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(54) **SPEAKER DEVICE**

(57) A speaker device includes: a speaker configured to output sound by causing a diaphragm to vibrate; and a facing member disposed to face the speaker in front of the speaker in a sound generation direction of the diaphragm, the facing member includes a frame-shaped outer frame portion and one or more bridge portions bridged inside the outer frame portion,

the outer frame portion and the bridge portions form a plurality of opening portions penetrating through the facing member along the sound generation direction, and when the facing member is viewed along the sound generation direction, at least portions of opening edges of the opening portions formed by the bridge portions have curved shapes.

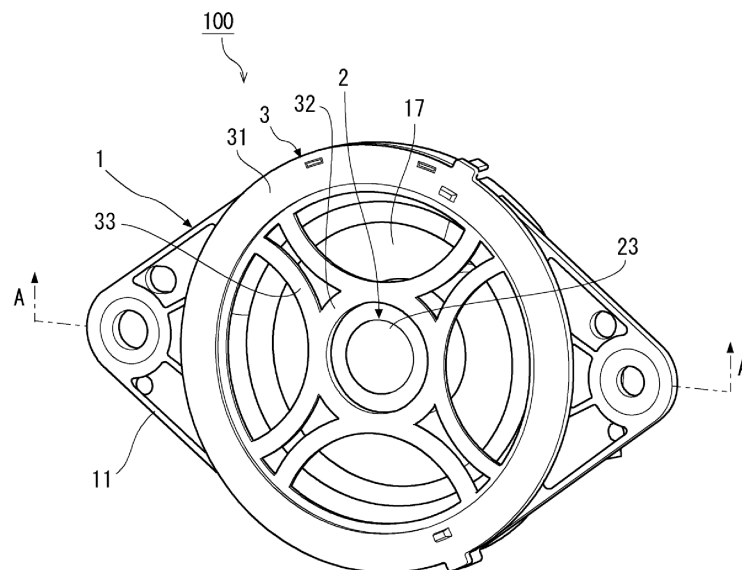


Fig. 1

Description**[Means for Solving the Problems]**

[Technical Field]

[0001] The present invention relates to a speaker device.

[Background Art]

[0002] In the related art, a speaker device including a speaker that generates sound by causing a diaphragm to vibrate is known. In this regard, Patent Document 1 discloses a speaker device in which a plurality of cover portions are disposed in front of a speaker in a sound generation direction and dimensions of widths formed between front and rear cover portions are non-uniform. Similarly, a coaxial speaker device in which two speakers with different diameters are disposed to be aligned in a sound generation direction is known as another example of a speaker device in which structures (components) are disposed in front of the speakers in the sound generation direction. In the coaxial speaker device, a tweeter which is a speaker for replaying high sound with a smaller diameter than a woofer which is a speaker for replaying low sound is disposed in front of the woofer, and the tweeter is supported by a support member made of a resin, for example.

[Citation List]

[Patent Document]

[0003] [Patent Document 1] Japanese Patent Laid-Open No. 2020-96214

[Summary of the Invention]

[Problems to Be Solved by the Invention]

[0004] In the aforementioned speaker device, the structures disposed in front of the speakers are obstacles of sound, and opening portions to cause sound emitted from the speakers to pass forward in the sound generation direction are thus typically formed in the structures. However, there is a concern that once sound is generated from the speakers, large peaks and dips may be generated at a specific frequency by diffracted waves diffracted by edges of the opening portions interfering with straight waves passing through the opening portions and sound quality of the speakers may be degraded.

[0005] The present invention was made in order to solve such a problem, and an object thereof is to provide a technology capable of curbing generation of peaks and dips in a speaker device.

[0006] In order to solve the above problem, the present invention adopts the following means.

[0007] In other words, the present invention provides a speaker device including: a speaker including a diaphragm and configured to output sound by causing the diaphragm to vibrate; and a facing member disposed to face the speaker in front of the speaker in a sound generation direction of the speaker. The facing member includes a frame-shaped outer frame portion and one or more bridge portions bridged inside the outer frame portion, and the outer frame portion and the bridge portions form a plurality of opening portions penetrating through the facing member along the sound generation direction. When the facing member is viewed along the sound generation direction, at least portions of opening edges of the opening portions formed by the bridge portions have curved shapes.

[Effects of the Invention]

[0008] According to the present invention, it is possible to disperse timings and wavelengths at which diffracted waves diffracted by opening edges with a curve shape and straight waves passing through opening portions interfere with each other by forming at least portions of opening edges formed by bridge portions in curved shapes. As a result, it is possible to curb generation of peaks and dips.

[Brief Description of the Drawings]

[0009]

[Fig. 1] Fig. 1 is an overall perspective view of a speaker device according to an embodiment.

[Fig. 2] Fig. 2 is a sectional view along A-A in Fig. 1.

[Fig. 3] Fig. 3 is a plan view of a support member according to the embodiment.

[Fig. 4] Fig. 4 is a sectional view of a bridge portion according to the embodiment.

[Fig. 5] Fig. 5 is a diagram for schematically explaining sound interference in the speaker device according to the embodiment.

[Fig. 6] Fig. 6 is a diagram for schematically explaining sound interference in a speaker device according to a comparative example.

[Fig. 7] Fig. 7 is a plan view of a support member according to a first modification.

[Fig. 8] Fig. 8 is a plan view of a support member according to a second modification.

[Fig. 9] Fig. 9 is a plan view of a support member according to a third modification.

[Fig. 10] Fig. 10 is a plan view of a support member according to a fourth modification.

[Fig. 11] Fig. 11 is a plan view of a support member

according to a fifth modification.

[Mode for Carrying Out the Invention]

[0010] Hereinafter, an aspect in which the present invention is applied to a speaker device with a plurality of speakers disposed to be aligned in a sound generation direction will be described with reference to the drawings as an exemplary embodiment of the present invention. However, the embodiment described below is an illustrative example for implementing the present invention, and the present invention is not limited to the aspect described below. The speaker device according to the present invention may include two or more speakers or may include only one speaker. Also, the type of speakers according to the present invention is not particularly limited, and speakers of various sound generation schemes such as a cone-type speaker, a dome-type speaker, and a horn-type speaker can be adopted.

[Overall Configuration]

[0011] Fig. 1 is an overall perspective view of a speaker device 100 according to an embodiment. Fig. 2 is a sectional view along A-A in Fig. 1. Hereinafter, a direction in which sound is output from a woofer 1, which is a speaker denoted by a reference sign 1, will be referred to as a "sound generation direction" and is indicated by arrows in Fig. 2 and the like. The sound generation direction coincides with a direction (axial direction) in which an axis of the woofer 1 extends. Also, a direction moving to the same side as the sound generation direction will be referred to as "forward (front side)", while a direction moving to the side opposite to the sound generation direction will be referred to as "backward (rear side)". Fig. 2 illustrates a section along the sound generation direction.

[0012] A speaker device 100 according to the present embodiment is configured as a so-called coaxial speaker in which a plurality of (two in this example) speakers with different diameters are disposed in the sound generation direction. Specifically, the speaker device 100 includes the woofer (an example of a "speaker" and a "first speaker" according to the present invention) 1 which is a speaker with a large diameter that outputs sound from a low range to a high range and a tweeter (an example of a "second speaker" according to the present invention) 2 which is a speaker with a small diameter that is disposed to be aligned with the woofer 1 in the sound generation direction of the woofer 1 and outputs sound in the high range, as illustrated in Figs. 1 and 2. The tweeter 2 has a smaller diameter than the woofer 1 and is disposed in front of the woofer 1 in the sound generation direction. In the speaker device 100, an axis CL1 of the woofer 1 and an axis CL2 of the tweeter 2 extend along the sound generation direction, and the axis CL1 and the axis CL2

coincide with each other. In other words, the woofer 1 and the tweeter 2 are coaxially disposed in the present embodiment. However, the present invention is not limited thereto, and it is not essential that the first speaker and the second speaker be coaxially disposed. The speaker device 100 further includes a support member 3 that supports the tweeter 2. The speaker device 100 is incorporated in a dashboard or the like as an in-vehicle speaker mounted in a vehicle, for example. However, applications of the speaker device according to the present invention are not particularly limited. Hereinafter, each component of the speaker device 100 will be described.

[Woofer]

[0013] The woofer 1 is configured as a so-called cone-type speaker using a conical diaphragm 17. As illustrated in Fig. 2, the woofer 1 has a frame 11, a yoke 12, a plate 13, a magnet 14, a voice coil 15, a damper 16, the diaphragm 17, a center cap 18, an audio signal input terminal, which is not illustrated, and the like. The woofer 1 causes sound to be generated by causing a magnetic field generated by a magnetic circuit 10 including the magnet 14 to act on the voice coil 15 and causing the diaphragm 17 to vibrate back and forth in the sound generation direction.

[0014] The frame 11 includes a tubular portion 111 expanding on the front side in a multi-step tapered shape and a bottom portion 112 that closes a rear end portion of the tubular portion 111. A through-hole 112a is formed at the center of the bottom portion 112. Note that an opening portion for releasing backward the air pushed out when the diaphragm 17 and the like vibrate may be formed in the frame 11. The opening portion may be formed in the tubular portion 111, for example. The yoke 12 is a member formed of a magnetic material and is disposed behind the frame 11. The yoke 12 has a columnar center pole 121 extending along the sound generation direction and a disk-shaped base portion 122 projecting outward in the radial direction from the rear end portion of the center pole 121. The plate 13 is an annular member formed of a magnetic material and is fixed to the bottom portion 112 of the frame 11. The center pole 121 is inserted into the plate 13 with a gap formed between itself and the plate 13. The magnet 14 is formed into an annular shape and is disposed between the plate 13 and a base portion 122 of the yoke 12. The center pole 121 is inserted into the magnet 14. The yoke 12, the plate 13, and the magnet 14 constitute the magnetic circuit 10. The voice coil 15 extends to follow the sound generation direction. The rear end portion of the voice coil 15 is inserted into the gap between the center pole 121 and the plate 13, while the front end portion thereof is inserted to the inside of the frame 11 via the through-hole 112a. A magnetic field generated by the magnetic circuit 10 acts on the voice coil 15. The damper 16 is an elastic

member with a corrugated section and couples the voice coil 15 and the tubular portion 111. The diaphragm 17 is a cone-shaped (conical tubular) member with a diameter increasing toward the front side and generates sound by vibrating together with the voice coil 15. The diaphragm 17 is disposed inside the frame 11. The rear end portion of the diaphragm 17 is coupled to the front end portion of the voice coil 15, and the front end portion of the diaphragm 17 is coupled to the front end portion of the tubular portion 111. The center cap 18 is formed in a dome shape projecting forward and closes an opening at the front end of the voice coil 15.

[0015] If a voice current is applied to the voice coil 15, then a drive force acts on the voice coil 15 due to an electromagnetic force excited by the magnetic field caused to act on the voice coil 15 by the magnetic circuit 10 and the voice current. The voice coil 15 on which the drive force acts vibrates back and forth in the sound generation direction along with the diaphragm 17 due to elastic deformation of the damper 16. In this manner, a sound pressure is output (released) forward in the sound generation direction from the diaphragm 17, and the woofer 1 generates sound.

[Tweeter]

[0016] The tweeter 2 is configured as a so-called dome-type speaker using a dome-shaped diaphragm 23 protruding forward. As illustrated in Fig. 2, the tweeter 2 includes a magnetic circuit 21 including a magnet, a voice coil 22 on which a magnetic field generated by the magnetic circuit 21 acts, a diaphragm 23 that generates sound in a high range by vibrating together with the voice coil 22, an audio signal input terminal, which is not illustrated, and the like. The tweeter 2 is supported by the support member 3 and is disposed in front of the woofer 1 and at the position at which the tweeter 2 faces the opening at the center portion of the diaphragm 17. The tweeter 2 generates sound by causing a magnetic field generated by the magnetic circuit 21 to act on the voice coil 22 and causing the diaphragm 23 to vibrate back and forth in the sound generation direction similarly to the woofer 1.

[Support Member]

[0017] The support member 3 is a member that is disposed to face the woofer 1 in front of the woofer 1 in the sound generation direction of the woofer 1 and supports the tweeter 2. The support member 3 is an example of a "facing member" according to the present invention. Fig. 3 is a plan view of the support member 3 according to the embodiment. Specifically, Fig. 3 illustrates a state where the support member 3 is seen from the front side along the sound generation direction. As illustrated in Fig. 3, the support member 3 includes a frame-shaped outer frame portion 31, a holding portion

32 that holds the tweeter 2, and a plurality of bridge portions 33 bridged inside the outer frame portion 31 and is formed by these components being integrated. The support member 3 is formed of a resin material, for example. However, the material of the facing member according to the present invention is not particularly limited. Note that although the support member 3 according to the present embodiment is formed by the outer frame portion 31, the holding portion 32, and the bridge portions 33 being integrated, these components of the support member according to the present invention may be configured as separate elements.

[0018] As illustrated in Fig. 3, the outer frame portion 31 is formed in an annular shape and constitutes an outer frame of the support member 3. The support member 3 is disposed in a direction such that the center axis direction of the outer frame portion 31 coincides with the sound generation direction of the woofer 1. The reference sign 311 in Fig. 3 denotes the inner circumferential surface of the outer frame portion 31. The inner circumferential surface 311 is formed as a curved surface with an arc shape in a view in the sound generation direction. As illustrated in Fig. 2, the outer frame portion 31 is fixed to the front end portion of the frame 11 in the woofer 1. Note that the shape of the outer frame portion 31 is not limited to the annular shape.

[0019] As illustrated in Fig. 3, the holding portion 32 is formed in an annular shape with a smaller diameter than the outer frame portion 31 and is disposed inside the outer frame portion 31. The holding portion 32 is disposed at the center of the outer frame portion 31. The reference sign 321 in Fig. 3 denotes the outer circumferential surface of the holding portion 32. The outer circumferential surface 321 is formed as a curved surface with an arc shape in a view in the sound generation direction. As illustrated in Fig. 2, the tweeter 2 is attached to the inside of the holding portion 32. The tweeter 2 is fixed to the holding portion 32 with an arbitrary means (screwing, crimping, or the like). In this manner, the holding portion 32 holds the tweeter 2 in front of the woofer 1. Note that the shape of the holding portion 32 is not limited to the annular shape.

[0020] As illustrated in Fig. 3, the plurality of bridge portions 33 couple the outer frame portion 31 to the holding portion 32. The bridge portions 33 extend in an arc shape protruding to the inside of the outer frame portion 31 in a view in the sound generation direction. In the extending direction of the bridge portions 33, both end portions of the bridge portions 33 are connected to the outer frame portion 31, and the intermediate portions of the bridge portions 33 are connected to the holding portion 32. In the present embodiment, four bridge portions 33 are disposed at equal intervals in the circumferential direction of the outer frame portion 31. However, the shape and the number of bridge portions 33 are not limited thereto. The bridge portions 33 may extend in an arc shape protruding to the outside of the outer frame portion 31, for example. The reference sign

331 in Fig. 3 denotes the inner circumferential surfaces of the bridge portions 33, and the reference sign 332 denotes the outer circumferential surfaces of the bridge portions 33. The inner circumferential surfaces 331 and the outer circumferential surfaces 332 constitute both side surfaces of the bridge portions 33 and are formed in curved surfaces with an arc shape in a view in the sound generation direction.

[0021] Here, Fig. 4 is a sectional view of each bridge portion 33 according to the embodiment. Fig. 4 illustrates a section perpendicularly intersecting the extending direction of the bridge portion 33. Here, the direction of the bridge portion 33 perpendicularly intersecting the extending direction of the bridge portion 33 and the sound generation direction of the woofer 1 (that is, the front-back direction) will be referred to as a width direction of the bridge portion 33. The reference sign 333 in Fig. 4 denotes the front surface of the bridge portion 33 in the sound generation direction, and the reference sign 334 denotes the rear surface of the bridge portion 33 in the sound generation direction. The front surface 333 and the rear surface 334 of the bridge portion 33 are connected via the inner circumferential surface 331 and the outer circumferential surface 332. The rear surface 334 facing the diaphragm 17 of the woofer 1 is formed as a flat surface with no groove or rib in the speaker device 100.

[0022] As illustrated in Fig. 4, side surfaces (the inner circumferential surface 331 and the outer circumferential surface 332) of the bridge portion 33 are inclined with respect to the sound generation direction such that the width of the bridge portion 33 increases toward the front side in the sound generation direction. Specifically, the inner circumferential surface 331, which is one side surface of the bridge portion 33, has a tapered surface 3311 and a straight surface 3312, and the outer circumferential surface 332, which is the other side surface of the bridge portion 33, has a tapered surface 3321 and a straight surface 3322. The tapered surfaces 3311 and 3321 are connected to the rear surface 334 and are inclined with respect to the sound generation direction such that the width increases toward the front side. The straight surfaces 3312 and 3322 connect the tapered surfaces 3311 and 3321 to the front surface 333 and extend along the sound generation direction. The bridge portion 33 has the narrowest width at the rear surface 334 and has a width gradually increasing toward the front side in the sound generation direction. Note that the sectional shape of the bridge portion 33 is not limited to the aforementioned shape and may be a shape having only either the straight surfaces or the tapered surfaces.

[0023] Here, the thickness dimension of the bridge portion 33 in the sound generation direction is defined as a_1 , and the width dimension of the bridge portion 33 is defined as a_2 . The bridge portion 33 according to the present embodiment is formed to satisfy $a_2 < a_1$. In other words, the thickness is longer than the width in

the bridge portion 33. However, the present invention is not limited thereto and may satisfy $a_2 \geq a_1$.

[0024] As illustrated in Fig. 3, a plurality of opening portions 4A and 4B are formed by the outer frame portion 31, the holding portion 32, and the bridge portions 33 in the support member 3. The plurality of opening portions 4A and 4B penetrate through the support member 3 along the sound generation direction such that sound output from the woofer 1 can pass there-through. The opening portions 4A are formed as spaces surrounded by the outer frame portion 31 and the bridge portions 33. In other words, the opening portions 4A are formed inside the bridge portions 33. Also, the opening portions 4B are formed as spaces surrounded by the outer frame portion 31, the holding portion 32, and the bridge portions 33 and 33 that are adjacent to each other in the circumferential direction of the outer frame portion 31.

[0025] As illustrated in Fig. 3, each opening portion 4A includes opening edges 4A1 and 4A2 which are peripheral edges. The opening edge 4A1 is formed by the inner circumferential surface 311 of the outer frame portion 31, and the opening edge 4A2 is formed by the inner circumferential surface 331 of the bridge portion 33. Therefore, the opening edges 4A1 and 4A2 are formed in a curved shape (specifically, an arc shape) in a view in the sound generation direction. Moreover, each opening portion 4B includes opening edges 4B1, 4B2, and 4B3 which are peripheral edges. The opening edge 4B1 is formed by the inner circumferential surface 311 of the outer frame portion 31, the opening edge 4B2 is formed by the outer circumferential surface 332 of the bridge portion 33, and the opening edge 4B3 is formed by the outer circumferential surface 321 of the holding portion 32. Therefore, the opening edges 4B1, 4B2, and 4B3 are formed in a curved shape (specifically, an arc shape) in a view in the sound generation direction. Therefore, all the opening edges of the opening portions 4A and 4B formed in the support member 3 according to the present embodiment have curved shapes.

[Actions and Effects]

[0026] As described above, the speaker device 100 according to the present embodiment includes the woofer 1 that has the diaphragm 17 and output sound by causing the diaphragm 17 to vibrate and the support member 3 that is disposed to face the woofer 1 in front of the woofer 1 in the sound generation direction of the woofer 1. Also, the support member 3 includes the frame-shaped outer frame portion 31, and the one or more bridge portions bridged inside the outer frame portion 31. Moreover, the outer frame portion 31 and the bridge portions 33 form the plurality of opening portions 4A and 4B penetrating through the support member 3 along the sound generation direction, and the opening edges 4A2 and 4B2 of the opening portions

4A and 4B formed by the bridge portions 33 have the curved shapes when the support member 3 is viewed along the sound generation direction.

[0027] According to this, it is possible to disperse a time and a wavelength at which the diffracted waves diffracted by the opening edges of the curved shapes and the straight waves passing through the opening portions interfere with each other, by forming at least portions of the opening edges 4A2 and 4B2 formed by the bridge portion 33 in curved shapes. As a result, it is possible to curb generation of peaks and dips.

[0028] Fig. 5 is a diagram for schematically explaining sound interference in the speaker device 100 according to the embodiment. Fig. 6 is a diagram for schematically explaining sound interference in a speaker device according to a comparative example. In Figs. 5 and 6, the reference sign W1 denotes a straight wave output from the woofer 1, traveling straight along the sound generation direction, and passing through each opening portion 4A in the support member 3. Also, the reference sign W2 denotes a diffracted wave output from the woofer 1 and then diffracted by the opening edge 4B2 of each opening portion 4B. Moreover, the reference sign S1 denotes a part (interference portion) where the straight wave W1 and the diffracted wave W2 interfere with each other. The speaker device according to the comparative example is different from the speaker device 100 according to the present embodiment in that bridge portions 330 are formed in a straight shape. Note that Figs. 5 and 6 are schematic diagrams illustrating an example of a sound interference state and are not intended to limit the present invention. The wavelength and the diffraction angle of sound are not limited to those in the aspects in Figs. 5 and 6.

[0029] In the comparative example, the bridge portions 330 are formed in a straight shape in a view in the sound generation direction, and the opening edge 4B2 thus has a straight shape. Therefore, the diffracted wave W2 moves around in a planar shape and interferes with the straight wave W1 as illustrated in Fig. 6. At this time, the straight wave W1 and the diffracted wave W2 interfere with each other while concentrating on a specific timing and wavelength as illustrated by the interference portion S1 in Fig. 6. As a result, a large peak and dip may be generated at a specific frequency. On the other hand, according to the present embodiment, the opening edges 4B2 have a curved shape in a view in the sound generation direction, and the diffracted wave W2 moves around in a curved shape and interferes with the straight wave W1 as illustrated in Fig. 5. Therefore, interference at each frequency temporally deviate, and the timings and the wavelengths at which the straight wave W1 and the diffracted wave W2 interfere with each other are dispersed, as illustrated by the interference portion S1 in Fig. 5. Therefore, according to the speaker device 100 of the present embodiment, it is possible to curb generation of peaks and dips

by the support member 3. As a result, it is possible to curb degradation of sound quality of the woofer 1. Moreover, it is also possible to expect an improvement in a feeling of cutting-through in a high range, reduction of a feeling of muffled sound in a mid-range, an increase in amount of sound information due to dip filling, and the like by forming at least portions of the opening edges 4A2 and 4B2 in curved shapes.

[0030] Note that although the support member 3 according to the present embodiment has the plurality of bridge portions 33, the number of bridge portions according to the present invention may not be plural, and it is only necessary for the number of bridge portions to be one or more.

[0031] Also, all the opening edges 4A2 and 4B2 of the opening portions 4A and 4B formed by the bridge portions 33 have curved shapes when the support member 3 is viewed along the sound generation direction, in the speaker device 100 according to the present embodiment. According to this, the waves diffracted by the opening edges 4A2 and 4B2 spread in curved surface shape as a whole, and it is thus possible to more widely disperse the timings and the wavelengths at which the straight waves and the diffracted waves interfere with each other as compared with a case where only portions of the opening edges 4A2 and 4B2 have curved shapes. As a result, it is possible to more effectively curb generation of peaks and dips. However, it is not necessary for all the opening edges of the opening portions formed by the bridge portions to have curved shapes, and it is only necessary for at least portions thereof to have curved shapes in the present invention.

[0032] In the speaker device 100 according to the present embodiment, the bridge portions 33 extend in an arc shape when the support member 3 is viewed along the sound generation direction. It is thus possible to form the opening edges 4A2 and 4B2 formed by the bridge portions 33 in the curved shape (the arc shape in this example). However, the shape of the bridge portions according to the present invention is not limited to the arc shape. The bridge portions may extend in various curved shapes. In addition, it is not necessary for the entire bridge portions to have a curved shape, and at least one of both side surfaces of each bridge portion may have a curved shape in a view in the sound generation direction.

[0033] As described above, the side surfaces (inner circumferential surface 331 and the outer circumferential surface 332) of each bridge portion 33 are inclined with respect to the sound generation direction such that the width of the bridge portion 33 increases toward the front side in the sound generation direction in a section perpendicularly intersecting the extending direction of the bridge portion 33 in the speaker device 100 according to the present embodiment. The air is likely to flow forward in the sound generation direction along the side surfaces of the bridge portion 33 by forming the bridge portion 33 in a tapered shape. In this manner, accumu-

lation of air between the diaphragm 17 and the bridge portion 33 is curbed. As a result, it becomes easy for sound output from the woofer 1 to pass through the opening portions 4A and 4B in the support member 3, and it is possible to improve a feeling of cutting-through of the sound. Also, the rear surface 334 of the bridge portion 33 facing the diaphragm 17 is formed as a flat surface with no groove and rib, and accumulation of air is thus further curbed. Furthermore, the strength of the bridge portions 33 is secured while the feeling of cutting-through of the sound is improved by setting the thickness to be longer than the width of the bridge portions 33 in the present embodiment. Moreover, it is also possible to expect an increase in amount of information in the high range and the like by forming the sectional shape of the bridge portions 33 in a tapered shape. Note that the sectional shape and the dimension of the bridge portions according to the present invention are not limited to those described above.

[0034] Also, the speaker device 100 according to the present embodiment further includes the tweeter 2 disposed to be aligned with the woofer 1 in the sound generation direction, and the tweeter 2 is held by the support member 3. It is thus possible to curb peaks and dips of the woofer 1 while configuring the speaker device 100 as a coaxial speaker. Note that although the woofer 1 is disposed as the first speaker and the tweeter 2 is disposed as the second speaker in the present embodiment, the present invention is not limited thereto. For example, a woofer for a low range may be disposed as a first speaker with a speaker for a mid-range disposed as a second speaker in front thereof, or a speaker for a mid-range may be disposed as a first speaker with a tweeter disposed as a second speaker in front thereof. Also, the number of speakers is not limited two, may be only one, or may be three or more. The present invention may be adapted such that at least one of a plurality of speakers is supported by a facing member.

[0035] Note that although the facing member according to the present invention is configured as the support member 3 for supporting the tweeter 2 disposed in the sound generation direction in the aforementioned embodiment, the present invention is not limited thereto. It is only necessary for the facing member according to the present invention to be a member that is disposed to face the speaker in front of the speaker. The facing member may be configured as a cover member that covers the diaphragm by bridge portions, for example. In that case, the cover member may be a dust cover that prevents entrance of foreign matters into the speaker by the plurality of bridge portions, for example. Also, the facing member according to the present invention may be configured as an acoustic lens that causes speaker sound to converge or diverge by a plurality of bridge portions formed in a fin shape, for example.

[Modifications]

[0036] Hereinafter, modifications of the support member will be described. In the following description, differences from the above-described support member 3 will be mainly described, and detailed description of configurations similar to those of the support member 3 will be omitted by applying the same reference signs thereto.

[0037] Figs. 7 to 11 are plan views of support members according to modifications. In a support member 301 according to a first modification illustrated in Fig. 7, opening portions 4C, 4D, and 4E are formed by arc-shaped bridge portions 33 intersecting each other. In a support member 302 according to a second modification illustrated in Fig. 8, four arc-shaped bridge portions 33 extend radially from a holding portion 32, and opening portions 4F are formed between the bridge portions 33 and 33 adjacent to each other in the circumferential direction. In support members 303, 304, and 305 according to third to fifth modifications illustrated in Figs. 9 to 11, both side surfaces of each bridge portion 33 are formed in an arc shape protruding toward each other in a view in the sound generation direction. In the support member 303 according to the third modification illustrated in Fig. 9, three bridge portions 33 disposed at equal intervals in the circumferential direction extend radially from a holding portion 32, and opening portions 4G are formed between the bridge portions 33 and 33 adjacent to each other in the circumferential direction. In the support member 304 according to the fourth modification illustrated in Fig. 10, four bridge portions 33 disposed at equal intervals in the circumferential direction extend radially from a holding portion 32, and opening portions 4H are formed between the bridge portions 33 and 33 adjacent to each other in the circumferential direction. In the support member 305 according to the fifth modification illustrated in Fig. 11, two bridge portions 33 extend from each of both sides of a holding portion 32, and opening portions 4I and 4J are formed between the bridge portions 33 and 33 adjacent to each other in the circumferential direction.

<Others>

[0038] Although the present invention has been described above with reference to the embodiment, the present invention is not limited to the aforementioned embodiment.

[Supplement]

[0039] Features of the present invention will be described below as supplement.

[1] A speaker device including:

a speaker including a diaphragm and config-

ured to output sound by causing the diaphragm to vibrate; and
 a facing member disposed to face the speaker in front of the speaker in a sound generation direction of the speaker,
 in which the facing member includes a frame-shaped outer frame portion and one or more bridge portions bridged inside the outer frame portion,
 the outer frame portion and the bridge portions form a plurality of opening portions penetrating through the facing member along the sound generation direction, and
 when the facing member is viewed along the sound generation direction, at least portions of opening edges of the opening portions formed by the bridge portions have curved shapes.

[2] The speaker device according to [1], in which when the facing member is viewed along the sound generation direction, entireties of the opening edges of the opening portions formed by the bridge portions have curved shapes.

[3] The speaker device according to [1] or [2], in which when the facing member is viewed along the sound generation direction, the bridge portions extend in an arc shape.

[4] The speaker device according to any one of [1] to [3], in which side surfaces of the bridge portions are inclined with respect to the sound generation direction such that a width of the bridge portions increases toward a front side in the sound generation direction in a section perpendicularly intersecting an extending direction of the bridge portions.

[5] The speaker device according to any one of [1] to [4], further including:

a second speaker disposed to be aligned with a first speaker, which is the speaker, in the sound generation direction of the first speaker, in which the second speaker is held by the facing member.

[6] The speaker device according to [5], in which the first speaker and the second speaker are coaxially disposed.

[7] The speaker device according to any one of [1] to [6], in which the facing member is configured as a cover member to cover the diaphragm with the plurality of bridge portions.

[Description of the Reference Numerals and Symbols]

[0040]

1 Woofer (example of "speaker" and "first speaker")
 2 Tweeter (example of "second speaker")

3 Support member (example of "facing member")
 17 Diaphragm
 31 Outer frame portion
 32 Holding portion
 33 Bridge portion
 4A, 4B Opening portion
 100 Speaker device

10 Claims

1. A speaker device comprising:

a speaker including a diaphragm and configured to output sound by causing the diaphragm to vibrate; and
 a facing member disposed to face the speaker in front of the speaker in a sound generation direction of the speaker,
 wherein the facing member includes a frame-shaped outer frame portion and one or more bridge portions bridged inside the outer frame portion,
 the outer frame portion and the bridge portions form a plurality of opening portions penetrating through the facing member along the sound generation direction, and
 when the facing member is viewed along the sound generation direction, at least portions of opening edges of the opening portions formed by the bridge portions have curved shapes.

2. The speaker device according to claim 1, wherein when the facing member is viewed along the sound generation direction, entireties of the opening edges of the opening portions formed by the bridge portions have curved shapes.

3. The speaker device according to claim 1 or 2, wherein when the facing member is viewed along the sound generation direction, the bridge portions extend in an arc shape.

4. The speaker device according to any one of claims 1 to 3,
 wherein side surfaces of the bridge portions are inclined with respect to the sound generation direction such that a width of the bridge portions increases toward a front side in the sound generation direction in a section perpendicularly intersecting an extending direction of the bridge portions.

5. The speaker device according to any one of claims 1 to 4, further comprising:

a second speaker disposed to be aligned with a first speaker, which is the speaker, in the sound generation direction of the first speaker,

wherein the second speaker is held by the facing member.

6. The speaker device according to claim 5, wherein the first speaker and the second speaker are coaxially disposed. 5
7. The speaker device according to any one of claims 1 to 6, wherein the facing member is configured as a cover member to cover the diaphragm with the plurality of bridge portions. 10

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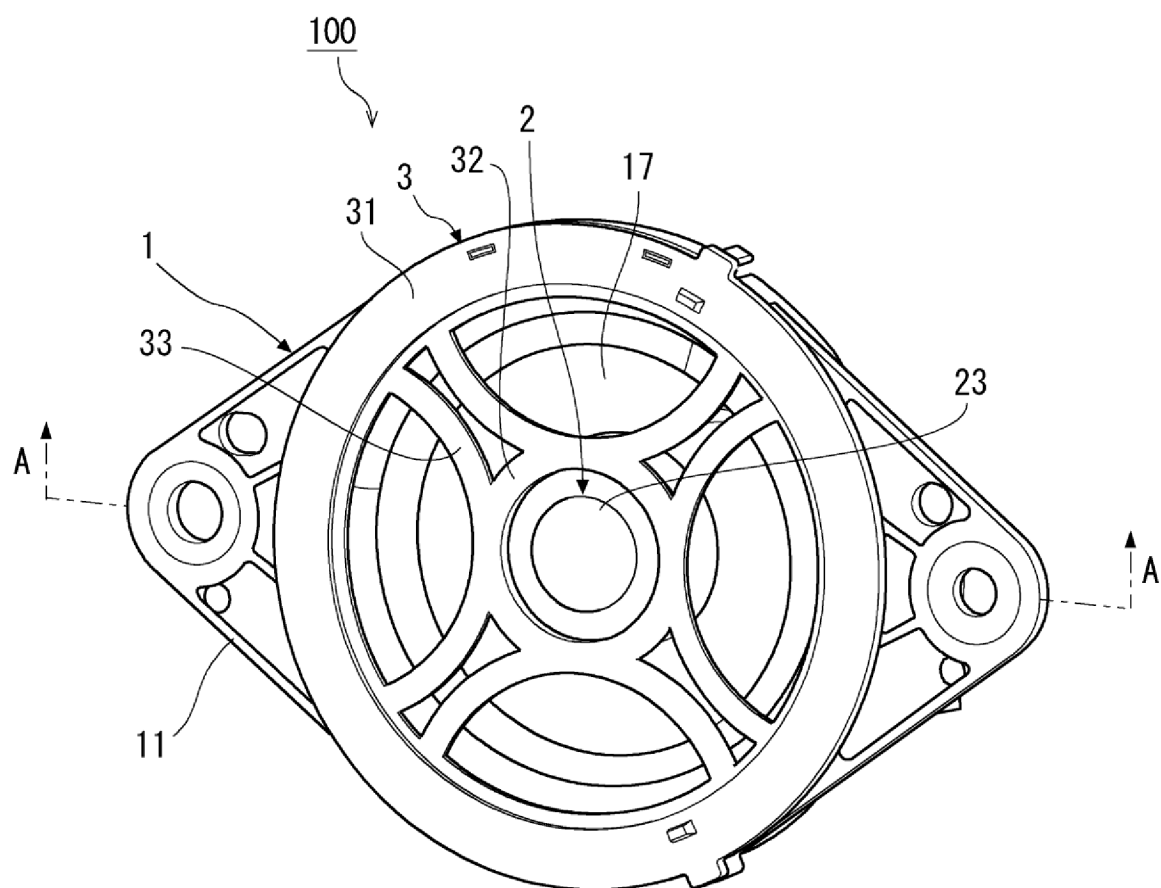


Fig. 1

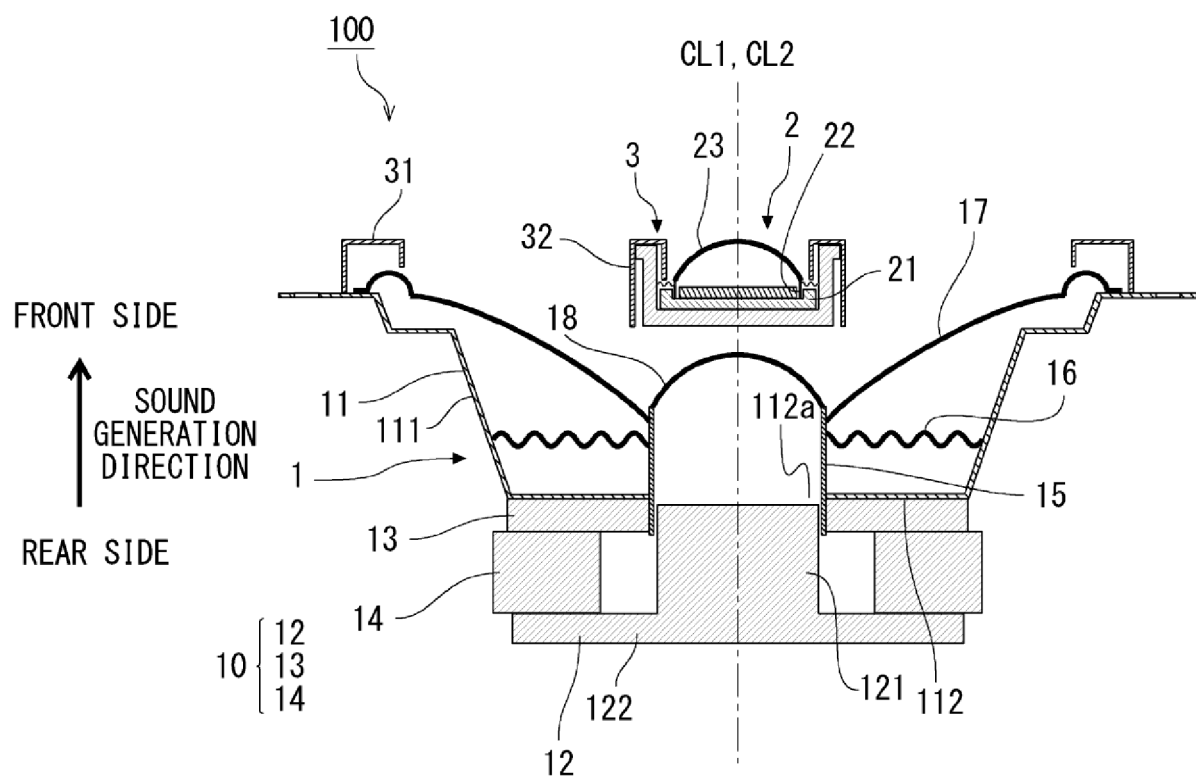


Fig. 2

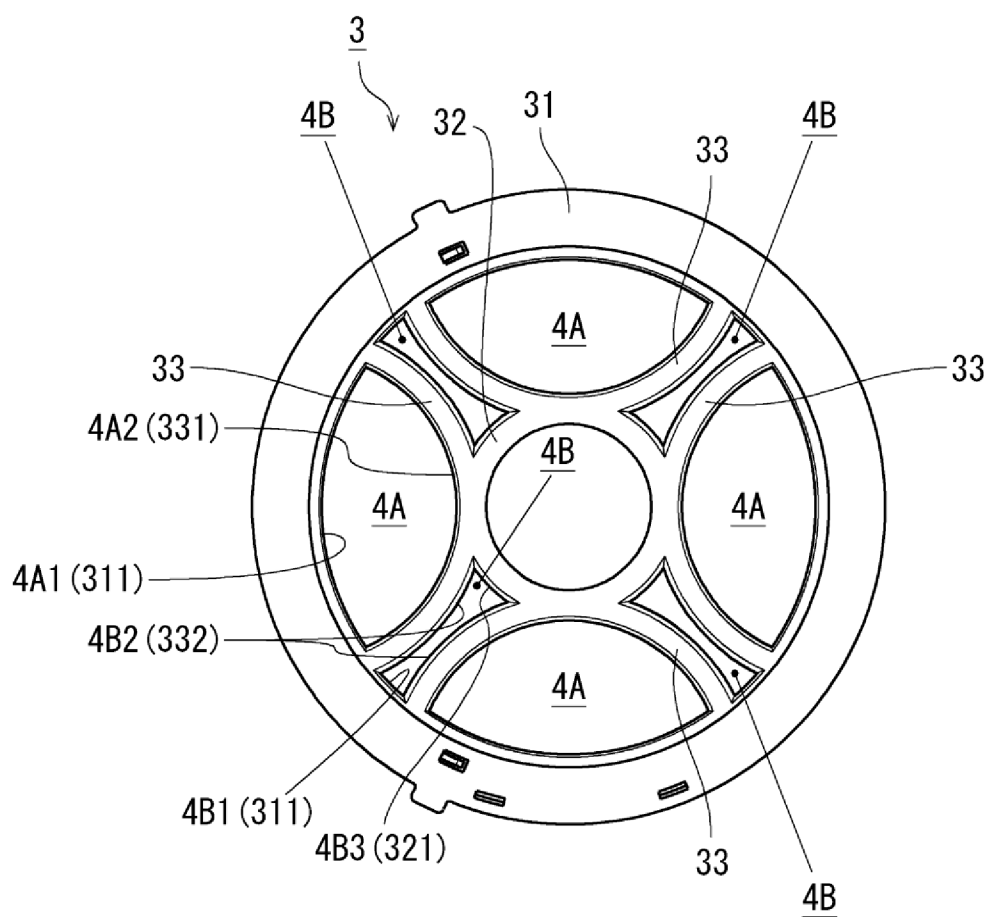


Fig. 3

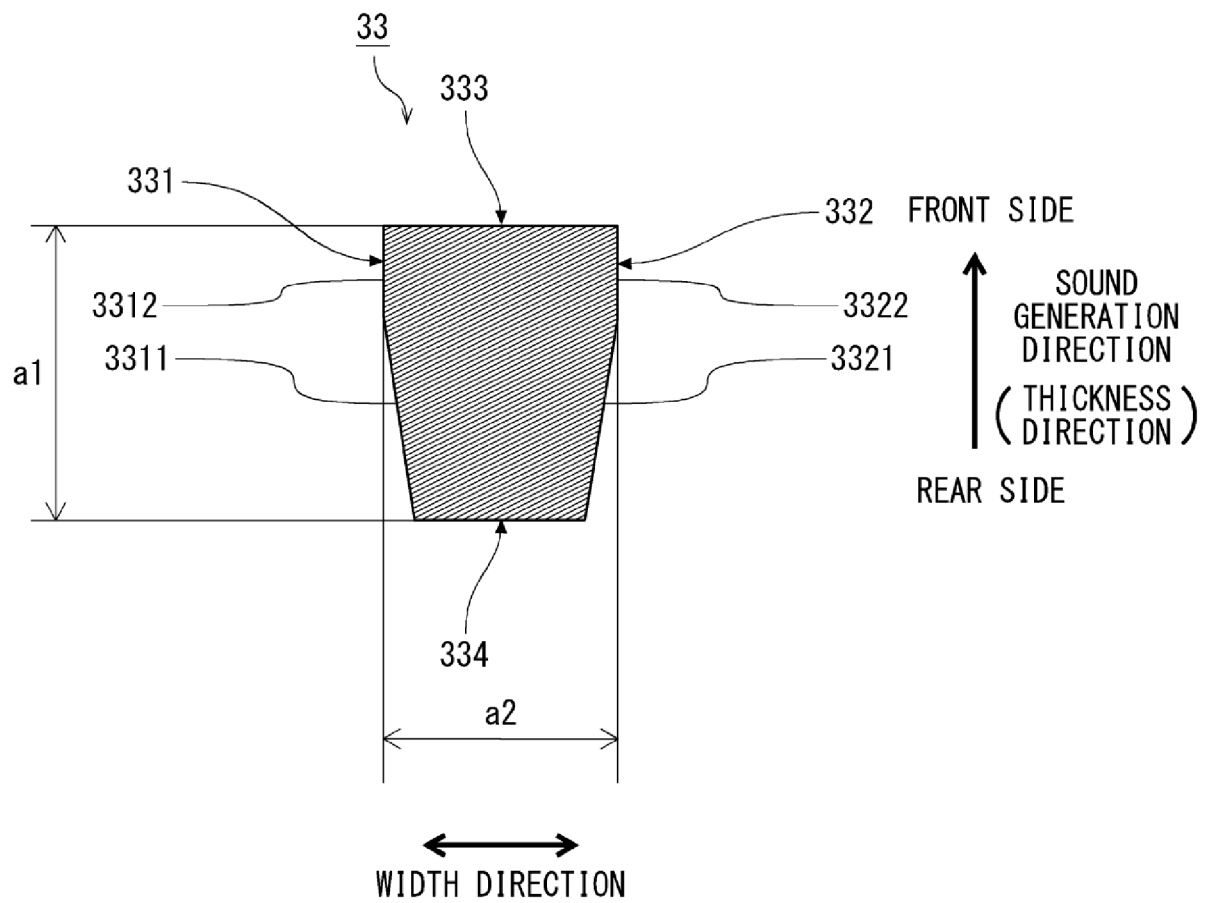


Fig. 4

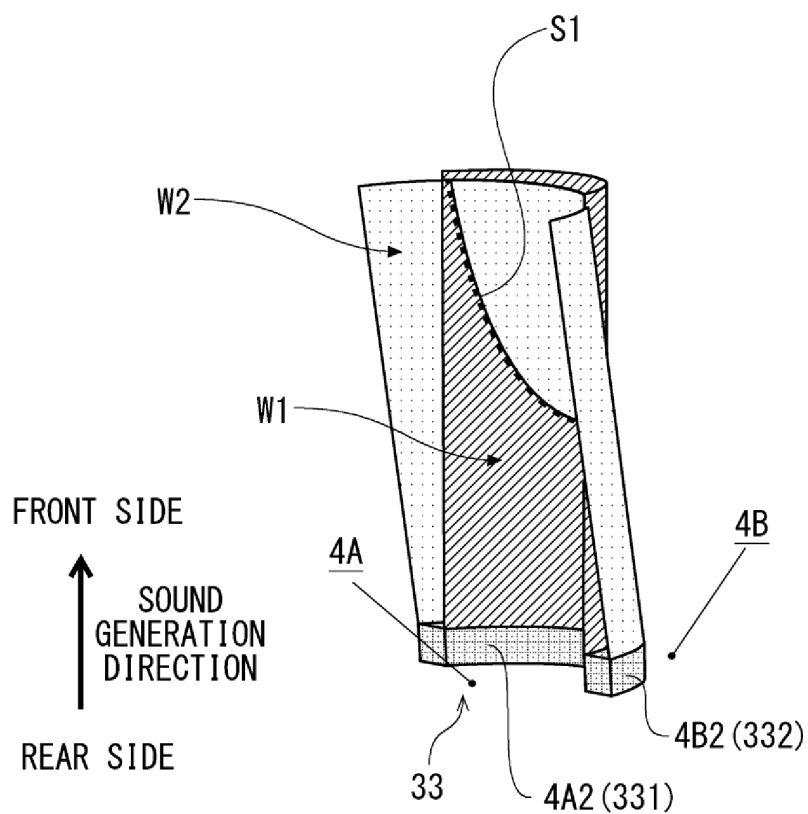


Fig. 5

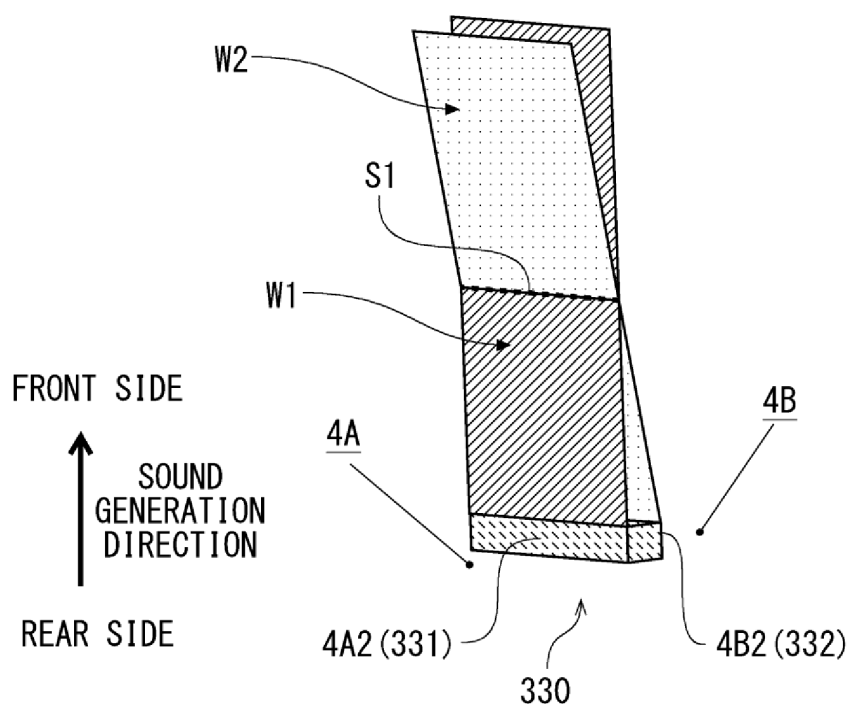


Fig. 6

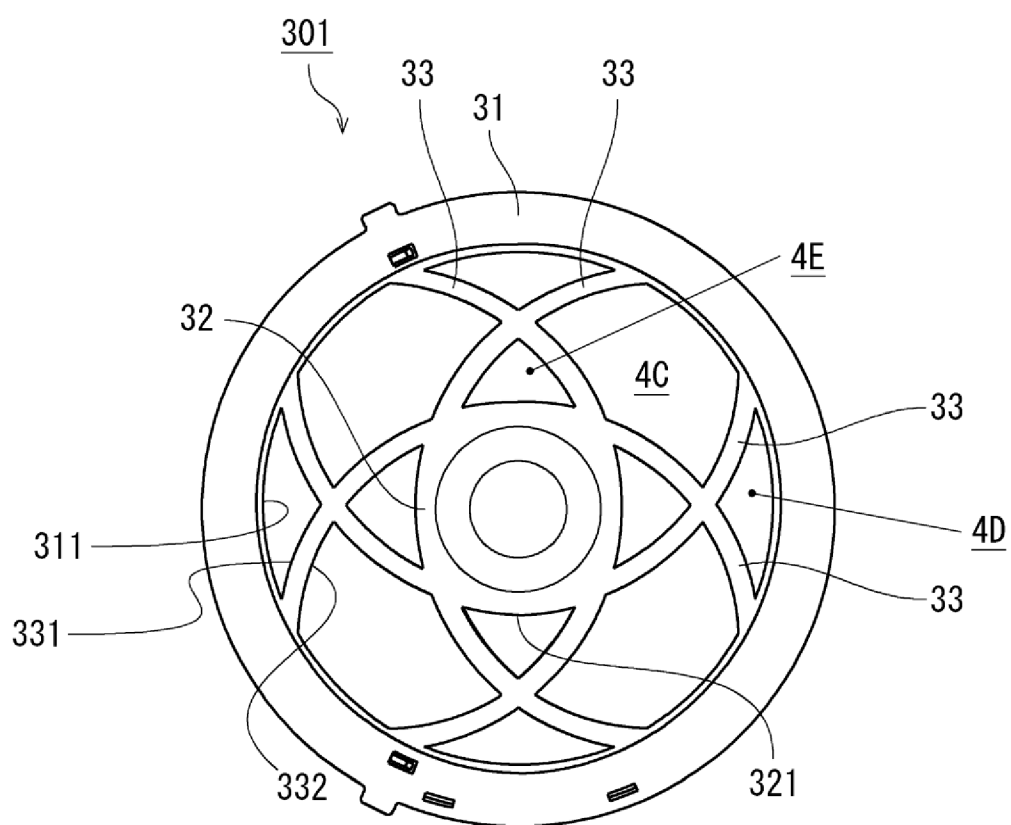


Fig. 7

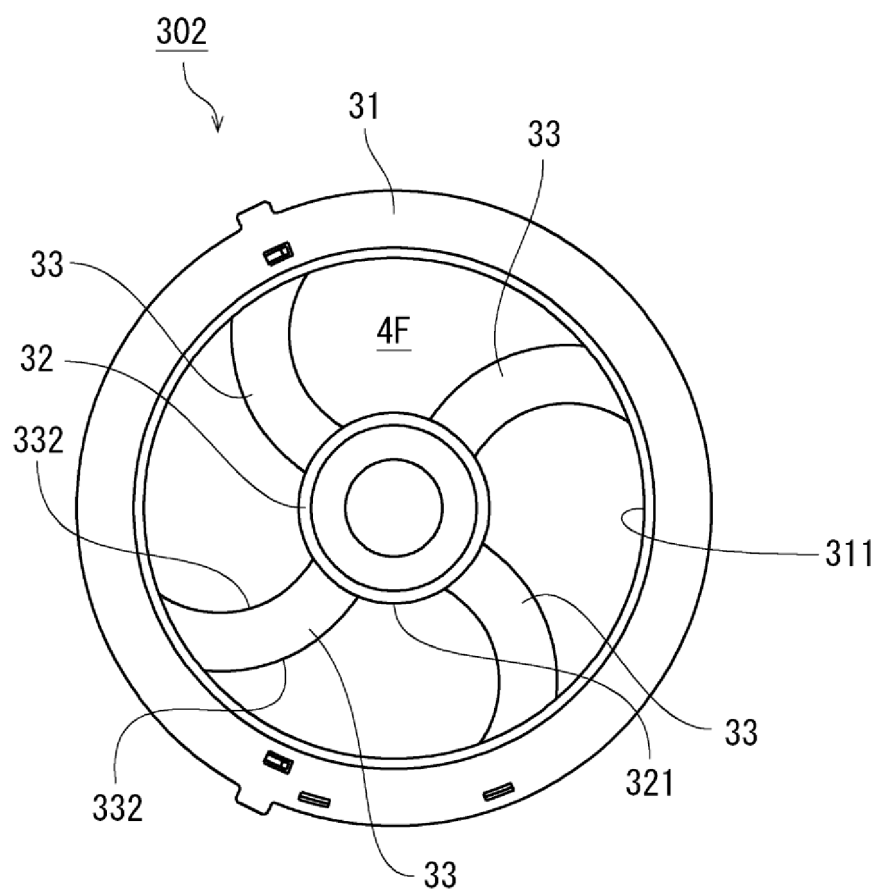


Fig. 8

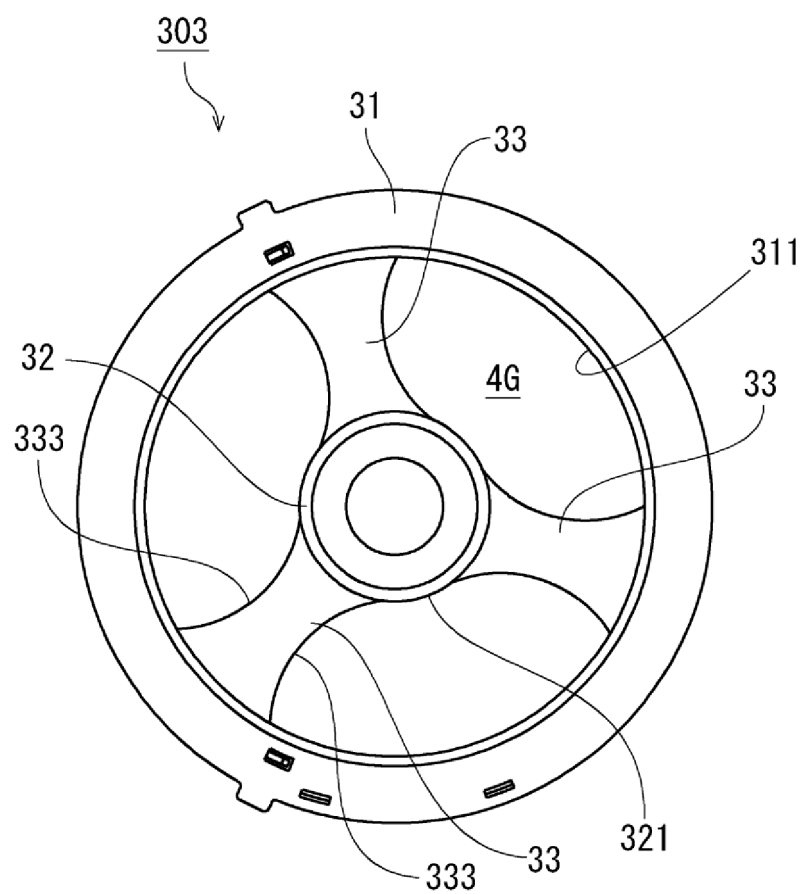


Fig. 9

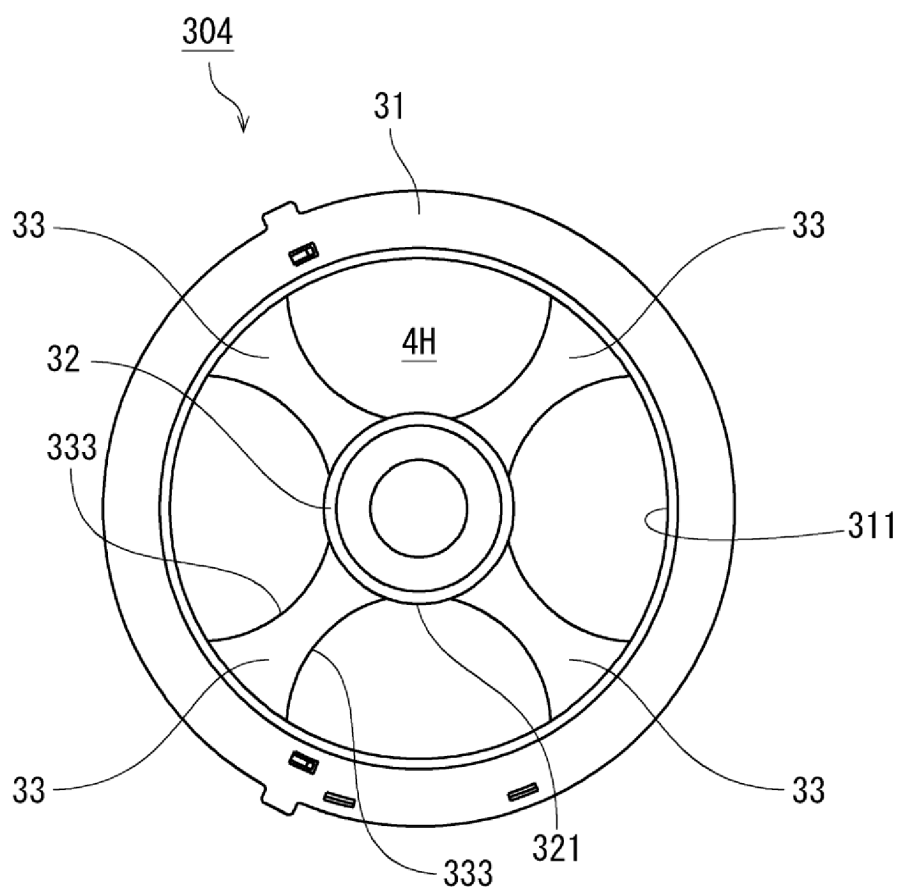


Fig. 10

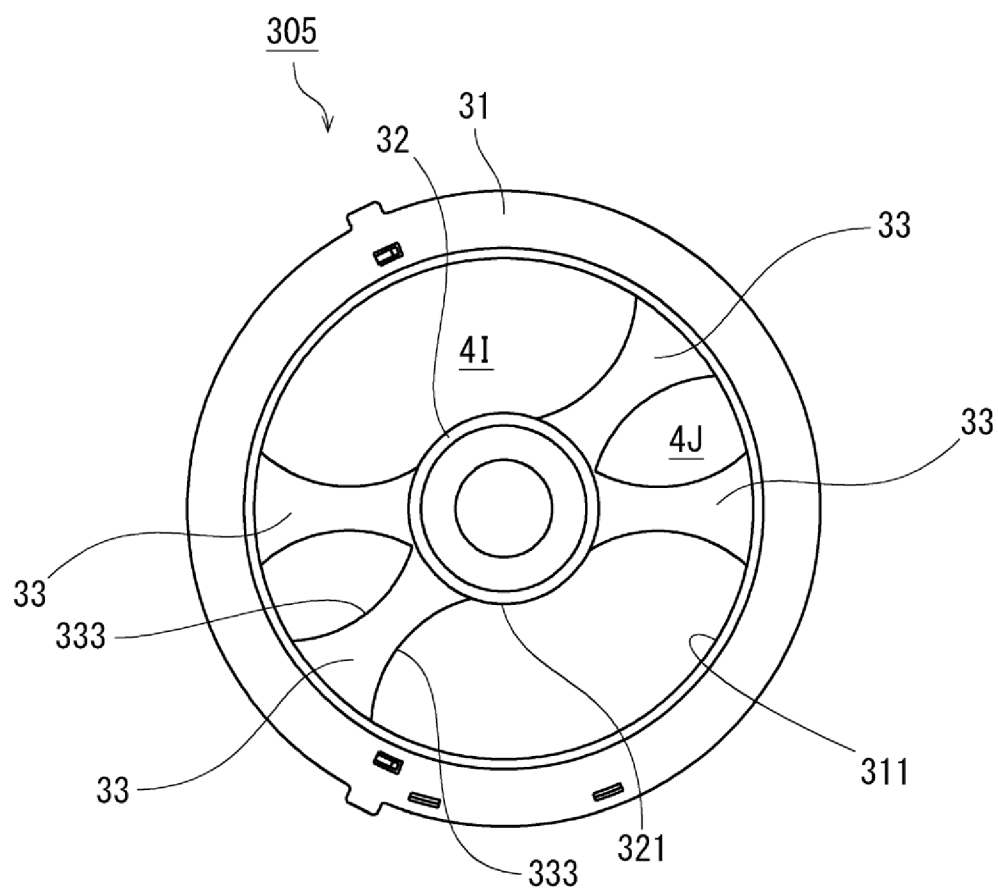


Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/044204

A. CLASSIFICATION OF SUBJECT MATTER

H04R 1/24(2006.01)i; **H04R 1/34**(2006.01)i
FI: H04R1/24 Z; H04R1/34 310

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04R1/00-1/46

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2024
Registered utility model specifications of Japan 1996-2024
Published registered utility model applications of Japan 1994-2024

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 85271/1989 (Laid-open No. 24798/1991) (FOSTER ELECTRIC CO., LTD.) 14 March 1991 (1991-03-14), fig. 1, 3	1-3, 5-7 4
X A	JP 2015-80137 A (JVC KENWOOD CORP.) 23 April 2015 (2015-04-23) fig. 1-5	1-3, 5-7 4
X A	JP 2008-259243 A (SONY CORPORATION) 23 October 2008 (2008-10-23) fig. 12-14	1-3, 5-7 4
X	JP 2022-118360 A (YAMAHA CORPORATION) 15 August 2022 (2022-08-15) fig. 1-2	1, 3, 7

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

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“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

08 February 2024

Date of mailing of the international search report

20 February 2024

Name and mailing address of the ISA/JP

Japan Patent Office (ISA/JP)
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Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/044204

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 78417/1984 (Laid-open No. 189196/1985) (MINEBEA CO., LTD.) 14 December 1985 (1985-12-14), fig. 1-5	1-7
A	JP 2019-121842 A (JVC KENWOOD CORP.) 22 July 2019 (2019-07-22) fig. 1-5	1-7

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2023/044204

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Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 3-24798 U1	14 March 1991	(Family: none)	
JP 2015-80137 A	23 April 2015	US 2016/0234590 A1 fig. 1-5 WO 2015/056371 A1	
JP 2008-259243 A	23 October 2008	(Family: none)	
JP 2022-118360 A	15 August 2022	US 2022/0248129 A1 fig. 1-2 CN 217088134 U CN 114845207 A	
JP 60-189196 U1	14 December 1985	(Family: none)	
JP 2019-121842 A	22 July 2019	US 2020/0322717 A1 fig. 1-5 EP 3734991 A1 CN 111418218 A WO 2019/130790 A1 JP 2022-90000 A	

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

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