation material to thereby fix the plate member over the magnet.

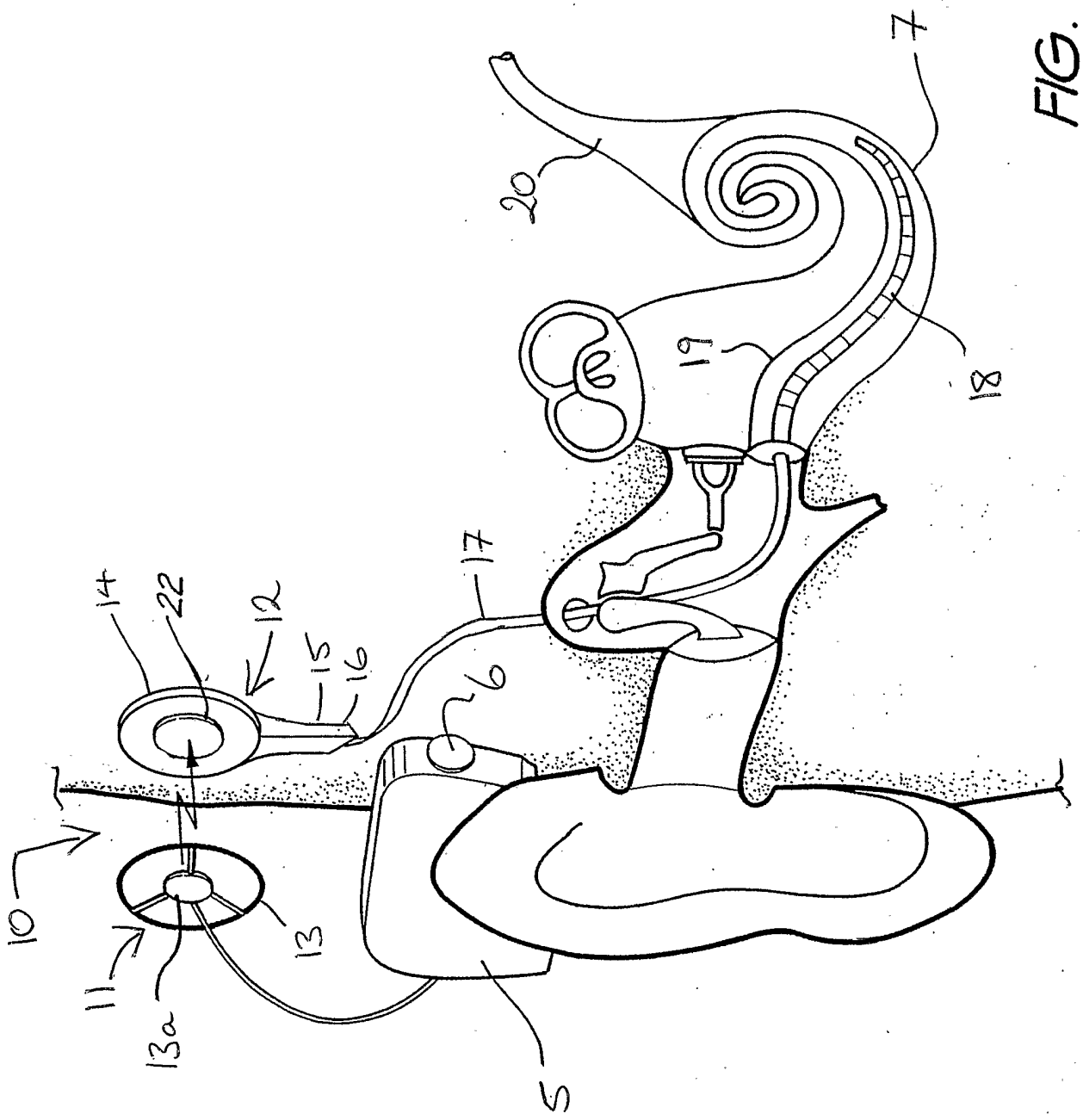

FIG. 1

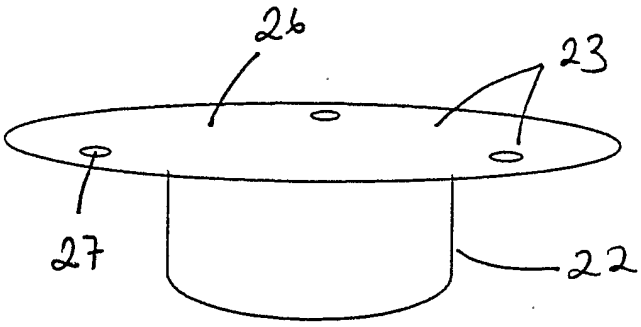

Figure 2

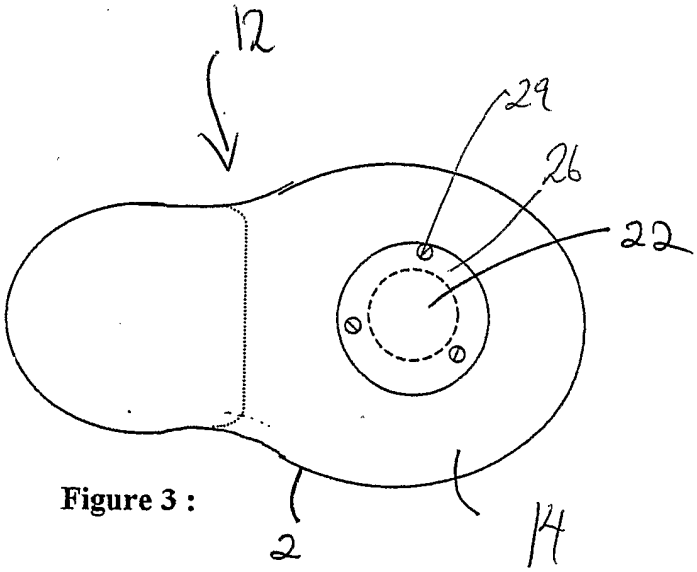

Figure 3 :

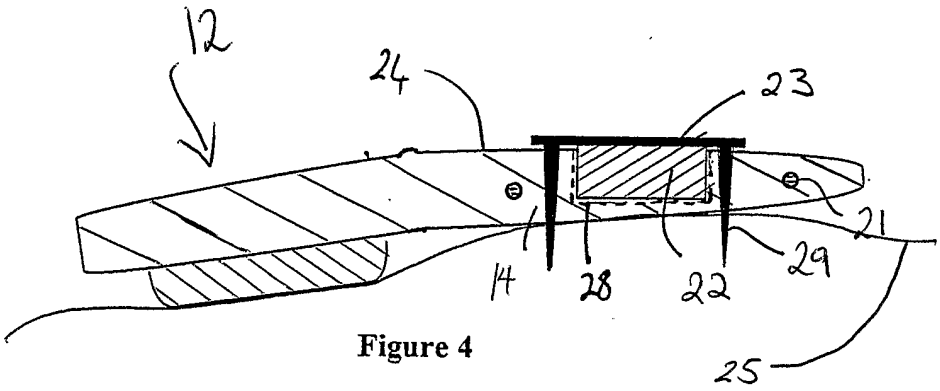

Figure 4

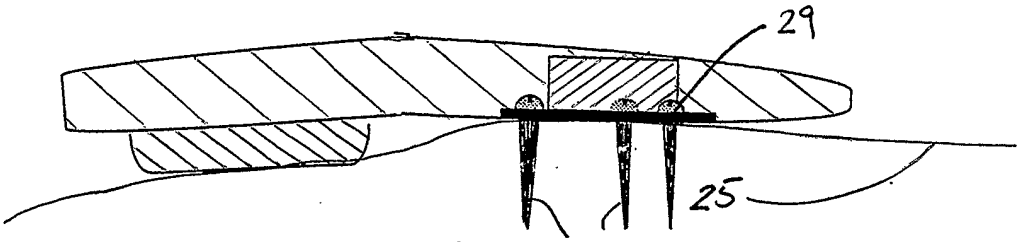

Figure 5

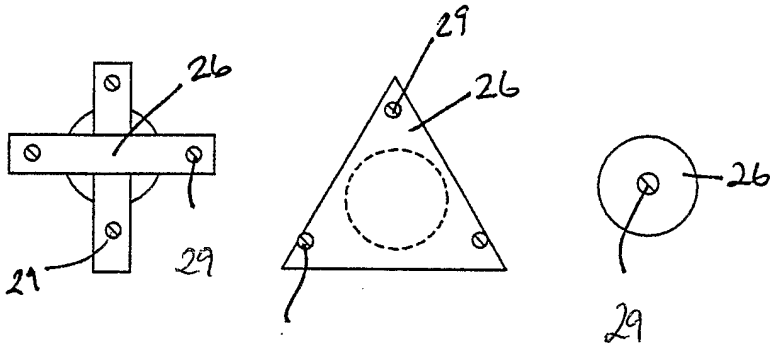

Figure 6

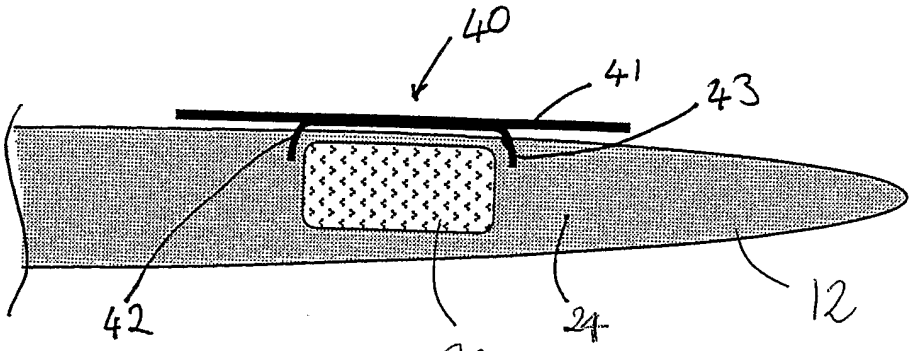

Figure 7

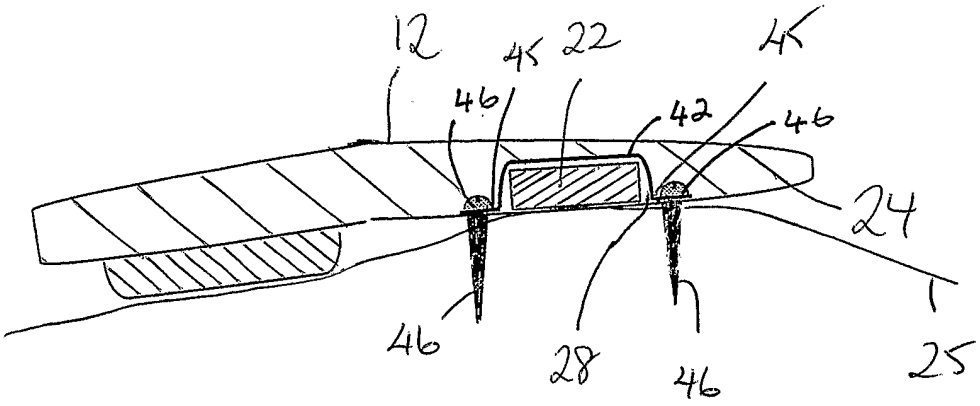

Figure 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00464

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: H04R 25/00

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)

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT, USPTO: MAGNET, TRANSMITTER, RECEIVER, IMPLANT AND SIMILAR TERMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4606329 (HOUGH) 19 August 1986 whole document	1-6, 16-19
A		7-15, 20-23
X	US 4352960 (DORMER et al) 5 October 1982 whole document	16-19
A		1-15, 20-23
A	US 4696287 (HORTMANN et al) 29 September 1987 whole document	1-23

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 May 2003	29 MAY 2003
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **SUSHIL AGGARWAL** Telephone No : (02) 6283 2192

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 99/18879 A1 (LIGHT SCIENCES LIMITED PARTNERSHIP) 22 April 1999 whole document	1-23

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU03/00464

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	4606329	AU	57547/86	BE	904799	CA	1249653
		DE	3617118	DK	2375/86	ES	555179
		FR	2586557	GB	8612349	IL	78838
		IT	8620509	NL	8601307	SE	8602289
		US	4776322	US	5015225		
US	4352960	NONE					
US	4696287	DE	3506721	EP	193145		
WO	99/18879	AU	89221/98	EP	1028667	US	6138681

END OF ANNEX