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(71) Applicant: **Onkyo Corporation**
Osaka 572-0028 (JP)

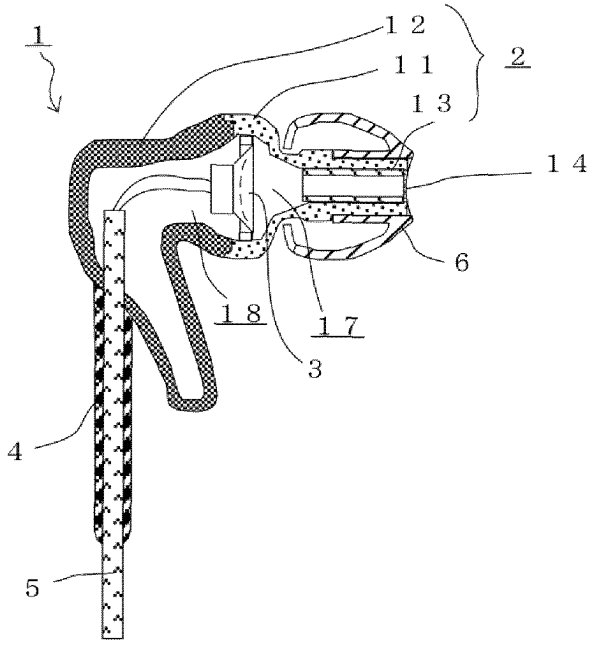
(72) Inventor: **OUCHI, Takashi**
Osaka, Osaka 572-0028 (JP)

(74) Representative: **Horn Kleimann Waitzhofer**
Patentanwälte PartG mbB
Ganghoferstrasse 29a
80339 München (DE)

(54) EARPHONE

(57) The earphone is an earphone including a speaker unit configured to electroacoustically transduce an audio signal into a sound wave, and a housing configured to define an acoustic space on at least one side of a diaphragm of the speaker unit, the speaker unit being attached to the inside of the housing. The housing includes a nozzle portion forming an acoustic path communicating with the acoustic space to guide the sound wave to the ear canal of the user. The nozzle portion includes a base member made of a first metal material and defining an outer shell of the nozzle portion, and a tubular member of which outer wall surface is fixed to an inner wall surface of the base member to form the acoustic path on the inside and which is made of a second metal material different from the first metal material.

FIG. 2



EP 3 261 358 A1

Description

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0001] The present invention relates to an earphone attached to a user's ear to reproduce sound, and specifically relates to an earphone configured such that a reproduced sound wave outlet is inserted into an ear canal inlet of a user.

2. DESCRIPTION OF THE RELATED ART

[0002] Headphones and earphones are each configured to apply an audio signal to a speaker unit closely disposed in contact with a user's ear, thereby reproducing sound. There are various forms of the earphone attached to the user's ear.

[0003] For example, the earphones include an earphone having a relatively-large speaker unit as in a headphone and having an ear hook portion configured to attach and place a main unit onto the ear pinna. Moreover, there is an inner ear type earphone used such that a main unit is attached and accommodated on the inside of the ear pinna and that sound is emitted from a sound emission surface of the main unit to the ear canal. In addition, a so-called canal earphone has become widespread, which is used such that a main unit is attached and accommodated on the inside of the ear pinna and that a sound cylinder portion protruding from the main unit is, together with an earpiece attached to the sound cylinder portion, inserted into the ear canal.

[0004] A smaller speaker unit results in a higher sound pressure level and more difficulty in sufficient expansion of a sound reproduction frequency band for ensuring a favorable reproduced sound quality. Similar problems are also caused for the speaker unit of the inner ear type earphone or the canal earphone attached to the user's ear. Specifically, in the canal earphone configured such that a reproduced sound wave outlet is inserted into an ear canal inlet of a user, there are the following problems: a housing to which the speaker unit is attached is small; it is difficult to employ the speaker unit having a necessary and sufficient sound reproduction capacity and having a large diaphragm diameter; and the canal earphone is susceptive to influence of the structure of the housing.

[0005] Japanese Patent No. 5696249 discloses a typical canal earphone including a housing having an acoustic space on the inside and provided with a tubular sound guide portion protruding from a front surface of the housing, an ear pad attached to the sound guide portion and inserted into the ear canal, a frame provided with a first air hole and provided in the housing to divide the acoustic space into a first acoustic space and a second acoustic space, an electricity/sound wave conversion portion configured to covert an electric signal into a first sound wave to output the first sound wave to the sound guide portion, and a sound pressure adjustment portion attached to the frame. The sound pressure adjustment portion includes a third acoustic space communicating with the first air hole, a tubular second air hole communicating with the second and third acoustic spaces, and a first acoustic resistor inserted into the second air hole and configured to reduce a sound pressure with a predetermined frequency band by adjustment of such an insertion position.

[0006] Further, JP-A-2008-48303 discloses an attachment provided on a speaker side of a typical inner ear type electroacoustic transducing device. Such an attachment is made of at least two or more flexible materials with different degrees of hardness and/or different densities, and includes an ear insertion portion at least acoustically linked to a transducer configured to perform electroacoustic conversion. The ear insertion portion is provided with a sound passing hole configured to transmit acoustic output from the transducer to the inside of the ear. Such a document describes that an inner wall made of a higher-hardness and/or higher-density metal than those of the flexible materials is formed around the sound passing hole of the ear insertion portion and that the metal includes Ti, Al, Au, Pt, brass, or a combination thereof. However, a specific structure for the case of using plural types of metal is not clearly described, and the typical technique is insufficient for realizing both of improvement of a reproduced sound quality of the earphone and manufacturing cost reduction.

SUMMARY OF THE INVENTION

[0007] The present invention has been made to solve the above-described problems of the typical technique. An object of the present invention relates to an earphone configured such that a reproduced sound wave outlet is inserted into an ear canal inlet of a user, and is to provide an earphone configured so that both of improvement of a reproduced sound quality and manufacturing cost reduction can be realized for natural preferable sound reproduction.

[0008] The earphone of the present invention is an earphone including a speaker unit configured to electroacoustically transduce an audio signal into a sound wave, and a housing configured to define an acoustic space on at least one side of a diaphragm of the speaker unit, the speaker unit being attached to the inside of the housing. The housing includes a nozzle portion forming an acoustic path communicating with the acoustic space to guide the sound wave to an ear canal of a user. The nozzle portion includes a base member made of a first metal material and defining an outer shell of the nozzle portion, and a tubular member of which outer wall surface is fixed to an inner wall surface of the base member to form the acoustic path on the inside and which is made of a second metal material different from the first metal material.

[0009] Preferably, in the earphone of the present invention, the inner wall surface of the base member and the outer wall surface of the tubular member are fixed

together through an adhesive layer.

[0010] Preferably, in the earphone of the present invention, the inner wall surface of the base member and/or the outer wall surface of the tubular member has a groove formed in a direction along the acoustic path such that an adhesive forming the adhesive layer is accumulated in the groove.

[0011] Preferably, in the earphone of the present invention, the nozzle portion further includes, at an opening end portion of the tubular member, a protection member exhibiting air permeability, and a peripheral portion of the protection member is fixed with the protection member being sandwiched between the base member and the tubular member.

[0012] Preferably, in the earphone of the present invention, two different materials are, as the first metal material forming the base member and the second metal material forming the tubular member, selected from any of aluminum alloy, copper alloy, zinc alloy, titanium alloy, magnesium alloy, and iron alloy.

[0013] Preferably, in the earphone of the present invention, the first metal material forming the base member is the aluminum alloy, and the second metal material forming the tubular member is oudou (in Japanese) or brass.

[0014] Preferably, in the earphone of the present invention, the housing further includes a cord connection portion configured to connect a cord to the speaker unit, the audio signal being supplied via the cord.

[0015] Preferably, in the earphone of the present invention, the housing further includes, at a tip end of the nozzle portion, an earpiece attachment portion to which an earpiece is attached, the earpiece being to be inserted into the ear canal of the user, and the earphone further includes the earpiece attached to the earpiece attachment portion.

[0016] Hereinafter, features of the present invention will be described.

[0017] The earphone of the present invention includes the speaker unit configured to electroacoustically transduce the audio signal into the sound wave, and the housing configured to define the acoustic space on at least one side of the diaphragm of the speaker unit, the speaker unit being attached to the inside of the housing. The housing includes the nozzle portion forming the acoustic path communicating with the acoustic space to guide the sound wave to the ear canal of the user. Thus, the canal earphone can be realized such that the earpiece closely contacts the ear canal as long as the housing further includes the cord connection portion configured to connect the cord configured to supply the audio signal to the speaker unit and the nozzle portion of the housing further includes the earpiece attachment portion to which the earpiece to be inserted into the ear canal of the user is attached.

[0018] The nozzle portion of the housing of the earphone includes the base member made of the first metal material and defining the outer shell of the nozzle portion, and the tubular member (may be provided with a slit) of which outer wall surface is fixed to the inner wall surface of the base member to form the acoustic path on the inside and which is made of the second metal material different from the first metal material. The inner wall surface of the base member and the outer wall surface of the tubular member are preferably fixed together through the adhesive layer. That is, since the nozzle portion forming the acoustic path of the earphone is formed in such a manner that two types of metal with different vibration modes are joined together, vibration from the speaker unit can be significantly attenuated by friction heat and the adhesive layer between the inner wall surface of the base member and the outer wall surface of the tubular member. As a result, even in the canal earphone, vibration at the nozzle portion is properly reduced, and, e.g., occurrence of sound accompanied by vibration of the housing is reduced. Thus, natural preferable sound reproduction can be realized.

[0019] Preferably, for forming the nozzle portion by joining of two types of metal with different vibration modes, the inner wall surface of the base member and/or the outer wall surface of the tubular member may have, in the earphone, the groove formed in the direction along the acoustic path such that the adhesive forming the adhesive layer is accumulated in the groove. In the case of inserting and bonding the tubular member in the base member, defects such as closing of the acoustic path due to the adhesive can be prevented, and the adhesive layer providing adhesive force can be formed. Note that in the case of forming the slit at the tubular member, the tubular member can be inserted into an inner wall surface side of the base member with the outer diameter of the tubular member being decreased, and therefore, bonding can be made with a double-sided tape being attached to the outer wall surface of the tubular member.

[0020] Moreover, in the earphone, the nozzle portion further includes, at the opening end portion of the tubular member, the protection member exhibiting air permeability, and the peripheral portion of the protection member is fixed with the protection member being sandwiched between the base member and the tubular member. This realizes the structure in which two types of metal are joined together to form the acoustic path while preventing defects such as closing or narrowing of the second acoustic path due to entrance of a foreign substance into the tubular member through the opening end portion thereof.

[0021] In a case where two different materials are, as the first metal material forming the base member and the second metal material forming the tubular member, selected from any of the aluminum alloy, the copper alloy, the zinc alloy, the titanium alloy, the magnesium alloy, and the iron alloy, occurrence of sound or the like accompanied by vibration of the nozzle portion of the housing can be specifically reduced in the earphone. Specifically, in a case where the first metal material forming the base member is the aluminum alloy and the second metal

material forming the tubular member is oudou or brass, occurrence of sound or the like accompanied by vibration is effectively reduced with a relatively-low manufacturing cost, and natural preferable sound reproduction can be realized.

[0022] The earphone of the present invention relates to an earphone configured such that a reproduced sound wave outlet is inserted into an ear canal inlet of a user, and is configured so that both of improvement of a reproduced sound quality and manufacturing cost reduction can be realized for natural preferable sound reproduction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig. 1 is a view for describing an earphone of a preferred embodiment;

Fig. 2 is a view for describing an internal structure of the earphone of the preferred embodiment;

Fig. 3(includes 3(a) to 3(d)) are views for describing the internal structure of the earphone of the preferred embodiment; and

Fig. 4 is a graph for describing vibration attenuation properties of a member forming a housing of the earphone of the preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Hereinafter, an earphone of a preferred embodiment of the present invention will be described. However, the present invention is not limited to such an embodiment.

[0025] Figs. 1 to 3 are views for describing an earphone 1 of the preferred embodiment of the present invention. Specifically, Fig. 1 is a perspective view of the earphone 1 attached to one ear of a user. Moreover, Fig. 2 is a sectional view for describing an internal structure of the earphone 1. Further, Fig.3 (includes 3(a) to 3(d)) are sectional views of a base member 11 and a nozzle member 13. Note that other structures of the earphone 1 not necessarily described regarding to the present invention will not be shown in the figures, and will not be described later.

[0026] The earphone 1 of the present embodiment is a canal earphone configured such that a reproduced sound wave outlet is inserted into an ear canal hole of the ear pinna of the user. The earphone 1 includes, for stereo reproduction, substantially symmetrical earphones attached respectively to the right and left ears of the user. The structure of the earphone 1 corresponding to one ear will be described below. Needless to say, the form of the earphone 1 is not limited to the case of the present embodiment.

[0027] The earphone 1 is configured such that a speaker unit 3 configured to receive an audio signal supplied via a cord 5 to reproduce sound is attached to a housing 2 of the earphone 1. The speaker unit 3 is an electrodynamic electroacoustic transducer including a magnetic circuit with a magnetic gap and configured to vibrate a diaphragm coupled to a voice coil inserted into the magnetic gap, the audio signal being supplied to the voice coil. The speaker unit 3 emits sound waves to front and back sides of the (not-shown) diaphragm, the sound waves being in an opposite phase relationship. Thus, the housing 2 needs to be attached to the speaker unit 3 such that one side of the diaphragm of the speaker unit 3 is separated from the other side.

[0028] The housing 2 of the present embodiment can be attached to the speaker unit 3 having a diameter corresponding to the size of the ear canal hole of the ear pinna of the user. The housing 2 includes a substantially cylindrical base member 11 having a nozzle portion, and the housing member 12 coupled to a back side of the base member 11 to form a cavity. The base member 11 and the housing member 12 of the housing 2 define an acoustic space 17 on the front side of the diaphragm of the speaker unit 3, and form an acoustic space 18 separated from the acoustic space 17 on the back side on which the magnetic circuit of the speaker unit 3 is present.

[0029] The base member 11 is made of a metal material includes aluminium, and includes a speaker unit attachment portion at which the speaker unit 3 is attached to an inner wall portion. An outer-diameter frame of the speaker unit 3 has outer dimensions substantially matching with the inner-diameter dimensions of the speaker unit attachment portion of the substantially cylindrical base member 11. The base member 11 includes the nozzle portion 11a formed thinner on a tip end side than the speaker unit attachment portion such that the base member 11 is inserted into the ear canal hole of the ear pinna of the user. The nozzle portion 11a forms, on the inside thereof, an acoustic path communicating with the acoustic space 17 to guide a sound wave to the ear cannel of the user.

[0030] The tubular nozzle member 13 made of a brass material is attached to the inside of the nozzle portion 11a of the base member 11. An outer wall surface of the nozzle member 13 is fixed to an inner wall surface of the nozzle portion 11a of the base member 11, thereby forming the above-described acoustic path on the inside. A lock portion 11b of which inner-diameter dimension is smaller than the outer dimension of the nozzle member 13 is provided at an end portion of the nozzle portion 11a of the base member 11.

[0031] Thus, the nozzle member 13 is inserted into the nozzle portion 11a from the inside on which the diameter of the base member 11 defining the acoustic space 17 is large. Note that a protection net 14 as a protection member exhibiting air permeability is attached to an opening end portion of the nozzle portion 11a. The protection net 14 prevents defects such as closing of the acoustic path due to entrance of a foreign substance into

the nozzle portion 11a through the opening end portion thereof. The protection net 14 is fixed with the protection net 14 being sandwiched between the lock portion 11b of the base member 11 and an end surface 13b of the nozzle member 13.

[0032] An inner wall surface of the base member 11 and the outer wall surface of the nozzle member 13 are fixed together through an adhesive layer formed of an adhesive. For example, a rubber-based adhesive, an acrylic-based adhesive, a silicon-based adhesive, a butyl-based adhesive, or a double-sided tape containing these adhesives can be used as the adhesive. Grooves 11c, 13c along the acoustic path are formed respectively at the inner wall surface of the nozzle portion 11a of the base member 11 and the outer wall surface of the nozzle member 13. Thus, in a case where there is an extra adhesive for forming the adhesive layer between the inner wall surface of the base member 11 and the outer wall surface of the nozzle member 13, such an adhesive can be accumulated without overflowing to the outside, leading to firm bonding and fixing.

[0033] The nozzle member 13 may be a tubular body formed in such a manner that a strip-shaped brass material is rounded in a tubular shape. In this case, a slit is axially formed at the nozzle member 13, and therefore, there is an advantage that the tubular nozzle member 13 can be inserted with the diameter of the nozzle member 13 being temporarily decreased upon attachment to the inner wall surface of the nozzle portion 11a of the base member 11. The length of the nozzle member 13 may be a length corresponding to the length of the nozzle portion 11a, but is not necessarily coincident with the length of the nozzle portion 11a. The length of the nozzle member 13 may be longer or shorter than that of the nozzle portion 11a.

[0034] An earpiece attachment portion to which an earpiece 6 is attached is formed on an outer peripheral surface of the nozzle portion 11a of the base member 11. With attachment of the shade-shaped earpiece 6 exhibiting elasticity, the canal earphone can be realized such that the earpiece 6 closely contacts the ear canal hole. The earpiece 6 allows the user to stably attach the earphone 1 to the ear pinna.

[0035] Meanwhile, the housing member 12 defines the acoustic space 18 formed separately from the acoustic space 17. The housing member 12 is made of a metal material or a resin material, and a cord bush 4 configured to fix the cord 5 is coupled to the housing member 12, the audio signal being supplied to the speaker unit 3 through the cord 5.

[0036] The cord bush 4 is made of a soft rubber material to contain the cord 5, and one side of the cord bush 4 is attached to an attachment hole of the housing member 12. In the case of the earphone 1 configured such that a jack for plug connection is provided at the housing 2, the housing member 12 may include, as a cord connection portion for connecting the cord 5 configured to supply the audio signal to the speaker unit 3, a jack into which a plug at a tip end of the cord 5 is inserted, instead of the cord bush 4.

[0037] The material of the member forming the housing 2 influences a reproduced sound quality of the earphone 1. Note that the base member 11 forming the housing 2 includes the nozzle portion 11a to be inserted into an external ear hole of the user, and therefore, the influence of such a material on the reproduced sound quality is relatively greater as compared to the housing member 12. Thus, vibration of the nozzle portion 11a of the base member 11 due to vibration caused at the speaker unit 3 is preferably reduced.

[0038] Fig. 4 is a graph for describing vibration attenuation properties of the member forming the housing 2 of the earphone 1 of the present embodiment and a member forming a housing 2 of an earphone 10 of a comparative example. For the vibration attenuation properties of the member, a test piece in a predetermined plate shape is vibrated by an impact hammer, and then, an acceleration at a predetermined position of the test piece is measured by an acceleration pickup. The horizontal axis indicates an elapsed time after vibration, and the vertical axis indicates a normalized acceleration value.

[0039] The test piece equivalent to the earphone 1 of the present embodiment is configured such that an aluminum plate material and a oudou plate material, i.e., a brass plate material, are bonded together with a double-sided tape. On the other hand, the test piece equivalent to the earphone 10 of the comparative example includes only an aluminum plate material. The results show that in the case of the earphone 1 of the present embodiment, vibration of the base member 11 of the housing 2 including the brass nozzle member 13 is attenuated and returns to normal in a much shorter time as compared to the case of the earphone 10 of the comparative example. On the other hand, vibration with a natural resonant frequency continues longer in the case of the earphone 10 of the comparative example.

[0040] In the housing 2 of the earphone 1, the reproduced sound quality of the earphone changes depending on the presence or absence of the nozzle member 13. The case of the (not-shown) earphone 10 of the comparative example is equivalent to the case of not including the nozzle member 13 in the nozzle portion 11a of the base member 11 in the housing 2 of the earphone 1 of the present embodiment. Thus, Fig. 4 shows features and effects of the brass nozzle member 13 in the canal earphone 1.

[0041] That is, in the case of the earphone 1 of the present embodiment, sound accompanied by vibration of the nozzle member 11 of the housing 2 is less caused as compared to the case of the earphone 10 of the comparative example, and therefore, a reproduced sound articulation can be improved. In a case where different metal materials are used for multiple members forming the housing 2, it is most preferred that the material of the nozzle portion to be inserted into an ear canal inlet and the material of the nozzle member 13 to be inserted into

the nozzle portion are different from each other. The canal earphone 1 configured such that the reproduced sound wave outlet is inserted into an ear canal inlet of the user can realize more natural preferable sound reproduction as compared to the earphone 10 of the comparative example.

[0042] Specifically in a case where the nozzle member 13 is made of a oudou material or a brass material, e.g., occurrence of sound accompanied by vibration is effectively reduced with a relatively-low manufacturing cost, and natural preferable sound reproduction can be realized. Note that the nozzle member 13 is not necessarily made of the oudou material or the brass material as long as the material of the nozzle member 13 is different from an aluminum material forming the base member 11. Note that the base member 11 and the nozzle member 13 may be a combination of different metal materials.

[0043] For example, in a case where the base member 11 is made of the aluminum material, e.g., titanium, magnesium alloy, zinc alloy, an iron material, a steel material, or a stainless material can be, in addition to the oudou material or the brass material, employed for the nozzle member 13. Alternatively, the materials of the base member 11 and the nozzle member 13 may be interchanged as long as the metal materials forming these two members are different from each other. For example, occurrence of sound accompanied by vibration of the nozzle portion 11a of the housing 2 can be reduced.

[0044] Note that the inner wall surface of the base member 11 and the outer wall surface of the nozzle member 13 are, as described above, preferably fixed together through the adhesive layer. Two types of metal with different vibration modes are joined together as the base member 11 and the nozzle member 13. Thus, in a case where each of these members vibrates in association with vibration from the speaker unit 3, even when friction is caused between these members, such vibration can be significantly attenuated by the adhesive layer formed between the members. As a result, in the canal earphone 1 of the present embodiment, vibration at the nozzle portion 11a can be properly reduced. Consequently, occurrence of sound or the like accompanied by vibration of the housing 2 is reduced, and therefore, natural preferable sound reproduction can be realized.

[0045] The earphone of the present invention is not limited to the canal earphone as illustrated in the figures, and may be an earphone further including another ear hook portion. Moreover, the present invention is not limited to the earphone, and overhead earphones may be configured such that earphones corresponding respectively to the right and left ears are coupled together through a headband. The earphone is not limited to stereo reproduction and multichannel surround reproduction for home use, and is also applicable to in-vehicle audio equipment and sound reproduction facilities such as movie theaters.

Claims

1. An earphone comprising:

a speaker unit configured to electroacoustically transduce an audio signal into a sound wave; and

a housing configured to define an acoustic space on at least one side of a diaphragm of the speaker unit, the speaker unit being attached to an inside of the housing,

wherein the housing includes a nozzle portion forming an acoustic path communicating with the acoustic space to guide the sound wave to an ear canal of a user, and

the nozzle portion includes

a base member made of a first metal material and defining an outer shell of the nozzle portion, and

a tubular member of which outer wall surface is fixed to an inner wall surface of the base member to form the acoustic path on the inside and which is made of a second metal material different from the first metal material.

2. The earphone according to claim 1, wherein

the inner wall surface of the base member and the outer wall surface of the tubular member are fixed together through an adhesive layer.

3. The earphone according to claim 2, wherein

the inner wall surface of the base member and/or the outer wall surface of the tubular member has a groove formed in a direction along the acoustic path such that an adhesive forming the adhesive layer is accumulated in the groove.

4. The earphone according to any one of claims 1 to 3, wherein

the nozzle portion further includes, at an opening end portion of the tubular member, a protection member exhibiting air permeability, and

a peripheral portion of the protection member is fixed with the protection member being sandwiched between the base member and the tubular member.

5. The earphone according to any one of claims 1 to 4, wherein

two different materials are, as the first metal material forming the base member and the second metal material forming the tubular member, se-

lected from any of aluminum alloy, copper alloy, zinc alloy, titanium alloy, magnesium alloy, and iron alloy.

6. The earphone according to any one of claims 1 to 5, wherein

the first metal material forming the base member is the aluminum alloy, and the second metal material forming the tubular member is oudou or brass.

7. The earphone according to any one of claims 1 to 6, wherein

the housing further includes a cord connection portion configured to connect a cord, the acoustic signal being supplied to the speaker unit through the cord.

8. The earphone according to any one of claims 1 to 7, wherein

the housing further includes, at a tip end of the nozzle portion, an earpiece attachment portion to which an earpiece is attached, the earpiece being to be inserted into the ear canal of the user, and
the earphone further includes the earpiece attached to the earpiece attachment portion.

FIG. 1

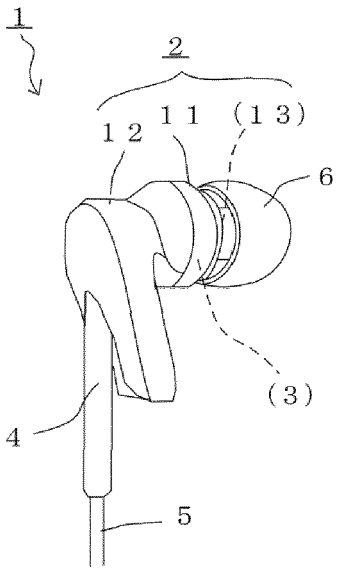


FIG. 2

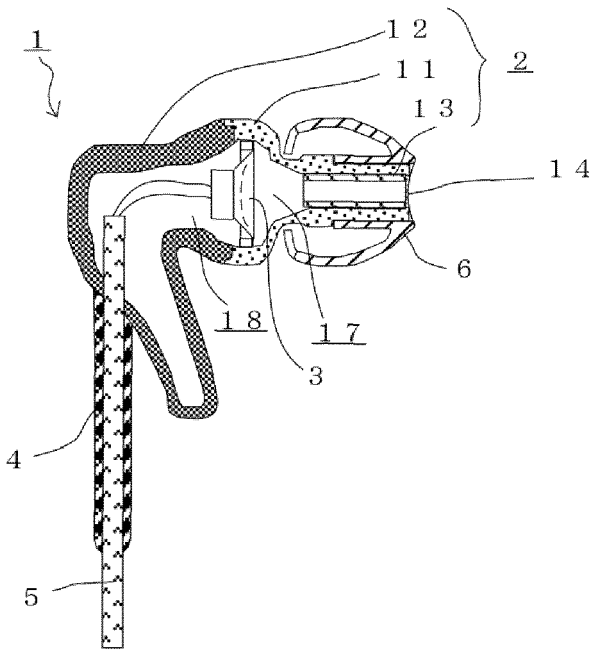


FIG. 3

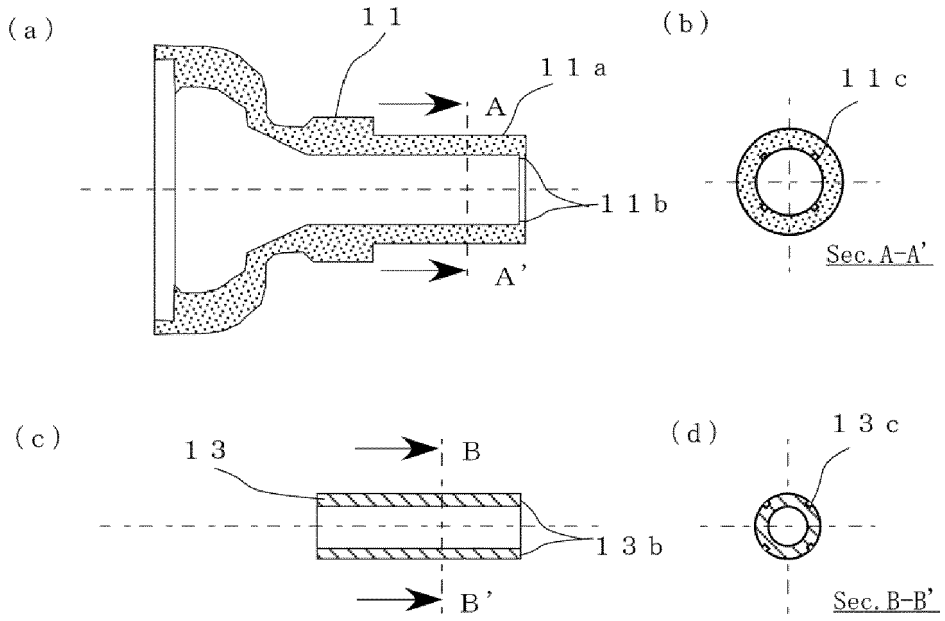

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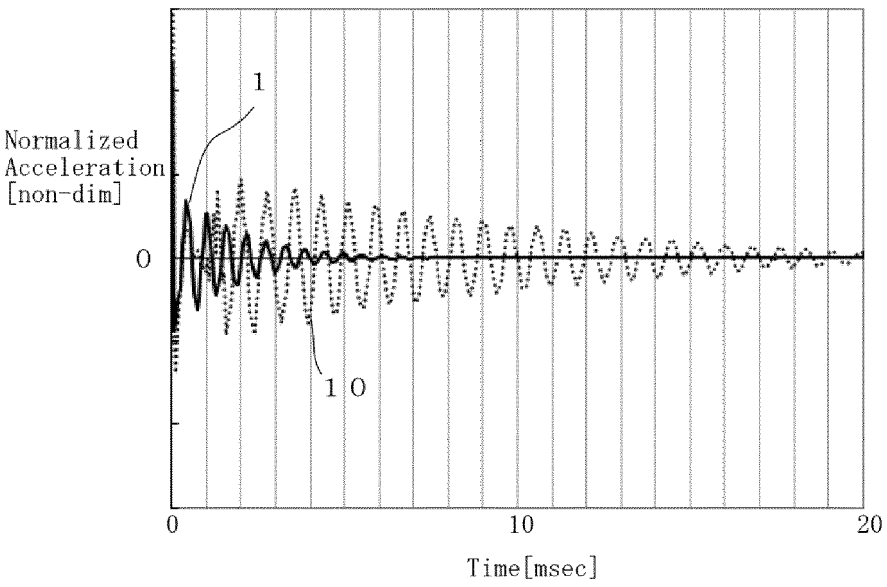
FIG. 4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EUROPEAN SEARCH REPORT

Application Number
EP 17 17 6425

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 2010/322453 A1 (MATSUYAMA EIJI [JP] ET AL) 23 December 2010 (2010-12-23) * paragraphs [0032] - [0071]; figure 1 * -----	1,5,7,8	INV. H04R1/10 G10K11/168
Y	Steve Guttenberg: "Shure SE846 In-Ear Headphone", Sound&Vision - Headphone Reviews, 14 January 2014 (2014-01-14), pages 1-5, XP055406595, Retrieved from the Internet: URL:https://www.soundandvision.com/content/shure-se846-ear-headphone [retrieved on 2017-09-14] * figure on page 3; page 2, last paragraph * -----	1,5,7,8	ADD. H04R1/28
X	"jamnperry" ET AL: "SE846 Filter mod", Discussion in 'Portable Headphones, Earphones and In-Ear Monitors', 15 June 2016 (2016-06-15), pages 1-7, XP055406941, Retrieved from the Internet: URL:https://www.head-fi.org/threads/se846-filter-mod.802350/ [retrieved on 2017-09-15] * posts #1, #14 * -----	1-8	TECHNICAL FIELDS SEARCHED (IPC) H04R G10K
A	US 2012/195440 A1 (YAMAGISHI MAKOTO [JP]) 2 August 2012 (2012-08-02) * paragraph [0089]; figure 11 * -----	1-8	
A	JP 2008 109206 A (STAR MFG CO) 8 May 2008 (2008-05-08) * paragraphs [0021], [0034], [0035]; figures 1, 2, 6, 7 * * computer-translation available at espacenet.com * ----- -/--	1-8	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 September 2017	Lörch, Dominik

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
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EPO FORM 1503 03.82 (P04C01)

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EUROPEAN SEARCH REPORT

Application Number
EP 17 17 6425

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP 2008 048303 A (MITSUI SHINYA) 28 February 2008 (2008-02-28) * paragraphs [0011], [0025], [0028], [0033], [0044]; figures 4 - 8 * * computer translation available at espacenet.com * -----	1-8	

TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 September 2017	Lörch, Dominik

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