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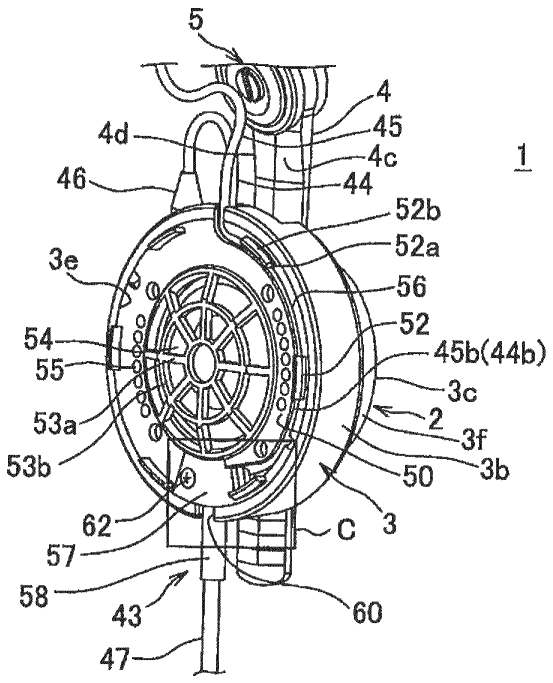
(54) HEADPHONE DEVICE

(57) An object of the invention is to solve a problem that a cable exposed to an outside of a sound-emitting unit is tangled in fingers. In order to achieve the object, a headphone (1) includes: a sound-emitting unit (2) housing a speaker (48) having a diaphragm (49); and a cable unit (43) configured to transmit an electric signal to the speaker. The cable unit detachable from the sound-emitting unit is inserted in the sound-emitting unit from a bottom of the sound-emitting unit, disposed at an axially outer side than the diaphragm in a sound radiation direction of the diaphragm within the sound-emitting unit, and pulled from a top of the sound-emitting unit to an outside of the sound-emitting unit.

FIG. 3



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Description

TECHNICAL FIELD

[0001] The present invention relates to a headphone including a sound-emitting unit.

BACKGROUND ART

[0002] For instance, Patent Literature 1 discloses a headphone provided with a single sided cord (not shown). In this headphone, an input cord (cable) to be connected to a headphone connection terminal of an audio device is drawn downward from a headphone body (sound-emitting unit) on a left side and fixed to a bottom of the headphone body on the left side.

[0003] An input cord to an electroacoustic transducer within a headphone body on a right side passes through an inside of a headband and is collected together with the input cord to an electroacoustic transducer within the headphone body on the left side. Since the input cords are collectively drawn from one of the headphone body, wiring of the cords is simple.

[0004] Fig. 1 is a view illustrating an exemplary embodiment of a typical headphone. In a headphone 35, a cable 36 is detachably fixed to a holder 39 on an outer surface (a surface remote from ears of a user) 38a of a casing 38 of a sound-emitting unit 37. The user can replace the cable 36 with a new cable after removing a screw 39a of the holder 39.

[0005] For instance, Patent Literature 2 discloses a headphone (not shown) including an arm of a sound-emitting unit, the arm rotatable with respect to a band. The arms of both of right and left channels are rotatable with respect to the band, for instance, in a front-back direction of a head of the user.

[0006] This headphone includes: a pair of press portions connected to respective ends of the band; and support arms each having one end connected to one of the press portions and the other end connected to a speaker and configured to support the speaker in a predetermined position. The support arms are rotatable, for instance, in a front-back direction of a temporal region, around an axial line in a right-left direction orthogonal to a contact surface between the press portion and the temporal region of the user.

CITATION LIST

PATENT LITERATURE(S)

[0007]

Patent Literature 1: JP-A-2005-295461

Patent Literature 2: JP-A-2013-172371

SUMMARY OF THE INVENTION

PROBLEM(S) TO BE SOLVED BY THE INVENTION

[0008] In the headphone as disclosed, for instance, in Patent Literature 1 and other general headphones, the most common cause of failures is a failure of a cable for transmitting an audio signal to the speaker in the sound-emitting unit. Since the cable is generally fixed to the sound-emitting unit, it is difficult for the user to replace the cable with a new one. In contrast, the headphone 35 shown in Fig. 1 solves this problem.

[0009] However, in the headphone 35 of Fig. 1 (referred to as a first related art), the cable 36 is extensively exposed to an outer side (a side remote from a head of the user) of an arm 41 connecting the sound-emitting unit 37 and a headband 40. Accordingly, when the headphone 35 is used by a DJ (disc jockey) and the like (user) who frequently change an attachment state of the sound-emitting unit 37 to his/her head, the cable 36 may be tangled in his/her fingers or the like, and, when the cable 36 is frequently or strongly tangled in his/her fingers or the like, the cable 36 may be broken.

[0010] Moreover, since the holder 39 of the cable projects from an outer surface 38a of the sound-emitting unit 37, the user may have an uncomfortable feeling on his/her palm, which may cause a difficulty in DJ performance and the like.

[0011] Moreover, in the headphone as disclosed in Patent Literature 2 and similar headphones, for instance, when a typical headphone is used by a DJ (disc jockey) and the like, the DJ (user) occasionally dynamically uses the headphone. For instance, the DJ listens to sounds only from one of right and left channels of the headphone while the sound-emitting unit of the other of the right and left channels is kept rotated (swung), for instance, in the front-back direction in order that the DJ listens to sounds in a hall such as a dancing hall and a party site. It depends on the DJ (user) which of the sound-emitting units of the right and left channels is rotated or which of the sound-emitting units of the right and left channels is not rotated. It should be noted that the "channel" means a transmission path of, for instance, an audio signal.

[0012] Moreover, for instance, when a user other than the DJ statically uses the headphone for a general purpose such as listening to music motionlessly, it is sometime suitable that the sound-emitting units of both channels are unrotatable.

[0013] However, the headphone as disclosed in Patent Literature 2 and similar headphones (referred as a second related art) sometimes cannot meet the above demand properly. Specifically, for instance, when the DJ (user) conducts an operation (DJ performance) with one ear put on a first one of the sound-emitting units of the headphone while a second one of the sound-emitting units is rotationally moved from the other ear, for instance, the first sound-emitting unit put on the ear is unintentionally rotated to cause the DJ (user) to miss his/her

playing music or a band is unintentionally rotated with respect to the first sound-emitting unit to cause the band to drop off the head of the DJ (user), which may hamper the DJ (user) to concentrate on the performance.

[0014] Moreover, when the user wants to listen to music motionlessly, one or both of the sound-emitting units put on both ears are unintentionally rotated with respect to the band, or when the band is unintentionally rotated with respect to both the sound-emitting units, the band may drop off the head of the user, which may hamper the user to concentrate on listening to music.

[0015] A problem to be solved by the invention is exemplarily the above problem occurring in the first related art as described above, specifically, that the cable exposed to the outside of the sound-emitting units tangles in fingers of the user or the cable holder exposed to the outside of the sound-emitting units causes an uncomfortable feeling on the user's palm. Moreover, another problem to be solved by the invention is exemplarily the above problem occurring in the second related art as described above, specifically, that the sound-emitting unit may be unintentionally rotated against the user's will together with the arm with respect to the headband.

MEANS FOR SOLVING THE PROBLEM(S)

[0016] According to an aspect of the invention, a headphone includes: a sound-emitting unit housing a speaker having a diaphragm; and a cable unit configured to transmit an electric signal to the speaker, in which the cable unit detachable from the sound-emitting unit is inserted in the sound-emitting unit from a bottom of the sound-emitting unit, disposed radially outside relative to the diaphragm in a sound radiation direction of the diaphragm inside the sound-emitting unit, and pulled from a top of the sound-emitting unit to an outside of the sound-emitting unit.

[0017] According to another aspect of the invention, a headphone includes: an arm connecting a sound-emitting unit to a headband; a rotary mechanism configured to rotate the arm with respect to the headband in a radial direction of the sound-emitting unit; and a controller provided to the rotary mechanism and configured to avoid the arm from being rotated.

BRIEF DESCRIPTION OF DRAWING(S)

[0018]

Fig. 1 illustrates an exemplary embodiment of a typical headphone.

Fig. 2 is an overall view illustrating a structure of a first sound-emitting unit of a headphone in Example 1 in a first exemplary embodiment of the invention.

Fig. 3 illustrates the first sound-emitting unit in which an ear pad is unfixed.

Fig. 4 illustrates the first sound-emitting unit in which the ear pad and a cable unit are unfixed.

Fig. 5 illustrates the ear pad unfixed from the first sound-emitting unit in a reversed state so that a back side of the ear pad can be seen.

Fig. 6 is an enlarged view illustrating a front side of a C portion in Fig. 3.

Fig. 7 is a cross sectional view on arrows D-D in Fig. 6.

Fig. 8 is an overall view illustrating a headphone in Example 1 in a second exemplary embodiment of the invention.

Fig. 9 is an enlarged view illustrating a relevant part of the headphone in Example 1.

Fig. 10 is a schematic cross-sectional view on arrows A-A in Fig. 9.

Fig. 11(a) and 11(b) are cross-sectional views each illustrating a relevant part of the headphone in Example 2.

Fig. 12 is a cross-sectional view illustrating a relevant part of the headphone in Example 3.

Fig. 13(a) is a cross-sectional view illustrating a relevant part of the headphone in Example 4. Fig. 13(b) is a cross-sectional view illustrating a relevant part of the headphone in Example 5.

Fig. 14 is a cross-sectional view illustrating a relevant part of the headphone in Example 7.

Fig. 15 is a perspective view illustrating a relevant part of the headphone in Example 8.

Fig. 16 is a cross-sectional view illustrating a relevant part of the headphone in Example 9.

DESCRIPTION OF EMBODIMENT(S)

[0019] A first exemplary embodiment of the invention will be described below.

[0020] A headphone according to the first exemplary embodiment of the invention includes: a sound-emitting unit housing a speaker having a diaphragm; and a cable unit configured to transmit an electric signal to the speaker, in which the cable unit detachable from the sound-emitting unit is inserted in the sound-emitting unit from a bottom of the sound-emitting unit with respect to the headphone attached to ears of a user in an upright posture, disposed radially outside relative to the diaphragm in a sound radiation direction of the diaphragm within the sound-emitting unit, and pulled from a top of the sound-emitting unit to an outside of the sound-emitting unit.

[0021] With this arrangement, since the cable unit is housed inside the sound-emitting unit, such disadvantages of a typical cable-detachable headphone that the cable exposed to the outside of the sound-emitting unit is tangled in fingers of the user or a cable holder projecting to the outside of the sound-emitting unit causes an uncomfortable feeling on the user's palm can be solved. Since the cable unit is disposed radially outside relative to the diaphragm within the sound-emitting unit, the cable unit does not obstruct sound radiation by the diaphragm.

[0022] The headphone further includes: a connector provided on the top of the sound-emitting unit and elec-

trically connected to the speaker (hereinafter, referred to as a sound-emitting-unit-side connector); and a connector provided at an end of the cable unit pulled out from the top of the sound-emitting unit and electrically connected to the sound-emitting-unit-side connector (hereinafter, referred to as a cable-side connector).

[0023] With this arrangement, since the cable unit is connected to the speaker inside the sound-emitting unit through the cable-side connector and the sound-emitting-unit-side connector, the cable is easily replaceable by plugging or unplugging the cable-side connector in or from the sound-emitting-unit-side connector.

[0024] The headphone still further includes: an arm connecting the sound-emitting unit to the headband, in which the sound-emitting-unit-side connector and the cable-side connector connected to the sound-emitting-unit-side connector are disposed at an inner side than the arm with respect to the user with the sound-emitting unit attached to his/her ears.

[0025] With this arrangement, since the cable-side connector connected to the sound-emitting-unit-side connector is hidden behind the arm, fingers and the like of the user are unlikely to interfere with the cable-side connector, so that an accidental unplugging of the cable-side connector and deformation and the like of the cable-side connector caused by being caught by the fingers and the like can be prevented.

[0026] Moreover, the sound-emitting-unit-side connector and the cable-side connector connected to the sound-emitting-unit-side connector are disposed at a more rear side than the arm with respect to the user in an upright posture with the sound-emitting units attached to ears of the user.

[0027] With this arrangement, for instance, interference between the arm and the cable-side connector projecting from the sound-emitting-unit-side connector is prevented and the user can ergonomically easily hold the sound-emitting unit.

[0028] The cable unit pulled out from the top of the sound-emitting unit is disposed at an inner side than the arm with respect to the user with the sound-emitting unit attached to his/her ears.

[0029] With this arrangement, since the cable unit pulled out from the top of the sound-emitting unit is disposed to be hidden behind the arm, the cable is kept from touching or tangling with the fingers of the user.

[0030] Moreover, the sound-emitting unit includes a groove in which the cable unit is disposed.

[0031] With this arrangement, since the cable unit is housed in the groove, rattling and the like of a cable(s) within the sound-emitting unit can be prevented. Moreover, a projecting length of the cable unit from the sound-emitting unit can be determined constant by housing a constant length of the cable unit along the groove.

[0032] Moreover, the cable unit includes a plurality of cables, in which the plurality of cables are juxtaposed in the groove in a depth direction of the groove, and a first cable of the plurality of cables is disposed close to the speaker in the groove and a second cable of the plurality of cables is disposed remote from the speaker.

[0033] With this arrangement, since two cables are overlaid on each other not in a radial direction of the sound-emitting unit but in an axial direction thereof (i.e., a depth direction of the groove), a cross-section area (i.e., outer diameter) of the sound-emitting unit in the radial direction can be made small and compact. The first cable of the two cables is disposed at a deeper side of the groove while the second cable thereof is disposed at a shallower side of the groove. For instance, the first cable can be connected to the speaker of a closer one of the sound-emitting units while the second cable can be connected to the speaker of a remote one of the sound-emitting units.

[0034] Moreover, the groove is covered with a cushion member.

[0035] With this arrangement, since the groove is shielded by the sound-emitting unit, removal of the cable unit from the groove can be prevented.

[0036] The cable unit includes a block, and the block is screwed into a recess continuous to the groove in the sound-emitting unit to be fixed.

[0037] With this arrangement, the cable unit is fixed in the groove by the screwed block. Even when the cable unit led out from the sound-emitting unit is pulled or the like, the cable is not displaced outward from the sound-emitting unit, so that the length of the cable outside the sound-emitting unit is constant.

[0038] The sound-emitting unit includes a casing and an ear pad detachable from the casing, in which the groove is provided on a wall to be exposed near the casing when the ear pad is removed.

[0039] With this arrangement, the cable can be easily replaced by removing the ear pad from the sound-emitting unit, releasing the cable unit from the groove on the wall exposed near the casing, attaching a new cable unit into the groove, and again attaching the ear pad to the sound-emitting unit.

[0040] A second exemplary embodiment of the invention will be described below.

[0041] According to the second exemplary embodiment of the invention, a headphone includes: a sound-emitting unit; a headband; an arm connecting the sound-emitting unit to the headband; a rotary mechanism configured to rotationally move the arm in the radial direction of the sound-emitting unit with respect to the headband; and a controller provided in the rotary mechanism and configured to stop the rotational movement of the arm.

[0042] With this arrangement, the sound-emitting unit can be avoided from being unintentionally rotated against the user's will together with the arm with respect to the headband.

[0043] The sound-emitting unit includes a pair of right and left sound-emitting units, the arm includes a pair of right and left arms, the rotary mechanism includes a pair of right and left rotary mechanisms, and the controller includes a pair of right and left controllers.

[0044] With this arrangement, according to a preference and needs of the user, the right or left rotary mechanism is fixed by the corresponding controller in a manner to be unrotatable. Alternatively, both of the right and left rotary mechanisms are fixed by the controllers in a manner to be unrotatable. When the controllers are released (i.e., not in use), both of the right and left sound-emitting units are rotationally movable with respect to the headband. Thus, the user has four options to be selected: both of the right and left sound-emitting units are rotationally movable; only the left sound-emitting unit is rotationally movable; only the right sound-emitting unit is rotationally movable; and none of the right and left sound-emitting units are rotationally movable.

[0045] The rotary mechanism includes: a headband rotary portion provided to the headband; an arm rotary portion provided to the arm; a rotary shaft disposed in common in the headband rotary portion and the arm rotary portion, and the arm rotary portion is rotated around the shaft with respect to the headband rotary portion to rotate the arm with respect to the headband.

[0046] Each of the arm rotary portion and the headband rotary portion has a hole in which the shaft is inserted, and the shaft has a hole in which a fixing member is inserted.

[0047] The controller includes: a first hole provided on the headband rotary portion; a second hole provided on the arm rotary portion; and a lock pin to be inserted into the first and second holes.

[0048] With this arrangement, the headband rotary portion and the arm rotary portion can be simultaneously, easily and reliably (firmly) locked by a single lock pin at a low cost.

[0049] The first and second holes are disposed closer to a base of the arm rotary portion than the shaft.

[0050] With this arrangement, since the lock pin is disposed by insertion at a base of the arm rotary portion more rigid than a distal end thereof, even when a strong rotation force is applied on the lock pin, the rotary mechanism can be reliably locked and the distal end of the arm rotary portion is prevented from be broken.

[0051] The rotary mechanism includes a cover member covering the controller. The rotary mechanism includes a cover member covering the controller. With this arrangement, for instance, a member such as the lock pin in the controller can be covered with the cover member to prevent the controller from dropping off the rotary mechanism.

Example(s)

[0052] The headphone in Examples of the first exemplary embodiment of the invention will be described below with reference to Figs. 2 to 7. It should be noted that the same reference numerals as those in Example 1 are used in Example 2 and subsequent examples for the same or similar components as those in Example 1 for convenience of the description. Illustrations of Example 2 and subsequent examples are omitted.

Example 1

[0053] Fig. 2 illustrates a structure of a first (left) sound-emitting unit of a headphone 1 in Example 1 of the invention.

[0054] As shown in Fig. 2, the headphone 1 includes: a pair of right and left sound-emitting units 2 (see Fig. 8 with respect to the right sound-emitting unit in the later-described second exemplary embodiment); arms 4 each shaped in an elongated plate, provided to the respective sound-emitting units 2 and configured to be slidable in a top-bottom direction with respect to the respective sound-emitting units 2; a headband 6 connecting the right and left arms 4 (see Fig. 8); and a cable unit 43 that is inserted from a bottom of a first (left) sound-emitting unit 2 and led out from a top of the first sound-emitting unit 2.

[0055] Further, a first cable-side connector 46 is provided to a first cable 44 of the cable unit led out (pulled out) from the top of the sound-emitting unit 2. A first sound-emitting-unit-side connector 24 is provided to the first sound-emitting units 2 and configured to be plugged with the first cable-side connector 46 to be connected (see Fig. 8). After being led out from the top of the first sound-emitting unit 2, the first cable 44 is turned downward (the turned part is denoted by a reference numeral 44a) and connected to the first sound-emitting-unit-side connector 24 (see Fig. 8) by the first cable-side connector 46.

[0056] A second cable 45 of the cable unit 43 is led out from the top of the first (left) sound-emitting unit 2, passes along an inner surface 4c (i.e., a closer side to the ears of the user) of the corresponding arm 4, passes along an inner surface of the headband 6 (Fig. 8), and inserted in a second (right) sound-emitting unit 2. The second cable 45 also has a second cable-side connector 46 at a distal end. The second cable-side connector 46 is plugged in a second sound-emitting-unit-side connector 24 of the second sound-emitting unit 2.

[0057] The partial cable 47 led out downward from the bottom of the first sound-emitting unit 2 has a synthetic-resin-made outer cover 47a simultaneously covering the two cables 44, 45. The partial cable 47 led out downward is connected to audio equipment (not shown) by a connector. An electrical signal from the audio equipment (not shown) is transmitted to the two cables 44, 45 of the cable unit 43. A speaker 48 (Fig. 7) of each of the right and left sound-emitting units 2 is grounded to a common ground (not shown).

[0058] An upper end 8 of each of the right and left arms 4 is rotatably connected to between right and left (inner and outer) walls 12, 13 that are provided at each lower end of the headband 6 (Fig. 8). The right and left sound-emitting units 2 are connected to the headband 6 (Fig. 8) through the arms 4.

[0059] Each of the arms 4 is slidably inserted into a hole 3d from above, the hole 3d penetrating each of the

sound-emitting units 2 in the top-bottom direction. Each of the arms 4 is synthetic resin-made and includes a plurality of projections 4b juxtaposed in the top-bottom direction on the inner surface (a surface closer to the ear of the user) 4c. Parts (not shown) to be fitted to the projections 4b are provided inside the hole 3d, so that a position of each of the sound-emitting units 2 in the top-bottom direction with respect to the corresponding arm 4 can be determined. The hole 3d is referred to as a connection portion between each of the arms 4 and the corresponding sound-emitting unit 2.

[0060] Each of the sound-emitting units 2 includes: a hard casing 3 made of a synthetic resin and shaped substantially in a cup; a soft ear pad 7 made of a synthetic resin and fixed to an inner end (an end closer to the ear of the user) 3a of the casing 3; and the speaker 48 (Fig. 7) disposed inside the casing 3. A sound is radiated from a diaphragm 49 of the speaker 48 (Fig. 7) and passes through an opening 7a at the center of the ear pad 7 to be transmitted to the ear of the user. A direction of sound radiation of the diaphragm 49 conforms with a direction toward the ear.

[0061] Fig. 3 shows an example of wiring of the cable unit 43 on a circular wall 50 of the inner end of the sound-emitting unit 2 when the ear pad 7 is removed from the sound-emitting unit 2 in Fig. 2. Fig. 4 shows a cable unit (module) in a form of the cable unit 43, the cable unit being removed from the sound-emitting unit 2.

[0062] As shown in Fig. 3, the two cables 44, 45 of the cable unit 43 are wired along a front half of the periphery of the wall 50 of the inner end (closer to the ear of the user) of the left sound-emitting unit 2 in a manner to form an arc (substantially semicircle) from the bottom to the top of the sound-emitting unit 2 (the partial cables shaped in an arc are denoted by reference numerals 44b, 45b). Radially outside the partial cables 44b, 45b, plurality of claws 52 for fixing the ear pad 7 of Fig. 2 are provided approximately at an equal pitch on the periphery of the wall 50 of the inner end. The arc-shaped partial cables 44b, 45b are wired radially inside each of the claws 52 on the front half of the wall 50 of the inner end. Each of the claws 52 includes: a flexible plate 52a projecting from the wall 50 of the inner end; and a claw body (catching portion) 52b extending outward in the radial direction from a projecting end of the plate 52a.

[0063] The wall 50 of the inner end is made of a synthetic resin and integrally formed with the claws 52. The wall 50 of the inner end covers an opening 3e of an inner end of an annular wall (peripheral wall) 3b of the casing 3 of the sound-emitting unit 2. The annular wall 3b of the casing 3 extends to integrate with a tapered wall 3f at an outer side of the casing 3 (remote from the ear of the user). The tapered wall 3f extends to integrate with a circular wall 3c (bottom wall, see Fig. 8) at an outer side of the casing 3.

[0064] On the wall 50 of the inner end, openings 54 are provided between a radial rib 53a and an annular rib 53b and a plurality of small holes 55 are provided radially outside the openings 54. With this arrangement, for instance, the sound radiation of the diaphragm 49 of the speaker 48 (Fig. 7) within the casing can be uniformed. The arc-shaped partial cables 44b, 45b of Fig. 3 are disposed radially outside relative to the peripheral portion 49a of the diaphragm 49 (Fig. 7). With this arrangement, the arc-shaped partial cables 44b, 45b are kept from obstructing the sound radiation of the diaphragm 49.

[0065] As shown in Fig. 4, an arc-shaped groove 56 is provided radially outside relative to the small holes 55 at the front half of the wall 50 of the inner end. As shown in Fig. 3, the arc-shaped partial cables 44b, 45b are housed in the groove 56. The arc-shaped partial cables 44b, 45b pass through an inside of a lower block 57 and an inside of a pipe 58 projecting from a bottom of the block 57 to be led out downward from the sound-emitting unit 2. As shown in Fig. 4, on the wall 50 of the inner end, a recess 59 housing the block 57 is provided continuous to the groove 56. A cutout 60 for receiving the pipe 58 is provided continuous to the recess 59 on a lower portion of the annular wall 3b of the casing 3 (also referred to as a lower cutout 60).

[0066] In this Example, the cutout 60 is provided to the lower end of the casing 3. As shown in Fig. 3, at least the pipe 58 continuous to the block 57 is wired along (so as to be hidden from the outside by the arm 4) the inner surface (surface closer to the ear of the user) 4a of a lower half of the arm 4. The term "inner" side means a side closer to the ear(s) of the user along the axial direction of the sound-emitting unit 2. The term "outer" side means an opposite side from the inner side.

[0067] As shown in Fig. 4, the arc-shaped groove 56 extends continuously to a short groove 56a curved upward on the upper portion of the wall 50 of the inner end. The groove 56a curved upward is in communication with a cutout 61 on the upper portion of the annular wall 3b of the casing 3 (also referred to as an upper cutout 61). In this Example, the groove 56a curved upward and the upper cutout 61 are disposed substantially at the upper end of the casing 3.

[0068] As shown in Fig. 3, the two cables 44, 45 led upward from the groove 56a curved upward and the cutout 61 are disposed along the inner surface (surface closer to the ear of the user) 4c of the upper half of the arm 4 to be hidden from the outside by the arm 4 (located behind the arm 4). The second cable 45 of the two cables 44, 45 passes inside the rotary mechanism 5 along the inner surface 4c of the upper half of the arm 4 and passes inside the headband 6 (Fig. 8) to be guided to the second sound-emitting unit 2 (see Fig. 8). Since the cable unit 43 is not housed in the second sound-emitting unit 2 (Fig. 8), it is unnecessary to form the groove 56.

[0069] The first cable 44 is folded downward in an inverse U-shape and connected to the sound-emitting-unit-side connector 24 (see Fig. 8) using the cable-side connector 46 provided at a distal end of the cable 44. The first cable 44, the cable-side connector 46 and the sound-emitting-unit-side connector 24 (Fig. 8) are disposed on

an inner side (a side closer to the ear of the user) of the arm 4 to be hidden from the outside by the arm 4 (located behind the arm 4). With this arrangement, for instance, when the user holds and presses the sound-emitting units 2 onto the ears, the cables 44, 45 led out from the top of the sound-emitting unit 2 and the respective cable-side connectors 46 are prevented from interfering with or being caught by the fingers of the user.

[0070] The sound-emitting-unit-side connector 24 (Fig. 8) and the cable-side connector 46 connected to the sound-emitting-unit-side connector 24 are disposed at a rear (back) side from the upper end (top) of the sound-emitting unit 2. The term "rear (back)" side means a rear (back) side seen from the user with the sound-emitting units 2 put on the ears (with respect to the user). For instance, the sound-emitting-unit-side connector 24 (Fig. 8) and the cable-side connector 46 connected thereto are disposed along a rear end 4d of the arm 4 or at the rear side from the rear end 4d of the arm 4. Since the cable-side connector 46 is disposed at the rear side of the sound-emitting unit 2, the cable-side connector 46 does not interfere with the arm 4 and the user ergonomically easily holds the sound-emitting unit 2. Moreover, the fingers of the user are unlikely to touch (interfere with) the cable-side connector 46.

[0071] Further, since the two cables 44, 45 housed in the arc-shaped groove 56 are covered with the ear pad 7 as shown in Fig. 2 to be protected from the outside, the partial cables 44b, 45b are not exposed to the outside, so that the partial cables 44b, 45b are prevented from tangling or interfering with the fingers of the user.

[0072] For instance, in a professional headphone (1) such as a headphone for a DJ (disc jockey), a use of the headphone is not limited to a static use of motionlessly listening to music with the right and left sound-emitting units 2 put on the respective right and left ears. Examples of the use of the headphone 1 by the DJ at a performance site include the following.

[0073] In order that the user with the headphone 1 put on a first ear listens to surrounding sounds, the user fixes one of the sound-emitting units 2 to the first ear with a hand while pushing the other of the sound-emitting units 2 with the other hand, for instance, in a front-back direction to separate from a second ear.

Alternatively, while the headphone 1 is hung around a neck of the user, the user puts only one of the sound-emitting units 2 on one ear.

Alternatively, while holding only one of the sound-emitting units 2 of the headphone 1, the user frequently puts the one of the sound-emitting units 2 on or off one ear.

Alternatively, the user holds one of the sound-emitting units 2 of the headphone 1 placed down and puts the one of the sound-emitting units 2 onto one ear. Subsequently, the user immediately returns the headphone 1 to a state where the headphone 1 is placed down.

[0074] As described above, the headphone is sometimes used extremely dynamically. Thus, a dynamic use of the headphone 1 such as a quick movement of the sound-emitting unit 2 of the headphone 1 and a frequent switch of putting the sound-emitting unit 2 on and off the ear can been seen.

[0075] Even when the headphone is dynamically used as described above, with the headphone 1 of this Example, the cable unit 43 is prevented from being caught or interfering with the outside, so that a failure such as cable breakage is unlikely to occur.

[0076] As shown in Fig. 4, a radially inner surface 52c of the claw 52 for fixing the ear pad is disposed continuously to a radially outer surface 56b of the arc-shaped groove 56. The cables 44, 45 are smoothly inserted and guided into the groove 56 along the radially inner surface 52c of the claw 52. Even when the cables 44, 45 are insufficiently received in the groove 56, since the cables 44, 45 contact with the radially inner surface 52c of the claw 52, the cables 44, 45 are prevented from dropping off the casing 3. Moreover, when the ear pad 7 is attached to the casing 3, the cables 44, 45 are prevented from being caught between the ear pad 7 and the wall 50 of the inner end of the casing. Accordingly, performance of an attachment operation of the cable unit 43 to the sound-emitting unit 2 is improved.

[0077] The arc-shaped groove 56 has a lower portion in a form of a tapered extension (the extension is denoted by a reference numeral 56c) and extends continuously to the substantially rectangular recess 59. A projecting wall 59a is provided on a rear half of the recess 59 and has a female screw hole 59b (which may be a pilot hole for screwing a tapping screw). A male screw member 62 is screwed into the female screw hole 59b to fasten and fix the block 57. The recess 59 is formed between the annular wall 3b of the casing 3 and the annular rib 53b on a radially inner side. The block 57 is shaped in a substantially rectangular fan.

[0078] After the two cables 44, 45 are led out in parallel in a top-bottom direction from a front wall 57a of the block 57, the two cables 44, 45 are twisted counterclockwise at the front wall 57a as a fulcrum as shown in Fig. 4 (the twisted part is denoted by a reference numeral 45c) and housed in the groove 56 while the cables 44, 45 are overlaid on each other in parallel in a right-left direction in an axial direction of the casing 3. Herein, the "top-bottom" direction means, for instance, a longitudinal direction of the arm 4 and the "right-left" direction means a thickness direction of the arm 4, in other words, a depth direction of the groove 56.

[0079] The cable 44 wired along (in contact with) a bottom surface 56d of the groove 56 (Fig. 7) is led from a top of the groove 56 to the outside of the casing 3 and, subsequently, folded downward (the folded part is denoted by a reference numeral 44a). The cable-side connector 46 provided at the distal end of the cable 44 is inserted into the sound-emitting-unit-side connector 24 of the same casing 3 to be connected (Fig. 8).

[0080] The cable-side connector 46 includes: a male (pin) terminal 46a; and an insulation resin portion 46b covering the terminal 46a, in which a distal end of the

terminal 46a projects (is exposed) to the outside. The sound-emitting-unit-side connector 24 (Fig. 8) includes: a bottomed hole provided on the annular wall 3b of the casing 3; and a female terminal (not shown) provided in the hole. The terminal of the sound-emitting-unit-side connector 24 (Fig. 8) is electrically connected to a voice coil (not shown) of the speaker 48 in the sound-emitting unit 2 (Fig. 7).

[0081] The cable 45 wired along the opening 56e (a side closer to the surface of the wall 50 of the inner end) of the groove 56 is led from the top of the groove 56 to the outside of the casing 3 and, subsequently, is wired in the second sound-emitting unit 2 (Fig. 8) along the inner surface 4c on an upper half of the arm 4 and the inner surface of the headband 6 (Fig. 8). The cable-side connector 46 provided at the distal end of the cable 45 is inserted into the second sound-emitting-unit-side connector 24 to be connected.

[0082] The block 57, the two cables 44, 45 wired upward from the block 57, the cable-side connectors 46 provided at the distal ends of the respective cables 44, 45, the partial cable 47 wired downward from the block 57, and a connector (not shown) provided at a distal end of the partial cable 47 define a cable unit (cable module) in a form of the cable unit 43.

[0083] For instance, when a failure (e.g., cable breakage) of the cables 44, 45 occurs, the user replaces the cable unit 43 in failure with another purchased cable unit 43 or a spare cable unit 43.

[0084] For replacement of the cable unit 43, the ear pad 7 is removed from the casing 3, the male screw member 62 on the block 57 is unfastened using a driver (not shown), and the partial cable 47 extending downward from the block 57 is pulled inward in the axial direction of the casing 3 (toward the ears of the user), whereby the block 57 and the two arc-shaped partial cables 44b, 45b are easily removed from the groove 56. The cable-side connectors 46 provided at the distal ends of the two cables 44, 45 are respectively removed from the sound-emitting-unit-side connectors 24 of the sound-emitting units 2 (Fig. 8) (the connectors 46 may be removed in advance). Thus, the cable unit 43 in failure is easily removable from the headphone 1.

[0085] An attachment of a new cable unit 43 is conducted in reverse order from the above. The block 57 is fitted in the recess 59 and fixed by the male screw member 62. The two cables 44, 45 are housed while being bent in an arc along the groove 56. At this time, the two cables 44, 45 are pushed into the groove 56 so as to be overlaid on each other in parallel in the right-left direction (from the inside to the outside). Insulative outer covers of the overlaid two cables 44, 45 may be bonded to each other. Next, the ear pad 7 is attached to the casing 3 and the cable-side connectors 46 are inserted into the respective sound-emitting-unit-side connectors 24 (Fig. 8) to be connected.

[0086] Fig. 5 shows an example of a fixation structure of the ear pad 7 and the casing 3.

[0087] As shown in Fig. 5, the ear pad 7 includes: a soft annular pad body 63 made of a synthetic resin and having a substantially semicircular cross section; and a soft or slightly hard cushion member 64 (see Fig. 7) made of a synthetic resin, shaped in an annular plate and disposed to shield an opening 7b of an outer end (a side remote from the ear of the user) of the pad body 63.

[0088] The cushion member 64 has an annular tapered wall 64a at the center. The tapered wall 64a extends toward the opening 7a at the center. The cushion member 64 includes elongated rectangular holes 65 into which the respective claws 52 projecting from the wall 50 of the inner end of the casing are inserted to be fitted. A claw body 66 (see Fig. 7) extending inward in the radial direction is provided on a part of an inner surface 65a that is a radially outer surface of each of the holes 65, the part being near an opening of the holes 65.

[0089] By inserting each of the claws 52 of the casing 3 into each of the holes 65 of the ear pad 7, a claw body 52b extending radially outward of each of the claws 52 is fitted with the claw body 66 extending radially inward of each of the holes 65, whereby the ear pad 7 is fixed (locked) to the casing 3. When the ear pad 7 is removed (unlocked) from the casing 3, for instance, by inserting the fingers in the opening 7a at the center of the ear pad 7 and applying a pressing force radially outward from the holes 65, the claws 52 are smoothly removed from the hole 65 due to a gap generated therebetween. The "radially (radial direction)" means the radial direction of each of the casing 3 and the ear pad 7.

[0090] Fig. 6 is an enlarged view showing the example of the fixation structure of the block 57 and the casing unit 43 of Fig. 3.

[0091] The block 57 is fixed with the male screw member 62 to the recess 59 of the wall 50 of the inner end. The partial cable 47 extending downward from the block 57 is led out from the lower cutout 60 of the casing 3. The two cables 44, 45 are introduced into the groove 56 from the projecting wall 57a of the front end of the block 57. The two cables 44, 45 are bent downward inside the block 57 and inserted in the insulative pipe 58 of the partial cable 43 extending downward. Each of the cables 44, 45 includes an insulative cover and a metallic wiring (not shown) inserted in the insulative cover. The block 57 and the recess 59 are shaped substantially in a rectangular fan.

[0092] The projecting wall 57a of the block 57 is fitted in an extension 59c at the lower portion of the groove 56 continuous to the recess 59. In a tapered extension 56c (a width of which gradually becomes narrower toward the top) of the groove 56 continuous to the extension 59c, bases of the respective two cables 44, 45 led out from the projecting wall 57 are twisted by 90 degrees to change a state of the cables 44, 45 from horizontal two rows (a state where the cables 44, 45 are placed in parallel in a width direction of the groove 56) to vertical two rows (a state where the cables 44, 45 are placed in parallel in the depth direction of the groove 56) and housed. The

two cables 44, 45 in the vertical two rows are housed in the arc-shaped groove 56. In Fig. 6, the reference numeral 4a denotes the lower half of the arm 4. A reference numeral ? denotes a groove-shaped opening 3d1 near the lower end of the hole 3d of the casing 3, the hole 3d vertically penetrating the arm 4.

[0093] Fig. 7 is a cross sectional view on arrows D-D in Fig. 6 and mainly shows the groove 56 through which the cables 44, 45 pass and a structure for preventing an insufficient reception of the cables 44, 45 in the groove 56.

[0094] The wall 50 of the inner end of the casing 3 is disposed facing an inner side (a side closer to the ear of the user) of the diaphragm 49 of the speaker 48. The cross-sectionally U-shaped groove 56 is provided on the wall 50 of the inner end radially outside relative to the peripheral portion 49a of the diaphragm 49. The groove 56 is formed inside a cross-sectionally U-shaped wall 67 projecting from the wall 50 of the inner end outward in the axial direction of the casing 3 and extending integrally with the wall 50. The depth of the groove 56 is determined so that the cable 45 near the opening 56e at the inner end of the groove 56 is positioned substantially flush with a surface of the wall 50 of the inner end (the cable 45 is allowed to slightly project beyond the opening 56e of the inner end of the groove 56), when the two cables 44, 45 are overlaid on each other vertically (in the depth direction) in the groove 56. The width of the groove 56 is determined slightly larger than an outer diameter of each of the cables 44, 45.

[0095] Since the two cables 44, 45 are overlaid on each other in the groove 56 not in the radial direction of the sound-emitting unit 2 but in the axial direction thereof, a size in the sound-emitting unit 2 in the radial direction is reduced and made compact. Since the groove 56 is deepened into a space 68 in the casing 3, the sound-emitting unit 2 is kept from being enlarged in the axial direction.

[0096] Except for the center part (a part where there are the openings 54 and the small holes 55 for sound emission) of the wall 50 of the inner end facing the diaphragm 49, the cushion member 64 of the ear pad (see Fig. 5) is disposed on the surface of the radially outer side of the wall 50 of the inner end and a surface of a flange 69 at an inner end of the annular peripheral wall of the casing 3, and is fixed with the claws 52 of the wall 50 of the inner end. The claw body 52b extending radially outward of each of the claws 52 is fitted with the claw body 66 extending radially inward in the each of the holes 65 of the cushion member 64.

[0097] In this state, the cushion member 64 touches or is in close contact with the surface of the wall 50 of the inner end, whereby a back side 64b of the cushion member 64 shields the opening 56e of the groove 56 to prevent the cables 44, 45 from being insufficiently received in the groove 56 or dropping off the groove 56. With this arrangement, the cables 44, 45 are prevented from dropping off the groove 56, rattling in the groove 56, and the like when the headphone 1 is in use, whereby damage on the cables 44, 45 and generation of abnormal sounds are prevented.

[0098] A step 70 is provided radially inside the opening of the peripheral wall 3b of the casing 3. A peripheral portion 50g of the wall 50 of the inner end is fitted in the step 70 to be supported. On a rear side of the center of the wall 50 of the inner end, the diaphragm 49, the voice coil (not shown) connected to the diaphragm 49, and a magnet, a yoke and the like provided on the axially outer side from the diaphragm 49 define the speaker 48. In Fig. 7, a reference numeral 71 denotes a support column supporting the speaker 48.

Example 2

[0099] In Example 1, the lower cutout 60 for leading out the lower partial cable 47 of the cable unit 43 is provided substantially at a lower end of the casing 3 of the sound-emitting unit 2 while the upper cutout 61 for leading out the two cables 44, 45 of the cable unit 43 is provided substantially at the upper end of the casing 3 in a direction of approximately 180 degrees from the lower cutout 60. In Example 2, as shown in Fig. 3, the upper cutout 61 is provided on the upper portion of the casing 3 to be shifted from the lower cutout 60 located substantially at the lower end of the casing 3 by 180 degrees or more (optionally at about 190 degrees) counterclockwise.

[0100] The two cables 44, 45 led upward out of the upper cutout 61 are preferably positioned facing the inner surface 4c of the arm 4. The cables 44, 45 may be disposed inside the rear end 4d of the arm 4 or along an inside of a front end of the arm 4. With this arrangement, the cables 44, 45 are hidden inside (behind) the arm 4, so that the cables 44, 45 are prevented from being caught by the fingers or the like of the user. In this arrangement, the cable-side connector 46 is disposed at the rear side from the rear end 4d of the arm 4. Interference of the cables 44, 45 with the fingers or the like is further prevented when the cable-side connector 46 is disposed at the rear side in the sound-emitting unit 2 with respect to the arm 4 compared with when the cable-side connector 46 is disposed at the front side in the sound-emitting unit 2 with respect to the arm 4.

[0101] The lower cutout 60 of the casing 3 may be disposed slightly at a front side or a rear side from the lower end (bottom) of the casing 3. In this arrangement, the lower partial cable 47 led out from the lower cutout 60 is preferably disposed inside the arm 4 in order to prevent interference with the fingers or the like. The lower partial cable 47 may be disposed along an inside of the front end or the rear end of the arm 4. The term "rear (back) side" means a rear (back) side seen from the user with the sound-emitting units 2 on the ears (with respect to the user).

Example 3

[0102] In Example 1, a pair of right and left sound-emit-

ting units 2 are connected through the respective arms 3 by the common headband 6 (Fig. 8). However, in Example 3, the right and left sound-emitting units 2 or only right or left one of the sound-emitting units 2 in an ear hanging-type is fixed to the ear(s) of the user without using the headband 6. An ear hanging portion in place of the headband 6 may be in a form of independent right and left ear hanging portions, or alternatively, may be in a form of right and left ear hanging portions connected like the headband 6. When only one of the sound-emitting units 2 is used, a single cable 44 is used in place of the cables 44, 45.

[0103] The headphone in Examples of the second exemplary embodiment of the invention will be described below with reference to Figs. 8 to 10. It should be noted that the same reference numerals as those in Example 1 are used in Example 2 and subsequent examples for the same or similar components as those in Example 1 for convenience of the description. Illustrations of Example 2 and subsequent examples are omitted. The same components as those in the first exemplary embodiment will be described with the same reference numerals.

Example 1

[0104] Fig. 8 illustrates a headphone 1 in Example 1 of the second exemplary embodiment. Fig. 9 illustrates a relevant part of the headphone 1. Fig. 10 schematically illustrates a cross section taken along A-A line in Fig. 9.

[0105] As shown in Fig. 8, the headphone 1 includes: a pair of right and left sound-emitting units 2; the hard arms 4 made of synthetic resin, respectively penetrating the casings 3 of the respective sound-emitting units 2 in the top-bottom direction, and configured to be slidable in the top-bottom direction with respect to the respective sound-emitting units 2; and the headband 6 made of synthetic resin and connected to the upper ends of the respective arms 4 through the respective rotary mechanisms 5.

[0106] Each of the sound-emitting units 2 includes: the hard casing 3 made of a synthetic resin and shaped substantially in a cup; and the soft ear pad 7 made of a synthetic resin and fixed to the inner end 3a of the casing 3. The "inner end" of the casing 3 means an end closer to the ear (not shown) of the user.

[0107] The casing 3 includes: the annular peripheral wall 3b; and the flat outer wall (bottom wall) 3c continuous to the substantially tapered wall on the outside of the peripheral wall 3b. The diaphragm and components (not shown) such as the voice coil connected to the diaphragm are disposed inside the casing 3. An illustration of a cable connected to the voice coil is omitted. The casing 3 includes an annular connector 24 for electrically connecting the cable.

[0108] Each of the arms 4 is shaped in an elongated plate. A plurality of projections 4b having a triangular cross section are provided on the inner surface 4a of each of the arms 4 in parallel in the longitudinal direction of the arm 4. The "inner surface" of the arm 4 means a surface closer to the ear of the user. Moreover, a positioning fixation portion (not shown) configured to be elastically fitted to each of the projections 4b is provided in the hole 3d penetrating the casing 3 in the top-bottom direction. With this arrangement, the sound-emitting unit 2 can be positioned slidably in the top-bottom direction with respect to the arm 4. The arm 4 is removable upward from the hole 3d of the casing 3.

[0109] The upper end of the arm 4, namely, an arm rotary portion 8 is formed wider in the front-back direction than the other parts of the arm and substantially circular. The sound-emitting units 2 are connected to the headband 6 through the respective arms 4.

[0110] The headband 6 is curved so as to fit a shape of a head (not shown) of the user. A curved cushion material 9 is provided to an inner (lower) surface of the headband 6. A partial band 6a extending downward from the cushion material 9 includes: front and back ribs 10 formed gradually wider downward and having a triangular shape in a front view; and a curved bottom wall 11 projecting upward and connecting lower ends of the front and back reinforcing rib 10. The bottom wall 11 is wider in the right-left direction than the band 6b at an upper side of the bottom wall 11.

[0111] Further, as shown in Fig. 9, a pair of right and left walls 12, 13 extend downward from the bottom wall 11 to face each other. A gap 14 is formed in a slit between the pair of right and left walls 12, 13. The pair of right and left walls 12, 13 define the lower end of the headband 6. A lower half of each of the pair of walls 12, 13 is formed semicircular. The upper end (arm rotary portion) 8 of the arm 4 is inserted upward from below into the gap 14 between the pair of walls 12, 13 and configured to be rotatable. The arm 4 is configured to be rotatable in the radial direction of the sound-emitting unit 2 (i.e., in the front-back direction of the user) with respect to the headband 6.

[0112] At the lower end of the headband 6, at least the pair of right and left walls 12, 13, the gap 14 therebetween, and the bottom wall (connecting wall) 11 above the gap 14 define a headband rotary portion 15. The substantially circular upper end of the arm 4 defines the arm rotary portion 8. A peripheral surface 8a of an upper end of the arm rotary portion 8 is rotatably positioned along an arc-shaped lower surface 11 a of the bottom wall 11 of the headband rotary portion 15.

[0113] A shallow circular recess (groove) 16 is formed on an inner surface of the wall 12 that is located on an inner side (i.e., a side closer to the head of the user) among the pair of right and left walls 12, 13 of the headband rotary portion 15. Among the pair of right and left walls 1, 13, a similar shallow recess 17 (see Fig. 10) is also formed on an outer surface of the wall 13 that is located on an outer side. An inner cover member 18 is fitted to the recess 16 of the wall 12 on the inner side while an outer cover member 19 fitted to the recess 17 (Fig. 10) of the wall 13 on the outer side..

[0114] A hole 20 concentric with the recesses 16, 17

is formed at the center of each of the pair of right and left walls 12, 13. The hole 20 is formed in a step (irregular shape) at least on the inner wall 12. The stepped hole includes: a large-diameter hole 20a on the inner side (the side closer to the head of the user); and a small-diameter hole 20b on the outer side. The hole 20 of each of the right and left walls 12, 13 further includes: upper and lower flat surfaces 20c in parallel; and front and rear arc surfaces 20d connecting the flat surfaces 20c. A circular hole 21 concentric (coaxial) with the hole 20 is formed at the arm rotary portion 8. An inner diameter of the circular hole 21 is the same as an inner diameter of the irregular hole 20.

[0115] At a position lower than the holes 20, 21, in other words, at a position closer to a base 8b of the arm rotary portion 8 (closer to the sound-emitting unit 2), cross-sectionally circular holes 22, 23 having a smaller diameter than the holes 20, 21 concentrically penetrate the pair of right and left walls 12, 13 of the headband rotary portion 15 and the arm rotary portion 8. A lock pin 25 is to be inserted into the holes 22, 23.

[0116] The lock pin 25 and the holes 22, 23 into which the lock pin 25 is to be inserted define a controller 26 for inhibiting the rotational movement of the arm 4 with respect to the headband 6 (or the rotational movement of the headband 6 with respect to the arm 4). The controller 26 is provided at each of the headband rotary portion 15 and the arm rotary portion 8 in each of right and left channels (transmission paths). The hole 22 of the headband rotary portion 15 is referred to as a first hole. The hole 23 of the arm rotary portion 8 is referred to as a second hole.

[0117] The lock pin 25 is inserted from the hole 22 of the inner wall 12 of the headband rotary portion 15 through the hole 23 of the arm rotary portion 8 to the hole 22 of the outer wall 13 of the headband rotary portion 15. After the outer cover member 19 is attached to the outer wall 13 of the headband rotary portion 15, the lock pin 25 is to be inserted. The lock pin 25 is attached to the right rotary mechanism 5 and/or the left rotary mechanism 5 as needed, for instance, by the user.

[0118] The lock pin 25 is formed in a metallic or hard synthetic resin-made cylinder having a constant outer diameter. The outer diameter of the lock pin 25 is determined slightly smaller than the inner diameter of each of the holes 22, 23. A length of the lock pin 25 is equal to or slightly shorter than a distance from the surface 16a of the recess 16 of the inner wall 12 to the surface 17a of the recess 17 (Fig. 10) of the wall 13. A tapered chamfered edge 25a is formed at each of right and left ends of the lock pin 25.

[0119] The holes 22, 23 into which the lock pin is to be inserted are disposed not at the upper end of the arm rotary portion 8 but at the lower end, namely, near the base 8b of the arm rotary portion 8, because a part near the upper end of the arm rotary portion 8 may become brittle by a rotational force applied on the lock pin 25 and the holes 22, 23 to be damaged in an arrangement that the holes 22, 23 are formed near the upper end (free end) of the arm rotary portion 8.

[0120] Although the hole 22 is provided near the lower end (free end) of the headband rotary portion 15, since the headband rotary portion 15 includes the pair of right and left walls 12, 13 and the hole 22 penetrates both of the walls 12, 13, the hole 22 sufficient to avoid the damage is secured.

[0121] Since the holes 22, 23 are formed near the lower end of the arm rotary portion 8, even when a strong rotational force is applied on the lock pin 25 and the holes 22, 23, the holes 22, 23 firmly receive the guide pin 25 and reliably inhibit the rotation of the arm 4 with respect to the headband 6 or the rotation of the headband 6 with respect to the arm 4 without causing damages on both of the rotary portions 8 and 15.

[0122] The outer cover member (cap) 19, which is made hard using a synthetic resin, includes: a tapered wall 27; a radial rib 28 that reinforces an inside of the tapered wall 27; an annular surface 27a of an inner end of the tapered wall 27; and a shaft 29 projecting inward from the center of the tapered wall 27. The shaft 29 includes: upper and lower flat surfaces 29a in parallel configured to avoid rotation of the shaft 29; and front and rear arc surfaces 29b connecting the upper and lower flat surfaces 29a.

[0123] When the upper and lower flat surfaces 29a of the shaft 29 are brought into contact with the upper and lower flat surfaces 20c of the hole 20 of the headband rotary portion 15, the outer cover member 19 is fixed to be unrotatable with respect to the headband rotary portion 15. Simultaneously, the front and rear arc surfaces 29b of the shaft 29 are brought into contact with the front and rear arc surfaces 20d, 21a of the holes 20, 21 penetrating the headband rotary portion 15 and the arm rotary portion 8, whereby the arm rotary portion 8 is supported rotatably in the front-back direction with respect to headband rotary portion 15.

[0124] At the center of the shaft 29 of the outer cover member 19, a small hole 30 is provided in an axial direction of the shaft 29 from a shaft end surface 29c. A metallic bolt (a fixing member, male screw member, or rotary shaft body) 31 is screwed from the inner cover member 18 into the hole 30. The hole 30 is tapped in advance, or alternatively, the hole 30 is formed to have a smaller diameter than the bolt 31 and the bolt 31 serving as a tapping screw is screwed into the hole 30. +Inside the hole 30, a nut (not shown) may be buried in the shaft 29. The bolt 31 includes a male screw shaft 31a and a circular head 31b. The head 31b has a groove 31c into which a screwdriver or the like is fitted.

[0125] The inner cover member 18, which is made hard using a synthetic resin, includes: a circular periphery 18a having a smaller diameter than the recess 16 of the inner wall 12 of the headband rotary portion 15; and a circular bolt insertion hole 32 at the center. A recess 18b in which the head 31b of the bolt 31 is fitted is formed on an inner end (a side near the head of the user) of the inner cover

member 18. At an outer end of the inner cover member 31, it is preferable to provide a projection (not shown) configured to avoid the rotation of the inner cover member 18 and fitted into the large diameter hole part 20a of the stepped hole 20 of the inner wall 12 of the headband rotary portion 15.

[0126] An outer surface (remote from the head of the user) of the inner cover member 18 covers an opening of the hole 22, into which the lock pin is to be inserted, of the inner wall 12 of the headband rotary portion 15. The inner annular surface 27a of the outer cover member 19 covers an opening of the hole 22, into which the lock pin is to be inserted, of the wall 13. Both of the cover members 18, 19 also serve as a member for preventing the lock pin 25 from dropping off the hole.

[0127] The headband rotary portion 15, the arm rotary portion 8, the outer cover member 19 having the shaft 29, the inner cover member 18, and the bolt 31 define the rotary mechanism 5. The rotary mechanism 5 is provided symmetrically on each of the right and left channels of the headphone 1.

[0128] As shown in Fig. 10, the arm rotary portion 8 is inserted between the right and left (inner and outer) walls 12, 13 of the headband rotary portion 15; the outer cover member 19 is attached to the outer wall 13 of the headband rotary portion 15; the shaft 29 of the outer cover member 19 penetrates the holes 20, 21 of the outer wall 13, the arm rotary portion 8 and the inner wall 12; and the inner end surface 27a of the outer cover member 19 contacts with the outer surface 17a of the recess 17 of the outer wall 13.

[0129] The headband rotary portion 15 and the arm rotary portion 8 are rotationally supported by the shaft 29. A distal end 29c of the shaft 29 is located at the outer side (on the right side in Fig. 10) from the inner end surface 16a of the inner wall 12 (i.e., the distal end 29c does not project beyond the inner end surface 16a of the inner wall 12).

[0130] In this state, the lock pin 25 is to be inserted into the small-diameter holes 22, 23 of the headband rotary portion 15 and the arm rotary portion 8. An insertion distal end (outer end) 25b of the lock pin 25 is brought into contact with the inner end surface 27a of the outer cover member 19, so that a further insertion of the lock pin 25 is inhibited.

[0131] Next, the inner cover member 18 is attached to the recess 16 of the inner wall 12. The bolt (Fig. 9) 31 is screwed into the hole 32 of the inner cover member 18 as shown by an arrow B and further screwed into the hole 30 at the center of the shaft 29 of the outer cover member 19 fitted in the large-diameter holes 20, 21 of the headband rotary portion 15 and the arm rotary portion 8.

[0132] With this arrangement, the shaft 29 is prevented from dropping off the large-diameter holes 20, 21 of the headband rotary portion 15 and the arm rotary portion 8. Moreover, the outer end surface 18c of the inner cover member 18 approaches or is in contact with the inner end surface 25a of the lock pin 25, so that the lock pin 25 is prevented from dropping off the hole inward or outward.

[0133] Since the lock pin 25 is fitted into the holes 22, 23 of the headband rotary portion 15 and the arm rotary portion 8, the rotational movement of the headband rotary portion 15 and the arm rotary portion 8 (i.e., the rotation of the arm rotary portion 8 with respect to the headband rotary portion 15 and the rotation of the headband rotary portion 15 with respect to the arm rotary portion 8) is inhibited.

[0134] As described above, since the hole 23 into which the lock pin is inserted is provided not at a side (a low rigid portion) near the upper end of the arm rotary portion 8 but at a position (a high rigid portion) lower than the hole 21 at the center, the side near the upper end of the arm rotary portion 8 is kept from being damaged even when a strong rotational force is applied on the lock pin 25.

[0135] In the above Example, the headphone 1 before inserting the right and left lock pins 25 is provided to the user. For instance, the DJ (user) unfastens and removes the bolt 31 of the rotary mechanism 5 of one of the right and left channels, removes the inner cover member 18, inserts the lock pin 25 into the holes 22, 23, and again fastens the inner cover member 18 using the bolt 18 to lock the headband rotary portion 15 and the arm rotary portion 8 via the lock pin 25 so that the headband rotary portion 15 and the arm rotary portion 8 are unrotatable.

[0136] In this state, the user can listen to music and the like with both of the right and left sound-emitting units 2 put on the right and left ears. However, the user often listens to sounds within a hall (e.g., venue) directly by one of the ears while the other of the ears is free from one of the right and left sound-emitting units 2 and the one of the right and left sound-emitting units 2 is rotated (pushed upward) in the front-back direction (forward or backward) like the sound-emitting unit 2 shown on the left side of Fig. 8.

[0137] For instance, when the DJ (user) performs an operation with one hand simultaneously holding one of the sound-emitting units 2 and one of the arms 4 or one of partial headbands 6a, in a conventional headphone, one of the sound-emitting units 2 is rotated in the front-back direction together with the arm 4 with respect to one of the partial headbands 6a to sometimes temporarily disturb the user to listen to music. However, since the rotary mechanism 5 connecting the arm 4 and the headband 6 of one of the sound-emitting units 2 is locked (fixed) by the lock pin 25, the rotational movement of the one of the sound-emitting units 2 in the front-back direction is prevented, so that the DJ (user) is prevented from missing music and the like.

[0138] Moreover, for instance, the headband 6 of the conventional headphone is likely to be unintentionally rotated in the front-back direction due to the force generated when the other of the sound-emitting units 2 is pushed upward. However, since the rotary mechanism 5 connecting the arm 4 and the headband 6 of one of the

sound-emitting units 2 is locked (fixed) by the lock pin 25, the rotational movement of the headband 6 is prevented, so that the DJ (user) can concentrate on the operation.

[0139] Further, in the conventional headphone, for instance, when the DJ (user) listens to music and the like with one hand pressing one of the sound-emitting units 2 on one of the ears, the headband 6 is likely to be unintentionally rotated in the front-back direction to drop off the head of the DJ. However, since the rotary mechanism 5 connecting the arm 4 and the headband 6 of one of the sound-emitting units 2 is locked (fixed) by the lock pin 25, even when the other hand is separated from the other of the sound-emitting units 2, the one of the sound-emitting units 2 can be kept being pressed on the one of the ears (i.e., the DJ (user) can keep listening to music and the like) using the headband 6 put on the head.

[0140] Furthermore, when a user other than the DJ listens to music motionlessly, with the arrangement that both of the right and left rotary mechanisms 5 of the headphone 1 are locked (fixed) by the lock pin 25, an unintentional rotational movement of each of the right and left sound-emitting units 2 with respect to the headband 6 and an unintentional rotational movement of the headband 6 with respect to each of the right and left sound-emitting units 2 can be prevented, so that the user can deeply appreciate music.

[0141] In order to freely rotate the right and left sound-emitting units 2 with respect to the headband 6 in the same manner as in the conventional headphone, it is only necessary to use the headphone 1 without inserting the head pin 25. It depends on the user (individual) which of the right and left sound-emitting units 2 is put on the ear or removed from the ear.

[0142] As described above, for instance, in a professional headphone such as a headphone for the DJ, a use of the headphone is not limited to a static use of motionlessly listening music with the right and left sound-emitting units 2 on the right and left ears. Examples of the use of the headphone 1 in a DJ site include the following.

[0143] In order that the user with the headphone 1 put on a first ear listens to surrounding sounds, the user fixes one of the sound-emitting units 2 to the first ear with a hand while pushing the other of the sound-emitting units 2 with the other hand, for instance, in a front-back direction to separate from a second ear.

Alternatively, while the headphone 1 is hung around a neck of the user, the user puts one of the sound-emitting units 2 on one ear.

Alternatively, while holding only one of the sound-emitting units 2 of the headphone 1, the user frequently puts the one of the sound-emitting units 2 on or off one ear. Alternatively, the user holds one of the sound-emitting units 2 of the headphone 1 placed down and puts the one of the sound-emitting units 2 onto one ear. Subsequently, the user immediately returns the headphone 1 to a state where the headphone 1 is placed down.

[0144] As described above, the headphone 1 is sometimes used extremely dynamically. Thus, a dynamic use of the headphone 1 such as a quick movement of the sound-emitting unit 2 of the headphone 1 and a frequent switch of putting the sound-emitting unit 2 on and off the ear can been seen.

[0145] Even when the headphone is dynamically used as described above with the headphone 1 of this Example, an unintentional rotational movement of one of the sound-emitting units 2 with respect to the headband 6 and an unintentional rotational movement of the headband 6 with respect to one of the sound-emitting units 2 can be reliably prevented. Moreover, according to a preference and needs of the user, the right or left rotary mechanism 5 or both of the right and left rotary mechanisms 5 are fixed by the controller 26 in a manner to be unrotatable. With this arrangement, the DJ can accurately perform the operation with concentration.

Example 2

[0146] In the headphone 1 in the above Example 1, the lock pin 25 and the holes22, 23 into which the lock pin 25 is to be inserted are used as the controller 26 for controlling the rotation of the arm 4. In Example 2, the structure of the controller other than the lock pin 25 and the holes22, 23 will be described.

[0147] As shown in Fig. 11 (a), a plunger 76 is used as the controller. The plunger 76 includes: a metallic sphere 73; a spring member (preferably a compression coil) 74 configured to bias the sphere 73; and a tubular casing 75 that houses the sphere 73 and the spring member 74 and configured to expose (project) about a half of the sphere 73 while the sphere 73 is kept biased by the spring member 74.

[0148] The arm rotary portion 8 of the arm 4 further includes a cross-sectionally semicircular recess 77 or a through-hole (not shown) into which the sphere 73 of the plunger 76 is to be fitted. The plunger 76 and the recess 77 or the through hole define the control portion 78. For instance, the plunger 76 is fixed in the hole 22 of the inner wall 12 of the headband rotary portion 15 while the recess 77 (optionally the hole 23 in Fig. 9) is provided in the arm rotary portion 8 of the arm 4. Alternatively, the plunger 76 is fixed in the hole 23 (Fig. 9) of the arm rotary portion 8 while the recess 77 (optionally the hole 22) is provided in the headband rotary portion 15. It is preferable to use the spring member 74 strong enough to avoid an easy rotation of the arm 4 in a state where the sphere 73 is fitted in the recess 77. In Fig. 11(a), a reference numeral 18 denotes the inner cover member and a reference numeral 19 denotes the outer cover member.

[0149] Alternatively, as shown in Fig. 11(b), the casing 75 (Fig. 11(a)) of the plunger 76 is not provided and the spring member 74 is housed, for instance, in a bottomed hole 79 provided on the arm rotary portion 8. Further, for instance, a pin member 80 longer than the sphere 73 is displaceably housed in the hole 79. A reference numeral 80a denotes a spring fixing portion. A through hole 81

into which the pin member 80 is inserted is provided on, for instance, the inner wall 12 of the headband rotary portion 15. Since the pin member 80 is insertible deeper into the through hole 81 or the recess than the sphere 73, a rotation preventive force of the rotary mechanism 5 is increased. With use of the through hole 81, locking between the through hole 81 and the pin member 80 can be easily released by inserting a jig stick or the like into the through hole 81 and pushing a distal end of the pin member 80 against a bias force of the spring member 79.

Example 3

[0150] As shown in Fig. 12, a bolt 82 is used as the controller in place of the lock pin 25 of Example 1. The bolt 82 is inserted through a bolt insertion hole 83 provided under the bolt insertion hole 32 at the center of the inner cover member 18 (Fig. 9). A male screw 82a (or a shaft) of the bolt 82 is inserted through the hole 22 of the inner wall 12 of the headband rotary portion 15 and the hole 23 of the arm rotary portion 8 in this order, and is screwed into a hole 22a of the outer wall 13 of the headband rotary portion 15. The hole 22a is smaller than the other holes 22, 23 in diameter. The hole 22a may be tapped in advance. Attachment and detachment of the bolt 82 can be easily conducted without removing the inner cover member 18 and the outer cover member 19.

Example 4

[0151] As shown in Fig. 13a, in place of the lock pin 25 and the like of Example 1, for instance, a slide member 84 shaped in a rectangular cylinder is used as the controller. The slide member 84 is attached to an upper portion 4c (Fig. 8) of the arm 4 or a lower portion 6a of the headband 6 and configured to be slidable in the top-bottom direction. The slide member 84 has a pair of front and back walls 84a that simultaneously cover (contact with) front and back surfaces 6c (Fig. 8) of the lower portion 6a of the headband 6 and front and back surfaces 4d (Fig. 8) of the upper portion of the arm 4. Since the arm 4 is extendable and an upward-projecting length of the arm 4 from the sound-emitting unit 2 (Fig. 8) is variable, the slide member 84 is preferably attached to the headband 6.

[0152] When the slide member 84 is slid to the headband rotary portion 15 and the arm rotary portion 8 as shown by an arrow, the pair of front and back walls 84a of the slide member 84 are brought into contact with the front and back surfaces 4d, 6c of the lower portion 6a of the headband 6 and the upper portion 4c of the arm 4, thereby avoiding (locking) the rotation of the rotary portions 8, 15. Since the slide member 84 is not removable from the arm 4 or the headband 6, it is unlikely that the user loses the slide member 84. In order to release the locking of the rotary portions 8, 15, the slide member 84 is displaced along the headband 6 and is preferably usable as a part of the headband 6.

Example 5

[0153] As shown in Fig. 13(b), a fitting member 84A is used as the controller. The fitting member 84A has a single wide slit 84c that is longitudinally provided at the center in the front-back direction of one of right and left (inner and outer) walls 84b of the slide member 84 shaped in a rectangular cylinder of Example 4 shown in Fig. 13(a) to provide an incompletely annular cross section of the fitting member 84A. Moreover, the fitting member 84A is slightly narrower than the slide member 84 in width in the front-back direction, so that the fitting member 84A is configured to be non-slidably fitted to the upper portion 4c of the arm 4 and the lower portion 6a of the headband 6. The fitting member 84A has a length enough to simultaneously cover the front and back surfaces 4d of the arm 4 and the front and back surfaces 6c of the lower portion 6a of the headband 6.

[0154] The fitting member 84A is opened by being bent forward and backward from the slit 84c as shown by arrows, and the headband rotary portion 15 and the arm rotary portion 8 in Fig. 13(a) are covered from the outside with the fitting member 84A, so that the front and back walls 84a of the fitting member 84A are simultaneously in contact with the front and back surfaces 4d, 6c of the upper portion 4c of the arm 4 and the lower portion 6a of the headband 6, thereby avoiding the rotation of the rotary portions 8, 15. In order to release the locking of the rotary portions 8, 15, the fitting member 84A is bent forward and backward from the slit 84c to be opened and removed from the rotary portions 8, 15. The fitting member 84A may be set to be substantially equal to the slide member 85 in width in the front-back direction and may be slid as the slide member to the headband 6 and kept thereon.

Example 6

[0155] The headphone 1 of Example 1 is in a type of a headphone in which the headband 6 is hung downward from an upper potion (top) of the head of the user. However, the headphone of Example 1 relates to a type of a headphone (ear-hanging type headphone) in which the headband 6 is put forward substantially horizontally from a back side of the head of the user to the ears (see, for instance, a headphone of Patent Literature 1).

[0156] For instance, as shown in the left side of Fig. 8, the sound-emitting unit 2 is rotated in a direction substantially orthogonal to the headband 6 (at or around 90 degrees) and, in this state, the lock pin 25 is inserted into the holes 22, 23 of the headband rotary portion 15 and the arm rotary portion 8 to lock the rotary portions 8, 15.

[0157] As shown in Fig. 9, in Example 1, the holes 22, 23 into which the lock pin is to be inserted are provided at the lower sides of the headband rotary portion 15 and the arm rotary portion 8. However, in Example 6, the holes 22, 23 into which the lock pin is to be inserted are provided at front sides and/or rear sides of the headband

rotary portion 15 and the arm rotary portion 8.

Example 7

[0158] As the controller of Example 6, for instance, the bolt 82 of Example 3 is usable in place of the lock pin 25. Moreover, as shown in Fig. 14, a fitting member 85 provided by bending the fitting member 84A of Example 5 into a substantially L-shape is usable as the controller of Example 6. The fitting member 85 includes: upper and lower walls 85a, 85b; front and back walls 85c, 85d; right and left (inner and outer) walls 85e; and a wide substantially L-shaped slit 85f provided on one of the right and left walls 85e. The upper and lower walls 85a, 85b of the fitting member 85 are brought into contact with the upper and lower surfaces 6c of the base 6a of the headband 6 and, simultaneously, the front and back walls 85c, 85d of the fitting member 85 are brought into contact with the front and back surfaces 4d of the upper portion 4c of the arm 4, thereby avoiding the rotation of the arm rotary portion 8 and the headband rotary portion 15.

Example 8

[0159] As shown in Fig. 15, the arm 4 is integrated (integrally resin-made) with the casing 3 of the sound-emitting unit 2 to be non-slidable. The arm 4 integrated with the sound-emitting unit 2 is rotatably connected to the headband 6 using the rotary mechanism 5. The hole 3d of the casing 3, which the arm penetrates, and the partial arm (denoted by the reference numeral 4a) projecting from the lower portion of the casing 3 as shown in Fig. 8 are not provided. The controllers of Examples 1 to 7 are applicable to the arm 4 of Example 8 (the controller of Example 1 is applied in Fig. 15).

Example 9

[0160] In Example 1, the headband rotary portion 15 has a pair of right and left (inner and outer) walls 12, 13 and the arm rotary portion 8 has a single wall to be inserted into the pair of walls 12, 13 of the headband rotary portion 15. However, in Example 9, as shown in Fig. 16, the arm rotary portion 8 has a pair of right and left (inner and outer) walls 86, 87 and the headband rotary portion 15 has a single wall to be inserted into the pair of walls 86, 87 of the arm rotary portion 8.

[0161] The holes 22, 23 into which the lock pin is to be inserted are provided on the pair of walls 86, 87 of the arm rotary portion 8 and the headband rotary portion 15. The holes 20, 21 in which the shaft 29 of the outer cover member 19 is inserted are provided at the center of each of the pair of walls 86, 87 of the arm rotary portion 8 and the headband rotary portion 15. The holes 22, 23 into which the lock pin is to be inserted are provided closer to a base 15a of the headband rotary portion 15 than the holes 20, 21 for the shaft insertion.

EXPLANATION OF CODE(S)

[0162]

1	headphone
2	sound-emitting unit
3	casing
4	arm
5	rotary mechanism
6	headband
7	ear pad
8	arm rotary portion
8b	base
15	headband rotary portion
18	inner cover member (cover member)
19	outer cover member (cover member)
20, 21	hole
22	hole (first hole)
23	hole (second hole)
24	sound-emitting-unit-side connector
25	lock pin
26	controller
29	shaft
30	hole
31	bolt (fixing member)
43	cable unit
44, 45	cable
46	cable-side connector
48	speaker
49	diaphragm
50	wall
56	groove
57	block
59	recess
64	cushion member

Claims

1. A headphone comprising:

a sound-emitting unit housing a speaker comprising a diaphragm; and
a cable unit configured to transmit an electric signal to the speaker, wherein
the cable unit detachable from the sound-emitting unit is inserted in the sound-emitting unit from a bottom of the sound-emitting unit, disposed radially outside relative to the diaphragm in a sound radiation direction of the diaphragm inside the sound-emitting unit, and pulled from a top of the sound-emitting unit to an outside of the sound-emitting unit.

2. The headphone according to claim 1, further comprising:

a sound-emitting-unit-side connector provided

on the top of the sound-emitting unit and electrically connected to the speaker; and
a cable-side connector provided at an end of the cable unit pulled out from the top of the sound-emitting unit and electrically connected to the sound-emitting-unit-side connector.

3. The headphone according to claim 2, further comprising:

an arm connecting the sound-emitting unit to the headband, wherein
the sound-emitting-unit-side connector and the cable-side connector connected to the sound-emitting-unit-side connector are disposed at an inner side than the arm with respect to a user with the sound-emitting unit attached to his/her ears.

4. The headphone according to claim 3, wherein
the sound-emitting-unit-side connector and the cable-side connector connected to the sound-emitting-unit-side connector are disposed at a more rear side than the arm.

5. The headphone according to claim 1, wherein
the cable unit pulled out from the top of the sound-emitting unit is disposed at an inner side than the arm with respect to a user with the sound-emitting unit attached to his/her ears.

6. The headphone according to claim 1, wherein
the sound-emitting unit comprises a groove in which the cable unit is disposed.

7. The headphone according to claim 6, wherein
the cable unit comprises a plurality of cables,
the plurality of cables are juxtaposed in the groove in a depth direction of the groove, and
a first cable of the plurality of cables is disposed close to the speaker in the groove and a second cable of the plurality of cables is disposed remote from the speaker in the groove.

8. The headphone according to claim 6, wherein
the groove is covered with a cushion member.

9. The headphone according to claim 6, wherein
the cable unit comprises a block, and
the block is screwed into a recess continuous to the groove in the sound-emitting unit to be fixed.

10. The headphone according to claim 6, wherein
the sound-emitting unit comprises a casing and an ear pad detachable from the casing, wherein
the groove is provided on a wall to be exposed near the casing when the ear pad is removed.

11. A headphone comprising:

an arm connecting a sound-emitting unit to a headband;
a rotary mechanism configured to rotate the arm with respect to the headband in a radial direction of the sound-emitting unit; and
a controller provided to the rotary mechanism and configured to avoid the arm from being rotated.

12. The headphone according to claim 11, wherein
the sound-emitting unit comprises a pair of right and left sound-emitting units, the arm comprises a pair of right and left arms,
the rotary mechanism comprises a pair of right and left rotary mechanisms, and the controller comprises a pair of right and left controllers.

13. The headphone according to claim 11, wherein
the rotary mechanism comprises: a headband rotary portion provided to the headband; an arm rotary portion provided to the arm; a rotary shaft disposed in common in the headband rotary portion and the arm rotary portion, and
the arm rotary portion is rotated around the shaft with respect to the headband rotary portion to rotate the arm with respect to the headband.

14. The headphone according to claim 13, wherein
each of the arm rotary portion and the headband rotary portion comprises a hole in which the shaft is inserted, and
the shaft comprises a hole in which a fixing member is inserted.

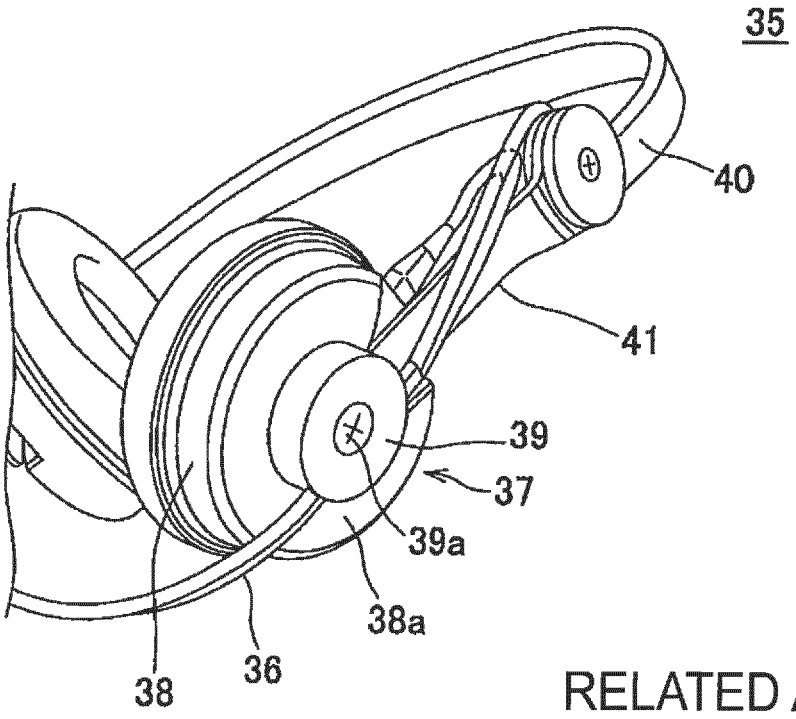
15. The headphone according to claim 13, wherein
the controller comprises: a first hole provided on the headband rotary portion; a second hole provided on the arm rotary portion; and a lock pin to be inserted into the first and second holes.

16. The headphone according to claim 15, wherein
the first and second holes are disposed closer to a base of the arm rotary portion than the shaft.

17. The headphone according to claim 11, wherein
the rotary mechanism comprises a cover member covering the controller.

18. The headphone according to claim 17, further comprising: a fixing member for attaching the cover member to the rotary mechanism.

FIG. 1



RELATED ART

FIG. 2

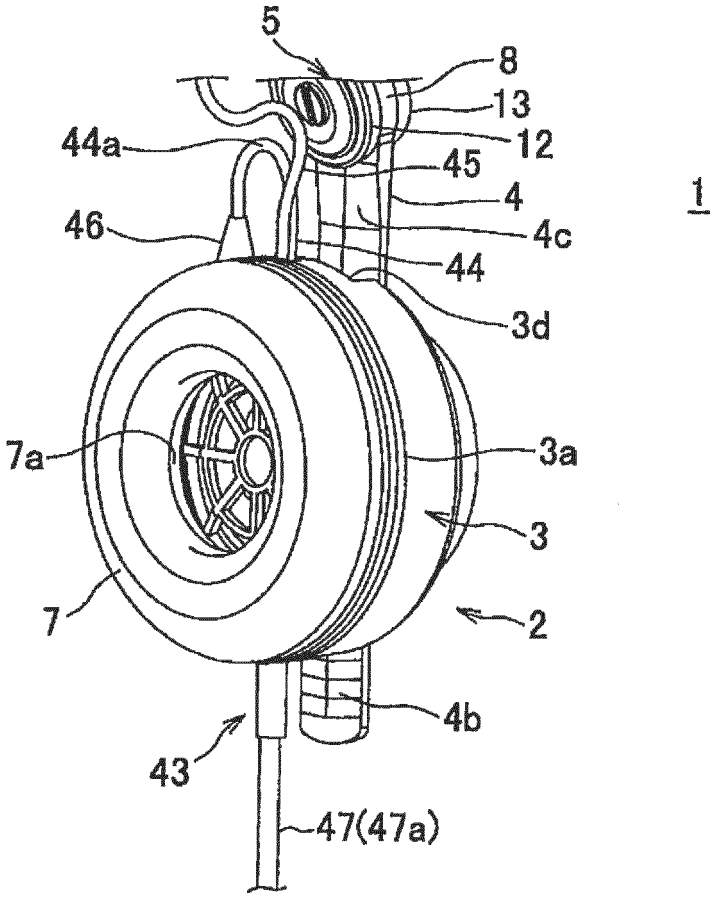
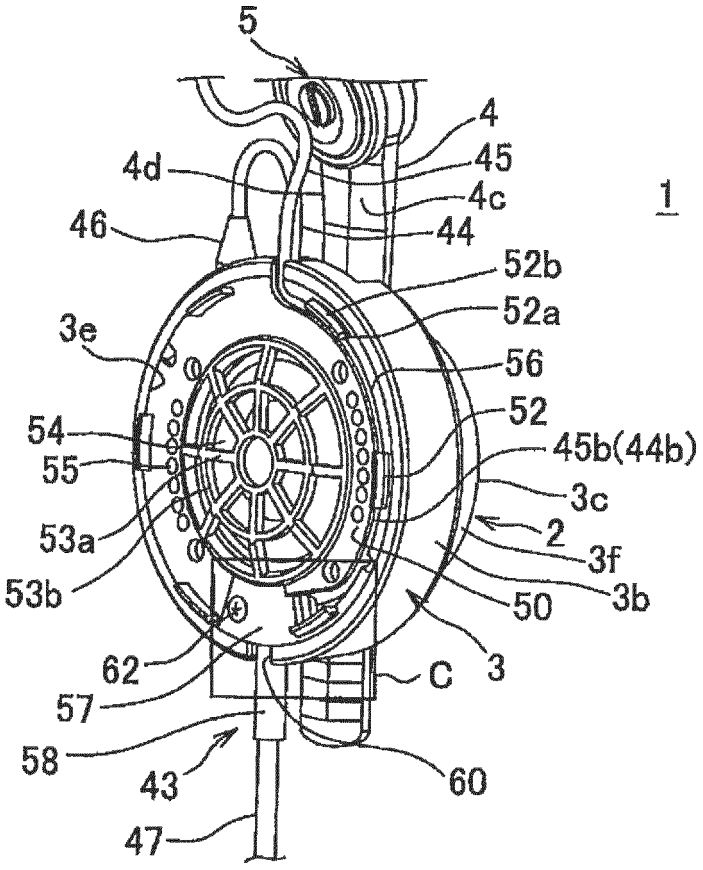


FIG. 3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4
45
4d
4c
1
46
44
52b
52a
3e
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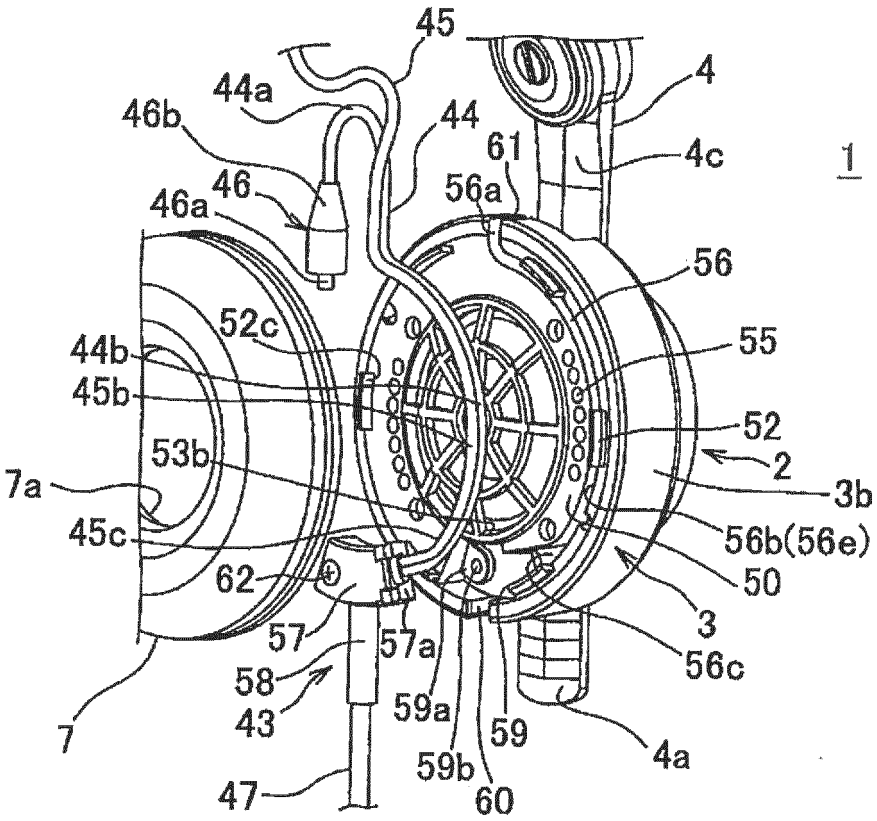
52
54
45b(44b)
55
3c
2
53a
3f
53b
50
3b
62
C
3
57
58
43
60
47

FIG. 4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56a
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52c
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3b
7a
45c
56b(56e)
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43
59
4a
7
59b
60
47

FIG. 5

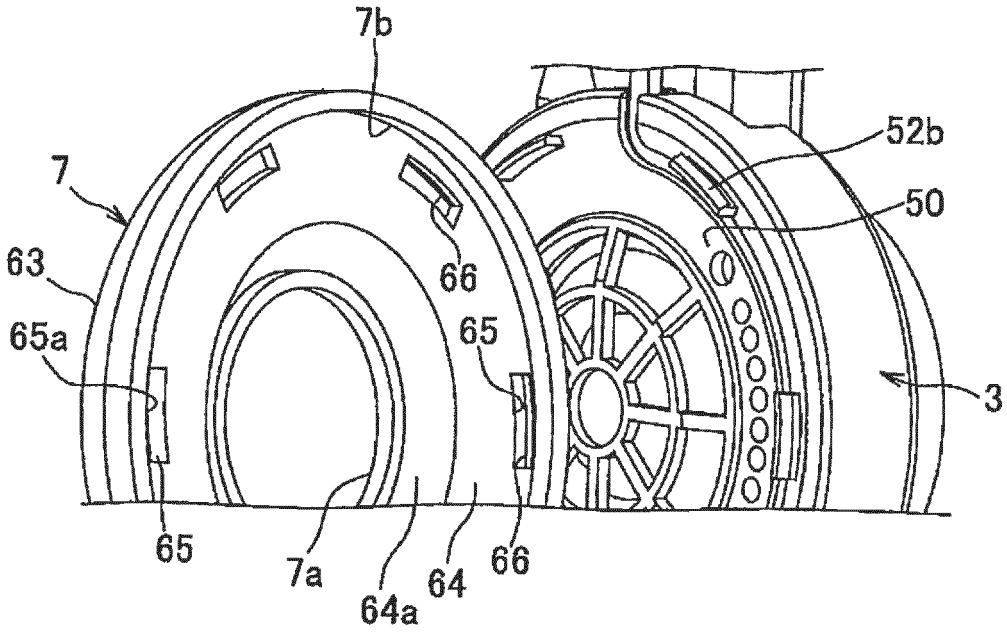


FIG. 6

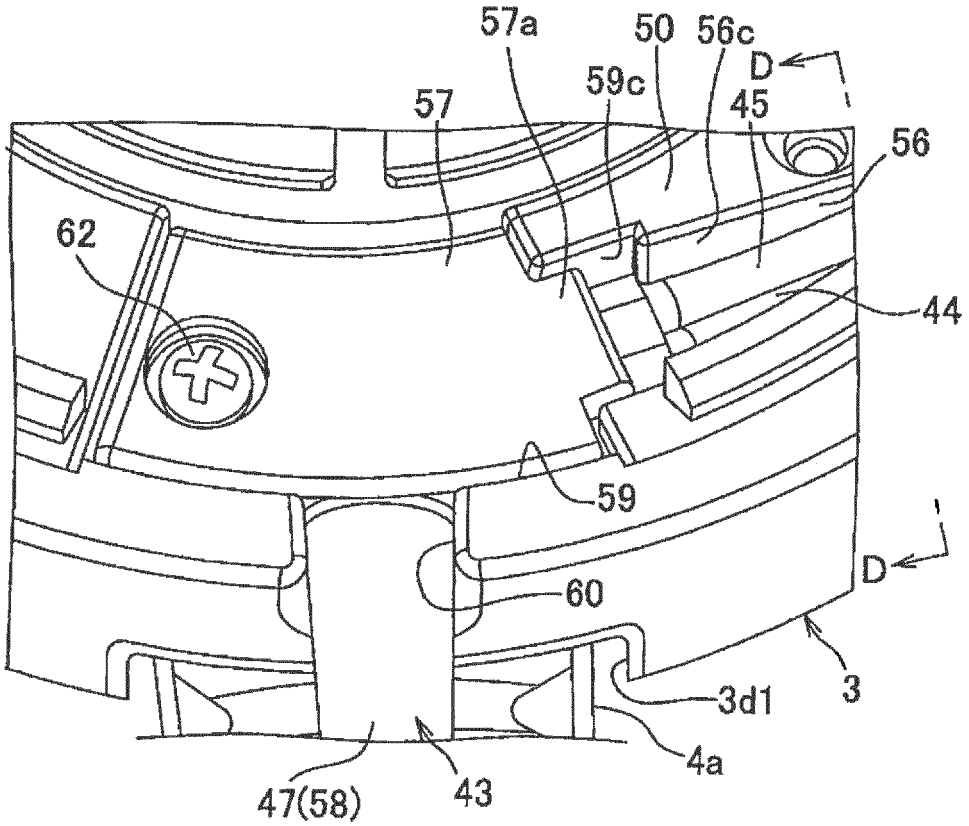
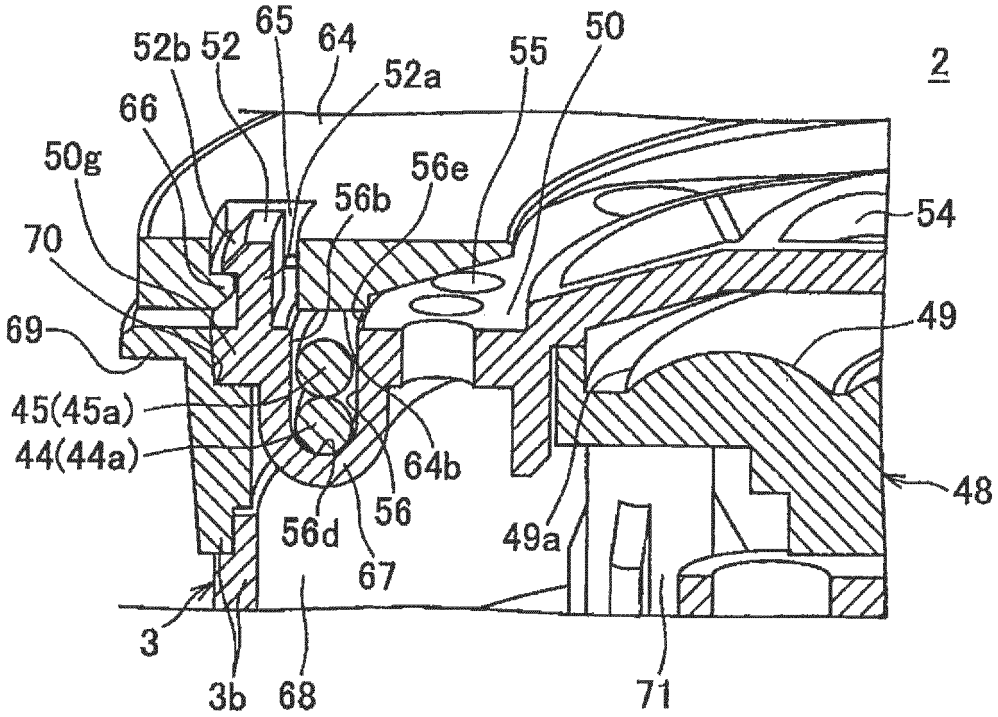


FIG. 7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64
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52a
55
50
2
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50g
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56b
54
70
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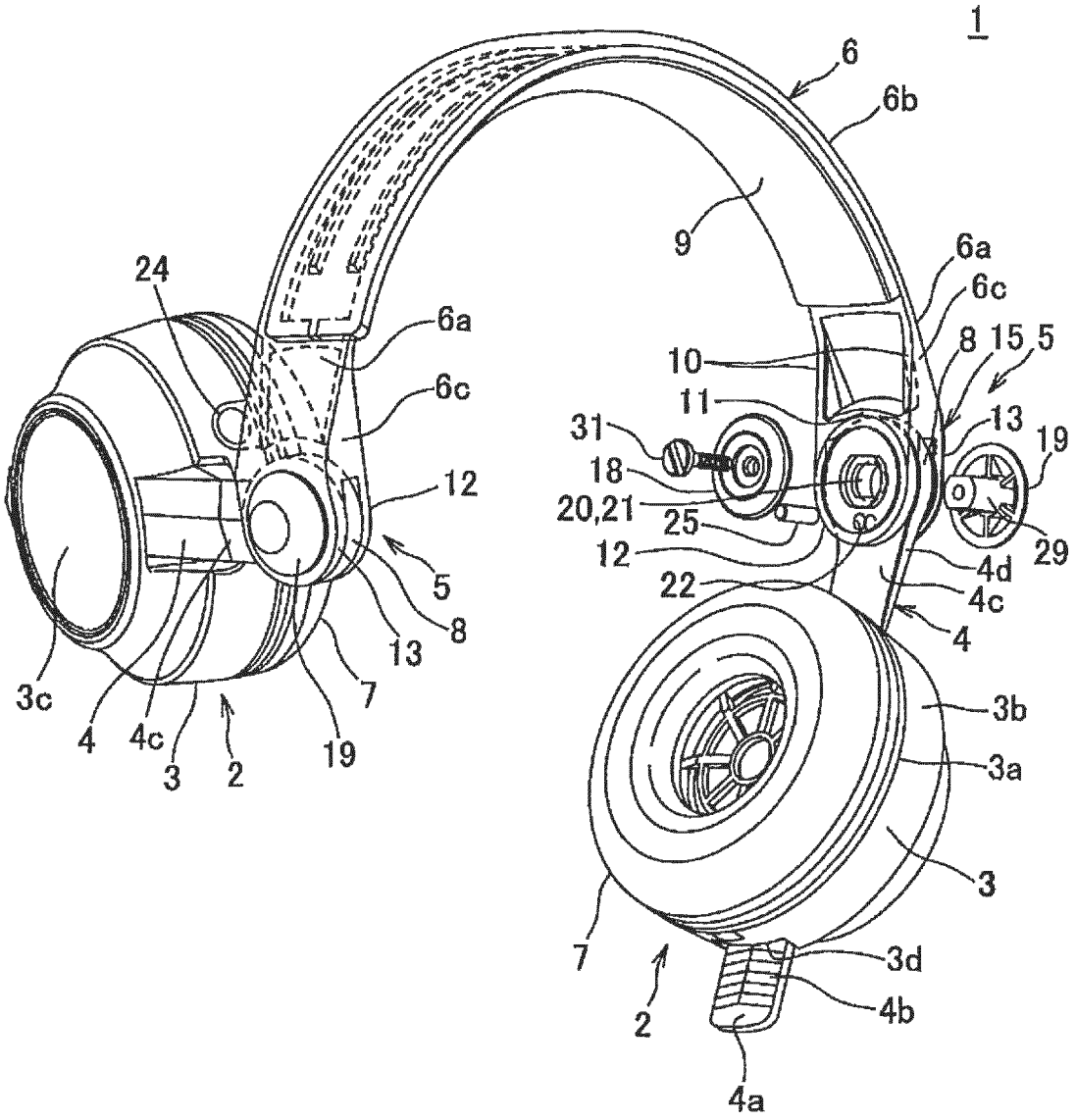
56d
49a
67
3
3b
68
71

FIG. 8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6c
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29
4d
4c
4
22
3b
3a
3
7
3d
4b
2
4a
24
6a
6c
12
5
8
13
7
19
3c
4
4c
3
2

FIG. 9

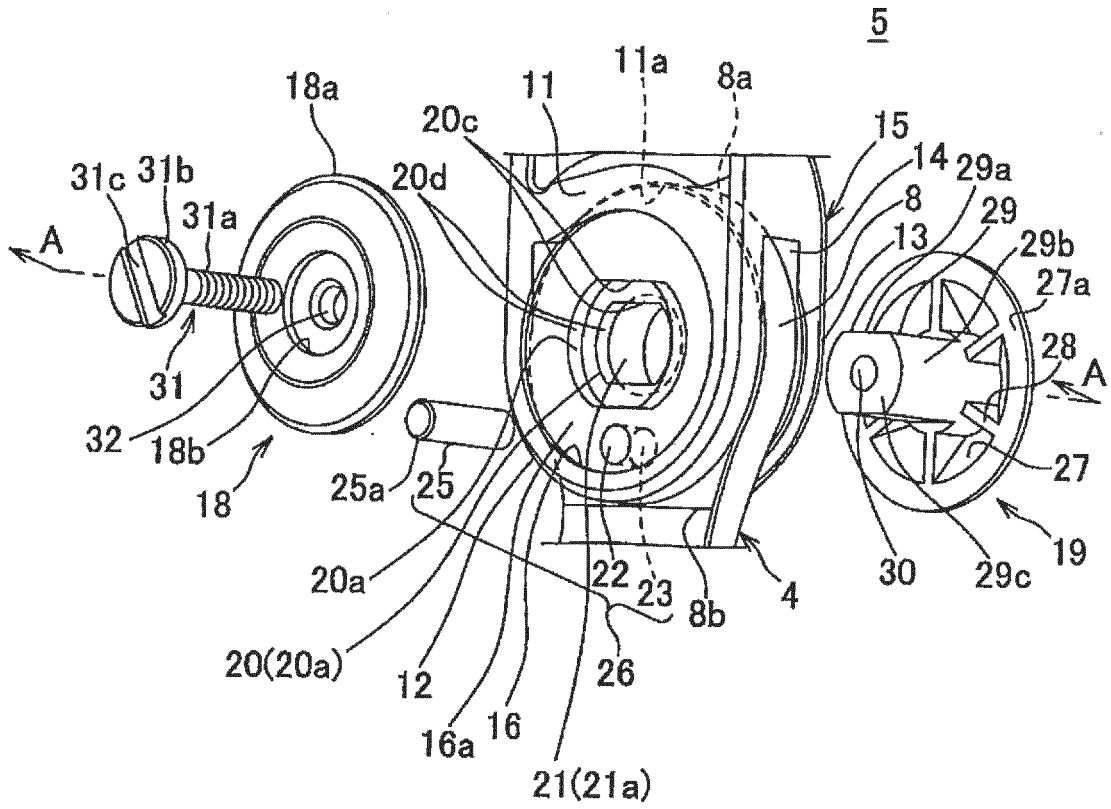

5
11a
8a
18a
11
20c
15
14
29a
31c
31b
20d
8
29
31a
13
29b
A
27a
28
A
31
32
18b
18
25a
25
27
19
20a
22
23
8b
4
30
29c
20(20a)
12
26
16a
16
21(21a)

FIG.10

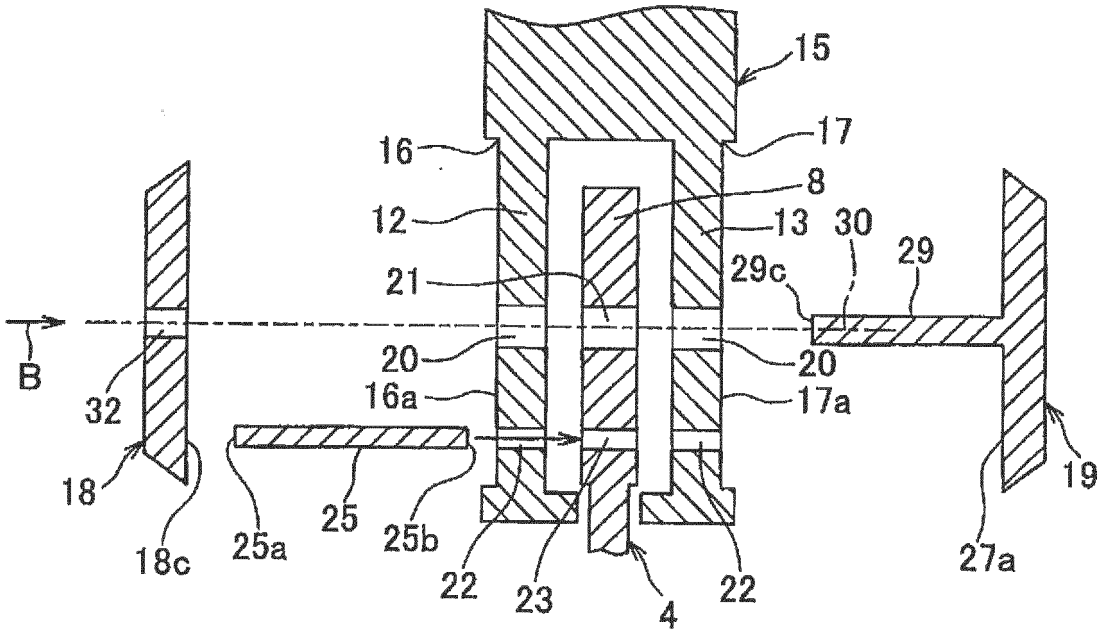
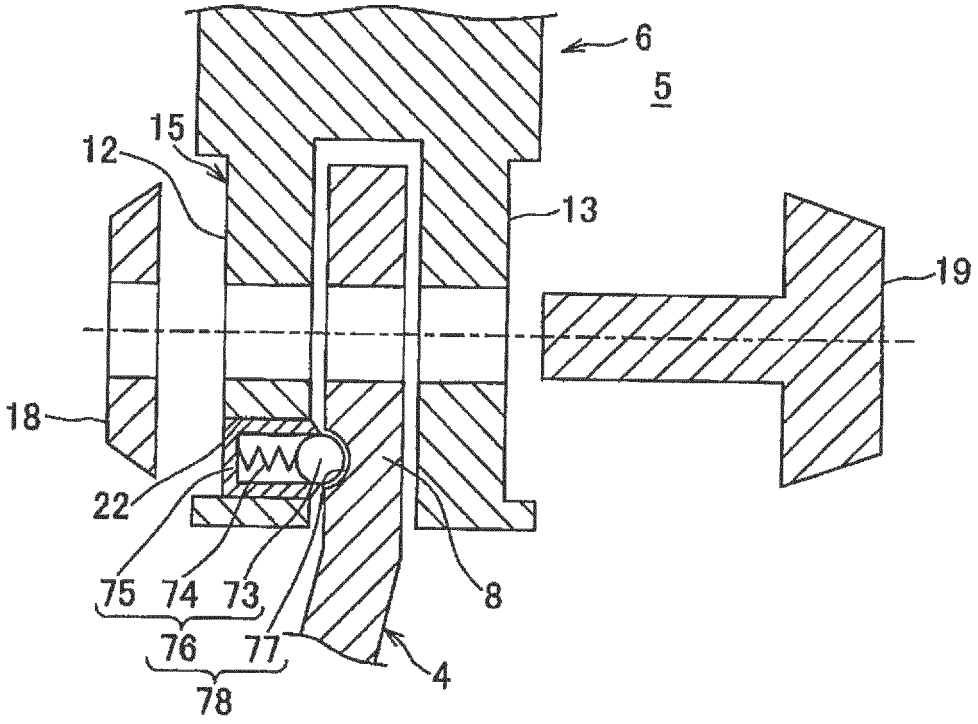

15
16
17
8
12
13
30
29
29c
21
B
20
20
16a
17a
32
18
25a
25
25b
19
18c
22
23
4
22
27a

FIG. 11

(a)



(b)

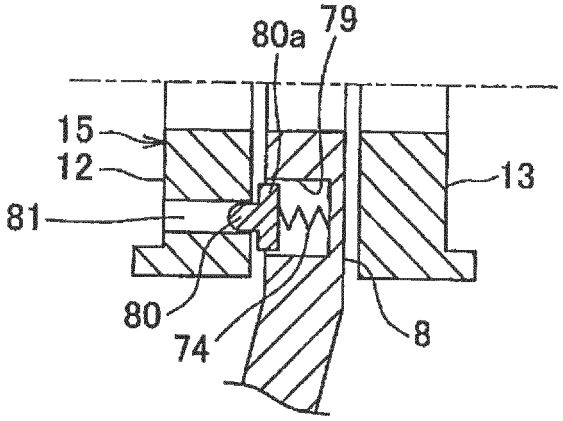


FIG. 12

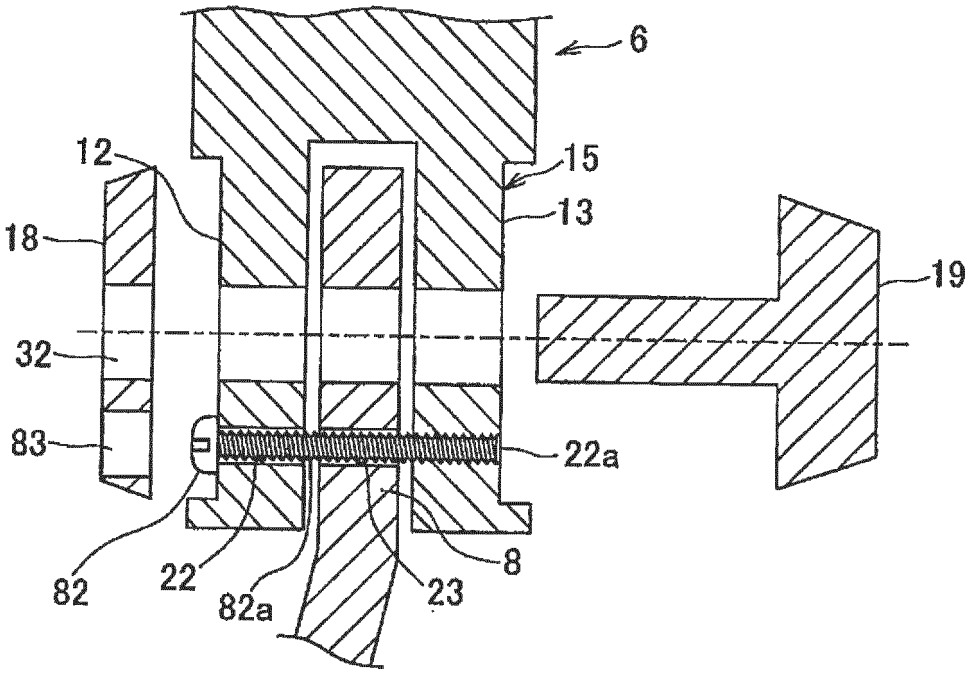


FIG. 13

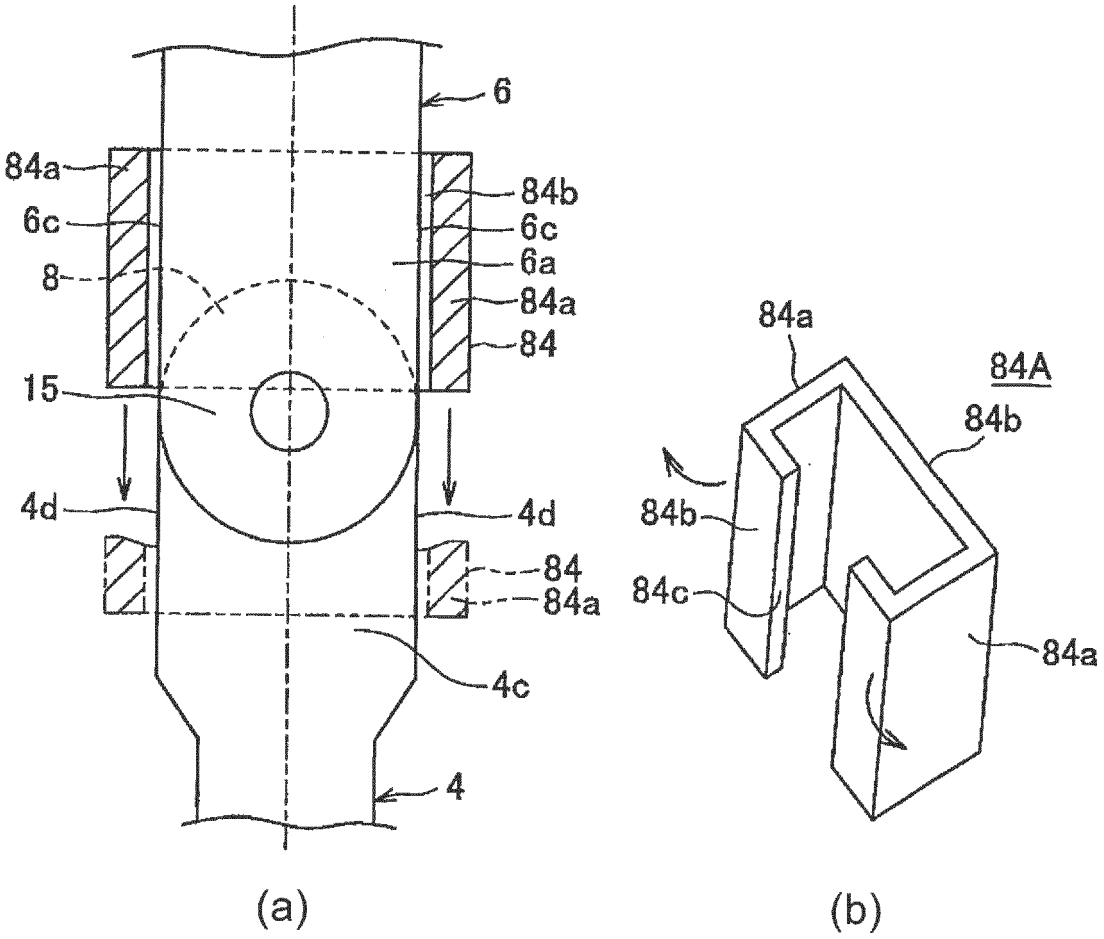

6
84a
84b
6c
6c
8
6a
84a
84
15
4d
4d
84
84a
4c
4
(a)
84a
84A
84b
84b
84c
84a
(b)

FIG. 14

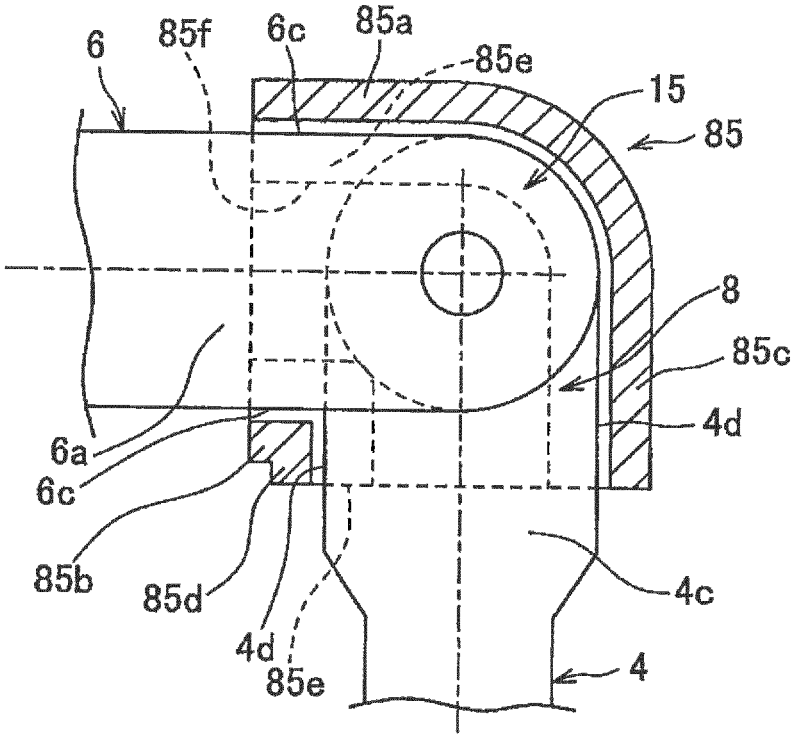


FIG. 15

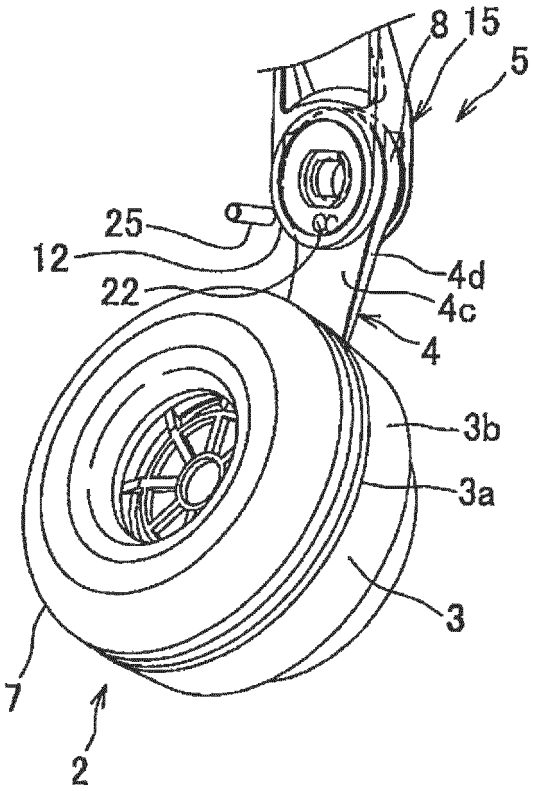
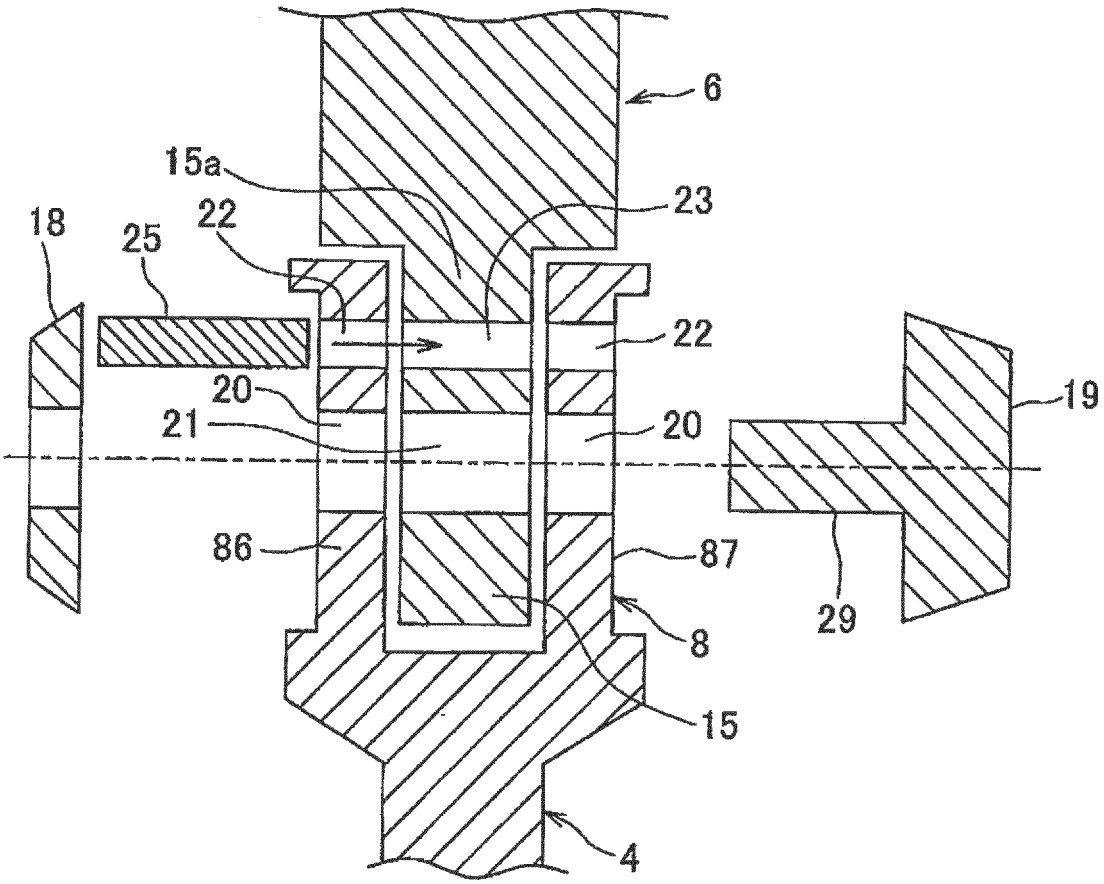


FIG. 16



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/059363

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

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04R1/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014
Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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 Y A	WO 2013/125355 A1 (MK Electronic Co., Ltd.), 29 August 2013 (29.08.2013), paragraphs [0040] to [0054]; fig. 1 to 3, 9 to 11 (Family: none)	11-13,17,18 14 1-10,15,16
X	JP 2000-125386 A (Sony Corp.), 28 April 2000 (28.04.2000), paragraph [0031]; fig. 7 & US 006385325 B1 & EP 000994636 A2 & DE 069943195 D & AU 005258499 A & ID 000025951 A & CA 002284341 A & KR 10-2000-0028892 A & CN 001255819 A	11-13

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

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16 June, 2014 (16.06.14)	24 June, 2014 (24.06.14)
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	JP 05-308694 A (Sony Corp.), 19 November 1993 (19.11.1993), paragraphs [0031] to [0034]; fig. 11 to 12 (Family: none)	14
A	JP 2005-287018 A (Bose Corp.), 13 October 2005 (13.10.2005), entire text; all drawings & US 2005/0213774 A1 & EP 001587342 A3 & CN 001678130 A	1-18
A	JP 2011-055177 A (Ashida Sound Co., Ltd.), 17 March 2011 (17.03.2011), entire text; all drawings (Family: none)	1-18
A	JP 3023116 U (Nobel Co., Ltd.), 12 April 1996 (12.04.1996), entire text; all drawings (Family: none)	1-18
A	JP 2009-538030 A (KIM, Sung-Ho), 29 October 2009 (29.10.2009), entire text; all drawings & US 2009/0185699 A1 & WO 2007/133055 A1 & KR 10-0730737 B1	1-18

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- JP 2005295461 A **[0007]**
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