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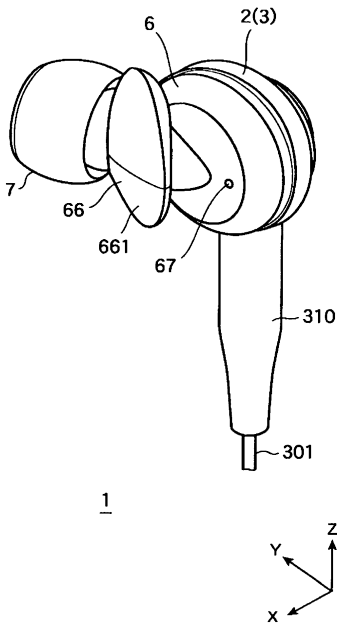
(54) EARPHONE

(57) An earphone exerting a preferable equipped with feeling is provided. Sound leakage is prevented. A preferable acoustic characteristic is obtained even when the relative angle between a speaker body part and an acoustic tube changes. An earphone with a comparatively simple structure is provided. An earphone 1 includes a speaker housing part 2 that includes a speaker body part 3 and an opening part 21 through which a sound wave from the speaker body part 3 is emitted, a acoustic tube 4 having a tubular shape and an elastic earflap inserting body 6 surrounding a part or whole of the acoustic tube 4 and the speaker housing part 2, and the earflap inserting body 6 is formed bendably and deformably in proximity of a connecting part 61 connecting the earflap inserting body 6 and the acoustic tube 4.

Fig.1



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Description

FIELD OF THE INVENTION

[0001] The present invention relates to an earphone.

BACKGROUND OF THE INVENTION

[0002] There is known an earphone that is equipped with an earflap or an external ear canal (for example, see patent literature 1).
Also, there is known an earphone that includes a housing having a driving unit and an acoustic tube provided so as to project from the front face of the housing. The acoustic tube is arranged outside of the center position of the housing and an edge portion of the acoustic tube is directed away from the center position of the housing. The acoustic tube of the earphone is equipped with the ear of a user.

[0003]

(Patent literature 1) Japanese utility model publication H 01 - 137691

DISCLOSURE OF THE INVENTION

PROBLEMS SOLVED BY THE INVENTION

[0004] Generally, a shape of an earflap or an external ear canal varies with individual users. According to the earphone described above, since the housing and the acoustic tube are positionally fixed so as to provide a prescribed angle therebetween, some users may have an uncomfortable feeling, for example, a feeling of pressure on their ears when the earphone is equipped with the external ear canal.
Also, according to the earphone described above, sound leakage may be caused, for example, by a portion not in close contact with the ear or a portion having little contact pressure against the ear.

[0005] For example, if an earphone is configured such that an acoustic tube is angle-variable with respect to an earphone body by using a joint part formed in a substantially spherical shape as a connecting part connecting the acoustic tube to the earphone body, the acoustic characteristic may be degraded when the angle is set significantly large. In addition, according to the above earphone, a process of making a connecting part with a substantially spherical shape is required.

[0006] It is an object of the present invention to solve the problem described above. That is, an object of the present invention is to provide an earphone that creates a preferable feeling when it is equipped with the ear, prevent sound leakage, generate a preferable acoustic characteristic even when the relative angle between the speaker body part and the acoustic tube is changed, provide an earphone having a comparatively simple structure, etc.

MEANS FOR SOLVING THE PROBLEMS

[0007] To achieve the above objects, an earphone according to the present invention has at least a configuration according to the following independent claim.

[0008] An earphone according to the present invention includes a speaker housing part that incorporates a speaker body part and has an opening part through which a sound wave from the speaker body part is emitted, an acoustic tube having a tubular shape and an elastic earflap inserting body surrounding a part or whole of the acoustic tube and the speaker housing part, and the earflap inserting body is formed bendably and deformably in proximity of a connecting part connecting the earflap and the acoustic tube.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a perspective view of an earphone 1 according to a first embodiment of the present invention;

Fig. 2 is a front view (Fig. 2(A)) and a back view (Fig. 2(B)) of the earphone 1 according to the first embodiment of the present invention;

Fig. 3 is a cross-sectional view of the earphone 1 shown in Fig. 1;

Fig. 4 is an exploded view of the earphone 1 shown in Fig. 3;

Fig. 5 is a cross-sectional view of a speaker body part 3 incorporated in the earphone 1 shown in Fig. 3;

Fig. 6 is a cross-sectional perspective view illustrating an earflap inserting body 6 of the earphone 1 shown in Fig. 3;

Fig. 7 is a perspective view (Fig. 7(A)) and a cross-sectional view (Fig. 7(B)) illustrating an earflap inserting body 6 of the earphone 1 shown in Fig. 3;

Fig. 8 is a perspective view of the earflap inserting body 6 and the acoustic tube 4 of the earphone 1 according to the first embodiment of the present invention;

Fig. 9 is a perspective view of the earphone 1 when the earflap inserting body and the acoustic tube are connected;

Fig. 10 is a view illustrating an operation of the earphone 1 shown in Fig. 3;

Fig. 11 is a view illustrating an operation of the earphone 1 shown in Fig. 3;

Fig. 12 (A) is a view illustrating a state when the earphone 1 is equipped with and Fig. 12(B) is a view illustrating another state when the earphone 1 is equipped with;

Fig. 13(A) is a view illustrating the state when the earphone 1 is equipped with and Fig. 12(B) is a view indicative of names of respective earflap parts;

Fig. 14 is a side view of an earphone 1B according to a second embodiment of the present invention;

Fig. 15 is a cross-sectional view of the earphone 1B shown in Fig. 14; and

Fig. 16 is a front view of an electronic device 100 equipped with the earphone shown in Fig. 1.

BEST MODE OF THE INVENTION

[0010] An earphone according to an embodiment of the present invention includes a speaker housing part that includes a speaker body part and an opening part through which a sound wave from the speaker body part is emitted, an acoustic tube having a tubular shape and an elastic earflap inserting body surrounding a part or whole of the acoustic tube and the speaker housing part, earflap inserting body is formed bendably and deformably in proximity of a connecting part connecting said earflap inserting body and said acoustic tube.

[0011] For example, the earphone includes an earflap inserting body and an acoustic tube through which a leading sound passage is formed. A sound wave output from a speaker body part is emitted outside through the leading sound passage of the earflap inserting body and the acoustic tube. The earflap inserting body of the earphone is formed with an elastic body, flexible material, etc. The earflap inserting body is formed so as to surround a part or whole of the acoustic tube and the speaker housing part. When the earphone is equipped with the ear of a user, the earflap inserting body is bent and deformed in proximity of a connecting part that is formed at the end portion thereof, for example, in response to the shape of the ear of the user. Specifically, the earphone is equipped with the ear of the user with the elastic earflap inserting body being bent and deformed such that the acoustic tube and the speaker body part are in the most suited angular position relationship in response to the shape of the ear of the user. Therefore, it is possible to provide an earphone that creates a preferable "equipped with feeling" for individual users.

[0012] Further, with the elastic earflap inserting body bent and deformed, the earphone according to the present invention is equipped with the ear of the user at the most suited angle of the axis of the acoustic tube with respect to the axis of the speaker body part for individual users, and thus a comparatively large contact property is created between the earphone and the ear. Therefore, sound leakage can be restrained compared to a general earphone.

[0013] Further, according to the above earphone, with the elastic earflap inserting body bent and deformed, a preferable acoustic characteristic can be generated even when the angle between each of the axes of the speaker body part and the acoustic tube is comparatively large. Also, the above earphone can be easily manufactured with the earflap inserting body that is formed, for example, with an elastic body (flexible material) such as resin so as to surround a part or whole of the acoustic tube and the speaker housing part. By assembling the earflap inserting body, the acoustic tube and the speaker housing part, a bendable and deformable earphone having a simple structure can be provided. Hereinafter, the earphone according to an embodiment of the present invention is described with reference to the drawings.

[First embodiment]

[0014] Fig. 1 is a perspective view of an earphone 1 according to a first embodiment of the present invention. Fig. 2 is a front view (Fig. 2(A)) and a back view (Fig. 2 (B)) of the earphone 1 according to the first embodiment of the present invention. Fig. 3 is a cross-sectional view of the earphone 1 shown in Fig. 1. Fig. 4 is an exploded view of the earphone 1 shown in Fig. 3. Fig. 5 is a cross-sectional view of a speaker body part 3 incorporated in the earphone 1 shown in Fig. 3. Fig. 6 is a cross-sectional perspective view illustrating an earflap inserting body 6 of the earphone 1 shown in Fig. 3. Fig. 7 is a perspective view (Fig. 7(A)) and a cross-sectional view (Fig. 7(B)) illustrating an earflap inserting body 6 of the earphone 1 shown in Fig. 3.

[0015] The earphone 1 according to an embodiment of the present invention is equipped with the ear of a user and emits a sound wave when a speaker diaphragm vibrates in response to a current signal input, for example, from a portable music player, etc. The earphone 1 is also referred to as a speaker device.

[0016] Specifically, as shown in Figs. 1-5, the earphone 1 (speaker device) includes, a speaker housing part 2, a speaker body part 3, an acoustic tube 4, a filter (sound absorption member) 5, an earflap inserting body 6 and an earplug (earpiece) 7.

The speaker housing part 2 corresponds to an embodiment of the speaker housing part according to the present invention, and the speaker body part 3 corresponds to an embodiment of the speaker body part according to the present invention. The acoustic tube 4 corresponds to an embodiment of the acoustic tube according to the present invention, and the earflap inserting body 6 corresponds to an embodiment of the earflap inserting body according to the present invention. The earplug 7 corresponds to an embodiment of the earplug according to the present invention.

Hereinafter, each component is described with reference to the drawings.

[Speaker housing part (housing part) 2]

[0017] The housing part 2 incorporates the speaker body part 3 and has an opening part 21 through which a sound wave from the speaker body part 3 is emitted. For example, the housing part 2 is formed with a material such as ABS resin (Acrylonitrile Butadiene Styrene : copolymerize synthetic resin), resin, etc. Alternatively, the housing part 2 may be formed with a conventional material such as thermoplastic resin, thermosetting resin, etc.

The housing part 2 includes a receiving part 210 in which the speaker body part 3 is received. For example, the housing part 2 includes a first housing (housing front part) 201 and a second housing (housing back part) 202. The speaker body part 3 is received in the receiving part 210 while the first housing 201 and the second housing 202 are disassembled. After the speaker body part 3 is received in the receiving part 210, the first housing 201 and the second housing 202 are joined by a joining process such as adhesive joining, joining by ultrasonic welding, etc.

Also, the receiving part 210 may receive the speaker body part 3 in whole or in part. As long as the receiving part 210 is formed in a shape so as to be mounted on the housing part 2, the receiving part 210 may be available. Specifically, the receiving part 210 may cover the front face of the housing part 2 (side face on the side of the acoustic tube 4), while it may fit in an engaging part formed at the front face of the housing part 2. For example, the engaging part includes an engaging part formed at the periphery side face of the housing part 2, which is referred to below. As shown in Fig. 3, the housing part 2 includes a pullout hole formed at the side face or the bottom part for a speaker code 301 pulled out of the speaker body part 3 to pass through. Also, as shown in Figs 1 and 2, the speaker housing part 2 includes a cord holding part 310 having a tubular shape in the lower side of the speaker housing part 2. The speaker code 301 is electrically connected to an external reproducing device, for example, such as a portable music player through the cord holding part 310.

[0018] As shown in Figs. 3 and 4, the speaker housing part 2 is formed such that a bottom face part 2021 is inclined toward the acoustic tube 4 with respect to the center axis P3 of the speaker body part 3.

With the bottom face part 2021 of the speaker housing part 2 formed inclined with respect to the center axis P3 of the speaker body part 3, the user can easily equip the external ear canal with the earphone 1, for example, by pressing with a finger the bottom face part 2021 in a direction orthogonal to the face the bottom face part.

[0019] Also, as shown in Fig. 3, the speaker housing part 2 includes a through hole 2017 formed at the first housing 201, communicating a space formed between the speaker housing part 2 and the speaker body part 3 with outside. The through hole 2017 is formed on the opposite side of the opening part 21 with respect to the center position of the speaker housing part 2.

[Speaker body part 3]

[0020] The speaker body part 3 emits a sound wave in response to a current signal input from the speaker code 301. A known speaker device such as an electromagnetic type speaker, dynamic speaker, electro static type speaker, piezoelectric type speaker, etc. can be adopted as the speaker body part 3. The speaker body part 3 according to this embodiment adopts a dynamic speaker.

[0021] The speaker body part 3 includes a magnetic circuit 31 and a vibrating body 32, for example, as shown in Fig. 5.

The magnetic circuit 31 can adopt an internal magnet type circuit, outer magnet type circuit, etc. The magnetic circuit according to this embodiment adopts the internal magnet type circuit.

[0022] The magnetic circuit 31 includes a yoke 311, a magnet 312 and a plate 313.

For example, the yoke 311 is formed with iron, magnetic material (ferromagnetic body included), metal material, etc. The cross-sectional shape in a radial direction of the yoke 311 is formed substantially in U-shape.

The magnet 312 is formed in a tabular shape and is arranged on the yoke 311. For example, a permanent magnet such as neodymium-system magnet, samarium-cobalt magnet, alnico magnet, rare earth-system magnet, ferrite-system magnet, etc. can be adopted as the magnet 312. Further, the magnet 312 is magnetized in the axis (P3) direction (acoustic wave emitting direction SD).

The plate 313 is formed in a tabular shape and is arranged on the magnet 312. For example, the plate 313 is formed with iron, magnetic material (ferromagnetic body included), metal material, etc.

The above magnetic circuit 312 includes a magnetic gap MG formed between the plate 313 and the yoke 311.

[0023] The vibrating body 32 includes a voice coil 321, a voice coil supporting part 322, a diaphragm 323 and an edge 324.

The voice coil 321 is connected to the diaphragm 323 directly or via the voice coil supporting part 322, and is arranged in the magnetic gap MG, vibratably in the axis direction. The diaphragm 323 is formed in a dome shape, planar shape, cone shape, etc. The voice coil 321 is connected to the diaphragm 323. The diaphragm 323 according to this embodiment is formed in a dome shape.

The edge 324 is annularly formed and the inner periphery part is connected to the diaphragm 323 while the outer periphery part is connected to the speaker housing part 2 (second housing 202).

[0024] In the speaker body part 3 described above, when a current signal is input to the voice coil 321, an electromagnetic force is generated in the voice coil 321 in response to the current signal and the voice coil 321 vibrates in the axis direction, and thus the diaphragm 323

vibrates and outputs a sound wave in an acoustic wave emitting direction SD.

[Acoustic tube 4]

[0025] As shown in Figs. 3 and 4, the acoustic tube 4 is formed in a tubular shape, and is formed with a material with comparatively large rigidity, for example, such as ABS resin, etc.
Specifically, the acoustic tube 4 has substantially the same rigidity as the speaker housing part 2, and has comparatively large rigidity compared to the earflap inserting body 6. That is, the acoustic tube 4 has rigidity with respect to a first elastic part 601 and a second elastic part 602 of an earflap inserting body 6 referred to below.
The acoustic tube 4 is formed substantially in a tubular shape, and one end part is connected to the earflap inserting body 6 while another end part is connected to the earplug 7. For example, the acoustic tube 4 according to this embodiment is detachably connected to the earflap inserting body 6.
[0026] Specifically as shown in Figs. 3 and 4, the acoustic tube 4 includes a tubular part 41, a first connecting part 42 and a second connecting part 43.
The tubular part 41 includes the flange shaped first connecting part 42 formed at one end part (earflap inserting body side), while it includes the flange shaped second connecting part 43 formed at another end part (earplug side).
[0027] In the acoustic tube 4, the opposite end part of the acoustic wave emitting side (first connecting part 42) fits in a connecting part 61 of the earflap inserting body 6. The connecting part 61 includes an annular concave portion formed in the inner face side, and the opposite end part in the acoustic wave emitting direction of the acoustic tube 4 (first connecting part 42) is inserted in the concave portion described above. The acoustic tube 4 is has a concave cross-sectional shape with both end parts projecting outward, and the end part of the earplug 7 contacting with the acoustic tube 4 is inserted between both end parts of the acoustic tube 4.
The acoustic tube 4 extends out of line with respect to the center axis P3 of the speaker body part 3 as shown in Fig. 3.

[Filter (sound absorption member) 5]

[0028] For example, the filter (sound absorption member) 5 is provided at the opening part of one end part of the acoustic tube 4. As shown in Fig. 3, the filter 5 is arranged at the front face of the acoustic tube 4. For example, even when a sound wave with the acoustic characteristic having a comparatively large sound pressure is output from the speaker body part 3 in the high frequency range, the earphone 1 can reduce the sound pressure in the high frequency range with the filter 5 provided at the acoustic tube 4, and thus a substantially flat frequency characteristic is generated from the low frequency range to the mid frequency range and from the mid frequency range to the high frequency range. For example, the filter 5 may be a sheet-shaped member including fibers, unwoven fabric, woven fabric etc. The filter 5 is not restricted to the embodiments described above. For example, the filter 5 may be arranged at both end parts of the acoustic tube 4 or at either one of the end parts.

[Earflap inserting body 6]

[0029] The earflap inserting body 6 is formed with an elastic body and is formed so as to surround a part or whole of the acoustic tube 4 and the housing part 2 as shown in Fig. 3. A flexible material, for example, resin such as silicon rubber, etc. may be adopted as the elastic body. For example, the earflap inserting body 6 according to this embodiment is formed so as to cover the speaker housing part 2 as shown in Fig. 3. In addition, the earflap inserting body 6 is formed bendably in proximity of the connecting part 61 connecting the earflap inserting body and the acoustic tube 4.
[0030] The earflap inserting body 6 includes the first elastic part 601 and the second elastic part 602. In the earflap inserting body 6 according to this embodiment, the first elastic part 601 and the second elastic part 602 are integrally formed. In the earflap inserting body 6, the connecting part 61 connecting the earflap inserting body and the acoustic tube 4 is formed with the first elastic part 601.
[0031] The first elastic part 601 is formed with a material having comparatively large rigidity.
The second elastic part 602 is formed with a material having smaller rigidity than the first elastic part 601. The second elastic part 602 is formed at a part of earflap inserting body 6 near the connecting part 61, and is located in the side of the speaker housing part 2 with reference to the connecting part 61 as a boundary. The second elastic part 602 in proximity of the connecting part 61 with the acoustic tube 4 can be effectively bendable by reducing rigidity thereof.
[0032] Specifically, the degree of hardness of the first elastic part 601 is preferably about 60° to 80° to prevent accidental disengagement of the acoustic tube 4 and the most suited degree of hardness should be 70°. The degree of hardness of the second elastic part 602 is preferably adjusted about 20° to 40° to make the connecting part 61 bendable and deformable such that the acoustic tube and the speaker body part are in the most suited angular position relationship in response to the shape of the ear of the user and the most suited degree of hardness should be 30°. For example, the above degree of hardness may be measured by a hardness meter stipulated in JIS K 6253 type A. For example, the first elastic part 601 can be formed with silicon rubber with 70° as the degree of hardness while the second elastic part 602 can be formed with silicon rubber with 30° as the degree of hardness.

[0033] For example, the first elastic part 601 and the second elastic part 602 can be formed by the double mold method (double color molding process). The double mold method is a method of integral molding combining different materials inside dies.

The method of manufacturing the earflap inserting body 6 should not be restricted to the embodiments described above. For example, the earflap inserting body 6 may be formed by joining the first elastic part 601 and the second elastic part 602 with adhesive, etc. or by integral molding method such as inner molding method, etc.

[0034] The earflap inserting body 6 includes the connecting part 61, a receiving part 62, a leading sound hole part 65, an earflap contacting part 66 and a vent hole 67 as shown in Figs. 3, 4, 6 and 7.

The connecting part 61 is formed at one end part (acoustic tube 4 side) of the earflap inserting body 6 to detachably connect with the acoustic tube 4. For example, the connecting part 61 is formed in a shape corresponding to the shape of the tubular part 41 and the first connecting part 42. More specifically, the cross-sectional shape of the connecting part 61 is formed substantially in C-shape so as to engage with the flange-shaped first connecting part 42 of the acoustic tube 4 and connect with the acoustic tube 4. Since the connecting part 61 is formed with an elastic body with comparatively high rigidity (first elastic part 601), the connecting part 61 can securely connect with the acoustic tube 4, thereby preventing accidental disengagement of the acoustic tube 4. Further, the connecting part 61 includes a leading sound hole part formed in the axis direction.

[0035] Further, the earflap inserting body 6 is formed such that the connecting part 61 and the speaker housing part 2 are spaced apart by a specified distance L600 or more, and a bending part 600 in proximity of the connecting part 61 is bendable and deformable.

[0036] The receiving part 62 receives the speaker housing part 2. The receiving part 62 is formed with the second elastic part 602 in a shape corresponding to the shape of the speaker housing part 2. More specifically, the cross-sectional shape of the receiving part 62 is formed substantially in C-shape. Also, the receiving part 62 includes an engaging part 621 at the end part of the receiving part 62. The engaging part 621 projects toward the inside of the receiving part 62. The engaging part 621 engaging with an engaging step counterpart 2025 as an engaging counterpart of the speaker housing part 2 can securely receive the speaker housing part 2.

[0037] The cord holding part 310 is provided at the periphery side face of the speaker housing part 2 where the engaging counterpart is formed. Particularly, with the cord holding part 310 provided at the periphery side face of the speaker housing part 2, the width (length) in the thickness direction of the earphone 1 can be comparatively small, and thereby saving a space in a user's bag, etc. carrying the earphone 1 (space saving).

[0038] Since the cord holding part 310 is provided at the engaging counterpart of the speaker housing part 2, a notch portion 62A is formed at the engaging part 621 of the receiving part 62 corresponding to the shape of the cord holding part 310. The cord holding part is arranged inside the notch portion 62A such that the receiving part 62, in other words, the earflap inserting body 6 can be engaged to the speaker housing part 2.

[0039] By the way, there is a case that the speaker body part 3 in the earphone 1 is formed comparatively large with respect to the earplug 7 in order to comparatively make sound pressure of the earphone 1 large. In this case, the speaker housing part 2 receiving the speaker body part 3 is equipped with the earflap while the speaker housing part 2 extends from the external ear canal (H71 ; Fig. 13 (B)) to the earflap. Specifically, the speaker housing part 2 is inserted in a gap between a tragus (H72 ; Fig. 13(B)), an antitragus (H74 ; Fig. 13(B)) and an anthelix (H5 ; Fig. 13(B)), while the speaker housing part 2 is fixed to an ear contacting with the antitragus and the anthelix. When the earphone is equipped with the ear as described above, the speaker housing part 2 projects from the external ear canal largely, and thus it is likely to contact with an external thing, which may cause the earphone 1 to come off the ear of the user. Particularly, an external force may be applied to the speaker housing part 2 via the code leader 301 provided at the speaker housing part 2, and thereby the earphone 1 may come off the ear of the user.

[0040] It is possible that the earphone 1 is prevented from coming off the ear of the user and contacting with the external thing by comparatively the small length of the speaker housing part 2 in the center axis direction and the speaker housing part 2 arranged closer to the side of the external ear canal. Also, the code leader 301 may be provided at the side face of the speaker housing part 2 in order to make the length of the speaker body part 3 comparatively small. Although the code leader 301 is provided at the side face of the speaker housing part 2, the speaker housing part 2 is fixed to the ear of the user while the speaker housing part 2 is arranged closer to the external ear canal, thus the earphone 1 may be prevented from coming off from the ear of the user even when an external force is applied to the speaker housing part 2 via the code leader 301.

[0041] Also, when the earflap inserting body 6 is engaged with the speaker housing part 2, for example, the earphone 1 is housed in a storage case such as a bag, the earflap inserting body 6 and the speaker housing part 2 may be disengaged due to an external force applied to the earflap inserting body 6 and the speaker housing part 2.

[0042] Also, when the earphone 1 is equipped with the ear of the user, the speaker housing part 2 may come off the ear of the user, in condition that the earflap inserting body 6 is equipped with the ear of the user, due to an external force, which is caused by the code leader 301 being pulled and applied to the earflap inserting body 6 and the speaker housing part 2.

[0043] Further, as the outer shape of the speaker hous-

ing part 2 becomes large, the earflap inserting body 6 surrounding the speaker housing part 2 contacts more area of the ear of the user. When the earflap inserting body 6 has more area contacting with the ear of the user, friction force generated between the ear of the user and the earflap inserting body 6 is increased as the user attaches or detaches the earphone 1, thereby the earflap inserting body 6 may easily come off the speaker housing part 2.

[0044] In order to keep a preferable engagement between the earflap inserting body 6 and the speaker housing part 2, the engaging part 621 is formed with a third elastic part 603 with rigidity higher than the second elastic part 602 such that the earflap inserting body 6 is engaged with the speaker housing part 2 as shown in Fig. 6 and Fig. 7. By the engaging part 621 formed with the third elastic part 603, the earflap inserting body 6 may be prevented from coming off the speaker housing part 2.

[0045] The third elastic part 603 may be formed with the similar material as the first elastic part. Any elastic material may be used for the third elastic part as long as the elastic material has rigidity with respect to the second elastic part.

[0046] The degree of hardness of the third elastic part 603 is preferably adjusted about 10° to 40° so as to construct a preferable engagement between the speaker housing part 2 and the earflap inserting body 6, and the most suited degree of hardness may be 20°. For example, the above degree of hardness may be measured by a hardness meter of JIS K 6253 type A. For example, the first elastic part 601 may be formed with silicon rubber with 70° hardness, the second elastic part 602 may be formed with silicon rubber with 30° hardness and the third elastic part may has 20° hardness.

[0047] The third elastic part 603 may be formed in the similar manner as the first elastic part 601 and the second elastic part 602. For example, the third elastic part may be formed by the double mold method (double color molding method). The double mold method is a method of integral molding combining different materials in a die.

[0048] The method of manufacturing the earflap inserting body 6 is not limited to the above embodiment. For example, the earflap inserting body 6 may be formed by joining the second elastic part 602 and the third elastic part 603 with adhesive, etc. or by a method of integral molding such as a method of inner molding, etc.

[0049] The leading sound hole part 65 is formed inside the earflap inserting body 6. More specifically, the leading sound hole part 65 is formed between the connecting part 61 and the receiving part 62 such that the leading sound hole part 65 is communicated with an acoustic tube 4 and the opening part of the speaker housing part. Also, the leading sound hole part 65 is formed in a direction along the center axis of the acoustic tube 4 and is formed in a direction out of line with respect to the center axis of the speaker body part 3.

The earflap contacting part 66 includes a planar shape surrounding the leading sound hole part 65 and a shape extending in a direction out of line with respect to the center axis P4 of the acoustic tube 4. The earflap contacting part 66 is formed between the acoustic tube 4 and the speaker housing part 2. Also, the earflap contacting part 66 is formed in a shape inclined toward the speaker housing part. Specifically, the earflap contacting part 66 includes a projection part 661 projecting along an axis P66 that is arranged substantially in parallel with face of the bottom face part 2021 of the speaker housing part 2. The projection part 661 obliquely projects toward the speaker housing part 2.

That is, the speaker housing part 2 or the bottom face part 2021 is formed so as to be substantially in parallel with the earflap contacting part 66.

[0050] The earflap contacting part 66 is deformed according to the shape of the earflap of the user and tightly contacts the earflap when the earphone 1 is equipped with the ear of the user. As such, occurrence of leak of sound, etc. can be prevented.

Further, with the projecting part 661 of the earflap contacting part 66 has a shape extending in a direction out of line with respect to the center axis P4 of the acoustic tube 4, the earphone 1 may be prevented from coming off the ear of the user.

[0051] In the earphone 1, a plurality of the earflap inserting bodies 6 including earflap contacting parts 66 that are different in shape and size may be provided such that a user can freely change to a desired earflap inserting body 6 that fits in the shape of the ear of the user.

[0052] A vent hole 67 is formed such that a vent hole is communicated with a through-hole 2017 formed at the speaker housing part 2. With the through-hole 2017 communicated with the vent hole 67, the earphone 1 can prevent a plurality of sound waves from interfering (resonating) with each other between the speaker diaphragm and the speaker housing part 2 when the speaker is driven. Also, a rise in the sound pressure level between about 20 Hz to 500 Hz can be prevented. Therefore, so-called muffled sound can be reduced.

[0053] Also, in the external ear canal of the user an external sound wave is shut out by the earflap inserting body 6, particularly the earflap contacting part 66. Thus, it is prevented that the user hardly listens to a desirable sound by a sound wave emitting from the through-hole 2017 via the vent hole 67, even though the vent hole 67 communicated with the through-hole 2017 is formed at the earflap inserting body 6.

[0054] In the above earflap inserting body 6, the connecting part 61 is formed with the first elastic part 601 having comparatively high rigidity, thus the acoustic tube 4 is prevented from being collapse even when the bending part 600 of the earflap inserting body 6 (second elastic part 602) is bent, and thus the earphone 1 can emit a sound wave with a preferable acoustic characteristic.

Also, in the earflap inserting body 6, the connecting part 61 is formed with the first elastic part 601 with relatively high rigidity, thereby the acoustic tube 4 can be securely fixed to the earflap inserting body 6. The other parts

(bending part 600, etc.) are formed with the second elastic part 602 having comparatively low rigidity, thereby the direction of the acoustic tube 4 can be changed comparatively freely.

[Earplug 7]

[0055] The earplug (earpiece) 7 is inserted into the external ear canal of the external ear of the user. The earplug 7 is attached to the end part of the acoustic tube 4 in the acoustic wave emitting side and is provided with a tubular part 71 communicated with the acoustic tube 4, and an outer periphery part 72 is formed elastically deformable as shown in Fig. 1. The earplug 7 and the acoustic tube 4 are formed as separable members from each other. For example, the earplug 7 is formed with a soft material such as silicon rubber.
Specifically, the tubular part 71 is formed such that the inner diameter of the inner periphery end part (end part in the acoustic wave emitting side) is larger than the inner diameter of the acoustic tube 4. According to the configuration of the earplug 7 communicated with the acoustic tube 4, the internal configuration is formed in a horn shape, and thus acoustic characteristic is improved.

[0056] In the above earphone 1, a sound wave outputted from the speaker body part 2 is emitted from the opening part 21 of the speaker housing part 2. Then, the sound wave passes through the earflap inserting body 6 and the leading sound passage of the acoustic tube 4 and is emitted outside from the opening part of the earplug 7 via a filter 5 as shown in Fig. 3.

[0057] Fig. 8 is a perspective view of the earflap inserting body 6 and the acoustic tube 4 of the earphone 1 according to the first embodiment of the present invention. Fig. 9 is a perspective view of the earphone 1 when the earflap inserting body and the acoustic tube are connected.
With reference to Figs. 8 and 9, a process of attaching the acoustic tube 4 to the earflap inserting body 6 of the earphone 1 is described.

[0058] As shown in Figs. 8 and 9, the acoustic tube 4 is attached to the earflap inserting body 6 by pressing the acoustic tube 4 toward the earflap inserting body 6 in the axial direction (direction of center axis P4 of acoustic tube 4) such that the acoustic tube 4 is fitted to the connecting part 61 of earflap inserting body 6 as an elastic body.
The acoustic tube 4 is removed from the earflap inserting body 6 with the acoustic tube 4 pressed toward the opposite side of the earflap inserting body 6 in the axial direction.

[0059] Figs. 10 and 11 are views illustrating an operation of the earphone 1 shown in Fig. 3.
As shown in Figs. 10 and 3, initially, the acoustic tube 4 is formed such that the axis P4 has a prescribed angle $\theta 1$ with respect to the center axis P3 of the speaker housing part 2 (speaker body part 3). When the earphone 1 is equipped with the ear of the user, the center axis P4' of the acoustic tube 4 can be shifted within angle $\theta 2$ from the initial position in response to bending of the bending part 600 in proximity of the connecting part 61 of the earflap inserting body 6 as shown in Fig. 10. For example, the angle $\theta 2$ is about 80 ° toward the center axis P3 and about 30 ° in the opposite direction. Further, according to the present embodiment, for example, the angle $\theta 2$ is about 10° with respect to the initial center axis P4. Further, in the acoustic tube 4, the center axis P4' can be shifted by about 10 ° in a direction perpendicular to the plane including the initial center axis P4 and the center axis P3.

[0060] The earflap contacting part 66 is formed around the leading sound hole part 4, the earflap contacting part 66 moves along with the leading sound hole part 4 in accordance with the movement of the earplug 7, as shown in Fig. 11. As such, when the earplug 7 falls in a direction intersecting the center axis P3 of the speaker housing part 2, the projecting part 661 of the earflap contacting part 66 rises along the center axis P3. On the contrary, when the earplug 7 rises along the center axis P3, the projecting part 661 falls in a direction intersecting the center axis P3.

[0061] Figs. 12 and 13 are views illustrating various ways the earphone 1 is equipped with the ear of the user. As shown in Figs. 12(A) and 12(B), when the earphone 1 is equipped with the external ear canal H71 of the user H, the earflap inserting body 6 is bent and deformed in response to the shape of the external ear canal H71, and thereby the earphone 1 and the external ear canal H71 tightly contact each other. Further, when the earphone 1 is equipped, the earflap contacting part 66 of the earflap inserting body 6 contacts the earflap H70 and deforms, thereby high contact property is obtained. In this way, the earphone 1 is equipped with the ear of the user with comparatively high contact property, and thus sound leakage can be prevented.

[0062] Also, in the earphone 1 including the above earflap inserting body 6, the connecting part 61 detachably connected to the acoustic tube is formed with the first elastic part 601 with comparatively high rigidity, thereby the leading sound passage of the earflap inserting body 6 cannot be collapse even when the relative angle between the speaker body part and the acoustic tube is changed, and thus preferable acoustic characteristic can be obtained with the secured leading sound passage.

[0063] Further, as shown in Fig. 13(A), the speaker housing part 2 is arranged outside the external ear canal H71 in the side of the concha of ear H73, and a part of the acoustic tube 4 is bent and deformed with respect to the speaker housing part 2 while the earplug 7 is inserted into the external ear canal H71, and a part of the earflap contacting part 66 contacts with the concha of ear H73 and a part of the receiving part 62 contacts with tragus H72, and thereby the external ear canal H71 can be sealed against outside (see Fig. 13(B) for terms of each part of the earflap H70).

[0064] As described above, the earflap contacting part

66 being formed around the leading sound hole part 4, the earflap contacting part 66 moves along with the leading sound hole part 4 in accordance with the movement of the earplug 7 (see Fig. 11). Therefore, when the earplug 7 is inserted into the external ear canal H71, the earplug 7 is bent with respect to the speaker housing part 2 following to the external ear canal H71 of the user. At the same time the earflap contacting part 66 also moves in the similar direction to the direction that earplug 7 is bent, and thus the external ear canal H71 can be preferably sealed.

Specifically, when the earplug 7 is inserted into the external ear canal H71, the earflap contacting part 66 moves in the direction the earplug 7 is bent such that a part of the concha of ear H73 contacts with the projecting part 661 of the earflap contacting part 66. In addition, the receiving part 62 of the earflap inserting body 6 contacts with a part of the tragus H72, and thus the external ear canal H71 can be preferably sealed by the projecting part 661 of the earflap contacting part 66 and the receiving part 62.

Also, since the bottom face part 2021 of the speaker housing part 2 is formed substantially in parallel with the projecting part 661 of the earflap contacting part 66, the user can press the bottom face part 2021 such that the projecting part 661 of the earflap contacting part 66 contacts with the concha of ear H73, and thus the external ear canal H71 can be preferably sealed against outside.

[Second embodiment]

[0065] Fig. 14 is a side view of an earphone 1B according to a second embodiment of the present invention. Fig. 15 is a cross-sectional view of the earphone 1B shown in Fig. 14. The same configuration as the first embodiment is not described.

[0066] An earphone 1B according to the second embodiment of the present invention includes a speaker housing part 2B, a speaker body part 3, an acoustic tube 4, an earflap inserting body 6B and an earplug 7 as shown in Figs. 14 and 15.

The earphone 1B according to this embodiment is formed such that an angle $\theta 1$ between the center axis P3 of the speaker housing part 2B (speaker body part 3) and the center axis P4 of the acoustic tube 4 is formed small compared to the first embodiment.

Further in the earphone 1B according to this embodiment, since the acoustic tube 4 and the earflap inserting body 6B are mold formed, the acoustic tube 4 cannot be detached from the earflap inserting body 6B. Specifically, the earflap inserting body 6B is mold formed fitted to the acoustic tube 4.

Further, the engaging part 68 of the earflap inserting body 6B formed at the end part in the side opposing to the connecting part of the acoustic tube 4 is engaged with the engaging counterpart 2015 of the speaker housing part 2B, and thus the earflap inserting body 6B is connected to the speaker housing part 2B.

[0067] In the above earphone 1B, the earflap inserting body 6B as the elastic body is formed bendable and deformable in proximity of the connecting part connecting with the acoustic tube 4 and the earflap inserting body 6B, thereby the acoustic tube 4 is bendably deformable with respect to the speaker body part 3, and thus the earphone 1B can include comparatively high contact property, which enables prevention of sound leakage.

[0068] As described above, an earphone according to the present invention includes a speaker housing part 2B that incorporates a speaker body part 3 and has an opening part 21 through which a sound wave from the speaker body part 3 is emitted, the acoustic tube 4 having a tubular shape and an earflap inserting body 6 as the elastic body surrounding a part or whole of the acoustic tube 4 and the speaker housing part 2B, and the earflap inserting body 6 is formed bendable and deformable in proximity of a connecting part 61 with the acoustic tube 4. Therefore, when the earphone is equipped with the ear of the user, the earphone can exert a preferable equipped with feeling.

[0069] Specifically, when the earphone 1B is equipped with the ear of the user, the earflap inserting body 6 is bent and deformed in proximity of the connecting part formed at the edge part of the earflap inserting body 6, for example in response to the shape of the ear of the user, and thus the earphone 1 can be equipped with the ear of the user such that the acoustic tube 4 and the speaker body part 3 are in the most suited angular position relationship in response to the shape of the ear of the user. Therefore, an earphone, which can exert a preferable equipped with feeling for each user, can be provided.

[0070] Also, the earphone 1 is equipped with the ear of the user such that the angle of the axis of the acoustic tube with respect to the axis of the speaker body part is adapted to be most suited for each user due to bending and deforming of the earflap inserting body 6 as the elastic body. Thus, the comparatively tight contact property between the earphone and the ear can be provided and enables prevention of sound leakage compared to a general earphone. Also, the earphone 1 can provide preferable acoustic characteristic even when the earflap inserting body 6 is bent.

[0071] Also, in the earflap inserting body 6 of the earphone 1, the connecting part 61 is formed with the first elastic part 601. A part of the earflap inserting body 6 in the side of the speaker housing part 2 with reference to the connecting part 61 as a boundary is formed with the second elastic part 602. The engaging part 621 formed at the receiving part 62 is formed with the third elastic part 603, and the first elastic part 601 and the third elastic part 603 have comparatively high rigidity while the second elastic part 602 has comparatively low rigidity. Therefore the direction of the acoustic tube 4 connected to the connecting part 61 and the direction of the earplug 7 attached to the acoustic tube can be freely changed with respect to the speaker housing part 2 that is received in

the receiving part 62. And, it is possible to stiffly engage the speaker housing part 2 in the receiving part 62.

[0072] Also, when the earphone 1 is equipped with the ear of the user, the angle of the earplug 7 is changed due to the insertion of the earplug 7 into the external ear canal H71, thereby in the earflap inserting body 6 the projecting part 661 of the earflap contacting part 66 contacts with the concha of ear H73.Thus, the external ear canal H71 can preferably sealed against outside by the earflap inserting body 6. In this way, sound leakage can be prevented while preventing ambient noise from entering the external ear canal H71.

[0073] The present invention is not limited to the embodiments described above. For example, each example of the embodiments may be combined. For example, a planar part of the speaker housing part 2B may be formed to be substantially in parallel with the earflap contacting part of the earflap inserting body 6B.

The speaker housing part 2 or the speaker body part 3 are not limited to the embodiments described above. Also, the shape of the earflap inserting body 6 is not limited to the embodiments described above.

[0074] Further, for example, the earphone 1 may be applied to an electronic device such as a portable audio player, portable video player, etc. Fig. 16 shows a portable audio player 100 and earphone 1 as an electronic device. The portable audio player 100 includes a case of portable type 101 formed with resin member or metal member, various operation switches 103 provided on a front face 102 of the case of portable type 101 and a display 104. Also, the portable audio player 100 includes a connector 115 on a bottom face 107. The connector electrically connects a signal generating device in the electronic device 100 and a signal processing device in other electronic device.

The earphone 1 is attached to the electronic device 100 as an accessory component. The earphone 1 includes a remote controller part 151, an earphone part 152, a plug part 153 and a cord part 154. The remote controller part 151 is constructed such that the remote controller part can remote control the electronic device 100 via the cord part 154 with the miniature switch, the miniature monitor, etc. For example, the remote controller part 151 is constructed to enable volume control, balance control of the right and left earphone parts 152, selection and change of a displayed content of a screen, a program or a game by external operation. Also, these controls can be performed by using the operation switches 103 provided on the front face 102. Further, the earphone part 152 is constructed to convert to a sound wave a voice signal received via the cord 154 and output the sound wave.

Although embodiments of the present invention are described in detail with reference to the drawings, specific configurations are not limited to these embodiments, and any modifications without departing from the scope of the present invention are included in the present invention. Further, the technology of each embodiment described above can be used by each other, unless specific contradictions or problems are found in their objects, the configurations, etc. This application claims the benefit of PCT/JP2007/067517, filed September 7, 2007, the entirety of which is hereby incorporated by reference.

Claims

1. An earphone, comprising:

a speaker housing part that includes a speaker body part and an opening part through which a sound wave from said speaker body part is emitted;
an acoustic tube having a tubular shape; and
an elastic earflap inserting body surrounding a part or whole of said acoustic tube and said speaker housing part, wherein
said earflap inserting body is formed bendably and deformably in proximity of a connecting part connecting said earflap inserting body and said acoustic tube.

2. The earphone according to claim 1, wherein
said acoustic tube and said earflap inserting body are formed as members separable from each other, and
said earflap inserting body includes a connecting part connecting with said acoustic tube and a receiving part receiving said speaker housing part, and
said connecting part is formed with a first elastic part, and
a part of said earflap inserting body in proximity of said connecting part is formed with a second elastic part, wherein
said part of earflap inserting body is arranged in the side of said speaker housing part with reference to said connecting part as a boundary , and rigidity of said second elastic part is smaller than that of said first elastic part.

3. The earphone according to claim 2, wherein
said acoustic tube has rigidity with respect to said first elastic part and said second elastic part.

4. The earphone according to claim 3, wherein
said earflap inserting body includes a leading sound hole part arranged between said connecting part and said receiving part, and communicating with said acoustic tube and said opening part of said speaker housing part, and
an earflap contacting part having a planar shape surrounding said leading sound hole part.

5. The earphone according to claim 4, wherein
said leading sound hole part is formed in a center axis of said acoustic tube and is formed out of line with respect to said center axis of said speaker body

part, and
said earflap contacting part extends out of line with respect to said center axis of said acoustic tube.

6. The earphone according to claim 5, wherein
said earflap contacting part includes a projecting part, wherein
said projecting part projects in a direction that is out of line with respect to said center axis of said acoustic tube and is inclined to the side of said speaker housing part.

7. The earphone according to claim 6, wherein
said receiving part of said earflap inserting body includes an engaging part engaging with an engaging counterpart formed at said outer periphery side face of said speaker housing part.

8. The earphone according to claim 7, wherein
said engaging part of said receiving part has an inwardly projecting shape, and
said engaging counterpart of said speaker housing part is formed as a step part, and
said engaging part of said receiving part fits in said engaging counterpart of said speaker housing part.

9. The earphone according to claim 8, wherein
said engaging counterpart of said speaker housing part includes a cord holding part, and
said engaging part of said receiving part includes a notch portion and one end part of said cord holding part is arranged inside said notch portion.

10. The earphone according to claim 9, wherein
said engaging part of said receiving part is formed with a third elastic part with rigidity larger than said second elastic part.

11. The earphone according to claim 10, comprising an earplug connected to said end part in the acoustic wave emitting side of said acoustic tube, wherein
said acoustic tube formed in a tubular shape has rigidity, and
said earplug and said acoustic tube are formed as members separable from each other, and
said end part opposite to the acoustic wave emitting side of said acoustic tube fits in said connecting part of said earflap inserting body.

12. The earphone according to claim 11, wherein
said connecting part of said earflap inserting body includes an annular concave portion formed at the inner side face, and
said end part opposite to the acoustic wave emitting side of said acoustic tube is inserted into said concave portion.

13. The earphone according to claim 12, wherein
said acoustic tube has a concave cross-sectional shape with both end parts of said acoustic tube projecting outside, and
said end part of said earplug contacting with said acoustic tube is inserted between both end parts of said acoustic tube.

14. The earphone according to claim 13, wherein
said speaker housing part includes a through hole communicating a space formed between said speaker housing part and said speaker body part with outside, and
said through hole is formed in the side opposite to the side of said opening part with respect to said center position of said speaker housing part.

15. The earphone according to claim 14, wherein
a filter is provided at said end part of said acoustic tube in said acoustic wave emitting side.

16. The earphone according to claim 15, wherein
said earplug is provided at said end part of said acoustic tube in the acoustic wave emitting side, and
said speaker housing part is arranged outside an external ear canal in the side of a concha of ear, and
a part of said acoustic tube is bent and deformed with respect to said speaker housing part such that said earplug is inserted into said external ear canal, and
a part of said earflap contacting part contacts with said concha of ear, and
a part of said receiving part contacts with said tragus such that said external ear canal is sealed against outside.

17. The earphone according to claim 16, wherein
said speaker housing part is formed such that said bottom face part is inclined toward a side of said acoustic tube with respect to said center axis of said speaker body part.

18. The earphone according to claim 17, wherein
said speaker housing part is formed such that said bottom face part is substantially in parallel with said earflap contacting part.

19. An electronic device comprising said earphone according to claim 1.

Fig.1

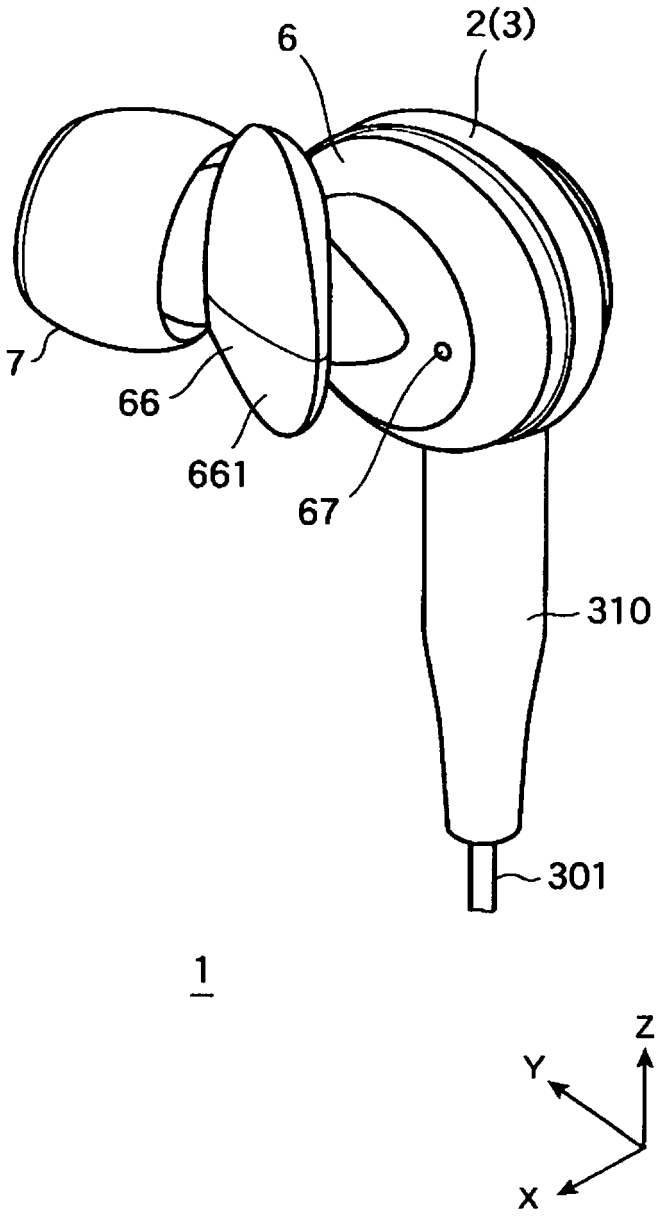

Fig.2

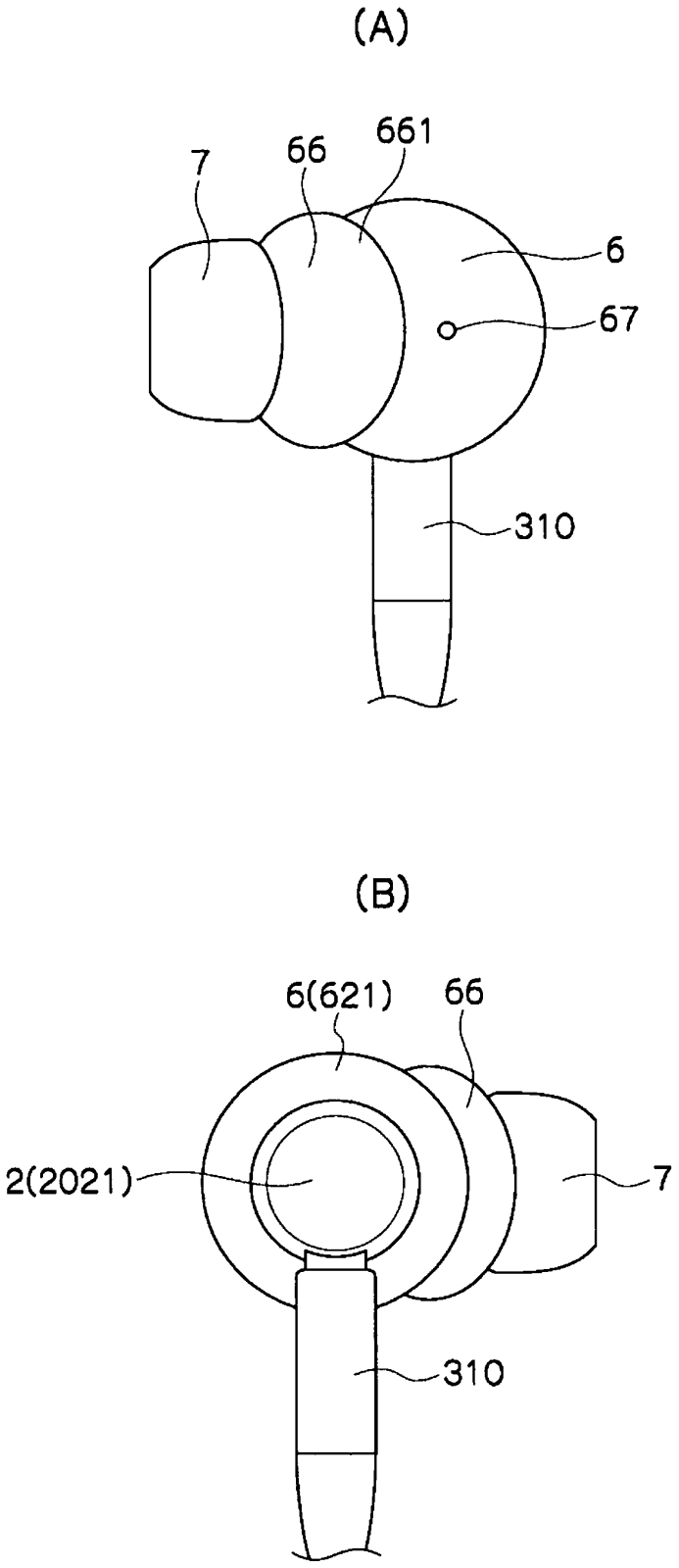

Fig.3

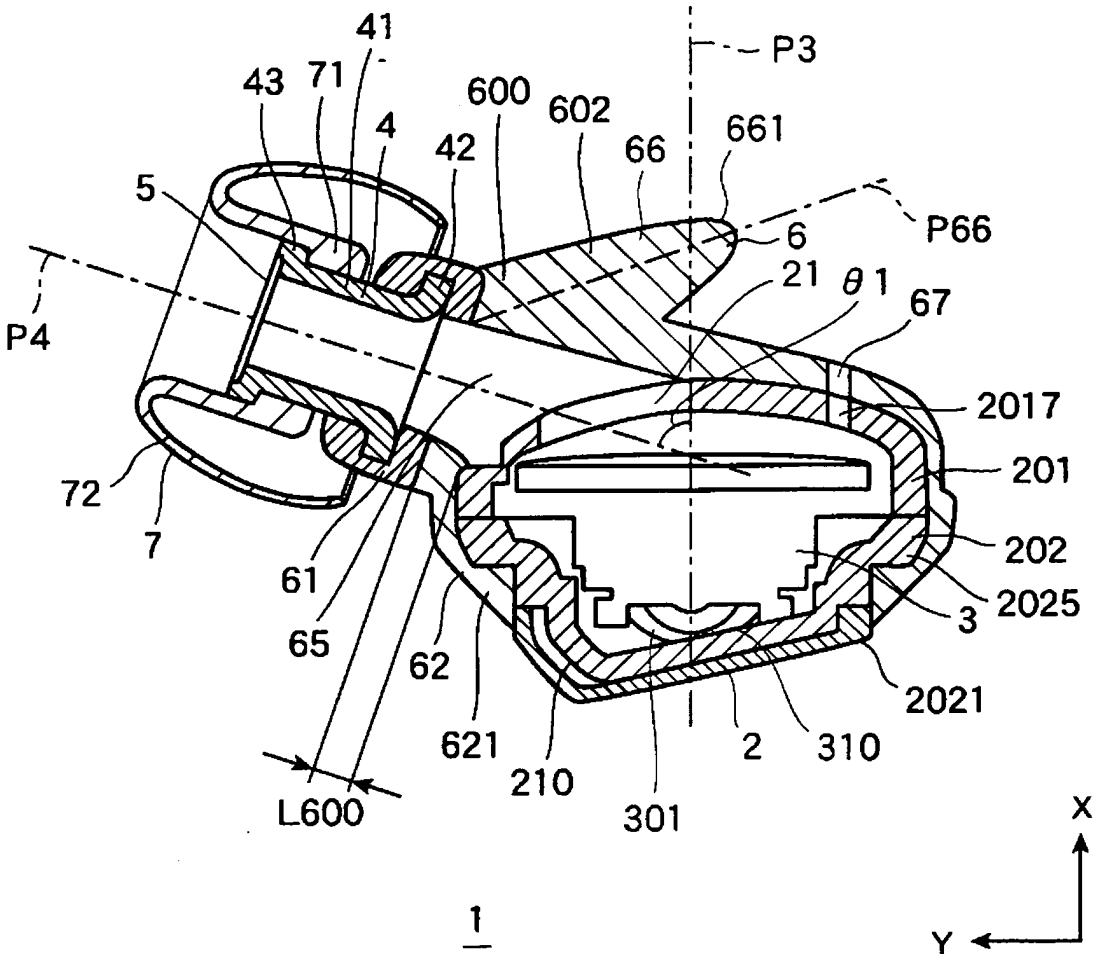
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Fig.4

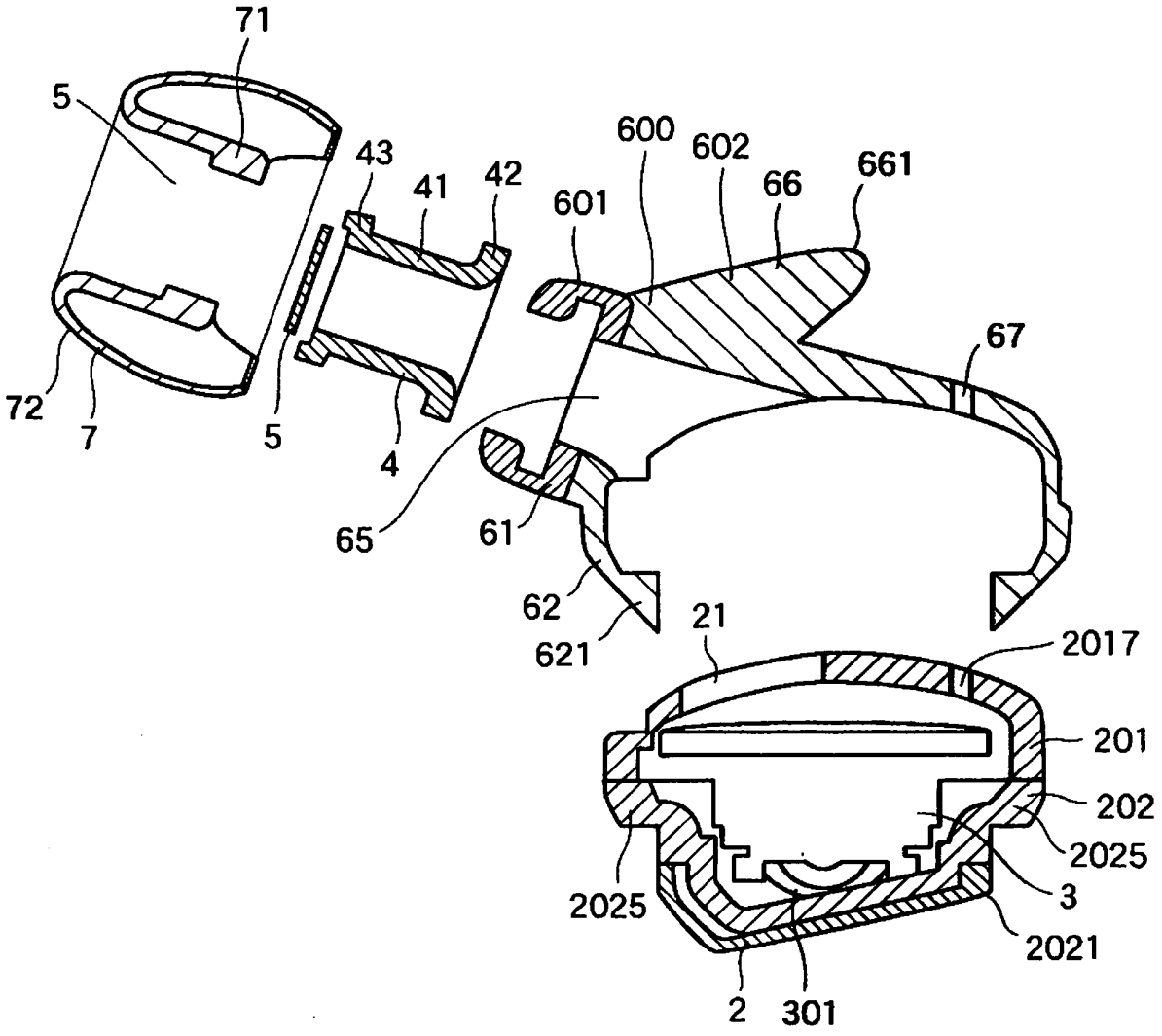
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Fig.5

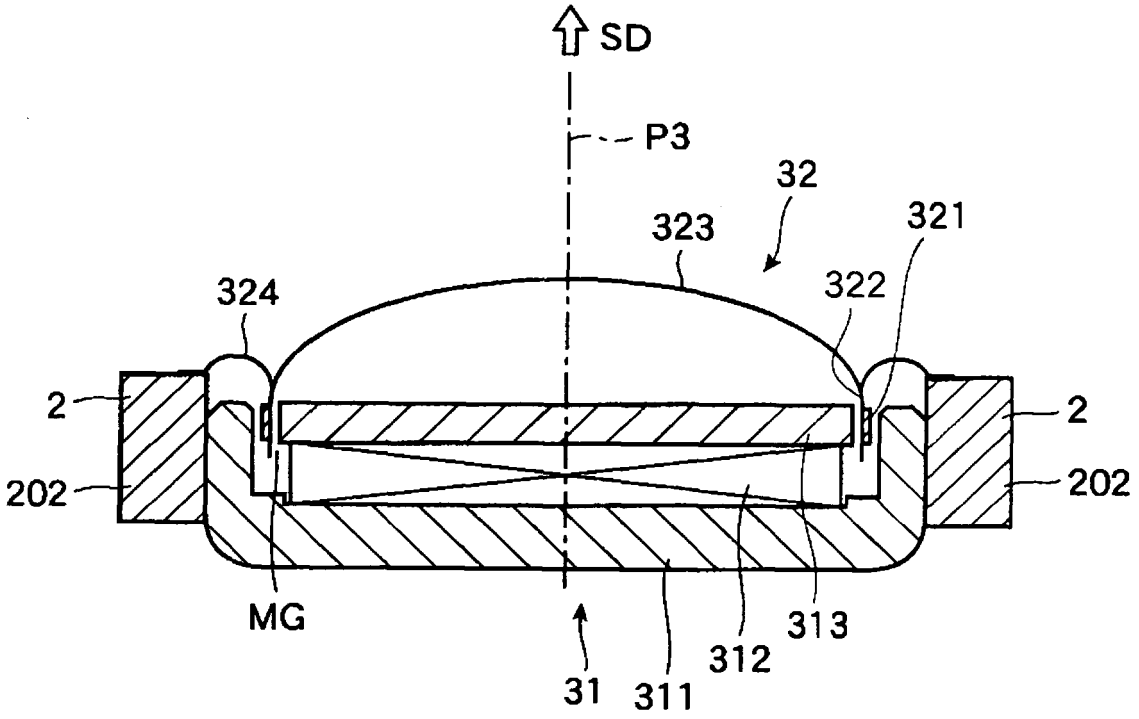

Fig.6

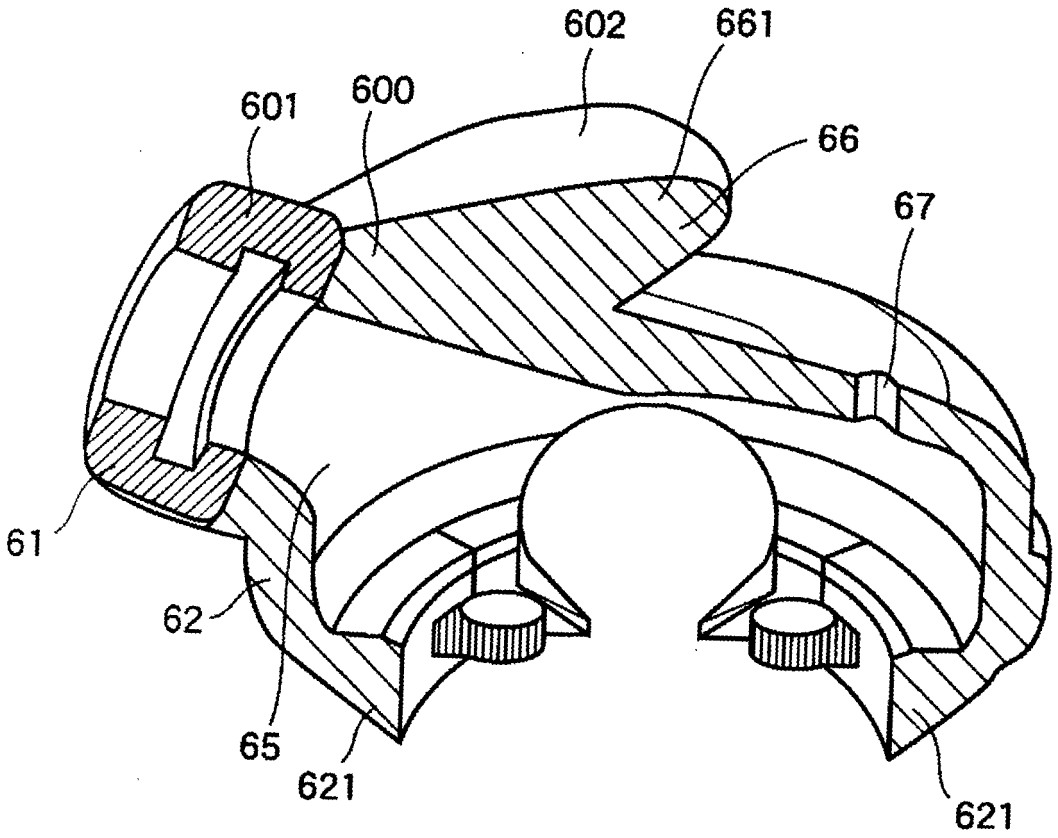

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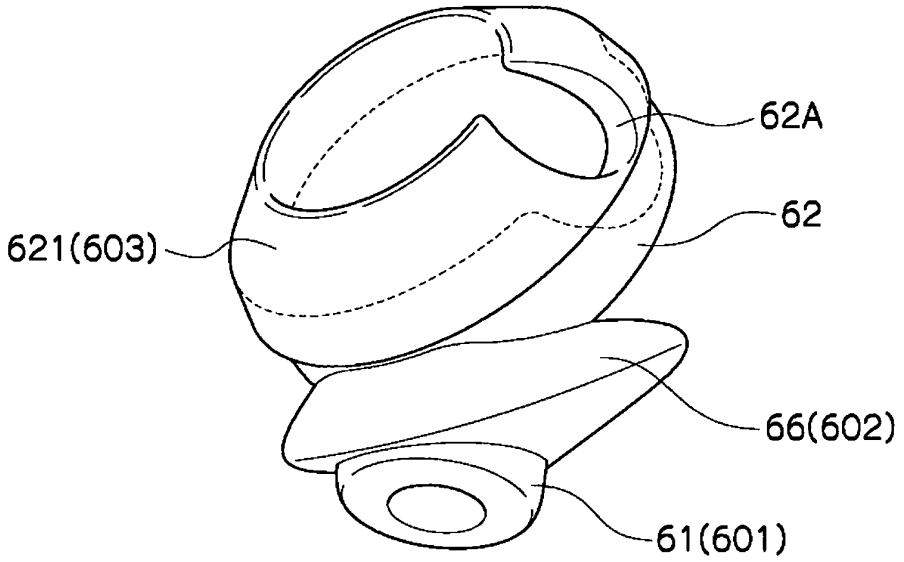
Fig.7

(A)



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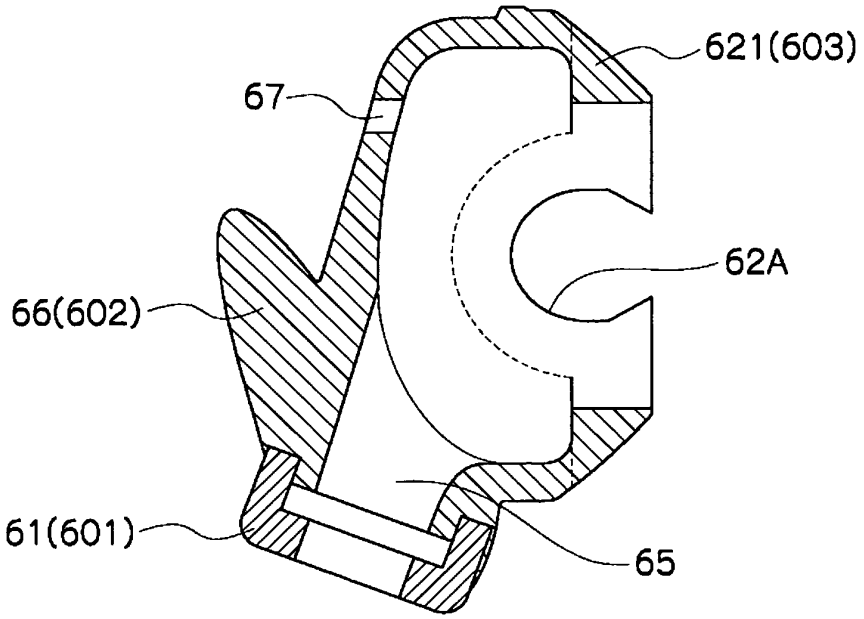


Fig.8

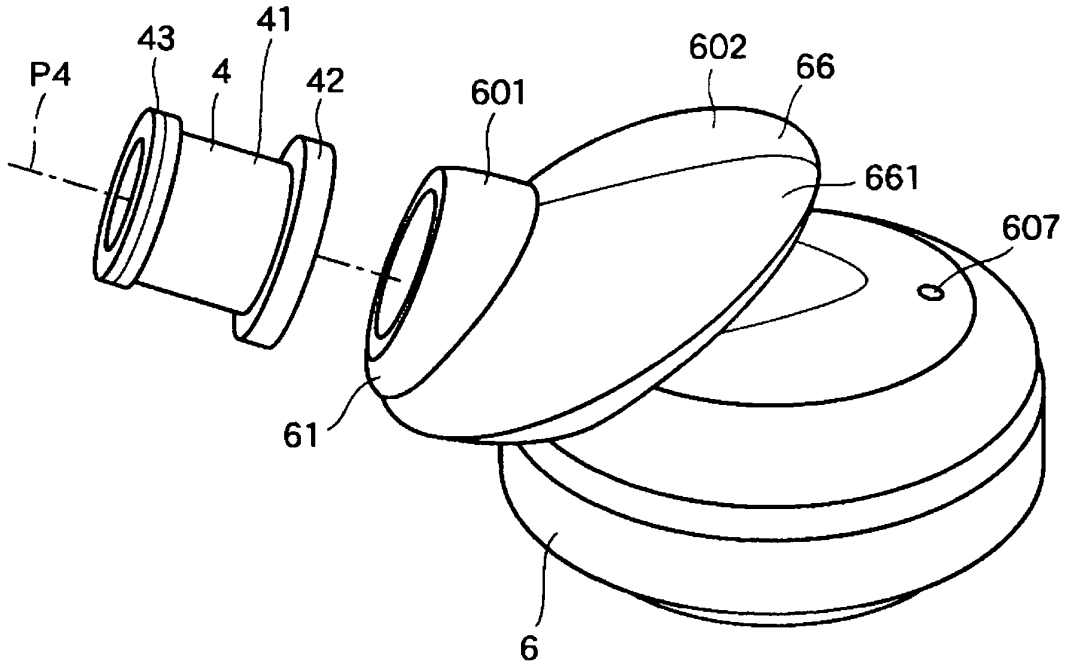


Fig.9

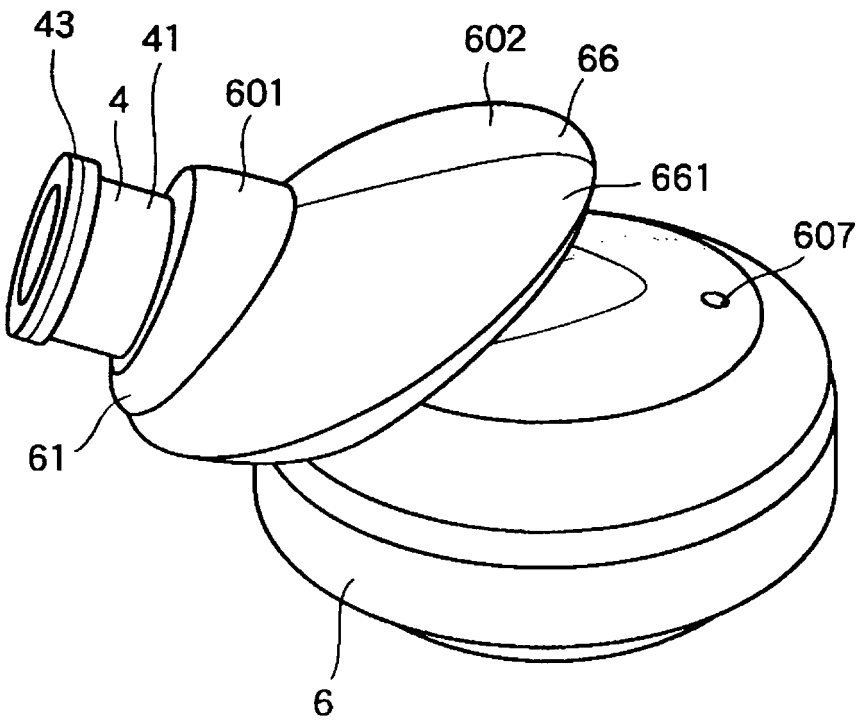


Fig.10

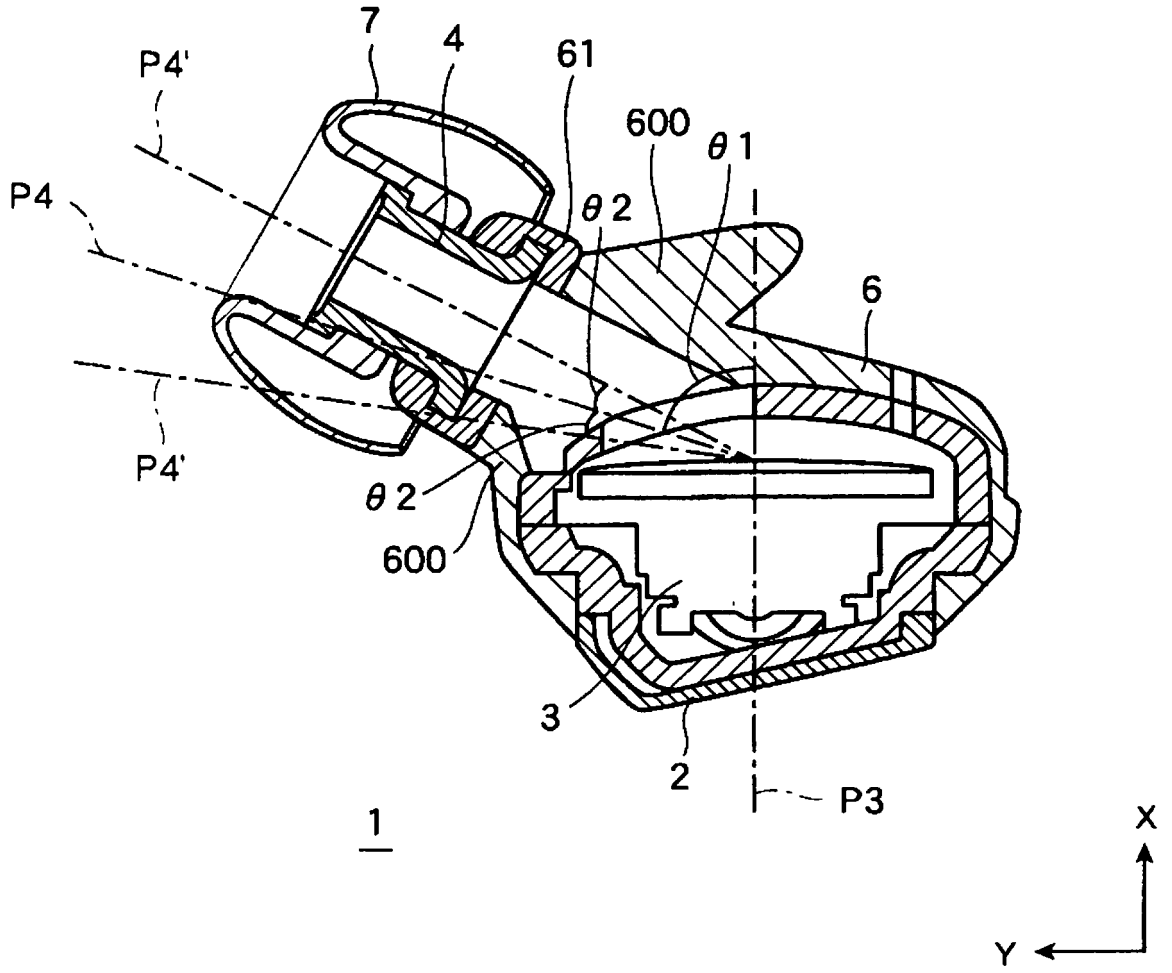


Fig.11

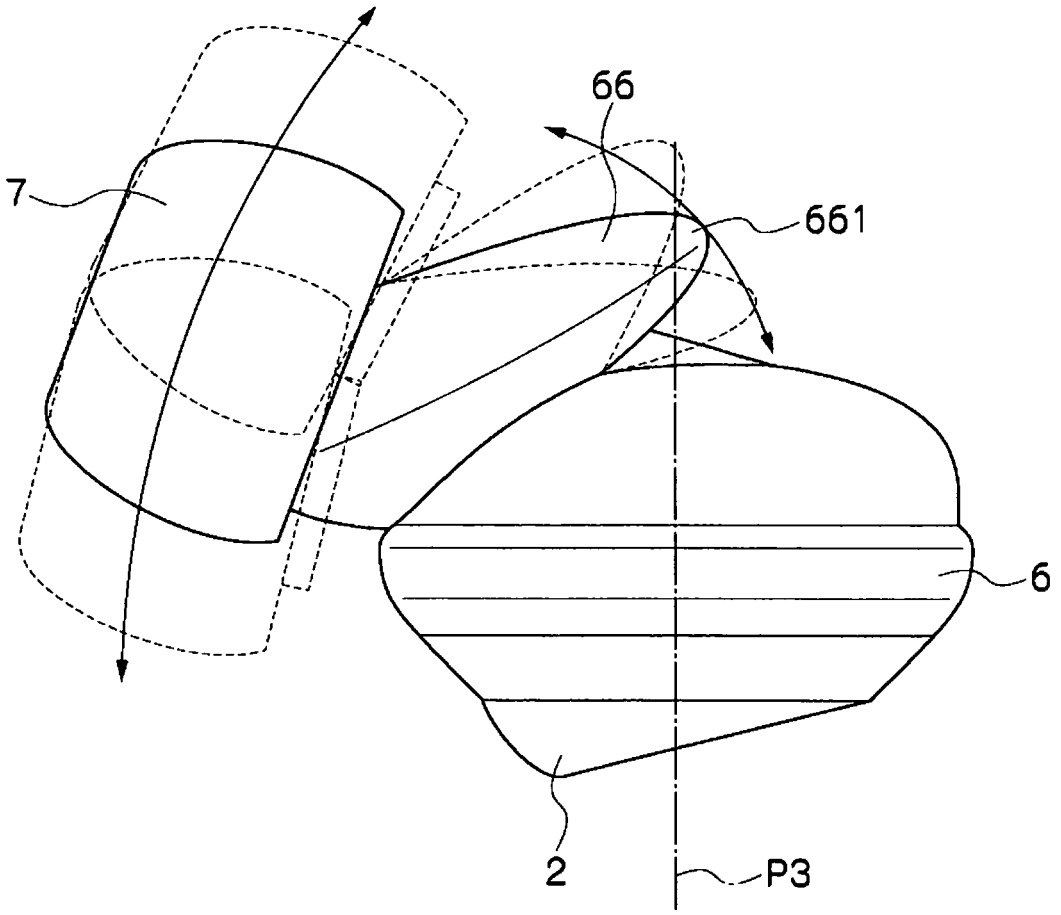
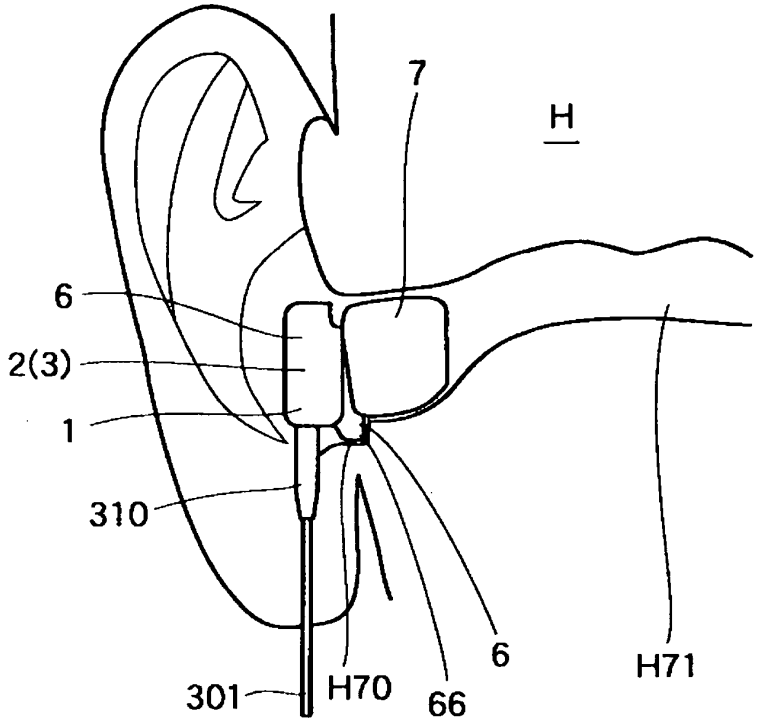


Fig.12

(A)



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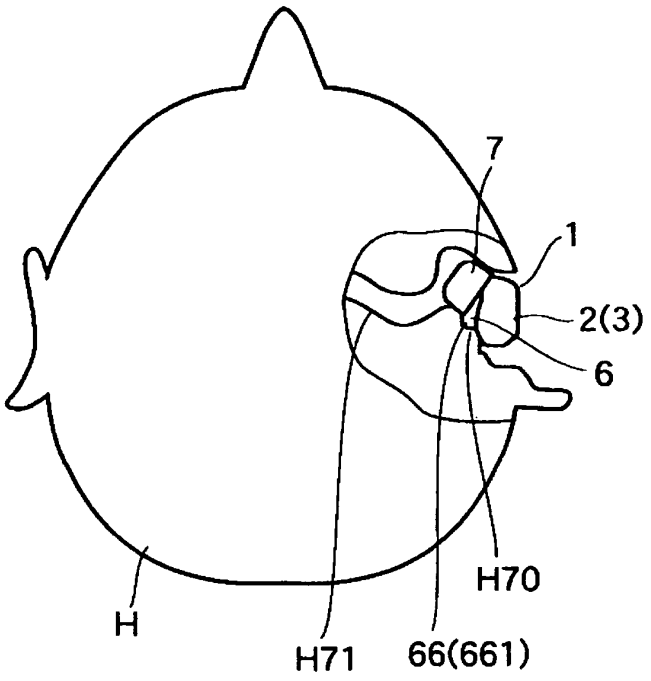
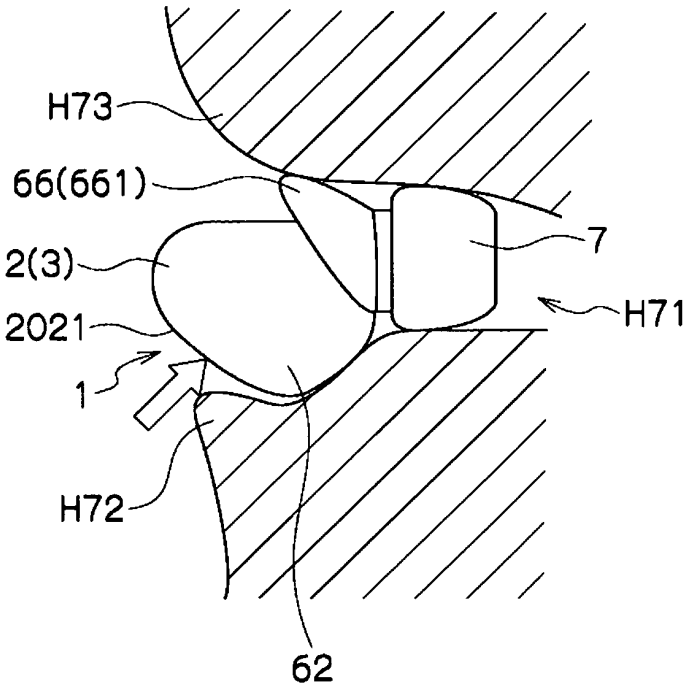


Fig.13

(A)



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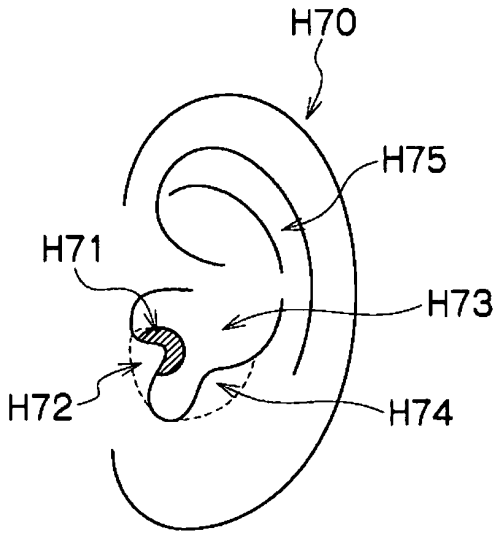


Fig.14

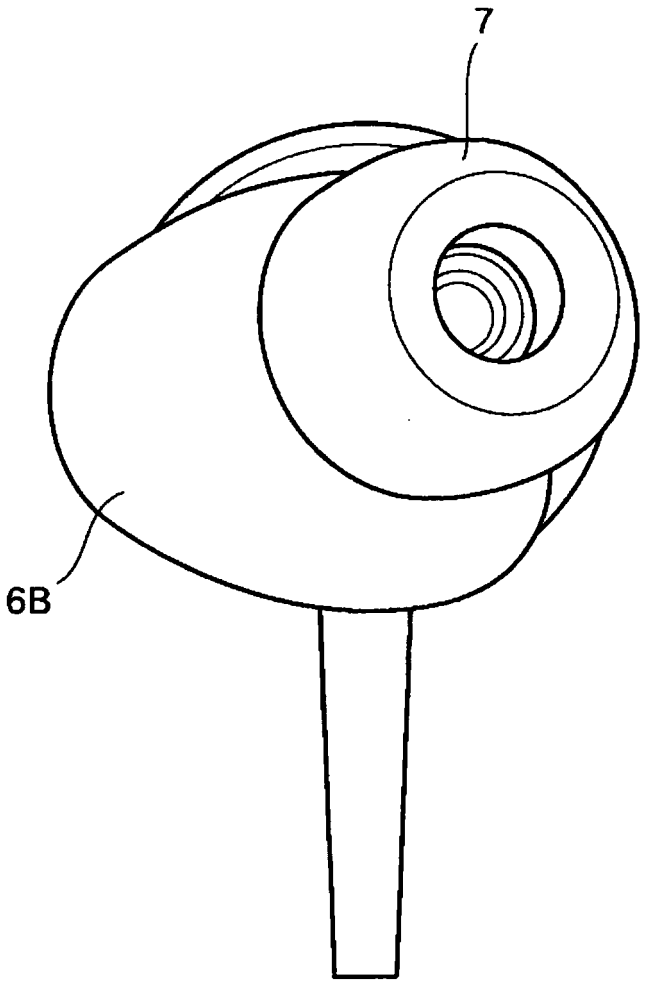


Fig.15

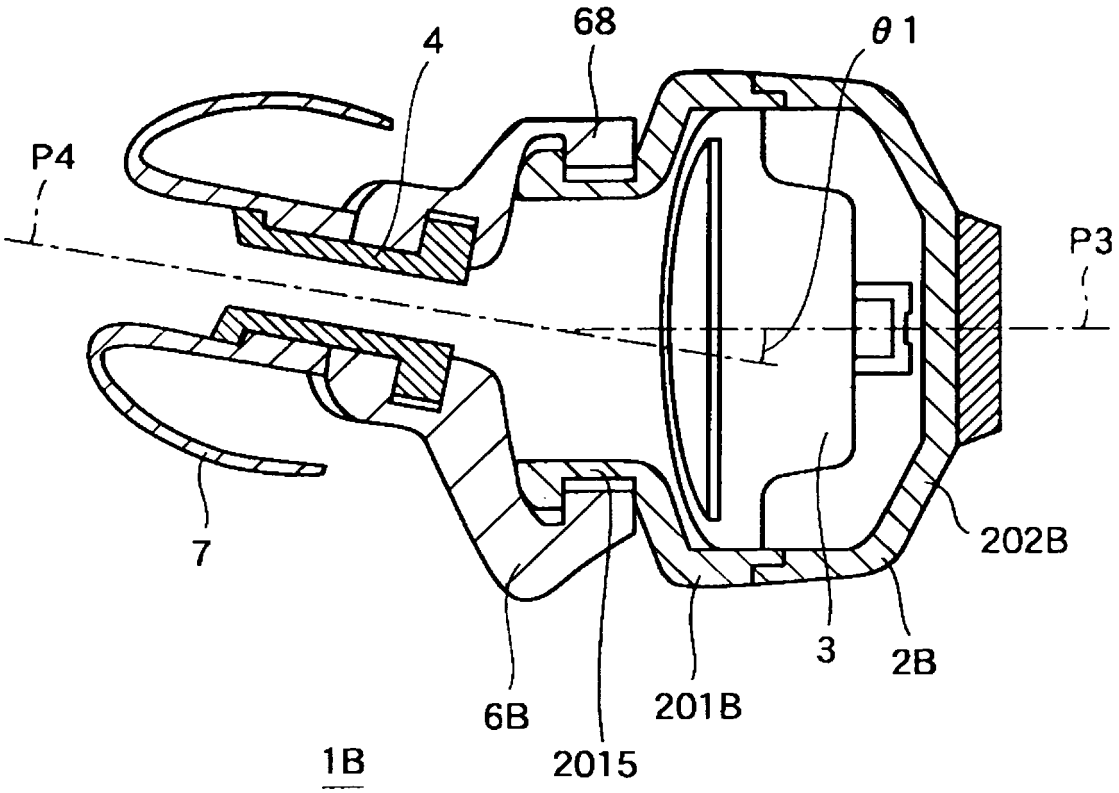
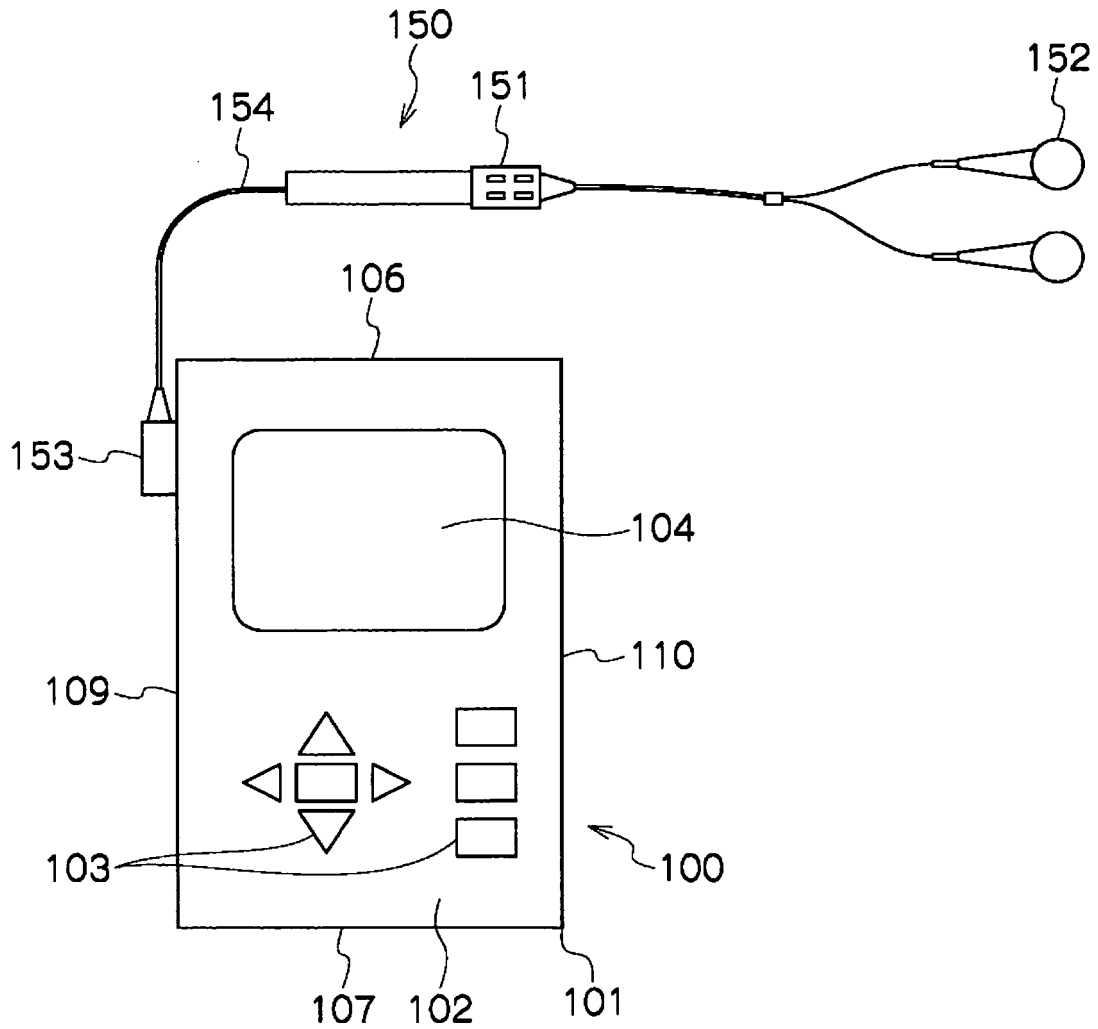


Fig.16



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/062485

A. CLASSIFICATION OF SUBJECT MATTER
H04R1/10(2006.01)i

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)
H04R1/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2009
Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 169462/1981(Laid-open No. 076288/1983) (Rion Co., Ltd.), 23 May, 1983 (23.05.83), Page 3, line 12 to page 7, line 12; Fig. 5 (Family: none)	1-19
Y	JP 2007-189468 A (Sony Corp.), 26 July, 2007 (26.07.07), Par. No. [0059]; Fig. 4 & US 2007/0189570 A1 & EP 1809069 A1 & KR 10-2007-0075352 A & CN 101001479 A	1-19

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
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INTERNATIONAL SEARCH REPORT

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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.
Y	JP 2008-060943 A (Kazuo SUZUKI (et al.)), 13 March, 2008 (13.03.08), Par. Nos. [0034] to [0043]; Figs. 1 to 3 (Family: none)	2-18
Y	JP 10-098792 A (Kaoru KOBAYASHI), 14 April, 1998 (14.04.98), Par. Nos. [0008] to [0015]; Figs. 1 to 4 (Family: none)	2-18
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Y	JP 1322466 S (Victor Company Of Japan, Ltd.), 25 February, 2008 (25.02.08), All drawings (Family: none)	4-18
Y	JP 09-065476 A (Sony Corp.), 07 March, 1997 (07.03.97), Par. Nos. [0053] to [0063]; Figs. 12 to 15 (Family: none)	4-18

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REFERENCES CITED IN THE DESCRIPTION

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