

(12) International application published under Patent Cooperation Treaty

(19) World Intellectual Property Organization
International bureau



(10) International publication number

WO 2008/007666 A1

(43) International publication date
January 17, 2008 (17.01.2008)

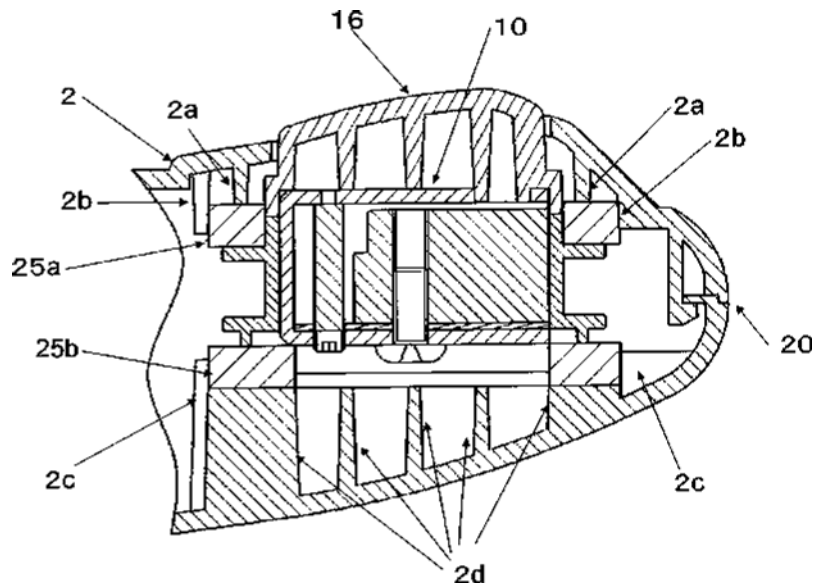
PCT

- (51) International patent classification: **H04R 1/00** (2006.01) **H04R 1/02** (2006.01) **H04M 1/05** (2006.01) **H04R 17/00** (2006.01)
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(21) International application number: PCT/JP2007/063730
(22) International filing date: July 10, 2007 (10.07.2007)
(25) International application language: Japanese
International publication language: Japanese
(26) language: Japanese
(30) Priority data:
Patent application July 10, 2006 (10.07.2006)
2006-189084 JP
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(54) Title: BONE CONDUCTION RECEIVER

(54) Title of Invention: bone conduction receiver



(57) Abstract: Provided is a bone conduction receiver which can efficiently transmit outputted oscillation from a bone conduction speaker. A bone conduction receiver (1) is provided with a bone conduction speaker (10) for converting sound information to oscillation, and a case (2) for storing the bone conduction speaker (10). The bone conduction speaker (10) is provided with a multilayer columnar piezoelectric element (12) for generating oscillation in accordance with the sound information, and a pad (16), which protrudes from the case (2) for transmitting the oscillation generated by the multilayer columnar piezoelectric element (12) by abutting to the human head.

(57) Abstract: a bone conduction receiver is provided, which can efficiently transmit the output vibration of a bone conduction speaker. The present invention discloses a bone conduction receiver 1, which comprises the following parts: a bone conduction speaker 10 converting sound information into vibration, and a casing 2 for accommodating the bone conduction speaker 10. The bone conduction speaker 10 comprises the following parts,

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(81) Designated countries (if no indication is given, all kinds of domestic protection apply): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated countries (if no indication is given, all kinds of wide protection apply): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Appendix Disclosure Documents:

-International Investigation Report

-Amendment/specification

2 For character codes and other abbreviations, see the "Guidance Notes on Codes and Abbreviations" published at the beginning of each periodic issue of the PCT Gazette.

a stacked columnar piezoelectric element 12 generating vibration according to sound information, and a convex cushion protruding from the casing 2, and transmitting vibration generated by the stacked columnar piezoelectric element 12 to the cushion 16 for a human head when being in close contact with the human head.

Specification

Bone Conduction Receiver

Technical Field

[0001] The present invention relates to a bone conduction receiver utilizing a bone conduction speaker.

Background Art

[0002] Conventionally, bone conduction receivers have been developed as hearing aids based on bone conduction. In recent years, bone conduction receivers have been applied as man-machine interface devices, utilized as input/output devices for audio information connected to information devices such as mobile phones (for example, see Patent Document 1). Therefore, bone conduction receivers used as interfaces for information devices are required to accurately convey audio information from devices such as mobile phones to their users. Furthermore, bone conduction receivers are also required to reliably transmit user voice or operational information to the information devices and to offer high portability as devices connected to mobile information devices.

[0003] To meet such demands, bone conduction receivers utilizing bone conduction speakers have been proposed. A bone conduction speaker transmits audio information to the user by applying vibrations to the human head, which are conveyed to the auditory organs. In such bone conduction receivers, compared to air conduction speakers, which transmit audio information through air vibrations, it is possible to accurately convey audio information to individuals with impairments in the sound transmission parts of the outer or inner ear. Furthermore, because air conduction speakers are not used, there is no sound leakage to the surroundings, ensuring a high level of privacy. Additionally, since the auricle can remain open during use, external sounds and alarm signals can still be heard, which offers safety advantages when used in crowded or noisy environments.

Due to these features, it is desirable to use bone conduction speakers in bone conduction receivers. These bone conduction receivers can accurately transmit audio information, have excellent portability, and can be effectively utilized by a wide range of users, including both individuals with normal hearing and some individuals with hearing impairments. Therefore, bone conduction receivers using bone conduction speakers are suitable as input/output devices for audio signals and are increasingly being used by both individuals with normal hearing and those with hearing impairments.

[0004] In recent years, a bone conduction speaker composed of a piezoelectric ceramic material has been proposed as a bone conduction speaker for a bone conduction receiver, allowing anyone to accurately listen to sound information, such as mobile phone calls, and offering excellent portability. In the bone conduction speaker, a stacked columnar piezoelectric element is adopted, and the longitudinal displacement of the stacked columnar piezoelectric element is amplified through a displacement amplifier and transmitted to the contacted head through a vibration output part. In addition, a weight of sufficient size is arranged at a fixing part of the amplifier, so that the displacement of a fulcrum (fixing part) of a loudspeaker is suppressed as much as possible.

In particular, by integrating the bone conduction speaker into a bone conduction receiver, the vibration output part can ensure a large displacement while suppressing the vibration of the fixing part as much as possible. Therefore, sound leaked from the bone conduction receiver can be further reduced. Secondly, the bone conduction speaker made of the piezoelectric ceramic materials is low in power consumption, can be used for an extended period with the same battery, and has excellent portability.

[0005] When the stacked columnar piezoelectric element is installed in portable devices, such as bone conduction receivers or mobile phones, due to product size constraint, the reasonable length of the stacked columnar piezoelectric element is smaller than or equal to about 10 mm. The standard expansion and contraction quantity of the about 10 mm stacked columnar piezoelectric element is about 2 μm to 3 μm , making it difficult to meet the expansion and contraction quantity required to transmit sound information.

Moreover, if the stacked columnar piezoelectric element is used for a power source and driven by a displacement amplification structure, the output end of the element can achieve displacement amplified to a specified amount. Therefore, complete sound information can be transmitted to a perception part of a user. However, depending on the posture of use, sound information cannot be accurately transmitted. Moreover, in the displacement amplification structure of the stacked columnar piezoelectric element, measures for miniaturization and weight reduction are insufficient.

[0006] Secondly, the previous using method of a bone conduction receiver is to place the output part of a bone conduction speaker close to the face of a user. Therefore, in the propagation path of vibration generated by the stacked columnar piezoelectric element of the bone conduction receiver, structural loss of the bone conduction speaker and loss caused by contact between the output part and the face can be produced. By sufficiently increasing the weight of the fixing part of the bone conduction speaker, the structural loss of the bone conduction speaker can be reduced. In contrast, the loss caused by contacting with the face is difficult to fully reduce.

Patent document 1: unexamined Japanese patent application publication No. 2006-86581

Disclosure of the invention

Problems to be solved by the invention

[0007] Therefore, in the previous bone conduction receivers, there is a problem that the output vibration of the bone conduction speaker cannot be efficiently transmitted.

The purpose of the present invention is to provide a bone conduction receiver capable of efficiently transmitting the output vibration of the bone conduction speaker according to the problem. Means for solving the problem

[0008] The present invention discloses a bone conduction receiver, which comprises the following parts: a bone conduction speaker converting sound information into vibration, and a casing for accommodating the bone conduction speaker. The bone conduction speaker comprises the following parts: a vibration generating part generating vibration according to sound information, and a convex vibration transmitting part protruding from the casing, and transmitting the vibration generated by the vibration generating part to a human head when being in close contact with the human head. In the composition, the vibration transmitting part protruding from the casing makes accurate contact with the face. Therefore, the output vibration of the bone conduction speaker can be efficiently transmitted.

[0009] Secondly, the vibration transmitting part is provided with a U shape, and the vibration generating part is positioned between two symmetrical surfaces of the vibration transmitting part and arranged near a surface different from the two surfaces, and generates vibration between the two symmetrical surfaces according to the sound information. As a result, greater vibration is generated at a part farther from the vibration center of the vibration transmitting part.

[0010] Secondly, the protruding convex apex part in the vibration transmitting part is positioned farther from the vibration generating part than the center of the vibration transmitting part. Therefore, the apex part far from the vibration generating part can produce greater vibration. Therefore, output vibration can be efficiently transmitted through the apex part.

[0011] Secondly, the vibrating end of the vibration transmitting part is arranged in one side closer to the end surface than to the center of the bone conduction receiver. Therefore, the vibrating end can generate greater vibration, and the transmission efficiency of the output vibration is further enhanced.

[0012] The vibration transmitting part is arranged on one of a U-shaped frame surface and a surface symmetrical with the U-shaped frame, and is provided with a cushion in close contact with the human head, and exposed in a convex shape when protruding from the casing. Therefore, the part in contact with the face consists of the cushion, allowing easy adjustment of contact with the face.

[0013] Moreover, the vibration generating part is a stacked columnar piezoelectric element.

[0014] The bone conduction speaker is provided with a frame accommodating the vibration generating part, with a convex cushion fixedly arranged on the outer wall of the frame and protruding from the casing.

[0015] The cushion is provided with a vertex part at the most protruding part of the casing, and the vertex part is arranged near one end of the cushion.

[0016] The vibration generating part is arranged near the other end of the cushion.

[0017] Additionally, the invention provides a bone conduction receiver, which comprises the following parts: a bone conduction speaker converting sound information into vibration, and a casing for accommodating the bone conduction speaker. The bone conduction speaker comprises the following components: a U-shaped frame, a vibration generating part arranged between the two symmetrical surfaces of the frame to generate vibration between the two symmetrical surfaces according to the sound information, and a cushion arranged on one of the two symmetrical surfaces of the frame and exposed in a convex shape when protruding from the casing. In the composition, the vibration transmitting part protruding from the casing makes accurate contact with the face. Therefore, the output vibration of the bone conduction speaker can be efficiently transmitted.

Effect of the invention

[0018] The present invention provides a bone conduction receiver efficiently transmitting the output vibration of a bone conduction speaker.

Brief description of drawings

[0019] [Figure 1] An oblique diagram of the appearance of the bone conduction receiver according to the present invention.

[Figure 2] A sectional diagram of the bone conduction speaker in the bone conduction receiver according to the present invention.

[Figure 3] A sectional diagram of the installation status of the bone conduction speaker in the bone conduction receiver according to the present invention.

[Figure 4] A sectional diagram of the contact status between the bone conduction receiver and the head according to the present invention.

[Figure 5] A diagram of the equivalent circuit model of the skin of the contact part between the bone conduction receiver and the head according to the present invention.

[Figure 6] A contact pressure distribution diagram of the contact state between the cushion of the bone conduction receiver and the head according to the present invention.

[Figure 7A] A schematic diagram of the usage posture of the bone conduction receiver and head according to the present invention.

[Figure 7B] A schematic diagram of the usage posture of the bone conduction receiver and head according to the present invention.

[Figure 7C] A schematic diagram of the usage posture of the bone conduction receiver and head according to the present invention.

[Figure 8] A schematic diagram of the usage posture of the bone conduction receiver according to the present invention.

Explanation of symbols

[0020] 1... bone conduction receiver, 2... body casing, 2a, 2b, 2c, 2d... reinforcing rib, 3... flip cover, 4... connecting wire, 4a... plug, 10... bone conduction speaker, 11... frame, 11a... vibration output part, 11b... elastic part, 11c... frame fixing part, 11d... vibration transmitting part, 12... stacked columnar piezoelectric element, 13... base weight, 14... fixing part, 15a, 15b... compression screw, 16... cushion, 16a... convex close contact surface, 16b... apex, 18... positioning plate, 21... call button, 22... volume switch, 23... LED indicator, 24... hinge, 25a, 25b ... supporting component, 31 ... microphone

51...skull, 52...skin, 52a...skin viscosity, 52b...skin elasticity 52c...skin weight Best mode for implementing the invention

[0021] Referring to the following drawings, embodiments of the present invention are described.

The bone conduction receiver related to this embodiment comprises a structure using a bone conduction speaker, and the bone conduction speaker converts sound information, such as sound and music, into vibration. The bone conduction speaker transmits the vibration converted from sound information to a specific part of the human head, and then transmits the vibrations to auditory organs, thereby identifying the sound information.

Specifically, in the bone conduction receiver according to the embodiment, efforts are made to address the contact state between the bone conduction speaker and the face, the structure of the close contact part and the installation method of the bone conduction speaker. Through relevant solutions, it is possible to more effectively transmit the vibration generated by the stacked columnar piezoelectric element to the structure of the auditory organs through the user skin, regardless of any close contact conditions.

[0022] First, the overall composition of the bone conduction receiver according to the embodiment is described with reference to Figure 1. Figure 1 is an oblique diagram of the bone conduction receiver according to the present embodiment.

As shown in Figure 1, the bone conduction receiver 1 of the embodiment comprises a bone conduction speaker 10, a call button 21, a volume switch 22, an LED indicator 23, a microphone 31, a body frame 2, a flip cover 3, and a connecting wire 4.

[0023] The bone conduction speaker 10 converts electrical signals transmitted by a mobile phone via the connecting wire 4 into mechanical vibration. The call button 21 controls the bone conduction receiver 1 to start or end a call. The volume switch 22 adjusts the volume of the bone conduction speaker 10. The LED indicator 23 inform call or the like through illumination. The microphone 31 picks up the sound of a user.

The body casing 2 accommodates the bone conduction speaker 10, the call button 21, the volume switch 22, the LED indicator 23 and other components of the bone conduction receiver 1. In addition, a circuit board that processes electrical signals sent by the mobile phone (not shown) and operation signals of the call button 21 is also accommodated in the body casing 2. Flip cover 3 accommodates the microphone 31. The hinge 24 rotationally supports the flip cover on the body casing 2 through a shaft. The connecting wire 4 is connected to a mobile phone (not shown) and the bone conduction receiver 1 by connecting the plug 4a to the mobile phone.

[0024] Next, the structure of the bone conduction speaker 10 of the bone conduction receiver 1 according to the embodiment of the present invention is described with reference to Figure 2. Figure 2 is a sectional diagram of the bone conduction speaker 10.

As shown in Figure 2, in the cross-sectional view of the bone conduction speaker 10, a U-shaped plate-shaped frame

11 is assembled at the center. The frame 11 comprises a frame structure, which is composed of 3 parts: a vibration output part 11b on the front surface, an elastic part 11b on the side surface, and a frame fixing part 11c on the back surface. Moreover, the frame 11 is formed into a structure with a front surface, side surfaces, and a rear surface by pressing a metal plate or the like. In the frame 11, an aftermentioned stacked columnar piezoelectric element 12 is accommodated.

In detail, the vibration output part 11 for outputting vibration is arranged on one side of the U-shaped frame 11, and the weight is reduced as much as possible. Reinforcing ribs for enhancing the rigidity of the vibration output part 11a are downward arranged at the end parts of the two sides of the vibration output part 11a. The flat elastic part 11b supports the vibration output part 11a, and meanwhile, the lower part of the flat elastic part 11b is supported through the frame fixing part 11c. The frame fixing part 11c is arranged on the other side of the U-shaped frame 11 symmetrical to the vibration output part 11a. Reinforcing ribs 11cc for enhancing the rigidity of the frame fixing part 11c are downward arranged at the end parts of the two sides of the frame fixing part 11c.

[0025] The stacked columnar piezoelectric element 12 has a characteristic of displacement in the length direction and is arranged between two symmetrical surfaces of the vibration output part 11a and the frame fixing part 11c. The upper end of the stacked columnar piezoelectric element 12 is in close contact with the vibration output part 11a of the frame 11 and is fixed through an adhesive (not shown) to prevent displacement. The adhesive (not shown) is made of a material with a Young modulus lower than that of the frame 11 and the stacked columnar piezoelectric element 12.

The lower end of the stacked columnar piezoelectric element 12 closely contacts the end surface of a compression screw 15b, and the compression screw 15b is screwed and fixed in the threaded hole of the frame fixing part 11c. The four side surfaces of the lower end of the stacked columnar piezoelectric element 12 are limited by holes of a positioning plate 18 and are fixed through an adhesive (not shown) after pressurization operation. Furthermore, the input wire of the stacked columnar piezoelectric element 12 passes through the lower part of the elastic part 11b and are connected to a drive circuit board (not shown) in the body casing of the bone conduction receiver 1.

[0026] Within the inner space of the U-shaped frame 11 structure, a base weight 13 is provided. The base weight 13 is clamped into positioning plate 18 between the frame fixing parts 11c, and at the state, is fixed to the frame fixing parts 11c through screws 15a. A fixing part 14 is formed through the frame fixing part 11c, the positioning plate 18, the base weight 13 and the screws 15a. Compared to the total weight of the vibration output part 11a and the cushion 16, the total weight of the fixing part 14 is recommended to be at least 2 times, and ideally not less than 10 times. Furthermore, the base weight 13 and the positioning plate 18 can be an integrally formed component.

[0027] In the aforementioned basic structure, the vibration output part 11a is provided with a cushion 16. The vibration output part 11a and the cushion 16 form a vibration transmitting part 11d, and the vibration transmitting part 11d transmits the vibration generated by the stacked columnar piezoelectric element 12. The vibration output part 11a and the cushion 16 are ideally as light as possible while having a highly rigid structure. The vibration output part 11a and the cushion 16 rotate and vibrate with the rotation center of the vibration output part 11a near the intersection of the vibration output part 11b and the elastic part 11b as a reference. Therefore, the elastic part 11b possesses a hinge function for supporting the vibration output part 11a at a rotatable state. Secondly, the elastic part 11b possesses a function of applying pressure to the stacked columnar piezoelectric element 12, and besides the functions, the elastic part 11b is further provided with a spring function as a vibrating body. Furthermore, the frame fixing part 11c along with the base weight 13 and the positioning plate 18 serves as an integral fixing supporting part, and can suppress the vibration of the fixing part 14 by obtaining greater weight.

[0028] When the bone conduction receiver 1 is used, the vibration output part 11a contacts the face near an auricle and functions to vibrate the contacted facial area through vibration action. Therefore, compared to the advantages of the elastic part 11b, the vibration output part 11a needs to maintain good contact with the face.

Therefore, a cushion 16 is arranged on the upper surface of the vibration output part 11a, and the cushion 16 is made of a material with low thermal conductivity, low specific gravity and high rigidity. The cushion 16 is positioned and fit between a positioning hole and a boss, then fixed in high rigidity state. When the fixation between the vibration output part 11a and the cushion 16 is weak, secondary vibration occurs between the two, and harsh sound information with the secondary vibration is transmitted to the user.

In the position, the reason why the cushion 16 uses the material with low thermal conductivity is that the metal part of the vibration output part 11a becomes cold in winter mornings, and the material lessen the "cold feeling" when directly contacting the face. Additionally, the reason why the material with low specific gravity and high rigidity is to increase the amplitude by reducing the weight of the vibration part, and to prevent secondary vibration generated in the vibration output part 11a through high rigidity.

[0029] Then, the installation state of the bone conduction speaker 10 in the bone conduction receiver 1 is explained with reference to Figure 3. Figure 3 is a sectional diagram of the installation state of the bone conduction speaker 10.

As shown in Figure 3, the bone conduction speaker 10 is held by the reinforcing ribs 2a, 2b, 2c and 2d of the casing

2 via the supporting components 25a and 25b. The supporting components 25a and 25b are made of a viscoelastic material and have a function of absorbing the vibration of the fixing part 14. In detail, after the bone conduction speaker 10 generates vibration, the vibration is transmitted from the vibration output part 11a through the cushion 16 to the head of the user. The fixing part 14 vibrates through counter force corresponding to the vibration (acting force) transmitted to the head, and the supporting components 25a and 25b absorb the vibration. In the position, the viscoelastic material is a material that has both viscosity and elasticity, such as a silicone material, with a hardness of less than 5 degrees, or a colloidal material with silicon as a substrate.

[0030] The vibration output part 11a (front) of the bone conduction speaker 10 is provided with a cushion 16. The cushion 16 is an interface for transmitting vibration to the user and is extremely important. In the bone conduction receiver 1, the cushion 16 of the bone conduction speaker 10 directly contacts the skin of the head of the user, and transmits the vibration output part 11a to auditory organs of the user through the skin of a contact part. The cushion 16 is made of a material with low thermal conductivity, low specific gravity and high rigidity. In contrast, the head is provided with a structure covered over a skull 51 through soft skin 52. The contact structure between the cushion 16 and the head is as shown in Figure 4, and the hard cushion 16, the soft skin 52 and the hard skull 51 form a sandwich structure. The cushion 16 is a component protruding from the casing 2. The cushion 16 is provided with an apex part in the position most protruding from the casing 2. The apex part is arranged near one end of the cushion 16. In addition, the stacked columnar piezoelectric element 12 is arranged near the other end of the cushion 16.

[0031] In the sandwich structure, the skin 52 is a soft part existing between epidermis and the skull 51, with softness and corresponding weight. The softness of the skin 52 is characterized as viscoelasticity in terms of physical properties, which can be decomposed into viscosity and elasticity. The sandwich structure and an equivalent circuit model are as shown in Figure 5.

As shown in Figure 5, in a signal (vibration) transmission system from the cushion 16 to the skull 51, a contact point a is a contact point corresponding to an input signal of the cushion 16. Transmission elements of the skin 52 in contact with the contact point a comprise the viscosity 52a of the skin, the elasticity 52b of the skin, and the weight 52c of the skin. A contact point b is a contact point corresponding to an output signal of the skull 51. Connection elements of the contact point b also comprise the viscosity 52a of the skin, the elasticity 52b of the skin, and the weight 52c of the skin. In an equivalent circuit model, the transmitting vibration (signal) is further amplified, namely the impedance of the transmission system is reduced when transmission is performed without attenuation. Specifically, the viscosity 52a and the weight 52c are reduced, and the elasticity 52b is increased.

[0032] Regarding the impedance reduction in the equivalent circuit model, the close contact state between the bone conduction receiver 1 and the head is specifically described with reference to Figure 4. As shown in Figure 4, when the cushion 16 is in close contact with the skin 52, a close contact surface 16a of the cushion 16 sinks into the contacted skin 52 to form a convex surface. When the user uses the bone conduction receiver 1, the cushion 16 of the bone conduction receiver 1 is in close contact with the facial skin 52 near the auricle. As a result, the convex close contact surface 16a formed by the cushion 16 slightly presses the skin 52 of the face of the user, causing the skin 52 of the user to form a concave part along the convex surface of the cushion 16. Through the series of actions, the convex close contact surface 16a of the cushion 16 and the concave part of the skin 52 achieve a tight fit.

[0033] Figure 6 illustrates the pressure distribution of the cushion 16 and skin 52 matched with each other. In the cushion 16, the apex 16b of the convex close contact surface 16a exerts the greatest pressure on the skin 52, with the contact pressure reaching the top (pressure center). In the high-pressure part (pressure center) generated by the close contact, the soft skin 52 expands laterally due to the close contact pressure, causing a part of the skin 52 to spatially shift toward the periphery. Simultaneously, owing to the close contact force, the peripheral skin part with low close contact force migrates to the non-contact part with even lower pressure. Therefore, the skin 52 is subjected to the highest contact pressure at the part (pressure center) where the convex close contact surface 16a of the cushion 16 is most depressed, and the contact pressure decreases as the skin 52 approaches the periphery of the most depressed area.

[0034] The contact part between the cushion 16 and the skin 52 is explained in more detail through the equivalent circuit model as shown in Figure 5.

The skin 52 at the high-pressure part is a part corresponding to the vertex 16b of the convex close contact surface 16a of the cushion 16 (pressure center), experiencing the greatest compression towards the skull 51. Concurrent with the compression, skin tissue at the pressure center bears the peripheral high pressure to cause the soft skin tissue to laterally expand. Simultaneously, fluid (body fluid) of the skin tissue migrate to the periphery. As a result, finally the volume of the skin tissue composition is reduced to the maximum extent.

Physically, as the fluid proportionally is reduced, the weight and viscosity are reduced, and as the skin tissue is hardened, the elasticity is increased. In the equivalent circuit model shown in Figure 5, the impedance of the transmission system is reduced, and the transmissibility is enhanced. That is, due to the close contact between the cushion 16 and the skin 52, vibration is transmitted more effectively at the part where contact pressure is high, and

the most effective vibration transmission is achieved near the pressure center.

[0035] Compared with the pressure center, the contact pressure at the peripheral part of the pressure center is low, resulting in a small reduction in weight and a small increase in elasticity. However, compared with the non-contact area, the peripheral part generates a sufficiently large change, allowing the vibration to be transmitted. Based on the aforementioned characteristics of the skin, to more effectively transmit vibration to the perception part of the user through contact, it is recommended to adopt a close contact structure increasing the contact pressure within a range that does not cause discomfort to the user.

[0036] The bone conduction speaker 10 of the bone conduction receiver 1 according to the embodiment as shown in Figure 2, a stacked columnar piezoelectric element 12 is inserted into the U-shaped frame, and a structure with the displacement of the stacked columnar piezoelectric element 12 is amplified through a "lever principle" is provided. The displacement of the stacked columnar piezoelectric element 12 takes the rotation center of the vibration output part 11a near the intersection of the vibration output part 11a and the elastic part 11b as a reference (origin), causing the vibration output part 11a to undergo rotational vibration.

On the vibration output part 11a, the farther the vibration output part 11a is from the rotation reference, the greater the displacement amplification of the vibration output part 11a becomes. In contrast, in a position far from the stacked columnar piezoelectric element 12, the displacement of the vibration output part 11a exceeds that of the monomer of the stacked columnar piezoelectric element 12, and reaches the maximum extent at the front end of the vibration output part 11a farthest from the rotation center.

[0037] Therefore, in the bone conduction speaker 10 according to the embodiment, the pressure center of the cushion 16, i.e., the vertex 16b of the convex close contact surface 16a, is arranged on the front end 16c side of the central part of the cushion 16 in the length direction as viewed from the rotation center. By adopting the structure, the vertex 16b of the convex close contact surface of the cushion 16 can ensure a large displacement. Simultaneously, the effect of the convex shape of the cushion 16 can be utilized. Therefore, the vibration of the stacked columnar piezoelectric element 12 can be effectively transmitted to the perception part of the user.

Secondly, in the bone conduction speaker 10 of the bone conduction receiver 1 according to the embodiment, as shown in Figure 3, the rotation center of the vibration output part 11a is arranged on the central side of the bone conduction receiver 1. Simultaneously, the front end of the vibration output part 11a, which has a larger displacement (vibration) than that of the vibration output part 11a when in operation, is arranged on the front end 20 side of the body casing 2 of the bone conduction receiver 1. Therefore, the vibration of the bone conduction speaker 10 can be more effectively transmitted to the perception part of the user.

[0038] The usage posture of the bone conduction receiver 1 according to the embodiment is described with reference to Figure 7A~C.

As shown in Figure 7A, the ideal usage posture of the bone conduction receiver 1 of the embodiment is to be arranged substantially parallel to the face 52a. However, the usage posture of the bone conduction receiver 1, especially the angle of contact with the face, is assumed to vary greatly depending on the user.

Specifically, the ideal close contact state in which the bone conduction receiver 1 and the face 52a are basically parallel and in close contact as shown in Figure 7A is composed. Based on the state, as shown in Figure 7B, it is assumed that the face 52a and the bone conduction receiver 1 are in a close contact state with each other at a slight inclination. Secondly, as shown in Figure 7C, it is assumed that the face 52a and the bone conduction receiver 1 are in a close contact state with each other at a large inclination.

[0039] Therefore, different users can produce a variety of close contact states. In the bone conduction receiver 1 according to the embodiment, the apex 16b of the convex close contact surface 16a of the cushion 16 is arranged on the front end 20 side of the bone conduction receiver 1 at the central part of the cushion part 16. Therefore, the apex 16b of the convex close contact surface 16a of the cushion 16 can be ensured to be in close contact with the face of the user, so that the vibration can be accurately transmitted to the perception part of the user.

[0040] Finally, the use of the bone conduction receiver 1 according to the embodiment is described with reference to Figure 8. Figure 8 is a diagram of the usage state of the bone conduction receiver 1 according to the embodiment. In the position, description is made with reference to Figure 1.

As shown in Figure 8, when the bone conduction receiver 1 is used, connecting the connecting wire 4 to a mobile phone (not shown) in advance is more convenient. In the state, when the mobile phone receives a call from another phone device, the user opens the flip cover 3, and presses the call button 21. Therefore, an electrical signal of the sound information, such as call sound, emitted by the mobile phone (not shown) connected to the bone conduction receiver 1 is transmitted to a circuit board in the body casing 2 of the bone conduction receiver 1 through the connecting wire 4. The electrical signal, as an AC signal, is input to the stacked columnar piezoelectric element 12 as shown in Figure 2 through the circuit board and the input wire. Based on the electrical signal, the stacked columnar piezoelectric element 12 performs expansion and contraction changes (displacement) along a long axis

direction in accordance with the signal.

[0041] Due to the expansion and contraction changes of the stacked columnar piezoelectric element 12, the vibration output part 11a of frame 11 and the frame fixing part 11c continuously displace relative to each other as the elastic part 11b bends and deforms. As shown in Figure 2, in the bone conduction speaker 10 according to the embodiment, a structure based on the lever principle is adopted. Therefore, even if the expansion and contraction amount of the stacked columnar piezoelectric element 12 monomer is approximately 2 μm to 3 μm , the displacement of the cushion 16 mounted to the vibration output part 11a is still amplified by the design-specified value. Therefore, sufficient vibration can be transmitted to the perception part of the user and recognized as sound information.

[0042] In addition, at the moment, as shown in Figure 7c, the bone conduction receiver 1 is closely contact with the head of the user in a relatively high inclination state. At the moment, the close contact surface 16a of the cushion 16 fixed to the vibration output part 11a of the bone conduction receiver 1 forms a convex shape with an apex 16b on the front end side rotated relative to the rotation center of the cushion 16. Therefore, even if the bone conduction receiver 1 is close contact with the head of the user in a relatively high inclination state, vibration can be effectively transmitted to the user.

[0043] When the bone conduction speaker 10 of the bone conduction receiver 1 according to the embodiment is in operation, the vibration output part 11a and the frame fixing part 11c perform displacement vibration actions in the opening and closing directions of the front ends. At the moment, the weight of the vibration output part 11a and the cushion 16 is sufficiently smaller than the total weight of the positioning plate 18, the base weight 13, the frame fixing part 11c, and the fixing part 14 integrally formed with the screws 15. Therefore, the expansion and contraction displacement generated by the stacked columnar piezoelectric element 12 mainly causes the vibration output part 11a to generate displacement. In other words, the vibration generated by the stacked columnar piezoelectric element 12 can centrally drive the vibration output part 11a and transmit the signal to the user.

[0044] In addition, the weight of the fixing part 14 on the supporting side of the body casing 2 is relatively large, and the vibration generated by the stacked columnar piezoelectric element 12 is mainly released from the vibration output part 11a, so that the vibration of the fixing part 14 is relatively small. Secondly, a supporting component 25 made of a viscoelastic material is arranged between the frame fixing part 11c and the casing 2. Therefore, the vibration generated in the stacked columnar piezoelectric element 12 and transmitted to the fixing part 11c is attenuated by the supporting component 25 and then transmitted to the body casing 2. Therefore, the vibration transmitted to the body casing 2 is relatively small, and the volume of sound leaked from the body casing 2 to the outside, especially the volume of sound leaked to the surrounding air, can be reduced to a very small level without any problem. Therefore, sound leakage can be prevented. Moreover, the sound leakage reduction effect corresponds to the total weight of the fixing part 14, and the greater the weight, the more significant the effect. However, the setting should be made in consideration of the size and weight of an entire product.

[0045] As mentioned above, through the bone conduction receiver 1 of the embodiment, even when the stacked columnar compression element 12 with a small displacement amount is used, the generated vibration can be concentrated on the vibration output part 11a. Therefore, the vibration generated by the stacked columnar piezoelectric element 12 can be efficiently transmitted to the head of the user, and the necessary volume can be sufficiently ensured.

Secondly, the amount of vibration transmitted to the casing (the reason causing increased amount of sound leakage) can be reduced with a relatively simple structure, and the necessary level of sound leakage reduction effect can be achieved without a special sound leakage packaging structure. Moreover, by arranging the front end of the vibration output part 11a on the front end 20 side of the bone conduction receiver 1, the influence of the usage posture of the user can be reduced.

[0046] Therefore, through the embodiment, the loss caused by contact with the face can be improved, and the output vibration of the bone conduction speaker with a displacement amplification structure can be more reasonably transmitted to auditory organs of the user. Therefore, in the bone conduction receiver 1 according to the present invention, compared to other bone conduction speakers using the same stacked columnar piezoelectric element, the bone conduction receiver 1 can transmit greater vibration to auditory organs of the user, thereby achieving a bone conduction receiver that is easier to use. Possibility of commercial use

[0047] The present invention can be applied to bone conduction receivers containing bone conduction speakers.

Claims

[1] A bone conduction receiver, comprising the following parts:

a bone conduction speaker converting sound information into vibration, and a casing accommodating the bone conduction speaker, wherein the bone conduction speaker comprises the following parts: a vibration generating part generating vibration according to the sound information, and a convex vibration transmitting part protruding from the casing, and transmitting the vibration generated by the vibration generating part to a human head when being in close contact with the human head.

[2] The bone conduction receiver according to claim 1, characterized in that: the vibration transmitting part is provided with a U shape, and the vibration generating part is positioned between two symmetrical surfaces of the vibration transmitting part and arranged near a surface different from the two surfaces, and generates vibration between the two symmetrical surfaces according to the sound information.

[3] The bone conduction receiver according to claim 1 or claim 2, characterized in that the convex apex part of the vibration transmitting part is arranged in a position farther away from the vibration generating part than the center of the vibration transmitting part.

[4] The bone conduction receiver according to any one of claim 1 to claim 3, characterized in that the vibration generating part is arranged on one side closer to the end surface than the center of the bone conduction receiver.

[5] The bone conduction receiver as claimed in claim 1 to claim 4, characterized in that the vibration transmitting part is arranged on one of a U-shaped frame surface and a surface symmetrical with the U-shaped frame, and is provided with a cushion in close contact with the human head, exposed in a convex shape when protruding from the casing.

[6] The bone conduction receiver according to claim 1 to claim 5, characterized in that the vibrating end part of the vibration transmitting part is a stacked columnar piezoelectric element.

[7] The bone conduction receiver according to claim 1, characterized in that the bone conduction speaker is provided with a frame accommodating the vibration generating part, with a convex cushion fixedly arranged on the outer wall of the frame and protruding from the casing.

[8] The bone conduction receiver according to claim 1, characterized in that the cushion is provided with a vertex part at the most protruding part of the casing, and the vertex part is arranged near one end of the cushion.

[9] A bone conduction receiver according to claim 8, characterized in that the vibration generating part is arranged near the other end of the cushion.

[10] A bone conduction receiver comprising the following parts: a bone conduction speaker converting sound information into vibration, and a casing accommodating the bone conduction speaker, wherein the bone conduction speaker comprises the following parts: characterized in that a bone conduction speaker converting sound information into vibration, a vibration generating part arranged between the two symmetrical surfaces of the frame to generate vibration between the two symmetrical surfaces according to the sound information, and a cushion arranged on one of the two symmetrical surfaces of the frame and exposed in a convex shape when protruding from the casing.

Claims in Amendment
[Accepted by the International Bureau on October 16, 2007
(16.10.2007)]

1. (After amendment)

A bone conduction receiver, characterized by comprising the following parts: a bone conduction speaker converting sound information into vibration, and a casing accommodating the bone conduction speaker, wherein the bone conduction speaker comprises the following parts: a vibration generating part generating vibration according to the sound information, The bone conduction speaker converts sound information into vibrations, and a convex vibration transmitting part protruding from the casing, and transmitting the vibration generated by the vibration generating part to a human head when being in close contact with the human head, wherein vibration transmitting part is provided with a U shape, and the vibration generating part is positioned between two symmetrical surfaces of the vibration transmitting part and arranged near a surface different from the two surfaces, and generates vibration between the two symmetrical surfaces according to the sound information.

2. (After amendment)

The bone conduction receiver according to claim 1, characterized in that the convex apex part of the vibration transmitting part is arranged in a position farther away from the vibration generating part than the center of the vibration transmitting part.

3. (After amendment)

The bone conduction receiver according to claim 1 or claim 2, characterized in that the vibration generating part is arranged on one side closer to the end surface than the center of the bone conduction receiver.

4. (After amendment)

The bone conduction receiver according to claim 1 to claim 3, characterized in that characterized in that the vibration transmitting part is arranged on one of a U-shaped frame surface and a surface symmetrical with the U-shaped frame, the cushion is exposed in a convex shape when protruding from the casing.

5. (After amendment)

The bone conduction receiver according to claim 1 to claim 4, characterized in that the vibration generating part in the vibration transmitting part is a stacked columnar piezoelectric element.

6. (After amendment)

The bone conduction receiver according to claim 1, characterized in that the bone conduction speaker is provided with a frame accommodating the vibration generating part, with a convex cushion fixedly arranged on the outer wall of the frame and protruding from the casing.

7. (After amendment)

The cushion is provided with a vertex part at the most protruding part of the casing, the cushion is provided with a vertex part at the most protruding part of the casing, and the vertex part is arranged near one end of the cushion.

Amended format (Article 19 of the Treaty)

8. (After amendment)

The bone conduction receiver according to claim 7, characterized in that the vibration generating part is arranged near the other end of the cushion.

9. (After amendment)

A bone conduction receiver, characterized by comprising the following parts: a bone conduction speaker converting sound information into vibration, and a casing accommodating the bone conduction speaker, wherein the bone conduction speaker comprises the following parts: characterized in that a bone conduction receiver, a vibration generating part arranged between the two symmetrical surfaces of the frame to generate vibration between the two symmetrical surfaces according to the sound information, and a cushion arranged on one of the two symmetrical surfaces of the frame and exposed in a convex shape when protruding from the casing.

10. (After amendment)

A bone conduction receiver, characterized by comprising the following parts: a bone conduction speaker converting sound information into vibration, and a casing accommodating the bone conduction speaker, wherein the bone conduction speaker comprises the following parts: characterized in that a bone conduction receiver, a vibration generating part arranged between the two symmetrical surfaces of the frame to generate vibration between the two symmetrical surfaces according to the sound information, A bone conduction receiver is provided with a cushion transmitting the vibration generated by the frame to the outside.

Amended format (Article 19 of the Treaty)

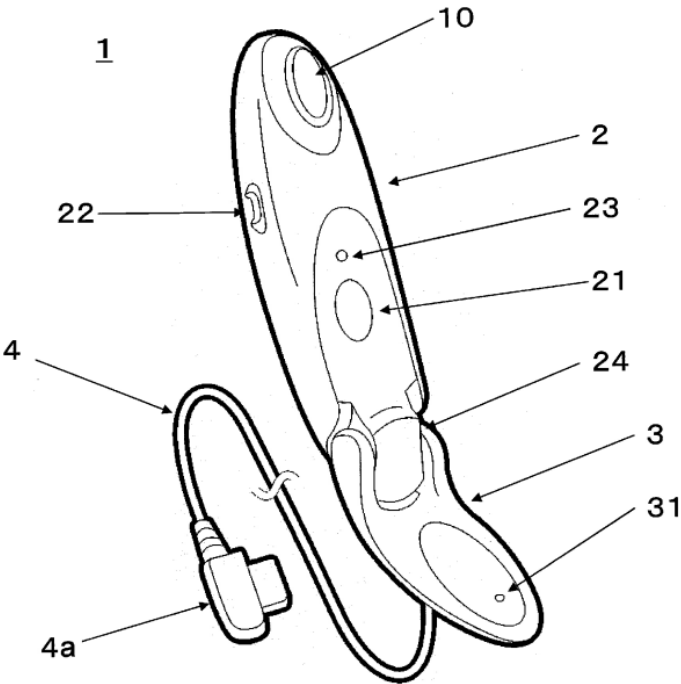
Specification under Article 19(1) of the Treaty

The new item 1 of claims limits the original step item 2 in the original item 1, and the part "arranged near a surface different from the two surfaces" in the original item 1 is removed.

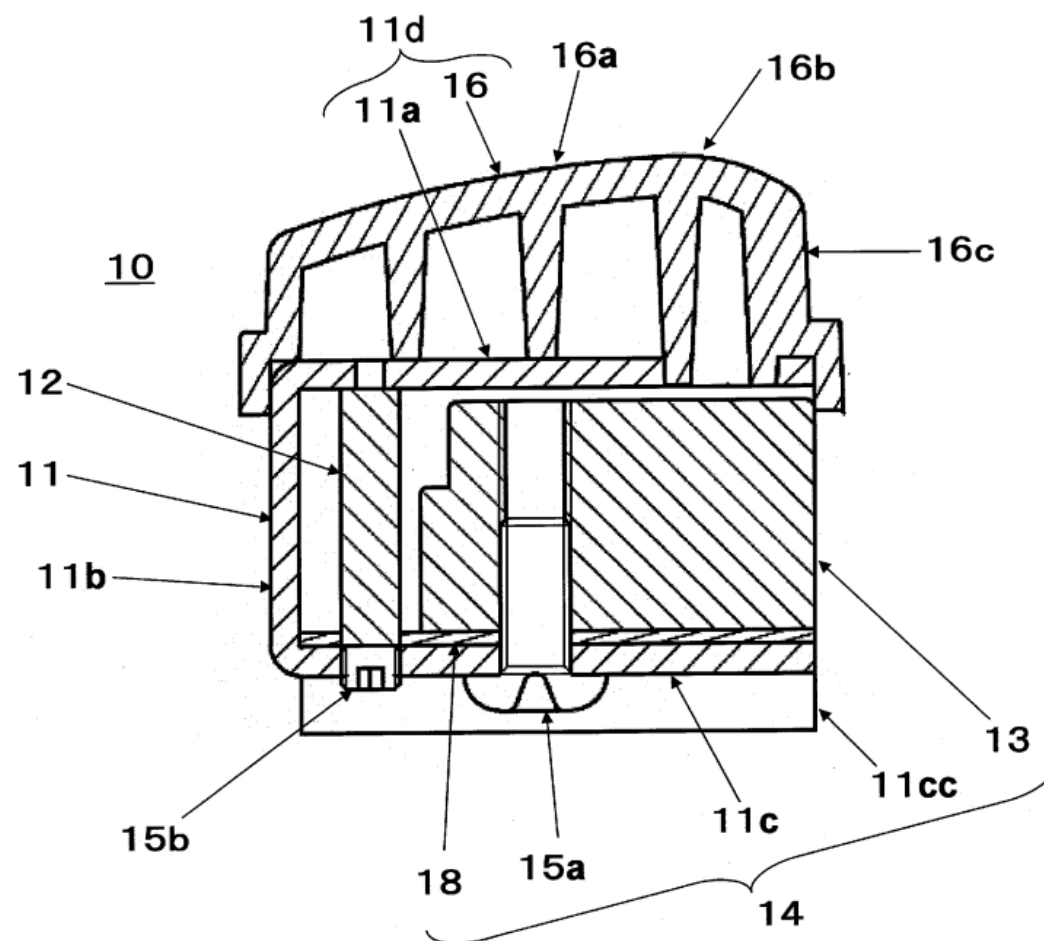
Item numbers of the new items 2 to 9 are changed, and reference items are changed formally according to the requirements. However, the new item 5 changes the expression "the vibrating end of the vibration transmitting part" in the original item 6 to "the vibration generating part in the vibration transmitting part". Therefore, it has been clarified that the vibration generating part is the stacked columnar piezoelectric element.

The new item 10 is an added item. The function of the cushion has been clarified based on the description in paragraphs 0029-0030.

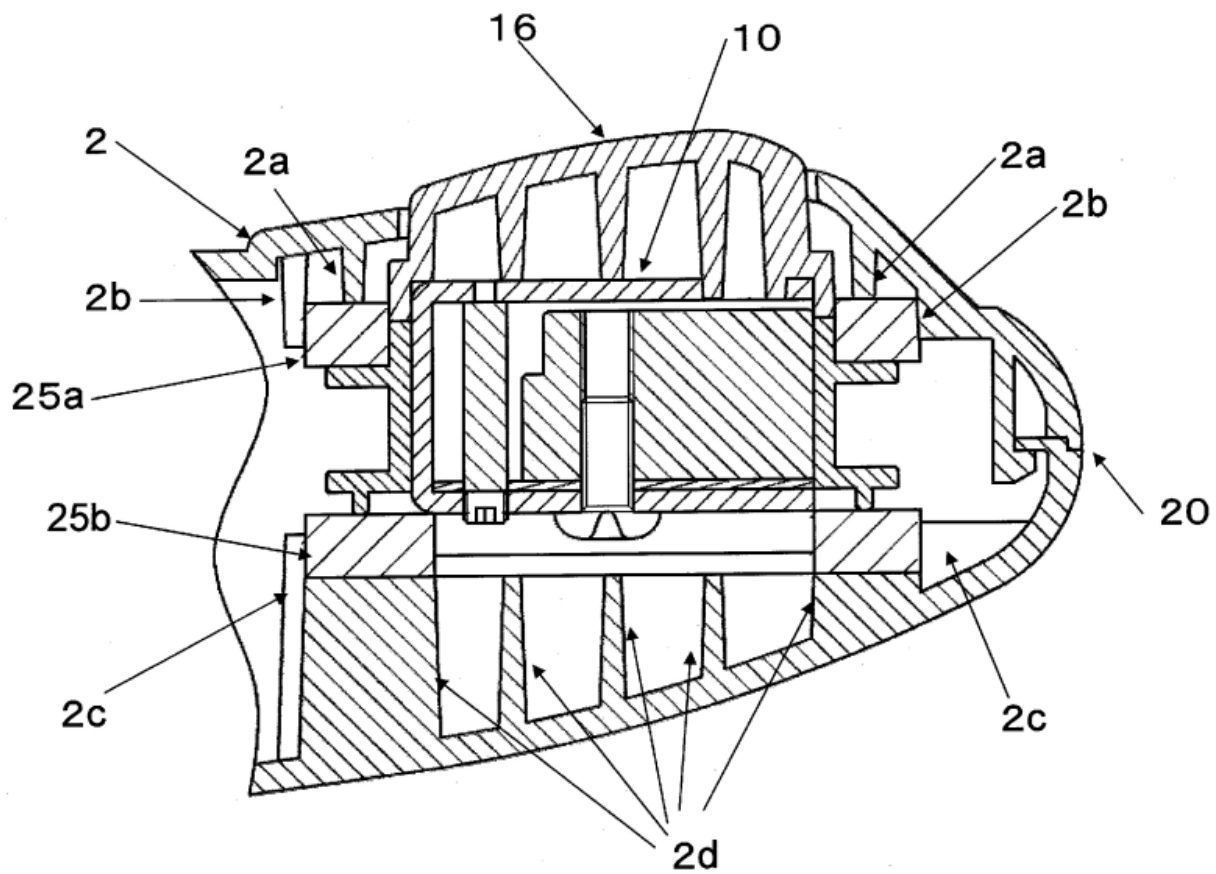
[Figure 1]



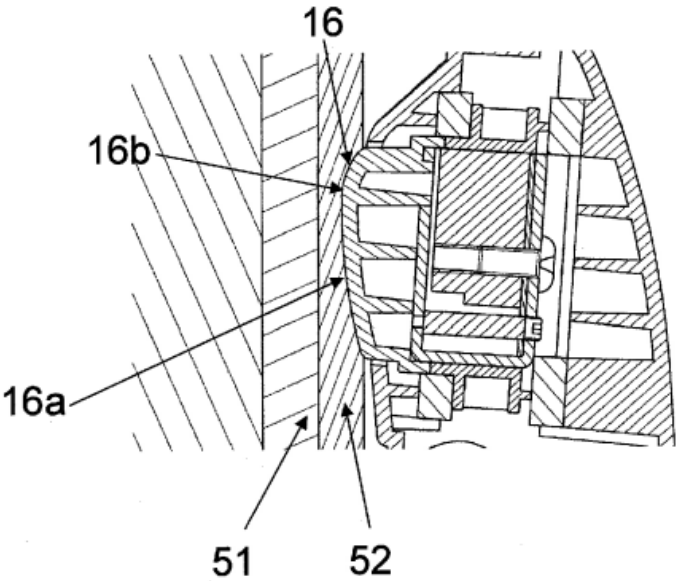
[Figure 2]



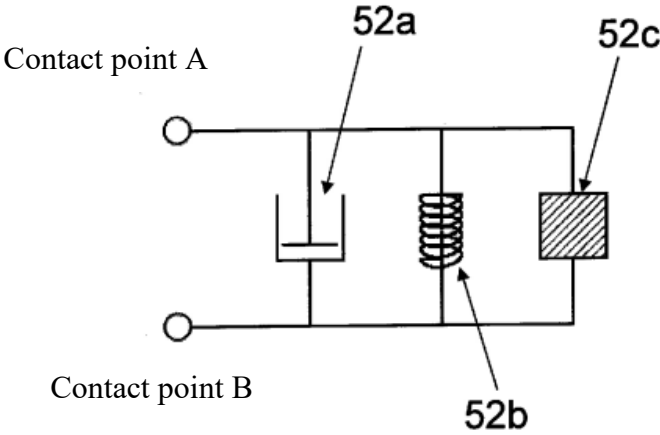
[Figure 3]



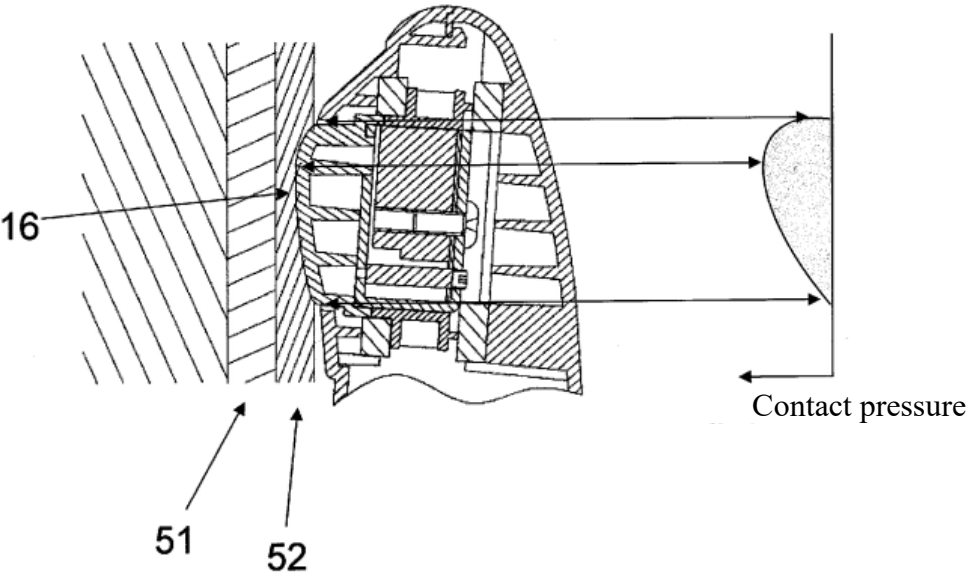
[Figure 4]



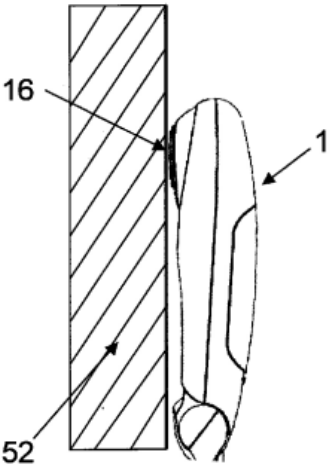
[Figure 5]



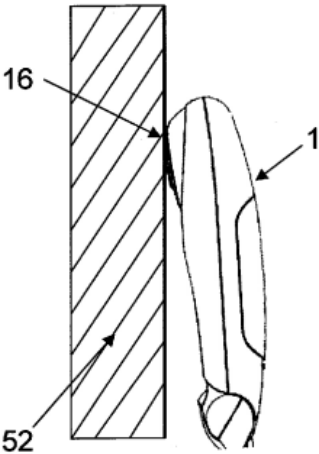
[Figure 6]



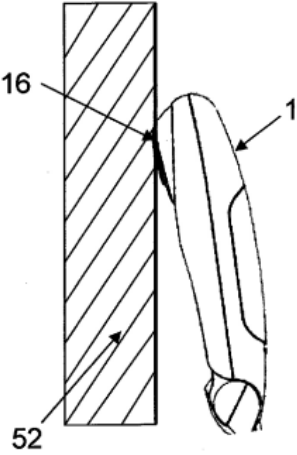
[Figure 7A]



[Figure 7B]



[Figure 7C]



[Figure 8]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/063730

A. CLASSIFICATION OF SUBJECT MATTER *H04R1/00(2006.01)i, H04M1/05(2006.01) i, H04R1/02(2006.01)i, H04R17/00 (2006.01)i*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols) H04R1/00, H04M1/05, H04R1/02, H04R17/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996 Jitsuyo Shinan Toroku Koho	1996-2007
Kokai Jitsuyo Shinan Koho	1971-2007 Toroku Jitsuyo Shinan Koho	1994-2007

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 2005/069586 A1 (Temco Japan Co., Ltd.), 28 July, 2005 (28.07.05), Full text; all drawings (Family: none)	1, 3-9 2, 10
X A	JP 2003-348208 A (Temco Japan Co., Ltd.), 05 December, 2003 (05.12.03), Par. Nos. [0019] to [0020]; Fig. 6 & US 2005/0176459 A1 & EP 1524823 A1 & WO 03/101075 A & CA 2487456 A & CN 1656781 A	1, 3-9 2, 10

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

* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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"&" document member of the same patent family	
Date of the actual completion of the international search 26 July, 2007 (26.07.07)	Date of mailing of the international search report 07 August, 2007 (07.08.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet)(April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/063730

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 149062/1977(Laid-open No. 75126/1979) (Sony Corp.), 28 May, 1979 (28.05.79), Full text; all drawings (Family: none)	2, 5 - 6, 10

Form PCT/ISA/210 (continuation of second sheet)(April 2005)

A. The field to which the invention belongs is classified (International Patent Classification (IPC)) Int. Cl. H04R1/00 (2006.01)i, H04M1/05 (2006.01)i, H04R1/02 (2006.01)i, H04R17/00 (2006.01)i			
B. Areas investigated			
Minimum information investigated (International Patent Classification (IPC)) Int. Cl. H04R1/00, H04M1/05, H04R1/02, H04R17/00			
Parts of the field investigated based on information other than the minimum information Japanese Utility Model Patent Gazette From 1922 to 1996 Japanese Utility Model Patent Gazette From 1971 to 2007 Japanese Utility Model Patent Gazette From 1996 to 2007 Japanese Utility Model Patent Gazette From 1994 to 2007			
Electronic databases used in international investigation (names of databases, terms used in investigation)			
C. Identification of relevant documents			
Classification of cited documents*	Prompt correlation contents when document names and part of content correlation are cited.	Correlation Claim number	
X	W0 2005/069586 A1 (TEMCO JAPAN Co., Ltd.) 2005.07.28, full text,	1, 3-9	
A	Full figure (no family)	2, 10	
X	JP 2003-348208 A (TEMCO JAPAN Co., Ltd.) 2003.12.05, [0019] - [0020], Figure 6 & US 2005/0176459 A1 & EP 1524823 A1 & W0 03/101075 A & CA 2487456 A & CN 1656781 A	1, 3-9	
A		2, 10	
A	The contents of the specification and drawings annexed to the Japanese Utility Model Registration Application No. 52-149062 (Japanese Utility Model Registration Application Publication No. 54-75126) have been recorded by photography.	2, 5 - 6, 10	
☒ Documents are also listed following the column. ☐ Refer to the relevant appendix on patent families.			
Classification of cited documents "A" refers to a document that is not particularly relevant, indicating document in general description level "E" denotes applications or patents filed before the international filing date, with content published after the international filing date. "L" represents the publication date of documents or other documents contesting the priority claim, or documents cited for establishing special reasons (with reasons attached) "O" represents oral publicity, usage, display and related documents "P" indicates applications filed before the international filing date that claim priority Documents published subsequently "T" denotes documents published after the international filing date or priority date, which are not inconsistent with the application and are cited to understand the principles or theories of the inventions "X" is a document particularly related, lacking the novelty or creativity of the invention only "Y" represents a document under special management; the combination of this document with one or more documents is clearly known content to industry personnel, and therefore it is determined that there is no creative content. "&" represents documents in same patent family.			
Date the international investigation was completed July 26, 2007		Sending date of international investigation report August 7, 2007	
Name and address of the International Investigation Authority Japan Patent Office (ISA/JP) Postal Code 100-8915 4-3 Kasumigaseki 3-chome, Chiyoda-ku, Tokyo		Patent office examiner (authorized staff) Hiroshi Ohno	5Z 9175
		Telephone number: 03-3581-1101 ext. 3541	

C (continuation). Identification of relevant documents		
Classification of cited documents*	Prompt correlation contents when document names and part of content correlation are cited.	Correlation Claim number
	Microfilm (Sony Corporation), 1979.05.28, full text and full figure (no family)	

TRANSLATION CERTIFICATION

Date: 2025/01/26

To whom it may concern:

This is to certify that the attached translation is an accurate representation of the documents received by this company. The translation was completed from:

- Chinese (PRC)

To:

- English (USA)

The documents are designated as:

- ' D3 - CN104023288A '

- ' D26 - CN205356672U '

- ' D27 - CN205017577U '

- Japanese (JAP)

To:

- English (USA)

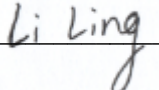
The documents are designated as:

- ' D10 - WO2008007666A1 '

- ' D24 - JP2008294872A '

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“Under penalty of perjury under the laws of the United States of America, to the best of my knowledge, the aforementioned documents are a true, full and accurate translation of the specified documents.”

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