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(54) **EARPHONES**

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(2013.01)

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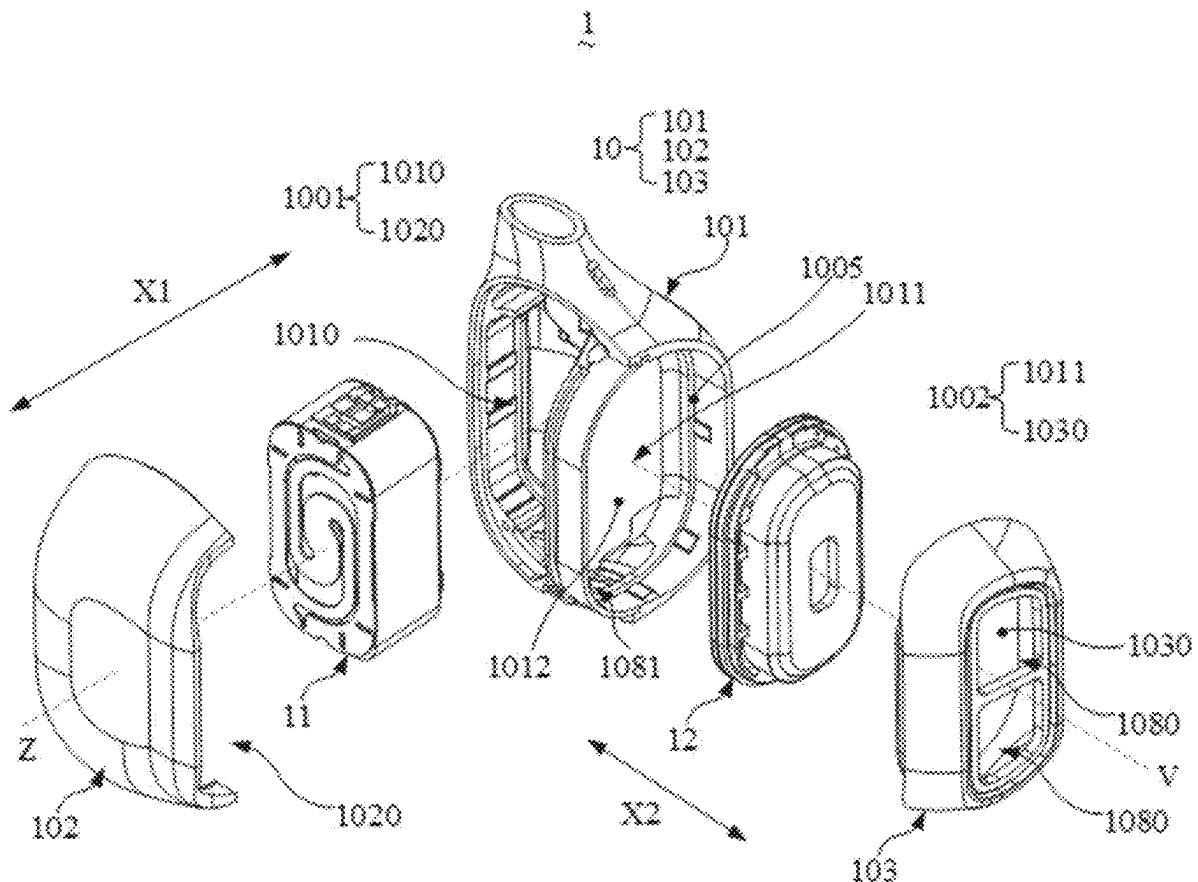
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H04R 1/10 (2006.01)

H04R 1/24 (2006.01)

(57) **ABSTRACT**

The present disclosure relates an earphone, comprising a shell assembly, a bone-conducting loudspeaker, and a fixing adhesive. The shell assembly is provided with an accommodation cavity. The bone-conducting loudspeaker is accommodated in the accommodation cavity. The bone-conducting loudspeaker is configured to vibrate along a central axis direction of the bone-conducting loudspeaker. The shell assembly and/or the bone-conducting loudspeaker is provided with a locating portion. The locating portion is configured to maintain a predetermined gap between an inner peripheral surface of the shell assembly and an outer peripheral surface of the bone-conducting loudspeaker along a radial direction of the bone-conducting loudspeaker. The fixing adhesive is filled in the predetermined gap and configured to connect the shell assembly to the bone-conducting loudspeaker. The present disclosure facilitates the adhesive fixation of the internal parts of the earphone and reduces the difficulty of assembling the earphone.



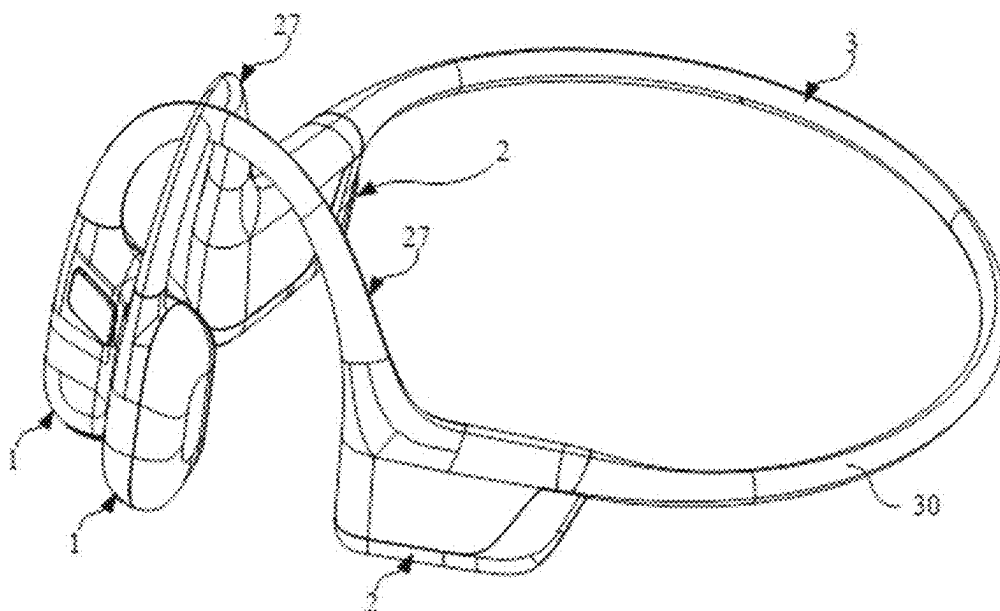


FIG. 1

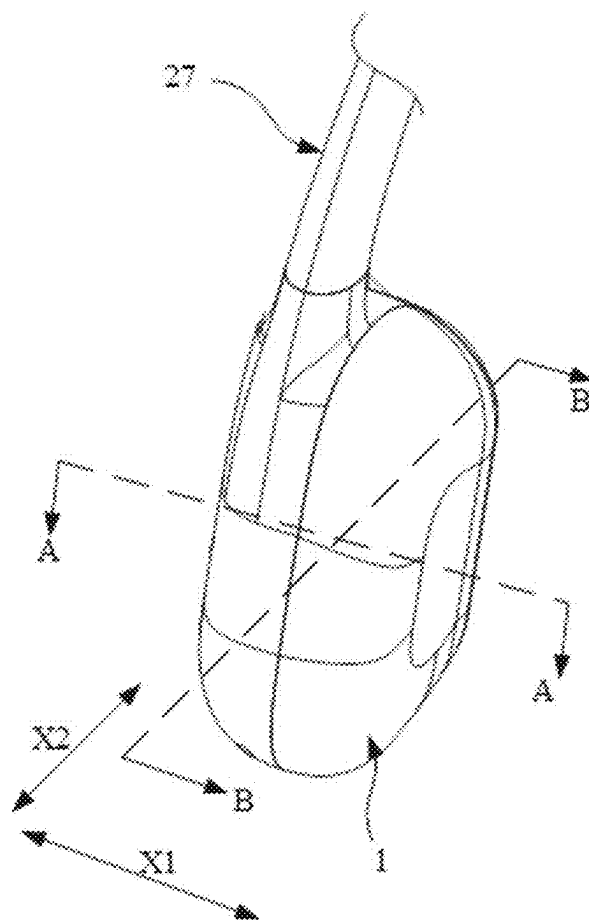


FIG. 2

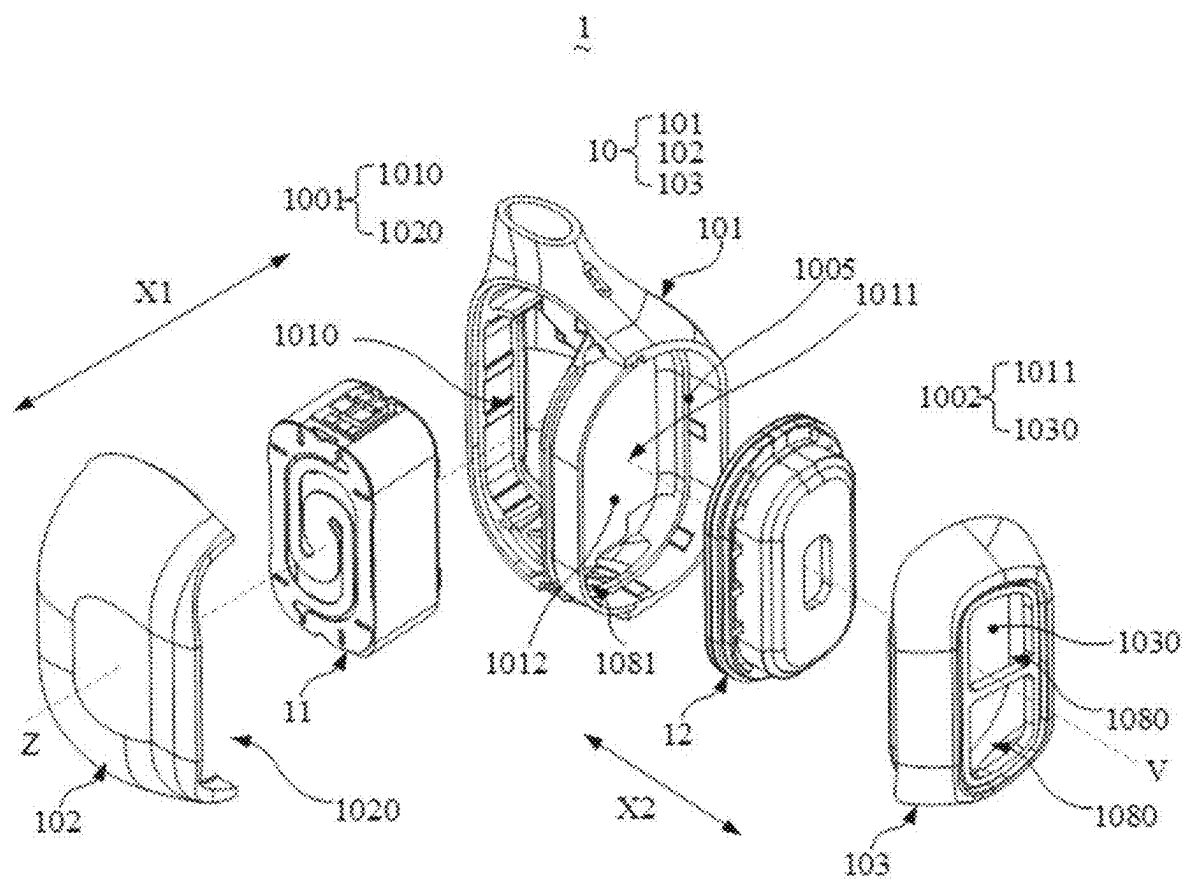


FIG. 3

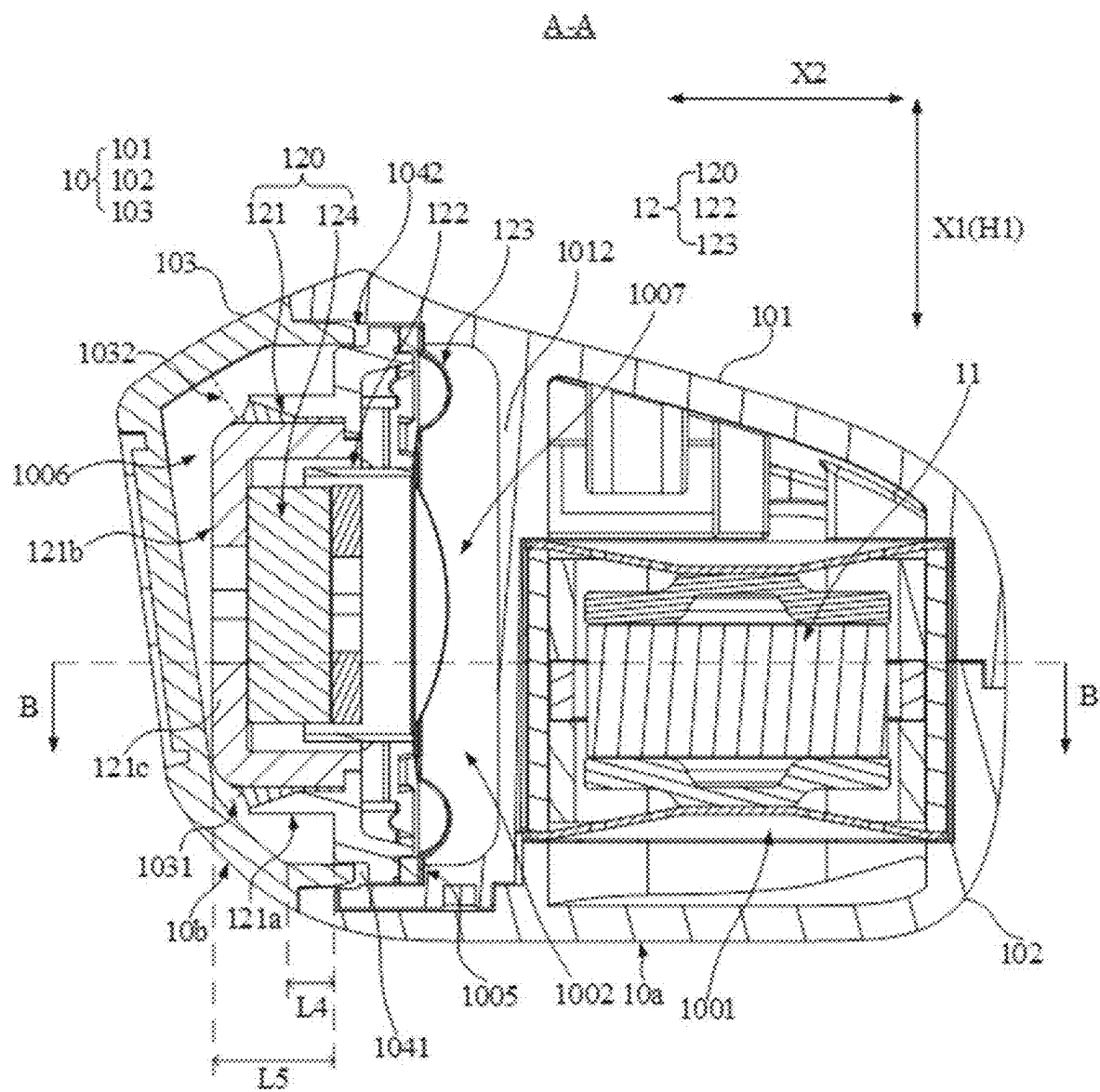


FIG. 4

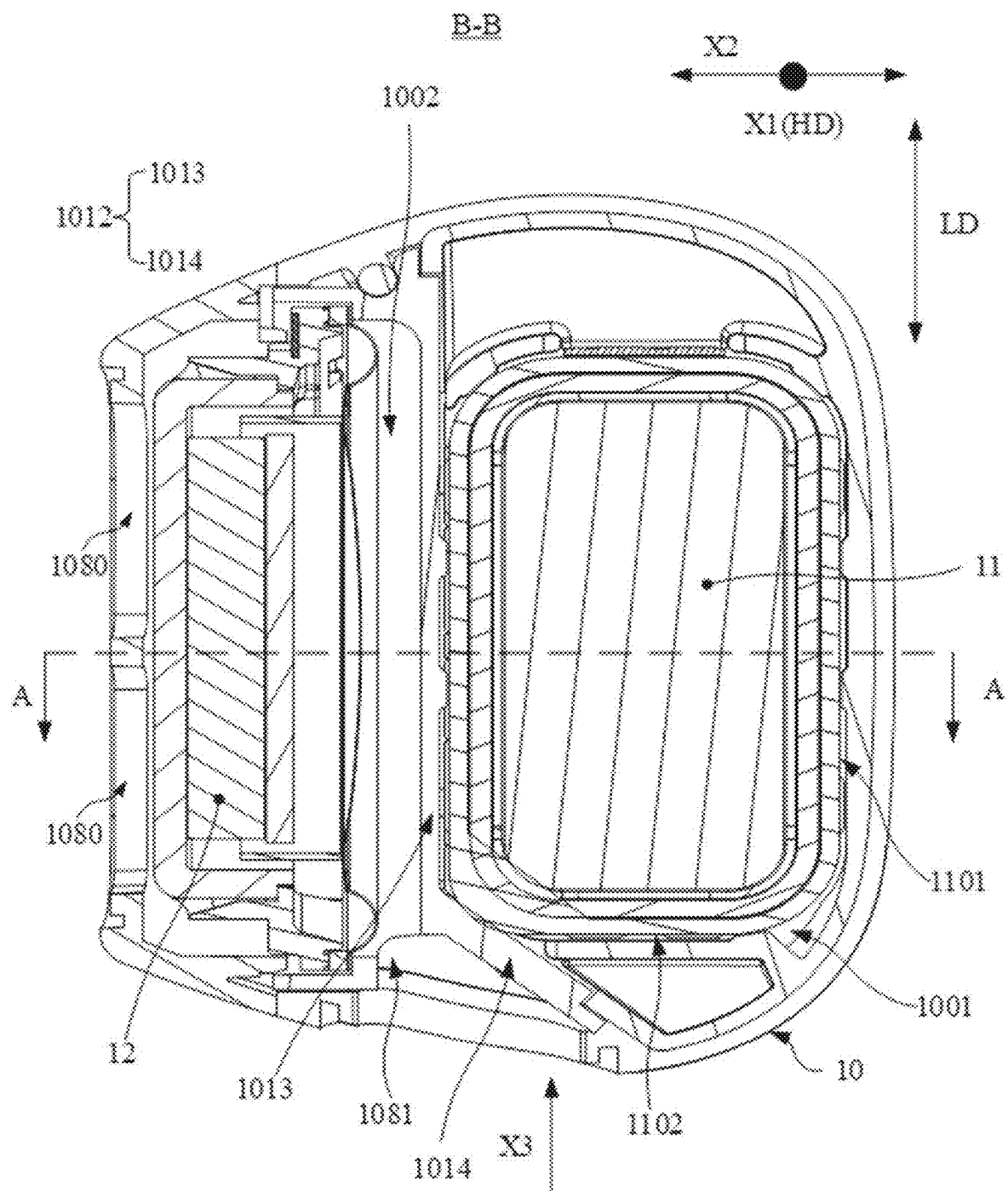


FIG. 5

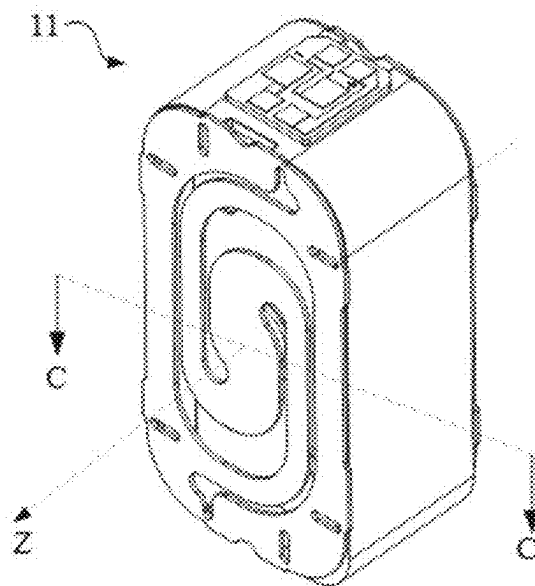


FIG. 6

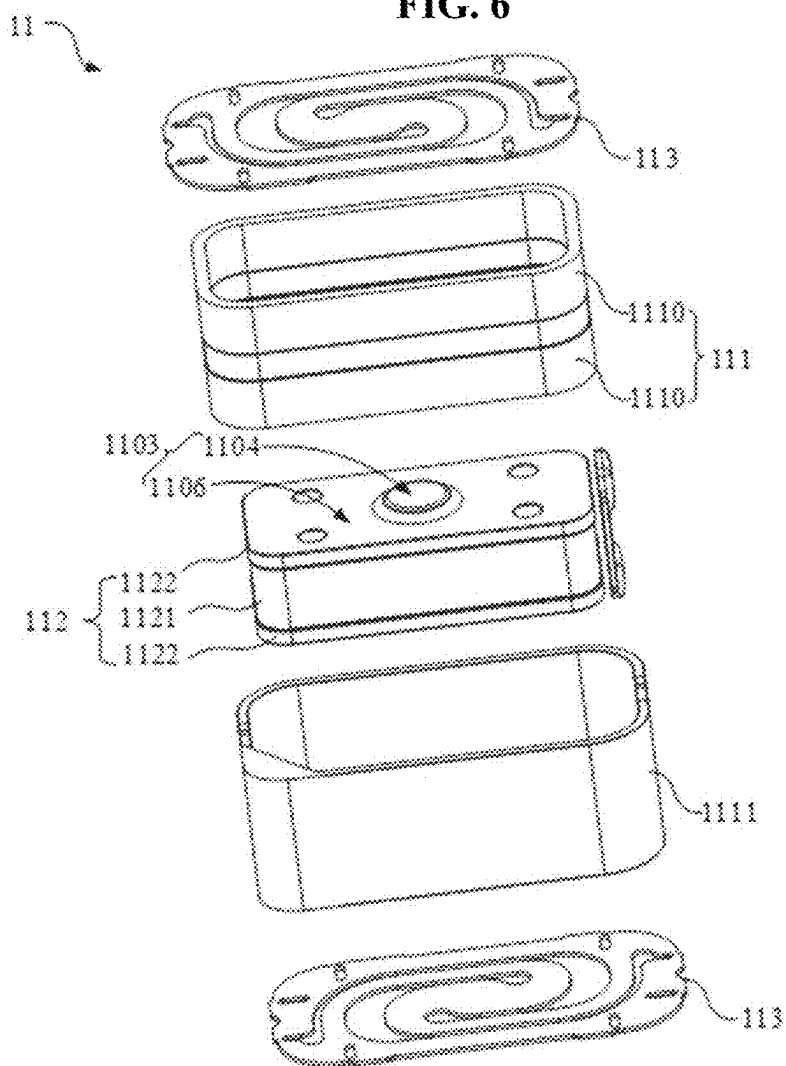


FIG. 7

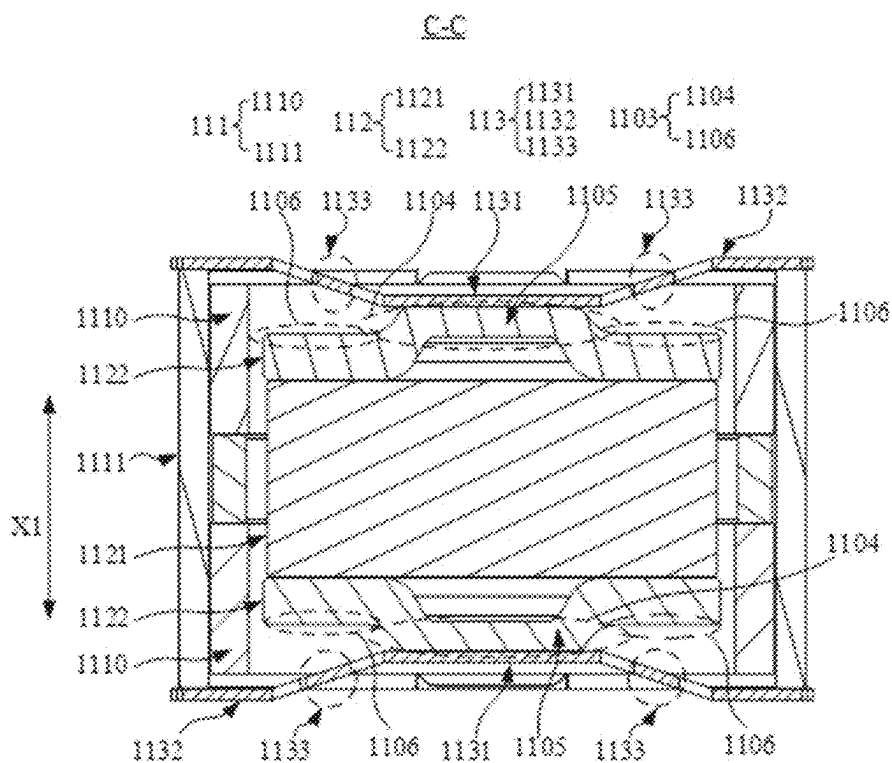


FIG. 8

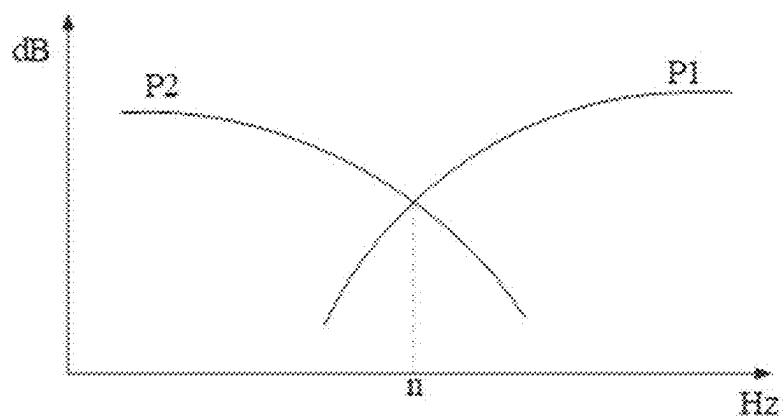


FIG. 9a

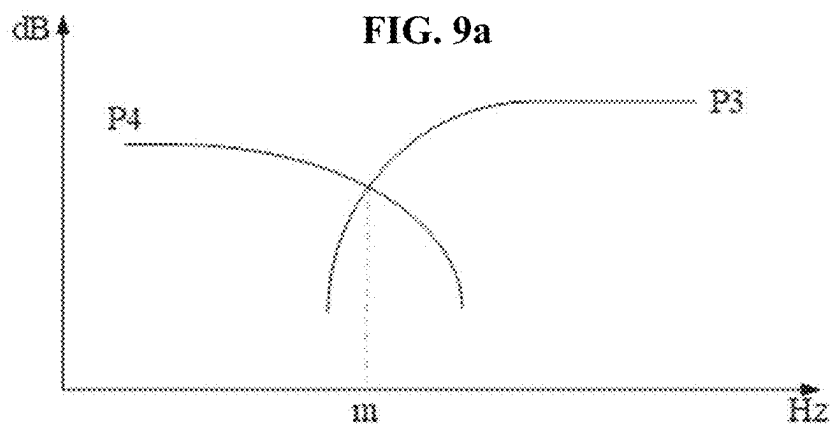
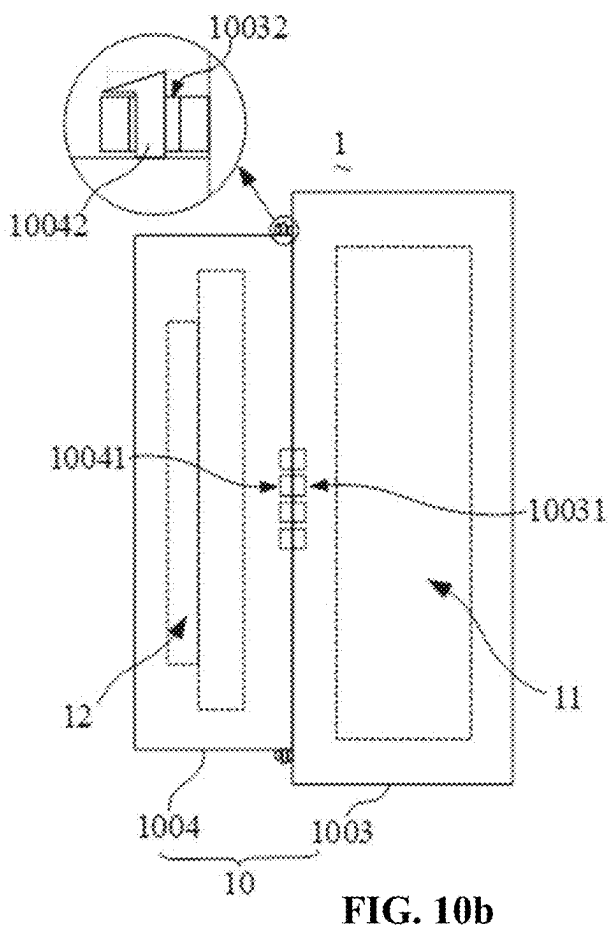
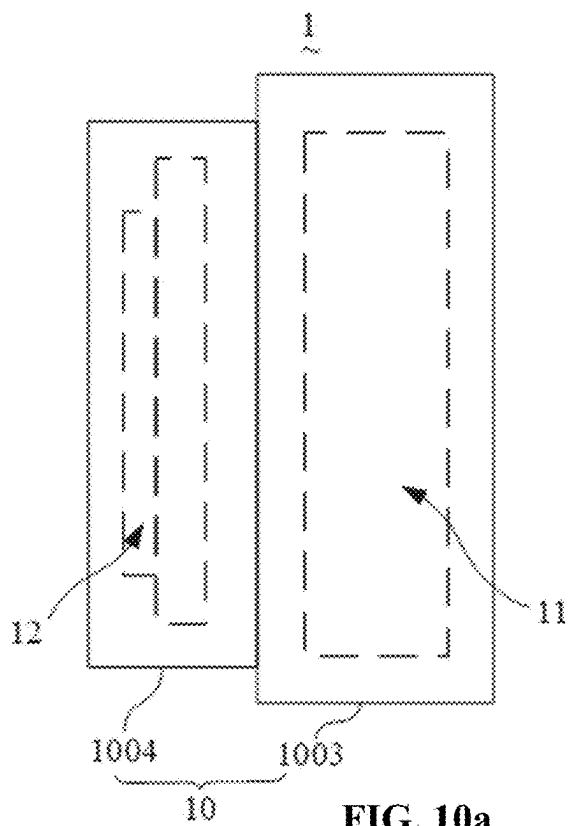


FIG. 9b



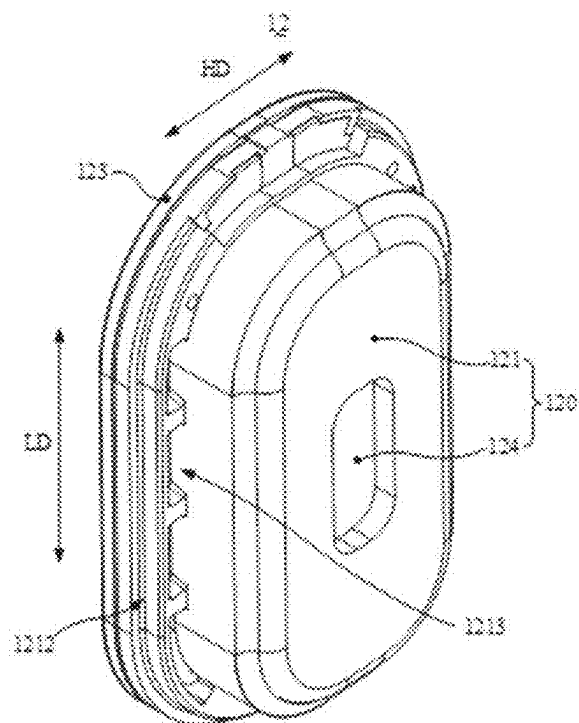


FIG. 11

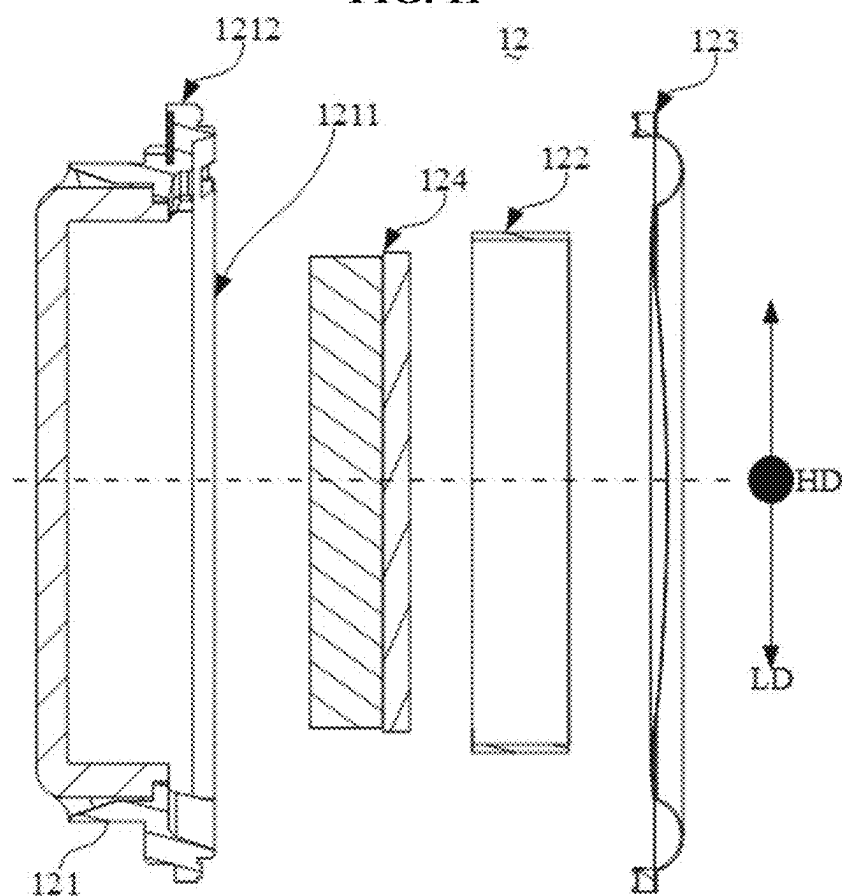


FIG. 12

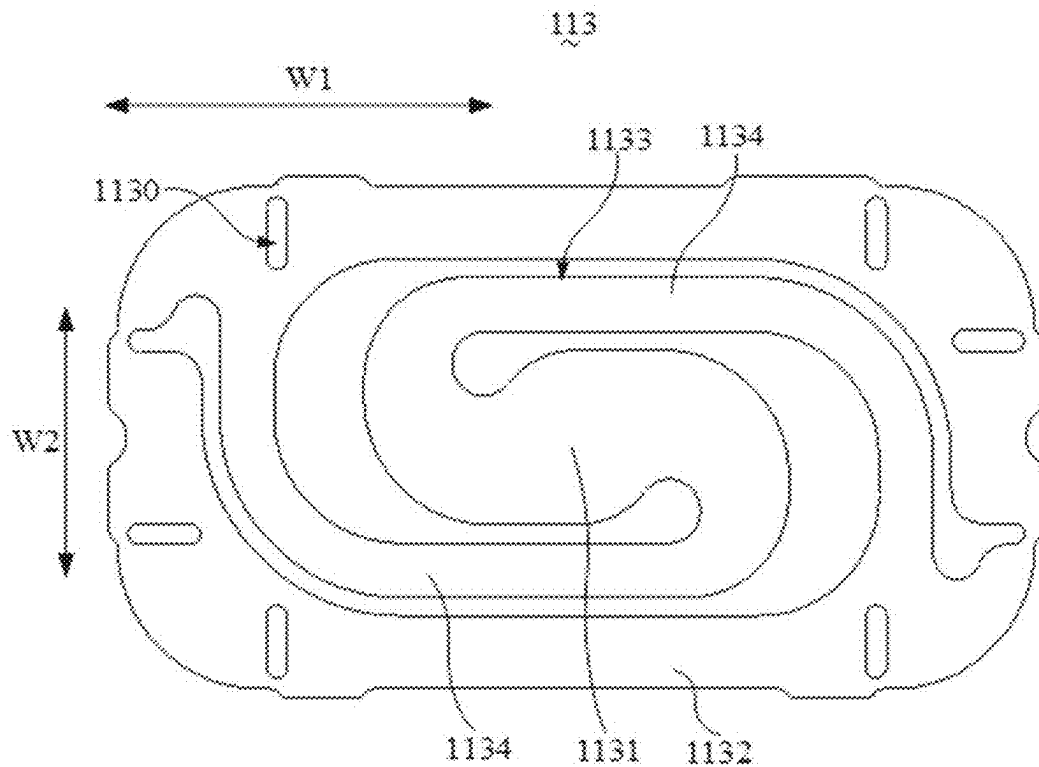


FIG. 13

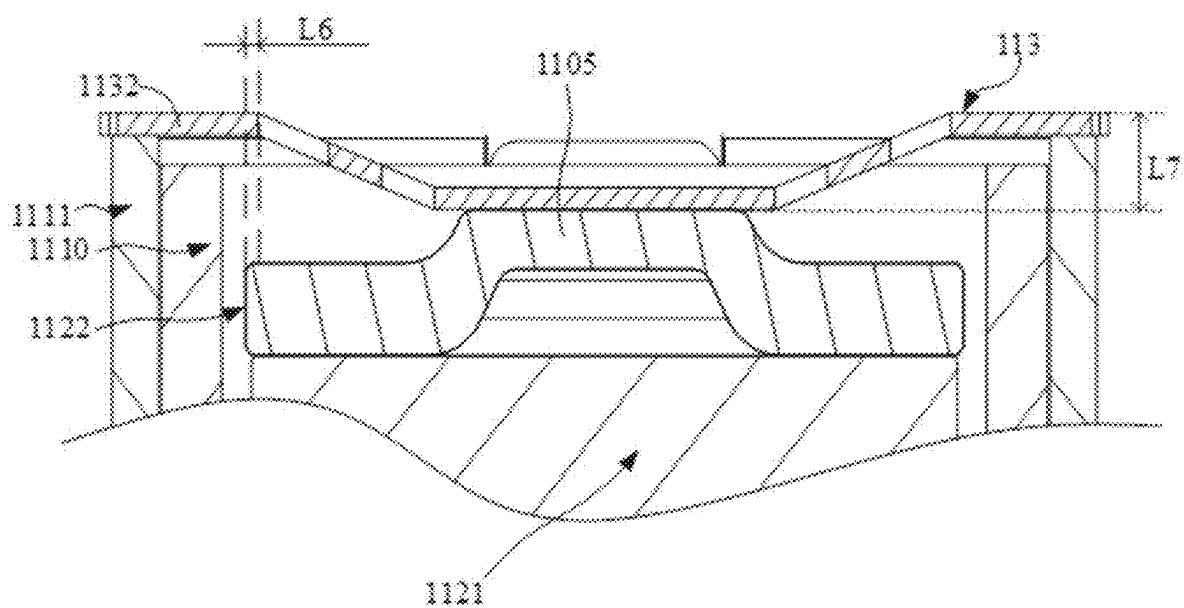


FIG. 14

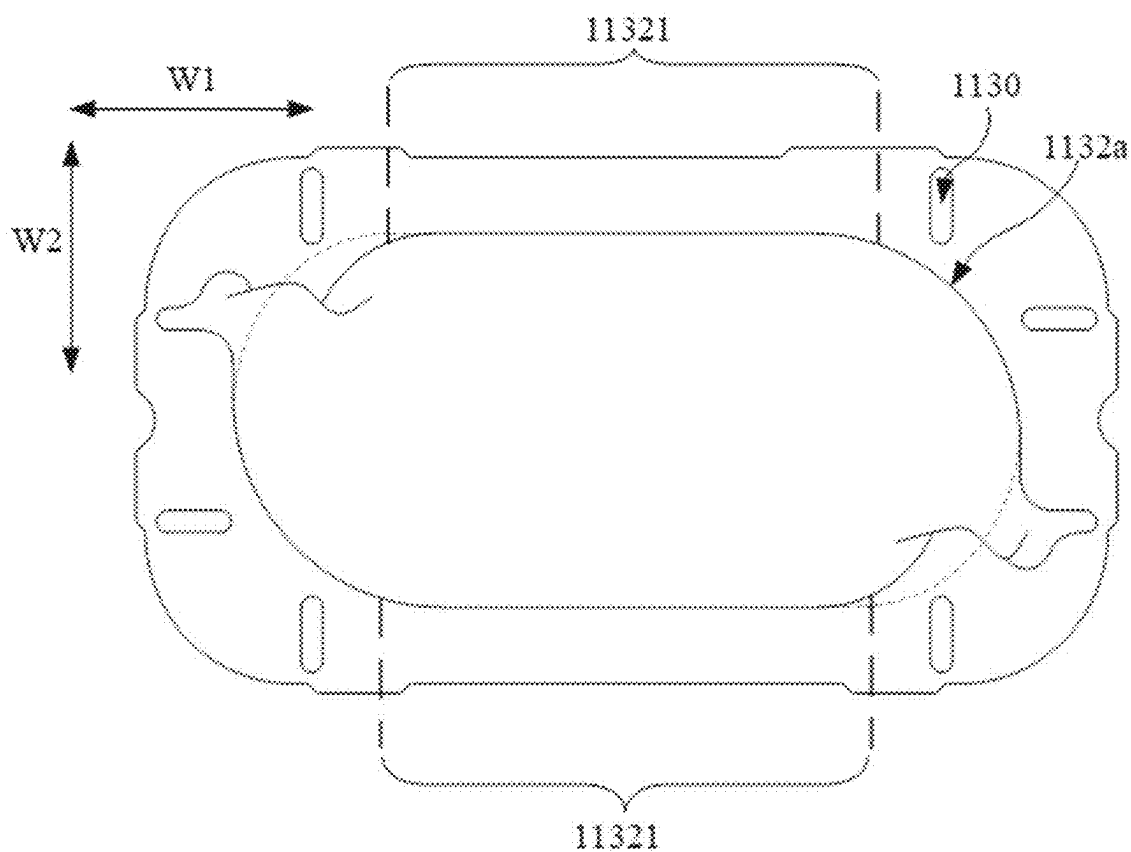


FIG. 15

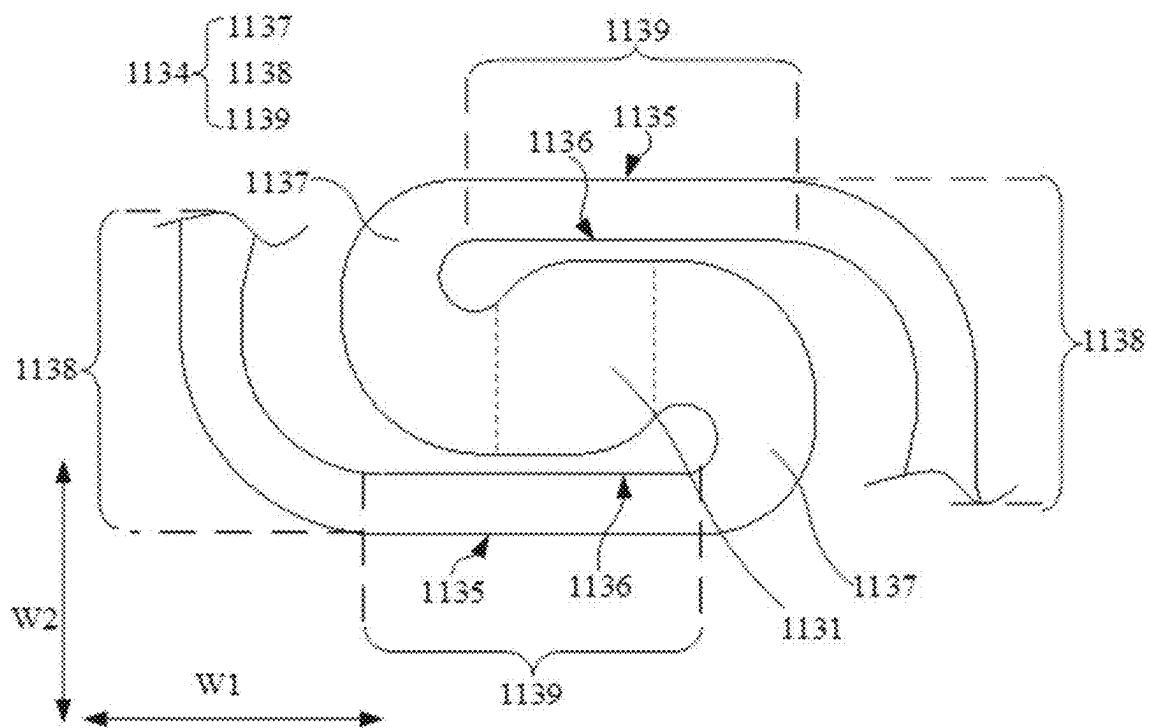


FIG. 16

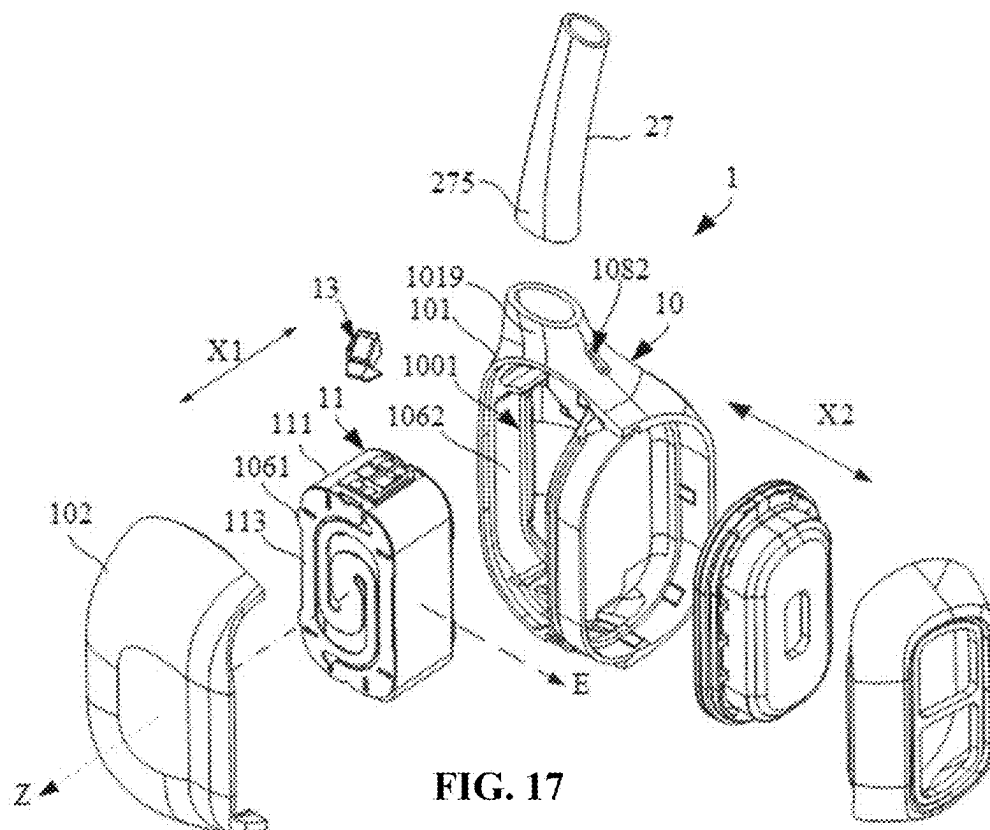


FIG. 17

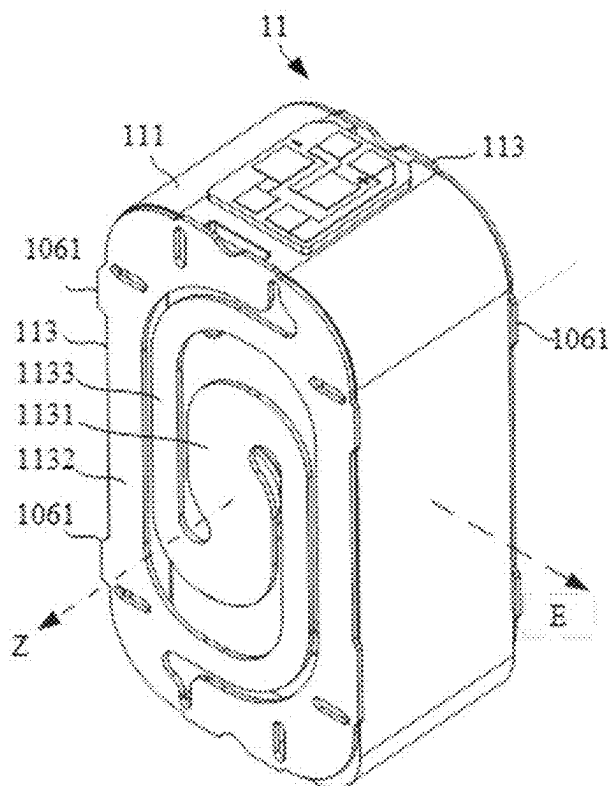


FIG. 18

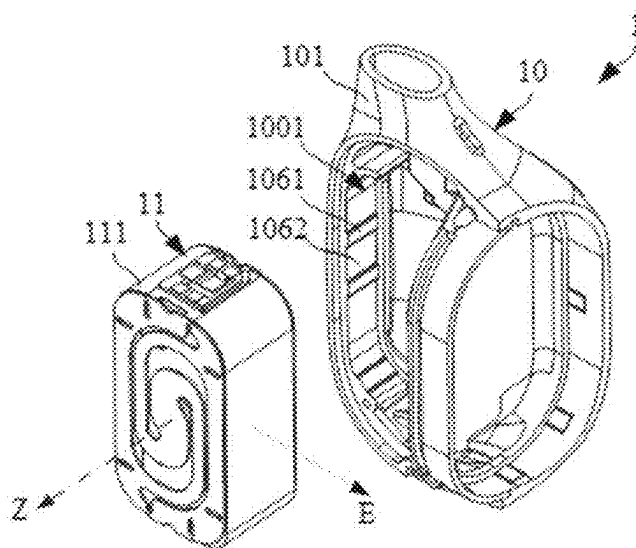


FIG. 19

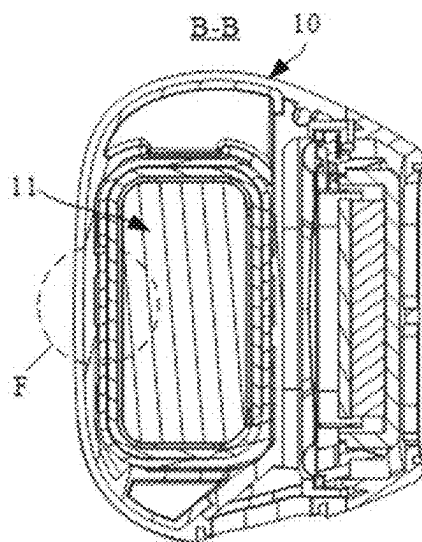


FIG. 20

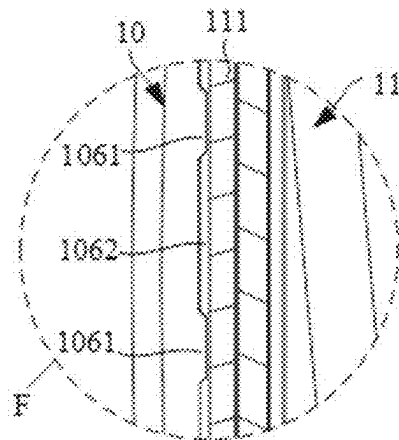


FIG. 21

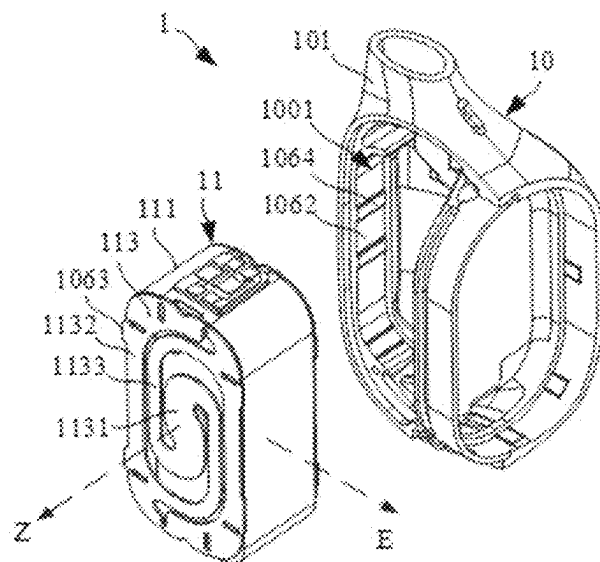


FIG. 22

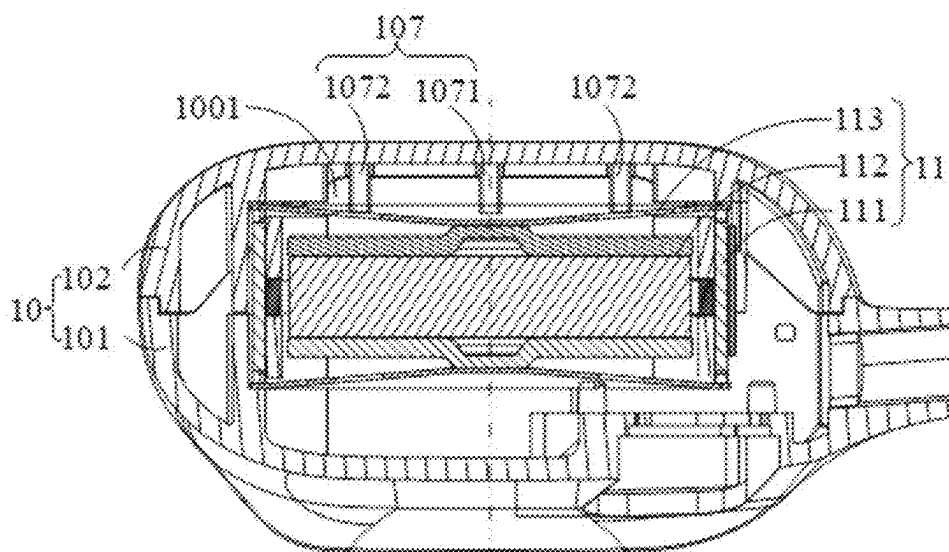


FIG. 23

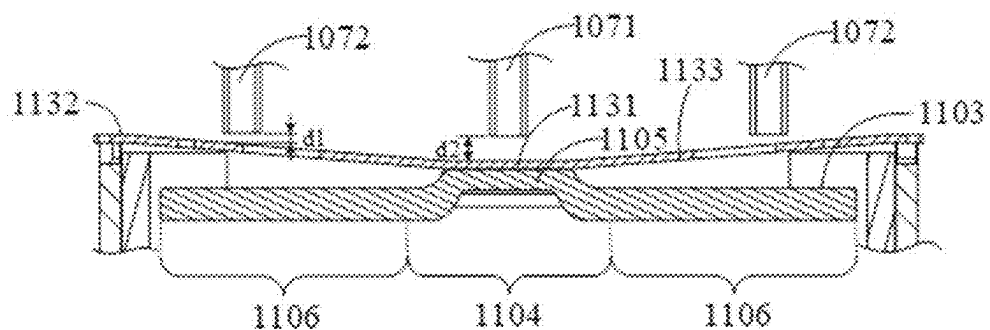


FIG. 24

EARPHONES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation of International Application No. PCT/CN2023/140254, filed on Dec. 20, 2023, which claims priority to Chinese Patent Application No. 202310541798.X, entitled Earphones, filed on May 12, 2023, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present application relates to the technical field of electronic devices, and in particular, to earphones.

BACKGROUND

[0003] With the increasing prevalence of electronic devices, they have become indispensable social and entertainment tools in people's daily lives, leading to higher user expectations. Earphones, as a type of electronic device, are now widely used in daily life and can be paired with terminal devices such as mobile phones and computers to provide an immersive auditory experience. However, some shell assemblies of earphones are not easily secured with adhesive, making assembly more challenging.

SUMMARY

[0004] The present disclosure provides an earphone, comprising a shell assembly, a bone-conducting loudspeaker, and a fixing adhesive. The shell assembly is provided with an accommodation cavity. The bone-conducting loudspeaker is accommodated in the accommodation cavity, and the bone-conducting loudspeaker is provided to vibrate along a central axis direction of the bone-conducting loudspeaker. The shell assembly and/or the bone-conducting loudspeaker is provided with a locating portion, the locating portion is configured to maintain a predetermined gap between an inner peripheral surface of the shell assembly and an outer peripheral surface of the bone-conducting loudspeaker along a radial direction of the bone-conducting loudspeaker. The fixing adhesive is filled in the predetermined gap and configured to connect the shell assembly to the bone-conducting loudspeaker.

[0005] In some embodiments, there are a plurality of locating portions and the plurality of locating portions are spaced apart along a circumferential direction of the bone-conducting loudspeaker.

[0006] In some embodiments, the bone-conducting loudspeaker includes a vibration transmission sheet, the vibration transmission sheet includes a central fixing portion, an annular fixing portion around a periphery of the central fixing portion, and a linkage assembly connected between the central fixing portion and the annular fixing portion, and the locating portion is integrally molded to an outer ring edge of the annular fixing portion.

[0007] In some embodiments, the locating portion is integrally molded to the inner peripheral surface of the shell assembly.

[0008] In some embodiments, the bone-conducting loudspeaker includes a vibration transmission sheet, the vibration transmission sheet includes a central fixing portion, an annular fixing portion around a periphery of the central fixing portion, and a linkage assembly connected between

the central fixing portion and the annular fixing portion, the locating portion includes a first locating portion integrally molded to an outer ring edge of the annular fixing portion and a second locating portion integrally molded to the inner peripheral surface of the shell assembly.

[0009] In some embodiments, the first locating portion and the second locating portion are staggered from each other along a circumferential direction of the bone-conducting loudspeaker.

[0010] In some embodiments, the bone-conducting loudspeaker includes a voice coil assembly, a vibration transmission sheet, and a magnet assembly. The voice coil assembly is arranged around the magnet assembly, the vibration transmission sheet is elastically connected to the voice coil assembly and the magnet assembly to elastically constrain relative movement between the voice coil assembly and the magnet assembly along the central axis direction of the bone-conducting loudspeaker, and the fixing adhesive connects the shell assembly and the voice coil assembly.

[0011] In some embodiments, the voice coil assembly includes two sets of voice coils spaced apart along the central axis direction and a magnetic conduction shield arranged around an outer periphery of the two sets of voice coils. The magnet assembly includes a magnet and two magnetic conduction plates, the two magnetic conduction plates are arranged on opposite end surfaces of the magnet along the central axis direction, projections of the two magnetic conduction plates along the radial direction overlap with the two sets of voice coils, and current directions of the two sets of voice coils are opposite to each other.

[0012] In some embodiments, the earphone further comprises a wearing assembly. The shell assembly includes a shell and a shell, the shell and the shell fit with each other to form the accommodation cavity, the shell is connected to the wearing assembly, and the fixing adhesive connects the shell and the voice coil assembly.

[0013] In some embodiments, the shell and the shell fit with each other along the central axis direction, and the shell further presses and fixes the voice coil assembly to the shell.

[0014] In some embodiments, the bone-conducting loudspeaker includes a voice coil assembly, a magnet assembly, and a vibration transmission sheet. The vibration transmission sheet is elastically connected to the voice coil assembly and the magnet assembly to elastically constrain relative movement between the voice coil assembly and the magnet assembly along the central axis direction of the bone-conducting loudspeaker, one of the voice coil assembly and the magnet assembly is rigidly connected to the shell assembly. The shell assembly is provided with a stop member, and the stop member rigidly constrains a range of relative movement between the voice coil assembly and the magnet assembly along the central axis direction.

[0015] In some embodiments, the stop member is protrudingly arranged on a surface of the shell assembly directed toward another one of the voice coil assembly and the magnet assembly along the central axis direction and abuts against the vibration transmission sheet or the another one of the voice coil assembly and the magnet assembly after the another one of the voice coil assembly and the magnet assembly moves a predetermined distance relative to the one of the voice coil assembly and the magnet assembly.

[0016] In some implementations, the stop member is integrally molded to the shell assembly.

[0017] In some embodiments, the one of the voice coil assembly and the magnet assembly is arranged around the another one of the voice coil assembly and the magnet assembly. The vibration transmission sheet includes a central fixing portion, an annular fixing portion around a periphery of the central fixing portion, and a linkage assembly connected between the central fixing portion and the annular fixing portion. The annular fixing portion is connected to the one of the voice coil assembly and the magnet assembly, the central fixing portion is connected to the another one of the voice coil assembly and the magnet assembly, and the stop member includes a first stop member configured to abut against the central fixing portion.

[0018] In some embodiments, the stop member includes a second stop member configured to abut against the linkage assembly.

[0019] In some embodiments, in a natural state, the linkage assembly has an extension component starting at the annular fixing portion and pointing toward an interior of the bone-conducting loudspeaker along the central axis direction. Along the central axis direction, a spacing from the first stop member to the central fixing portion is greater than a spacing from the second stop member to the linkage assembly.

[0020] In some embodiments, in the natural state, the second stop member abuts against the linkage assembly.

[0021] In some embodiments, the spacing from the first stop member to the central fixing portion is greater than or equal to 0.1 mm.

[0022] In some embodiments, along an extension direction of the linkage assembly, a position of the second stop member abutting against the linkage assembly is closer to the annular fixing portion compared to the central fixing portion.

[0023] In some embodiments, the shell assembly includes a first shell and a second shell fitting with each other along the central axis direction. The stop member is arranged on an inner surface of the first shell and/or an inner surface of the second shell, and an outer surface of the first shell and/or an outer surface of the second shell is in contact with a user's skin.

[0024] In some implementations, the voice coil assembly is arranged around the magnet assembly, and the voice coil assembly is rigidly connected to the first shell and/or second shell.

[0025] In some embodiments, the second shell further presses and fixes the voice coil assembly to the first shell.

[0026] The beneficial effect of the present disclosure is as follows: by maintaining the predetermined gap between the bone-conducting loudspeaker and the shell assembly along the circumferential direction of the bone-conducting loudspeaker can facilitate the addition of the fixing adhesive, thereby simplifying the process of producing the earphone. This allows the fixing adhesive to flow along the circumferential direction of the bone-conducting loudspeaker and fill the gap between the bone-conducting loudspeaker and the shell assembly more evenly, thereby enhancing the fixing effect of the fixing adhesive, stabilizing the position of the bone-conducting loudspeaker in the accommodation cavity, and rendering the structure of the earphone more compact and stable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] To more clearly illustrate the technical solutions in the embodiments of the present disclosure, the accompanying drawings that need to be used in the description of the embodiments will be briefly introduced in the following, and it will be obvious that the accompanying drawings in the following description are only some of the embodiments of the present disclosure, and other attachments can be obtained according to them without creative labor to a person of ordinary skill in the art.

[0028] FIG. 1 is a schematic diagram illustrating a 3D structure of a general assembly of an earphone according to some embodiments of the present disclosure;

[0029] FIG. 2 is a schematic diagram illustrating a 3D structure of a portion between a core assembly and a wearing assembly shown in FIG. 1;

[0030] FIG. 3 is an exploded structural diagram of the core assembly shown in FIG. 2;

[0031] FIG. 4 is a schematic diagram illustrating a sectional structure of the core assembly shown in FIG. 2 along A-A;

[0032] FIG. 5 is a schematic diagram illustrating a sectional structure of the core assembly shown in FIG. 2 along B-B;

[0033] FIG. 6 is a schematic diagram illustrating a 3D structure of a bone-conducting loudspeaker shown in FIG. 3;

[0034] FIG. 7 is an exploded schematic diagram of a bone-conducting loudspeaker shown in FIG. 3;

[0035] FIG. 8 is a schematic diagram illustrating a sectional structure of the bone-conducting loudspeaker shown in FIG. 6 along C-C;

[0036] FIG. 9a is a schematic diagram illustrating sound signals in a first frequency band and a second frequency band in the earphone shown in FIG. 1;

[0037] FIG. 9b is a schematic diagram illustrating frequencies of electrical signals input to a bone-conducting loudspeaker and an air-conducting loudspeaker of the earphone shown in FIG. 1 in a first operation mode;

[0038] FIG. 10a is a schematic diagram illustrating an exemplary structure of a detachable solution for a bone-conducting loudspeaker and an air-conducting loudspeaker of the earphone shown in FIG. 1;

[0039] FIG. 10b is a schematic diagram illustrating an exemplary structure of the bone-conducting loudspeaker and the air-conducting loudspeaker shown in FIG. 10a;

[0040] FIG. 11 is a schematic diagram illustrating a 3D structure of an air-conducting loudspeaker shown in FIG. 3;

[0041] FIG. 12 is an exploded schematic diagram of the air-conducting loudspeaker shown in FIG. 11;

[0042] FIG. 13 is a schematic diagram illustrating a vibration transmission sheet shown in FIG. 7 from a front view;

[0043] FIG. 14 is a schematic diagram illustrating a portion of a sectional structure of the bone-conducting loudspeaker shown in FIG. 8;

[0044] FIG. 15 is a schematic diagram illustrating an exemplary structure of an annular fixing portion of the vibration transmission sheet shown in FIG. 13;

[0045] FIG. 16 is a schematic diagram illustrating an exemplary structure of a linkage assembly of the vibration transmission sheet shown in FIG. 13 connected to a central fixing portion;

[0046] FIG. 17 is another schematic diagram illustrating a disassembled structure of the core assembly shown in FIG. 2;

[0047] FIG. 18 is a schematic diagram illustrating an exemplary structure of a bone-conducting loudspeaker shown in FIG. 17;

[0048] FIG. 19 is a schematic diagram illustrating a portion of a disassembled structure of the core assembly shown in FIG. 17;

[0049] FIG. 20 is a schematic diagram illustrating another sectional structure of the core assembly shown in FIG. 2 along B-B;

[0050] FIG. 21 is a schematic diagram illustrating an enlarged structure of an F-region shown in FIG. 20;

[0051] FIG. 22 is another schematic diagram illustrating a portion of a disassembled structure of the core assembly shown in FIG. 18;

[0052] FIG. 23 is a schematic diagram illustrating a sectional structure of the core assembly shown in FIG. 2; and

[0053] FIG. 24 is a schematic diagram illustrating a portion of a sectional structure of the core assembly shown in FIG. 23.

DETAILED DESCRIPTION

[0054] The present application is described in further detail below in conjunction with the accompanying drawings and embodiments. In particular, it is noted that the following embodiments are only used to illustrate the present disclosure, but do not limit the scope of the present disclosure. Similarly, the following embodiments are only part of the embodiments of the present disclosure rather than all of the embodiments, and all other embodiments obtained by a person of ordinary skill in the art without creative labor fall within the scope of protection of the present disclosure. [0055] References to “embodiments” in the present disclosure mean that particular features, structures, or characteristics described in conjunction with embodiments may be included in at least one embodiment of the present disclosure. It is understood by those of skill in the art, both explicitly and implicitly, that the embodiments described in the present disclosure may be combined with other embodiments.

[0056] The following embodiments of the present disclosure describe an exemplary structure of an earphone 100.

[0057] As shown in FIG. 1, the earphone 100 may include a core assembly 1, an ear-hook assembly 2, and a rear-hook assembly 3. There may be two core assemblies 1. The two core assemblies 1 are used to transmit vibration and/or sound to the user's left ear and right ear, respectively. The two core assemblies 1 may be the same or different. For example, one of the core assemblies 1 may be provided with a microphone, and another core assembly 1 may not be provided with a microphone. For example, one of the core assemblies 1 may be provided with a key and a corresponding circuit board, and another core assembly 1 may not be provided with a key and a corresponding circuit board. The two core assemblies 1 may be identical on a core module (e.g. a loudspeaker module). The core assembly 1 described in the following text can be considered as being detailed with one of the two core assemblies 1 as an example. There may be two ear-hook assemblies 2, and the two ear-hook assemblies 2 may be located on the user's left and right ears, respectively, so that the core assemblies 1 can be fitted to the user's face. For example, one of the ear-hook assemblies 2 may be provided with a battery, and another ear-hook assembly 2 may be provided with a control circuit, or the like. One end of the ear-hook assembly 2 is connected to the

core assembly 1, and another end of the ear-hook assembly 2 is connected to the rear-hook assembly 3. The rear-hook assembly 3 connects the two ear-hook assemblies 2, and the rear-hook assembly 3 is used to wrap around the back of a user's neck or the back of a user's head and provide a clamping force that allows the two core assemblies 1 to be clamped to two sides of a user's face and the ear-hook assemblies 2 to be more securely attached to the user's ears. It should be understood that the earphone 100 may also not include the rear-hook assembly 3, and the core assembly 1 may be worn on the user's ears through the ear-hook assembly 2.

[0058] The following content primarily provides an exemplary description of the core assembly 1 and other structures of the earphone 100.

[0059] As shown in FIG. 2, FIG. 3, FIG. 4, and FIG. 5, the core assembly 1 may include a shell assembly 10, a bone-conducting loudspeaker 11, and an air-conducting loudspeaker 12.

[0060] Optionally, the shell assembly 10 may be provided with an accommodation cavity 1001 and an accommodation cavity 1002 that are isolated from each other. The shell assembly 10 may also be referred to as a core shell assembly 10. The bone-conducting loudspeaker 11 is accommodated in the accommodation cavity 1001, and the accommodation cavity 1001 may be referred to as a first accommodation cavity. The air-conducting loudspeaker 12 is accommodated in the accommodation cavity 1002, and the accommodation cavity 1002 may be referred to as a second accommodation cavity.

[0061] The air-conducting loudspeaker 12 conducts the sound into the ear canal of the user through air vibration, and the bone-conducting loudspeaker 11 conducts the sound into the user through bone-conducting vibration. Optionally, the sealing performance of the accommodation cavity 1001 is greater than the sealing performance of the accommodation cavity 1002. The sealing performance can be considered as airtightness. Optionally, the accommodation cavity 1001 may be provided as a completely airtight accommodation cavity, and the accommodation cavity 1002 is provided as an accommodation cavity with a relatively high degree of sealing performance while guaranteeing sound generation of the air-conducting loudspeaker 12. In the above-described manner, as the accommodation cavity 1002 in which the air-conducting loudspeaker 12 is placed needs to be connected to the outside world to facilitate the conduction of the sound waves through the air, the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12 are separately and independently arranged. There is no need to set the bone-conducting loudspeaker 11 in the accommodation cavity 1002. Instead, the bone-conducting loudspeaker 11 is separately arranged in the accommodation cavity 1001, and since the accommodation cavity 1001 is independent, it is possible to set the sealing performance of the accommodation cavity 1001 at a higher level, which effectively enhances the sealing effect of the bone-conducting loudspeaker 11, thereby preventing the bone-conducting loudspeaker 11 from being damaged by erosion of the external environmental factors, and at the same time guaranteeing the sound quality effect of the air-conducting loudspeaker 12. Additionally, in the earphone 100, when the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12 are operating at the same time, the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12 are

arranged in the accommodation cavity 1001 and the accommodation cavity 1002, respectively, which can effectively reduce mutual interference between the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12, thereby effectively enhancing the sound quality of the earphone 100.

[0062] Optionally, referring to FIG. 2 and FIG. 3, the shell assembly 10 may include a shell 101, a shell 102, and a shell 103, and the shell 101 and the shell 102 fit with each other to form the accommodation cavity 1001. The shell 101 and/or the shell 102 further form a portion of the accommodation cavity 1002, and the shell 103 may form another portion of the accommodation cavity 1002, and in turn, the shell 103 and the shell 101 and/or the shell 102 fit with each other to form the accommodation cavity 1002.

[0063] The shell assembly 10 may be composed of the shell 101, the shell 102, and the shell 103. The shell 101 and the shell 102 fit with each other to form the accommodation cavity 1001, and the shell 103 and the shell 101 fit with each other to form the accommodation cavity 1002. The shell assembly 10 is formed by the shell 101, the shell 102 and the shell 103 fitting with each other in the structure described above, which can make the core assembly 1 compact and at the same time facilitate the assembly of the core assembly 1, thereby enhancing the assembly efficiency of the core assembly 1. In some embodiments, the shell 101 may be referred to as a first shell; the shell 102 may be referred to as a second shell; and the third shell 103 may be referred to as a third shell.

[0064] As another example, a portion of the accommodation cavity 1002 may also be provided in the shell 102. The shell 103 and the shell 102 form the accommodation cavity 1002 by fitting with each other, or the shell 101 and the shell 102 fit with each other to form a portion of the accommodation cavity 1002, and the shell 103, the shell 101, and the shell 102 fit with each other to form the accommodation cavity 1002.

[0065] Through the above structure, it is possible to place the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12 in the accommodation cavity 1001 and the accommodation cavity 1002 which are independent of each other, respectively, reducing the mutual influence between the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12. This setup maximizes the acoustic output of both the air-conducting loudspeaker 12 and the bone-conducting loudspeaker 11, while enabling a compact structure of the core assembly 1, which in turn contributes to the miniaturization of the core assembly 1 and facilitates its assembly, thereby improving the assembly efficiency of the core assembly 1.

[0066] Optionally, a vibration direction of the bone-conducting loudspeaker 11 is arranged to intersect with a vibration direction of the air-conducting loudspeaker 12, and the shell 101 and the shell 102 fit along the vibration direction of the bone-conducting loudspeaker 11. The shell 103 fits with the shell 101 and/or the shell 102 along the vibration direction of the air-conducting loudspeaker 12.

[0067] Specifically, the vibration direction of the bone-conducting loudspeaker 11 is arranged to intersect with the vibration direction of the air-conducting loudspeaker 12. The vibration direction of the bone-conducting loudspeaker 11 is referred to as a bone-conducting vibration direction X1, and the vibration direction of the air-conducting loudspeaker 12 is referred to herein as an air-conducting vibration

direction X2, wherein the bone-conducting vibration direction X1 and the air-conducting vibration direction X2 are arranged to intersect rather than being parallel to each other. For example, the bone-conducting vibration direction X1 and the air-conducting vibration direction X2 are arranged perpendicularly or approximately perpendicular to each other (e.g., $90^{\circ} \pm 10^{\circ}$). When the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12 are operating at the same time, the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12 are vibrating along the bone-conducting vibration direction X1 and the air-conducting vibration direction X2, respectively. Since the two vibration directions are arranged to intersect with each other, this can effectively mitigate the impact of the bone-conducting loudspeaker 11's vibration on the sound quality of the air-conducting loudspeaker 12. Further, the shell 101 and the shell 102 may be assembled in conjunction with each other along the bone-conducting vibration direction X1, and the shell 103 and the shell 101 may be assembled in conjunction with each other along the air-conducting vibration direction X2. For example, the accommodation cavity 1002 may be formed by only the shell 101 and the shell 103 fitting together, with the shell 103 having a fitting relationship only with the shell 101 along the air-conducting vibration direction X2. As another example, instead of fitting with the shell 101 to form the accommodation cavity 1002, the shell 103 may fit with other shells along the air-conducting vibration direction X2 to form the accommodation cavity 1002, or the shell 103 may fit with the shell 101 and other shells to form the accommodation cavity 1002. In this way, it is favorable for the assembly of the core assembly 1 to enhance the efficiency of the assembly of the core assembly 1.

[0068] Referring to FIG. 6 and FIG. 7, optionally, the bone-conducting loudspeaker 11 includes a voice coil assembly 111 and a magnet assembly 112. The voice coil assembly 111 is provided around the magnet assembly 112 and is fixedly connected to the shell 101 and/or the shell 102. The surface of the shell 101 and/or the shell 102 that is disposed opposite to the bone-conducting loudspeaker 11 along the vibration direction of the bone-conducting loudspeaker 11 is configured to contact the user's skin and transmit bone-conducting vibration.

[0069] Optionally, referring to FIG. 6, FIG. 7, and FIG. 8, the voice coil assembly 111 includes two sets of voice coils 1110 spaced apart along a central axis direction Z of the bone-conducting loudspeaker 11 and a magnetic conduction shield 1111 surrounding an outer periphery of the two sets of voice coils 1110. The magnet assembly 112 includes a magnet 1121 and two magnetic conduction plates 1122, and the two magnetic conduction plates 1122 are respectively disposed on opposite end surfaces of the magnet 1121 along the central axis direction Z. Projections of the two magnetic conduction plates 1122 along a radial direction of the bone-conducting loudspeaker 11 overlap with the two sets of voice coils 1110, respectively, and current directions of the two sets of voice coils 1110 are opposite to each other. The central axis direction Z of the bone-conducting loudspeaker 11 coincides with the vibration direction of the bone-conducting loudspeaker 11 (i.e., the bone-conducting vibration direction X1).

[0070] Optionally, referring to FIG. 5, FIG. 7 and FIG. 8, an outer peripheral surface of the magnetic conduction shield 1111 may be in contact with the shell assembly 10

and/or fixedly connected to the shell assembly 10 by an adhesive material, whereby the bone-conducting loudspeaker 11 and the shell assembly 10 can be rigidly connected/rigidly contacted, such that the bone-conducting loudspeaker 11 can be securely accommodated within the accommodation cavity 1001. Further, the outer peripheral surface of the magnetic conduction shield 1111 may be completely in contact with the shell assembly 10 or a portion of the outer peripheral surface may be in contact with the shell assembly 10. Further, a portion of the outer peripheral surface of the magnetic conduction shield 1111 may be partially connected to the shell assembly 10 and another portion may be fixedly connected to the shell assembly 10 by an adhesive material. For the portion in contact with the shell assembly 10, the shell assembly 10 and/or the outer peripheral surface of the magnetic conduction shield 1111 may be provided with a structure such as a supporting rib, supporting bump, or the like, to realize the partial contact between the two.

[0071] For example, the outer peripheral surface of the magnetic conduction shield 1111 is in contact with the shell assembly 10 and/or is fixedly connected to the shell assembly 10 by an adhesive material along at least two normal directions perpendicular to each other (a normal direction of the outer peripheral surface of the magnetic conduction shield 1111). Optionally, the outer peripheral surface of the magnetic conduction shield 1111 is in contact with the shell assembly 10 along a first direction and/or is fixedly connected to the shell assembly 10 by an adhesive material. For example, the outer peripheral surface of the magnetic conduction shield 1111 is in contact with the shell assembly 10 along a second direction and/or is fixedly connected to the shell assembly 10 by an adhesive material. For example, the first direction includes a first positive direction and a first negative direction that are opposite to each other. For example, the outer peripheral surface of the magnetic conduction shield 1111 is in contact with the shell assembly 10 and/or is fixedly connected to the shell assembly 10 by an adhesive material along the first positive direction and/or along the first negative direction. The second direction includes a second positive direction and a second negative direction that are opposite to each other. For example, the outer peripheral surface of the magnetic conduction shield 1111 is in contact with the shell assembly 10 and/or is fixedly connected to the shell assembly 10 by an adhesive material along the second positive direction and/or the second negative direction. The first direction is perpendicular to the second direction. The perpendicular mentioned here may allow for some deviation, such as angles ranging from 80° to 100°, all of which can be considered perpendicular.

[0072] As shown in FIG. 7, the outer peripheral surface of the magnetic conduction shield 1111 may include, for example, two opposite first outer side surfaces and two opposite second outer side surfaces. Each of the second outer side surfaces is located between the two first outer side surfaces, and the two second outer side surfaces and the two first outer side surfaces enclose an annular structure. For example, each of the first outer side surfaces is in contact with and/or fixedly connected to the shell assembly 10 by an adhesive material, and each of the second outer side surfaces is in contact with and/or fixedly connected to the shell assembly 10 by an adhesive material. For example, the two first outer side surfaces may be arranged opposite along the first direction, and the two second outer side surfaces may be

arranged opposite along the second direction. For example, the first direction may be a direction X2 illustrated in FIG. 5 and the second direction may be a direction LD illustrated in FIG. 5.

[0073] Optionally, each of the second outer side surfaces and the two first outer side surfaces may be connected directly at an angle (corner) to each other, e.g. vertically. The transition between each second outer side surface and the two first outer side surfaces may also be curved, such as being connected by a curved connection surface. In this way, there is at least one curved connection surface between the two second outer side surfaces and the two first outer side surfaces. For example, there are four curved connection surfaces. Further, at least one curved connection surface is in contact with the shell assembly 10 or is fixedly connected to the shell assembly 10 by an adhesive material, or four curved connection surfaces are in contact with the shell assembly 10 or are fixedly connected to the shell assembly 10 by an adhesive material.

[0074] Set up in this way, a rigid contact/rigid connection can be realized between the bone-conducting loudspeaker 11 and the shell assembly 10, effectively improving the overall strength of the shell assembly 10 and making the vibration transmission between the two more efficient, thereby reducing noises and sound leakage.

[0075] Referring to FIG. 9a, optionally, the earphone 100 includes a first operation mode and a second operation mode. In the first operation mode, the bone-conducting loudspeaker 11 plays sound signals in a first frequency band P1, and the air-conducting loudspeaker 12 plays sound signals in a second frequency band P2. In the second operation mode, the bone-conducting loudspeaker 11 plays sound signals in the first frequency band P1 and sound signals in the second frequency band P2, and the first frequency band P1 and the second frequency band P2 are at least partially offset in a frequency domain. For example, if the first frequency band P1 and the second frequency band P2 do not overlap in the frequency domain, a frequency range of the first frequency band P1 is higher than a frequency range of the second frequency band P2. For example, if the first frequency band P1 and the second frequency band P2 partially overlap in the frequency domain, a frequency range of an offset portion of the first frequency band P1 is higher than a frequency range of an offset portion of the second frequency band P2.

[0076] In some embodiments, the earphone 100 includes a frequency division point n (as shown in FIG. 9a), the first frequency band P1 includes a frequency band that is greater than the frequency division point n, and the second frequency band P2 includes a frequency band that is lower than the frequency division point n. The frequency division point n is located at an intersection point of the first frequency band P1 and the second frequency band P2. When the earphone 100 is in the first operation mode, the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12 are operating together, the bone-conducting loudspeaker 11 mainly outputs sound signals in the first frequency band P1, and the air-conducting loudspeaker 12 mainly outputs sound signals in the second frequency band P2. That is, an operation frequency band of the bone-conducting loudspeaker 11 includes a frequency band greater than the frequency division point n, and an operation

frequency band of the air-conducting loudspeaker 12 includes a frequency band lower than the frequency division point n.

[0077] Referring to FIG. 9b, FIG. 9b illustrates an electrical signal band P3 input into the bone-conducting loudspeaker 11 and an electrical signal band P4 input into the air-conducting loudspeaker 12, respectively, when the earphone 100 is in the first operation mode. In some embodiments, the electrical signal band P3 of the bone-conducting loudspeaker 11 and the electrical signal band P2 of the air-conducting loudspeaker 12 have an overlapping intersection point m. The frequency division point n is located within a frequency range of 0.5 to 3 times the frequency span of the overlapping intersection point m. For example, if the overlapping intersection point m is 300 Hz, the frequency division point n may be located in a range of 150 Hz to 900 Hz, such as 500 Hz.

[0078] In some embodiments, the first frequency band P1 includes a mid-high frequency or a high frequency, and the second frequency band P2 includes a mid-low frequency or a low frequency. For example, a low-frequency range of 30 Hz to 150 Hz is considered a low-frequency band, a mid-frequency range of 150 Hz to 500 Hz is a mid-low frequency band, and 500 Hz to 5 KHz is a mid-high frequency band, and a high-frequency range of 5 KHz to 16 KHz is a high-frequency band.

[0079] When the earphone 100 is in the first operation mode, the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12 are operating together, the bone-conducting loudspeaker 11 mainly outputs sound signals in the first frequency band P1, and the air-conducting loudspeaker 12 mainly outputs sound signals in the second frequency band P2. In the earphone 100, the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12 operate together, wherein the bone-conducting loudspeaker 11 outputs the sound signals in the first frequency band P1 and the air-conducting loudspeaker 12 outputs the sound signals in the second frequency band P2. These signals are combined to form a more complete sound signal that is transmitted to the user's ear, which enhances the sound quality of the mid-low frequency band of the sound signal emitted by the earphone 100, thereby significantly improving the overall sound quality of the sound signal emitted by the earphone 100. Furthermore, the bone-conducting loudspeaker 11 may also operate separately, i.e., in the second operation mode, the air-conducting loudspeaker 12 does not work, and the bone-conducting loudspeaker 11 may simultaneously output sound signals in the first frequency band P1 and sound signals in the second frequency band P2. For example, when the earphone 100 is working in an environment where the user is sweating heavily during exercise or where the user is in a humid and rainy environment, the earphone 100 may actively cut off the operation of the air-conducting loudspeaker 12, and only the bone-conducting loudspeaker 11 is used for sound generation, thereby ensuring the overall sound quality of the sound signal emitted by the earphone 100 while preventing the air-conducting loudspeaker 12 from being eroded by unfavorable factors such as sweat or rain, effectively enhancing the reliability and stability of the earphone 100.

[0080] Optionally, the earphone 100 may further include a third operation mode. In the third operation mode, the air-conducting loudspeaker 12 plays sound signals in the first frequency band P1 and the second frequency band P2.

Specifically, the earphone 100 switches to the third operation mode in response to detecting that the bone-conducting loudspeaker 11 is damaged and unavailable or that the environment in which the earphone 100 is currently located is unfavorable for the bone-conducting loudspeaker 11 to operate. In the third operation mode, the air-conducting loudspeaker 12 operates alone and outputs sound signals in the first frequency band P1 and the second frequency band P2, to ensure that the earphone 100 can output high-quality sound signals normally.

[0081] An alternative embodiment of the shell assembly 10 as illustrated in FIG. 10a and FIG. 10b is described below, and different from the shell assembly 10 described above, the shell assembly 10 hereinafter includes a first portion 1003 and a second portion 1004, with the first portion 1003 being connected to a wearing assembly 27 (as illustrated in FIG. 1 and FIG. 2). The second portion 1004 is detachably connected to the first portion 1003 or the wearing assembly 27. The bone-conducting loudspeaker 11 is provided on the first portion 1003, and the air-conducting loudspeaker 12 is provided on the second portion 1004 and can be removed from the wearing assembly 27 in a detachable manner. In other words, the shell assembly 10 includes the detachable first portion 1003 and the detachable second portion 1004. The bone-conducting loudspeaker 11 is provided on the first portion 1003, the air-conducting loudspeaker 12 is provided on the second portion 1004, and the second portion 1004 is detachably connected to the first portion 1003 or the wearing assembly 27. With this arrangement, the air-conducting loudspeaker 12 can be separately detachable from the rest of the components on the earphone 100, and the bone-conducting loudspeaker 11 can continue to operate after the air-conducting loudspeaker 12 is separately detached. Separately detaching the air-conducting loudspeaker 12 from the other components of the earphone 100 can enhance the environmental adaptability of the earphone 100, which allows the air-conducting loudspeaker 12 to be quickly detached from the earphone 100 in extreme environments, such as when the user is sweating heavily during exercise or in humid and rainy conditions, preventing damage to the air-conducting loudspeaker 12. Meanwhile, the earphone 100 can continue to output high-quality sound signals through the bone-conducting loudspeaker 11. When only the bone-conducting loudspeaker 11 in the earphone 100 is operating alone, the earphone 100 can control the bone-conducting loudspeaker 11 to operate through the second operation mode, to ensure the sound quality of the sound signals output by the earphone 100. Furthermore, the second portion 1004 is detachably connected to the first portion 1003 or the wearing assembly 27, which facilitates the replacement of the second portion 1004. On one hand, this allows for the replacement with the air-conducting loudspeaker 12 of different performance characteristics, and on the other hand, it also makes maintenance easier.

[0082] Optionally, as shown in FIG. 10b, the earphone 100 has a wire group for supplying power and/or audio signals to, for example, the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12. The wire group may be connected within the first portion 1003. The first portion 1003 may be provided with a first electrode portion 10031, and the second portion 1004 may be provided with a second electrode portion 10041. After the first portion 1003 and the second portion 1004 are detachably assembled, the first electrode portion 10031 and the second electrode portion

10041 are in contact and can be electrically connected. The first electrode portion **10031** and the second electrode portion **10041** may have various structures, for example, the first electrode portion **10031** includes at least two first electrode contacts. The second electrode portion **10041** includes at least two second electrode contacts, and the at least two first electrode contacts and the at least two second electrode contacts may be in one-to-one correspondence. For example, one of the first electrode portion **10031** and the second electrode portion **10041** includes a pogo pin, and another includes a leaf spring or contact. The electrical connection is established through the contact between the pogo pin and the leaf spring or contact. For example, the first electrode portion **10031** and the second electrode portion **10041** each includes a leaf spring, and the electrical connection is realized by the elastic contact between the leaf springs of the first electrode portion **10031** and the second electrode portion **10041**. As another example, the first electrode portion **10031** and the second electrode portion **10041** include other forms. For example, the first electrode portion **10031** includes a plurality of ring electrodes that are nested together, and the second electrode portion **10041** includes a plurality of ring electrodes that are nested together. The first electrode portion **10031** and the second electrode portion **10041** may establish an electrical connection through the corresponding contact between their ring electrodes. The first electrode portion **10031** and the second electrode portion **10041** are not limited to the examples listed above, and the first electrode portion **10031** and the second electrode portion **10041** are configured to ensure electrical connection when the first portion **1003** and the second portion **1004** are assembled and to allow for their separation after disassembly.

[0083] In some implementations, the wire group is coupled to the bone-conducting loudspeaker **11** and the first electrode portion **10031**, and the second electrode portion **10041** is coupled to the air-conducting loudspeaker **12**. After the second portion **1004** and the first portion **1003** are assembled, the first electrode portion **10031** and the second electrode portion **10041** are in contact with each other correspondingly and are conductive such that the wire group is also capable of powering and/or providing audio signals to the air-conducting loudspeaker **12**.

[0084] In other embodiments, the first electrode portion **10031** is coupled to the bone-conducting loudspeaker **11**, and the second electrode portion **10041** is coupled to the air-conducting loudspeaker **12**. The wire group is coupled to at least two first electrode portions **10031**, and the wire group may supply power and/or audio signals to the bone-conducting loudspeaker **11** through the first electrode portion **10031**, and may also supply power and/or audio signals to the air-conducting loudspeaker **12** through the contact between the first electrode portion **10031** and the second electrode portion **10041**.

[0085] As another example, the wire group may also be connected to the second portion **1004**, the first portion **1003** is detachably connected to the second portion **1004**, and a specific connection relationship can be referred to the above description.

[0086] The first portion **1003** is provided with a first connection portion **10032**, and the second portion **1004** is provided with a second connection portion **10042**. The first connection portion **10032** and the second connection portion **10042** are detachably connected by snap-fit, adhesion, mag-

netic suction, threaded connection, or the like. For example, the first connection portion **10032** may be provided as one of a slot or a snap, and the second connection portion **10042** may be provided as another of a slot or a snap. The first portion **1003** and the second portion **1004** are detachably connected by a snap-fit mechanism, allowing the first electrode portion **10031** and the second electrode portion **10041** to contact each other and establish an electrical connection.

[0087] Referring to FIG. 3 and FIG. 5, optionally, the shell assembly **10** may also be provided with a pressure relief hole **1081** for connecting the accommodation cavity **1002** to the external environment. The pressure relief hole **1081** is provided to extend toward the side where the accommodation cavity **1001** is located. Specifically, the bone-conducting loudspeaker **11** and the air-conducting loudspeaker **12** may be accommodated in the accommodation cavity **1001** and the accommodation cavity **1002**, respectively, and the shell assembly **10** is provided with the pressure relief hole **1081** for relieving pressure for the air-conducting loudspeaker **12**. The pressure relief hole **1081** enables the accommodation cavity **1002** to be in communication with the external environment, and the pressure relief hole **1081** extends from the connection position with the accommodation cavity **1002** toward the side where the accommodation cavity **1001** is located. For example, a portion of a hole wall of the pressure relief hole **1081** extends from the connection position with the accommodation cavity **1002** toward the side where the accommodation cavity **1001** is located. With this setup, it is possible to effectively reduce the shell space occupied by the pressure relief hole **1081** on a periphery of the accommodation cavity **1002**, making efficient use of the space between the accommodation cavity **1001** and the accommodation cavity **1002**. This improves the spatial utilization of the shell assembly **10**, enabling a more compact and reasonable configuration while meeting the sound production requirements of the air-conducting loudspeaker **12**. Besides, such an inclined extension can increase the dimension of the pressure relief hole **1081**, which makes it possible to provide the air-conducting loudspeaker **12** with better sound quality.

[0088] Optionally, a projection of the pressure relief hole **1081** along a direction **X3** (shown in FIG. 5) perpendicular to an arrangement direction of the accommodation cavity **1001** and the accommodation cavity **1002** at least partially overlaps with the accommodation cavity **1001**. The direction **X3** perpendicular to the arrangement direction of the accommodation cavity **1001** and the accommodation cavity **1002** may be understood as a direction perpendicular to the bone-conducting vibration direction **X1** and perpendicular to the air-conducting vibration direction **X2**. The projection of the pressure relief hole **1081** along the direction **X3** at least partially overlaps with the accommodation cavity **1001**, which ensures that the dimension of the pressure relief hole **1081** satisfies the pressure relief requirements of the air-conducting loudspeaker **12**. At the same time, this arrangement effectively reduces the space occupied by the pressure relief hole **1081** and the corresponding shell portion, thereby reducing the structural dimension of the shell assembly **10** in the region where the air-conducting loudspeaker **12** is located.

[0089] Further, the pressure relief hole **1081** is provided to extend inclined toward the side on which the accommodation cavity **1001** is located, and along the direction **X3** perpendicular to the arrangement direction of the accom-

modation cavity **1001** and the accommodation cavity **1002**, the dimension of the pressure relief hole **1081** gradually increases in the direction from the accommodation cavity **1002** to the external environment. In other words, while the pressure relief hole **1081** extends inclined toward the accommodation cavity **1001**, the dimension of the pressure relief hole **1081** gradually increases in the direction from the accommodation cavity **1002** to the external environment, which makes the air discharge smoother, and can reduce the velocity of the air, thereby enhancing the sound quality of the sound emitted by the earphone **100**.

[0090] Referring to FIG. 3, FIG. 4, and FIG. 5, the shell assembly **10** includes a partition wall **1012** for isolating the accommodation cavity **1001** from the accommodation cavity **1002**. At least a portion of the partition wall **1012** extends toward the side on which the accommodation cavity **1001** is located, and forms a portion of the hole wall of the pressure relief hole **1081**.

[0091] Specifically, in a cross-section perpendicular to a vibration direction (i.e., the bone-conducting vibration direction **X1**) of the bone-conducting loudspeaker **11**, the bone-conducting loudspeaker **11** has a long-side edge **1101** and a short-side edge **1102**, with the long-side edge **1101** being longer than the short-side edge **1102**. The partition wall **1012** includes a wall segment **1013** and a wall segment **1014**. The wall segment **1013** is disposed side-by-side with the long-side edge **1101**, and the wall segment **1014** is connected to the wall segment **1013** and extends from a periphery of the connection between the long-side edge **1101** and the short-side edge **1102** toward the side on which the accommodation cavity **1001** is located. The wall segment **1014** is used to form a portion of the hole wall of the pressure relief hole **1081**. In some embodiments, the wall segment **1013** may be referred to as a first wall segment and the wall segment **1014** may also be referred to as a second wall segment.

[0092] The above spatial layout and structural arrangement of the pressure relief hole **1081** may be realized by the shell assembly **10**. It should be understood that the above spatial layout and structural arrangement of the pressure relief hole **1081** may also be realized by other solutions, which will not be discussed in detail herein. In addition to the earphone **100** provided with both the bone-conducting loudspeaker **11** and the air-conducting loudspeaker **12**, the above spatial layout and structural arrangement of the pressure relief hole **1081** may also be applied to the earphone **100** provided with only the air-conducting loudspeaker **12**, which will not be described in detail herein.

[0093] Optionally, as shown in FIG. 3, a central axis **Z** of the bone-conducting loudspeaker **11** (a central axis direction of the bone-conducting loudspeaker **11** may also be denoted by **Z**) may intersect with a central axis **V** of the air-conducting loudspeaker **12**, or may not intersect with the central axis **V** of the air-conducting loudspeaker **12**. For example, the central axis **Z** and the central axis **V** are skew lines, not lying in the same plane, and are arranged in a staggered manner. In a direction perpendicular to the central axis **Z** and the central axis **V**, the central axis **Z** is disposed farther away from the pressure relief hole **1081** compared to the central axis **V**. Generally speaking, along an LD direction shown in FIG. 5, the bone-conducting loudspeaker **11** is located farther away from the pressure relief hole **1081** compared to the air-conducting loudspeaker **12**. By setting the central axis **Z** and the central axis **V** to be skew lines and

by setting the central axis **Z** farther away from the pressure relief hole **1081** as compared to the central axis **V**, a larger space can be made available for the design of the pressure relief hole **1081**, which in turn allows the dimension of the pressure relief hole **1081** to be larger, thereby enhancing the pressure relief effect.

[0094] Optionally, the distance between the central axis **Z** and the central axis **V** is in a range of 0.3 mm to 1 mm, in a range of 0.5 mm to 0.8 mm, such as 0.6 mm, 0.7 mm, or in a range of 0.2 mm to 1.2 mm. By setting the above dimensions, on the one hand, it is possible to ensure the sound quality effect of the bone-conducting loudspeaker **11** and the air-conducting loudspeaker **12** while keeping the core assembly **1** small, and on the other hand, it is possible to provide a larger space for setting the pressure relief hole **1081**, which in turn allows for the setting of a larger pressure relief hole **1081**.

[0095] As mentioned above, the shell assembly **10** includes the shell **101**, the shell **102**, and the shell **103**. The partition wall **1012** may be disposed on the shell **101** and/or the shell **102**, and the shell **101** and the shell **102** fit with each other to form the accommodation cavity **1001** and the pressure relief hole **1081**. For example, the shell **101** and/or the shell **102** further form a portion of the accommodation cavity **1002**. For example, the shell **103** may form another portion of the accommodation cavity **1002**, with the shell **103** fitting with the shell **101** and/or the shell **102** to form the accommodation cavity **1002**. The partition wall **1012** disposed on the shell **101** and/or the shell **102** may be understood as the partition wall **1012** being a part of the shell **101** and/or the shell **102**. It should be understood that how the partition wall **1012** is disposed is not limited to be disposed on the shell **101** and/or the shell **102**. In other embodiments, the partition wall **1012** may be a component that is independent of the shell **101** and/or the shell **102**.

[0096] As shown in FIG. 3, the partition wall **1012** is disposed on the shell **101**, and the shell **101** is provided with a sub-accommodation cavity **1010** and a sub-accommodation cavity **1011** located on opposite sides of the partition wall **1012**. An opening direction of the sub-accommodation cavity **1010** is oriented toward a wall surface of the partition wall **1012**. Specifically, the opening direction of the sub-accommodation cavity **1010** is parallel or substantially parallel to the wall surface of the partition wall **1012**. The opening direction of the sub-accommodation cavity **1011** intersects with the wall surface of the partition wall **1012**. The shell **102** is provided with a sub-accommodation cavity **1020**, the shell **102** is capped at an open end of the sub-accommodation cavity **1010**, and the sub-accommodation cavity **1020** fits with the sub-accommodation cavity **1010** to form the accommodation cavity **1001**. The shell **103** is provided with a sub-accommodation cavity **1030**, the shell **103** is capped at an open end of the sub-accommodation cavity **1011**, and the sub-accommodation cavity **1030** fits with the sub-accommodation cavity **1011** to form the accommodation cavity **1002**. In some embodiments, the sub-accommodation cavity **1010** may also be referred to as a first sub-accommodation cavity, the sub-accommodation cavity **1011** may also be referred to as a second sub-accommodation cavity, the sub-accommodation cavity **1020** may also be referred to as a third sub-accommodation cavity, and the sub-accommodation cavity **1030** may also be referred to as a fourth sub-accommodation cavity.

[0097] By providing the partition wall 1012 to divide the shell 101 into the sub-accommodation cavity 1010 whose opening direction is oriented towards the wall surface of the partition wall 1012 and the sub-accommodation cavity 1012 that intersects with the wall surface of the partition wall 1012, both the sub-accommodation cavity 1010 and the sub-accommodation cavity 1012 can have larger spaces. This improves the spatial utilization of the shell 101 and helps reduce mutual interference caused by vibrations between the bone-conducting loudspeaker 11 and the air-conducting loudspeaker 12 during operation, thereby enhancing sound quality.

[0098] As shown in FIG. 4, the air-conducting loudspeaker 12 includes a vibration diaphragm 123. The vibration diaphragm 123 divides the accommodation cavity 1002 into a cavity portion 1006 disposed on the side of the vibration diaphragm 123 away from the partition wall 1012 and a cavity portion 1007 disposed between the vibration diaphragm 123 and the partition wall 1012. The pressure relief hole 1081 is in communication with the cavity portion 1007. As shown in FIG. 3 and FIG. 5, the shell assembly 10 is further provided with a sound outlet hole 1080 in communication with the cavity portion 1006. The cavity portion 1007 is in communication with the external environment via the pressure relief hole 1081. When the vibration diaphragm 123 vibrates along the air-conducting vibration direction X2, the cavity portion 1007 may be relieved of the pressure via the pressure relief hole 1081, to ensure normal and stable operation of the air-conducting loudspeaker 12. In some embodiments, the cavity portion 1006 may also be referred to as a first cavity portion, and the cavity portion 1007 may also be referred to as a second cavity portion.

[0099] Optionally, the distance between the vibration diaphragm 123 and a cavity wall of the accommodation cavity 1002 along a vibration direction of the vibration diaphragm 123 (the air-conducting vibration direction X2) is greater than 0.8 mm, or greater than 1 mm. Specifically, the distance (i.e., the distance along the air-conducting vibration direction X2) between the vibration diaphragm 123 and the partition wall 1012 (i.e., a portion of the cavity wall of the accommodation cavity 1002) may be greater than 0.8 mm, or greater than 1 mm. This ensures that the vibration diaphragm 123 has a larger vibration space, and the distance enables the airflow in the cavity portion 1007 to be distributed more uniformly, which in turn enables the air pressure to be more uniform and improves the consistency of the vibration of the vibration diaphragm 123. In some embodiments, the distance between the vibration diaphragm 123 and the partition wall 1012 refers to the minimum distance between the two. In other embodiments, the distance between the vibration diaphragm 123 and the partition wall 1012 refers to the distance between a vibration region of the vibration diaphragm 123 (e.g., a center region or a region of maximum amplitude) and the partition wall 1012.

[0100] As shown in FIG. 3 to FIG. 5, optionally, in a wearing state, the center of the pressure relief hole 1081 is not higher than the center of the sound outlet hole 1080, and in the wearing state, a line connecting the center of the pressure relief hole 1081 and the center of the sound outlet hole 1080 is pointed toward the user's ear. Optionally, in the wearing state, the line connecting the center of the pressure relief hole 1081 to the center of the sound outlet hole 1080 is pointed toward the ear canal of the user's ear. Generally speaking, the line connecting the center of the pressure relief

hole 1081 and the center of the sound outlet hole 1080 may be inclined upward toward the head top direction relative to the human body and point toward the user's ear. The center of the pressure relief hole 1081 may be the centroid of the pressure relief hole 1081. The center of the sound outlet hole 1080 may be the centroid of the sound outlet hole 1080. This setup helps to avoid the user's ear (especially the ear canal) being at the acoustic null point in the wearing state or in cases of improper wearing (such as slight tilting). As a result, it ensures that the user can hear the sound properly, reducing hearing loss and improving sound quality.

[0101] If there is a plurality of sound outlet holes 1080, the line described above may be a line connecting the center of at least one of the sound outlet holes 1080 and the center of the pressure relief hole 1081. As another example, if there is a plurality of sound outlet holes 1080, a line connecting the centers of the plurality of sound outlet holes 1080 forms a shape, and the center of the shape serves as the center of the plurality of sound outlet holes 1080, and the line described above may be a line connecting the center of the shape and the center of the pressure relief hole 1081 that is pointed toward the user's ear.

[0102] Optionally, in the wearing state, an angle between the line connecting the center of the pressure relief hole 1081 and the center of the sound outlet hole 1080 and the coronal axis of the user is $\geq 0^\circ$ and $< 90^\circ$, and an angle between the line and the vertical axis of the user is $> 0^\circ$ and $\leq 90^\circ$. This setup helps to avoid the user's ear being at the acoustic null point in the wearing state or in cases of improper wearing (such as slight tilting). As a result, it ensures the output of the earphone 100 and the acoustic effect.

[0103] As shown in FIG. 4, the air-conducting loudspeaker 12 further includes a magnetic circuit assembly 120 and a voice coil 122. The magnetic circuit assembly 120 includes a cover body 121 with an open end 1211, and an annular flange 1212 that is disposed at the open end 1211 of the cover body 121 and protrudes from an outer peripheral surface of the cover body 121. A rim of the vibration diaphragm 123 is fixed to a side of the annular flange 1212 facing the open end 1211 and covers the open end 1211 of the cover body 121. The voice coil 122 is connected to the vibration diaphragm 123. As shown in FIG. 3 and FIG. 5, the vibration diaphragm 123 is arranged opposite to the cover body 121, away from the sound outlet hole 1080.

[0104] The air-conducting loudspeaker 12 requires a larger vibration diaphragm 123 to achieve good sound quality, and the larger vibration diaphragm 123 also requires a larger support structure such as the annular flange 1212. In other words, the annular flange 1212 and the vibration diaphragm 123 are both structures in the air-conducting loudspeaker 12 that have large radial dimensions compared to the other structures, which greatly affects the overall structural dimension of the shell assembly 10. By setting the annular flange 1212 and the vibration diaphragm 123 on the side away from the sound outlet hole 1080, the vibration diaphragm 123 and the annular flange 1212 can be located closer to the interior of the shell assembly 10. With such an arrangement, in the air-conducting loudspeaker 12, structures with a larger radial dimension are arranged away from the sound outlet hole 1080, and structures with a smaller dimension can be located closer to the sound outlet hole 1080. Such an opposite configuration inside the air-conducting loudspeaker 12, compared to the traditional loudspeaker design where the vibration diaphragm must be oriented

toward the sound outlet hole **1080**, effectively reduces the dimension of the portion of the shell assembly **10** that is near the sound outlet hole **1080**, which allows the dimension of the shell assembly **10** to decrease from the central region to the region around the sound outlet hole **1080** (i.e., the radial dimension of the outer peripheral surface of the shell assembly **10** can gradually decrease). As a result, the structure becomes more compact, significantly improving the spatial utilization of the shell assembly **10** and reducing the overall volume of the shell assembly **10**. Such an opposite configuration can optimize the sound path and thus improve the sound quality. In short, by reversing the air-conducting loudspeaker **12** along the air-conducting vibration direction **X2**, the structural dimension of the shell assembly **10** can be effectively reduced.

[0105] Optionally, as shown in FIG. 3 and FIG. 4, the cavity wall of the accommodation cavity **1002** is provided with an annular table surface **1005** (the annular table surface **1005** is also shown in FIG. 5, but not labeled). As shown in FIG. 4 and FIG. 5, the annular flange **1212** is pressed against the annular table surface **1005**. The vibration diaphragm **123** divides the accommodation cavity **1002** into the cavity portion **1006** and the cavity portion **1007**, with the cavity portion **1006** being disposed on the side of the vibration diaphragm **123** facing the sound outlet hole **1080** and the cavity portion **1007** being disposed on the side of the vibration diaphragm **123** away from the sound outlet hole **1080**. The magnetic circuit assembly **120** is located within the cavity portion **1006**. As shown in FIG. 5, the shell assembly **10** is provided with the pressure relief hole **1081** to enable communication between the cavity portion **1007** and the external environment. Specifically, the annular table surface **1005** may be provided on shell **101**.

[0106] As shown in FIG. 4, the vibration diaphragm **123** may be disposed on the side of the annular flange **1212** toward the annular table surface **1005**. The earphone **100** further includes a sealing adhesive **1041** that seals a gap between the side of the annular flange **1212** that is opposite the annular table surface **1005** and the shell assembly **10**. The annular flange **1212** fits with the shell assembly **10** to form an adhesive accommodation groove **1042** for accommodating the sealing adhesive **1041** on the side of the annular flange **1212** that is opposite the annular table surface **1005**. Based on reversing the air-conducting loudspeaker **12**, since the vibration diaphragm **123** is closer to an inner side of the shell assembly **10** compared to the adhesive accommodation groove **1042**, while the adhesive accommodation groove is closer to an outer side of the shell assembly **10**, on the one hand, it is easy to dispense the adhesive, and on the other hand, when dispensing the adhesive on the adhesive accommodation groove **1042**, it can prevent the adhesive from overflowing onto the vibration diaphragm **123**, reducing the effect of the adhesive on the vibration diaphragm **123**, thereby ensuring the sound quality effect.

[0107] Further as shown in FIG. 11, a sound-conducting hole **1213** is disposed on the annular flange **1212**. The sound-conducting hole **1213** is provided to connect a space surrounded by the vibration diaphragm **123** and the magnetic circuit assembly **120** to the cavity portion **1006** around the periphery of the magnetic circuit assembly **120**. A portion of sound waves generated by the vibration of the vibration diaphragm **123** along the air-conducting vibration direction **X2** is conducted via the sound-conducting hole

1213 to the cavity portion **1006** around the periphery of the magnetic circuit assembly **120**.

[0108] Optionally, as shown in FIG. 4, the shell **103** is used to accommodate one end of the cover body **121** away from the vibration diaphragm **123**, and the sound outlet hole **1080** is provided on the shell **103**. The cover body **121** includes a circumferential side surface **121a** and an end surface **121b**, and the end surface **121b** is connected to the circumferential side surface **121a**. The end surface **121b** is oriented toward the sound outlet hole **1080**. A first gap **1031** (a position of the dashed line pointed to by the label **1031** in FIG. 4) exists between a connection region between the end surface **121b** and the circumferential side surface **121a** located on a first side of the cover body **121** and the shell **103**. A second gap **1032** (a position of the dashed line pointed to by the label **1032** in FIG. 4) exists between a connection region between the circumferential side surface **121a** located on a second side of the cover body **121** and the end surface **121b** and the shell **103**. The first gap **1031** is smaller than the second gap **1032**. The size of the first gap **1031** and the size of the second gap **1032** may be distances between the corresponding connection regions to the shell **103**, respectively. For example, the distance is the length of the dashed line illustrated in FIG. 4 (the dashed line may be perpendicular to an inner surface of the shell **103** at a corresponding location). The first side and the second side refer to a first side and a second side of the circumferential side surface **121a** that are opposite to each other.

[0109] Referring to FIG. 4, FIG. 5, FIG. 11, and FIG. 12, in a cross-section perpendicular to the vibration direction of the vibration diaphragm **123**, the cover body **121** has a length direction **LD** and a width direction **HD**. The dimension of the cover body **121** along the length direction **LD** is larger than the dimension of the cover body **121** along the width direction **HD**, and the first side and the second side are opposite along the width direction **HD**. The first side may be located on the side of the magnetic circuit assembly **120** close to the user's face, as shown in FIG. 4. The first gap **1031** is smaller than the second gap **1032**, and the first gap **1031** is located on the first side, which in turn makes the smaller first gap **1031** closer to the user's face, and can ensure that the air-conducting loudspeaker **12** outputs sound signals normally, while also effectively reducing the dimension of the shell **103**.

[0110] Further, the first side is located on the side of the magnetic circuit assembly **120** close to the user's face, and at least a portion of an outer surface of the shell **103** is provided inclined toward the shell **101** and the shell **102** along a direction from the second side to the first side. For example, the portion of the outer surface of the shell provided with the sound outlet hole **1080** is provided inclined toward the shell **101** and the shell **102** along a direction from the second side to the first side, i.e., the sound outlet hole **1080** is disposed on the at least a portion of the shell **103**. With this setting manner, it is possible to make the sound outlet hole **1080** toward the user's ear, so that the sound signal output from the air-conducting loudspeaker **12** can be better transmitted into the user's ear. A portion of the shell **103** that is opposite the circumferential side surface **121a** is connected to a portion of the shell provided with the sound outlet hole. Optionally, after reversing the air-conducting loudspeaker **12**, an outer surface of the portion of the shell **103** that is opposite the circumferential side surface **121a** may be provided in an inclined manner, and specifi-

cally, the outer surface may gradually converge and tilt along the air-conducting vibration direction X2, from the first shell 101 to the direction away from the first shell 101 and into the accommodation cavity 1002, to make the shell assembly 10 compact and miniaturized, thereby reducing the volume of the shell assembly 10. Moreover, the shell assembly 10 may have a fitting surface 10a in contact with the user's face and an inclined surface 10b (the inclined surface may be a curved inclined surface that gradually tilts away from the face) connected to the fitting surface 10a and tilted away from the fitting surface 10a. The inclined surface 10b is used to avoid the user's tragus, thereby reducing the compression on the tragus, facilitating wearing, improving the wearing comfort, and having better sound quality effect. The fitting surface 10a is mainly composed of the shell 102, and the inclined surface 10b may be composed of the shell 102 and the shell 103 together.

[0111] Further, a portion of the end surface 121b adjacent to the circumferential side surface 121a disposed on the first side may be connected to the shell 103, or a connection region between the end surface 121b and the circumferential side surface 121a disposed on the first side may be in contact with the shell 103, further reducing the dimension of the shell assembly 10. The contact here can be direct contact, where further adhesive bonding can be applied for fixation, or it can be indirect contact through adhesive fixation. A portion of the cavity portion 1006 that is on the periphery of the cover body 121 may be further divided into a first space portion and a second space portion by the above contact position. Specifically, the first space portion may be enclosed between the circumferential side surface 121a disposed on the first side and the shell 103, or the first space portion may be enclosed by a combination of the end surface 121b, the circumferential side surface 121a disposed on the first side, and the shell 103, while the second space portion may be enclosed between at least a portion of the end surface 121b, a portion of the circumferential side surface 121a disposed on the second side, and the shell 103. The first gap 1031 is located in the first space portion, the second gap is located in the second space portion, and the second space portion is in communication with the sound outlet hole 1080. If the end surface 121b encloses both the first space portion and the second space portion, the area of the portion of the end surface 121b enclosing the first space portion is smaller than the area of the portion of the end surface 121b enclosing the second space portion, i.e., the contact position is closer to the first side and to the portion of the shell assembly 10 opposite the first side. Corresponding positions of the cover body 121 and the shell 103 may be contacted to form the contact position. In other embodiments, the corresponding positions of the cover body 121 and the shell 103 may be set to have a gap whose distance is greater than 0.1 mm, and the gap is so set that the cover body 121 does not collide with the shell 103 when vibrates due to the vibration of the vibration diaphragm 123, thereby reducing the possibility of generating noise. In conclusion, corresponding to the contact position, a position corresponding to the gap is referred to as a minimum gap position.

[0112] In the state in which the contact position is set, at least a portion of sound waves can enter the second space portion from the first space portion along the circumferential side surface 121a, and then pass out from the second space portion via the sound outlet hole 1080.

[0113] Optionally, referring to FIG. 4, on the first side, the average distance between the annular flange 1212 and the shell 103 along the vibration direction X2 of the vibration diaphragm 123 is greater than or equal to 0.5 mm. Optionally, on the second side, the second gap 1032 is greater than or equal to 0.5 mm. On the first side, the average distance between the annular flange 1212 and the shell 103 along the vibration direction X2 of the vibration diaphragm 123 is the average value of the sum of the maximum distance L5 and the minimum distance L4 between the annular flange 1212 and the shell 103 along the vibration direction of the vibration diaphragm 123 (i.e., the air-conducting vibration direction X2).

[0114] By setting the above dimensions, on the one hand, it is ensured that there is a sufficient size of a sound cavity to achieve a better sound quality before leading the sound waves out of the sound outlet hole 1080, and on the other hand, it is possible to make the shell assembly 10 smaller and more compact. In addition, by reversing the accommodation cavity 1002 and the air-conducting loudspeaker 12 as shown in FIG. 4, the sound waves enter the second space portion from the first space portion along the circumferential side surface 121a (i.e., the sound waves can enter the second gap 1032 from the first gap 1031), and along the air-conducting vibration direction X2, the second space portion is gradually inclined to the first space portion to better point to the sound outlet hole 1080, so that the transmission direction of the sound waves is more directed to the user's ear, further enhancing the transmission efficiency of the sound waves, and enhancing the sound quality.

[0115] Optionally, as shown in FIG. 4, the cover body 121 includes a magnetic conduction shield 121c. The magnetic circuit assembly 120 further includes the magnet 124 disposed within the magnetic conduction shield 121c, and the voice coil 122 extends into a magnetic gap formed by the magnetic conduction shield 121c and the magnet 124.

[0116] Referring to FIG. 6, FIG. 7, and FIG. 8, the bone-conducting loudspeaker 11 includes the voice coil assembly 111, the magnet assembly 112, and a vibration transmission sheet 113. The first one of the voice coil assembly 111 and the magnet assembly 112 surrounds the second one of the voice coil assembly 111 and the magnet assembly 112. For example, the voice coil assembly 111 surrounds the magnet assembly 112. As shown in FIG. 8 and FIG. 13, the vibration transmission sheet 113 includes a central fixing portion 1131, an annular fixing portion 1132 around the periphery of the central fixing portion 1131, and a linkage assembly 1133 connected between the central fixing portion 1131 and the annular fixing portion 1132. The annular fixing portion 1132 is connected to the first one of the voice coil assembly 111 and the magnet assembly 112, and the central fixing portion 1132 is connected to the second one of the voice coil assembly 111 and the magnet assembly 112. For example, the annular fixing portion 1132 is connected to the voice coil assembly 111 and the central fixing portion 1131 is connected to the magnet assembly 112. The linkage assembly 1133 is used to elastically constrain relative movement between the voice coil assembly 111 and the magnet assembly 112 along the central axis direction Z of the bone-conducting loudspeaker 11. It should be understood that the linkage assembly 1133 can maintain the stable position of the voice coil assembly 111 and the magnet assembly 112 along a radial direction perpendicular to the central axis direction Z, i.e., the linkage assembly

1133 can constrain the voice coil assembly **111** and the magnet assembly **112** along a radial direction. The relatively stable position of the voice coil assembly **111** and the magnet assembly **112** along the radial direction can render the relative movement between the two along the central axis direction **Z** more stable, which in turn makes the sound quality better. For example, the annular fixing portion **1132** serves as a stop member and rigidly constrains a range of relative movement between the voice coil assembly **111** and the magnet assembly **112** along the central axis direction **Z** (illustrated in FIG. 6). For example, the annular fixing portion **1132** is fixedly connected to the voice coil assembly **111**. When used as a stop member, the magnet assembly **112** may be rigidly stopped when the vibration magnitude of the magnet assembly **112** relative to the voice coil assembly **111** is excessive, thereby limiting the movement stroke of the magnet assembly **112** and imposing a rigid constraint on the range of relative movement between the voice coil assembly **111** and the magnet assembly **112**. It should be understood that the stop member may be realized in other structural forms or ways.

[0117] The central axis direction **Z** of the bone-conducting loudspeaker **11** may coincide with the vibration direction of the bone-conducting loudspeaker **11** (i.e., the bone-conducting vibration direction **X1**). The linkage assembly **1133** is an elastic member or can generate an elastic deformation that elastically constrains the voice coil assembly **111** and the magnet assembly **112**. The elastic constraint may be understood as the voice coil assembly **111** and the magnet assembly **112** moving relative to each other within the range of relative movement permitted by the elastic deformation of the linkage assembly **1133**. On the one hand, the linkage assembly **1133** can limit the range of relative movement between the voice coil assembly **111** and the magnet assembly **112** along the bone-conducting vibration direction **X1**, and on the other hand, the linkage assembly **1133** can reset the voice coil assembly **111** and the magnet assembly **112** through elastic recovery after the voice coil assembly **111** and the magnet assembly **112** have achieved relative movement. Rigidly constraining the range of relative movement between the voice coil assembly **111** and the magnet assembly **112** by the stop member along the central axis direction **Z** may be understood as the stop member constraining the maximum range of relative movement between the voice coil assembly **111** and the magnet assembly **112** along the central axis direction **Z**, preventing the relative movement between the voice coil assembly **111** and the magnet assembly **112** from exceeding the maximum range of relative movement and causing the vibration transmission sheet **113** to transition from elastic deformation to plastic deformation, resulting in a decrease in the elasticity of the vibration transmission sheet **113** and causing damage to the voice coil assembly **111** and the magnet assembly **112**. Rigidity and elasticity herein are relative, i.e., the constraining strength of the stop member is greater than the constraining strength of the linkage assembly **1133**.

[0118] As shown in FIG. 8, the annular fixing portion **1132** serves as a stop member, and a projection of the annular fixing portion **1132** along the central axis direction **Z** partially overlaps with an outer end surface **1103** of the second one of the voice coil assembly **111** and the magnet assembly **112**. Specifically, the annular fixing portion **1132** is connected to the voice coil assembly **111**, and the projection of the annular fixing portion **1132** along the central axis direc-

tion **Z** partially overlaps an outer end surface **1103** of the magnet assembly **112**. By setting the projection of the annular fixing portion **1132** to partially overlap the outer end surface **1103** of the second one of the voice coil assembly **111** and the magnet assembly **112** along the central axis direction **Z**, when the relative movement amplitude of the voice coil assembly **111** and the magnet assembly **112** along the central axis direction **Z** is too large, the outer end surface **1103** of the voice coil assembly **111** and the magnet assembly **112** may abut against with the annular fixing portion **1132**. Since the annular fixing portion **1132** is fixed relative to the first one of the voice coil assembly **111** and the magnet assembly **112**, the annular fixing portion **1132** rigidly abuts against the second one of the voice coil assembly **111** and the magnet assembly **112**, thus rigidly constraining the range of relative movement between the voice coil assembly **111** and the magnet assembly **112**. For example, if the earphone **100** is subjected to the drop or collision, the relative movement amplitude of the voice coil assembly **111** and the magnet assembly **112** along the central axis direction **Z** may be too excessive, resulting in the vibration transmission sheet **113** transition from elastic deformation to plastic deformation, which reduces its elasticity. By applying a rigid constraint through the annular fixing portion **1132**, the vibration transmission sheet **113** can be prevented from being over-stretched, thereby mitigating performance degradation and reducing the impact on sound quality. In addition, providing the annular fixing portion **1132** as the stop member can eliminate the need to add an additional stopper structure, leading to a simple and stable structure with reduced costs.

[0119] Optionally, as shown in FIG. 6, FIG. 7, and FIG. 8, the outer end surface **1103** includes a center region **1104** and a peripheral region **1106** surrounding the center region **1104**. The center region **1104** is provided with a protrusion portion **1105**, and the protrusion portion **1105** protrudes with respect to the peripheral region **1106**. The central fixing portion **1131** is fixedly connected to the protrusion portion **1105**, and the projection of the annular fixing portion **1132** along the central axis direction **Z** partially overlaps with the peripheral region **1106**.

[0120] Optionally, referring to FIG. 14, along the radial direction of the bone-conducting loudspeaker **11**, a width **L6** of an overlapping region between the annular fixing portion **1132** and the outer end surface **1103** is greater than or equal to 0.03 mm, thereby ensuring the constraining strength of the stop member.

[0121] Optionally, in a natural state, a spacing distance **L7** between an upper surface of the protrusion portion **1105** and a lower surface of the annular fixing portion **1132** of the vibration transmission sheet **113** along the central axis direction **Z** is less than or equal to 1 mm. Setting the spacing distance **L7** within the above range enables the linkage assembly **1133** to be reasonably pre-deformed when the central fixing portion **1131** and the protrusion portion **1105** are fixedly connected, which in turn improves the vibration efficiency of the vibration transmission sheet **113**. If the spacing distance **L7** is set too large, the pre-deformation amount of the linkage assembly **1133** will be excessive, making it prone to exceeding the yield limit and undergoing plastic deformation, which reduces its elastic deformation performance. Conversely, with the vibration transmission sheet **113** elastically suspended, the absence of pre-deformation would cause the relative position of the magnet assembly **112** and the voice coil assembly **111** along the

central axis direction Z to deviate from the central position under the influence of gravity. This deviation would affect the relative movement between the magnet assembly 112 and the voice coil assembly 111, thereby affecting sound quality performance. In some embodiments, since the lower surface of the central fixing portion 1131 and the upper surface of the protrusion portion 1105 need to be welded in affinity, the spacing distance L7 between the upper surface of the protrusion portion 1105 and the lower surface of the annular fixing portion 1132 along the central axis direction Z may also be considered as the spacing distance between the lower surface of the central fixing portion 1131 and the lower surface of the annular fixing portion 1132.

[0122] It should be understood that whether the protrusion portion 1105 is fixed to the central fixing portion 1131 by some other structures or means, the spacing distance between the lower surface of the central fixing portion 1131 and the lower surface of the annular fixing portion 1132 along the central axis direction Z indicates the pre-deformation amount of the vibration transmission sheet 113 along the central axis direction Z.

[0123] Optionally, in a natural state, a ratio of the spacing distance between the lower surface of the central fixing portion 1131 and the lower surface of the annular fixing portion 1132 along the central axis direction Z to an extension component of the length of at least one linkage 1134 along a first direction W1 is in a range of 0 to 0.1, and the range of values includes endpoint values. Optionally, a ratio of the spacing distance between the lower surface of the central fixing portion 1131 and the lower surface of the annular fixing portion 1132 along the central axis direction Z to the extension component of the length of the at least one linkage 1134 along a second direction W2 is in a range of 0 to 0.18, and the range of values includes endpoint values. With such an arrangement, it is possible to make the vibration transmission sheet 113 be capable of pre-deformation reasonably. On the one hand, suspended components (the voice coil assembly 111 or the magnet assembly 112) can be ensured sufficiently supported without sagging to ensure the vibration performance, and on the other hand, an excellent space for elastic deformation can be guaranteed. If the ratio is too large, it is likely to result in an excessive pre-deformation amount of the vibration transmission sheet 113 that exceeds the yield limit, resulting in a decrease in elastic performance. If the ratio is too small, it is likely to lead to insufficient support of the vibration transmission sheet 113 to the suspended components, which leads to degradation of vibration performance and loss of sound quality.

[0124] Optionally, the upper surface of the protrusion portion 1105 occupies less than or equal to 30% of the area of the outer end surface 1103, and the protrusion portion 1105 occupying a smaller area can realize a more stable fixed connection with the linkage assembly 1133. In this way, it does not occupy the linkage assembly 1133 excessively, but makes the linkage assembly 1133 have a sufficiently large area to generate elastic deformation, thereby providing sufficient deformation space to make the vibration transmission sheet 113 more elastic.

[0125] Optionally, as shown in FIG. 7 and FIG. 8, the magnet assembly 112 includes the magnet 1121 and two magnetic conduction plates 1122. The two magnetic conduction plates 1122 are disposed on two opposite end surfaces of the magnet 1121 along the central axis direction

Z. The protrusion portion 1105 is disposed on the magnetic conduction plates 1122 such that the center region 1104 and the peripheral region 1106 are formed on an outer surface of each of the magnetic conduction plates 1122. Two projections of the two magnetic conduction plates 1122 along a radial projection of the bone-conducting loudspeaker 11 overlap with the voice coil assembly 111, respectively. The peripheral region 1106 is provided affixed to the magnet 1121, the protrusion portion 1105 is disposed spaced apart from the magnet 1121, and the peripheral region 1106 occupies more than or equal to 60% of the area on the outer end surface 1103. In this way, setting the protrusion portion 1105 can make the pre-deformation amount of the vibration transmission sheet 113 more reasonable, and can reduce the pre-deformation amount, ensuring the elastic deformation performance of the vibration transmission sheet 113. In addition, there is also no need to set up additional connection members to connect the vibration transmission sheet 113 and the magnetic conduction plate 1122, which can reduce the overall mass of the entire bone-conducting loudspeaker 11, and thus can improve the vibration effect of the bone-conducting loudspeaker 11. Optionally, when the bone-conducting loudspeaker 11 is in a normal operation state, the stop member is provided so as not to constrain the relative movement between the voice coil assembly 111 and the magnet assembly 112 along the central axis direction Z. However, when the bone-conducting loudspeaker 11 is subjected to dropping, collision, or the like, the relative movement between the voice coil assembly 111 and the magnet assembly 112 may exceed the elastic constraint range permitted by the elastic deformation of the vibration transmission sheet 113, then at this time, the stop member may rigidly constrain the relative movement between the voice coil assembly 111 and the magnet assembly 112 along the central axis direction Z, reducing the probability that the relative movement between the voice coil assembly 111 and the magnet assembly 112 exceeds the permitted elastic constraint range, thereby reducing the probability of loss of elasticity of the vibration transmission sheet 113 due to overstretching.

[0126] Optionally, as shown in FIG. 7 and FIG. 8, there are two vibration transmission sheets 113, and the two vibration transmission sheets 113 are provided on two opposite sides of the bone-conducting loudspeaker 11 along the central axis direction Z. The linkage assembly 1133 of each vibration transmission sheet 113 includes two linkages 1134. In other embodiments, the linkage assembly 1133 also includes at least two linkages 1134.

[0127] Optionally, as shown in FIG. 7 and FIG. 8, the voice coil assembly 111 surrounds the magnet assembly 112. The voice coil assembly 111 includes two sets of voice coils 1110 spaced apart along the central axis direction Z and the magnetic conduction shield 1111 around the periphery of the two sets of voice coils 1110. The magnet assembly 112 includes the magnet 1121 and two magnetic conduction plates 1122. The two magnetic conduction plates 1122 are provided on two opposite end surfaces of the magnet 1121 along the central axis direction Z. Projections of the two magnetic conduction plates 1122 along the radial direction of the bone-conducting loudspeaker 11 overlap with the two sets of voice coils 1110, respectively, and current directions of the two sets of voice coils 1110 are opposite to each other.

[0128] Optionally, the voice coil assembly 111 surrounds the magnet assembly 112, and the voice coil assembly 111 is fixed to the shell assembly 10.

[0129] Optionally, the annular fixing portion 1132 is fixedly connected to the magnetic conduction shield 1111. Optionally, the annular fixing portion 1132 and the magnetic conduction shield 1111 are welded and fixed through offset welding. Specifically, an outer edge of the annular fixing portion 1132 is offset from an outer edge of a corresponding end portion of the magnetic conduction shield 1111. For example, the outer edge of the annular fixing portion 1132 overlaps the end portion of the magnetic conduction shield 1111 and is located between the outer peripheral surface and the inner peripheral surface of the magnetic conduction shield 1111, thereby forming an offset. Based on this offset, the outer edge of the annular fixing portion 1132 and the end portion of the magnetic conduction shield 1111 are welded and fixed. By welding and fixing the annular fixing portion 1132 and the magnetic conduction shield 1111 through offset welding, the welding position is more obviously presented, which facilitates the welding process and observation of the weld seam, effectively improving welding efficiency and yield rate, thereby ensuring welding strength. For the form of welding the weld seam, it may be spot welding or continuous welding. Optionally, the weld bearing force between the annular fixing portion 1132 and the magnetic conduction shield 1111 is in a range of 400 N to 1200 N.

[0130] It may be appreciated that in some other embodiments of the present disclosure, the welding method may also be other methods such as lap welding (butt welding). The lap welding specifically involves stacking the annular fixing portion 1132 with the corresponding end portion of the magnetic conduction shield 1111, and welding the stacked position together using methods such as laser welding.

[0131] Optionally, the vibration transmission sheet 113 is provided with an observation hole 1130 penetrating through two sides of the vibration transmission sheet 113, as shown in FIG. 13 and FIG. 15. The observation hole 1130 penetrating through two sides of the vibration transmission sheet 113 refers to that the observation hole 1130 penetrates through two sides of the vibration transmission sheet 113 along a thickness direction of the vibration transmission sheet 113, and the thickness direction of the vibration transmission sheet 113 may be the central axis direction Z. Specifically, the observation hole 1130 may be formed in the annular fixing portion 1132. Optionally, there are a plurality of observation holes 1130 arranged at intervals along the circumferential direction of the vibration transmission sheet 113. By providing the observation hole 1130 on the vibration transmission sheet 113, a structure of a magnetic circuit, such as a structure of the magnet assembly 112, inside the bone-conducting loudspeaker 11 can be observed through the observation hole 1130. Besides, the observation hole 1130 can be used to understand whether the position of the magnet assembly 112 is deviated, and even the working condition of the magnet assembly 112 can be observed, which is convenient for fault troubleshooting or structural optimization, or the like.

[0132] Optionally, the vibration transmission sheet 113 includes the central fixing portion 1131 formed by sheet processing, the annular fixing portion 1132 around the periphery of the central fixing portion 1131, and the linkage assembly 1133 connected between the central fixing portion

1131 and the annular fixing portion 1132. An inner ring edge 1132a of the annular fixing portion 1132 has the first direction W1 and the second direction W2 that are perpendicular to each other. That is, the annular fixing portion 1132 has the first direction W1 and the second direction W2. The linkage assembly 1133 is composed of two linkages 1134, each of the linkages 1134 has an outer edge 1135 toward the inner ring edge 1132a, and an inner edge 1136 away from the inner ring edge 1132a. An extension component of the outer edge 1135 along the first direction W1 is greater than or equal to one-half of a dimension of the inner ring edge 1132a along the first direction W1, and the width of the linkage 1134 is greater than or equal to one-tenth of a dimension of the inner ring edge 1132a along the second direction W2.

[0133] Specifically, the above description is illustrated in a case where the central fixing portion 1131, the annular fixing portion 1132, and the linkage assembly 1133 are set up coplanar. In the case where there are distortion points such as protrusions or grooves at the inner ring edge 1132a, these distortion points should be eliminated, and a smooth linear transition should be formed on the outside of the distortion points to create the inner ring edge 1132a. For example, the second direction W2 refers to a direction in which the shortest line segment intersecting the inner ring edge 1132a over the geometric center of the inner ring edge 1132a is located. The first direction W1 refers to a direction that is perpendicular to the second direction W2 in the plane in which the central fixing portion 1131, the annular fixing portion 1132, and the linkage assembly 1133 are located. The vibration transmission sheet 113 is provided as a two-linkage structure, and an extension component of the outer edge 1135 along the first direction W1 is greater than or equal to one-half of the dimension of the inner ring edge 1132a along the first direction W1. In this way, the extension length of the linkage 1134 can be increased, which makes the linkage 1134 has a larger deformation space. At the same time, since the width of the linkage 1134 is greater than or equal to one-tenth of the dimension of the inner ring edge 1132a along the second direction W2, it can improve the resistance as well as the service life of the linkage 1134.

[0134] Optionally, the extension component of the outer edge 1135 along the first direction W1 is further greater than or equal to two-thirds of the dimension of the inner ring edge 1132a along the first direction W1. Therefore, the extension component of the outer edge 1135 along the first direction W1 is further greater than or equal to two-thirds of the dimension of the inner ring edge 1132a along the first direction W1, which may further increase the extension length of the linkage 1134 and allows the linkage 1134 to have a greater deformation space.

[0135] Optionally, the extension component of the outer edge 1135 along the second direction W2 is greater than or equal to one-half of the dimension of the inner ring edge 1132a along the second direction W2. Therefore, the extension component of the outer edge 1135 along the second direction W2 is greater than or equal to one-half of the dimension of the inner ring edge 1132a along the second direction W2, which may further increase the extension length of the linkage 1134 and allows the linkage 1134 to have a larger deformation space.

[0136] Optionally, the extension component of the outer edge 1135 along the second direction W2 is greater than or equal to two-thirds of the dimension of the inner ring edge 1132a along the second direction W2. Therefore, the exten-

sion component of the outer edge 1135 along the second direction W2 is greater than or equal to two-thirds of the dimension of the inner ring edge 1132a along the second direction W2, which can further increase the extension length of the linkage 1134 and allows the linkage 1134 to have a larger deformation space.

[0137] Optionally, the width of the linkage 1134 is greater than or equal to one-eighth of the dimension of the inner ring edge 1132a along the second direction W2. Therefore, the width of the linkage 1134 is greater than or equal to one-eighth of the dimension of the inner ring edge 1132a along the second direction W2, which can further improve the resistance as well as the service life of the linkage 1134.

[0138] Optionally, the two linkages 1134 are rotationally symmetrical at 180 degrees centered on the central fixing portion 1131. With this setup, the vibration transmission stability and balance of the vibration transmission sheet 113 can be effectively improved.

[0139] Optionally, the dimension of the inner ring edge 1132a along the first direction W1 is larger than the dimension of the inner ring edge 1132a along the second direction W2. In other words, the annular fixing portion 1132 may be provided in a general runway shape. A ratio of the dimension of the inner ring edge 1132a along the first direction W1 to the dimension of the inner ring edge 1132a along the second direction W2 is greater than or equal to 1.5.

[0140] Optionally, along the first direction W1, two linkages 1134 are connected to two opposite sides of the central fixing portion 1131. With this setup, it is possible to increase the length of the linkages 1134 effectively. Specifically, as shown in FIG. 15, the inner ring edge 1132a includes two edge segments 11321 spaced apart along the second direction W2. Each of the linkages 1134 is provided to start at the central fixing portion 1131, to extend through a gap between the central fixing portion 1131 and one of the two inner ring edges 1132a, and to be connected to the other of the two edge segments 11321.

[0141] Optionally, one end of the linkage 1134 is smoothly connected to the central fixing portion 1131. Another end of the linkage 1134 is smoothly connected to the annular fixing portion 1132. Further, as shown in FIG. 16, the linkage 1134 includes a first sub-linkage portion 1137 connected to the central fixing portion 1131, a second sub-linkage portion 1138 connected to the annular fixing portion 1132 and a third sub-linkage portion 1139 connected between the first sub-linkage portion 1137 and the second sub-linkage portion 1138. At least a portion of the first sub-linkage portion 1137 is progressively wider in a direction toward the central fixing portion 1131 and smoothly connected to the central fixing portion 1131, at least a portion of the second sub-linkage portion 1138 is progressively wider in a direction toward the annular fixing portion 1132 and smoothly connected to the annular fixing portion 1132, and the third sub-linkage portion 1139 remains uniform in width.

[0142] Optionally, the inner edge 1136 of the first sub-linkage portion 1137 and the inner edge 1136 of the second sub-linkage portion 1138 are provided in an arcuate shape. The inner edge 1136 of the third sub-linkage portion 1139 is provided in a straight line and is in smooth transition with the inner edge 1136 of the first sub-linkage portion 1137 and the inner edge 1136 of the second sub-linkage portion 1138, and/or the outer edge 1135 of the first sub-linkage portion 1137 and the outer edge 1135 of the second sub-linkage portion 1138 are provided in an arcuate shape, and the outer

edge 1135 of the third sub-linkage portion 1139 is provided in a straight line and is in a smooth transition with the outer edge 1135 of the first sub-linkage portion 1137 and the outer edge 1135 of the second sub-linkage portion 1138. Such a setting can effectively reduce the internal stress at the connection point between the linkage 1134 and the central fixing portion 1131 and the connection point between the linkage 1134 and the annular fixing portion 1132.

[0143] Optionally, a portion of the second sub-linkage portion 1138 that is connected to the third sub-linkage portion 1139 is aligned with the width of the third sub-linkage portion 1139 and/or a portion of the first sub-linkage portion 1137 that is connected to the third sub-linkage portion 1139 is aligned with the width of the third sub-linkage portion 1139.

[0144] Optionally, an extension component of the outer edge 1135 of the third sub-linkage portion 1139 along the first direction W1 is greater than or equal to one-half of the dimension of the inner ring edge 1132a along the first direction W1, and the width of the third sub-linkage portion 1139 is greater than 0.5 mm.

[0145] Optionally, the inner edge 1136 of the first sub-linkage portion 1137 is provided as a concave arc, and an edge of the central fixing portion 1131 that is connected to the inner edge 1136 of the first sub-linkage portion 1137 is provided as a convex arc, forming a smooth transition with the inner edge 1136 of the first sub-linkage portion 1137. Set up in this way, on the one hand, it is possible to make a reasonable transition between the central fixing portion 1131 and the first sub-linkage portion 1137, and on the other hand, the convex arc setting can ensure the dimension of the central fixing portion 1131, and thus ensure the fixing effect of the central fixing portion 1131 and the magnet assembly 112.

[0146] Optionally, the bone-conducting loudspeaker 11 includes two vibration transmission sheets 113. The two vibration transmission sheets 113 are provided on two opposite sides of the bone-conducting loudspeaker 11 along the central axis direction Z, respectively. The extension direction of the linkage assembly 1133 of the first one of the two vibration transmission sheets 113, starting from the connected central fixing portion 1131, is opposite to the extension direction of the linkage assembly 1133 of the second one of the two vibration transmission sheets 113, which also starts from the connected central fixing portion 1131. With this setup, the moment of inertia around the bone-conducting vibration direction X1 can be offset when the bone-conducting loudspeaker 11 vibrates along the bone-conducting vibration direction X1.

[0147] Optionally, the magnet assembly 112 is less than or equal to 80% of the mass of the bone-conducting loudspeaker 11, and the mass of the load pushed by the bone-conducting loudspeaker 11 is less than or equal to 9 times the mass of the bone-conducting loudspeaker 11. The load pushed by the bone-conducting loudspeaker 11 includes the sum of the masses of the shell assembly 10 and the parts within the shell assembly 10 other than the magnet assembly 112.

[0148] Optionally, the mass of the bone-conducting loudspeaker 11 is less than or equal to 8 grams.

[0149] Optionally, the vibration transmission sheet 113 is set such that the earphone 100 has a resonance peak, with the peak of the resonance peak being less than or equal to 500 Hz. Referring to FIG. 3 and FIG. 17, the core assembly 1

includes the shell assembly 10, the bone-conducting loudspeaker 11, and a fixing adhesive 1062. The shell assembly 10 is used to accommodate the bone-conducting loudspeaker 11. The fixing adhesive 1062 is used to fix the bone-conducting loudspeaker 11 to the shell assembly 10. Specifically, the shell assembly 10 is provided with the accommodation cavity 1001. The bone-conducting loudspeaker 11 may be accommodated within the accommodation cavity 1001, and the bone-conducting loudspeaker 11 is provided to vibrate along the central axis direction Z of the bone-conducting loudspeaker 11. The portion of the shell assembly 10 corresponding to the bone-conducting loudspeaker 11 is fitted to the user's face, and the bone-conducting loudspeaker 11 can drive the shell assembly 10 to vibrate when vibrating, converting an electrical signal into a vibration signal and transmitting the vibration signal to the auditory nerve through the human tissues. The central axis direction Z of the bone-conducting loudspeaker 11 is shown in direction Z in FIG. 17.

[0150] As shown in FIG. 3 and FIG. 17, the earphone 100 further includes the wearing assembly 27. The shell 101 and the shell 102 fit with each other to form the accommodation cavity 1001, the shell 101 is connected to the wearing assembly 27, and the fixing adhesive 1062 connects the shell 101 to the bone-conducting loudspeaker 11. Fitting the shell 101 and the shell 102 to form the accommodation cavity 1001 can facilitate the earphone 100 to be installed with the wearing assembly 27 and the bone-conducting loudspeaker 11 during production, reduce the difficulty of the production of the earphone 100, and also facilitate the subsequent disassembly and maintenance of the earphone 100. The core assembly 1 includes the shell assembly 10 and a microphone assembly 13. The microphone assembly 13 is accommodated within the accommodation cavity 1001. As shown in FIG. 17, the shell assembly 10 is provided with a sound inlet hole 1082, and the microphone assembly 13 is configured to capture an external sound input via the sound inlet hole 1082.

[0151] For example, the wearing assembly 27 includes elements such as an ear-hook, a headband, a clip, or the like, to facilitate wearing and fixing the earphone 100 in a position via the wearing assembly 27. Optionally, the wearing assembly 27 is disposed on the shell 101 along a radial direction of the bone-conducting loudspeaker 11 such that the wearing assembly 27 does not interfere with the vibration effect brought about by the bone-conducting loudspeaker 11 along the central axis direction Z.

[0152] As shown in FIG. 7, the voice coil assembly 111 surrounds the magnet assembly 112, and the vibration transmission sheet 113 is elastically connected to the voice coil assembly 111 and the magnet assembly 112 to elastically constrain the relative movement between the voice coil assembly 111 and the magnet assembly 112 along the central axis direction Z. The fixing adhesive 1062 connects the shell assembly 10 and the voice coil assembly 111.

[0153] Specifically, the voice coil assembly 111 may interact with the magnet assembly 112 while current is passing through the voice coil assembly 111, thereby generating vibration. Therefore, by controlling the current passing through the voice coil assembly 111, the voice coil assembly 111 may interact with the magnet assembly 112 to generate corresponding vibration signals, and the vibration signals may be further transmitted to the shell assembly 10 and then to human tissues.

[0154] The vibration transmission sheet 113 is elastically connected to the voice coil assembly 111 and the magnet assembly 112 and can elastically constrain the voice coil assembly 111 and the magnet assembly 112, so that when the voice coil assembly 111 generates vibration, the voice coil assembly 111 and the magnet assembly 112 are less likely to move relative to each other along the central axis direction Z, thereby ensuring the stability of the earphone 100.

[0155] Optionally, the fixing adhesive 1062 connects the shell 101 and the voice coil assembly 111. Specifically, the inner peripheral surface of the shell 101 and an outer peripheral surface of the voice coil assembly 111 may be opposite to each other, and the fixing adhesive 1062 may be filled in a gap between the inner peripheral surface of the shell 101 and the outer peripheral surface of the voice coil assembly 111 to connect and fix the shell 101 and the voice coil assembly 111.

[0156] Optionally, the shell 101 and the shell 102 may fit along the central axis direction Z, and the shell 102 further presses and fixes the voice coil assembly 111 to the shell 101. In this way, by using the shell 102 to further press and fix the voice coil assembly 111 to the shell 101, it is possible to further stabilize the position of the voice coil assembly 111 along the central axis direction Z. The shell 101 and shell 102 fitting to further press and fix the voice coil assembly 111 reduces the need for additional fixing means, and also makes it easier for the voice coil assembly 111 to drive the shell assembly 10 to vibrate when it vibrates along the central axis direction Z, thereby improving the structural tightness of the earphone 100.

[0157] As previously described, there may be two sets of voice coils 1110, with the magnetic conduction shield 1111 around the periphery of the two sets of voice coils 1110. The two sets of voice coils 1110 are available for the passage of current for vibration by interacting with the magnet assembly 112 as the current passes. Besides, providing the two sets of voice coils 1110 spaced apart along the central axis direction Z enables a stronger vibration of the voice coil assembly 111.

[0158] The magnetic conduction shield 1111 is used to constrain the magnetic field direction of the magnet assembly 112, and is also used to contact the shell assembly 10. When the two sets of voice coils 1110 vibrate, the magnetic conduction shield 1111 can be driven to vibrate to transmit the vibration signals to the shell assembly 10 through the magnetic conduction shield 1111.

[0159] As previously described, there may be two magnetic conduction plates 1122, and the two magnetic conduction plates 1122 may be disposed on two opposite end surfaces of the magnet 1121 along the central axis direction Z, respectively. The two magnetic conduction plates 1122 are used to constrain the magnetic field direction of the magnet 1121 on two opposite end surfaces of the magnet 1121 along the central axis direction Z, thereby enhancing the effect of the interaction between the magnet 1121 and the voice coils 1110. Optionally, projections of the two magnetic conduction plates 1122 along a radial direction E overlap with the two voice coils 1110, ensuring that the magnetic conduction plates 1122 can act on the two voice coils 1110. The current directions of the two sets of voice coils 1110 are opposite to ensure that the two voice coils 1110 are subjected to the same direction of force under the interaction of the same magnet 1121.

[0160] A locating portion 1061 may be provided on the shell assembly 10 and/or the bone-conducting loudspeaker 11 as illustrated in FIG. 17 to FIG. 19. The locating portion 1061 is configured to maintain a predetermined gap between an inner peripheral surface of the shell assembly 10 and an outer peripheral surface of the bone-conducting loudspeaker 11 along a radial direction of the bone-conducting loudspeaker 11. The radial direction of the bone-conducting loudspeaker 11 is shown in the direction E in FIG. 17 to FIG. 19. Directions perpendicular to the central axis direction Z are all referred to as the radial direction E of the bone-conducting loudspeaker 11.

[0161] The position of the locating portion 1061 may be disposed on the shell assembly 10, on the bone-conducting loudspeaker 11, or on both the shell assembly 10 and the bone-conducting loudspeaker 11, which is not limited by the present disclosure herein. For example, the locating portion 1061 may be disposed on one of the shell assembly 10 or the bone-conducting loudspeaker 11, and is positioned against another one of the shell assembly 10 or the bone-conducting loudspeaker 11 along a radial direction of the bone-conducting loudspeaker 11, thus forming a gap between the inner peripheral surface of the shell assembly 10 and the outer peripheral surface of the bone-conducting loudspeaker 11.

[0162] The fixing adhesive 1062 may fill in the gap and connect the shell assembly 10 and the bone-conducting loudspeaker 11. This allows the fixing adhesive 1062 to fix the shell assembly 10 and the bone-conducting loudspeaker 11 along a circumferential direction of the bone-conducting loudspeaker 11, so that the bone-conducting loudspeaker 11 is less prone to deflection when vibrating along the central axis direction Z.

[0163] Maintaining the predetermined gap between the bone-conducting loudspeaker 11 and the shell assembly 10 along the circumferential direction of the bone-conducting loudspeaker 11 facilitates the addition of the fixing adhesive 1062, simplifies the production process of the earphone 100, and facilitates the flow of the fixing adhesive 1062 along the circumferential direction of the bone-conducting loudspeaker 11, which enables it to be uniformly filled in the gap between the bone-conducting loudspeaker 11 and the shell assembly 10. In this way, the fixing effect of the fixing adhesive 1062 can be improved, thus stabilizing the position of the bone-conducting loudspeaker 11 in the accommodation cavity 1001, thereby making the structure of the earphone 100 more compact and stable.

[0164] Optionally, there may be a plurality of locating portions 1061, and the plurality of locating portions 1061 are spaced apart along the circumferential direction of the bone-conducting loudspeaker 11. The plurality of locating portions 1061 are spaced apart along the circumferential direction of the bone-conducting loudspeaker 11, and the plurality of locating portions 1061 locate predetermined gaps along the circumferential direction of the bone-conducting loudspeaker 11 to facilitate application of the fixing adhesive 1062 along the circumferential direction of the bone-conducting loudspeaker 11, thereby enhancing the fixation effect of the fixing adhesive 1062. Optionally, the plurality of locating portions 1061 may be symmetrically arranged on two opposite sides of the bone-conducting loudspeaker 11 along the circumferential direction.

[0165] As shown in FIG. 18, the vibration transmission sheet 113 may elastically constrain the relative movement between the voice coil assembly 111 and the magnet assembly

112 along the central axis direction Z. Optionally, the central fixing portion 1131 is fixedly connected to the magnetic conduction plate 1122, the annular fixing portion 1132 is fixedly connected to the magnetic conduction shield 1111, and the linkage assembly 1133 connects the annular fixing portion 1132 and the central fixing portion 1131.

[0166] Specifically, the locating portion 1061 is disposed at an outer ring edge of the annular fixing portion 1132 of the vibration transmission sheet 113 and extends along the radial direction of the bone-conducting loudspeaker 11 toward the inner peripheral surface of the shell assembly 10 for abutting against the inner peripheral surface of the shell assembly 10, such that a predetermined gap can be maintained between the inner peripheral surface of the shell assembly 10 and the outer peripheral surface of the bone-conducting loudspeaker 11 along the radial direction of the bone-conducting loudspeaker 11, enabling the fixing adhesive 1062 to be filled within the gap. By disposing the locating portion 1061 on the vibration transmission sheet 113 can facilitate the machining out of the locating portion 1061 through a simple machining process. Besides, the vibration of the vibration transmission sheet 113 is mainly along the central axis direction Z and relies on elastic deformation generated by the linkage assembly 1133, on the one hand, disposing the locating portion 1061 at the outer ring edge of the annular fixing portion 1132 may not affect the elastic deformation of the linkage assembly 1133, ensuring the vibration and sound quality effect of the bone-conducting loudspeaker 11, and on the other hand, it can also enhance the strength of the annular fixing portion 1132, and the smaller displacement and the relatively fixed position of the annular fixing portion 1132 can better support the inner peripheral surface of the shell assembly 10 and can more stably maintain the predetermined gap.

[0167] As previously described, there may be two vibration transmission sheets 113, and the two vibration transmission sheets 113 are provided on two opposite sides of the bone-conducting loudspeaker 11 along the central axis direction Z. The locating portions 1061 may be disposed at the outer ring edge of the annular fixing portion 1132 of the two vibration transmission sheets 113, respectively, which can make the force of the bone-conducting loudspeaker 11 more uniform. Along the central axis direction Z of the bone-conducting loudspeaker 11, the gap between the inner peripheral surface of the shell assembly 10 and the outer peripheral surface of the bone-conducting loudspeaker 11 may be of a consistent width, which can enable the bone-conducting loudspeaker 11 to be set in a more accurate position and also enhance the filling effect of the fixing adhesive 1062.

[0168] In some embodiments, the locating portion 1061 is disposed at the outer ring edge of the annular fixing portion 1132 of the vibration transmission sheet 113, which also improves the assembly and positioning of the vibration transmission sheet 113 when it is fixed to the magnet assembly 112 and the magnetic conduction shield 1111 with a better locating accuracy, which in turn ensures that a magnetic gap between the magnetic conduction shield 1111 fixed with the voice coil 1110 and the magnet assembly 112 more uniform and balanced, thereby improving the sound quality. For example, the bone-conducting loudspeaker 11 can be assembled using an upper jig and a lower jig as follows: the magnet assembly 112 and the magnetic conduction shield 1111 fixed with the voice coil 1110 are located

using the lower jig, while the vibration transmission sheet **113** is located using the upper jig. In this way, the vibration transmission sheet **113** can be located using the locating portion **1061**, and the upper jig can be designed with holes to facilitate the welding of the vibration transmission sheet **113** to the magnet assembly **112** and the magnetic conduction shield **1111**, which also ensures the alignment of corresponding positions on the vibration transmission sheet **113** (e.g., the central fixing portion **1131**) with the corresponding holes on the upper jig. Then, the upper jig and the lower jig are aligned to ensure that the corresponding positions on the vibration transmission sheet **113** (e.g., the central fixing portion **1131**) align with the corresponding positions on the magnet assembly **112** (e.g., the protrusion portion **1105**). Similarly, the corresponding positions on the vibration transmission sheet **113** (e.g., the annular fixing portion **1132**) align with the corresponding positions on the magnetic conduction shield **1111**. This alignment allows for subsequent operations through the holes in the upper jig, such as pre-deforming the vibration transmission sheet **113** and fixing the vibration transmission sheet **113**, the magnetic conduction shield **1111**, and the magnet assembly **112** together.

[0169] As shown in FIG. 19 to FIG. 21, the locating portion **1061** may also be integrally molded to the inner peripheral surface of the shell assembly **10**.

[0170] In some embodiments, a plurality of locating portions **1061** may be spaced apart on an inner peripheral surface of the shell assembly **10**. The plurality of locating portions **1061** may be spaced apart on the shell assembly **10**, extend towards the bone-conducting loudspeaker **11**, and abut against the outer peripheral surface of the bone-conducting loudspeaker **11** to support a gap between the inner peripheral surface of the shell assembly **10** and the outer peripheral surface of the bone-conducting loudspeaker **11**. Optionally, the plurality of locating portions **1061** may be integrally molded to the inner peripheral surface of the shell **101**. By providing the locating portions **1061** on the inner peripheral surface of the shell assembly **10**, on the one hand, it can locate the bone-conducting loudspeaker **11** when assembling the bone-conducting loudspeaker **11**, which facilitates its assembly, on the other hand, since the locating portion **1061** is disposed on the inner peripheral surface of the shell assembly **10**, its position is stable and is not affected by the vibration of the bone-conducting loudspeaker **11**, and thus the predetermined gap can be stably maintained. Moreover, by disposing the locating portion **1061** on the shell assembly **10**, the bone-conducting loudspeaker **11** can be minimized and facilitate the vibration of the bone-conducting loudspeaker **11**, and by setting the locating portion **1061** on the shell assembly **10** abutting against the bone-conducting loudspeaker **11**, the vibration transmission of the bone-conducting loudspeaker **11** to the shell assembly **10** can be further ensured, thereby ensuring the sound quality effect of the bone-conducting loudspeaker **11**. Moreover, locating on the shell assembly **10** is relatively simple to process, which can streamline the manufacturing process of the locating portion **1061** and, in turn, reduce the overall manufacturing complexity of the earphone **100**.

[0171] In other embodiments, as illustrated in FIG. 22, the locating portion **1061** includes a first locating portion **1063** integrally molded to the outer ring edge of the annular fixing portion **1132** and a second locating portion **1064** integrally molded to the inner peripheral surface of the annular fixing

portion **1132**. The first locating portion **1063** is disposed on the annular fixing portion **1132** and extends along the radial direction E of the bone-conducting loudspeaker **11** to abut against the inner peripheral surface of the shell assembly **10**. The second locating portion **1064** is disposed on the inner peripheral surface of the shell assembly **10** and extends along the radial direction E of the bone-conducting loudspeaker **11** to abut against the outer peripheral surface of the bone-conducting loudspeaker **11**. It should be understood that the first locating portion **1063** may not be limited to being disposed on the annular fixing portion **1132**, but may also be disposed on the outer peripheral surface of the bone-conducting loudspeaker **11** such as the outer peripheral surface of the voice coil assembly **111**.

[0172] Both the bone-conducting loudspeaker **11** and the shell assembly **10** are provided with the locating portions **1061** to realize a bidirectional abut along the radial direction E, so that even if the locating portion **1061** on one of the sides is not effective in supporting the bone-conducting loudspeaker **11**, the locating portion **1061** on another side can ensure the support effect, which in turn enhances the redundancy and further stabilizes the position of the bone-conducting loudspeaker **11**. In this way, the locating portion **1061** can more securely support the gap between the inner peripheral surface of the shell assembly **10** and the outer peripheral surface of the bone-conducting loudspeaker **11**, to facilitate the addition of the fixing adhesive **1062** and to make the force of the bone-conducting loudspeaker **11** more even, thus making the structure of the earphone **100** more stable.

[0173] Optionally, the first locating portion **1063** and the second locating portion **1064** are staggered from each other along the circumferential direction of the bone-conducting loudspeaker **11**. Such an arrangement facilitates the assembly of the bone-conducting loudspeaker **11** into the shell assembly **10**, reduces friction and damage caused by the first locating portion **1063** and the second locating portion **1064** due to coming into contact with each other, and further stabilizes the position of the bone-conducting loudspeaker **11** and enhance the structural tightness of the earphone **100**.

[0174] Referring to FIG. 23, the shell assembly **10** includes the accommodation cavity **1001**. The bone-conducting loudspeaker **11** is accommodated within the accommodation cavity **1001**. The vibration transmission sheet **113** may connect the voice coil assembly **111** and the magnet assembly **112** and elastically constrain the relative movement between the voice coil assembly **111** and the magnet assembly **112** along the central axis direction Z of the bone-conducting loudspeaker **11**. First one of the voice coil assembly **111** and the magnet assembly **112** is rigidly connected to the shell assembly **10**, which in turn can transmit vibrations generated by the relative movement between the voice coil assembly **111** and the magnet assembly **112** to the shell assembly **10** for realizing bone conduction.

[0175] Specifically, the first one of the voice coil assembly **111** and the magnet assembly **112** refers to the voice coil assembly **111** and the second one of the voice coil assembly **111** and the magnet assembly **112** refers to the magnet assembly **112**. In this case, the voice coil assembly **111** may be rigidly connected to the shell assembly **10**. In other embodiments, the first one of the voice coil assembly **111** and the magnet assembly **112** also refers to the magnet

assembly 112, and the second one of the voice coil assembly 111 and the magnet assembly 112 refers to the magnet assembly 112.

[0176] As previously described, the central fixing portion 1131 may be connected to the magnet assembly 112 and the annular fixing portion 1132 may be connected to the voice coil assembly 111. The vibration transmission sheet 113 may be inherently elastic or may be subject to elastic deformation. The vibration transmission sheet 113 may adaptively deform elastically when the voice coil assembly 111 and the magnet assembly 112 move relative to each other. While the vibration transmission sheet 113 adaptively deforms elastically, the central fixing portion 1131 connecting the magnet assembly 112 and the annular fixing portion 1132 connecting the voice coil assembly 111 may move relative to each other along the central axis direction Z.

[0177] Usually, when the earphone 100 outputs sound normally, the range of relative movement between the magnet assembly 112 and the voice coil assembly 111 is within a permitted range, i.e., the relative movement between the two is realized through the elastic deformation generated by the vibration transmission sheet 113. However, in some special scenarios, the range of relative movement between the magnet assembly 112 and the voice coil assembly 111 may exceed the permitted range. For example, when the earphone 100 falls to the ground or collides, the magnet assembly 112 continues to move due to inertia, resulting in an excessive displacement of the magnet assembly 112 relative to the voice coil assembly 111, thereby exerting excessive force on the vibration transmission sheet 113. Consequently, the vibration transmission sheet 113 may be overstretched, potentially exceed its range of elastic deformation, and undergo plastic deformation, which would reduce its elasticity, weaken the elastic constraint effect, and ultimately affect the performance of the earphone 100.

[0178] To ameliorate the above-mentioned problems, the shell assembly 10 may be provided with the stop member 107. The stop member 107 may rigidly constrain the range of relative movement between the voice coil assembly 111 and the magnet assembly 112 along the central axis direction Z. That is to say, the stop member 107 may apply a rigid constraint to the magnet assembly 112 when the magnet assembly 112 moves excessively compared to the voice coil assembly 111, to limit the movement amplitude of the magnet assembly 112, which in turn can reduce the elasticity degradation of the vibration transmission sheet 113 caused by the excessive movement amplitude.

[0179] Setting the stop member 107 to limit the range of relative movement between the voice coil assembly 111 and the magnet assembly 112 can avoid an excessively large range of relative movement between the voice coil assembly 111 and the magnet assembly 112 or reduce the possibility of an excessively large range of relative movement between the voice coil assembly 111 and the magnet assembly 112, thereby minimizing the possibility of overstretching the vibration transmission sheet 113.

[0180] The rigid constraint imposed by the stop member 107 and the elastic constraint imposed by the vibration transmission sheet 113 are relative to each other, i.e., the constraining strength exerted by the stop member 107 on the magnet assembly 112 when stopping the magnet assembly 112 is greater than the constraining strength exerted by the vibration transmission sheet 113 on the magnet assembly 112 and the voice coil assembly 111.

[0181] Optionally, the stop member 107 protrudes from the shell assembly 10. The first one of the voice coil assembly 111 and the magnet assembly 112 may be fixedly connected to the shell assembly 10, and the stop member 107 is disposed on a surface of the shell assembly 10 towards the second one of the voice coil assembly 111 and the magnet assembly 112 along the central axis direction Z. The stop member 107 may be fixedly connected to the second one of the voice coil assembly 111 and the magnet assembly 112 or abut against the vibration transmission sheet 113 after the second one of the voice coil assembly 111 and the magnet assembly 112 moves a predetermined distance relative to the first one of the voice coil assembly 111 and the magnet assembly 112, which in turn can effectively limit the range of relative movement between the voice coil assembly 111 and the magnet assembly 112.

[0182] For example, the voice coil assembly 111 is fixedly connected to the shell assembly 10, and the stop member 107 may abut against the magnet assembly 112 or the vibration transmission sheet 113 after the magnet assembly 112 moves to a predetermined distance relative to the voice coil assembly 111, thereby imposing a rigid constraint on the magnet assembly 112 or the vibration transmission sheet 113. This makes it possible to limit the range of relative movement between the voice coil assembly 111 and the magnet assembly 112.

[0183] In other embodiments, the stop member 107 may also be in the form of a plate or other arbitrary shape.

[0184] Optionally, the stop member 107 is integrally molded to the shell assembly 10, which can improve productivity and assembly efficiency.

[0185] The stop member 107 may apply a rigid constraint to the magnet assembly 112 directly or indirectly after the magnet assembly 112 moves a predetermined distance relative to the voice coil assembly 111. Optionally, the stop member 107 applies the rigid constraint to the magnet assembly 112 indirectly by applying the rigid constraint directly on the vibration transmission sheet 113.

[0186] Referring to FIG. 24, the stop member 107 may abut against the central fixing portion 1131 of the vibration transmission sheet 113 and/or the linkage assembly 1133 to apply a rigid constraint on the vibration transmission sheet 113.

[0187] Optionally, the stop member 107 includes a first stop member 1071 for abutting against the central fixing portion 1131. The first stop member 1071 may effectively limit the vibration range of the vibration transmission sheet 113 and thus limit the range of relative movement between the voice coil assembly 111 and the magnet assembly 112.

[0188] Optionally, the stop member 107 includes a second stop member 1072 for abutting against the linkage assembly 1133. The second stop member 1072 may fit with the first stop member 1071 to allow the stop member 107 and the vibration transmission sheet 113 to be abutted against each other to a greater extent, so as to more contact the vibration transmission sheet 113 and further protect the vibration transmission sheet 113.

[0189] Optionally, there may be at least one first stop member 1071. Optionally, there may be at least two second stop members 1072.

[0190] During vibration of the vibration transmission sheet 113, the moveable distance of a region near the center of the vibration transmission sheet 113 (e.g., the central fixing portion 1131) is greater than the moveable distance of

a region away from the center of the vibration transmission sheet 113. If the first stop member 1071 and the second stop member 1072 are at the same distance from the bone-conducting loudspeaker 11 while the movement degrees in different regions of the vibration transmission sheet 113 are different, the first stop member 1071 and the second stop member 1072 may not simultaneously abut against the vibration transmission sheet 113, which makes the rigid constraint less effective.

[0191] Optionally, the vibration transmission sheet 113 may be configured with a pre-deformation design, i.e., in a natural state, the linkage assembly 1133 has an extension component starting at the annular fixing portion 1132 and pointing toward the interior of the bone-conducting loudspeaker 11 along the central axis direction Z. The vibration transmission sheet 113 may be pre-deformed toward the interior of the bone-conducting loudspeaker 11 or may be pre-deformed toward the exterior of the bone-conducting loudspeaker 11. The natural state refers to a state when the bone-conducting loudspeaker 11 is assembled or a state in which the voice coil assembly 111 and the magnet assembly 112 are relatively stationary when the bone-conducting loudspeaker 11 is not operating.

[0192] Along the central axis direction Z, a spacing d2 from the first stop member 1071 to the central fixing portion 1131 is greater than a spacing d1 from the second stop member 1072 to the linkage assembly 1133. In this way, the possibility of the first stop member 1071 and the second stop member 1072 simultaneously abutting against the vibration transmission sheet 113 can be increased, which facilitates the first stop member 1071 and the second stop member 1072 to jointly exert a rigid constraint on the vibration transmission sheet 113. Alternatively, as compared to the spacing d2 from the first stop member 1071 to the central fixing portion 1131 being equal to the spacing d1 from the second stop member 1072 to the linkage assembly 1133, the spacing d2 from the first stop member 1071 to the central fixing portion 1131 being greater than the spacing d1 from the second stop member 1072 to the linkage assembly 1133 can provide sufficient vibration space for the vibration transmission sheet 113 to vibrate during normal operation, thereby enhancing the sound quality of the earphone 100.

[0193] It should be understood that in a natural state, the second stop member 1072 and the linkage assembly 1133 may be spaced apart from each other or may abut against each other. Since the linkage assembly 1133 is relatively weak in rigidity and is susceptible to stretching, the second stop member 1072 and the linkage assembly 1133 abutting against each other in the natural state can further limit the vibration degree of the vibration transmission sheet 113 and better protect the linkage assembly 1133.

[0194] Optionally, the spacing d2 from the first stop member 1071 to the central fixing portion 1131 is greater than or equal to 0.1 mm, which can make the first stop member 1071 more sensitive against the vibration transmission sheet 113 and provide timely protection. In other words, the bone-conducting loudspeaker 11 can achieve bone conduction relatively well while being less prone to damage during drops or collisions.

[0195] Considering that the spacing d1 from the second stop member 1072 to the linkage assembly 1133 is smaller than the spacing d2 from the first stop member 1071 to the central fixing portion 1131, if the second stop member 1072 is too close to the first stop member 1071 (the central fixing

portion 1131), this may limit the movable distance of the magnet assembly 112 (i.e., the range of relative movement between the voice coil assembly 111 and the magnet assembly 112). Optionally, along an extension direction of the linkage assembly 1133, the position of the second stop member 1072 abutting against the linkage assembly 1133 is closer to the annular fixing portion 1132 as compared to the central fixing portion 1131. In this way, the vibration degree of the central fixing portion 1131 can be retained to a certain extent, which allows the voice coil assembly 111 and the magnet assembly 112 of the bone-conducting loudspeaker 11 to have a larger range of relative movement within a reasonable limit.

[0196] As described previously, the outer end surface 1103 of the second one of the voice coil assembly 111 and the magnet assembly 112 includes the center region 1104 and the peripheral region 1106 surrounding the center region 1104 (refer to FIG. 7 and FIG. 8 for illustrations). The center region 1104 is provided with the protrusion portion 1105. The protrusion portion 1105 protrudes with respect to the peripheral region 1106. The central fixing portion 1131 is connected to the protrusion portion 1105. In this case, it is advantageous for the second one of the voice coil assembly 111 and the magnet assembly 112 and the central fixing portion 1131 to be assembled together.

[0197] Taking the outer end surface 1103 disposed on the magnet assembly 112 as an example, the outer end surface 1103 includes the center region 1104 and the peripheral region 1106. By disposing the protrusion portion 1105 on the outer end surface 1103 of the magnet assembly 112, and fixedly connecting the central fixing portion 1131 of the vibration transmission sheet 113 to the protrusion portion 1105, on the one hand, this configuration minimizes the fixed connection region between the vibration transmission sheet 113 and the magnet assembly 112, reducing the limitations on the elastic deformation of the vibration transmission sheet 113 and improving the vibration effect while ensuring the elastic constraint, on the other hand, by not disposing the protrusion portion 1105 on the vibration transmission sheet 113, the weight of the vibration transmission sheet 113 can be kept at a certain level to reduce its impact on the vibration. At the same time, this design allows for a more reliable and stable connection between the magnet assembly 112 and the vibration transmission sheet 113.

[0198] Specifically, when the central fixing portion 1131 of the vibration transmission sheet 113 is rounded, the protrusion portion 1105 may also be cylindrical. The shape of the center region 1104 can be designed to match the shape of the central fixing portion 1131, ensuring that a stable connection is formed between the center region 1104 and the central fixing portion 1131 of the vibration transmission sheet 113.

[0199] Optionally, as shown in FIG. 17, the shell assembly 10 includes the shell 101 and the shell 102 that fit with each other along the central axis direction Z. The stop member 107 is provided on an inner surface of the shell 101 and/or an inner surface of the shell 102. The outer surface of the shell 101 and/or the outer surface of the shell 102 is in contact with the user's skin. The assembly of the bone-conducting loudspeaker 11 is facilitated by the above structure.

[0200] Optionally, the first one of the voice coil assembly 111 and the magnet assembly 112 surrounds the second one

of the voice coil assembly 111 and the magnet assembly 112. For example, the voice coil assembly 111 surrounds the magnet assembly 112. The voice coil assembly 111 is rigidly connected to the shell 101 and/or the shell 102. By setting the voice coil assembly 111 surrounding the magnet assembly 112, it can minimize the magnet assembly 112, which can reduce the volume of the bone-conducting loudspeaker 11, and thus reduce the volume of the earphone 100. In other embodiments, the magnet assembly 112 may also be provided outside the voice coil assembly 111.

[0201] Optionally, the shell 102 further presses and fixes the voice coil assembly 111 to the shell 101, so that the voice coil assembly 111 can be stably sandwiched between the shell 101 and the shell 102 with a better fixing effect, and thus enhancing the effect of vibration conduction to the shell assembly 10 and easily assembling the bone-conducting loudspeaker 11 in the shell assembly 10.

[0202] The foregoing is only a part of the embodiments of the present disclosure, and is not intended to limit the scope of protection of the present disclosure, and any equivalent device or equivalent process transformations utilizing the contents of the present disclosure and the accompanying drawings, or applying them directly or indirectly in other related technical fields, are similarly included in the scope of patent protection of the present disclosure.

What is claimed is:

1. An earphone, comprising:
 - a shell assembly, wherein the shell assembly is provided with an accommodation cavity;
 - a bone-conducting loudspeaker accommodated in the accommodation cavity, wherein the bone-conducting loudspeaker is configured to vibrate along a central axis direction of the bone-conducting loudspeaker, the bone-conducting loudspeaker includes a voice coil assembly, a magnet assembly, and a vibration transmission sheet,
 - the vibration transmission sheet is elastically connected to the voice coil assembly and the magnet assembly to elastically constrain relative movement between the voice coil assembly and the magnet assembly along the central axis direction of the bone-conducting loudspeaker,
 - one of the voice coil assembly and the magnet assembly is rigidly connected to the shell assembly,
 - the shell assembly is provided with a stop member, and the stop member rigidly constrains a range of relative movement between the voice coil assembly and the magnet assembly along the central axis direction.
2. The earphone of claim 1, wherein the stop member is protrudingly arranged on a surface of the shell assembly directed toward another one of the voice coil assembly and the magnet assembly along the central axis direction and abuts against the vibration transmission sheet or the another one of the voice coil assembly and the magnet assembly after the another one of the voice coil assembly and the magnet assembly moves a predetermined distance relative to the one of the voice coil assembly and the magnet assembly.
3. The earphone of claim 2, wherein the stop member is integrally molded to the shell assembly.
4. The earphone of claim 2, wherein the one of the voice coil assembly and the magnet assembly is arranged around the another one of the voice coil assembly and the magnet assembly,

the vibration transmission sheet includes a central fixing portion, an annular fixing portion around a periphery of the central fixing portion, and a linkage assembly connected between the central fixing portion and the annular fixing portion,

the annular fixing portion is connected to the one of the voice coil assembly and the magnet assembly, and the central fixing portion is connected to the another one of the voice coil assembly and the magnet assembly.

5. The earphone of claim 4, wherein the annular fixing portion serves as the stop member, and a projection of the annular fixing portion along the central axis direction partially overlaps with an outer end surface of the another one of the voice coil assembly and the magnet assembly.

6. The earphone of claim 4, wherein the stop member includes a first stop member configured to abut against the central fixing portion.

7. The earphone of claim 6, wherein a count of the first stop member is at least one.

8. The earphone of claim 6, wherein the stop member includes a second stop member configured to abut against the linkage assembly.

9. The earphone of claim 8, wherein a count of the second stop member is at least two.

10. The earphone of claim 8, wherein

in a natural state, the linkage assembly has an extension component starting at the annular fixing portion and pointing toward an interior of the bone-conducting loudspeaker along the central axis direction, and

along the central axis direction, a spacing from the first stop member to the central fixing portion is greater than a spacing from the second stop member to the linkage assembly.

11. The earphone of claim 10, wherein in the natural state, the second stop member abuts against the linkage assembly.

12. The earphone of claim 11, wherein the spacing from the first stop member to the central fixing portion is greater than or equal to 0.1 mm.

13. The earphone of claim 11, wherein along an extension direction of the linkage assembly, a position of the second stop member abutting against the linkage assembly is closer to the annular fixing portion compared to the central fixing portion.

14. The earphone of claim 1, wherein the shell assembly includes a first shell and a second shell fitting with each other along the central axis direction, the first shell and the second shell fit with each other to form the accommodation cavity.

15. The earphone of claim 14, wherein the stop member is arranged on an inner surface of the first shell and/or an inner surface of the second shell, and

an outer surface of the first shell and/or an outer surface of the second shell is in contact with a user's skin.

16. The earphone of claim 15, wherein the voice coil assembly is arranged around the magnet assembly, and the voice coil assembly is rigidly connected to the first shell and/or second shell.

17. The earphone of claim 15, wherein the second shell further presses and fixes the voice coil assembly to the first shell.

18. The earphone of claim 4, wherein the outer end surface of the another one of the voice coil assembly and the magnet assembly includes a center region and a peripheral region surrounding the center region, the center region is

provided with a protrusion portion, and the protrusion portion protrudes with respect to the peripheral region, the central fixing portion is fixedly connected to the protrusion portion, and a projection of the annular fixing portion along the central axis direction partially overlaps with the peripheral region.

19. The earphone of claim 1, further comprising:

an air-conducting loudspeaker, wherein the accommodation cavity includes a first accommodation cavity and a second accommodation cavity that are isolated from each other, the bone-conducting loudspeaker is accommodated in the first accommodation cavity, and the air-conducting loudspeaker is accommodated in the second accommodation cavity.

20. The earphone of claim 19, wherein a sealing performance of the first accommodation cavity is greater than a sealing performance of the second accommodation cavity.

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