(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 701 399 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
09.08.2017 Bulletin 2017/32

(21) Application number: **11863718.0**

(22) Date of filing: **20.04.2011**

(51) Int Cl.:
H04R 1/10 *(2006.01)* ***H04R 1/24*** *(2006.01)*

(86) International application number:
PCT/JP2011/059761

(87) International publication number:
WO 2012/144040 (26.10.2012 Gazette 2012/43)

(54) **EARPHONES**

KOPFHÖRER

ÉCOUTEURS

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(43) Date of publication of application:
26.02.2014 Bulletin 2014/09

(73) Proprietor: **Onkyo Kabushiki Kaisha d/b/a Onkyo Corporation**
Neyagawa-shi
Osaka 572-8540 (JP)

(72) Inventors:
- **KONUMA Shinsuke**
  Tendo-shi
  Yamagata 994-8585 (JP)
- **NAKAMURA Toru**
  Tendo-shi
  Yamagata 994-8585 (JP)

(74) Representative: **Hess, Peter K. G.**
Bardehle Pagenberg Partnerschaft mbB
Patentanwälte, Rechtsanwälte
Prinzregentenplatz 7
81675 München (DE)

(56) References cited:
EP-A2- 1 058 479
JP-A- 2 044 899
JP-A- 63 074 398
US-A- 4 456 797
US-A1- 2011 034 218
WO-A1-2009/141912
JP-A- 60 084 096
JP-A- 2010 010 885
US-A1- 2010 296 667

EP 2 701 399 B1

Printed by Jouve, 75001 PARIS (FR)

Description

FIELD OF THE INVENTION

[0001] The present invention relates to an earphone.

BACKGROUND OF THE INVENTION

[0002] An earphone as described in the below-described patent literature 1 includes a unit having a leading sound tube and an ear tip mounted on the leading sound tube in the unit, wherein the ear tip is used while being inserted into the outer ear canal of a user.

PRIOR ART

[0003] [Patent literature 1] Japanese Unexamined Patent Application Publication No. 2010-10885. Further in-ear earphones with conventional ear tips are known from the prior art documents EP 1058 479 A2, US 2011/0034218 A1 and US 2010/0296667 A1.

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] In a conventional insert-type earphone, a speaker unit of the earphone is held via an ear tip which is inserted into an outer ear canal, and therefore the speaker unit needs to be downsized to hold the speaker unit with an appropriate holding force. However, a small-sized speaker unit has difficulty in acquiring vibrations in the required low sound range, and thus has a problem that a favorable sound quality cannot be acquired in the low sound range during the reproduction of a music source and so forth including the low sound range.

[0005] Further, an ear tip included in the conventional insert-type earphone is designed focusing on the adhesion onto the inner surface of an ear canal (outer ear canal), and thus the compliance in the direction along the ear canal is small so that the low sound range cannot be effectively reproduced by vibrating the ear tip itself.

[0006] The present invention addresses such a problem. That is, the objective of the present invention is to provide an earphone capable of reproducing the low sound range even if the earphone includes a relatively small speaker unit and thus to allow for the sound reproduction creating the feeling of being at a live performance by reproducing the low sound range even if the earphone is small.

MEANS FOR SOLVING THE PROBLEM

[0007] To achieve such an objective, an earphone according to the present invention includes at least the following configuration:

[0008] An earphone comprising: a vibration means which vibrates in an uniaxial direction; a housing which supports said vibration means and vibrates in response to the vibration of the vibration means; and an ear tip which is mounted on said housing, wherein said ear tip is arranged around said uniaxial direction and includes a vibration part which vibrates in response to the vibration of said housing and a holding part which holds said housing in ear canal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a conceptual view showing a basic configuration of an earphone according to an embodiment of the present invention.

Fig. 2 is a view illustrating an example of more specific configuration of an earphone according to an embodiment of the present invention.

Fig. 3 is a view illustrating an example of a sound pressure frequency characteristic acquired by an earphone according to an embodiment of the present invention.

Fig. 4 is a view illustrating an example of the form of an ear tip when driving only a vibration unit in an earphone according to an embodiment of the present invention.

Fig. 5 is a view illustrating an example of the form of an ear tip when driving only a vibration unit in an earphone according to an embodiment of the present invention.

BEST MODE FOR PRACTICING THE INVENTION

[0010] Hereinafter, an embodiment according to the present invention is described with reference to the drawings. Fig. 1 is a conceptual view showing a basic configuration of an earphone according to an embodiment of the present invention. An earphone 1 comprises: a vibration means (vibration unit) 10 which vibrates in an uniaxial direction (direction of the X axis shown in the drawing); a housing 20 which supports the vibration means 10 and vibrates in response to the vibration of the vibration means 10; and an ear tip 40 mounted on the housing 20.

[0011] The ear tip 40 is arranged around the uniaxial direction (direction of the X axis shown in the drawing), that is, around the vibration direction of the vibration means 10. The ear tip 40 holds the housing 20 in an ear canal(outer ear canal) Y while vibrating by itself in response to the vibration of the housing 20, and has a vibration part 41 which vibrates in response to the vibration of the housing 20 and a holding part 42 which holds the housing 20 in ear canal.

[0012] The vibration means (hereinafter referred to as "vibration unit") is supported by a vibration unit support 21 in the housing 20. The vibration unit 10 is provided with a magnetic circuit 11 including a magnetic gap 11G, an excitation coil 13 positioned in the magnetic gap 11G, and a suspension 14 which supports the magnetic circuit

11 at the vibration unit support 21 of the housing 20. The excitation coil 13 is fixed to the vibration unit support 21 of the housing 20 directly or via a support section 13A.

[0013] In such an earphone 1, an excitation signal is input into the excitation coil 13 to vibrate the vibration unit 10 in the direction of the X axis and the vibration is transmitted to the housing 20 to vibrate the housing 20 in the direction of the X axis. Further, in response to the vibration of the housing 20, the ear tip 40 arranged around the vibration direction vibrates. The holding part 42 that is the outer peripheral part of the ear tip 40 keeps in contact with the inner surface of the ear canal Y so that the vibration of the vibration part 41 creates a pressure fluctuation in the space Ys inside the ear canal Y, and the pressure fluctuation allows for the reproduction of the low sound range.

[0014] The holding part 42 of the ear tip 40 is held by the ear canal Y so that the entire circumference of the holding part 42 is arranged in close contact with the inner surface of the ear canal Y. Thereby, the space Ys inside the ear canal Y is hermetically or semi-hermetically sealed so that the vibration of the vibration part 41 of the ear tip 40 effectively creates a pressure fluctuation in the space Ys, and thus allows for higher quality reproduction of the low sound range by driving the volume of the hermetically or semi-hermetically sealed space Ys.

[0015] Fig. 2 is a view illustrating an example of more specific configuration of the earphone 1 according to an embodiment of the present invention. According to the example shown in the drawing, the earphone 1 includes a speaker unit 30 and a vibration unit 10, which are housed in the housing 20. The speaker unit 30 emits a sound in response to an audio signal and has a voice coil 31 to which the audio signal is input. When an audio signal is input, the voice coil 31 vibrates in the vibration direction (X-axis direction) of the vibration unit (vibration means) 10.

[0016] Further, the speaker unit 30 includes a magnetic circuit 32 having a magnetic gap 32G and the voice coil 31 is arranged in the magnetic gap 32G. The magnetic circuit 32 includes, for example, a magnet 32A, a yoke 32B and a plate 32C, and the magnetic gap 32G is formed between the yoke 32B and the plate 32C. A diaphragm 33 is attached to the voice coil 31 and the diaphragm 33 is supported by a frame 34. The frame 34 is provided with an opening 34A for emitting the sound created by the diaphragm 33.

[0017] The vibration unit 10 includes the magnetic circuit 11, the excitation coil 13, and the suspension 14 as described above, and the magnetic circuit 11 is supported via the suspension 14 by the vibration unit support 21 of the housing 20 to which the excitation coil is fixed. The magnetic circuit 11 includes a magnet 11A, a yoke 11B and a plate 11C, and a magnetic gap 11C is formed between the yoke 11B and the plate 11C.

[0018] Further, a weight part 12 is provided on the magnetic circuit 11, and the mass of the magnetic circuit 11 including the weight part 12 is substantially the same as the total mass of the housing 20 and the speaker unit 30.

[0019] The housing 20 includes a tubular leading sound part 22 for leading the sound emitted from the speaker unit 30 and an opening 23 formed at one end of the leading sound part 22. The leading sound part 22 and the opening 23 are provided inside the ear tip 40. Further, the speaker unit 30 in the housing 20 is positioned closer to the leading sound part 22 than the vibration unit 10 in the housing 20.

[0020] In the example shown in the drawing, the vibration part 41 of the ear tip 40 has an inner peripheral part 41A which is supported by the housing 20, and an edge part 43 is provided between the vibration part 41 and the holding part 42. The aforementioned leading sound part 22 and the opening 23 are provided inside the inner peripheral part 41A of the ear tip 40. Further, the effective vibration area Va for the vibration of the ear tip 40 is acquired by the vibration part 41 and a part of the edge part 43. By making larger the effective vibration area Va, the sound pressure produced by the vibration of the ear tip 40 can be increased.

[0021] In the example shown in the drawing, the ear tip 40 is annularly provided on the circumference of the housing 20, and the outer periphery of the vibration part 41 is connected to the inner periphery of the edge part 43, and the outer periphery of the edge part 43 is connected the inner periphery of the holding part 42. Such a formation can be created by integrally molding the vibration part 41, the edge part 43, and the holding part 42.

[0022] In the earphone 1 according to an embodiment of the present invention, it is preferable that the ear tip 40 itself is soft and has a desirable elasticity, while having a large compliance with respect to a force in the axial direction (X-axis direction). Also, it is preferable that the holding part 42 of the earphone 1 is arranged in close contact with the inner surface of the ear canal so that the space in the ear canal is hermetically or semi-hermetically sealed.

[0023] The form of the edge part 43 is important for the ear tip 40 to have such a characteristic. In the example shown in the drawing, the edge part 43 has a cross-sectional shape with a wave shape in the uniaxial direction (X-axis direction). Further, the thickness tb of the edge part 43 is formed thinner than the thickness ta of the vibration part 41. The edge part 43 formed in such a manner has a relatively large compliance with respect to a force in the direction of the X axis, and allows the holding part 42 to keep in close contact with the inner surface of the ear canal by having a force to elastically expand the holding part 42 toward the outside thereof. In the example shown in the drawing, the maximum diameter of the holding part 42 of the ear tip 40 is larger than the maximum diameter of the housing 20. According to this formation, it is possible to allow the holding part 42 to keep in close contact with the inner surface of the ear canal by expanding the holding part 42 toward the outside thereof, and thus to hermetically seal the space in the ear canal.

[0024] Such a earphone 1 can be driven by a common

signal which is input into the voice coil 31 of the speaker unit 30 as an audio signal while being input into the excitation coil 13 of the vibration unit 10 as an excitation signal. According to this configuration, the vibration part 41 of the ear tip 40 effectively reproduces low frequency sound, and thus even if the earphone is made small, it is possible to reproduce a sufficient low sound range in both vibration and sound pressure. The ear tip 40 has a large compliance and thus makes it easy to cut low-to-mid range frequencies that may cause an unwanted dull sound so that a high-quality low frequency sound can be reproduced by the vibration of the vibration part 41 with no use of an electric filter. Further, the diaphragm 33 of the speaker unit 30 can reproduce a relatively high frequency sound, thereby expanding reproduction frequency band.

[0025] Fig. 3 is a view illustrating an example of a sound pressure frequency characteristic acquired by the earphone 1 according to an embodiment of the present invention. This example shows a high sound pressure level in low frequencies no more than 100Hz. The necessary frequency band and sound pressure can be adjusted by properly setting the mass of the magnetic circuit 11 including the weight part 12 of the vibration unit 10, the mass of the housing 20 including the speaker unit 30, the spring constant of the suspension 14, and the spring constant and compliance of the ear tip 40 for the earphone 1 according to an embodiment of the present invention. Specifically, the resonant frequency for the mass of the magnetic circuit 11 including the weight part 12 of the vibration unit 10 and the resonant frequency for the mass of the housing 20 including the speaker unit 30 produce a sound (vibration), and the peaks of these two resonant frequencies represent a frequency characteristic. Any frequency characteristic can be simply acquired by positioning both resonant frequencies for these two peaks closer to each other through adjustment of a spring constant and by adjusting resonance sharpness through the addition of a resistor.

[0026] The performance required for the ear tip 40 of the earphone 1 is, for example, to increase the effective vibration area Va in order to increase sound pressure caused by vibration; to employ a shape which allows for a broad design scope of compliance in order to set any frequency characteristic; and to improve the adhesion onto the wall surface of the ear canal in order to efficiently convert the vibration of the ear tip 40 to the pressure fluctuation in the volume of the ear canal.

[0027] By increasing the effective vibration area Va of the ear tip 40 the sound pressure sensitivity can be increased. It is preferable to increase the width of the edge part 34 in a direction intersecting with the X axis or the edge part 43 is arranged further outside from the center of the housing 20 in order to increase the effective vibration area Va.

[0028] By increasing the compliance of the ear tip 40 the resonant frequency of vibration is shifted to a lower sound range, and thus a lower sound range can be reproduced. The form of the edge part 43 needs to be devised so as to increase the compliance.

[0029] Figs. 4 and 5 are views illustrating examples of the form of an ear tip when driving only a vibration unit in an earphone according to an embodiment of the present invention. Not only the cross-sectional shape of wave shape for the edge part $_{43}$ of the ear tip 40 shown in the example of Fig. 2, but also various types of cross-sectional shapes as shown in Figs. 4 and 5 allow for the increase of the compliance of the ear tip 40.

[0030] Figs. 4(a) to 4(c) and Figs. 5(a) and 5(b) show the cross-sectional shapes of the ear tip 40 in the vibration direction (X-axis direction) of the vibration unit 10. The ear tips 40 (40A to 40E) shown in Figs. 4(a) to 4(c) and Figs. 5(a) and 5(b) are arranged around the vibration direction (X-axis direction shown in the drawing) of the vibration unit 10 in the same manner as the example described above, and include the vibration part 41 which vibrates in response to the vibration of the housing 20 and the holding part 42 which holds the housing 20 in the ear canal. Further, the ear tip 40 includes the edge part 43 between the vibration part 41 and the holding part 42.

[0031] In the ear tip 40 (40A) shown in Fig. 4(a), the edge part 43 extends in a direction intersecting with the X axis and is arranged annularly around X-axis, and the cross-sectional shape of the edge part 43 in the direction intersecting with the vibration direction (in the direction of the X axis) is formed in a convex (or concave) shape in the direction of the X axis. Further, the example shown in Fig. 4(a) illustrates that the holding part 42 provided outside the edge part 43 has an uprise part 42a which rises up from the outer end of the edge part 43 along the X axis and an umbrella-shaped part 42b which extends in the direction opposite the uprise part 42a from the end of the uprise part 42a. According to this example, by increasing the width of the edge part 43, it is possible to increase compliance while increasing the effective vibration diameter. Further, even if the compliance of the edge part 43 is increased, since the uprise part 42a is provided, it is possible to increase adhesion onto the inner surface of ear canal via the elastic force of the uprise part 42a and the umbrella-shaped part 42b.

[0032] In the ear tip 40 (40B) shown in Fig. 4(b), the edge part 43 extends in the direction along the X axis and is provided annularly around X-axis, and the cross-sectional shape of the edge part 43 in the direction intersecting with the vibration direction (X-axis direction) is formed in a convex (or concave) shape in the direction intersecting with X-axis. According to this example, by having the inner peripheral part 41A projecting outwards, the position of the edge part 43 is arranged outwards, and thereby creating a relatively large effective vibration diameter. Further, similarly to the aforementioned example, the ear tip 40B includes the uprise part 42a extending along the X axis from the end of the edge part 43 and the umbrella-shaped part 42 extending in the direction opposite the uprise part 42a from the end of the uprise

part 42a so that even if compliance is increased, the elastic force of the uprise part 42a and the umbrella-shaped part 42b can improve adhesion toward the inner surface of ear canal.

[0033] In the ear tip 40 (40C) shown in Fig. 4(c), the edge part 43 extend in the direction along the X axis and is provided annularly around X-axis, and the cross-sectional shape of the edge part 43 in a direction intersecting with the vibration direction (in the direction of the X-axis) is formed in a concavo-convex shape in a direction intersecting with X-axis. Particularly, in the illustrated example, the edge part 43 has a rectangular concavo-convex shape. According to this example, the vibration of the housing 20 can be converted to sound pressure on the concavo-convex surface of the edge part 43 intersecting with the X axis so that the amplitude of the housing 20 can be effectively converted to sound pressure.

[0034] In the ear tip 40 (40D, 40E) shown in Figs. 5(a) and 5(b), the edge part 43 is tubularly formed along the circumference in the direction of the X axis and is provided annularly around the X axis. The inside of the tubular edge part 43 can be filled with air or other gas, liquid or solid. In the example shown in Fig. 5(a), a vibration part 41 for mounting the ear tip 40 (40D) onto the housing 20 extends in a direction intersecting with X-axis, while in the example shown in Fig. 5(b), the vibration part 41 for mounting the ear tip 40 (40E) onto the housing 20 extends along the X axis so that the edge part 43 is supported in the manner of a cantilever.

[0035] According to such an ear tip 40 (40D, 40E), a suitable spring constant in addition to a large compliance can be acquired by the tubular edge part 43. The shape of the edge part 43 allows for a large compliance in the direction of the X axis, and the compliance can be easily adjusted by adjusting the diameter of the tubular edge part 43. Further, the ear tip 40 is configured to easily support the housing 20 horizontally along an ear canal even if the edge part has a relatively large compliance.

[0036] The ear tip 40 (40D, 40E) as shown in Fig. 5 is also provided with the holding part 42 extending outside the edge part 42 like an umbrella. Even when the edge part 43 has a large compliance, it is possible to improve adhesion onto the inner surface of the ear canal by forming the holding part 42 into a shape which extends to the outside thereof. Thereby, it is possible to effectively create the space Ys in the ear canal in a hermetically or semi-hermetically sealed state.

[0037] In the earphone 1 according to such an embodiment the ear tip 40 is vibrated by vibrating the vibrating unit 10 via the housing 20 in the direction of the X axis with reference to the inner surface of the ear canal Y (human body), and thereby effectively driving the air volume of the space Ys in the ear canal, which is hermitically or semi-hermetically sealed. Accordingly, the ear tip 40 having a large compliance with respect to the force in the direction of the X axis functions as a diaphragm, and thereby reproducing a high-quality low frequency range with little dull sound. Further, the vibration of the ear tip 40 creates a pressure fluctuation in the space Ys in the ear canal, and the pressure fluctuation allows for the reproduction of low sound range. As such, the earphone 1 according to the embodiment of the present invention allows for the sound reproduction creating the feeling of being at a live performance even if the earphone is small.

[0038] Further, in the earphone 1 according to an embodiment of the present invention the resonant frequency of vibration is shifted to a lower sound range by increasing the compliance of the ear tip 40 in the direction of the X axis. Therefore, since the frequency of the sound pressure excited by the vibration of the vibration unit 10 is in a lower sound range, unprecedented reproduction of low frequency range can be achieved. Further, the sound pressure sensitivity due to vibration can be increased by increasing the effective vibration diameter of the ear tip 1.

[0039] Although the embodiments of the present invention have been described with reference to the drawings, specific configurations are not limited to these embodiments, and a design modification and so forth without departing from the subject matter of the present invention should be also included in the present invention. The descriptions illustrated in the respective drawings concerning the above described embodiments can be mutually combined as long as no inconsistencies or problems exist in the objectives, configurations and so forth thereof. Further the descriptions of respective drawings can be mutually independent embodiment and the embodiments according to the present invention are not limited to a single embodiment created by combining the respective drawings.

Claims

1. An earphone (1) comprising:

   a vibration means (10) which vibrates in an uniaxial direction (X);
   a housing (20) which supports said vibration means (10) and vibrates in response to the vibration of the vibration means (10); and
   an ear tip (40) which is mounted on said housing (20),
   wherein said ear tip (40) is arranged around said uniaxial direction (X) and includes a vibration part (41) and a holding part (42), wherein said vibrating part (41) vibrates in response to the vibration of said housing (10) in said uniaxial direction (X), and
   said holding part (42) holds said housing (20) in an ear canal and contacts with the inner surface (Y) of the ear canal.

2. The earphone according to claim 1, wherein an edge part (43) is provided between said vibration part (41) and said holding part (42).

3. The earphone according to claim 2, wherein the cross-sectional shape of said edge part (43) in said uniaxial direction (X) has a wave shape.

4. The earphone according to claim 3, wherein the thickness of said edge part (43) is formed thinner than the thickness of said vibration part (41).

5. The earphone according to claim 2, wherein said edge part (43) is tubularly formed along the circumference of said uniaxial direction (X).

6. The earphone according to claim 2, wherein said ear tip (40) is annularly provided around said housing (20),
wherein the outer periphery of said vibration part (41) is connected to the inner periphery of said edge part (43) and the outer periphery of said edge part (43) is connected to the inner periphery of said holding part (42).

7. The earphone according to claim 6, wherein said vibration part (41), said edge part (43) and said holding part (42) are integrally molded.

8. The earphone according to claim 1, wherein the maximum diameter of said holding part (42) is larger than the maximum diameter of said housing (20).

9. The earphone according to claim 1, wherein said housing (20) houses a speaker unit (30) which emits a sound in response to an audio signal and a vibration unit (10) as a vibration means (10) which vibrates in response to an excitation signal.

10. The earphone according to claim 9, wherein said housing (20) includes a tubular leading sound part (22) for leading the sound emitted from said speaker unit (30) and an opening (23) formed at one end of the leading sound part (22).

11. The earphone according to claim 10, wherein said leading sound part (22) and said opening (23) are provided inside said vibration part (41).

12. The earphone according to claim 10, wherein said speaker unit (30) in said housing (20) is positioned closer to said leading sound part (22) than said vibration unit (10) in said housing (20).

13. The earphone according to claim 9, wherein said vibration unit (10) includes a magnetic circuit (11) including a magnetic gap (11C), an excitation coil (13) positioned in said magnetic gap (11C), and a suspension (14) for supporting said magnetic circuit (11) on said housing (20),
wherein said excitation coil (13) is fixed to said housing (20).

14. The earphone according to claim 9, wherein said magnetic circuit (11) is provided with a weight part (12).

15. The earphone according to claim 14, wherein the mass of said magnetic circuit (11) including said weight (12) part is substantially same as the total mass of said housing (20) and said speaker unit (30).

Patentansprüche

1. Kopfhörer (1) aufweisend:

ein Vibrationsmittel (10), welches in einer einachsigen Richtung (X) vibriert;
ein Gehäuse (20), welches das Vibrationsmittel (10) lagert und in Antwort auf die Vibration des Vibrationsmittels (10) vibriert; und
eine Ohrspitze (40), welche an dem Gehäuse (20) befestigt ist, wobei die Ohrspitze (40) um die einachsige Richtung (X) herum angeordnet ist und einen Vibrationsteil (41) und einen Halteteil (42) umfasst, wobei der vibrierende Teil (41) in Antwort auf die Vibration des Gehäuses (10) in der einachsigen Richtung (X) vibriert, und der Halteteil (42) das Gehäuse (20) in einem Gehörgang hält und die innere Oberfläche (Y) des Gehörgangs berührt.

2. Kopfhörer gemäß Anspruch 1, wobei ein Randteil (43) zwischen dem Vibrationsteil (41) und dem Halteteil (42) bereitgestellt wird.

3. Kopfhörer gemäß Anspruch 2, wobei die Querschnittsform des Randteils (43) in der einachsigen Richtung (X) eine Wellenform aufweist.

4. Kopfhörer gemäß Anspruch 3, wobei die Stärke des Randteils (43) dünner gebildet ist, als die Stärke des Vibrationsteils (41).

5. Kopfhörer gemäß Anspruch 2, wobei der Randteil (43) röhrenförmig entlang des Umfangs der einachsigen Richtung (X) gebildet ist.

6. Kopfhörer gemäß Anspruch 2, wobei die Ohrspitze (40) ringförmig um das Gehäuse (20) bereitgestellt wird, wobei
der äußere Umfang des Vibrationsteils (41) mit dem inneren Umfang des Randteils (43) verbunden ist, und der äußere Umfang des Randteils (43) mit dem inneren Umfang des Halteteils (42) verbunden ist.

7. Kopfhörer gemäß Anspruch 6, wobei der Vibrationsteil (41), der Randteil (43) und der Halteteil (42) integral geformt sind.

8. Kopfhörer gemäß Anspruch 1, wobei der maximale Durchmesser des Halteteils (42) größer ist als der maximale Durchmesser des Gehäuses (20).

9. Kopfhörer gemäß Anspruch 1, wobei das Gehäuse (20) eine Lautsprechereinheit (30) aufnimmt, welche einen Klang in Antwort auf ein Audiosignal emitiert, und eine Vibrationseinheit (10) als ein Vibrationsmittel (10), welches in Antwort auf ein Erregungssignal vibriert.

10. Kopfhörer gemäß Anspruch 9, wobei das Gehäuse (20) einen röhrenförmigen, führenden Klangteil (22) umfasst, zum Führen des Klangs, der von der Lautsprechereinheit (30) emittiert wurde, und eine Öffnung (23), die an einem Ende des führenden Klangteils (22) gebildet ist.

11. Kopfhörer gemäß Anspruch 10, wobei der führende Klangteil (22) und die Öffnung (23) innerhalb des Vibrationsteils (41) bereitgestellt werden.

12. Kopfhörer gemäß Anspruch 10, wobei die Lautsprechereinheit (30) in dem Gehäuse (20) näher an dem führenden Klangteil (22) angeordnet ist als die Vibrationseinheit (10) in dem Gehäuse (20).

13. Kopfhörer gemäß Anspruch 9, wobei die Vibrationseinheit (10) einen Magnetkreis (11) umfasst, der einen Magnetspalt (11C) umfasst, eine Erregungsspule (13), die in dem Magnetspalt (11C) angeordnet ist, und eine Lagerung (14) zum Lagern des Magnetkreises (11) an dem Gehäuse (20), wobei
die Erregungsspule (13) an dem Gehäuse (20) befestigt ist.

14. Kopfhörer gemäß Anspruch 9, wobei der Magnetkreis (11) mit einem Gewichtsteil (12) bereitgestellt wird.

15. Kopfhörer gemäß Anspruch 14, wobei die Masse des Magnetkreises (11) mit dem Gewicht (12) Teil im wesentlich gleich ist wie die Gesamtmasse des Gehäuses (20) und der Lautsprechereinheit (30).

Revendications

1. Un écouteur (1) comprenant :

un moyen vibrant (10) qui vibre dans une direction uniaxiale (X) ;
un boitier (20) qui supporte ledit moyen vibrant (10) et vibre en réponse à la vibration du moyen vibrant (10) ; et
un embout auriculaire (40) qui est monté sur ledit boitier (20), ledit embout auriculaire (40) étant agencé autour de ladite direction uniaxiale (X) et comprenant une partie vibrante (41) et une partie de maintien (42), ladite partie vibrante (41) vibrant en réponse à la vibration dudit boitier (10) dans ladite direction uniaxiale (X), et
ladite partie de maintien (42) maintient ledit boitier (20) dans un canal auriculaire et vient en contact avec la surface intérieure (Y) du canal auriculaire.

2. L'écouteur de la revendication 1, dans lequel une partie de bord (43) est disposée entre ladite partie vibrante (41) et ladite partie de maintien (42).

3. L'écouteur de la revendication 2, dans lequel la forme en section droite de ladite partie de bord (43) dans ladite direction uniaxiale (X) a une forme ondulée.

4. L'écouteur de la revendication 3, dans lequel l'épaisseur de ladite partie de bord (43) est formée plus mince que l'épaisseur de ladite partie vibrante (41).

5. L'écouteur de la revendication 2, dans lequel ladite partie de bord (43) est formée tubulairement le long de la circonférence de ladite direction uniaxiale (X).

6. L'écouteur de la revendication 2, dans lequel ledit embout auriculaire (40) est disposé annulairement autour dudit boitier (20),
la périphérie extérieure de ladite partie vibrante (41) étant reliée à la périphérie intérieure de ladite partie de bord (43) et la périphérie extérieure de ladite partie de bord (43) étant reliée à la périphérie intérieure de ladite partie de maintien (42).

7. L'écouteur de la revendication 6, dans lequel ladite partie vibrante (41), ladite partie de bord (43) et ladite partie de maintien (42) sont moulées monobloc.

8. L'écouteur de la revendication 1, dans lequel le diamètre maximal de ladite partie de maintien (42) est plus élevé que le diamètre maximal dudit boitier (20).

9. L'écouteur de la revendication 1, dans lequel ledit boitier (20) loge une unité de haut-parleur (30) qui émet un son en réponse à un signal audio et une unité vibrante (10) en tant que moyen vibrant (10) qui vibre en réponse à un signal d'excitation.

10. L'écouteur de la revendication 9, dans lequel ledit boitier (20) comprend une partie tubulaire de guidage du son (22) pour guider le son émis à partir de ladite unité de haut-parleur (30) et une ouverture (23) formée à l'une des extrémités de la partie de guidage du son (22).

11. L'écouteur de la revendication 10, dans lequel ladite partie de guidage du son (22) et ladite ouverture (23)

sont situées à l'intérieur de ladite partie vibrante (41).

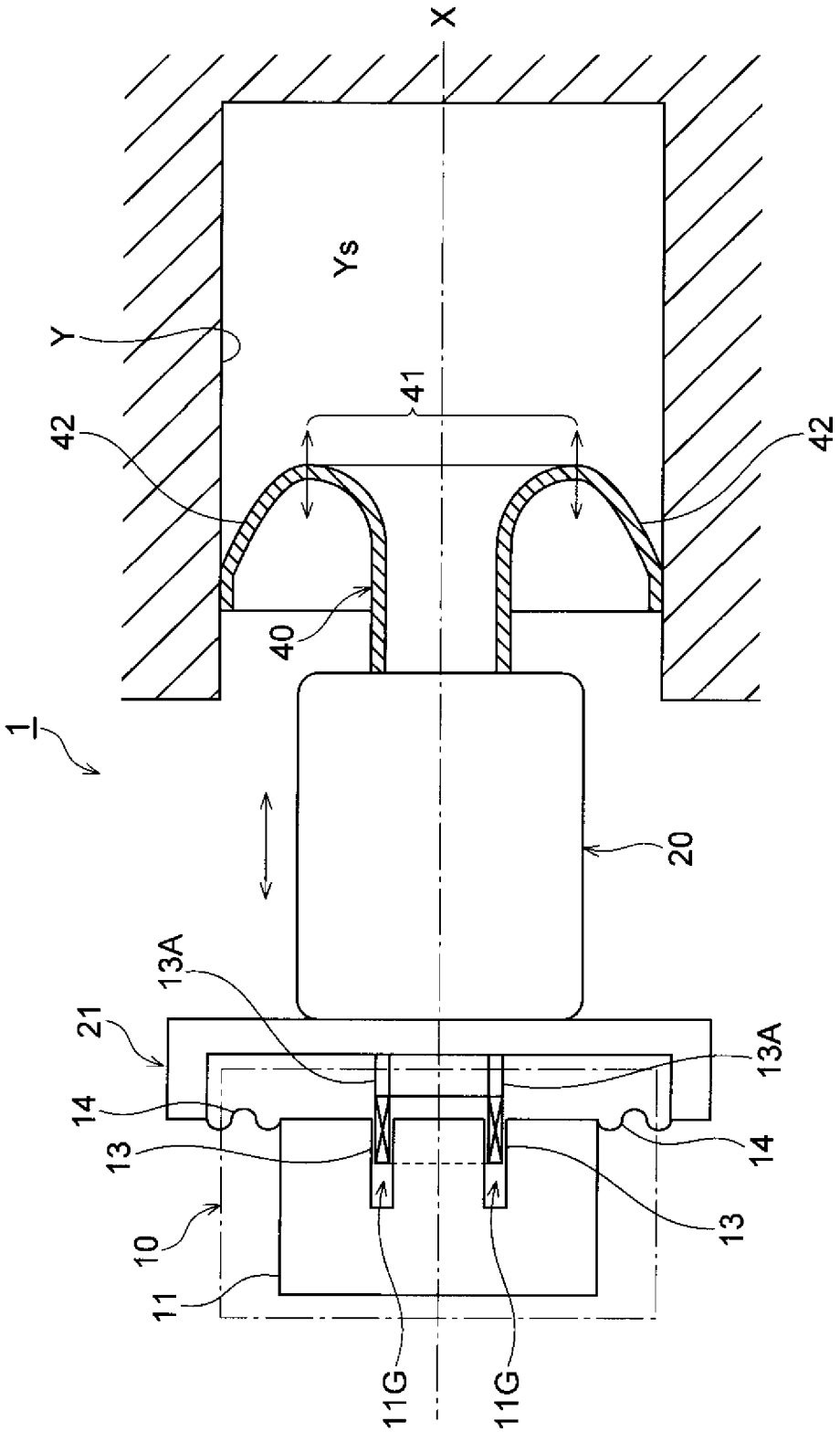
12. L'écouteur de la revendication 10, dans lequel ladite unité de haut-parleur (30) dudit boitier (20) est positionnée plus proche de ladite partie de guidage du son (22) que de ladite unité vibrante (10) dans ledit boitier (20).

13. L'écouteur de la revendication 9, dans lequel ladite unité vibrante (10) comprend un circuit magnétique (11) comprenant un entrefer magnétique (11C), une bobine d'excitation (13) située dans ledit entrefer magnétique (11C), et une suspension (14) pour supporter ledit circuit magnétique (11) sur ledit boitier (20), ladite bobine d'excitation (13) étant fixée audit boitier (20).

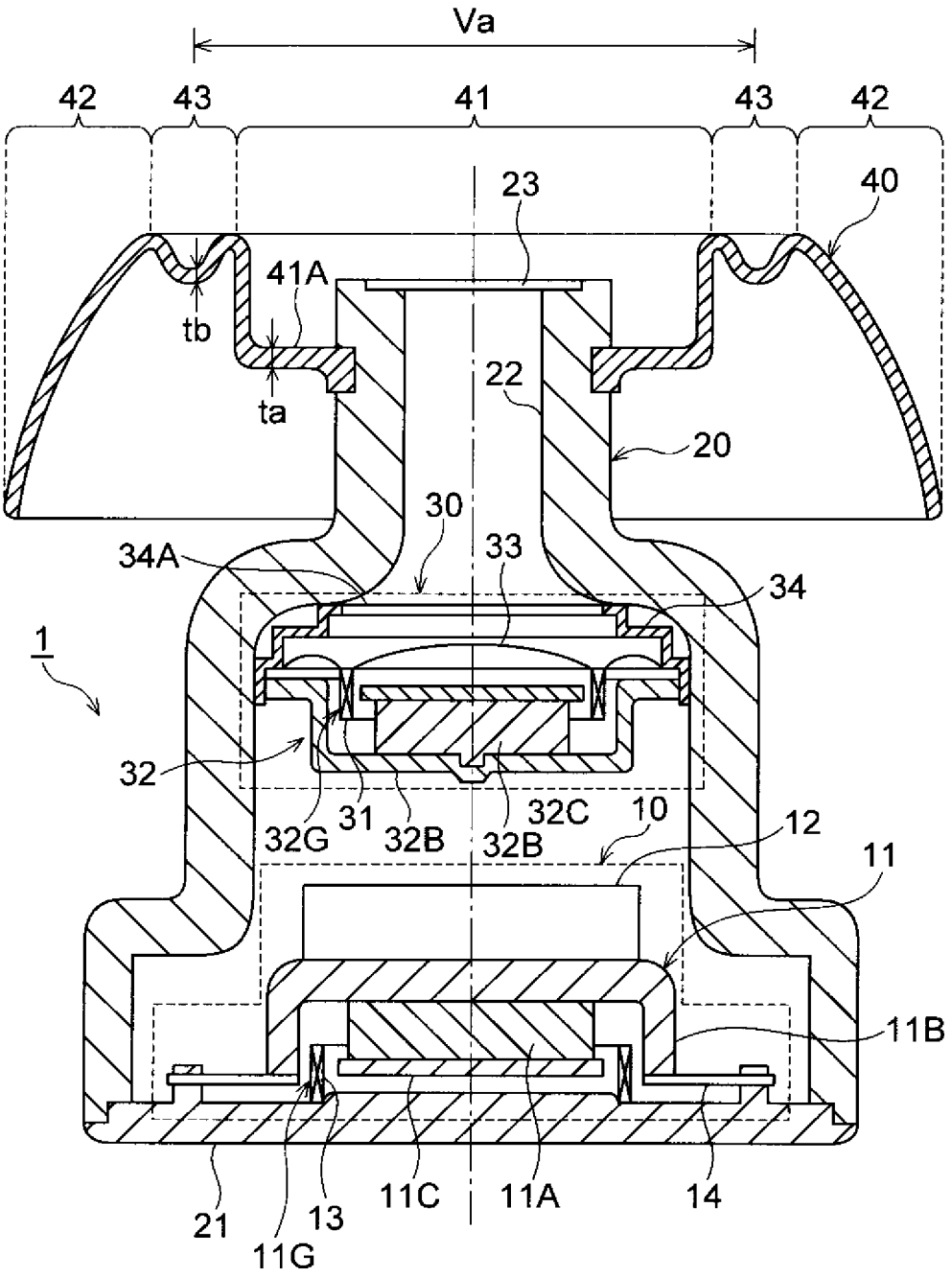
14. L'écouteur de la revendication 9, dans lequel ledit circuit magnétique (11) est pourvu d'une pièce pesante (12).

15. L'écouteur de la revendication 14, dans lequel la masse dudit circuit magnétique (11) comprenant ladite pièce pesante (12) est substantiellement la même que la masse totale dudit boitier (20) et de ladite unité de haut-parleur (30).

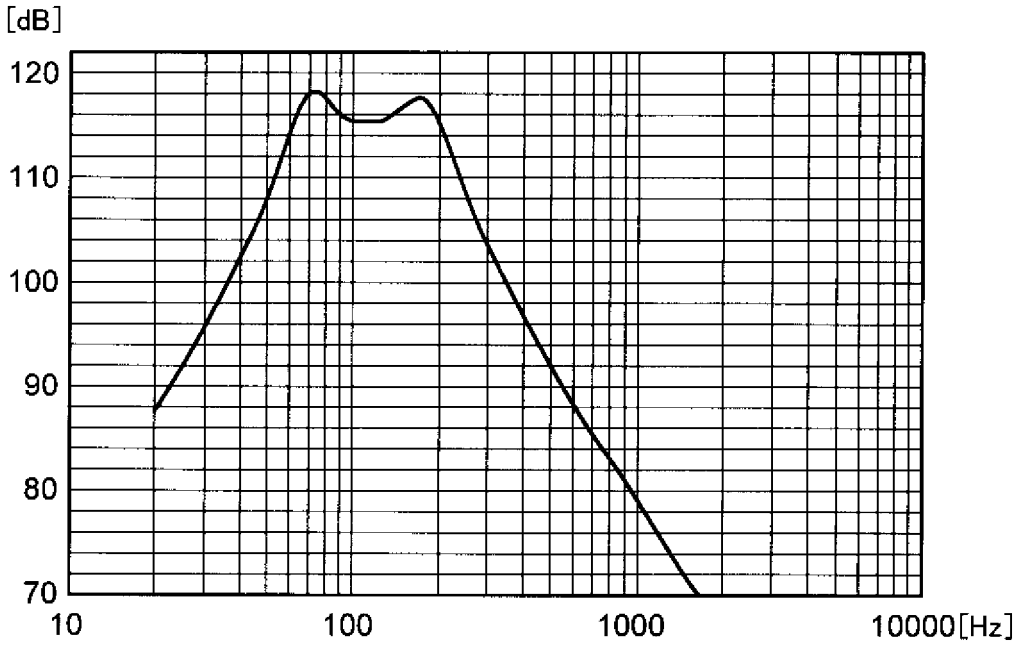
[Fig. 1]



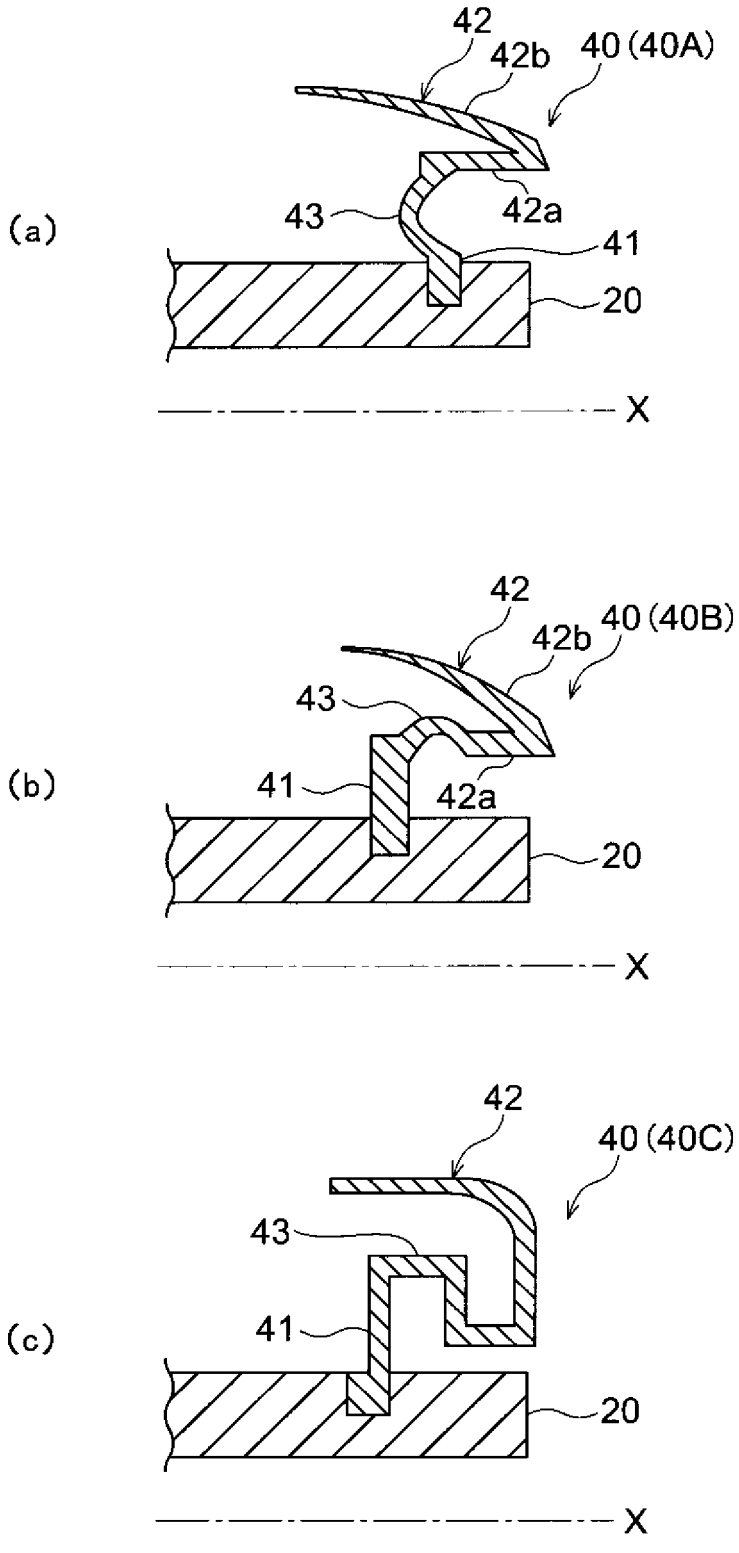
[Fig. 2]


Va
42
43
41
43
42
23
40
41A
tb
ta
22
20
30
34A
33
34
1
32
32G
31
32B
32C
32B
10
12
11
11B
21
11G
13
11C
11A
14

[Fig. 3]

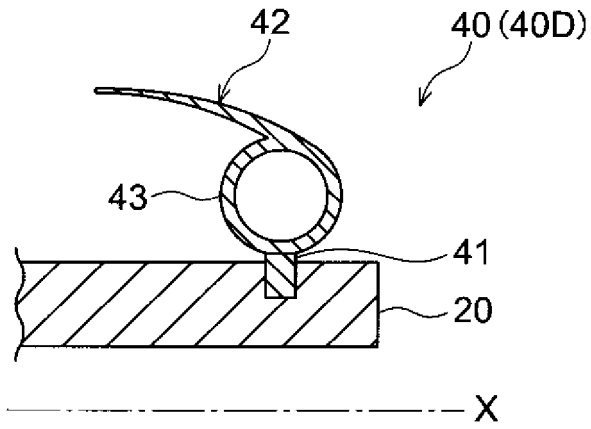


[Fig. 4]

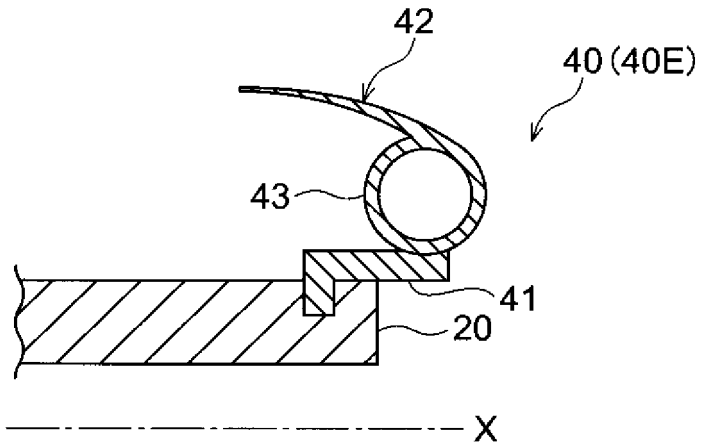

(a)
42
42b
40 (40A)
43
42a
41
20
X
(b)
42
42b
40 (40B)
43
41
42a
20
X
(c)
42
40 (40C)
43
41
20
X

[Fig. 5]

(a)



(b)



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2010010885 A **[0003]**
- EP 1058479 A2 **[0003]**
- US 20110034218 A1 **[0003]**
- US 20100296667 A1 **[0003]**