

Description

This invention relates to electroacoustic transducers forming in-the-ear (or inner-ear) type headphones.

The Figure 1 shows an example of a previously proposed in-the-ear type headphone, which is inserted into an auricle. A driver unit 15 which is accommodated within a housing 16 forms an electroacoustic transducer element and comprises a diaphragm and a magnetic circuit. An external connection cord 17 extends from the driver unit 15, and is supported by a cord supporting member 18 which is elongated from the housing 16.

As shown in Figure 2, the housing 16 has a size such that it can be inserted into a cavum concha b, that is the concave portion of an auricle a. Thus, when the housing 16 is inserted into the cavum concha b, it is supported at at least two outer points thereof by a tragus c and an antitragus d which form parts of the auricle a.

The rear peripheral portion of the housing 16 is tapered to form an inclined portion 19, so that, when the housing 16 is inserted into the cavum concha b, it is opposed to the outside of the auricle a. The inclination angle is selected so that the inclined portion 19 substantially corresponds to the curved, rising surface of the cavum concha b.

The cord supporting member 18 is downwardly elongated from the lower end of a rear side end face portion 20 of the housing 16, substantially parallel to the portion 20, so that, when the housing 16 is inserted into the cavum concha b, the cord supporting member 18 comes into contact with a point P3 on the outer surface of a lobe e at a position lower than points P1 and P2 of the top portions of the tragus c and the antitragus d. The points P1 and P1 are the supporting points to support the housing 16.

A ring member 21 made of a flexible and elastic material engages with a bonding portion at which the driver unit 15 and the housing 16 are bonded to each other. A front surface of the diaphragm (not shown) of the driver unit 15 is protected by a protecting plate 22 as shown in Figure 1.

As shown in Figure 2, the housing 16 of the headphone is inserted into the cavum concha b in a three-point-supporting fashion, so that it can be held at one portion of the auricle a without pressing the auditory opening.

In order that this headphone may fit properly regardless of the ear size, the elastic ring member 21 engages with the outer peripheral portion of the housing 16 so that the headphone can easily be fitted to the cavum concha b thereby to increase a closing property of the headphone.

Because there are differences between individuals in the size and shape of their ears it is impossible to form the ring member 21 so that it can be properly fitted to any ear regardless of the size and shape thereof. For example, if the ring member 21 is formed so as to be fitted to a relatively small ear, a frequency characteristic shown by a solid line S in Figure 3A can be obtained for small ears. However, the low band is reduced for large ears, as shown by a dashed line L in Figure 3A, and less bass is produced. If on the other hand the ring member 21 is formed so as to be fitted to large ears, a frequency characteristic shown by a solid line L in Figure 3B can be obtained for large ears, and the low band is increased too much, as shown by a dashed line S in Figure 3B, for small ears.

According to the present invention there is provided an electroacoustic transducer apparatus comprising:

a housing formed so as to be accommodated within a concave portion of a cavum concha between the tragus and antitragus of an auricle, said housing being supported by said tragus and antitragus when accommodated within said concave portion of said auricle;

an electroacoustic transducer element incorporated within said housing;

and

an elastic ring member attached to an outer peripheral portion of said housing;

characterized in that:

an air passage portion is formed through at least one of said housing and said ring member so as to communicate a sound emanating front portion and a sound emanating rear portion with each other.

Embodiments of the invention can provide an electroacoustic transducer apparatus with acoustic characteristics of substantially the same level from a low band to a high band regardless of the size of the user's ears.

The invention will now be described by way of example with reference to the accompanying drawings, throughout which like parts are referred to by like references, and in which:

Figure 1 is a side view of a previously proposed in-the-ear type headphone;

Figure 2 shows the headphone of Figure 1 in use; Figures 3A and 3B show frequency characteristics of the headphone of Figure 1;

Figure 4 is a perspective view of a first embodiment of electroacoustic transducer apparatus according to the present invention;

Figure 5 is a partially cut-away bottom view of the apparatus of Figure 4;

Figure 6 is a front view of a ring member used in the apparatus of Figure 4;

Figure 7 is a perspective view of the ring of Figure 6;

Figure 8 shows the apparatus of Figure 4 in use;

Figure 9 shows a frequency characteristic of the apparatus of Figure 4;

Figure 10 and 12 are partially cut-away bottom views of second and third embodiments respectively of electroacoustic transducer apparatus according to the present invention; and

Figure 11 is a perspective view of a ring member used in the apparatus of Figure 10.

Referring to Figures 4 and 5, it will be seen that an elastic ring member 1 is secured to a bonding portion where the housing 16 and the driver unit 15 are bonded. As shown in Figures 6 and 7, the ring member 1 is formed such that central positions of inner and outer circumferences are displaced from each other, so that the ring member 1 protrudes at the centre thereof in one direction to provide a thick portion 1a. In the ring member 1, an inside base ring portion 2 and an outside elastic ring portion 3 are moulded by, for example, a so-called dichromatic moulding method, that is, a double-moulding method.

The inside ring portion 2 is formed by moulding a resin having a sufficient hardness, for example, acrylonitrile butadiene styrene copolymer (ABS) resin, and is formed as a cylindrical-shaped portion having a flange portion 2a inwardly formed on one edge portion thereof. The elastic ring portion 3 is formed by moulding an elastic material, for example, a urethane resin. The elastic ring portion 3 is formed with a displacement relative to the base ring portion 2 in order to form the thick portion 1a, and a concave groove portion 10 is formed in the thick portion 1a at the outer surface portion thereof, and in the axial direction of the ring member 1.

The ring member 1 is secured to the bonding portion between the housing 16 and the driver unit 15 such that the flange portion 2a is located on the protecting plate 22 side, and is engaged with the protecting plate 22. The ring member 1 is so arranged that its thick portion 1a is opposed to the antitragus d side. Figures 4 and 5 illustrate the headphone which is fitted to the left ear. For a headphone to be fitted to the right ear, the thick portion 1a protrudes in the opposite direction.

In use, this headphone is inserted into the cavum concha b as shown in Figure 8.

The entrance of the external auditory meatus is not located at the centre of the cavum concha b but is located at the tragus c side. The elastic ring member 1 is formed to have the thick portion 1a protrude towards the antitragus d so that, when the user wears this type of headphone, it can be properly fitted to the user's ear, thereby improving the closing property. The concave groove portion 10

forms an air passage portion in the direction parallel to the axis of the ring member 1. Thus, the inside and outside portions of the cavum concha b are communicated with each other by air passing through the concave groove portion 10. Therefore, a certain amount of sound escapes to the outside through this air passage, whereby differences in the closing property, caused by the size and shape of ears, can be reduced. Accordingly, the difference between the frequency characteristic S for a small ear and the frequency characteristic L for a large ear can be reduced as shown in Figure 9. Thus, almost all users can enjoy excellent acoustic characteristics with this headphone.

In the second embodiment, shown in Figure 10 and 11, the ring member 1 secured to the bonding portion between the housing 16, and the driver unit 15 is constructed as follows.

Referring initially to Figure 11, it will be seen that the ring member 11 has a similar outer configuration to that of the ring member 1 of the first embodiment, in which the centre positions of the inner and outer circumferences are displaced from each other, so that a thick portion 11a protrudes from the centre in one direction. In this embodiment, however, the shape of the inner peripheral portion of the ring member 11 is different from that of the above ring member 1. This will be explained more fully below.

The ring member 11 comprises a cylindrical base ring portion 12 having a flange portion 12a inwardly formed around one edge portion thereof, and an eccentric elastic ring portion 13 formed around the outer peripheral portion of the base ring portion 12. One portion of the peripheral surface of the base ring portion 12, that is one portion of the base ring portion 12 corresponding to the same direction of the thick portion 11a of the ring member 11, is curved to the outer peripheral side thereof, to form a concave groove portion 14 extending in the axial direction of the ring member 11.

Similar to the above ring member 1, this ring member 11 is formed by a dichromatic moulding-process. For example, the base ring portion 12 is formed by moulding acrylonitrile butadiene styrene copolymer (ABS) resin or the like, and the elastic ring portion 13 is formed by moulding, for example, urethane resin.

As shown in Figure 10, the ring member 11 is secured to the bonding portion between the housing 16 and the driver unit 15 such that the flange portion 12a of the base ring portion 12 is located at the protecting plate 22 side of the driver unit 15. Accordingly, an axial air passage portion is formed between the inner peripheral surface of the housing 16 by the concave groove portion 14.

The electroacoustic transducer apparatus of Figure 10 and 11 is for the left ear. For the right

ear, the thick portion 11a will increase its thickness in the opposite direction.

In use, the second embodiment of headphone is inserted into the cavum concha b similarly to the first embodiment. The elastic ring member 11 is formed so as to protrude to the antitragus d side so that, when the user wears this type of headphone, it can easily be properly fitted to the user's ear, thereby increasing the closing property. Simultaneously, the air passage portion is formed between the ring member 11 and the housing 16 by the concave groove portion 14, thereby connecting the inside and outside portions of the cavum concha b air passage, so obtaining a similar effect to that of the first embodiment.

In the third embodiment shown in Figure 12, the housing 16 has a thick portion 16a formed at one portion of the outer periphery thereof, and an air hole 16a1 is formed through the thick portion 16a in the front to rear direction thereof. The housing 16 is attached to a ring member 31 formed similarly to the ring member 1 of the first embodiment.

As shown in Figure 12, the ring member 31 has a thick portion 31a which protrudes from the centre of the ring member 31 in one direction. A cylindrical base ring portion 32 has a flange portion 32a inwardly formed around one edge portion thereof and a thick portion 32b formed at one portion thereof. The configuration of the thick portion 32b follows the configuration of the outer peripheral portion of the housing 16, that is, the outer peripheral portion having the thick portion. The thick portion 32b is opposed to the thick portion 16a of the housing 16, and the thick portion 31a of the base ring member 33 is provided around the outer periphery of the base ring portion 32.

In the third embodiment, the elastic ring member 31 is formed so as to protrude towards the antitragus d side so that, when it is worn by the user, it can easily be properly fitted to the ear, thereby increasing the closing property. Simultaneously, the inside and outside portions of the cavum concha b are communicated with each other by means of the air hole 16a1 formed through the thick portion 16a of the housing 16, thus achieving the same action and effect as those of the first and second embodiments.

While in the first, second and third embodiments the centre positions of the inner and outer circles of each of the ring members 1, 11 and 31 are displaced from each other, the outer configuration of the ring members used need not be circular and may be elliptical or of other shape, so long as the thickness of one portion thereof is increased in one direction, and the front and rear portions of the driver unit are communicated with each other.

Claims

1. An electroacoustic transducer apparatus comprising:
 - a housing (16) formed so as to be accommodated within a concave portion of a cavum concha (b) between the tragus (c) and antitragus (d) of an auricle (a), said housing (16) being supported by said tragus (c) and antitragus (d) when accommodated within said concave portion of said auricle (a);
 - an electroacoustic transducer element incorporated within said housing (16); and
 - an elastic ring member (1) attached to an outer peripheral portion of said housing (16);
 characterized in that:
 - an air passage portion (10; 14; 16a) is formed through at least one of said housing (16) and said ring member (1) so as to communicate a sound emanating front portion and a sound emanating rear portion with each other.
2. Apparatus according to claim 1 wherein said ring member (11) increases in thickness thereof in one direction, so that a centre position of an inner circumference and a centre position of an outer circumference thereof are displaced from each other.
3. Apparatus according to claim 2 wherein said air passage portion (10) is formed through a thick portion (11a) of said ring member (11).
4. Apparatus according to claim 2 wherein the thick portion (11a) of said ring member (11) is secured to said housing (16) so that, upon use, said thick portion (11a) is supported by said antitragus (d) of the auricle (a).
5. Apparatus according to claim 1 wherein said housing (16) is increased in thickness at a portion thereof supported in use by said antitragus (d) so that said thick portion (11a) protrudes in the outer peripheral direction of said housing (16).
6. Apparatus according to claim 5 wherein said air passage portion (14) is formed through said thick portion (11a) of said housing (16).

Patentansprüche

1. Elektroakustische Wandlervorrichtung bestehend aus:
 - einem Gehäuse (16) das derart ausgebildet ist, daß es in einen konkaven Teil einer höhlenförmigen Muschel (b) zwischen dem Tragus (c) und dem Antitragus (d) einer Ohr-



ear, the thick portion 11a will increase its thickness in the opposite direction.

In use, the second embodiment of headphone is inserted into the cavum concha b similarly to the first embodiment. The elastic ring member 11 is formed so as to protrude to the antitragus d side so that, when the user wears this type of headphone, it can easily be properly fitted to the user's ear, thereby increasing the closing property. Simultaneously, the air passage portion is formed between the ring member 11 and the housing 16 by the concave groove portion 14, thereby connecting the inside and outside portions of the cavum concha b air passage, so obtaining a similar effect to that of the first embodiment.

In the third embodiment shown in Figure 12, the housing 16 has a thick portion 16a formed at one portion of the outer periphery thereof, and an air hole 16a1 is formed through the thick portion 16a in the front to rear direction thereof. The housing 16 is attached to a ring member 31 formed similarly to the ring member 1 of the first embodiment.

As shown in Figure 12, the ring member 31 has a thick portion 31a which protrudes from the centre of the ring member 31 in one direction. A cylindrical base ring portion 32 has a flange portion 32a inwardly formed around one edge portion thereof and a thick portion 32b formed at one portion thereof. The configuration of the thick portion 32b follows the configuration of the outer peripheral portion of the housing 16, that is, the outer peripheral portion having the thick portion. The thick portion 32b is opposed to the thick portion 16a of the housing 16, and the thick portion 31a of the base ring member 33 is provided around the outer periphery of the base ring portion 32.

In the third embodiment, the elastic ring member 31 is formed so as to protrude towards the antitragus d side so that, when it is worn by the user, it can easily be properly fitted to the ear, thereby increasing the closing property. Simultaneously, the inside and outside portions of the cavum concha b are communicated with each other by means of the air hole 16a1 formed through the thick portion 16a of the housing 16, thus achieving the same action and effect as those of the first and second embodiments.

While in the first, second and third embodiments the centre positions of the inner and outer circles of each of the ring members 1, 11 and 31 are displaced from each other, the outer configuration of the ring members used need not be circular and may be elliptical or of other shape, so long as the thickness of one portion thereof is increased in one direction, and the front and rear portions of the driver unit are communicated with each other.

Claims

1. An electroacoustic transducer apparatus comprising:
 a housing (16) formed so as to be accommodated within a concave portion of a cavum concha (b) between the tragus (c) and antitragus (d) of an auricle (a), said housing (16) being supported by said tragus (c) and antitragus (d) when accommodated within said concave portion of said auricle (a);
 an electroacoustic transducer element incorporated within said housing (16); and
 an elastic ring member (1) attached to an outer peripheral portion of said housing (16);
 characterized in that:
 an air passage portion (10; 14; 16a) is formed through at least one of said housing (16) and said ring member (1) so as to communicate a sound emanating front portion and a sound emanating rear portion with each other.
2. Apparatus according to claim 1 wherein said ring member (11) increases in thickness thereof in one direction, so that a centre position of an inner circumference and a centre position of an outer circumference thereof are displaced from each other.
3. Apparatus according to claim 2 wherein said air passage portion (10) is formed through a thick portion (11a) of said ring member (11).
4. Apparatus according to claim 2 wherein the thick portion (11a) of said ring member (11) is secured to said housing (16) so that, upon use, said thick portion (11a) is supported by said antitragus (d) of the auricle (a).
5. Apparatus according to claim 1 wherein said housing (16) is increased in thickness at a portion thereof supported in use by said antitragus (d) so that said thick portion (11a) protrudes in the outer peripheral direction of said housing (16).
6. Apparatus according to claim 5 wherein said air passage portion (14) is formed through said thick portion (11a) of said housing (16).

Patentansprüche

1. Elektroakustische Wandlervorrichtung bestehend aus:
 einem Gehäuse (16) das derart ausgebildet ist, daß es in einen konkaven Teil einer höhlenförmigen Muschel (b) zwischen dem Tragus (c) und dem Antitragus (d) einer Ohr-



muschel (a) eingepaßt werden kann, wobei das besagte Gehäuse (16) durch besagten Tragus (c) und Antitragus (d) gestützt wird, wenn es innerhalb des konkaven Teiles besagter Ohrmuschel (a) eingepaßt ist;

ein in besagtes Gehäuse (16) eingebautes elektroakustisches Wandlerelement; und

ein an einem äußeren peripheren Teil des besagten Gehäuses (16) befestigtes elastisches ringförmiges Teil (1);

dadurch gekennzeichnet, daß

ein Luftdurchgangsteil (10; 14; 16a) zur gegenseitigen Verbindung von einem vorderen tonabstrahlenden Teil und einem rückwärtigen tonabstrahlenden Teil in zumindest einem, dem besagten Gehäuse (16) oder dem besagten ringförmigen Teil (1), ausgebildet ist.

2. Vorrichtung nach Anspruch 1, worin das besagte ringförmige Teil (11) in seiner Stärke in einer Richtung zunimmt, so daß eine zentrale Position eines inneren Umfanges und eine zentrale Position eines äußeren Umfanges gegeneinander verlagert sind.

3. Vorrichtung nach Anspruch 2, worin besagtes Luftdurchgangsteil (10) in einem verstärkten Bereich (11a) des besagten ringförmigen Teiles (11) ausgebildet ist.

4. Vorrichtung nach Anspruch 2, worin der verstärkte Bereich (11a) des besagten ringförmigen Teiles (11) an besagtem Gehäuse (16) gesichert ist, so daß der verstärkte Bereich (11a) bei der Benutzung durch besagten Antitragus (d) der Ohrmuschel (a) gestützt ist.

5. Vorrichtung nach Anspruch 1, worin die Stärke des besagten Gehäuses (16) in einem Teil desselben vergrößert ist, welches bei der Benutzung von besagtem Antitragus (d) gestützt wird, so daß der besagte verstärkte Bereich (11a) in äußerer peripherer Richtung des besagten Gehäuses (16) hervorsteht.

6. Vorrichtung nach Anspruch 5, worin besagtes Luftdurchgangsteil (14) in besagtem verstärkten Bereich (11a) des besagten Gehäuses (16) ausgebildet ist.

Revendications

1. Appareil à transducteur électro-acoustique :

- un boîtier (16) formé de manière à être logé à l'intérieur d'une partie concave d'une conque (b) entre le tragus (c) et l'anti-tragus (d) d'un pavillon auriculaire (a), ledit boîtier (16) étant supporté par

ledit tragus (c) et ledit anti-tragus (d) lorsqu'il est reçu à l'intérieur de ladite partie concave dudit pavillon auriculaire (a);

- un élément transducteur électro-acoustique incorporé à l'intérieur dudit boîtier (16); et

- un élément annulaire élastique (1) attaché sur une partie périphérique extérieure dudit boîtier (16);

caractérisé en ce que :

un passage d'air (10; 14; 16a) est formé à travers l'un au moins dudit boîtier (16) et dudit élément annulaire (1) de manière à faire communiquer l'une avec l'autre une partie frontale d'émission sonore et une partie arrière d'émission sonore.

2. Appareil selon la revendication 1, dans lequel ledit élément annulaire (11) a une épaisseur qui augmente dans une direction, de sorte qu'une position centrale d'une circonférence intérieure et une position centrale d'une circonférence extérieure de celui-ci sont déplacées l'une de l'autre.

3. Appareil selon la revendication 2, dans lequel ledit passage d'air (10) à travers une partie épaisse (11a) dudit élément annulaire (11).

4. Appareil selon la revendication 2, dans lequel la partie épaisse (11a) dudit élément annulaire (11) est fixée sur ledit boîtier (16) de telle manière qu'en utilisation ladite partie épaisse (11a) soit supportée par ledit anti-tragus (d) du pavillon auriculaire (a).

5. Appareil selon la revendication 1, dans lequel boîtier (16) a une épaisseur qui augmente dans une région de celui-ci qui est supportée en utilisation par ledit anti-tragus (d), de sorte que ladite partie épaisse (11a) fait saillie dans la direction périphérique extérieure dudit boîtier (16).

6. Appareil selon la revendication 5, dans lequel ledit passage d'air (14) est formé à travers ladite épaisse (11a) dudit boîtier (16).