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(54) **A HEADPHONE WITH TWO EAR CUSHIONS OF DIFFERENT HARDNESS**

(57) A headphone (1) comprising a first circumaural earphone (2) and a holding member (4) for holding the headphone (1) on the head of the user and forcing the first earphone (2) against the head of the user. The first earphone (2) comprises an earphone housing (8) with a first housing side (12) facing the head (5) of the user when worn, a first ring-shaped ear cushion (9) with a first hardness and a first abutment face (16) for abutting the head of the user. The first ear cushion (9) confines together with the first housing side (12) and the head (5) of the user a first cavity (13). The first earphone (2) comprises on the first housing side (12) beside the first ear cushion (9) a second ear cushion (10) with a second hardness and a second abutment face (17) for abutting the head (5) of the user., and wherein the second ear cushion (10) is having a second hardness, which is larger than first hardness.

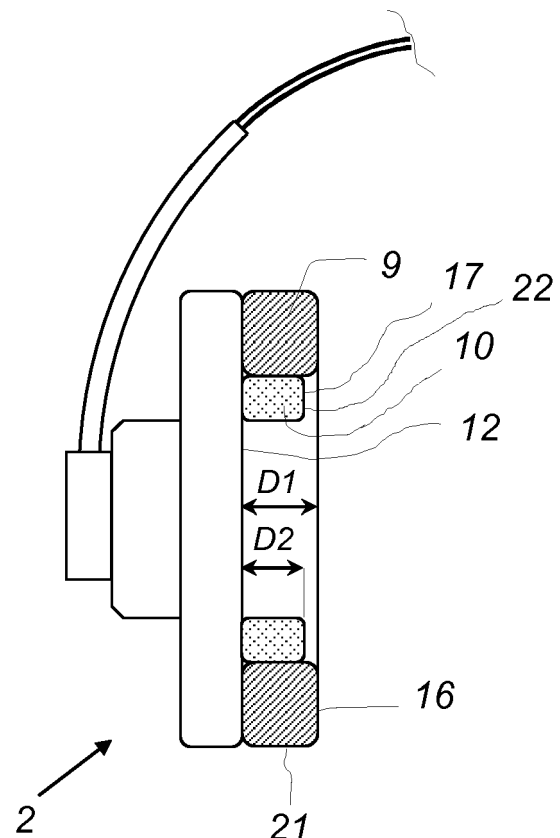


Fig. 2

Description

Technical Field

[0001] The invention relates to a headphone comprising a holding member, such as a headband, and at least one circumaural earphone.

Background Art

[0002] There exist different kinds of headphones. Normally a headphone comprises a headband and two earphones at the ends of the headband. The headband keeps the headphone on the head by pressing the earphones against the head of the user when worn. There also exist monaural headsets, which only comprise one earphone and where the opposite end of the headband comprises small plate or T- or Y-shaped bar, which rests on the head beside the ear. The earphones can be differently shaped. Supra-aural earphones rest on the ear and circumaural earphones are designed to rest on the user's head and surround the ear. Both circumaural and supra-aural headphones can be provided with open-back ear cups or closed-back ear cups. The open-back ear cups do not block out external noise and audio and leaks audio from the speaker to the surroundings. The closed-back ear cups more efficiently block out external noise and do not leak audio in any significant amount. This invention relates to circumaural headphones. The earphone housing side that faces the user's head is normally provided with a ring-shaped soft ear cushion, that rest on the head around the ear. This cushion must provide adequate support to keep the headphone in place. However, the ear cushion should also ensure a comfort wearing so the user does not feel a too strong pressure on the head around the ear, which may cause discomfort after a short time of wearing. Thus, the ear cushion must have a certain softness to ensure this purpose. When the headphone is a closed back headphone, and especially a headphone with so-called active noise cancellation, the ear cushion must also provide effective passive noise cancellation by providing an effective seal against the skin of the user to prevent that external noise enters the cavity enclosed by the ear cushion, the earphone housing side and the head of the user. A soft ear cushion is able to adapt itself to the unevenness of the head surface around the ear and thereby provide a good sealing. However, a soft ear cushion may cause the harder parts of the earphone housing to be felt through the compressed cushion which may cause discomfort. If the soft cushion is made thick enough to prevent this, it becomes inappropriate thick and/or "destroys" the supporting action, whereby the ear phone does not rest securely on around the ear.

[0003] Thus, there are conflicting purposes. A relatively soft ear cushion provides good sealing but less comfort, when it has a suitable thickness in relation to design purposes. A relatively ear hard ear cushion provides a good

support and good comfort but does not provide sufficient sealing. The relatively hard foam material may itself have good sound attenuating properties but that may be "cancelled out" by poor sealing properties.

[0004] There have been different attempts to solve these conflicting purposes.

[0005] EP 2 858 380 discloses an earphone where the thickness of the earpad varies across the perimeter in order to adapt it to the head of user in order to improve sealing.

[0006] US 4,922,542 discloses a headphone where the earphones comprise a double annulus circumaural cushion in order to provide a good sealing.

[0007] US 2015/0092976 disclose a headphone with an ear cushion comprising two layers of compliant material. A first layer close to the head is relatively soft and a second layer close to the earphone housing is harder. This solution provides an attempt to combine comfort with good sealing.

Disclosure of Invention

[0008] A headphone according to this specification comprises a first circumaural earphone and a holding member for holding the headphone on the head of the user and forcing the first earphone against the head of the user, wherein the first earphone comprises an earphone housing with a first housing side facing the head of the user when worn, a first circumferential ear cushion with a first hardness and a first abutment face for abutting the head of the user, which first ear cushion together with the first housing side and the head of the user confines a first cavity, wherein the first earphone on the first housing side beside the first ear cushion comprises a second ear cushion with a second hardness and a second abutment face for abutting the head of the user, and wherein the second hardness is larger than first hardness. With such a headphone, the first ear cushion can be utilised to seal the earphone against the head, whereas the second ear cushion provides comfortable resting of the earphone against the head.

[0009] The complete the first ear cushion, the second ear cushion and the holding member are dimensioned, such that the first and second ear cushions abut the head.

[0010] According to an embodiment, the first abutment face is located at first distance from the first housing side and the second abutment face at a second distance from the first housing side, wherein the first distance is equal with the second distance, when the headphone is worn, and wherein the first distance is larger than the second distance in a relaxed state, when the earphone is not forced against the head of the user.

[0011] The first ear cushion may be ring-shaped and extend along the circumference of the earphone housing.

[0012] The second ear cushion may be arranged in the first cavity. Thus, the second ear cushion is hidden when the headphone is worn.

[0013] The second ear cushion may be ring-shaped

like the first ear cushion.

[0014] According to an embodiment, the second earphone is adapted to not abut the head of the user in the area below the ear of the user. This area is relatively sensitive, and the user may feel less discomfort with this embodiment.

[0015] The second ear cushion is shaped as an inverted U, when the headset is worn and the user's head is in upright position.

[0016] The second ear cushion may alternatively be arranged outside the first cavity.

[0017] A headphone according to any of the preceding claims, wherein the first ear cushion and second ear cushion comprise foam.

[0018] The first ear cushion may comprise a first sheath and the second ear cushion may comprise a second sheath.

[0019] The holding member may be a headband comprising a first end part and a second end part, and wherein the first earphone is attached to a first end part.

[0020] According to an embodiment, the headphone comprises a second earphone, which is attached to the second end part of the headband.

[0021] According to an embodiment, the first ear cushion comprises foam with a Shore F hardness less than 30, and the second ear cushion comprises foam with a Shore F hardness of more than 40.

[0022] According to an embodiment, the first ear cushion comprises foam with a Shore F hardness less than 25, and the second ear cushion comprises foam with a Shore F hardness of more than 45.

[0023] A headphone according to any of the preceding claims, wherein the first and second ear cushions comprises a common sheath.

Brief Description of the Drawings

[0024] The invention is explained in detail below with reference to the drawing illustrating a preferred embodiment of the invention and in which

Figure 1 is a schematic view of a headphone according to a first embodiment comprising a first and a second earphone,

Figure 2 is a schematic partially cross-sectional view through the first earphone according to the first embodiment,

Figure 3 is a schematic partially cross-sectional view through the first earphone according to the first embodiment when mounted on the head of a user,

Figure 4 is a schematic end view of the first earphone according to the first embodiment,

Figure 5 is a schematic end view of the first earphone according to a second embodiment,

Figure 6 is a schematic end view of the first earphone according to a third embodiment,

Figure 7 is a schematic end view of the first earphone according to a fourth embodiment,

Figure 8 is a schematic end view of the first earphone according to a fifth embodiment,

Figure 9 is a schematic end view of the first earphone according to a sixth embodiment,

Figure 10 is a schematic and partial cross-sectional view through the first earphone according to the second embodiment,

Figure 11 is a schematic partially cross-sectional view through the first earphone according to the second embodiment when mounted on the head of a user,

Figure 12 is a schematic and partial cross-sectional view through the first earphone according to a seventh embodiment,

Figure 13 is a schematic and partial cross-sectional view through the first earphone according to an eighth embodiment, and

Figure 14 is a schematic end view of the first earphone according to the seventh embodiment, and

Figure 15 is a schematic end view of the first earphone according to the eighth embodiment.

Modes for Carrying out the Invention

[0025] Figure 1 is a schematic view of a headphone 1 according to a first embodiment mounted on the head 5 of user. The headphone 1 comprises a headband 4, a first earphone 2 and second earphone 3. The first earphone 2 is adapted to be arranged around the right ear 6 of the user while the second earphone 3 is adapted to be arranged around the left ear 7 of the user. The earphones are of the circumaural type, which means that they enclose the ears 6, 7 and rest on the sides of the head 5. The headband 4 extending between the first and second earphones 2, 3 provides a clamping force pressing the earphones 2, 3 against the sides of the head 5. The first and second earphones 2, 3 are identical in this embodiment and only the first earphone 2 will be described in detail in the following. The first earphone 2 comprises an earphone housing 8 with a first side 12 facing the head 5 when worn. A first ring-shaped ear cushion 9 extends along the entire circumference 11 of the headset housing 8. The first ear cushion 9, the first housing side 12 and the side of the head 5 defines a first cavity 13. The right ear 6 is located in this cavity 13. A second ear cushion 10 extends coaxial with the first ear cushion 9 on the inner side of this. A speaker unit is arranged in the first earphone housing 8 in order to provide audio to the ear. The speaker unit, electronics and cables are left out for clarity reasons. The outer diameter of the headset housing 8 may be approximately 110 mm. The inner diameter of the second ear cushion may be approximately 60 mm.

[0026] Figure 2 is a schematic partially cross-sectional view through the first earphone 2 in a relaxed state, where the headphone 1 is not arranged on the head 5. The first ear cushion 9 is made of a first foam with a hardness of approximately 20 Shore F. The first ear cushion 9 has a

first abutment face 16 for abutting the head 5. There is a first distance D1 between the first housing side 12 and the first abutment face 16. The foam of the first ear cushion 9 is covered with a first sheath 21 of flexible material. The second ear cushion 10 is made of a second foam with a hardness of approximately 50 Shore F. The second cushion 10 is covered with a second sheath 22 of elastic material. The second ear cushion 10 has a second abutment face 17 for abutting the head 5. There is a second distance D2 between the first housing side 12 and the second abutment face 17. The first distance D1 is larger than the second Distance 2. As an example, D1 may be approximately 10 mm and D2 approximately 8 mm.

[0027] Figure 3 is a schematic partially cross-sectional view through the first earphone 2 according to the first embodiment when mounted on the head 5 of a user. When the headphone 1 is arranged on the head 5 and a the headband presses the first earphone 2 against the head 5, the first ear cushion 9 and the second ear cushion 10 are compressed, whereby their abutment faces 16, 17 will align and obtain a common third distance D3 to the first housing side 12. As the second ear cushion 3 is relatively hard, it will only be compressed very little, whereby the second distance D2 and the third distance D3 are practically equally. Thus, the first ear cushion 9 is compressed the distance $D1-D3 \approx D1-D2$.

[0028] Figure 4 is a schematic end view of the first earphone 2 according to the first embodiment. It can be seen that both the first ear cushion 9 and the second ear cushion 10 are ring-shaped.

[0029] Figure 5 is a schematic end view of the first earphone according to a second embodiment. Here the first ear cushion 9b is arranged inside the second ear cushion 10b, which is arranged along the perimeter of the circular earphone housing 8. Both the first ear cushion 9 and the second ear cushion 10 are ring-shaped.

[0030] Figure 6 is a schematic end view of the first earphone according to a third embodiment. As with the first embodiment, the first ear cushion 9c is ring-shaped and arranged outermost. The second ear cushion 10c is crescent-shaped and abuts the head immediately in front of the ear. Despite the relatively small size, the second ear cushion 10c provides sufficient support, while the first earphone 9c seals the cavity 13.

[0031] Figure 7 is a schematic end view of the first earphone according to a fourth embodiment. The first ear cushion 9d corresponds to the first ear cushion 9, 9c according to the first and third embodiments. The second ear cushion 10d is shaped as a circle with a cut-out 25 below the ear. Thus, the second ear cushion has a shape that somewhat corresponds to an inverted U. This is advantageous, as the area is relatively sensible and a user may quickly feel discomfort if this area is exposed to pressing forces.

[0032] Figure 8 is a schematic end view of the first earphone according to a fifth embodiment. This embodiment comprises two first circular coaxial ear cushions 9e1, 9e2 of a first hardness and one second circular ear cushion

10e of a second hardness between the first ear cushions 9e1, 9e2.

[0033] Figure 9 is a schematic end view of the first earphone according to a sixth embodiment. This embodiment comprises an outer first ear cushion 9f and an inner circular second ear cushion 10f. The second ear cushion 10 f comprise two zones 15, 24 with softer foam to allow a side bar of a pair of glasses to pass without being forced against the head with unnecessary force causing discomfort for the user.

[0034] Figure 10 is a schematic and partial cross-sectional view through the first earphone 2 according to the second embodiment. A common sheath 23 of elastic material covers the first ear cushion 9b and the second ear cushion 10b. The common sheath 23 is left out from figure 5 for clarity reasons. The common sheath 23 does not affect the hardness of the first and second ear cushions 9b, 10b essentially but primarily serves an aesthetic purpose.

[0035] Figure 11 is a schematic partially cross-sectional view through the first earphone according to the second embodiment when mounted on the head of a user.

[0036] Figure 12 is a schematic and partial cross-sectional view through the first earphone according to a seventh embodiment. The cross-sections of the first ear cushion 9g and the second ear cushion 10g are circular.

[0037] Figure 13 is a schematic and partial cross-sectional view through the first earphone according to an eighth embodiment. The cross-sections of the first ear cushion 9h is rectangular and the cross-section of the second ear cushion 10h is circular.

[0038] Figure 14 is a schematic end view of the first earphone according to the seventh embodiment. Both the first ear cushion 9g and the second ear cushion 10g are oval.

[0039] Figure 15 is a schematic end view of the first earphone according to the eighth embodiment. Both the first ear cushion 9h and the second ear cushion 10h are rectangular.

[0040] Other cross-sections than those disclosed here can be used.

[0041] The earphones disclosed here provides efficient passive noise cancellation. Therefore, they are also very suitable for active noise cancellation headphones. The principle of active noise cancellation can for example explained in EP 2 827 608.

[0042] The invention can also be utilised for ear defenders, wherein the earphones are embodied as earmuffs without built-in speakers.

[0043] The term "ring-shaped" should be understood broadly. It is intended that the term covers "non-circular rings", such as the oval and rectangular "rings" shown here. Also quadratic, hexagonal and other forms may be used.

[0044] The first ear cushion 9 and the second ear cushion 10 could be more or less integrated, so that they are embodied as a common cushion with zones of different hardness.

Reference signs:

[0045]

1	headphone
2	first earphone
3	second earphone
4	headband
5	head of user
6	ear of user
7	ear of user
8	earphone housing
9	first ear cushion
10	second ear cushion
11	circumference of earphone housing
12	first housing side
13	cavity
14	side bar
15	soft area
16	first abutment face
17	second abutment face
18	second cavity
19	first end of headband
20	second end of headband
21	first sheath
22	second sheath
23	common sheath
24	soft area
25	cut-out
D1	first distance
D2	second distance
D3	third distance

Claims

1. A headphone (1) comprising a first circumaural earphone (2) and a holding member (4) for holding the headphone (1) on the head of the user and forcing the first earphone (2) against the head of the user, wherein the first earphone (2) comprises an earphone housing (8) with a first housing side (12) facing the head (5) of the user when worn, a first ring-shaped ear cushion (9) with a first hardness and a first abutment face (16) for abutting the head of the user, which first ear cushion (9) together with the first housing side (12) and the head (5) of the user confines a first cavity (13), wherein the first earphone (2) on the first housing side (12) beside the first ear cushion (9) comprises a second ear cushion (10) with a second hardness and a second abutment face (17) for abutting the head (5) of the user, and wherein the second hardness is larger than first hardness.
2. A headphone (1) according to claim 1, wherein the first abutment face (16) is located at first distance (D1) from the first housing side (12) and the second abutment face (17) is located at a second distance

(D2) from the first housing side (12), and wherein the first distance (D1) is equal with the second distance (D2), when the headphone (1) is worn, and wherein the first distance (D1) is larger than the second distance (D2) in a relaxed state, when the earphone (2) is not forced against (5) the head of the user.

3. A headphone (1) according to claim 1 or 2, wherein the first ear cushion (9) is ring-shaped and extends along the circumference (11) of the earphone housing (8).
4. A headphone (1) according to any of the preceding claims, wherein the second ear cushion (10) is arranged in the first cavity (13).
5. A headphone (1) according to claim 4, wherein the second ear cushion (10) is ring-shaped.
6. A headphone according to claim 4, wherein the second earphone (10d) is adapted to not abut the head (5) of the user in the area below the ear (6, 7) of the user.
7. A headphone (1) according to claim 6, wherein second ear cushion (10d) is shaped as an inverted U, when the headset is worn and the user's head (5) is in upright position.
8. A headphone (1) according to any of the claims 1-3, wherein the second ear cushion (10b) is arranged outside the first cavity (13).
9. A headphone (1) according to any of the preceding claims, wherein the first ear cushion (9) and second ear cushion (10) comprise foam.
10. A headphone (1) according to claim 9, wherein the first ear cushion (9) comprises a first sheath (21) and the second ear cushion (10) comprises a second sheath (22).
11. A headphone (1) according to any of the preceding claims, wherein the holding member is a headband (4) comprising a first end part (19) and a second end part (20), and wherein the first earphone (2) is attached to a first end part (19).
12. A headphone (1) according to claim 11, which comprises a second earphone (3), which is attached to the second end part (20).
13. A headphone (1) according to any of the preceding claims, wherein the first ear cushion (9) comprises foam with a Shore F hardness less than 30, and the second ear cushion (10) comprises foam with a Shore F hardness of more than 40.

14. A headphone (1) according to claim 13, wherein the first ear cushion (9) comprises foam with a Shore F hardness less than 25, and the second ear cushion (10) has a Shore F hardness of more than 45.

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15. A headphone (1) according to any of the preceding claims, wherein the first and second ear cushions (9, 10) comprises a common sheath (23).

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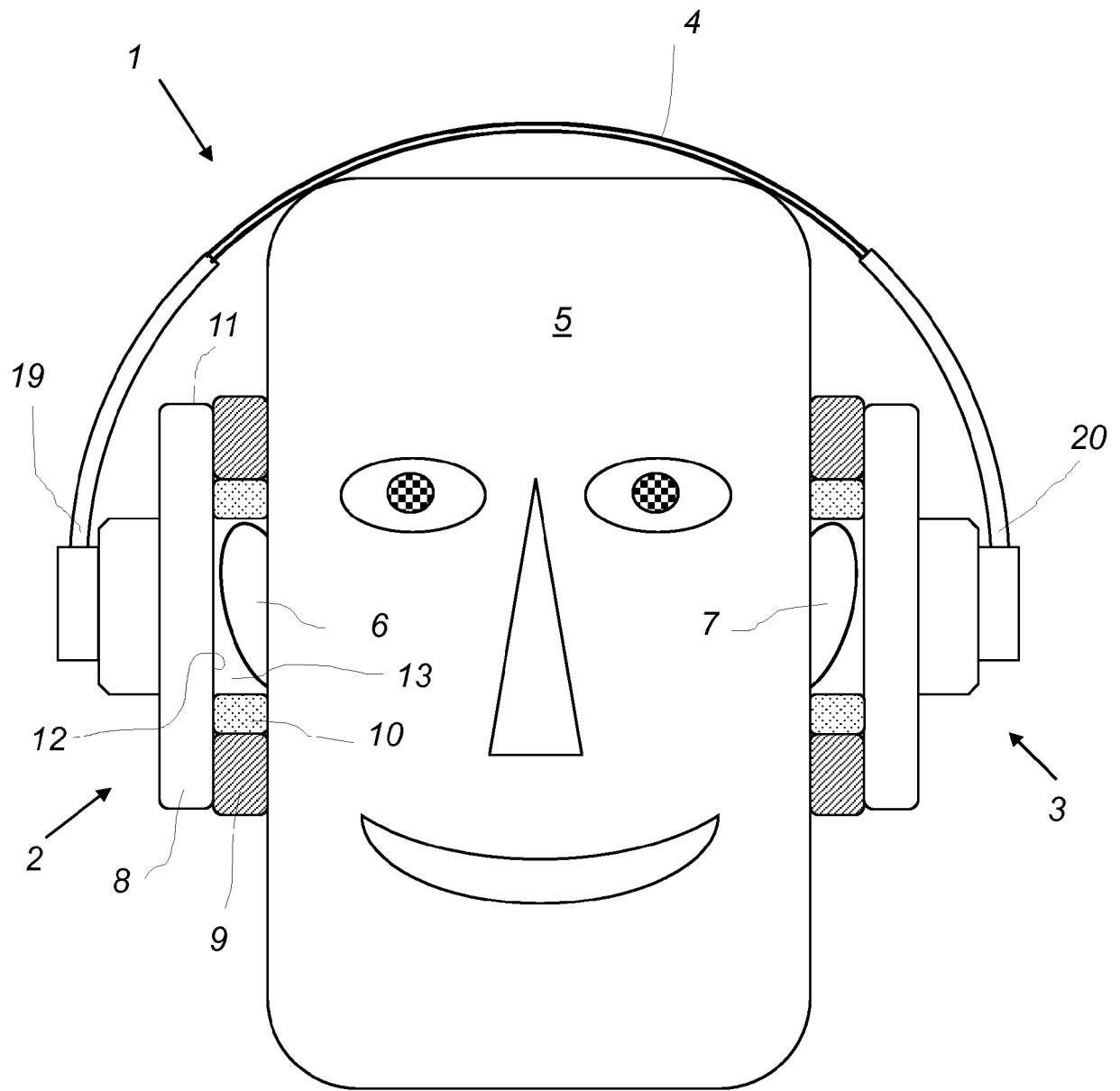


Fig. 1

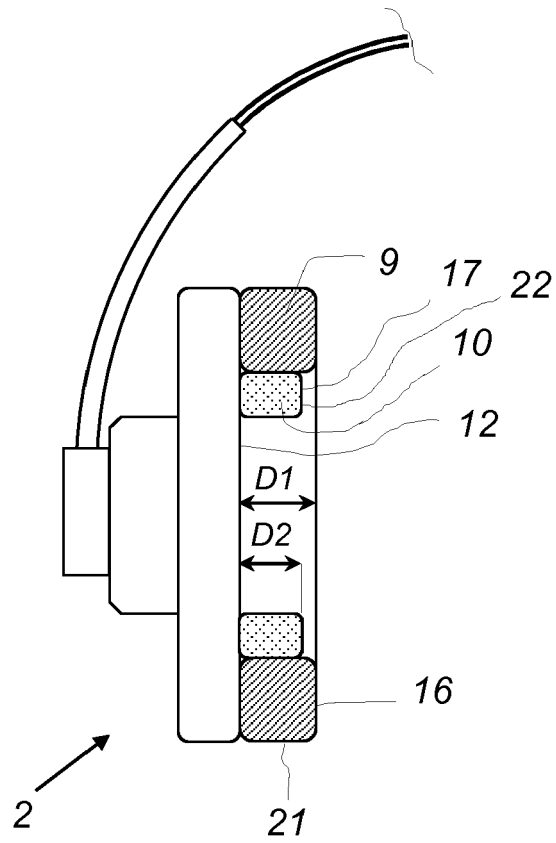


Fig. 2

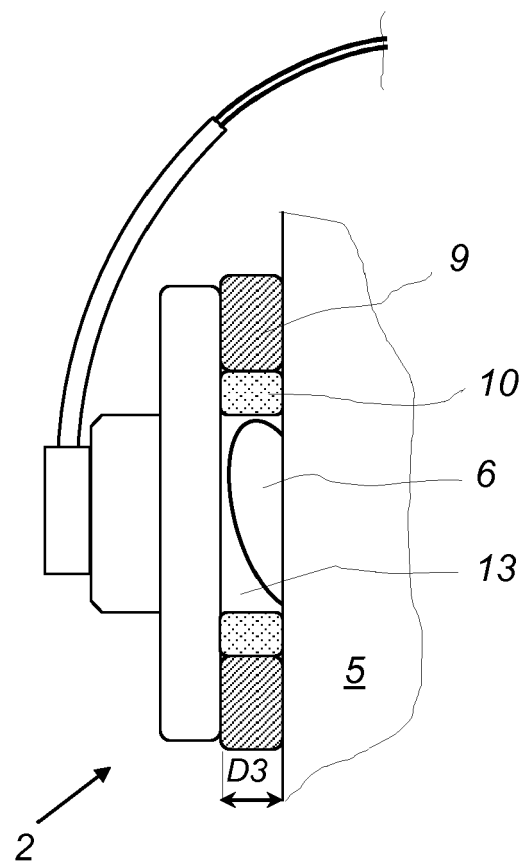


Fig. 3

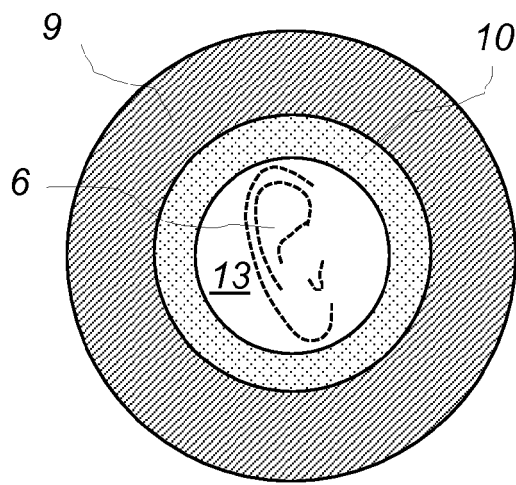


Fig. 4

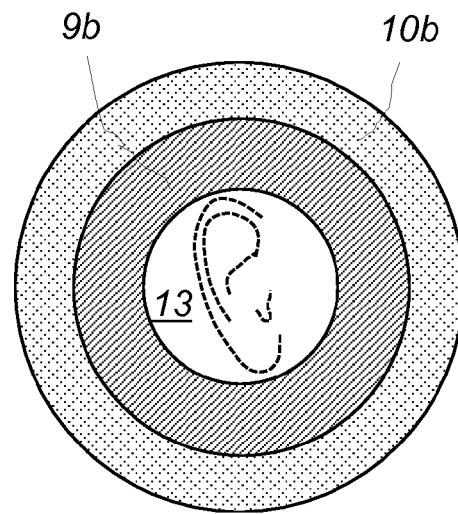


Fig. 5

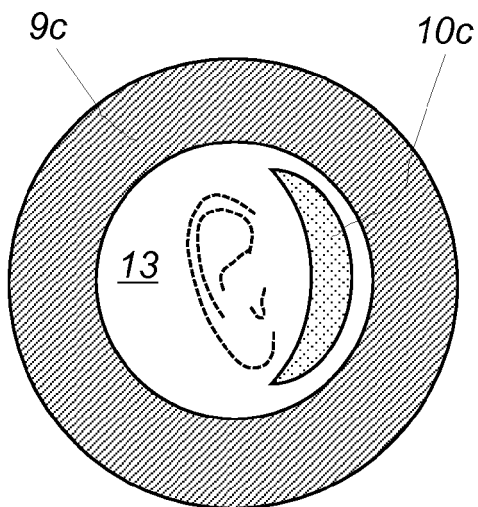


Fig. 6

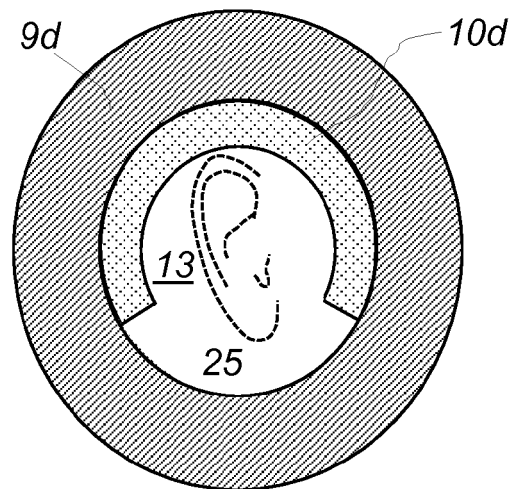


Fig. 7

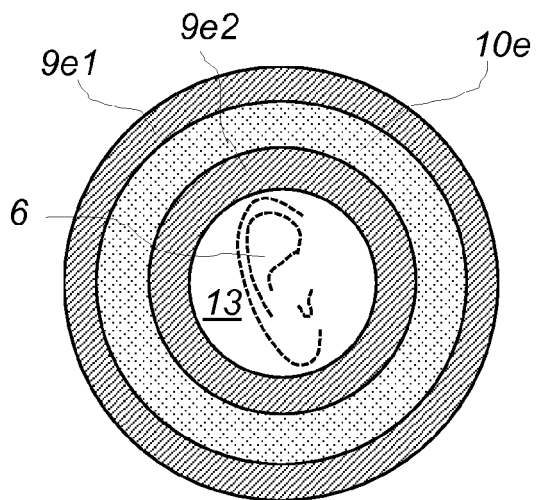


Fig. 8

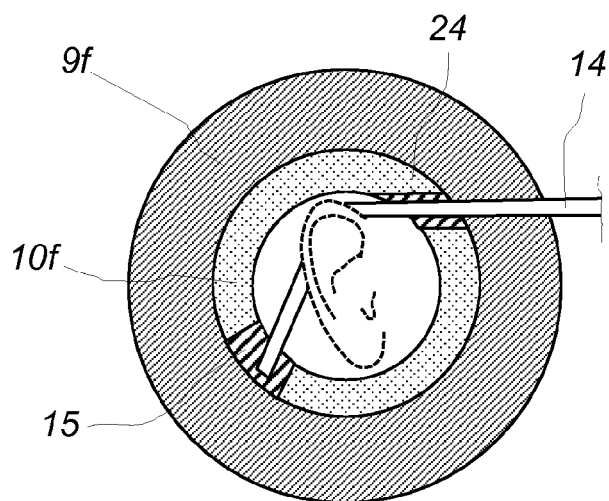


Fig. 9

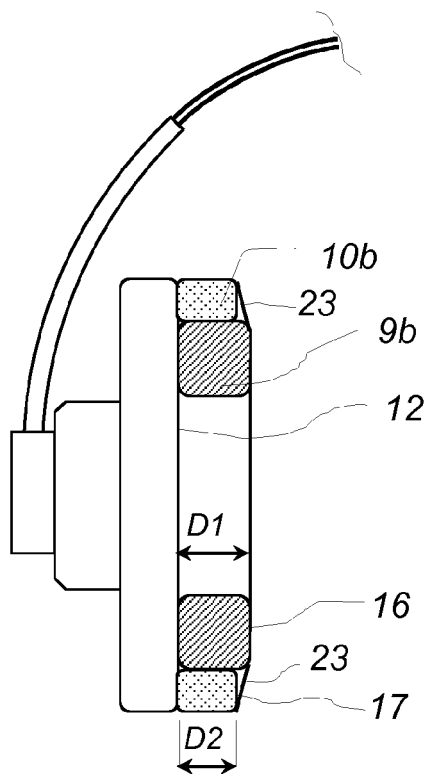


Fig. 10

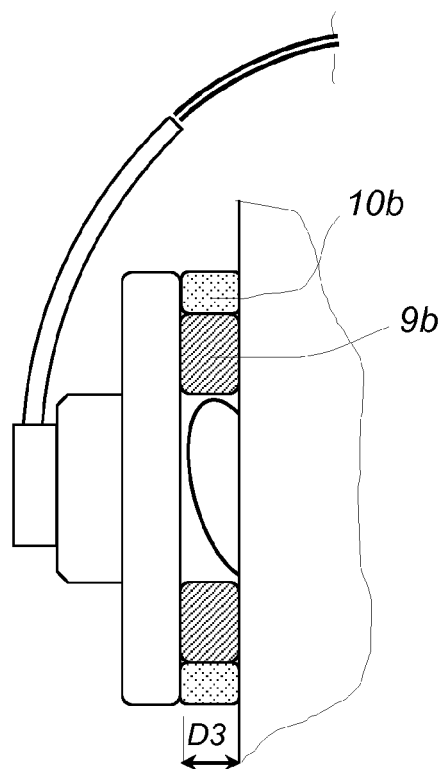


Fig. 11

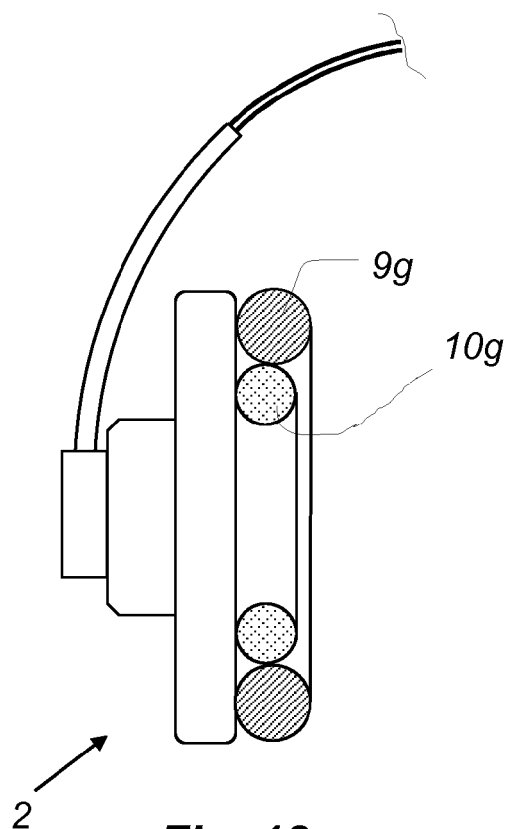


Fig. 12

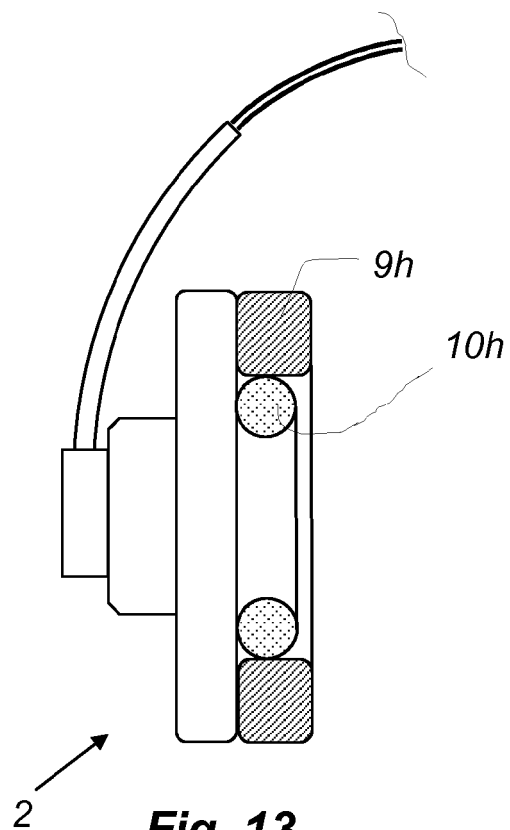


Fig. 13

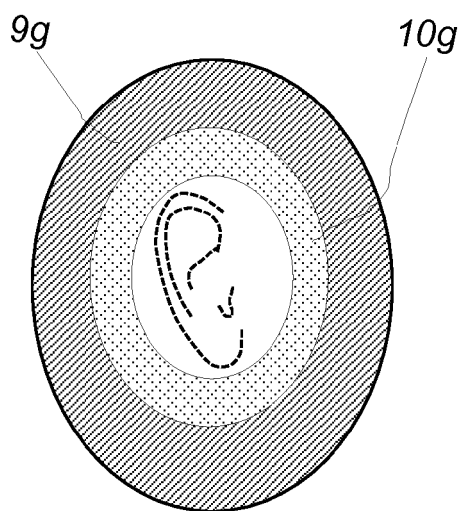


Fig. 14

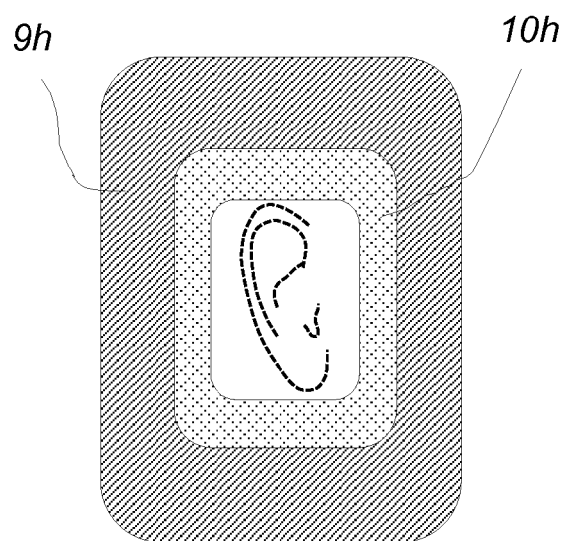


Fig. 15



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Application Number
EP 15 20 2888

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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