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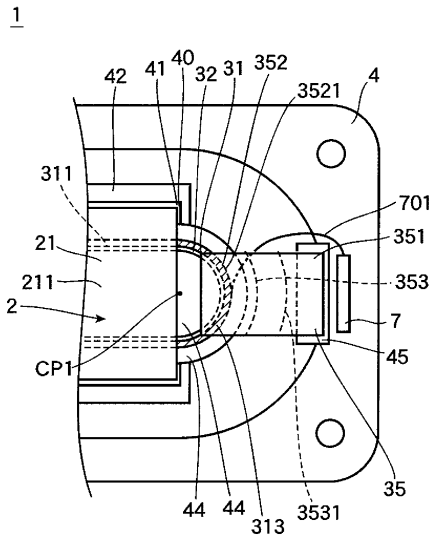
(54) **SPEAKER DEVICE**

(57) The present invention may provide a small size high-quality sound speaker device having an elongated shaped diaphragm, magnetic circuit and voice coil with a simple configuration, a speaker device having a magnetic circuit forming a narrow-width magnetic gap, etc. The speaker device 1 according to the present invention includes the magnetic circuit 2 that has a yoke 21 having a lateral portion forming a magnetic gap only in the short-side direction, a magnet 22 and a plate 23, a diaphragm 33, a voice coil 31 having a linear portion 311 and a substantially semicircular-shaped curved portion 313, a frame 4 and a damper 35. The damper 35 has a frame joint 351, a voice coil joint 352 and a corrugation part 353 formed in a corrugated cross-sectional shape. The voice coil joint 352 has the groove 3521 in which the lower end of the curved portion of the voice 31 coil is joined, and the corrugated cross-sectional shape of the corrugation part 353 has the planar shape formed in a concentric arc shape.

FIG.3(A)



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Description

FIELD OF THE INVENTION

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

BACKGROUND OF THE INVENTION

[0002] There is known a speaker device provided with a diaphragm in an elongated shaped (for example, see patent literature 1).
The speaker device described in the above patent literature 1 has the diaphragm provided with a voice coil bobbin, which is provided with a voice coil and connected to a frame via a damper having a corrugated cross-sectional shape. The above voice coil and the voice coil bobbin have a planar shape formed in a rectangular shape, and have a linear portion formed along the longitudinal direction. Further, the voice coil bobbin has the ends in the longitudinal direction and in the short-side direction connected to the frame via the damper. The above speaker device has a magnetic circuit forming a linear magnetic gap in which the linear portion of the voice coil is arranged.

[0003]

[Patent Literature 1] A pamphlet of international publication 2005/117489

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTON

[0004] The above speaker device is configured to have the voice coil in a space between the end in the short-side direction of the voice coil bobbin and the frame, where the damper is required to be placed. As such, it is comparatively difficult to downsize the speaker device if configured as above.

[0005] Further, for example, if a simple-shaped damper is provided only between the end in the longitudinal direction of the voice coil bobbin and the frame in order to downsize the above speaker device, the voice coil bobbin (voice coil) may be displaced in the short-side direction when driving a speaker. As such, the voice coil of the speaker device configured as above may also vibrate in the short-side direction other than along the vibration direction of the voice coil when driving a speaker, which may cause an unstable movement of the voice coil, thereby degrading the acoustic characteristic.

[0006] Further, in the above speaker device, if the voice coil bobbin (voice coil) is comparatively significantly displaced in the short-side direction, the voice coil bobbin (voice coil) may contact a yoke or a plate (pole piece) of the magnetic circuit, and thereby troubles such as generation of an abnormal noise or degradation of the acoustic characteristic may occur.

[0007] In the meantime, for example, an elongated voice coil having a racetrack shaped planar shape has the end in the longitudinal direction formed in a semicircular shape. Even if a damper having a simple corrugated cross-sectional shape is provided between the end in the longitudinal direction of the above shape voice coil and the frame, the voice coil may be displaced also in the short-side direction when driving a speaker, which may cause an unstable movement of the voice coil
Further, in the above elongated speaker device, since the linear portion of the voice coil (voice coil bobbin) has comparatively small intensity, the linear portion may be deformed when driving a speaker, and thereby causing a further unstable movement of the voice coil.

[0008] Further, in the speaker device configured as above, a magnetic circuit is required to form a comparatively wide-width magnetic gap to prevent troubles causing the voice coil bobbin (voice coil) to contact a yoke, a plate (pole piece), etc. when driving a speaker.
Further, if the magnetic circuit is provided with a comparatively wide-width magnetic gap, sensitivity of the voice coil becomes comparatively low when driving a speaker. Further, if the magnetic circuit is provided with a comparatively wide-width magnetic gap, the magnetic circuit is required to have a comparatively large magnet to generate large-scale magnetic flux in the magnetic gap. In the speaker device configured as above, manufacturing costs will be comparatively high.

[0009] It is an object of the present invention to overcome the problems described above. More specifically, an object of the present invention is to provide a small size speaker device that can create high-quality sound with a simple configuration having a diaphragm in an elongated shape, a magnetic circuit and a voice coil, to provide a speaker device that has a magnetic circuit forming a magnetic gap with a comparatively narrow width, or to provide a speaker device having comparatively low manufacturing costs, etc.

MEANS FOR SOLVING PROBLEMS

[0010] To achieve the above-mentioned objects, the present invention has at least a configuration according to the following independent claim:

A speaker device according to the present invention includes:

a magnetic circuit that has a yoke having an elongated-shaped bottom face portion and a lateral portion forming a magnetic gap only at the end in the short-side direction of the bottom face portion that has the ends in the short-side direction and the longitudinal direction, a magnet arranged on the bottom face portion of the yoke,
a plate arranged on the magnet, forming the linear magnetic gap between the plate and the yoke in the longitudinal direction;

a diaphragm having the planar shape orthogonal to the vibration transmission direction of a vibration source, the planar shape having the longitudinal direction and the short-side direction;

a voice coil joined to the diaphragm directly or via a voice coil bobbin, having the planar shape orthogonal to the vibration transmission direction formed in a racetrack shape with a linear portion arranged along the magnetic gap of the magnetic circuit and a substantially semicircular-shaped curved portion formed at the end in the longitudinal direction elongating from the end in the longitudinal direction of the bottom face portion of the yoke to the outside in the longitudinal direction;

a frame holding the magnetic circuit and vibratably supporting diaphragm; and

a damper having a frame joint joined to the frame, a voice coil joint joined to the curved portion of the voice coil and a corrugation part formed in a corrugated cross-sectional shape between the frame joint and the voice coil joint, wherein

the voice coil joint has a groove in which the lower end of the curved portion of the voice coil is joined, and the corrugation part has a corrugated cross-sectional shaped mold whose planar shape is formed in a concentric arc shape.

BRIEF DESCRIPTION OF THE DRAWIMGS

[0011]

Fig. 1(A) is a plan view of a speaker device 1 according to one embodiment of the present invention, Fig. 1(B) is a cross-sectional view taken along line B-B of the speaker device 1 shown in Fig. 1(A) and Fig. 1(C) is a cross-sectional view taken along line C-C of the speaker device 1 shown in Fig. 1(A).

Fig. 2(A) is a perspective view from the upper surface of a magnetic circuit 2 of the speaker device 1 shown in Fig. 1(B) and Fig. 1(C).

Fig. 2(B) is a perspective view from the back side of the magnetic circuit 2 of the speaker device 1 shown in Fig. 2(A) and Fig. 2(B).

Fig. 2(C) is a perspective view from the back side of a diaphragm 33, a voice coil bobbin 32 and a frame 4.

Fig. 3(A) is a bottom view that illustrates an enlarged major part of the back side of the speaker device 1 shown in Fig. 1(A). Fig. 3(B) is a cross-sectional view of a voice coil 31, the voice coil bobbin 32 and a damper 35 shown in Fig. 3(A).

Fig. 4(A) a plan view of a round shaped damper member 350. Fig. 4(B) is a plan view of a damper 35 made by cutting the round shaped damper member 350 shown in Fig. 4(A). Fig. 4(C) is a cross-sectional view of the damper 35 shown in Fig. 4(B).

Fig. 5(A) is a cross-sectional view of the damper 35 illustrating a method of manufacturing the speaker device according to one embodiment of the present invention. Fig. 5(B) is a cross-sectional view illustrating joining of the damper 35, the frame 4 and the voice coil 31.

Fig. 6(A) is a perspective view of an outer-magnetic type magnetic circuit of the speaker device according to another embodiment of the present invention. Fig. 6(B) is a cross-sectional view of the magnetic circuit shown in Fig. 6(A).

Fig. 7 is a bottom view of an inner-magnetic type magnetic circuit 2H of the speaker device according to another embodiment of the present invention.

Fig. 8(A) is a cross-sectional view of a yoke 21K of the speaker device according to a first example of the present invention. Fig. 8(B) is a cross-sectional view of a yoke 21M according to a second example. Fig. 8(C) is a cross-sectional view of a yoke 21N according to a third embodiment and Fig. 8(D) is a cross-sectional view of a yoke 21P according to a fourth example of the present invention.

DESCRIPTION OF SYMBOLS

[0012]

1	speaker device
2	magnetic circuit
3	vibrating body
4	frame
21	yoke
22	magnet
23	plate (pole piece)
31	voice coil
32	voice coil bobbin
33	diaphragm
34	edge (diaphragm support part)
35	damper
352	voice coil joint
353	corrugation part
3521	groove

BEST MODE OF THE INVENTION

[0013] A speaker device according to one embodiment of the present invention includes:

a magnetic circuit that has a yoke having an elongated-shaped bottom face portion and a lateral portion forming a magnetic gap only at the end in the short-side direction of the bottom face portion that has the ends in the short-side direction and the longitudinal direction, a magnet arranged on the bottom face portion of the yoke, a plate arranged on the magnet, forming a linear magnetic gap between the plate and the yoke in the longitudinal direction;

a diaphragm having the planar shape orthogonal to

the vibration transmission direction of the vibration source, the planar shape having the longitudinal direction and the short-side direction;
a voice coil joined to the diaphragm directly or via a voice coil bobbin, having the planar shape orthogonal to the vibration transmission direction formed in a racetrack shape with a linear portion arranged along the magnetic gap of the magnetic circuit and a substantially semicircular-shaped curved portion formed on the end in the longitudinal direction elongating from the end in the longitudinal direction of the bottom face portion of the yoke to the outside in the longitudinal direction;
a frame holding the magnetic circuit and vibratably supporting diaphragm; and
a damper having a frame joint joined to the frame, a voice coil joint joined to the curved portion of the voice coil and a corrugation part formed in a corrugated cross-sectional shape between the frame joint and the voice coil joint, wherein
the voice coil joint has a groove in which the lower end of the curved portion of the voice coil is joined, and the corrugation part has a corrugated cross-sectional shaped mold whose planar shape is formed in a concentric arc shape.

[0014] In the above speaker device, since the groove of the damper is joined to the lower end of the curved portion of the voice coil and the corrugated cross-sectional shaped corrugation part has the planar shape orthogonal to the vibration transmission direction of the vibration source (diaphragm or voice coil) formed in a concentric arc shape, vibrations in the short-side direction of the voice coil may be restrained even if the above damper is arranged only between the end in the longitudinal direction of the voice coil and the frame. As such, the speaker device may output a sound wave with high-quality sound since the voice coil may generate a comparatively stable vibration along the vibration direction when driving the speaker device.
Further, the above damper is arranged only between the end in the longitudinal direction of the voice coil and the frame, and thus a comparatively small size speaker device may be provided.
Further, the above speaker device, since the voice coil may generate a comparatively stable vibration along the vibration direction, may output a sound wave with high-quality sound.
Further, since the above speaker device has the above damper, the voice coil can vibrate comparatively stably along the vibration direction, the magnetic gap of the magnetic circuit may be limited to a comparatively narrow width. That is, a small size speaker device, which is provided with the magnetic circuit forming a comparatively narrow-width magnetic gap, may be provided. Further, in the above speaker device, sensitivity of the voice coil when driving the speaker will be comparatively high.
[0015] Further, the speaker device according to the present invention, even if provided with a magnetic circuit with a comparatively small magnet, may output a sound wave with comparatively high sound pressure, since a narrow-width magnetic gap is formed. Further the speaker device according to the present invention, if provided with a magnetic circuit with a comparatively small magnet, may make the manufacturing cost comparatively less costly than a typical speaker device, for example, including a magnetic circuit with a comparatively large magnet forming a wide-width magnetic gap.
[0016] The speaker device according to one embodiment of the present invention may be used for audio equipment such as a TV broadcast receiver speaker, a monitor speaker, an in-car speaker, a mobile phone speaker, a headphone, a PC speaker and an audio device.
[0017] Hereinafter, a speaker device according to one embodiment of the present invention is described with reference to the drawings.
[0018]

Fig. 1(A) is a plan view of a speaker device 1 according to one embodiment of the present invention, Fig. 1(B) is a cross-sectional view taken along B-B line of the speaker device 1 shown in Fig. 1(A) and Fig. 1(C) is a cross-sectional view taken along C-C line of the speaker device 1 shown in Fig. 1(A).
Fig. 2(A) is a perspective view from the upper surface of a magnetic circuit 2 of the speaker device 1 shown in Fig. 1(B) and Fig. 1(C).
Fig. 2(B) is a perspective view from the back side of the magnetic circuit 2 of the speaker device 1 shown in Fig. 2(A) and Fig. 2(B).
Fig. 2(C) is a perspective view from the back side of a diaphragm 33, a voice coil bobbin 32 and a frame 4.
Fig. 3(A) is a bottom view that illustrates an enlarged major part of the back side of the speaker device 1 shown in Fig. 1(A). Fig. 3(B) is a cross-sectional view of a voice coil 31, the voice coil bobbin 32 and a damper 35 shown in Fig. 3(A).

[0019] The speaker device 1 according to this embodiment includes the magnetic circuit 2, a vibrating body 3 and the frame 4 as shown in Fig. 1(A) to Fig. 1(C).
[0020] In the speaker device 1, the diaphragm 33 has the longitudinal direction and the short-side direction when viewed from the vibration direction (sound emission direction SD) as shown in Fig. 1(A). Specifically, the diaphragm 33 has the planar shape that is orthogonal to the vibration transmission direction of the vibration source (diaphragm or voice coil). The planar shape has the longitudinal direction and the short-side direction and is formed, for example, in a racetrack shape, an elliptical shape, an oval shape, a rectangular shape, etc. In this embodiment, it is formed in a racetrack shape. The racetrack shaped diaphragm 33 is formed with a linear portion and a curved portion of a semicircular shape with prescribed curvature. The sound emission direction SD cor-

responds to one embodiment of the vibration transmission direction of the vibration source (diaphragm or voice coil) according to the present invention.

[Magnetic circuit 2]

[0021] The magnetic circuit 2 according to this embodiment has the planar shape orthogonal to the vibration transmission direction of the vibration source (diaphragm or voice coil) and the planar shape has the longitudinal direction and the short-side direction, as shown in Figs. 1(B), 1(C), and Figs. 2(A) to 2(C). Further, the magnetic circuit 2 has a linear magnetic gap MG1 formed along the longitudinal direction. Magnetic flux is generated in the magnetic gap MG1. The voice coil 31, which is driven by the magnetic circuit 2, is arranged in the magnetic gap MG1. The magnetic circuit 2 according to this embodiment has the planar shape orthogonal to the vibration transmission direction of the vibration source formed in an elongated shape (rectangular shape).

[0022] The magnetic circuit 2 specifically includes a yoke 21, a magnet 22 and a plate (pole piece) 23.

[0023] The yoke 21 is, for example, formed with a metal material such as iron. The yoke 21 has the longitudinal direction and the short-side direction. The yoke 21 according to this embodiment is formed in an elongated shape (rectangular shape) in the longitudinal direction. The yoke 21 specifically has a bottom face portion 211 and a lateral portion 212. In this embodiment, the bottom face portion 211 and the lateral portion 212 are integrally formed.

The cross-sectional shape in the short-side direction of the yoke 21 has the bottom face portion 211 and both lateral portions 212 substantially orthogonal to the bottom face portion 211. The cross-sectional shape has three sides making the outer periphery inside which a space is formed.

[0024] Specifically, the bottom face portion 211 is formed in a shape having the longitudinal direction and the short-side direction, and formed, for example, in a substantially rectangular shape such that the longitudinal direction is the same as the longitudinal direction of the diaphragm 33.

The lateral portions 212 are formed in a shape elongated in the sound emission direction SD at the ends in the short-side direction of the bottom face portion 211. Specifically, the lateral portions 212 have magnetic gaps formed only at the ends in the short-side direction of the bottom face portion 211, which has the ends in the short-side direction and in the longitudinal direction. In this embodiment, the lateral portions 212 are formed on both ends in the short-side direction. More specifically, the yoke 21 has the cross-sectional shape in the short-side direction formed in a substantially U-Shape.

Further, the bottom face portion 211 of the yoke 21 is not necessarily flat, and the lateral portions 212 may be inclined against the bottom face portion 211 or may be bending-worked. It is only necessary for the yoke 21 to have the bottom face portion 211 and both lateral portions 212 substantially orthogonal to the bottom face portion 211 inside which a space is formed.

[0025] The yoke 21 according to this embodiment has a cross-sectional shape formed in a U-shape, for example, by press working a flat iron plate.

[0026] The magnet 22 is arranged on the bottom face portion 211 of the yoke 21. The magnet 22 has a planar shape orthogonal to the vibration transmission direction of the vibration source and the planar shape has the longitudinal direction and the short-side direction. The magnet 22 according to this embodiment has the planar shape formed in a rectangular shape and the longitudinal direction is arranged along the longitudinal direction of the yoke 21. The magnet 22 is magnetized along the vibration direction of the diaphragm 33. A permanent magnet, for example, such as a neodymium system, a samarium· cobalt system, an alnico system, a rare earth system and a ferrite system may be used as the magnet 22.

The length LY22 in the longitudinal direction of the magnet 22 according to this embodiment is substantially the same as the length LY21 in the longitudinal direction of the yoke 21, as shown in Fig. 1(B). Further, the length in the short-side direction of the magnet 22 is shorter than the inside dimension of the yoke 21.

[0027] The plate 23 is arranged on the magnet 22. The plate 23 has the planar shape orthogonal to the vibration transmission direction of the vibration source and the planar shape has the longitudinal direction and the short-side direction. The plate 23 according to this embodiment is formed in a rectangular shape.

The height of the upper end of the plate 23 is configured to be the same as the height of the upper end of the yoke 21. For example, the thickness of the plate 23 is substantially the same as the thickness of the yoke.

[0028] The length LY23 in the longitudinal direction of the plate 23 according to this embodiment is substantially the same as the length LY22 in the longitudinal direction of the magnet 22 and the length LY21 in the longitudinal direction of the yoke 21. The length LY21, LY22, and LY23 may be the same or different from each other.

[0029] The magnetic circuit 2 has the linear magnetic gap MG1 formed between the inner periphery of the lateral portion 212 of the yoke 21 and the plate 23 along the longitudinal direction.

Further, in the magnetic circuit 2, the lateral portion 212 of the yoke 21 is formed at the end in the longitudinal direction of the bottom face portion 211 of the yoke 21 while no lateral portion is formed at the end in the longitudinal direction and an opening is formed at the end in the longitudinal direction.

[Vibrating body 3]

[0030] The vibrating body 3 is vibratably supported by the frame 4. Specifically, the vibrating body 3 includes the voice coil 31, the voice coil bobbin (voice coil support

part) 32, the diaphragm 33, the edge (diaphragm support part) 34 and the damper 35. The voice coil 31 corresponds to one embodiment of the voice coil according to the present invention and the diaphragm 33 corresponds to one embodiment of the vibrating body according to the present invention.

[0031] The voice coil 31 is joined to the diaphragm 33 directly or via the voice coil bobbin 32. The voice coil 31 is formed in a tubular shape and the planar shape viewed from the vibration direction, specifically the planar shape orthogonal to the vibration transmission direction of the vibration source has the longitudinal direction and the short-side direction.

Further, in the voice coil 31 according to this embodiment, the planar shape viewed from the vibration direction is formed in a racetrack shape as shown in Fig. 1(B), Fig. 1(C), Fig.2(C) and Fig. 3(A).

[0032] Specifically, the voice coil 31 has a linear portion 310 and a curved portion 313.

The linear portion 310 is formed along the longitudinal direction. Further, the linear portion 310 of the voice coil 31 is formed along in parallel with the longitudinal direction of the diaphragm 33. Further, the linear portion 310 has a first linear portion 311 and a second linear portion 312 (position reference).

[0033] The first linear portion 311 is arranged in a linear magnetic gap MG1 of the magnetic circuit 2.

The second linear portion 312 is connected to the first linear portion 311 and is elongated outside the end in the longitudinal direction of the bottom face portion 211 of the yoke 21, as shown in Fig. 1(B), Fig. 4(A) and Fig. 4 (B). Further, the second linear portion 312 is arranged along the longitudinal direction opposite to the lateral portion of a projection 231 of the voice coil 31.

[0034] The curved portion 313 is arranged outside the end in the longitudinal direction of the yoke 21 and is formed near the end of the voice coil 31. The curved portion 313 according to this embodiment is formed in a semicircular shape.

[0035] The voice coil bobbin 32 is formed in a tubular shape and the planar shape viewed from the vibration direction, specifically the planar shape orthogonal to the vibration transmission direction of the vibration source has the longitudinal direction and the short-side direction.

In the voice coil bobbin 32 according to this embodiment, the planar shape viewed from the vibration direction is formed in a racetrack shape as shown in Fig.2(C). The racetrack shape has two parallel linear portions and a curved portion of substantially semicircular shape formed at the ends of the linear portions. The voice coil bobbin 32 is formed, for example, with a metal material such as iron, resin, etc.

The voice coil bobbin 32 has the upper end joined to the diaphragm 33 and has the voice coil 31 wound around near the lower end.

[0036] In the speaker device 1 according to this embodiment, although the voice coil 31 is joined to the diaphragm 33 via the voice coil bobbin 32, joining of the voice coil 31 is not limited to this embodiment. For example, the voice coil 31 may be directly jointed to the diaphragm 33.

[0037] The diaphragm 33 is vibratably supported by the frame 4 and is vibrated when driving a speaker to emit a sound wave in a sound emission direction SD.

The diaphragm 33 specifically has a first diaphragm (central part) 331, and a second diaphragm (cone shaped diaphragm) 332.

[0038] The edge (diaphragm support part) 34 is annularly formed as shown in Figs. 1(A) to 1(C), and the radially cross-sectional shape is formed in a semicircular shape, a corrugated shape, etc. The outer periphery of the edge is fixed to the frame 4 with adhesive, etc. while the inner periphery is joined to the outer periphery of the diaphragm 33. The edge 34 and the diaphragm 33 may be integrally formed, for example, by using the same material.

[Damper 35]

[0039] The damper 35 has the one end joined to the voice coil 31 or the voice coil bobbin 32, and the other end joined to the frame 4 as shown in Fig. 1(B), Fig. 3 (A) and Fig. 3(B). The damper 35 vibratably supports the voice coil 31 along the vibration direction while restricts movement of the voice coil 31 in other directions. The planar shape of the damper 35, which is orthogonal to the vibration transmission direction of the vibration source (diaphragm or voice coil), is formed in a substantially rectangular shape.

[0040] The damper 35 according to this embodiment is arranged only between the end in the longitudinal direction of the voice coil 31 and the frame 4, and is not arranged between the end in the short-side direction of the voice coil 31 and the frame 4.

As such, the speaker device 1 according to the present invention may be made comparatively smaller than a typical speaker device in which, for example, a damper is arranged between the end in the short-side direction of the voice coil 31 and the frame 4.

[0041] Specifically, the damper 35 has a frame joint 351, a voice coil joint 352 and a corrugation part 353.

[0042] The frame joint 351 is formed at one end of the damper 35 and joined to the frame 4 with adhesive, etc. The voice coil joint 352 is joined to the curved portion 313 of the voice coil 31.

Specifically, voice coil joint 352 has a groove 3521 with concave-shaped cross-section that is joined to the lower end of the curved portion 313 of the voice coil 31.

[0043] The corrugation part 353 has a mold (concavo-convex portion 3531), which is formed between the frame joint 351 and the voice coil joint 352 and has corrugated shaped cross-section. The concavo-convex portion 3531 with corrugated shaped cross-section has the planar shape formed in a concentric arc shape. More specifically, the concavo-convex portion 3531 has the planar shape formed in a concentric arc shape corresponding

to the semicircular shape of the voice coil 31.

[0044] Further, in the above-mentioned damper 35, the groove 3521 and the concavo-convex portion 3531 have the planar shape formed in a concentric arc shape having the same center of curvature radius (center of curvature CP1) as the curved portion of the voice coil.

[0045] Further, damper 35 is formed such that the frame joint 351 and the voice coil joint 352 are located substantially on the same plane.

[0046] Fig. 4(A) is a plan view of a round shaped damper member 350. Fig. 4(B) is a plan view of the damper 35 made by cutting out the round shaped damper member 350 shown in Fig. 4(A). Fig. 4(C) is a cross-sectional view of the damper 35 shown in Fig. 4(B).

[0047] The damper 35 is made by cutting the round shaped damper member 350 in a substantially rectangular shape, for example, as shown in Figs. 4(A) to 4(C). Specifically, in this embodiment, the damper 35 shown in Figs. 4(B) and 4(C) is made by cutting in parallel the round shaped damper member 350 from the outer periphery to the inner periphery in a prescribed width, by cutting it such that the angle θ35 becomes substantially 120° with reference to the center (CP1) of the round shaped damper member 350 and by cutting both ends thereof, for example, as shown in Fig. 4(A).

[0048] Fig. 5(A) is a cross-sectional view of the damper 35 illustrating a method of manufacturing the speaker device according to one embodiment of the present invention. Fig. 5(B) is a cross-sectional view illustrating joining of the damper 35, the frame 4 and the voice coil 31.

[0049] Adhesive 902 is applied to the groove 3521 and the frame joint 351 of the damper 35 with an adhesive coater 901, for example, as shown in Fig. 5(A). The adhesive 902 may be, for example, 2-liquid-mixing type adhesive or rubber-system adhesive. The 2-liquid-mixing type adhesive may produce comparatively high hardness in a short time, for example, by mixing base compound and hardener.

[0050] Next, the damper 35 is joined to the voice coil 31 while the voice coil 31, voice coil bobbin 32, etc are reversed as shown in Fig. 5(B). Specifically, the voice coil 31 has the lower end of the curved portion joined to the groove 3521 of the voice coil joint 352 and the lower end of the voice coil 31 is fixed in the groove 3521 with adhesive 902 while the inner side and the outer side of the voice coil 31 are held between the inner surfaces of the groove 3521.

[Frame 4]

[0051] The frame 4 holds the magnetic circuit 2 and vibratably supports the diaphragm 33. For example, an opening 44 is configured to open in the sound emission direction substantially at the central part of the back side of the frame 4 as shown in Figs. 1(A) to 1(C). Specifically, the frame 4 includes a mating counterpart 40, a yoke upper end joint 41, a yoke lateral joint 42, a flat part 43 for joining the diaphragm periphery, a yoke longitudinal direction end joint 425 and a damper joint 45. The above yoke upper end joint 41, the yoke lateral joint 42, the flat part 43 for joining the diaphragm periphery, the yoke longitudinal direction end joint 425 and the damper joint 45 are integrally formed, for example, with a material such as resin and metal.

[0052] The mating counterpart 40 into which the magnetic circuit 2 is fitted is formed on the back side of the frame 4. Specifically, the yoke 21 of the magnetic circuit 2 is fitted into the mating counterpart 40. The mating counterpart 40 includes the yoke upper end joint 41, the yoke lateral joint 42 and the yoke longitudinal direction end joint 425. The yoke upper end joint 41 is formed near the opening on the back side of the frame 4 and joined to the yoke upper end with adhesive, etc.
The whole or a part of the upper end of the yoke 21 may be joined to the yoke upper end joint 41 of the frame 4.

[0053] The yoke lateral joint 42 is formed in an elongated shape along the longitudinal direction, projecting opposite the sound emission direction SD near the opening on the back side of the frame 4. The yoke lateral joint 42 is joined to a fitting surface 2125 of the outer periphery of the lateral portion 212 of the yoke 21 with adhesive, etc.

[0054] The yoke longitudinal direction end joint 425 is configured to bend from the end in the longitudinal direction to the inner side in the short-side direction of the yoke lateral joint 42 as shown in Fig. 4(A). The end in the longitudinal direction of the yoke is joined to the inner periphery of the yoke longitudinal direction end joint 425.

[0055] The flat part 43 for joining the diaphragm periphery is formed near the upper end of the frame 4. The diaphragm 33 is vibratably connected to the flat part directly or via the edge 34.

[0056] The opening 44 is formed substantially on the central part of the back side of the frame 4.
The magnetic circuit 2 is arranged near the opening 44. The length in the longitudinal direction of the opening 44 of the frame 4 is longer than the length in the longitudinal direction of the yoke. Further, the length in the longitudinal direction of the opening 44 is longer than the length in the longitudinal direction of the plate 23. Further, the length in the longitudinal direction of the opening 44 is longer than the length in the longitudinal direction of the voice coil 31. Further, the length in the short-side direction of the opening 44 of the frame 4 is longer than the length in the short-side direction of the voice coil 31. That is, the opening 44 of the frame 4 is at least larger than the planar shape of the voice coil 31.

[0057] The frame joint 351 of the damper 35 is joined to the damper joint 45, which is formed near the opening 44 as shown in Fig. 1(B), Fig. 3(A) and Fig. 5(B).
The voice coil 31 is electrically joined to the terminal part 7 arranged near the damper joint 45 via a speaker wire 701 arranged in the opening 44.
Further, the speaker wires 701 extending radially outside from both ends in the longitudinal direction of the voice coil 31, are configured to be symmetrical with reference to the center axis of the speaker. Provided with the speak-

er wires 701 of the above configuration, the voice coil 31 may be substantially balanced in weight at both ends in the longitudinal direction and may generate stable vibrations along the vibration direction when driving the speaker.

[0058] The terminal part 7 is electrically connected, for example, to an audio signal processing circuit, an amplifier, etc. of the audio device.

[Operation of speaker device]

[0059] The operation of the above speaker device 1 is described.

For example, a signal current is inputted to the terminal part 7 from the audio device. The signal current is inputted to the voice coil 31 from the terminal part 7 via the speaker wire 701. Lorentz force is developed in the voice coil 31 in response to the signal current and the voice coil 31 is vibrated along the vibration direction by the driving force. Further, the driving force is transmitted to the diaphragm 33 via the voice coil bobbin 32. The diaphragm 33 is vibrated along the vibration direction by the driving force, thereby outputting a sound wave in the sound emission direction (SD).

[0060] In the speaker device 1, the voice coil 31 can generate stable vibrations along the vibration direction when driving the speaker, since the above damper 35 is provided between the end in the longitudinal direction of the voice coil 31 and the frame 4.

[0061] As described above, the speaker device 1 according to the present invention includes:

the magnetic circuit 2 that has the yoke 21 having an elongated-shaped bottom face portion 211 and a lateral portion 212 forming a magnetic gap only at the end in the short-side direction of the bottom face portion 211 that has the ends in the short-side direction and the longitudinal direction, the magnet 22 arranged on the bottom face portion 211 of the yoke 21 and the plate 23 arranged on the magnet 22, forming the linear magnetic gap MG1 between the plate 23 and the yoke 21 in the longitudinal direction;

the diaphragm 33 whose planar shape orthogonal to the vibration transmission direction of the vibration source (diaphragm or voice coil) has the longitudinal direction and the short-side direction;

the voice coil 31 joined to the diaphragm 33 directly or via the voice coil bobbin 32, having the planar shape orthogonal to the vibration transmission direction formed in a racetrack shape with the linear portion 311 arranged along the magnetic gap MG1 of the magnetic circuit 2 and a substantially semicircular-shaped curved portion 313 formed on the end in the longitudinal direction elongating from the end in the longitudinal direction of the bottom face portion 211 of the yoke 21 to the outside in the longitudinal direction;

the frame 4 holding the magnetic circuit 2 and vibratably supporting diaphragm 33; and

the damper 35 having the frame joint 351 joined to the frame 4, the voice coil joint 352 joined to the curved portion 313 of the voice coil 31 and the corrugation part 353 formed in a corrugated cross-sectional shape between the frame joint 351 and the voice coil joint 352, wherein

the voice coil joint 352 has the groove 3521 in which the lower end of the curved portion of the voice 31 coil is joined, and the corrugation part 353 has a corrugated cross-sectional shaped mold (concavo-convex portion 3531) whose planar shape is formed in a concentric arc shape. As such, the voice coil 31 can generate comparatively stable vibrations along the vibration direction when driving the speaker. In addition, the small-size high-quality sound speaker device 1 may be provided with a simple configuration.

[0062] Further, in the above speaker device 1, the vibration in the short-side direction of the voice coil 31 may be restrained even if the above damper 35 is arranged only between the end in the longitudinal direction of the voice coil 31 and the frame 4, since the groove 3521 of the damper 35 is joined to the lower end of the curved portion of the voice coil 31 and the corrugated cross-sectional shape of the corrugation part 353 has the planar shape formed in a concentric arc shape with the same center of curvature as the substantially semicircular shape of the curved portion of the voice coil. As such, since the voice coil can generate comparatively stable vibrations along the vibration direction when driving the speaker device, a sound wave with high-quality sound may be outputted.

[0063] Further, the above damper 35 is arranged only between the end in the longitudinal direction of the voice coil 31 and the frame 4, and thus a comparatively small size speaker device 1 may be provided.

[0064] Further, since the above speaker device has the above damper 35 and the voice coil 31 can generate a stable vibration in the vibration direction, the magnetic gap of the magnetic circuit 2 may be limited to a comparatively narrow width. That is, a small size speaker device 1, which is provided with the magnetic circuit 2 forming a comparatively narrow-width magnetic gap, may be produced. Further, in the above speaker device, sensitivity of the voice coil 31 when driving the speaker is comparatively high.

[0065] Further, the speaker device1 according to the present invention, even if provided with a magnetic circuit with a comparatively small magnet, may output a sound wave with comparatively high sound pressure, since a narrow-width magnetic gap is formed.

Further the speaker device according to the present invention, if provided with a small magnet, may make the manufacturing cost comparatively less costly than a typical speaker device, for example, including a magnetic circuit with a comparatively large magnet forming a wide-

width magnetic gap.

[0066] The present invention is not limited to the above embodiments.

In the speaker device according to the above embodiment, although the planar shape of the diaphragm 33 viewed from the vibration direction is formed in a racetrack shape, the planar shape is not limited to this shape and may be formed, for example, in an elliptical shape, an oval shape, a rectangular shape, etc.

[0067] Although the above speaker device includes an inner-magnetic type magnetic circuit, it is not limited to this embodiment.

For example, the speaker device according to the present invention may include an outer-magnetic type magnetic circuit as shown in Figs. 6(A) and 6(B). Specifically, the outer-magnetic type magnetic circuit 2E includes a yoke 21E, a magnet 22E arranged on the yoke 21E and a plate 23E arranged on the magnet 22E, as shown in Figs. 6 (A) and 6(B).

[0068] Fig. 7 is a bottom view of an inner-magnetic type magnetic circuit 2H of the speaker device according to another embodiment of the present invention. The magnetic circuit of the speaker device according to the present invention is not limited to the above embodiment. For example, a concave portion may be formed inside the yoke on the central part of the end 219 in the longitudinal direction on the bottom face portion 211H of the yoke 21H as shown in Fig. 7. That is, the magnetic circuit has the longitudinal direction and the short-side direction and the plate 23 may project from the end in the longitudinal direction of the bottom face portion of the yoke.

[0069] Further, the magnetic circuit of the speaker device according to the present invention may not be limited to the above embodiment. For example, the yoke may be formed in a shape as shown in Figs. 8(A) to 8(D). Specifically, the yoke 21K may have the cross-sectional shape formed in a substantially U-shape as shown in Fig. 8(A). The yoke 21M may be formed such that the lateral portion upper end bends inside as shown in Fig. 8(B). The yoke 21N may be formed in a substantially V-shape as shown in Fig. 8(C). The yoke 21P may be formed such that the bottom face portion has a central projection part as shown in Fig. 8(D). That is, the yoke of the speaker device according to the present invention may be formed such that the cross-sectional shape has a bottom face portion and both lateral portions substantially orthogonal to the bottom face portion and a space is formed inside these portions.

Claims

1. A speaker device comprising:

a magnetic circuit that has a yoke having an elongated-shaped bottom face portion and a lateral portion forming a magnetic gap only at the end in the short-side direction of the bottom face portion that has the ends in the short-side direction and the longitudinal direction, a magnet arranged on the bottom face portion of the yoke and a plate arranged on the magnet, forming the linear magnetic gap between the plate and the yoke in the longitudinal direction;

a diaphragm having a planar shape orthogonal to the vibration transmission direction of a vibration source, the planar shape having the longitudinal direction and the short-side direction;

a voice coil joined to the diaphragm directly or via a voice coil bobbin, having the planar shape orthogonal to the vibration transmission direction formed in a racetrack shape with a linear portion arranged along the magnetic gap of the magnetic circuit and a substantially semicircular-shaped curved portion formed at the end in the longitudinal direction elongating from the end in the longitudinal direction of the bottom face portion of said yoke to the outside in the longitudinal direction;

a frame holding the magnetic circuit and vibratably supporting the diaphragm; and

a damper having a frame joint joined to the frame, a voice coil joint joined to the curved portion of the voice coil and a corrugation part formed in a corrugated cross-sectional shape between the frame joint and the voice coil joint, wherein

said voice coil joint has a groove in which the lower end of the curved portion of the voice coil is joined, and

said corrugation part has a corrugated cross-sectional shaped mold whose planar shape is formed in a concentric arc shape.

2. The speaker device according to claim 1, wherein said corrugated cross-sectional shaped mold of said corrugation part has the planar shape formed in a concentric arc shape with the same center of curvature as the substantially semicircular shape of the curved portion of said voice coil.

3. The speaker device according to claim 1 or 2, wherein

the lower end of the curved portion of said voice coil is joined and fixed with adhesive in the groove of said voice coil joint while the inner side and the outer side of the lower end of the voice coil are held between the inner surfaces of the groove.

4. The speaker device according to claim 3, wherein said damper is formed such that said frame joint and said voice coil joint are arranged substantially in the same plane.

5. The speaker device according to claim 4, wherein the planar shape of said damper is formed in a sub-

stantially rectangular shape in the vibration direction.

6. The speaker device according to claim 5, wherein said damper is arranged only between the end in the longitudinal direction of said voice coil and said frame while it is not arranged between the end in the short-side direction of said voice coil and said frame.

7. The speaker device according to claim 6, wherein said frame includes an opening formed on the back side of said voice coil and a damper joint to which a frame joint of said damper is joined, the damper joint being formed near the opening, and
said voice coil is electrically joined to a terminal part arranged near said damper joint via a speaker wire arranged at said opening.

FIG.1(A)

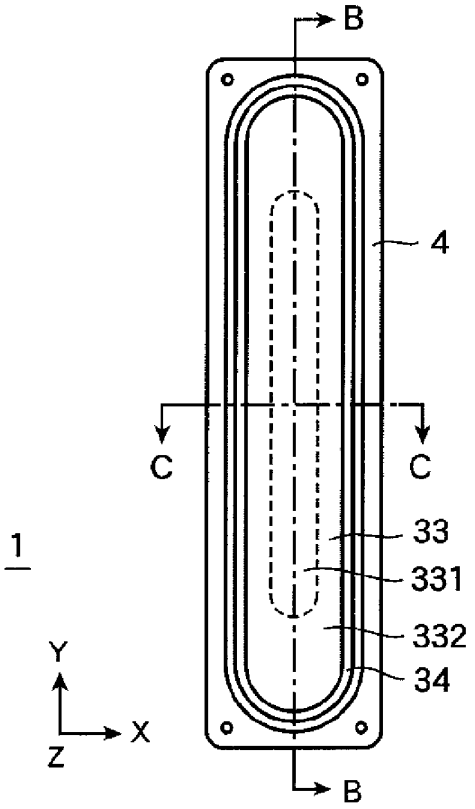


FIG.1(B)

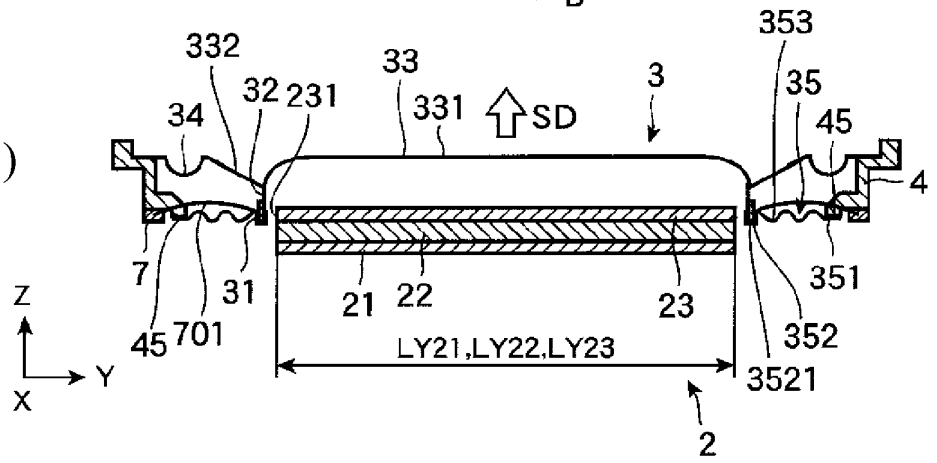


FIG.1(C)

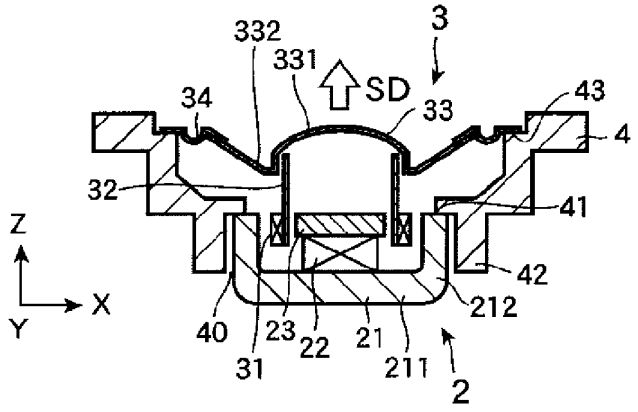


FIG.2(A)

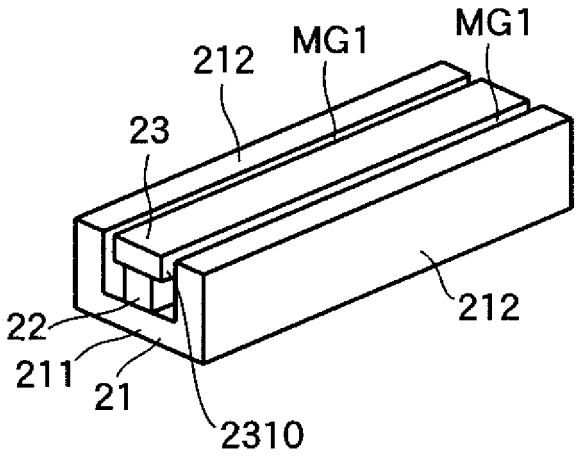


FIG.2(B)

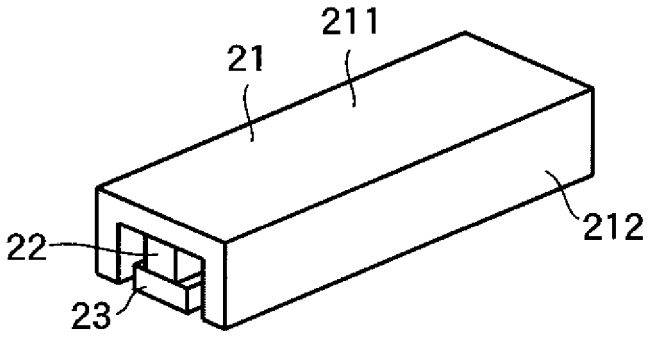


FIG.2(C)

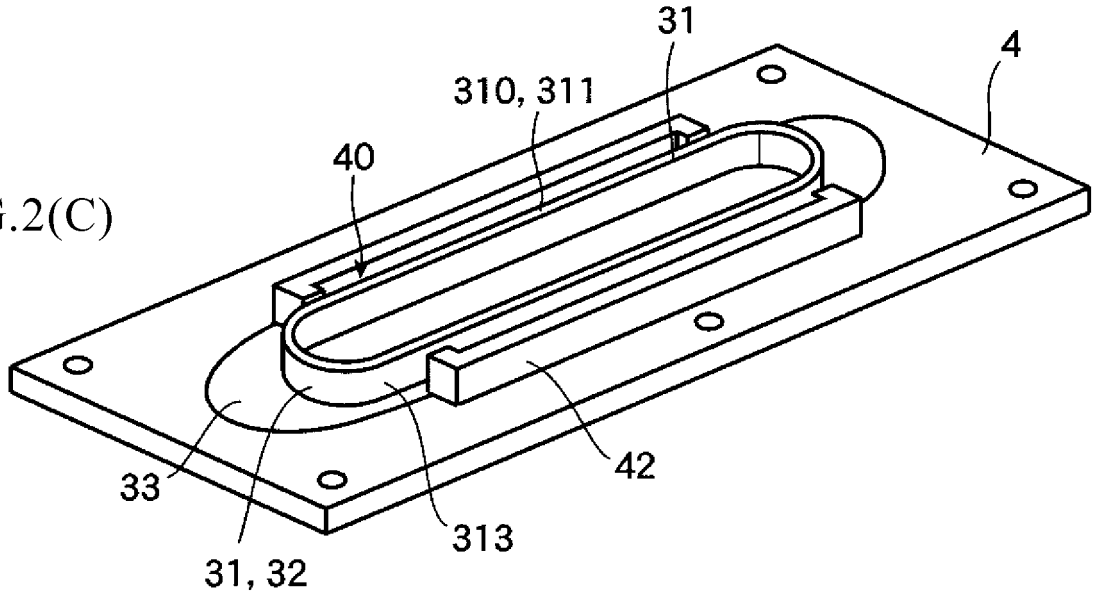
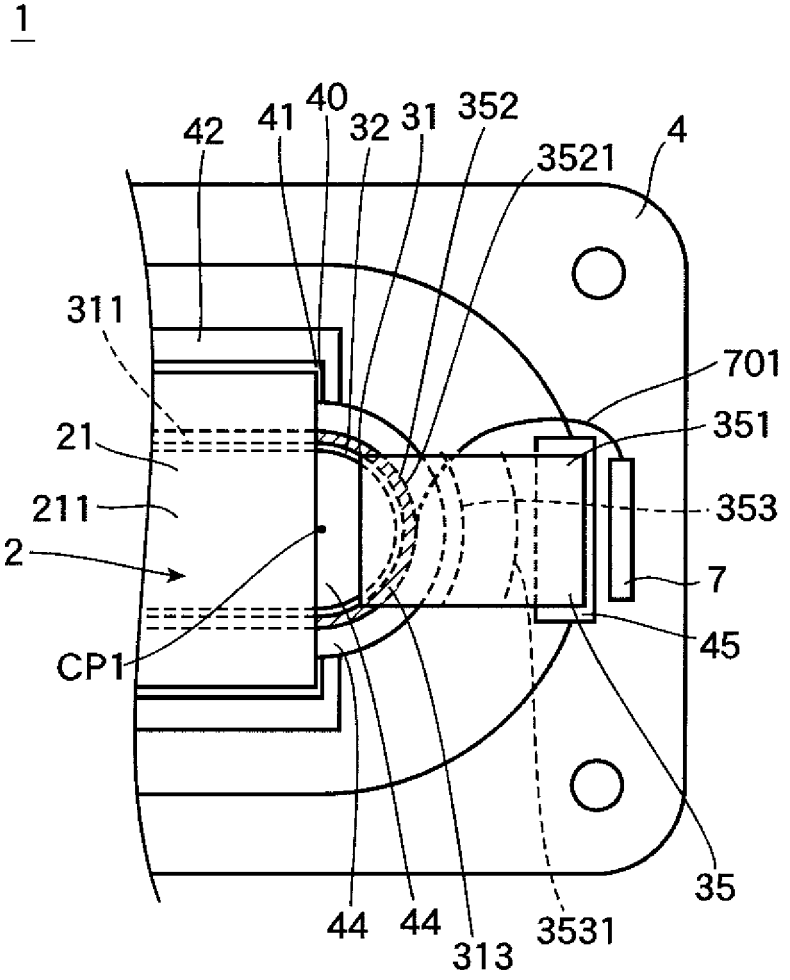


FIG.3(A)


1
42
41
40
32
31
352
3521
4
311
701
21
351
211
353
2
7
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CP1
35
44
44
313
3531

FIG.3(B)

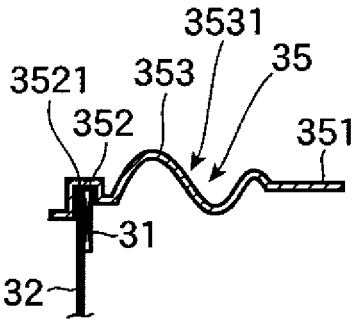

3531
35
3521
353
352
351
31
32

FIG. 4 (A)

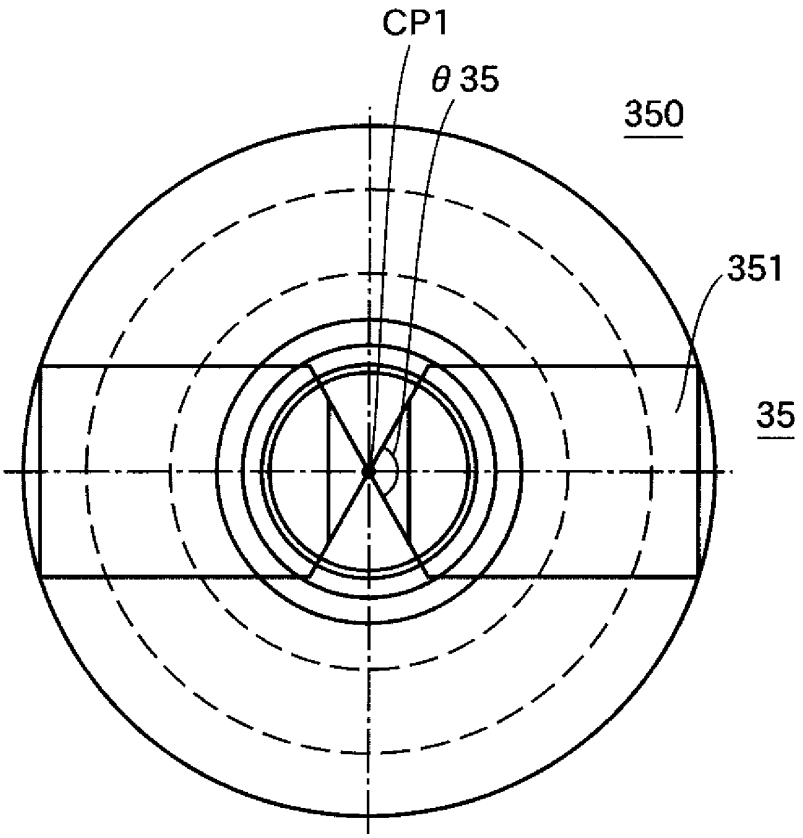


FIG. 4 (B)

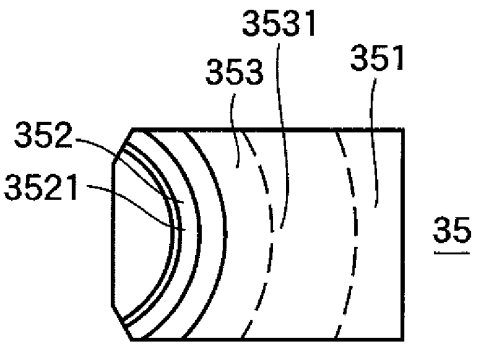


FIG. 4 (C)

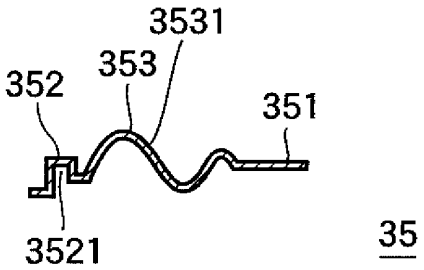


FIG. 5 (A)

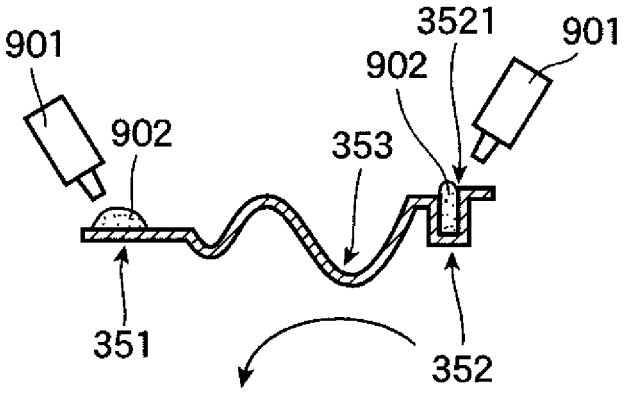


FIG. 5 (B)

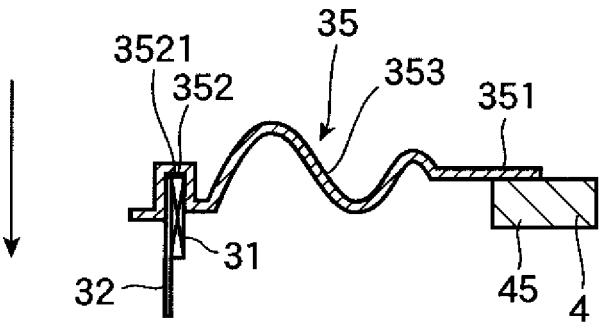


FIG. 6 (A)

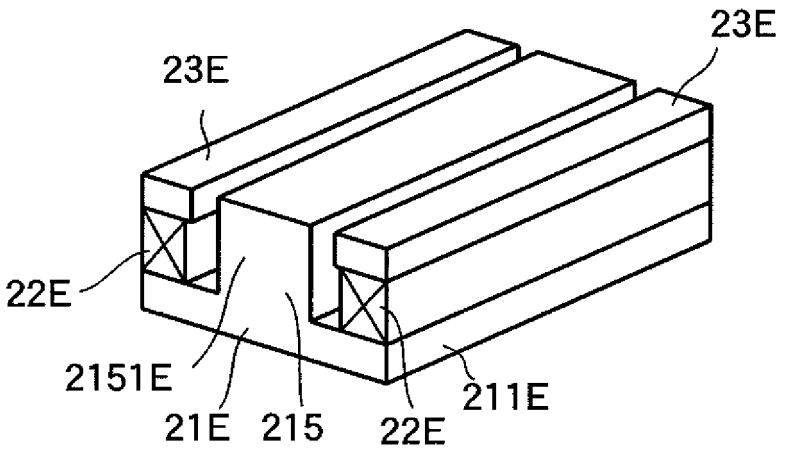


FIG. 6 (B)

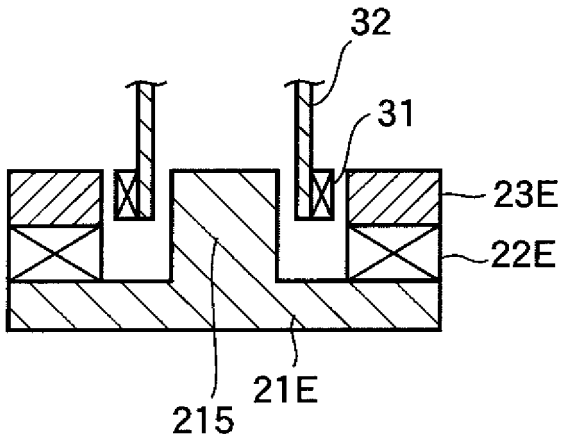


FIG. 7

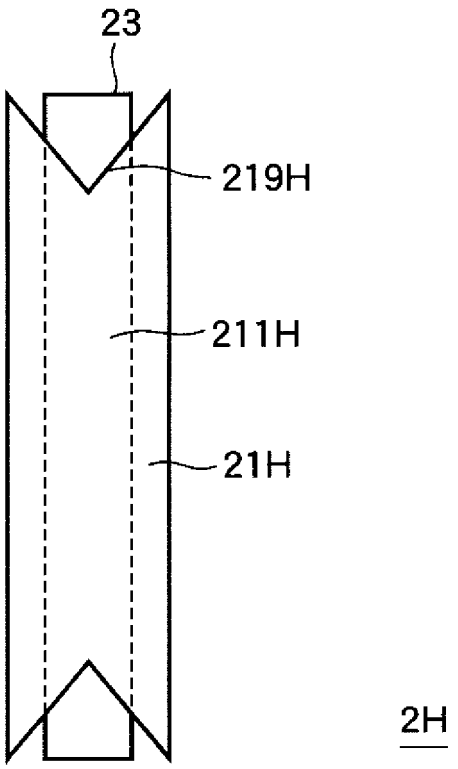
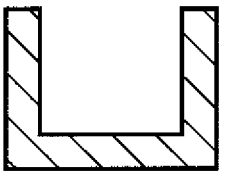
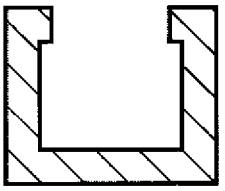


FIG. 8 (A)



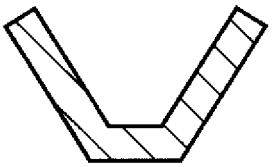
21K

FIG. 8 (B)



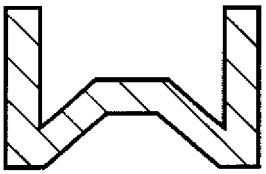
21M

FIG. 8 (C)



21N

FIG. 8 (D)



21P

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/063687

A. CLASSIFICATION OF SUBJECT MATTER
H04R9/04(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)
H04R9/04

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 1996-2008
Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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.
A	JP 2004-266337 A (Matsushita Electric Industrial Co., Ltd.), 24 September, 2004 (24.09.04), Full text; all drawings & US 2006/0050922 A1 & EP 1589782 A1 & WO 2004/068899 A1 & CN 1698396 A	1-7
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 35812/1983(Laid-open No. 143198/1984) (Onkyo Corp.), 25 September, 1984 (25.09.84), Full text; all drawings (Family: none)	1-7

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

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"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	Date of mailing of the international search report
22 August, 2008 (22.08.08)	02 September, 2008 (02.09.08)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

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Patent documents cited in the description

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