

A retaining module for the earpiece of a hearing aid

The present invention relates to hearing aids. The invention more specifically relates to a retaining module for retaining an earpiece
5 in an ear, as well as to a hearing aid using such a retaining module. In particular, but not exclusively, the present invention relates to a retaining module for holding an earpiece of a hearing aid at an appropriate place in the ear, e.g. in the ear canal or in the concha of the ear.

As the name suggests, Behind-The-Ear (BTE) hearing aids are
10 worn behind the ear. To be more precise an electronics unit comprising a housing containing the major electronics parts thereof, is worn behind the ear. An earpiece for emitting sound to the hearing aid user is worn in the ear, e.g. in the concha or the ear canal thereof. In a traditional BTE hearing aid, a sound tube is used because the output transducer, which
15 in hearing aid terminology is normally referred to as the receiver, is located in the housing of the electronics unit. In some modern types of hearing aids a conducting member comprising electrical conductors is used, because the receiver is placed in the earpiece in the ear. Such hearing aids are commonly referred to as Receiver-In-The-Ear (RITE)
20 hearing aids.

In particular when the earpiece is not inserted firmly in the ear canal of the hearing aid user, it is a problem to secure and keep the earpiece in the correct position in the ear.

In this respect, DE-U-29718483 discloses various embodiments
25 of a holding device for earpieces of *inter alia* hearing aids. Generally, the various embodiments are composed of C and T shaped resilient retaining members and combinations thereof, the retaining members engaging various parts of the ear allowing the earpiece to "float" freely in the concha, i.e. with only the retaining members engaging the ear. The various
30 embodiments are interchangeable with respect to the earpiece, but how the earpiece is in fact connected to the holding is not disclosed.

Based on this, it is the object of the present invention to provide a holding device with improved means for engaging the earpiece, improved retaining capabilities with respect to the ear and good wearing

comfort.

According to a first aspect of the invention, this object is achieved by a retaining module for retaining an earpiece in an ear, said retaining module comprising an annular sleeve having a central aperture adapted for receiving and holding at least a part of said earpiece, a first retaining member adapted for engaging at least a part of the concha of the ear a second retaining member, and a strut member, where said first retaining member, said second retaining member and said strut member essentially extend in one common plane, and said first retaining member has a proximal end connected to said annular sleeve at a first location, wherein said strut member has a proximal end connected to said annular sleeve at a second location, and a distal end connected to the distal end of said first retaining member, and wherein said central aperture of said annular sleeve has a longitudinal axis extending essentially in parallel with said common plane.

Constructing the retaining module in this way creates a closed topology, where the first retaining member and the strut member both support the annular sleeve, and thus the earpiece placed therein, thereby providing an improved resistance against dislocation or twisting of not only the retaining module itself, but also the earpiece as such, with respect to the ear. Moreover, this construction *inter alia* facilitates the achievement of a proper location of the mass distribution of the ear piece, and also allows the sound output port to be directed towards, but not into, the ear canal.

According to a preferred embodiment, said retaining module further comprises a second retaining member adapted for engaging at least a part of the ear spaced from the concha. Having a second retaining member further improves the resistance of the retaining module itself as well as the earpiece as such, with respect to the ear.

According to a further preferred embodiment, said second retaining member has a proximal end and a distal end, the proximal end of said second retaining member being connected to the distal end of said first retaining member and to the distal end of said strut member. Thereby it is possible to effectively shape the second member to facili-

tate an improved engagement with said other part of the ear.

According to yet another preferred embodiment, said proximal end of said first retaining member and the proximal end of said strut member are connected to essentially diametrically opposite sides of said annular sleeve. Having these symmetrically arranged improves resistance of the retaining module against undesired movements and twisting of the earpiece, as the mass of the earpiece may be evenly distributed on either side of the plane, in which, according to a further embodiment, the first retaining member, said second retaining member and said strut member preferably extend.

According to yet another preferred embodiment, said strut member has an arched section adapted for avoiding contact with the crus helcis of the ear. Avoiding contact with the crus helcis is important from a user viewpoint, as the retaining module may otherwise be uncomfortable to wear. Moreover, such curvature turns out to be advantageous when it comes to the rigidity of the retaining module in the plane.

According to a further preferred embodiment, said second retaining member is adapted for engaging at least a part of the crus antihelix of the ear. Using crus antihelix for engagement provides further resistance of the retaining module against dislocation and also allows for a simple construction of the retaining module as the second retaining member can be made as a natural extension of the first retaining member.

According to yet another preferred embodiment, said second retaining member is adapted for engaging at least a part of the fossa of helix of the ear. Using the fossa of helix for engagement provides further resistance of the retaining module against dislocation and also allows for a simple construction of the retaining module as the second retaining member can be made as a further natural extension of the second retaining member in the direction away from the first retaining member.

According to a further preferred embodiment, said second retaining member is adapted for engaging at least a part of the helix of the ear. Using the helix of the ear for engagement provides further re-

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sistance of the retaining module against dislocation and also allows for a simple construction of the retaining module as the second retaining member can be made as a further natural extension of the second retaining

member can be made as a further natural extension of the second retaining member in the direction away from the first retaining member.

In yet a further preferred embodiment, the first retaining member and the second retaining member are adapted to provide a smooth
5 transition without any discontinuity at the point where the proximal end of said second retaining member is connected to the distal end of said first retaining member. This improves wearing comfort and fits the natural curvature of those parts of the ear, which the retaining members engage.

10 According to a preferred embodiment, at least one of the first retaining member, the second retaining member and the strut has an essentially oval or elliptical cross-section. Having an oval or elliptical cross-section, rather than e.g. a circular one, imparts in the retaining member a propensity to flex in one plane, which stabilizes the seating
15 and improves wearing comfort. The wearing comfort is even further improved when the distal end of the second retaining member is rounded.

Preferably, the cross-sectional dimensions of at least one of the first retaining member, the second retaining member and the strut is essentially constant over the length thereof, the largest dimension of said
20 cross section being at least 0.5 mm, not more than 2 mm, and preferably approximately 1.5 mm. This allows the retaining members and thus the entire retaining module to appear inconspicuous.

According to another preferred embodiment, the retaining module is manufactured in one integral piece of material. This is advantageous as it furthermore allows the retaining module to be manufactured
25 by injection moulding or transfer moulding.

According to a further preferred embodiment, the material is an elastic material with a Shore A hardness in the interval from 50 to 90, preferably approximately 80. This ensures sufficient retaining capabilities
30 of the retaining module without compromising wearing comfort.

The invention will now be described in greater detail based on non-limiting exemplary embodiments and the appended drawings. In the drawings

fig. 1 shows a RITE hearing aid with a retaining module accord-

ing to the invention mounted on the earpiece,

fig. 2 shows a first embodiment of the retaining module according to the invention,

fig. 3 shows a second embodiment of the retaining module of
5 the invention,

fig. 4 shows the first embodiment of the invention placed in an ear,

fig. 5 shows the second embodiment of the invention placed in an ear,

10 fig. 6 shows a third embodiment of the invention placed in an ear,

fig. 7 shows a fourth embodiment of the invention,

fig. 8 shows a fifth embodiment of the invention,

fig. 9 shows a RITE hearing aid with the retaining module according to fig. 7 mounted on the earpiece.
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Figs. 1 and 9 both show a hearing aid 1 of the RITE type. The hearing aid 1 of Fig. 1 has a housing 2, which is shaped to be placed behind an ear. The illustrated hearing aid is of the RITE type, and it has an earpiece 3, which is connected to the electronics in the housing 1 by means of a conductor 4. The earpiece 3 is a part adapted to be placed at the auditory meatus, mainly in the concha and partially extending into the ear canal. For this purpose the earpiece 3 of Fig. 1 has a bent tubular portion leading to an ear bud. Likewise, the hearing aid 1 of Fig. 9 has a housing 2, which is shaped to be placed behind an ear. The illustrated
20 hearing aid is of the RITE type, and it has an earpiece 3, which is connected to the electronics in the housing 1 by means of a conductor 4. The earpiece 3 is a part adapted to be placed at the auditory meatus, mainly in the concha and partially extending into the ear canal. For this purpose the earpiece 3 of Fig. 9 is held at an angle differing from that of
25 Fig. 1, and thus does not have a bent tubular portion, but leads instead directly into an ear bud.
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The present invention, however, does not relate to these parts but to a retaining module 5 mounted on the earpiece 3. The skilled person will thus understand that it is not important whether the earpiece is

an earpiece of a BTE hearing aid 1 or a self contained hearing aid, i.e. the earpiece containing the entire hearing aid.

The retaining module 5 will now be described in greater detail with reference to various embodiments shown in the subsequent figures, where corresponding parts of different embodiments have same reference numerals.

Fig. 2 shows a first preferred embodiment of the retaining module 5 according to the invention. The retaining module 5 has an annular sleeve 6 adapted for receiving and holding at least a part of the earpiece 3 as seen in fig. 1. The annular sleeve has a central aperture 7 extending in the direction of a longitudinal axis A. The sleeve 6 receives the earpiece 3 and holds it by resilience and friction.

In a modified embodiment the sleeve is permanently joined with the earpiece by gluing or welding. In another modified embodiment the sleeve is cast integrally with an outer portion of the earpiece.

A first retaining member 8 extends from one side of the outer surface of the annular sleeve 6, the proximal end 9 of the first retaining member 8 being connected to the annular sleeve 6. Also, from the outer surface of the annular sleeve 6, a strut member 10 extends, the proximal end 11 of the strut member 10 being connected to the annular sleeve 6. Preferably, the proximal end 9 of the first retaining member 8 and the proximal end 11 of the strut member are located diametrically opposite each other on the annular sleeve 6.

The distal end 12 of the first retaining member 8 and the distal end 13 of the strut member 10 are connected to each other, so as to form a closed loop including the annular sleeve 6. In the illustrated embodiment a second retaining member 14 extends from the closed loop, the proximal end of the second retaining member being connected to both the distal end 12 of the first retaining member 8 and the distal end 13 of the strut member. The distal end 15 of the second retaining member is free. Preferably the distal end 15 of the second retaining member is rounded to improve wearing comfort.

The first retaining member 8, the strut member 10 and the second retaining member 14, preferably all lie in the same plane. Preferably

bly, the axis A also lies in this plane. When, as described above, the proximal end 9 of the first retaining member 8 and the proximal end 11 of the strut member 10 are located diametrically opposite each other on the annular sleeve 6, the annular sleeve 6 extends symmetrically out of the plane. Thus, the mass of the earpiece to be held in the central aperture 7 will also largely be evenly distributed on either side of the plane and thus have a reduced tendency to wobble.

Preferably the entire retaining module 5 is made as one integral piece by a suitable process such as injection moulding or transfer moulding.

The material is an elastic biocompatible material such as silicone, fluorosilicone or thermoplastic elastomere (TPE), but the skilled person will know alternative materials to these. Elastic in this context means that the material has a Shore A hardness in the interval from 50 to 90, preferably approximately 80. Lower hardness gives a softer retainer and lower bias in the seat in the ear.

Preferably, the cross-sections of the first retaining member 8, the strut member 10 and the second retaining member 14 are identical. The cross-section may be circular but is preferably oval or elliptical as this turns out to improve wearing comfort. The largest cross sectional dimension is at least 0.5 mm, at most 2 mm, and preferably approximately 1.5 mm. This renders the appearance of the retaining member quite inconspicuous, in particular when the retaining module is made of a transparent material such as silicone.

The particular dimension will be selected depending on the material and as appropriate to achieve the desired flexibility, larger cross sections yielding a sturdier retainer. One preferred embodiment has a retainer with a cross section of 1.5 mm and a material with a hardness of 80 Shore A. Another preferred embodiment has a retainer with a cross section of 2.0 mm and a material with a hardness of 40 Shore A. Still another preferred embodiment has a retainer with a cross section of 1.0 mm and a material with a hardness of 65 Shore D, equivalent to more than 90 Shore A. In still other embodiments the cross section could be varied along the length to adapt the bias force on the ear.

Fig. 3 illustrates a second embodiment of the retaining module according to the invention. It differs however only from the embodiment of fig. 2 in that the second retaining member is longer. The reason for this will be explained further below.

5 Turning now to Fig. 4, it can be seen that the first retaining member 8 has a curvature, which adapts it for engaging the concha 16 of the ear, more specifically the edge thereof. It can also be seen that the strut member 10 has a curvature in the same direction. The curvature of the strut member has two functions. One is to provide a spring
10 bias for keeping the distal end 9 and proximal end 12 of the first retaining member at fixed positions with respect to each other. Thus, when inserting the retaining module 5 in the concha 16 the distal end 12 and the proximal end 9 are pressed towards each other. At the same time the distal end 12 and the proximal end 11 of the strut member 10 are also
15 pressed towards each other. When released in the ear, the inherent elastic properties of the first retaining member 8 will try to return it to its natural relaxed shape, thereby forcing it into engagement with the concha 16 of the ear. The same happens for the strut member 10, which creates a bias because the distal end 13 is connected to the distal end 12
20 of the first retaining member 8, and because the proximal end 11 is connected to the proximal end 9 of the first retaining member 8 via the annular sleeve 6, which in comparison is rigid, because of the earpiece inserted therein. The strut member 10 thus aids in forcing the first retaining member 8 into engagement with the concha 16 of the ear. The other
25 reason for the curvature is to avoid contact between the strut member 10 and the crus helices 17 of the ear, so as improve wearing comfort.

 To further improve the engagement with the concha 16, the second retaining member 14 is adapted to provide a smooth extension of the first retaining member 8, and has a curvature allowing it to press
30 slightly against the concha 16 in the inserted position.

 As can be seen from fig. 5, the second retaining member 14 may extend further allowing it to engage the helix 18 of the ear or the adapted for engaging at least a part of the crus antihelix 19 of the ear, preferably in the fossa of helix 20 of the ear, where it can lie in an incon-

spicuous way.

As can be seen in fig. 6, the second retaining member 14 may be bent backwardly in shape, so as to point in the opposite direction when it is in engagement with the concha 16 of the ear, as compared to
5 fig. 4.

In a further variant (not shown), the second retaining member 14 may also have a backwardly bent shape so as to emerge from the fossa of helix 19 into the fossa triangularis 21.

Figs. 7 and 8 show different embodiments of the invention
10 suited for earpieces that are adapted for a seat somewhat deeper in the auditory canal. The embodiments of figs. 7 and 8 essentially differ only from the previously described embodiments in that the annular sleeve 6 has been turned 90 degrees, that is the central axis A of the annular sleeve is perpendicular to the plane in which the first retaining member
15 8, the second retaining member 14 and the strut member 10 lie. Accordingly, all other features of the previously described embodiments may freely be implemented in these embodiments too.

Having the central axis A at a different angle facilitates the use of other types of earpieces than the above-mentioned "floating" ear-
20 pieces, e.g. earpieces 3 comprising earplugs as illustrated in fig. 9 adapted to be inserted into the ear canal of the user.

The present invention has now been explained based on illustrative exemplary embodiments. The skilled person will know, however, that numerous modifications are possible within the scope of invention
25 as set out in the claims, e.g. in terms of shapes and dimensions but also choice of materials and material properties.

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P A T E N T C L A I M S

1. A retaining module for retaining an earpiece in an ear,
said retaining module comprising
an annular sleeve having a central aperture adapted for receiv-
5 ing and holding at least a part of said earpiece,
a first retaining member adapted for engaging at least a part of
the concha of the ear,
a second retaining member, and
a strut member, where
10 said first retaining member, said second retaining member and
said strut member essentially extend in one common plane, and said
first retaining member has a proximal end connected to said annular
sleeve at a first location, where said strut member has a proximal end
connected to said annular sleeve at a second location and a distal end
15 connected to the distal end of said first retaining member, and
wherein said central aperture of said annular sleeve has a longi-
tudinal axis extending essentially in parallel with said common plane.
2. A retaining module according to claim 1, wherein said second
retaining member is adapted for engaging at least a part of the ear
20 spaced from the concha.
3. A retaining module according to claim 2, wherein said second
retaining member has a proximal end and a distal end, the proximal end
of said second retaining member being connected to the distal end of
said first retaining member and to the distal end of said strut member.
- 25 4. A retaining module according to any one of the preceding
claims, wherein said proximal end of said first retaining member and the
proximal end of said strut member are connected to essentially diamet-
rically opposite sides of said annular sleeve.
5. A retaining module according to any one of the preceding
30 claims, wherein said strut member has an arched section adapted for
avoiding contact with the crus hellicis of the ear.
6. A retaining module according to any one of claims 3 to 5,
wherein said second retaining member is adapted for engaging at least
a part of the crus antihelix of the ear.

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7. A retaining module according to any one of claims 3 to 6, wherein said second retaining member is adapted for engaging at least a part of the fossa of helix of the ear.

8. A retaining module according to any one of claims 3 to 7, wherein said second retaining member is adapted for engaging at least a part of the helix of the ear.

9. A retaining module according to any one claims 3 to 8, wherein the first retaining member and the second retaining member are adapted to provide a smooth transition without any discontinuity at the point where the proximal end of said second retaining member is connected to the distal end of said first retaining member.

10. A retaining module according to any one of the preceding claims, wherein at least one of the first retaining member, the second retaining member and the strut has an essentially oval or elliptical cross-section.

11. A retaining module according to any one of the preceding claims, wherein the cross sectional dimensions of at least one of the first retaining member, the second retaining member and the strut is essentially constant over the length thereof, the largest dimension of said cross section being at least 1 mm, at most 2 mm, and preferably approximately 1.5 mm.

12. A retaining module according to any one of claims 3 to 11, wherein the distal end of the second retaining member is rounded.

13. A retaining module according to any one of the preceding claims, wherein the retaining module is manufactured in one integral piece of material.

14. A retaining module according to any one of the preceding claims wherein the retaining module is manufactured by injection moulding or transfer moulding.

15. A retaining module according to any one of the preceding claims, wherein the retaining module is permanently joined with at least an outer part of the earpiece.

16. A retaining module according to claim 10 or 12, wherein the material is an elastic material with a Shore A hardness in the interval

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from 50 to 90, preferably approximately 80.

17. A hearing aid comprising a retaining module according to any one of the preceding claims.

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