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Fujioka et al.

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(54) **LOUDSPEAKER**

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H04R 9/02 (2006.01)
H04R 9/04 (2006.01)

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CPC ***H04R 9/06*** (2013.01); ***H04R 9/027*** (2013.01); ***H04R 9/043*** (2013.01); ***H04R 9/046*** (2013.01)

(58) **Field of Classification Search**
CPC H04R 9/06; H04R 9/027; H04R 9/043; H04R 9/046
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(57) **ABSTRACT**

A loudspeaker including a magnetic circuit including a magnetic gap, a voice coil body inserted in the magnetic gap, a diaphragm attached to the voice coil body, transmission members arranged on a lateral side of the extend magnetic circuit along the magnetic circuit with a predetermined gap to transmit an electric signal to be input to the voice coil body, and a housing made of a resin and integrated with the magnetic circuit and the transmission members. The transmission members include externally exposed portions and internally exposed portions.

16 Claims, 5 Drawing Sheets

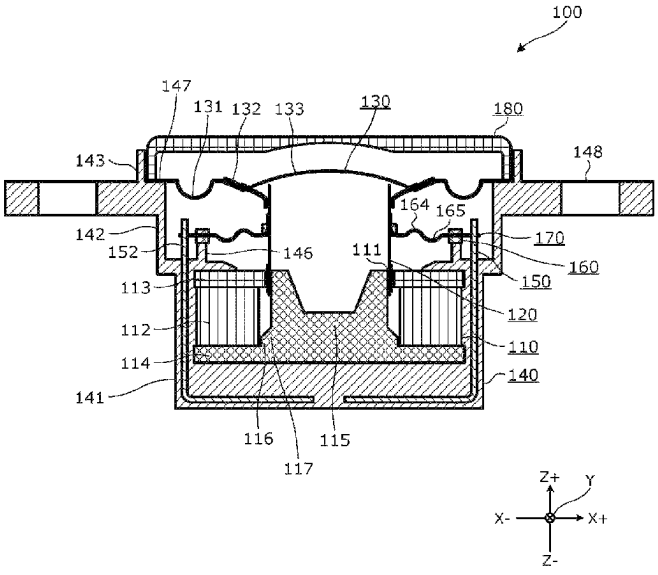

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FIG. 1

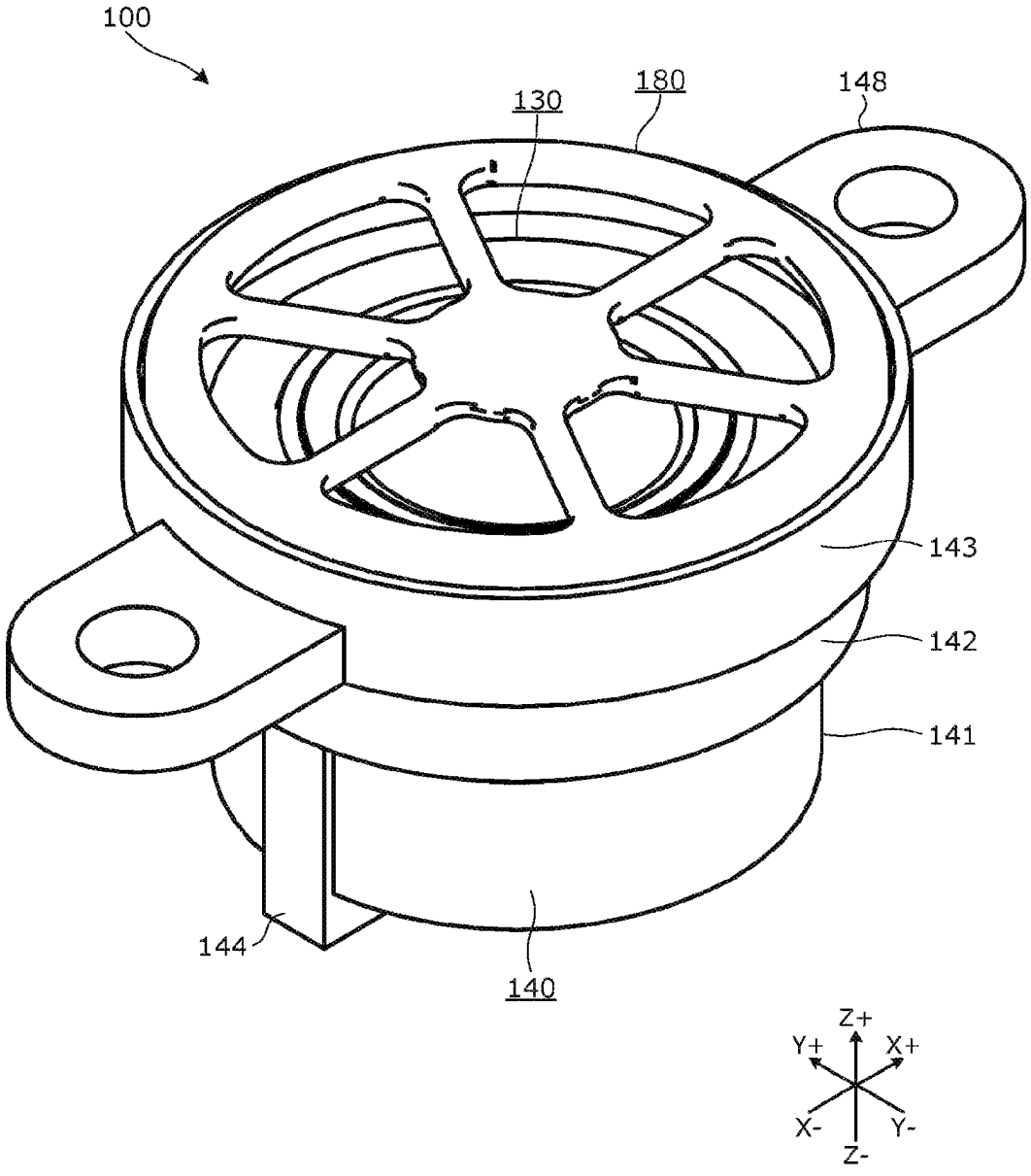


FIG. 2

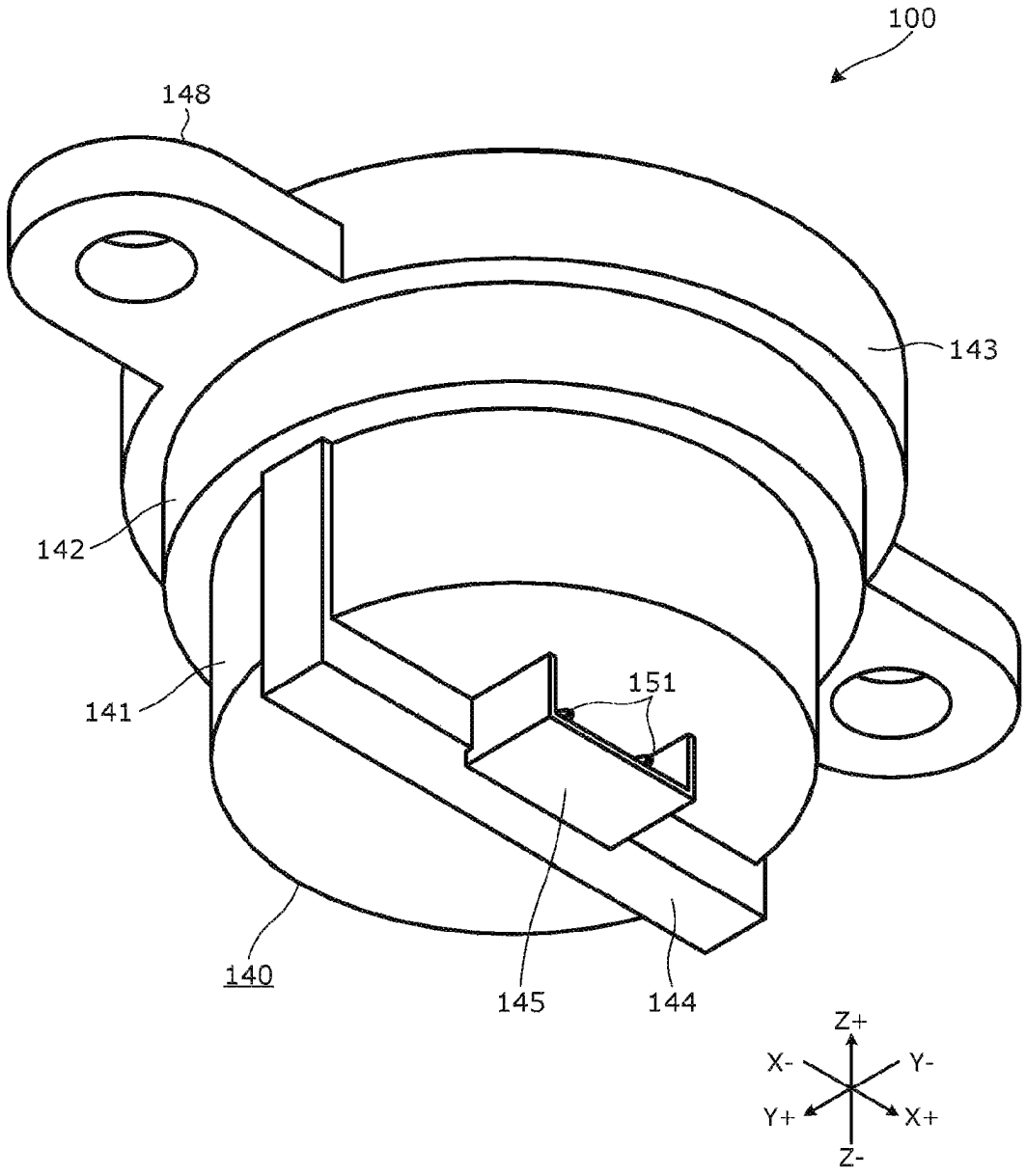
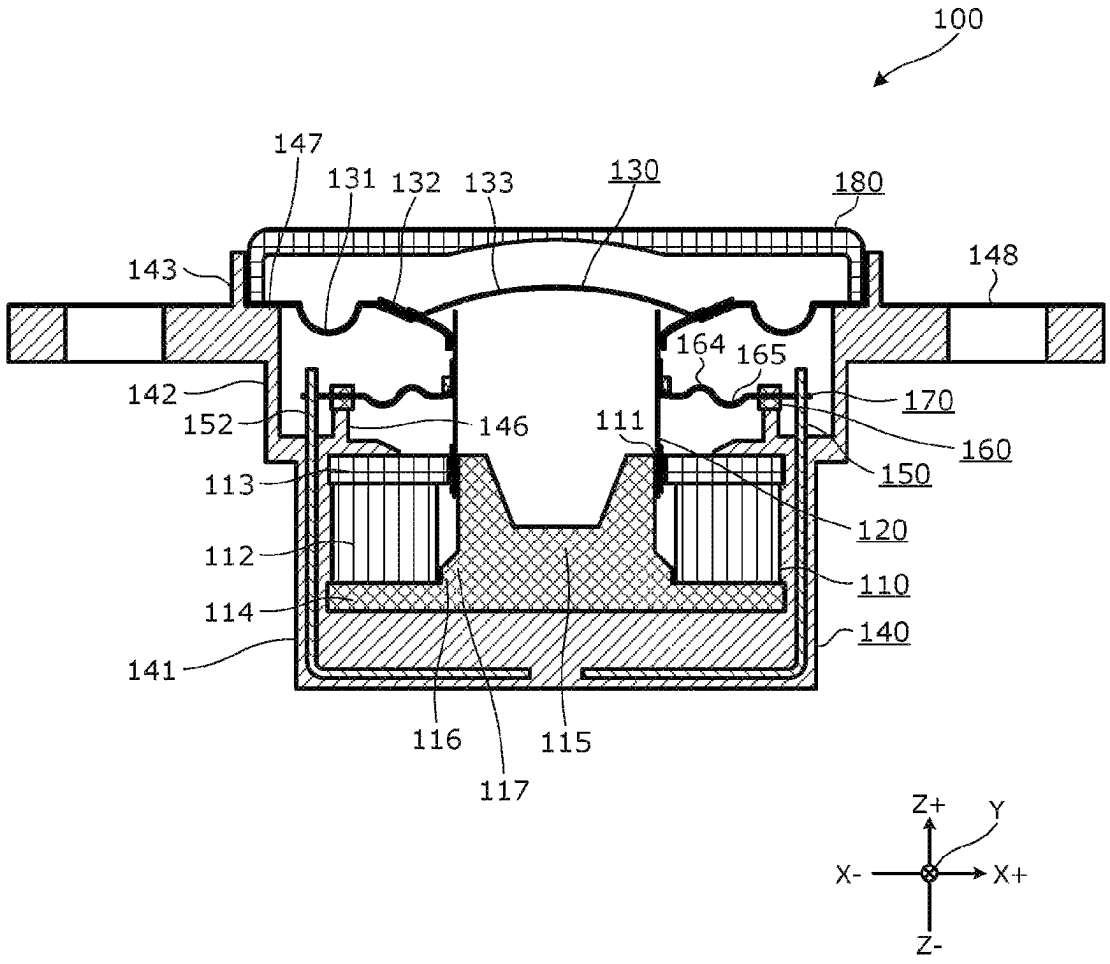


FIG. 3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111
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120
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114
140
141
116
115
117
Z+
Y
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X+
Z-

FIG. 4

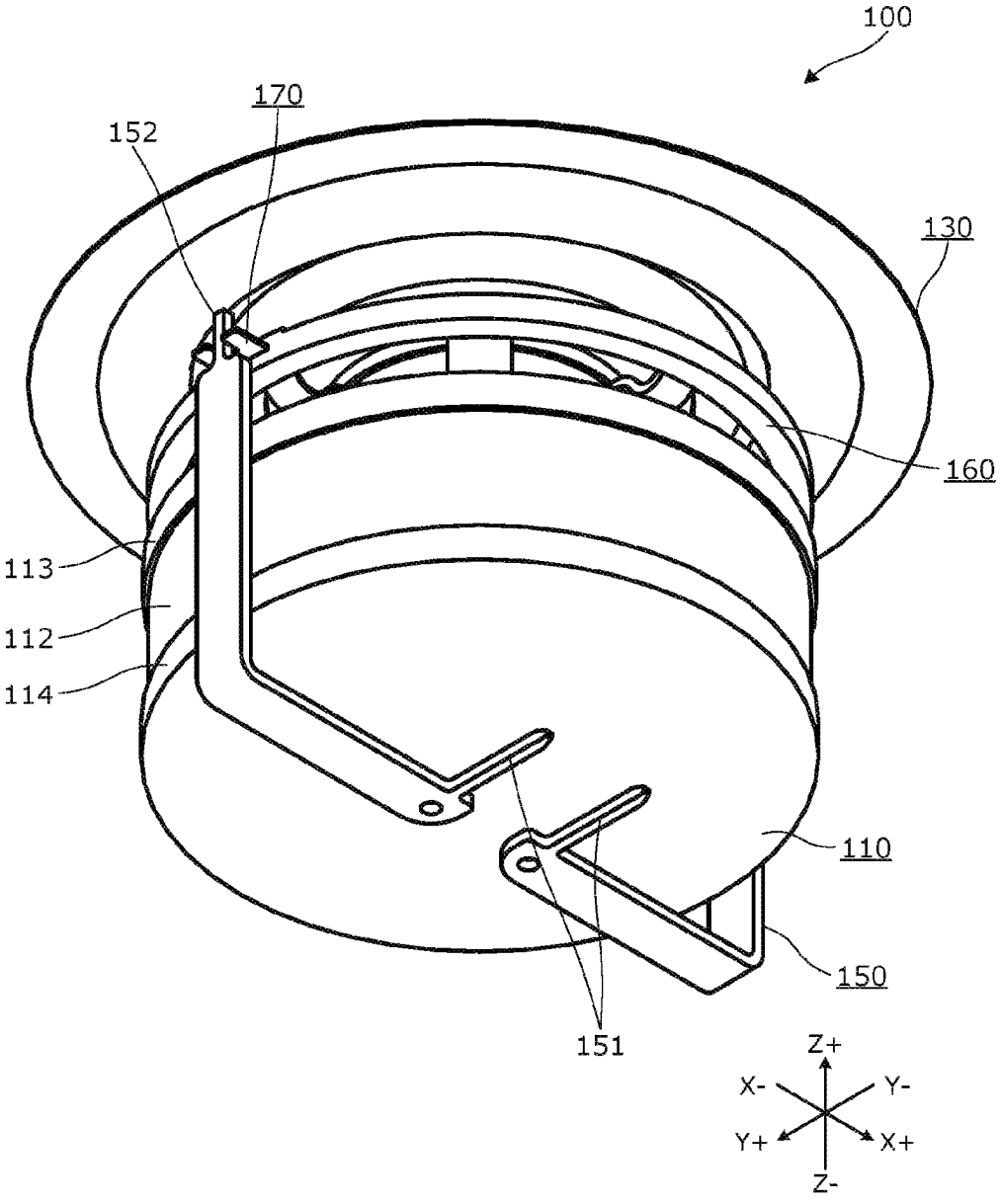
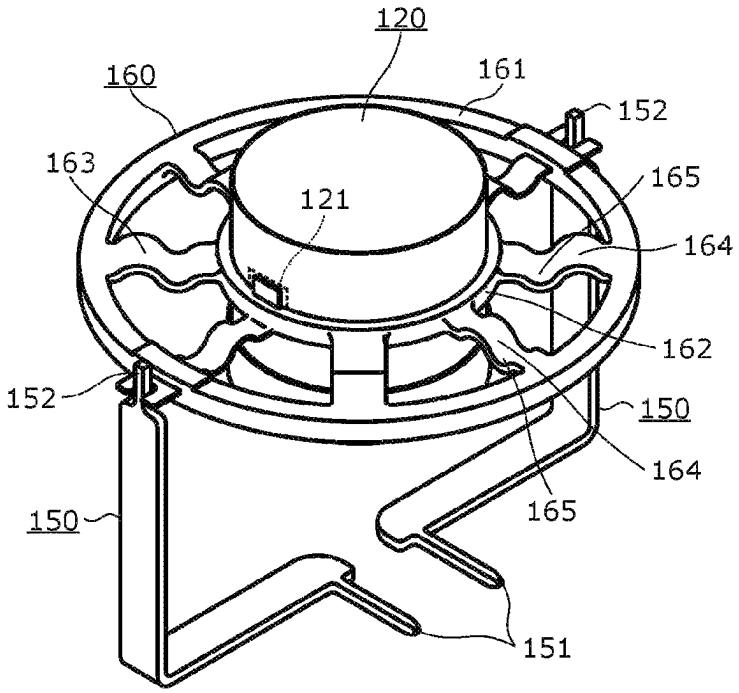


FIG. 5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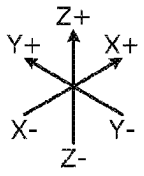
Z+
Y+
X+
X-
Y-
Z-

LOUDSPEAKER

CROSS REFERENCE TO RELATED APPLICATIONS

This is a continuation application of PCT International Application No. PCT/JP2021/044361 filed on Dec. 2, 2021, designating the United States of America, which is based on and claims priority of Japanese Patent Application No. 2020-209634 filed on Dec. 17, 2020, and Japanese Patent Application No. 2021-000995 filed on Jan. 6, 2021.

FIELD

The present disclosure relates to a loudspeaker which converts an electric signal to an acoustic sound.

BACKGROUND

Patent Literature (PTL) 1 discloses a loudspeaker including a magnetic circuit and a housing made of a resin, which are integrated by insert molding. PTL 2 discloses a loudspeaker including a damper including a conductor which transmits an electric signal, the damper being integrated with the conductor by insert molding.

CITATION LIST

Patent Literature

PTL 1: Japanese Unexamined Patent Application Publication No. H03-177198

PTL 2: Japanese Unexamined Patent Application Publication No. H09-307992

SUMMARY

However, the loudspeaker according to PTL 1 can be improved upon.

The present disclosure provides a loudspeaker capable of improving upon the above related art.

The loudspeaker according to an aspect of the present disclosure includes a magnetic circuit including a magnetic gap; a voice coil body arranged inserted in the magnetic gap; a diaphragm attached to the voice coil body; transmission members arranged on a lateral side of the magnetic circuit along the magnetic circuit with a predetermined gap to transmit an electric signal to be input to the voice coil body; and a housing made of a resin and integrated with the magnetic circuit and the transmission members. Here, the transmission members include externally exposed portions exposed outside the housing; and internally exposed portions exposed inside the housing.

The loudspeaker according to the present disclosure can be improved upon.

BRIEF DESCRIPTION OF DRAWINGS

These and other advantages and features of the present disclosure will become apparent from the following description thereof taken in conjunction with the accompanying drawings that illustrate a specific embodiment of the present disclosure.

FIG. **1** is a perspective view illustrating the loudspeaker according to an embodiment viewed from the front side.

FIG. **2** is a perspective view illustrating the loudspeaker according to the embodiment viewed from the rear side.

FIG. **3** is a cross-sectional view of the loudspeaker according to the embodiment.

FIG. **4** is a perspective view illustrating the positional relation among a magnetic circuit, transmission members, and the like where a housing is omitted.

FIG. **5** is a perspective view illustrating a damper, a voice coil body, and transmission members.

DESCRIPTION OF EMBODIMENTS

Hereinafter, an embodiment of the loudspeaker according to the present disclosure will be described with reference to drawings. The embodiment shown below is illustrative as examples to describe the present disclosure, and should not be construed as limitations to the present disclosure. For example, shapes, structures, materials, components, relatively positional relations, connection states, numeric values, expressions, contents of steps in methods, order of steps, and the like shown in the embodiments below are exemplary, and may contain contents not described below in some cases. When geometric expressions such as "parallel" and "orthogonal" are used, these expressions do not indicate mathematically strict meanings, and contain substantially allowable differences, deviations, and the like. Moreover, expressions such as "simultaneous" and "identical" also contain substantially allowable ranges.

The drawings are schematic diagrams subjected to appropriate emphasis, omission, or adjustment of ratios to describe the present disclosure, and have shapes, positional relations, and ratios different from actual shapes, positional relations, and ratios.

Hereinafter, a plurality of embodiments are generally described as one embodiment in some cases. Part of the contents described below will be described as optional components related to the present disclosure.

The loudspeaker according to one aspect of the present disclosure includes a magnetic circuit including a magnetic gap; a voice coil body arranged inserted in the magnetic gap; a diaphragm attached to the voice coil body; transmission members arranged on a lateral side of the magnetic circuit along the magnetic circuit with a predetermined gap to transmit an electric signal to be input to the voice coil body; and a housing made of a resin and integrated with the magnetic circuit and the transmission members. Here, the transmission members include externally exposed portions exposed outside the housing; and internally exposed portions exposed inside the housing.

According to this, because the transmission members extending along the magnetic circuit are integrated with the housing, breakage of the loudspeaker and drop-off of the transmission member can be avoided even when a force is applied, for example, when the externally exposed portion is pulled.

The loudspeaker according to another aspect of the present disclosure includes a magnetic circuit having a magnetic gap; a voice coil body arranged inserted in the magnetic gap; a diaphragm attached to the voice coil body; connection members connected to the voice coil body to transmit an electric signal to be input to the voice coil body; a housing which accommodates the magnetic circuit and the voice coil body; and a damper which connects the voice coil body to the housing. Here, the damper includes an outer ring which is in a ring shape and is attached to the housing; an inner ring which is in a ring shape and is attached to the voice coil body; and at least two arms each extending along a radial direction with respect to a winding axis of the voice coil body as a center to connect the outer ring to the inner ring,

and each of the connection members extends along the radial direction with respect to the winding axis of the voice coil body as a center, penetrates through the outer ring and the inner ring, and is held between the at least two arms by the damper.

According to this, a loudspeaker which can transmit an electric signal to the voice coil body while the rolling phenomenon is suppressed can be provided.

FIG. **1** is a perspective view illustrating the loudspeaker according to an embodiment viewed from a front side. FIG. **2** is a perspective view illustrating the loudspeaker according to the embodiment viewed from a rear side. FIG. **3** is a cross-sectional view of the loudspeaker according to the embodiment. As illustrated in these drawings, loudspeaker **100** includes magnetic circuit **110**, voice coil body **120**, diaphragm **130**, housing **140**, and transmission members **150**. In the case of the present embodiment, loudspeaker **100** includes damper **160**, connection members **170**, and cover **180**. In this specification and CLAIMS, with respect to magnetic circuit **110**, the side close to diaphragm **130** is expressed as the front side (Z+ side in the drawings), and the side close to diaphragm **130** is expressed as the rear side (Z− side in the drawings).

In the case of the present embodiment, loudspeaker **100** is illustrated as a loudspeaker provided on a moving body such as a vehicle. Loudspeaker **100** is a compact loudspeaker which can be embedded in a limited space of the moving body. In this specification, in some cases, the term "compact" is used to refer to a loudspeaker including housing **140** having an inner diameter of 10 cm or less. Although a compact loudspeaker is described, a large-sized loudspeaker may be used without limitation.

Magnetic circuit **110** is a part which generates a steady state magnetic flux in magnetic gap **111**, the steady state magnetic flux acting on a magnetic flux which changes based on an electric signal input to voice coil body **120**. Magnetic circuit **110** is integrally attached to housing **140** to be located behind diaphragm **130**, and includes magnetic gap **111** which is in an annular shape and is opposite to diaphragm **130**. Magnetic gap **111** is a gap in which a steady state magnetic flux is generated in the direction crossing the magnetic flux generated in voice coil body **120**.

In the case of the present embodiment, magnetic circuit **110** is of an external magnet type, and includes magnet **112** which is in a ring shape (cylindrical shape), and is magnetized and arranged coaxially with the winding axis of voice coil body **120**; front surface plate **113** which is in a ring shape and is arranged coaxially with the winding axis of voice coil body **120** on a surface of magnet **112** closer to diaphragm **130**; and rear surface member **114** arranged on a rear surface side of magnet **112** opposite to front surface plate **113**. Rear surface member **114** includes center pole **115** which is inserted from a central portion to a through hole of front surface plate **113** to define magnetic gap **111** with front surface plate **113**. Rear surface member **114** and center pole **115** are integrally formed.

Front surface plate **113** and rear surface member **114** including center pole **115** are made of a magnetic material. Magnet **112** preferably used is a neodymium magnet having high magnetic energy, for example. This can reduce the thickness of magnet **112**, and thus reduce the entire thickness of loudspeaker **100**. Furthermore, the weight can also be reduced. Alternatively, loudspeaker **100** may have an external magnet type structure including a ferrite magnet.

In the case of the present embodiment, magnet **112** is a permanent magnet having a through hole through which center pole **115** is inserted. Magnet **112** has an N pole at one end thereof and an S pole at the other end thereof in the thickness direction (Z-axis direction in the drawings). Front surface plate **113** is fixed to a surface of magnet **112** corresponding to one of the poles, and rear surface member **114** is fixed to a surface corresponding to the other of the poles. The outer diameter of magnet **112** is set to be smaller than the outer diameter of front surface plate **113**. The outer diameter of magnet **112** is set to be smaller than the maximum diameter of rear surface member **114** (excluding the portion corresponding to center pole **115**). Specifically, the dimensional relation among the outer diameters of magnet **112**, front surface plate **113**, and rear surface member **114** is implemented by setting the maximum value of the dimensional tolerance of the outer diameter of magnet **112** to be smaller than the minimum values of the dimensional tolerances of the outer diameters of front surface plate **113** and rear surface member **114**. When housing **140** is molded, a resin material is filled to the outer circumferential surface of magnet **112** which is a recessed portion of magnetic circuit **110**, and magnetic circuit **110** is tightly held by housing **140** due to an anchoring effect.

The distal end of center pole **115** defines a magnetic gap, and the proximal end thereof serves as positioner **116** having a larger diameter than that of the distal end to position magnet **112** inserted during assembling of magnetic circuit **110**. Magnet **112** is clearance fitted into positioner **116**, and the dimensions are set such that the outer circumferential surface of magnet **112** is not projected from the outer circumferential surfaces of rear surface member **114** and front surface plate **113** even in the state where part of the inner circumferential surface of magnet **112** is in abutment with part of the outer circumferential surface of positioner **116**.

Center pole **115** includes tapered portion **117** having a diameter reducing from positioner **116** toward the distal end to prevent chipping of magnet **112** when magnet **12** is inserted into center pole **115**.

Voice coil body **120** is a part having one end arranged inside magnetic gap **111** of magnetic circuit **110** and the other end attached to diaphragm **130**. Voice coil body **120** generates a magnetic flux based on an input electric signal, and vibrates in the winding axis direction (Z-axis direction in the drawings) as a result of interaction with a magnetic flux generated by magnetic circuit **110**.

The winding axis (central axis) of voice coil body **120** is arranged in the direction of vibration (amplitude) of diaphragm **130** (Z-axis direction in the drawings), and intersects orthogonal to the direction of the magnetic flux inside magnetic gap **111**.

In the case of the present embodiment, voice coil body **120** includes a coil configured of a single metallic wire material wound several times into an annular (cylindrical) shape, and a bobbin around which the coil is wound. The bobbin is a tubular member made of a material such as aluminum or a resin. The front end thereof is bonded to diaphragm **130**, and the rear end thereof is arranged inside magnetic gap **111**.

Voice coil body **120** included in loudspeaker **100** can be any other voice coil body than that described above, and a coil without a bobbin used in a microspeaker can be used, for example.

Diaphragm **130** is a member which is connected to voice coil body **120** and generates a sound by displacing diaphragm **130** in a back and forth direction (in the Z-axis direction in the drawings) from the neutral position based on the vibration of voice coil body **120** to vibrate the air. In the case of the present embodiment, the outer circumferential

portion of diaphragm **130** includes edge **131** having flexibility and resiliency, connection **132** which is in a coned shape and includes a hole into which voice coil body **120** is inserted to connect edge **131** to voice coil body **120**, and cap **133** which covers the hole of connection **132**.

Diaphragm **130** can be in any shape without limitation, and examples of the shape thereof include circular cone shapes, oval cone shapes, and pyramidal shapes. Diaphragm **130** may be in a flat shape such as a circular plate shape, an oval plate shape, or a flat plate shape. Diaphragm **130** may be made of any material without limitation, and examples of the material include paper and resins. Diaphragm **130** may be a single member, rather than a plurality of divided parts.

FIG. **4** is a perspective view illustrating the positional relation among the magnetic circuit, the transmission members, and the like where the housing is omitted. Transmission members **150** are members which extend on a lateral side of magnetic circuit **110** along magnetic circuit **110** with a predetermined gap, and transmit an electric signal to be input to voice coil body **120**. Transmission members **150** each include externally exposed portion **151** exposed outside housing **140**, and internally exposed portion **152** exposed inside housing **140**.

In the case of the present embodiment, transmission member **150** is a plate-like thin metal member molded by punching a metal plate, and is bent in an L-shape extending to the rear surface side of magnetic circuit **110** from the lateral side of magnetic circuit **110**. Such bending of elongated transmission members **150** allows transmission members **150** to be embedded inside housing **140** and integrated with housing **140**. Such a configuration can enhance strength in attachment of transmission member **150** to housing **140**. Transmission members **150** can be made of any material as long as they can transmit an electric signal. In the case of the present embodiment, brass or phosphorus bronze is used.

Two transmission members **150** are arranged in a positional relation of 180 degrees with respect to the winding axis of voice coil body **120** as a center. In such an arrangement, internally exposed portions **152** of transmission members **150** are symmetrically arranged with respect to the winding axis of voice coil body **120** as the center. Moreover, two connection members **170**, each of which each electrically connects internally exposed portion **152** to voice coil body **120**, are arranged radially with respect to the winding axis of voice coil body **120** as the center. In such a configuration, connection members **170** can suppress induction of the rolling phenomenon when voice coil body **120** reciprocally moves.

Externally exposed portion **151** of each transmission member **150** is projected in a direction crossing (orthogonal) to the bending direction of the body of transmission member **150**. Two externally exposed portions **151** are parallel. Externally exposed portions **151** of transmission members **150** function as male connection terminals to be connected to an external connector (not illustrated). Internally exposed portions **152** each have a width smaller than that of the body of transmission member **150**, and are inserted into forked portions at the distal ends of connection members **170**.

Housing **140** is a box-shaped member which accommodates and holds magnetic circuit **110**, and is integrated with magnetic circuit **110** and transmission members **150**. In the case of the present embodiment, housing **140** as a whole is in a bottomed cylindrical shape, and integrally includes holding portion **141** which integrally holds magnetic circuit **110** and transmission members **150**, intermediate portion **142** which accommodates damper **160** and the like, and frame **143** to which diaphragm **130** and cover **180** are attached. Moreover, housing **140** integrally includes projection **144** arranged along each transmission member **150** and projected outwardly from holding portion **141**. By forming projection **144** on the surface of holding portion **141**, strength of holding transmission member **150** is enhanced without increasing the total thickness of housing **140**.

Moreover, housing **140** integrally includes connector frame **145** which is arranged to surround externally exposed portions **151** of transmission members **150** and is fitted to hold an external connector (not illustrated) electrically connected to externally exposed portions **151**. Connector frame **145** is a portion to which an external connector for connecting loudspeaker **100** to an amplifier or the like is attached. When a male connector arranged at the distal end of the output cable of the amplifier is inserted to connector frame **145**, connector frame **145** enables electrical connection of the male connector to externally exposed portions **151** projected inside connector frame **145**. In such a configuration, when the electric wire connected to the external connector is pulled with a strong force, connector frame **145** can absorb and reduce a force applied to externally exposed portions **151**. Thus, failure such as deviation of transmission member **150** from housing **140** can be prevented. To be noted, connector frame **145** may have a shape to function as a male connector.

Housing **140** includes damper attachment **146** which is in a ring shape coaxial with the winding axis of voice coil body **120** and is projected forwardly from the front side of magnetic circuit **110** and to which damper **160** is attached, and diaphragm attachment **147** which is arranged outside damper attachment **146** concentrically therewith and to which edge **131** of diaphragm **130** is attached. Damper attachment **146** and diaphragm attachment **147** are integrally arranged inside intermediate portion **142**. Internally exposed portions **152** of transmission members **150** are exposed between damper attachment **146** and diaphragm attachment **147**.

Housing **140** can be configured of any material. In the case of the present embodiment, housing **140** is an insert molded article made of polycarbonate. The embrittlement temperature of polycarbonate is −100° C. or less, and loudspeaker **100** including housing **140** made of polycarbonate can have durability against a significant temperature change. When housing **140** is molded, magnetic circuit **110** and transmission members **150** are attached by insert molding. Housing **140** includes fixation portion **148** which is arranged integrally therewith and has a through hole for attaching housing **140** to another structured body.

FIG. **5** is a perspective view illustrating a damper, a voice coil body, and transmission members. Damper **160** is a member which assists linear moving of voice coil body **120** in the back and forth direction (Z-axis direction in the drawing), and includes outer ring **161**, inner ring **162**, and arms **163**.

Outer ring **161** is a portion which is in ring shape and is attached to damper attachment **146** of housing **140**. In the case of the present embodiment, outer ring **161** has a cross-section having a rectangular shape.

Inner ring **162** is a portion which is in ring shape and is attached to the outer circumferential surface of voice coil body **120**, and is arranged concentrically (coaxially) with outer ring **161**. In the case of the present embodiment, inner ring **162** has a cross-section having a rectangular shape as in outer ring **161**. In the case of the present embodiment, the thickness of inner ring **162** in the diameter direction is smaller than that of outer ring **161**, and the thickness thereof

in the back and forth direction (Z-axis direction in the drawing) is also smaller than that of outer ring **161**.

Arm **163** is a member which extends in a radial direction with respect to the winding axis of voice coil body **120** as the center to connect outer ring **161** and inner ring **162**, which are arranged coaxially with the winding axis of voice coil body **120**, like a bridge. It is sufficient that damper **160** includes at least two arms **163**. In the case of the present embodiment, damper **160** includes six arms **163**. Arms **163** are in a ribbon shape having a small thickness in the back and forth direction and a large width in the diameter direction, and are curved to form waves with respect to the winding axis of voice coil body **120** as the center. Such a configuration can ensure a long stroke of inner ring **162** reciprocally moving with voice coil body **120** with respect to outer ring **161**. In other words, each arm **163** includes peak **164** forwardly projected and valley **165** backwardly recessed, peak **164** and valley **165** continuing in the diameter direction. In the case of the present embodiment, each arm **163** includes one peak **164** and one valley **165**. When the curving state of a portion closer to outer ring **161** in one of adjacent arms **163** is peak **164**, the curbing state of a portion closer to outer ring **161** in the other arm **163** is valley **165**. That is, adjacent arms **163** in the diameter direction are curved to form waves, waves of one of adjacent arms **163** having phases opposite to those of waves of the other thereof. Adjacent arms **163** have different widths in the circumferential direction. In the case of the present embodiment, damper **160** includes four arms **163** having a larger width and two arms **163** having a smaller width. Arm **163** having a smaller width is arranged between two arms **163** having a larger width at an interval of 45 degrees. Two sets of arms **163** thus arranged are arranged at an interval of 180 degrees. Although in the case of the present embodiment, one arm **163** has the same width in the diameter direction, arm **163** may have a width varying in the diameter direction, for example, may be in a fan shape.

Each of connection members **170** is a member which is connected to voice coil body **120** to transmit an electric signal to be input to voice coil body **120**, and extends in a radial direction with respect to the winding axis of voice coil body **120** as the center. Each of connection members **170** penetrates through outer ring **161** and inner ring **162**, and is held between arms **163** by damper **160**. In the case of the present embodiment, connection members **170** are each in a ribbon shape having a smaller thickness in the back and forth direction and a larger width in the diameter direction. As in arm **163**, each connection member **170** includes one peak and one valley, and is curved to form waves having phases opposite to those of the waves of adjacent arms **163** in the diameter direction. Connection member **170** has a width in the circumferential direction different from those of adjacent arms **163**, and the width of connection member **170** is close to the width of arm **163** having a smaller width. Although in the case of the present embodiment, one connection member **170** has the same width in the diameter direction, connection member **170** may have a width varying in the diameter direction, for example, may be in a fan shape.

As described above, in damper **160**, connection members **170** and arms **163** are arranged in a radial direction with respect to the winding axis of voice coil body **120** as the center at an interval of 45 degrees, and arm **163** having a smaller width or connection member **170** is arranged between arms **163** which have a larger width and are arranged at an interval of 90 degrees. Arms **163** and their adjacent connection member **170** are curved to form waves having phases opposite to each other in the back and forth direction. Damper **160** is made of a resin, and outer ring **161**, inner ring **162**, and arms **163** are integrally molded. Connection members **170** are insert molded when damper **160** is integrally molded, and are integrated with damper **160**.

Connection member **170** can be configured of any material as long as it can transmit an electric signal. Connection member **170** demonstrates the same function as that of arm **163**, and is present as part of damper **160**. Accordingly, connection member **170** is preferably an elastic member having flexibility and resiliency. In the case of the present embodiment, brass or phosphorus bronze is used as in transmission member **150**. To be noted, to have flexibility and resiliency identical to those of arm **163** made of a resin, connection member **170** has a thickness smaller than that of arm **163** made of a resin.

Cover **180** is arranged on the front side of diaphragm **130** to protect diaphragm **130**. Edge **131** is clamped between cover **180** and diaphragm attachment **147** to improve attachment strength of diaphragm **130**.

Next, a method of producing loudspeaker **100** will be described. Magnetic circuit **110** and transmission members **150** are placed in a mold, polycarbonate for forming housing **140** is injected into the mold, followed by insert molding. Thus, an intermediate part is produced. This method enables one-step production of an intermediate part in which magnetic circuit **110** and transmission members **150** are held by housing **140** in a predetermined positional relation while insulation is ensured, thereby significantly simplifying the entire assembling process of loudspeaker **100**.

Voice coil body **120** is inserted into the hole of inner ring **162** of damper **160** until it reaches a predetermined position. The predetermined position indicates a position where ends of connection members **170** each penetrating through inner ring **162** and projecting to the front side (or the rear side) of inner ring **162** are in abutment with terminals **121** arranged on the outer circumferential surface of voice coil body **120**. Terminals **121** are electrically connected to the ends of the coil of voice coil body **120**. Voice coil body **120** and damper **160** are bonded with an adhesive or the like. Connection members **170** and terminals **121** of voice coil body **120** are electrically connected with solder or the like.

Connection **132** of diaphragm **130** is attached to voice coil body **120**, and cap **133** is attached to connection **132**.

Next, outer ring **161** of damper **160** is attached to damper attachment **146** of housing **140**, and voice coil body **120** is arranged inserted in the magnetic gap of magnetic circuit **110**. At this time, internally exposed portions **152** of transmission members **150** are inserted to the forked portions of the distal ends of connection members **170** to position damper **160** and voice coil body **120** with respect to housing.

Next, internally exposed portions **152** of transmission members **150** are electrically connected to connection members **170** with solder or the like. Next, edge **131** is attached to connection **132** and diaphragm attachment **147** with an adhesive or the like. Finally, cover **180** is inserted into frame **143** of housing **140**, and is attached to housing **140** to press the periphery of edge **131**. Thus, loudspeaker **100** is assembled.

In loudspeaker **100** described above, the material and shape of connection member **170** are set such that connection member **170** connects outer ring **161** of damper **160** and inner ring **162** thereof like a bridge to demonstrate the same function as that of arm **163**. Thus, the total weight of damper **160** and the elasticity performance thereof are balanced, enabling suppression of the rolling phenomenon of voice coil body **120**.

Moreover, connection members **170** are integrated with outer ring **161**, inner ring **162**, and arms **163** by insert molding. Such a configuration can stabilize precision of the positional relation between arms **163** and connection member **170**, further enabling suppression of the rolling phenomenon of voice coil body **120**. Moreover, the process of assembling loudspeaker **100** can be simplified.

In addition, transmission members **150** extending on at least the lateral side of magnetic circuit **110** and magnetic circuit **110** are integrated with housing **140**. Thus, positional deviation of transmission member **150** with respect to housing **140** or drop-off of transmission member **150** from housing **140** can be suppressed even when externally exposed portion **151** of transmission member **150** receives a strong force. Because a worker does not assemble housing **140**, transmission members **150**, and magnetic circuit **110**, precision of their positional relation can be stabilized, and the process of assembling loudspeaker **100** can be simplified.

Because the diameter of the outer circumferential surface of magnet **112** is smaller than those of the outermost circumferential surfaces of front surface plate **113** and rear surface member **114**, a resin can be filled into the space between front surface plate **113** and rear surface member **114**, and thus magnetic circuit **110** can be tightly fixed to housing **140** due to an anchoring effect.

Because transmission members **150** are symmetrically arranged in a positional relation of 180 degrees, a resin can be evenly injected near transmission members **150** during insert molding, and thermal impact or the like can be relaxed.

To be noted, the present disclosure is not limited to the embodiment above described. For example, embodiments according to the present disclosure may include embodiments including any combination of the components described in this specification, and other embodiments implemented by excluding some of the components. The present disclosure also covers modifications obtained by subjecting the above embodiment to a variety of modifications conceived by persons skilled in the art without departing from the gist of the present disclosure, namely, without departing from the meanings of the terms and expressions described in CLAIMS.

For example, although arms **163** of damper **160** excluding connection members **170** integrated with damper **160** have been described as portions made of a resin and integrated with outer ring **161** and inner ring **162**, at least two of arms **163** may be made of a metal identical to that of connection members **170**. In this case, arms **163** made of a metal other than connection members **170** are not electrically connected to voice coil body **120**, and function as dummies of connection members **170**.

Loudspeaker **100** can include any type of magnetic circuit **110**, and magnetic circuit **110** of an internal magnet type may be used.

Although the case where magnetic circuit **110** and transmission members **150** are integrated with housing **140** has been described, magnetic circuit **110** and transmission members **150** may be separated from housing **140**, and magnetic circuit **110** may be assembled by a worker or the like. Housing **140** may be made of a material other than a resin.

To reduce the lowest resonance frequency of loudspeaker **100** and improve the sound quality, loudspeaker **100** may have a damperless configuration.

Alternatively, damper **160** may be attached to diaphragm **130**, rather than to voice coil body **120**.

FURTHER INFORMATION ABOUT TECHNICAL BACKGROUND TO THIS APPLICATION

The disclosures of the following patent applications including specification, drawings, and claims are incorporated herein by reference in their entirety: Japanese Patent Application No. 2020-209634 filed on Dec. 17, 2020, and Japanese Patent Application No. 2021-000995 filed on Jan. 6, 2021, and PCT International Application No. PCT/JP2021/044361 filed on Dec. 2, 2021.

INDUSTRIAL APPLICABILITY

The present disclosure can be used as loudspeakers which convert an electric signal to an acoustic sound.

The invention claimed is:

1. A loudspeaker comprising:
a magnetic circuit including a magnetic gap;
a voice coil body arranged inserted in the magnetic gap;
a diaphragm attached to the voice coil body;
transmission members arranged on a lateral side of the magnetic circuit along the magnetic circuit with a predetermined gap to transmit an electric signal to be input to the voice coil body, the transmission members extending to a rear surface side of the magnetic circuit from the lateral side of the magnetic circuit; and
a housing made of a resin and integrated with the magnetic circuit and the transmission members,
wherein the transmission members include:
externally exposed portions exposed outside the housing; and
internally exposed portions exposed inside the housing.

2. The loudspeaker according to claim **1**,
wherein the externally exposed portions of the transmission members are connection terminals to be connected to an external connector, and
the housing integrally includes a connector frame which holds the external connector.

3. The loudspeaker according to claim **1**,
wherein the transmission members are each a metal plate.

4. The loudspeaker according to claim **1**,
wherein the transmission members which total two are arranged in a positional relation of 180 degrees with respect to a winding axis of the voice coil body as a center.

5. The loudspeaker according to claim **1**,
wherein the magnetic circuit includes:
a magnet which is an a ring shape and is arranged coaxially with the winding axis of the voice coil body;
a rear surface member arranged on a rear surface side of the magnet; and
a front surface plate which is in a ring shape and is arranged on a front surface side of the magnet coaxially with the winding axis, and
the magnet has an outer diameter smaller than an outer diameter of the front surface plate.

6. The loudspeaker according to claim **1**,
wherein the magnetic circuit includes:
a magnet which is in a ring shape and is arranged coaxially with the winding axis of the voice coil body;
a rear surface member arranged on the rear surface side of the magnet; and

a front surface plate which is in a ring shape and is arranged on a front surface side of the magnet coaxially with the winding axis, and

the rear surface member includes:

a positioner inserted in the magnet to position the magnet; and

a tapered portion having a diameter reducing from the positioner toward a front direction.

7. The loudspeaker according to claim **1**,

wherein the housing integrally includes:

a damper attachment which is in a ring shape coaxial with the winding axis of the voice coil body and is projected forwardly from a front side of the magnetic circuit and to which a damper is attached; and

a diaphragm attachment which is arranged outside the damper attachment concentrically with the damper attachment and to which the diaphragm is attached, and

each of the internally exposed portions of the transmission members is exposed between the damper attachment and the diaphragm attachment.

8. The loudspeaker according to claim **1**,

wherein the housing is formed of polycarbonate.

9. A loudspeaker comprising:

a magnetic circuit having a magnetic gap;

a voice coil body arranged inserted in the magnetic gap;

a diaphragm attached to the voice coil body;

connection members connected to the voice coil body to transmit an electric signal to be input to the voice coil body;

a housing which accommodates the magnetic circuit and the voice coil body; and

a damper which connects the voice coil body to the housing,

wherein the damper includes:

an outer ring which is in a ring shape and is attached to the housing;

an inner ring which is in a ring shape and is attached to the voice coil body; and

at least two arms each extending along a radial direction with respect to a winding axis of the voice coil body as a center to connect the outer ring to the inner ring, and

each of the connection members extends along the radial direction with respect to the winding axis of the voice coil body as a center, penetrates through the outer ring and the inner ring, and is held between the at least two arms by the damper.

10. The loudspeaker according to claim **9**,

wherein the connection members are curved to form waves with respect to the winding axis as the center.

11. The loudspeaker according to claim **9**,

wherein the at least two arms are curved to form waves with respect to the winding axis as the center.

12. The loudspeaker according to claim **10**,

wherein the at least two arms adjacent to each other are curved to form waves, waves of one of the at least two arms having phases opposite to phases of waves of an other of the at least two arms.

13. The loudspeaker according to claim **9**,

wherein the at least two arms adjacent to each other have different widths in a circumferential direction.

14. The loudspeaker according to claim **9**,

wherein the at least two arms are made of a metal.

15. The loudspeaker according to claim **9**,

wherein the outer ring, the inner ring, and the at least two arms are integrated, and the connection members are insert molded when the damper is formed.

16. The loudspeaker according to claim **15**,

wherein each of the connection members is insert molded with the outer ring and the inner ring.

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