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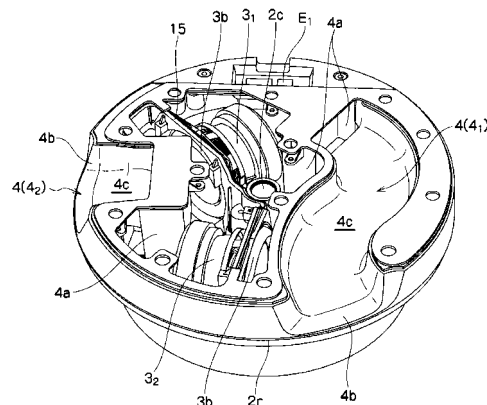
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(54) **SPEAKER DEVICE**

(57) Even in limited installation space of a speaker device 1, the air chamber and so forth of a cabinet is efficiently secured, whereby a preferable acoustic characteristic in a low frequency range can be acquired. A speaker device 1 comprises a cabinet 2 configured with a housing part 10 and a cap part 13, a wall part 15 arranged in the cabinet 2, partitioning the space in the cabinet 2 by extending from the central part 2c to two different positions in the outer periphery part 2r of the cabinet 2, and a plurality of speaker units 3₁, 3₂ arranged in the cabinet 2 and attached to the wall part 15, wherein a first speaker unit 3₁ is arranged in one space 2S₁ partitioned by the wall part 15 with the sound emission surface of the first speaker unit 3₁ being directed to the other space 2S₂ partitioned by the wall part 15, while a second speaker unit 3₂ is arranged in the other space 2S₂ with the sound emission surface being directed to said one space 2S₁, and a duct 4 (4₁, 4₂) is provided in the cabinet 2 to communicate between the space 2S₁, 2S₂ and the outside.

Fig. 3



Description

FIELD OF THE INVENTION

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

BACKGROUND OF THE INVENTION

[0002] In a speaker device equipped with a cabinet and a speaker unit, those which have a bass reflex type cabinet for actively utilizing the sound emitted from the rear side of a speaker unit (diaphragm) are known. A bass reflex type or an acoustimass type cabinet forms a given volume of space on the rear side of a speaker unit, and one end of the space is opened while the other end has a duct which is opened toward the sound emission side.

[0003] A patent literature 1 that is shown below describes a small-sized and light-weighted speaker device capable of reproducing a low frequency range, wherein a speaker unit is attached at the central part of the rear surface board of a speaker box, and a low-frequency reproduction duct is provided on the sound emission side of the speaker unit while a bass-reflex duct is provided on the rear side of the speaker unit, and the low-frequency reproduction duct is constituted of a first and a second duct parts, wherein the first duct part extends along the rear surface board and the upper surface board to open at the upper front surface of the speaker unit while the second duct part extends along the rear surface board and the bottom surface board to open at the lower front surface of the speaker box.

[0004] Further, a patent literature 2 that is shown below describes a speaker device comprising a first duct elongatedly formed in the direction orthogonal to the emission direction of sound pressure that is emitted from the front side of a speaker unit and a second duct elongatedly formed with one end being joined to the first duct, wherein the speaker unit is arranged at the joining portion of the first duct and the second duct, and the sound pressure emitted from the rear side of the speaker unit is transmitted to the first duct side via the second duct, joined together with the sound pressure emitted from the front side of the speaker unit, and then released to the outside from the first duct.

[0005]

[Patent literature 1] Japanese laid-open patent publication 11-136786

[Patent literature 2] Japanese patent 3410206

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006] A speaker device equipped with the aforementioned cabinet is required to secure space for arranging

a speaker device in accordance with the volume of the cabinet, whereby the installation position of a speaker device is subject to limitation. When adopting the aforementioned bass reflex type or acoustimass type cabinet, an air chamber is provided on the opposite side of the sound emission side of a speaker unit and a duct is required to be elongatedly formed from the air chamber toward the sound emission side, whereby it becomes difficult to install a speaker device in narrow space. In addition, when a plurality of speaker units is provided, in order to acquire a preferable acoustic characteristic in low frequency range, it is required to secure a sufficient volume of the air chamber, and thus the installation position of a speaker device is subjected to further limitation unless the speaker device is efficiently arranged.

[0007] When a speaker device is arranged in limited space such as the inside of a car, it is effective in improving utilization efficiency to arrange a speaker device by using space which is to be dead space under ordinary circumstances. When the space which is to be dead space under ordinary circumstances is utilized as an air chamber, the volume of the air chamber is subject to constraints, and therefore it becomes necessary to create an efficiently way of making the partition of the cabinet and making the arrangements of the speaker unit and the duct.

[0008] For example, when a speaker device is arranged in a spare tire housed in a car body, constraints arise such that the outer diameter of the speaker device is required to be smaller than the inner diameter of the spare tire or smaller than the outer diameter of a wheel. Hereby, the outer diameter as well as the shape of a cabinet is necessarily subject to constraints. In such a speaker device, for example, when an acoustimass type cabinet is employed, a preferable acoustic characteristic in a low frequency range cannot be acquired unless there is ingenuity in the arrangement of an air chamber or a duct on the front side and the rear side of the speaker unit. Further, when two or more speaker units are arranged, further efficient arrangements and configurations of an air chamber and a duct including the arrangements of the speaker units are required.

[0009] In a speaker device for low-frequency reproduction wherein a speaker unit is arranged in a cabinet, the diameter of the diaphragm of a speaker unit is subject to limitation due to the height of a cabinet, whereby the diameter of the diaphragm for acquiring desired large sound pressure may not be established depending on the installation space of the speaker device. In this case, when a large sound pressure is sought by increasing the amplitude of vibration of the diaphragm, creating a design for the support system and the drive system of a speaker unit becomes difficult. As a result a problem arises due to distortion that is frequently generated in the reproduced sound pressure.

[0010] Therefore, an object of the present invention is to address such a problem. That is, it is an object of the present invention to provide a speaker device wherein a

preferable acoustic characteristic in a low frequency range can be acquired by effectively securing an air chamber and so forth in a cabinet even in limited installation space of the speaker device; a bass reflex type cabinet can be adopted by efficiently arranging an air chamber and a duct even when the outer diameter and the shape of a cabinet is limited and a comparatively large air chamber can be secured even when a plurality of speaker units is used while making efficient use of the space in the cabinet; and in a speaker device for low-frequency reproduction with a speaker unit being arranged in the cabinet, even when the diameter of the diaphragm is subject to limitation due to the installation space of the speaker device, large sound pressure as well as high-quality reproduced sound can be generated.

MEANS FOR SOLVING THE PROBLEM

[0011] In order to achieve such an object, a speaker device according to the present invention includes at least the following configuration.

[0012] A speaker device includes a cabinet configured with a housing part and a cap part, a wall part arranged in the cabinet, partitioning a space in the cabinet by extending from a central part to two different positions in an outer periphery part of the cabinet, and a plurality of speaker units arranged in the cabinet and attached to the wall part, wherein a first speaker unit is arranged in one space partitioned by the wall part with a sound emission surface of the first speaker unit being directed to the other space partitioned by the wall part, while a second speaker unit is arranged in the other space with the sound emission surface being directed to the one space, and a duct is provided in the cabinet to communicate between the space and the outside.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 is a perspective view illustrating the outer appearance of the configuration of a speaker device according to one embodiment of the present invention;

Fig. 2 is a view illustrating the internal structure of a speaker device according to one embodiment of the present invention;

Fig. 3 is a view illustrating a duct structure of a speaker device (perspective view of a speaker device 1 without a cap part) according to one embodiment of the present invention;

Fig. 4 is a view illustrating an attachment relationship between a housing part and a wall part in a speaker device according to an embodiment of the present invention;

Fig. 5 is a view illustrating a cap part of a speaker device according to an embodiment of the present invention (Fig. 5(a) is a plan view and Fig. 5(b) is a

rear side perspective view);

Fig. 6 is a view illustrating a sound emitting part of a speaker device according to an embodiment of the present invention (Fig. 6(a) is a plan view and Fig. 6(b) is a rear side perspective view);

Fig. 7 is a view illustrating a speaker unit of a speaker device according to an embodiment of the present invention (Fig. 7(a) is a perspective view of the outer appearance and Fig. 5(b) is a cross-sectional perspective view);

Fig. 8 is a view illustrating an example of mounting a speaker device 1 according to an embodiment of the present invention; and

Fig. 9 is a view illustrating a vehicle equipped with a speaker device according to an embodiment of the present invention.

BEST MODE FOR PRACTICING THE INVENTION

[0014] Hereinafter, an embodiment of the present invention is described with reference to the drawings. Although an embodiment of the present invention includes the contents shown in the drawings, it is not limited hereto. Fig. 1 is a view illustrating the outer appearance of the configuration of a speaker device 1 (perspective view) according to one embodiment of the present invention, and Fig. 2 is a view illustrating the internal structure of a speaker device 1 according to one embodiment of the present invention.

[0015] A speaker device 1 according to an embodiment of the present invention is provided with a cabinet 2 and a duct 4, and a speaker unit 3 (3₁, 3₂) is deployed in a cabinet 2. The cabinet 2 is provided with at least a housing part 10 and a cap part 13, and a duct 4 is provided on the cabinet 2. In an example shown in the drawing, the cabinet 2 is formed with the housing part 10 and a sound emitting part 14 that is made of a member different from the housing part 10. The example shows that the duct 4 (4₁, 4₂) is provided on the sound emitting part 14, but not limited hereto, the duct 4 (4₁, 4₂) may be provided on the part integrally configured with the housing part 10 and the sound emitting part 14. The speaker device 1 is particularly suitable for low frequency reproduction, and sound emitted from a speaker unit that is driven in the cabinet 2 is released from the duct 4 (4₁, 4₂) to the outside. In the example shown in the drawing, the lateral shape of the housing part 10 forming the cabinet 2 is shown in a cylindrical shape as an example, but is not limited thereto, and various types of shapes such as a rectangular shape may be used. The shape of the cabinet 2 is determined by the shape of space where the speaker device 1 is housed. The housing part 10, the sound emitting part 14, and the cap part 13 may be respectively formed with different members. Also, the housing part 10 and the sound emitting part 14 or the sound emitting part 14 and the cap part 13 can be integrally formed.

[0016] A wall part 15 is arranged in the cabinet 2 so as to extend from the central part 2c of the cabinet 2

toward different positions $2r_1$, $2r_2$ in the outer periphery part $2r$, and the wall part 15 partitions the space $2S$ in the cabinet 2 into two spaces (one space $2S_1$ and the other space $2S_2$). In the example shown in the drawing, the wall part 15 is a plate shaped member and has planar parts 15A, 15B along the axial direction L of the cabinet 2. The planar parts 15A, 15B respectively extend in two directions $R1$, $R2$ orthogonally to the axial direction L of the cabinet 2. In the example shown in the drawing, the angle defined by the two directions $R1$, $R2$ of the planar parts 15A, 15B is less than 180 degrees and is in refractive state, and the wall part 15 is arranged in the cabinet 2 such that the volume of one partitioned space $2S_1$ is larger than the volume of the other space $2S_2$. The angle defined by the two directions $R1$, $R2$ of the planar parts 15A, 15B may be adjustable to 180 degrees as necessary.

[0017] Two speaker units 3 (first speaker unit 3_1 and second speaker unit 3_2) are arranged in the cabinet 2 (housing part 10) and the first speaker unit 3_1 and the second speaker unit 3_2 are attached to the wall part 15. The first speaker unit 3_1 and the second speaker unit 3_2 are attached respectively to the planar parts 15A, 15B, whereby the sound emission directions are directed to two directions orthogonally to the axial direction L of the cabinet 2. Further, the first speaker unit 3_1 is arranged in one space $2S_1$ partitioned by the wall part 15 and the second speaker unit 3_2 is arranged in the other space $2S_2$ partitioned by the wall part 15, and the first speaker unit 3_1 and the second speaker unit 3_2 are arranged such that the sound emission surfaces $3a_1$, $3a_2$ are directed to mutually different spaces $2S_1$, $2S_2$. That is, the sound emission surface $3a_1$ of the first speaker unit 3_1 arranged in one space $2S_1$ is directed to the other space $2S_2$, and the sound emission surface $3a_2$ of the second speaker unit 3_2 arranged in the other space $2S_2$ is directed to one space $2S_1$.

[0018] A regulating device 40 electrically connected to one or both of the speaker unit 3_1 and the second speaker unit 3_2 is arranged in one of the spaces $2S_1$, $2S_2$ in the cabinet 2 partitioned by the wall part 15. In the example shown in the drawing, the space $2S_1$ is made larger than the space $2S_2$ and the regulating device (amplifier) 40 is arranged in the space $2S_1$ that is larger than the other. Further, one of the ducts 4 is arranged above the regulating device 40 as described later. A heat releasing fin 40a is provided on the regulating device 40 on the side of the first speaker unit 3_1 or the second speaker unit 3_2 . The first speaker unit 3_1 and the second speaker unit 3_2 are driven by the regulating device 40 in substantially the same phase. Specifically, when the first speaker unit 3_1 emits a sound wave toward the other space $2S_2$, the second speaker unit 3_2 also emits a sound wave toward the other space $2S_2$. In other words, when the diaphragm of the first speaker unit 3_1 vibrates or is displaced toward the other space $2S_2$, the diaphragm of the second speaker unit 3_2 also vibrates or is displaced toward the other space $2S_2$.

[0019] In a speaker device 1 having such a structure, when the duct 4 is provided so as to communicate between only one of the partitioned spaces $2S_1$ and $2S_2$ and the outside, a bass reflected type cabinet system can be realized, and when two ducts 4_1 , 4_2 are provided so as to communicate between each of the spaces $2S_1$ and $2S_2$ and the outside as described later, an acousti-mass type cabinet system can be realized.

[0020] The cabinet 2 is covered with a cap part 13, and has the speaker units 3_1 , 3_2 arranged therein, whereby the speaker units 3_1 , 3_2 are not exposed, and thus the cabinet 2 is structured to substantially protect the speaker units 3_1 , 3_2 . Hereby, the speaker device 1 can be deployed with no relation to the surrounding condition of the installation space. The speaker device 1 can protect the speaker unit 3_1 , 3_2 from being damaged even in the space where a movable object exists around or in the place where hand touching commonly occurs.

[0021] Further, in the speaker device 1, the ducts 4 (4_1 , 4_2) are formed at the upper part of the housing part 10. As such, even when the lateral side of the housing part 10 is covered with a support body and so forth, the sound emitting opening of the ducts 4 (4_1 , 4_2) can be effectively opened. Further, the ducts 4 (4_1 , 4_2) are opened on the lateral side of the cabinet 2, whereby the sound emitting opening of the ducts 4 (4_1 , 4_2) can be effectively opened even when the top of the cap part 13 is covered with some items placed on the cap part 13. Specifically, in the example shown in the drawing, since the top surface of the cap part 13 is formed in a planar shape, the top of the cap part 13 can be used for placing some items thereon.

[0022] The wall part 15 for partitioning the space inside the cabinet 2 partitions the space inside the cylindrical cabinet 2 along a cylindrical axis, whereby internal arrangement can be made effectively using the height of the cabinet 2. The speaker units 3_1 , 3_2 are attached in the direction obliquely to the plane forming the wall part 15 having the planar parts 15A, 15B which are along the axis of the cabinet 2, specifically in substantially the orthogonal direction in the example shown in the drawing, whereby the speaker units 3_1 , 3_2 can be deployed, having diameters in accordance with the height of the cabinet 2.

[0023] The wall part 15 is provided with the planar parts 15A, 15B radially shaped from the central part $2c$ of the cabinet 2 toward the outer periphery part $2r$ of the cabinet 2, and by arbitrarily setting the angle of the planar parts 15A, 15B, the space in the cabinet 2 can be partitioned at any ratio. Hereby, the acoustic characteristic such as the minimum resonance frequency or the low frequency reproduction band can be adjusted.

[0024] By arranging the regulating device 40 in the space $2S_2$ of the cabinet 2, the space in the cabinet 2 can be effectively used, and the speaker device 1 can be made compact. Further since the regulating device 40 is provided between the first speaker unit 3_1 and the second speaker unit 3_2 , it is cooled down by the airflow generated by the speaker units 3_1 , 3_2 , and thus the tem-

perature of the entire regulating device 40 can be decreased. Here, by providing the heat releasing fin 40a, the airflow generated from the speaker units 3₁, 3₂ impinges on the heat releasing fin 40a, and thus the regulating device 40 can be further cooled down.

[0025] In the example shown in the drawing, by making an angle between the planar parts 15A, 15B of the wall part 15, one of the partitioned spaces 2S₁, 2S₂ becomes larger than the other in the cabinet 2, and by arranging the regulating device 40 in the larger space 2S₁, the utilization efficiency of the space in the cabinet 2 is increased while the volume of the air chamber in the cabinet 2 is sufficiently secured.

[0026] The diaphragms of the two speaker units 3₁, 3₂ are respectively driven substantially in the same phase. That is, the diaphragms of the two speaker units 3₁, 3₂ substantially vibrate simultaneously in the direction of entering the space 2S₂ and vibrate simultaneously in the direction of exiting the space 2S₂, hereby, the speaker unit can generate larger sound pressure than in the case of a single speaker unit. When the cabinet 2 is provided in the limited space, although the height of the cabinet 2 may not be increased and the diameter of the diaphragm may not be increased, by driving the two speaker units 3₁, 3₂ substantially in the same phase, large sound pressure can be generated.

[0027] The reproduced sound pressure of a speaker unit is determined by the volume of air that a diaphragm discharges (in proportion to diaphragm area × amplitude of vibration). If the diaphragm area cannot be increased, when the reproduced sound pressure is increased by means of amplitude of vibration, it is difficult to design the support system and the drive system of a speaker unit, which can respond to the large amplitude of vibration. As a result, the reproduced sound pressure is subject to distortion. When the two speaker units 3₁, 3₂ are driven substantially in the same phase as shown in the embodiment according to the present invention, the amplitude of vibration of a diaphragm required for generating substantially the same sound pressure can be halved, whereby high quality reproduced sound with reduced distortion can be acquired.

Further, when the two speaker units 3₁, 3₂ are driven substantially in the same phase, the diaphragm of the first speaker unit 3₁ vibrates or is displaced toward the other space 2S₂, while the diaphragm of the second speaker unit 3₂ also vibrates or is displaced toward the other space 2S₂.

[0028] When the diaphragms of the two speaker units 3₁, 3₂ substantially vibrate to simultaneously enter the space 2S₂ and vibrate to simultaneously exit the space 2S₂, the distortions of the support system or the drive system generated by each of the speaker units 3₁, 3₂ can cancel each other out, whereby high quality reproduced sound can be acquired.

[0029] Fig 3 is a view illustrating a duct structure of a speaker device according to an embodiment of the present invention (perspective view of a speaker device

1 when a cap part is removed). The two ducts 4 (first duct 4₁ and second duct 4₂) are provided in the cabinet 2. The first duct 4₁ communicates between one space 2S₁ of the spaces in the cabinet 2 that are partitioned by the wall part 15 and the outside, while the second duct 4₂ communicates between the other space 2S₂ and the outside.

[0030] The two ducts 4 (first duct 4₁ and second duct 4₂) are provided on the sound emission sides of each of the two speaker units 3 (first speaker unit 3₁ or second speaker unit 3₂) and the first speaker unit 3₁ and the second speaker unit 3₂ are driven by the regulating device 40 substantially in the same phase as described above or the second speaker unit 3₂ may be configured with a passive unit (passive radiator). Further, when the second speaker unit 3₂ is a passive unit, a voice coil included in the second speaker unit 3₂ is short-circuited or a magnetic circuit is removed, and a dust cap and so forth is provided on the inner side of a voice coil or a voice coil support part supporting the voice coil, and a vibrating body (includes a diaphragm, an edge and a voice coil and also may include a voice coil support part) efficiently receiving air pressure released from the rear side of the first speaker unit 3₁ may be configured, or the voice coil may not be provided.

[0031] In the ducts 4 (first duct 4₁ and second duct 4₂), one end part 4a is arranged between the first speaker unit 3₁ and the second speaker unit 3₂, and the other end part 4bis arranged near the outer periphery part 2r of the cabinet 2.

[0032] Further, the ducts 4 (first duct 4₁ and second duct 4₂) are configured from one end through the other end such that one part extends in the axial direction (L direction) of the cabinet 2, and then the other part extends from the central part 2c to the outer periphery part 2r of the cabinet 2 (R direction). That is, the end part 4a of the duct 4 is formed in the axial direction (L direction) of the cabinet 2 while the other part is formed in the direction along a planar surface substantially orthogonally to the axial direction (L direction) and the end part 4b is directed to the outer periphery part 2r of the cabinet 2.

[0033] Further, at least one (the first duct 4₁ in the example shown in the drawing) of the ducts 4 (first duct 4₁ and second duct 4₂) is formed such that the part extending from the central part 2c through the outer periphery part 2r of the cabinet 2 is formed adjacently to the outer periphery part 2r of the cabinet 2.

[0034] The ducts 4 are formed within the cabinet 2, wherein the first duct 4₁ and the second duct 4₂ are provided within the space surrounded by the first speaker unit 3₁, the second speaker unit 3₂ and the cabinet 2. The ducts 4 are formed using a part of the space within the spaces 2S₁, 2S₂, and the bottom face part 4c of the first duct 4₁ and the second duct 4₂ is arranged in the position lower than the upper end part 3b of the first speaker unit 3₁ and the second speaker unit 3₂ in the axial direction (L direction) of the cabinet 2. The bottom face part 4c of the first duct 4₁ and the second duct 4₂

may be arranged in the position substantially the same as or higher than the upper end part 3b of the first speaker unit 3₁ and the second speaker unit 3₂ in the axial direction (L direction) of the cabinet 2.

[0035] As can be seen in the drawing, the first duct 4₁ through which the larger space 2S₁ of the spaces 2S₁, 2S₂ in the cabinet 2 partitioned by the wall part 15 communicates with the outside, is arranged so as to extend comparatively long and the second duct 4₂ through which the smaller space 2S₂ communicates with the outside, is arranged so as to extend comparatively short. Further the first duct 4₁ through which the larger space 2S₁ communicates with the outside is formed in a curved shape, whereby the effective length is made comparatively long. Further, in order to prevent the effective length of the duct from becoming shorter eventually by liquid flowing along the shortest path even if the duct is formed in a curved shape, the first duct 4₁ is adapted such that the exit cannot be viewed from the entrance, that is, a straight flow passage is not formed. By employing such a duct configuration, it becomes possible to lower the low-frequency reproduction limit frequencies, that is, to broaden the low-frequency reproduction band of the speaker device 1.

[0036] Further, each of the first duct 4₁ and the second duct 4₂ is configured to have a constant cross-sectional shape (rectangular shape) along the length direction, and thus the occurrence of abnormal noises (wind noises) is prohibited. Further, the first duct 4₁ and the second duct 4₂ are configured to change the extending directions from the vertical direction (axial direction) to the horizontal direction (the direction orthogonal to the axis) and the flow passage of the duct is changed with the highest possible curvature at this direction changing part. Also by this configuration, the occurrence of abnormal noises can be prohibited.

[0037] Further, the bottom face part 4c of the first duct 4₁ and the second duct 4₂ is arranged in the position lower than the upper end part 3b of the first speaker unit 3₁ and the second speaker unit 3₂ in the axial direction (L direction) of the cabinet 2, and the first duct 4₁ and the second duct 4₂ are arranged, efficiently utilizing the upper part of the empty space in the cabinet 2 where no speaker units 3₁, 3₂ exist. Hereby, the ducts 4₁, 4₂ having desired diameters and the effective lengths can be formed in the limited space within the cabinet 2 while a comparatively large air chamber can be secured under the bottom face part 4c of the ducts 4₁, 4₂.

[0038] Fig. 4 is a view illustrating attachment relationship of a wall part 15 to a housing part 10 in a speaker device 1. The wall part 15 is provided with an attaching counterpart 15C to which a first speaker unit 3₁ and a second speaker unit 3₂ are attached. The aforementioned planar parts 15A, 15B form this attaching counterpart 15C. The attaching counterpart 15C has a central contact part 15D which comes into contact with the central part 2c of the cabinet 2, and both ends of the outer periphery part of the attaching counterpart 15C are formed integrally with a circumferential part 15E which

is formed along the outer periphery part 2r of the cabinet 2. Further, the circumferential part 15E of the wall part 15 is provided with an attachment part 15E1 attached to the outer periphery part 2r of the cabinet 2. The attachment part 15E1 is formed in a flange shape extending from the circumferential part 15E, and is mounted on a mounting surface 2ra formed on the outer periphery part 2r of the cabinet 2 (housing part 10), and thereby the wall part 15 is attached to the cabinet 2.

[0039] The cabinet 2 has the aforementioned housing part 10 (first housing part 11) and a second housing part 12 is configured in the first housing part 11, wherein the second housing part 12 forms the aforementioned wall part 15. The second housing part 12 includes a bottom face part 12a and an outer periphery tubular part 12b. A reinforcing part 12c having protruding shape is formed on the second housing part 12 in the radial or peripheral direction of the cabinet 2. Further, a projection part (not shown, for example, having a shape like a projection part 2d) that supports the speaker unit 3₂, especially a magnetic circuit that is described later is provided on the bottom face part 12a of the second housing part. The projection part forms a gap between the magnetic circuit of the speaker unit 3₂ and the bottom face part 10a, whereby the occurrence of abnormal noises due to the speaker unit 3 coming into contact with the cabinet 2 is reduced. Further, the abnormal noises may be reduced by providing a buffer material (cushion material, damping material) between the projection part and the magnetic circuit of the speaker unit 3₂.

[0040] Further, a terminal part E1 is provided on the outer periphery part of the cabinet 2. The terminal part E₁ is provided on a sound emitting part 14 that is described later, and serves as a terminal part electrically connecting a regulating device that is described later to the outside.

[0041] A housing part 10 (first housing part 11) is provided with a bottom face part 10a and an outer periphery tubular part 10b that support the wall part 15, and a tubular part 10c is erected in the axial direction from the bottom face part 10a, forming a central part 2c. The projection part 2d is provided on the bottom face part 10a to support a second housing part 12. The protrusion part 2d forms a gap between the bottom face part 12a of the second housing part 12 and the bottom face part of the housing part 10 whereby the occurrence of abnormal noises due to the contact between the second housing part 12 and the housing part 10 is reduced. The abnormal noises may be reduced by providing a cushion material (cushion material, damping material) in between the projection part 2d and the second housing part 12.

[0042] The outer periphery part of a sound emitting part 14 as a separate member which is described later is arranged on a mounting surface 2ra formed on the outer periphery part of the first housing part 11. A coupling part 2ra1 formed on the mounting surface 2ra is coupled with the outer periphery part of the sound emitting part 14.

[0043] Further, the first cabinet 21 is formed as the first

housing part 11 while the second cabinet 2₂ is formed with the wall part 15 and the second housing part 12, and the second cabinet 2₂ integrally formed with the first speaker unit 3₁ and the second speaker unit 3₂ can be separated from the first cabinet 21. Hereby, it becomes possible to easily attach the wall part 15 and two speaker units 3₁, 3₂ to the first cabinet 21.

[0044] As such, the speaker device 1 arranges the second cabinet 2₂ in the first cabinet 2₁ and the second cabinet 2₂ configures a half cabinet volume in the acoustimass method. The second cabinet 2₂ is integrally formed with the first speaker unit 3₁ and the second speaker unit 3₂ as the second housing part 12 including the wall part 15 to which the first speaker unit 3₁ and the second speaker unit 3₂ are attached. The second cabinet 2₂ is formed as the integrally formed housing part 12, whereby it becomes easy to secure the sealing performance of the half cabinet volume of the acoustimass method.

[0045] In the second cabinet 2₂, the wall part 15 along the axial direction of the cabinet 2 forms two baffle surfaces, to each of which the first speaker unit 3₁ and the second speaker unit 3₂ are attached. Since the baffle surfaces are integrally formed with the second cabinet 2₂ as described above, the strength of the baffle surfaces can be increased, and thus the first speaker unit 3₁ and the second speaker unit 3₂ can be firmly held when the speaker device 1 is driven. That is, owing to the integral structure of the second cabinet 2₂ the rigidity of the second housing part 12 is increased, and thus the vibration due to air pressure that the first speaker unit 3₁ and the second speaker unit 3₂ generate can be prohibited. Further, the vibrations caused when the first speaker unit 3₁ the second speaker unit 3₂ are driven can cancel each other out in the second housing part 12 without transmitting throughout the speaker device 1.

[0046] The central part of the wall part 15 in the second cabinet 2₂ is arranged so as to embrace the tubular part 10c erecting on the central part 2c of the first cabinet 21 (first housing part 11). Hereby, the wall part 15 to which the first speaker unit 3₁ and the second speaker unit 3₂ are attached is deployed radially (in the peripheral direction) from the central part 2c. The second cabinet 2₂ is positioned by the tubular part 10c and the inner surface of the first housing part 11, whereby the second cabinet 2₂ substantially increases the strength of the tubular part 10c provided on the first cabinet 2₁. Since the tubular part 10c forms an attaching counterpart into which an attaching member is inserted, such a double cabinet structure contributes to improve the attachment strength of the cabinet 2.

[0047] Fig. 5 is a view illustrating a cap part 13 of the speaker device 1 according to an embodiment of the present invention (Fig. 5(a) is a plan view, and Fig. 5(b) is a rear side perspective view). The cap part 13 is formed with a tabular member which closes the upper surface of the cabinet 2 described above. A hole part 13P is formed in the central part of the cap part 13, and the hole part 13P is formed in a surrounding recessed part 13P1.

The recessed part 13P1 serves as space which receives the attaching member. A reinforcing part 13 having protruding shape is formed on the front surface or the rear surface of the cap part 13 in the radial direction or the peripheral direction of the cap part 13. Further, a plurality of coupling protrusions 13b are protruded from the rear surface of the cap part 13 in order to couple with a sound emitting part which is described later.

[0048] Fig. 6 is a view illustrating a sound emitting part 14 of a speaker device 1 according to an embodiment of the present invention (Fig. 6(a) is a plan view and Fig. 6 (b) is a rear side perspective view). The sound emitting part 14 forms the aforementioned ducts 4 (first duct 4₁ and second duct 4₂) and can be formed integrally with the aforementioned cabinet 2. As shown in the drawing, the sound emitting part 14 can be also formed with a separate member. Such a sound emitting part 14 formed with a separate member is mounted on the housing part 10 (first housing part 11) thereby forming the first duct 4₁ and the second duct 4₂.

[0049] The sound emitting part 14 has a joint surface 14s formed on the top surface which is joined to the aforementioned cap part 13, and the joint surface has a coupling hole 14p which is formed to fit the aforementioned coupling protrusion 13b of the cap part 13. Further, a terminal part provided on the sound emitting part is covered with a protection part 14t.

[0050] In the duct 4 (first duct 4₁, second duct 4₂) formed on the sound emitting part 14, the end part 4a is formed in the axial direction (L direction) and other parts are formed in the planar direction orthogonally to the axial direction (L direction) with the end part 4b approaching the outer periphery part 14a of the sound emitting part 14. Further, the sound emitting part 14 is provided with an opening part 14b which is formed between the first duct 4₁ and the second duct 4₂. The cap part 13 is joined so as to close the opening part 14b and form the top surface of the first duct 4₁ and the second duct 4₂.

In the example shown in the drawing, the opening parts 4b that are provided on the first duct 4₁ and the second duct 4₂ are configured with the sound emitting part 14 and the cap part 13. The corner part of the opening part 4b formed on the side of the sound emitting part 14 is formed in a curved shape while the corner part of the opening part 4b on the side of the cap part 13 is formed in a rectangular shape. However, the corner part on the side of the cap part 13 may be formed in a curved shape, which is preferable to reduce the occurrence of abnormal noises (wind noises).

[0051] The cap part 13 is configured to be able to integrally join the sound emitting part 14, and the sound emitting part 14 is configured to be able to integrally join the second cabinet 2₂ including the first speaker unit 3₁ and the second speaker unit 3₂. Further, attachment parts 14c for attaching a regulating device 40 are provided on the bottom surface 4c of the first duct 4₁ of the sound emitting part 14. As such, the cap part 13, the sound emitting part 14, the second cabinet 2₂ including

the first speaker unit 3_1 and the second speaker unit 3_2 and the regulating device 40 are integrally joined, and can be jointly separated from the first cabinet 21 (first housing part 11) or attached to the first cabinet 2_1 . Hereby, a wiring work and so forth for the regulating device 40 can be easily performed, and after thoroughly completing various adjustments of the speaker units 3_1 , 3_2 , the other components can be integrally incorporated into the first cabinet 2_1 that is attached to an installation space, and thus the workability of component mounting is improved.

[0052] Fig. 7 is a view illustrating a speaker unit 3 of a speaker device 1 according to an embodiment of the present invention (Fig. 7(a) is an outer appearance perspective view and Fig. 7(b) is a cross-sectional perspective view along with an enlarged view of part A). The speaker unit 3 (first speaker unit 3_1 or second speaker unit 3_2) is provided with a static part 30 formed with a frame and so forth, a vibrating body 31 supported by the static part 30 and a magnetic circuit 38. The vibrating body 31 is provided with a diaphragm 32 and an edge 33 for supporting the diaphragm 32 at the static part 30 and so forth. The magnetic circuit 38 is provided with a magnet 38A, a yoke 38B and a plate 38C.

[0053] The vibrating body 31 is provided with a voice coil 34 and a driving member 35 which transmits the vibration of the voice coil 34 to the diaphragm 32. In the example shown in the drawing, the driving member 35 is provided with a venting hole 35e. The voice coil 34 is wound around a voice coil support part (voice coil bobbin) 36 and vibrates integrally with the voice coil support part 36. In order to transmit the vibration of the voice coil 34 to the diaphragm 32 via the voice coil support part 36 and the driving member 35, one end of the driving member 35 is joined to the diaphragm 32, and the other end of the driving member 35 is joined to the voice coil support part 36.

[0054] The venting hole 35e formed on the driving member 35 may be a hole part which communicates between the inside and outside spaces of the driving member 35 or may be a hole part as a through-hole for connecting a lead wire pulled out from the voice coil 34 to a terminal part arranged outside the driving member 35. Further, a plurality of venting holes 35e is provided such that the driving member 35 is provided with a hole part which communicates between the inside and outside spaces of the driving member 35 and a hole part as a through-hole.

[0055] The diaphragm 32 is tabularly formed and the outer edge part of the diaphragm 32 is joined to the inner edge part of the edge 33 directly or via another member, and the outer periphery part 33a of the edge 33 is joined to the static part (frame) 30. By forming the diaphragm 32 in a tabular shape, sound waves with substantially the same phase can be emitted from the entire diaphragm 32. In the example shown in the drawing, the outer edge part of the diaphragm 32 is attached to the inner edge part of the edge 33 via the outer edge part of the driving

member 35.

[0056] The outer periphery part 35a of the driving member 35 is attached to the diaphragm 32 and a recessed part 35b is formed on the outer periphery part 35a of the driving member 35 on the side that faces the diaphragm 32 (see an enlarged view of part A in Fig. 7 (b)). A protrusion part 35c that protrudes in the sound emission direction is provided on the outer periphery part 35a of the driving member 35 on the outside of the recessed part 35b and the outer periphery part of the diaphragm 32 and the inner periphery part 33b of the edge 33 is attached to the surface of the protrusion part 35c on the side of the magnetic circuit 38. In the outer periphery part 33a of the edge 33 the thickness of the outer side is formed larger than the thickness of the inner side, and a given gap t is formed between the outer periphery part 30a of the static part (frame) 30 and the outer periphery part 33a of the edge 33.

[0057] When joining the diaphragm 32 and the driving member 35 with a connecting member, a recessed part 35b is formed on the outer periphery part 35a of the driving member 35 on the side that faces the diaphragm 32 and the protrusion part 35c that protrudes in the sound emission direction is provided outside the recessed part 35b and the outer periphery part of the diaphragm 32, whereby a connecting member (for example, adhesive and so forth) that connects the diaphragm 32 and the driving member 35 can be restrained from running down the inner surface of the driving member 35 and dripping to a magnetic gap and so forth. Further, the connecting member pools in the recessed part 35b, thereby improving an adhesive force between the diaphragm 32 and the driving member 35, thus the diaphragm 32 can be accurately attached to the driving member 35.

[0058] The outer periphery part 33a of the edge 33 is formed such that the outside thickness is larger than the inside thickness and a given gap t is formed between the outer periphery part 30a of the static part (frame) 30 and the outer periphery part 33a of the edge 33, whereby unwanted vibrations can be restrained from being transmitted from the diaphragm 32 to the static part 30 via the edge 33. Further, the outer periphery part 33a of the edge 33 comes into contact with the wall part 15, whereby air can be restrained from leaking out of the joint surface between the speaker unit 3 and the wall part 15, thus the occurrence of abnormal noises due to the leakage of air can be restrained.

[0059] The vibrating body 31 is provided with a damper 37 which supports the voice coil 34 at the static part (frame) 30. In the example shown in the drawing, the voice coil 34 is supported by the static part 30 via the voice coil support part 36 by way of the damper 37. The inner periphery part 35d of the driving member 35 and the inner periphery part 37a of the damper 37 are attached to the voice coil 34 or the voice coil support part 36, and an annular reinforcing part 39 which supports the inner periphery part 35d of the driving member 35 or the inner periphery part 37a of the damper 37 is connect-

ed to the outer periphery surface side of the voice coil 34 or the voice coil support part 36.

[0060] In the speaker unit 3, a terminal part 41 is provided on the side part of the static part (frame) 30. Both ends of the voice coil 34 are connected to respective terminals 41a, 41b of the terminal part 41. Thus, the terminal parts 41a, 41b are connected to the connecting terminal of the regulating device 40.

[0061] Fig. 8 is a view illustrating an example of mounting a speaker device 1 according to an embodiment of the present invention. Here, a speaker device 1 is mounted within a wheel of a spare tire provided in a vehicle. Figs. 8 (a) to 8(c) show different structures of an attaching member.

[0062] The speaker device 1 (cabinet 2) is formed in a prescribed shape corresponding to the inner side face of a wheel T1 of a spare tire T1 provided in a vehicle. Further, a hole part 2a into which a connecting tool M is inserted is formed in the central part 2c of the cabinet 2. The attaching member M is attached to a vehicle integrally with the spare tire T. The opening part 14b of the sound emitting part 14 shown in Fig. 6 configures the hole part 2a into which the attaching member M is inserted.

The speaker device 1 is placed on a wheel K provided on the spare tire T, and the other end of the connecting tool M is inserted into the hole part 2a of the speaker device 1, the end of the attaching member M being fixed to an attaching counterpart N. Further, a fastening member V is provided on one end of the connecting tool M and by applying rotations and so forth to the fastening member V, speaker device 1 is fixed on the side of attaching counterpart N and is attached to the wheel K.

[0063] The aforementioned first duct 4₁ and second duct 4₂ is provided with a sound emitting hole (end part 4b) on the outer periphery side face of the cabinet 2, which faces the inner periphery side face of the wheel T1 of the spare tire T. A gap K that guides to the outside sound waves emitted from the first duct 4₁ and second duct 4₂ is provided between the outer periphery side face of the cabinet 2 where the sound emitting hole is formed and the wheel T1 of the spare tire T. Such a structure can keep sounds from being cut off even when a floor mat or the like is placed on the cabinet 2, since by securing the gap K the sound emitting holes of the first duct 4₁ and the second duct 4₂ are opened to the gap K. Further, the gap K may also be a sound guide tube which guides sound waves emitted from the first duct 4₁ and the second duct 4₂ to the outside.

[0064] Fig. 9 is a view illustrating a vehicle equipped with a speaker device according to an embodiment of the present invention. A vehicle C is provided with a speaker device 1, a spare tire T in which the speaker device 1 is mounted, and an attaching counterpart N to which the spare tire T is attached, the speaker device 1 and the spare tire T are integrally attached to the attaching counterpart N by means of the attaching member M.

[0065] Here, the cabinet 2 is adapted to fit the wheel

T1 of the spare tire T, and the space in the wheel T1 of the spare tire T is effectively utilized so as to operate as the acoustic load of the speaker device 1. Further the cabinet 2 is adapted to fit the wheel shape of the spare tire T, whereby attachment can be effected with little looseness within the wheel T1. Owing to the shape of the cabinet 2 fitting the wheel T1, the volume of the cabinet attached within the wheel T1 can be secured to the maximum extent possible, and therefore low frequency reproduction is advantageously effected.

[0066] In order to attach the cabinet 2 to the wheel T1 of the spare tire T, the outer diameter of the cabinet 2 is made smaller than the inner diameter of the wheel T1, and a gap may be formed between the outer periphery side face of the cabinet 2 and the inner periphery side face of the wheel. In this case, the bottom face part of the cabinet 2 is fixed to the wheel T1, whereby the occurrence of abnormal noises caused by the contact between the cabinet 2 and the wheel T1, specifically the contact between the outer periphery side face of the cabinet 2 and the inner diameter side surface of the wheel T1 can be restrained.

[0067] The first duct 4₁ and the second duct 4₂ which respectively communicate between the two spaces 2S₁, 2S₂ in the cabinet 2 and the outside serve as sound emitting parts of an acoustimass type cabinet. Two spaces 2S₁, 2S₂ are formed by partitioning the wheel T1 in the axial direction of the wheel T1, and thus an acoustimass type cabinet is effectively formed by utilizing the space within the cylindrical wheel T1.

[0068] Notably, the wall part 15 for partitioning the spaces 2S₁, 2S₂ includes the attaching counterpart 15C (planar parts 15A, 15B) that makes an angle, and the space 2S₂ surrounded by the planar parts 15A, 15B that makes an angle can collect sound waves emitted from the rear side of the second speaker unit 3₂ and efficiently guide the collected sound waves to the second duct 4₂.

[0069] Two speaker units 3₁, 3₂ arranged in the cabinet 2 are covered with the cap part 13, and thus are substantially protected. As such, even when tools and the like are deployed near the wheel T₁, or a spare tire T is arranged together with other items in a trunk room, the speaker units 3₁, 3₂ that are in the cabinet 2 are not subject to damages. For example, if a speaker device 1 is a subwoofer for low frequency reproduction, a directional characteristic in a low frequency range is comparatively small, and thus even when the speaker device 1 is mounted in a spare tire wheel in a trunk room, it is possible to successfully provide reproduced sound to the entire room of a car.

[0070] Further, the sound emitting holes of the first duct 4₁ and the second duct 4₂ are provided near the opening part of the wheel T1 (upper part), whereby a rate of emitted sound waves interfering with the wheel T1 can be reduced. If the sound emitting holes of the duct 4 is provided on the lower part, emitted sound waves are interrupted by the side surface of the wheel T1 and are damped before they reach inside the room in a car. How-

ever, according to the speaker device 1, such a problem does not occur.

Further, a spare tire is arranged under the floor (under floor mat) in the trunk room of a vehicle and so forth, but is not limited thereto, and may be arranged anywhere in a vehicle as long as it has little effect on passengers.

[0071] As described above, an embodiment of the present invention has been described in detail with reference to the drawings. But a specific configuration is not limited to these embodiments, and any alterations in design, etc. without departing from the scope of the present invention can be included in the present invention. In addition, each of the above-described embodiments can be combined by mutually using each technology unless there is a specific contradiction or problem in the purpose and configuration and so forth.

Claims

1. A speaker device comprising:

a cabinet configured with a housing part and a cap part;

a wall part arranged in said cabinet, partitioning a space in said cabinet by extending from a central part to two different positions in an outer periphery part of said cabinet; and

a plurality of speaker units arranged in said cabinet and attached to said wall part, wherein a first speaker unit is arranged in one space partitioned by said wall part with a sound emission surface of said first speaker unit being directed to the other space partitioned by said wall part, while a second speaker unit is arranged in the other space with said sound emission surface being directed to said one space, and a duct is provided in said cabinet to communicate between said space and the outside.

2. The speaker device according to claim 1, wherein said duct has a first duct communicating between said one space and the outside, and a second duct communicating between said other space and the outside.

3. The speaker device according to claim 2, wherein said speaker unit directed to one of said first or second duct is a passive unit.

4. The speaker device according to claim 2, wherein said first duct and said second duct are adapted such that one end is arranged between said first speaker unit and said second speaker unit while the other end is arranged near said outer periphery part of said cabinet, and one part extends in the axial direction of said cabinet

from said one end to the other end while the other part extends in the direction from said central part to said outer periphery part of said cabinet.

5. The speaker device according to claim 2, wherein a portion provided on at least one of said ducts and extending from said central part to said outer periphery part of said cabinet is formed adjacently to said outer periphery part of said cabinet.

6. The speaker device according to claim 5, wherein said first duct and said second duct are provided within the space surrounded by said first speaker unit, said second speaker unit and said cabinet.

7. The speaker device according to claim 6, wherein a bottom face part of said first duct and said second duct is lower than an upper end part of said first speaker unit and said second speaker unit in the axial direction of said cabinet.

8. The speaker device according to claim 7, wherein said wall part includes an attaching counterpart attaching said first speaker unit and said second speaker unit, and a circumferential part is provided on said outer periphery part of said attaching counterpart so as to be formed along said outer periphery part of said cabinet.

9. The speaker device according to claim 8, wherein said circumferential part of said wall part is provided with an attachment part attached to said outer periphery part of said cabinet

10. The speaker device according to claim 9, wherein said housing part of said cabinet is defined as a first housing part and a second housing part is configured in said first housing part, and said second housing part includes a bottom face part and an outer periphery tubular part, and said second housing part forms said wall part.

11. The speaker device according to claim 10, wherein said cabinet configured with said first housing part is defined as a first cabinet, and said second housing part configures a second cabinet formed in said first cabinet, and said second cabinet is separated from said first cabinet integrally with said first speaker unit and said second speaker unit.

12. The speaker device according to claim 11, wherein a reinforcing part having protruding shape is formed on said second housing part in the radial or peripheral direction of said first cabinet.

13. The speaker device according to claim 12, wherein

said first housing part includes a bottom face part supporting said wall part, and an outer periphery tubular part, and
said cap part is formed in a tabular shape.

14. The speaker device according to claim 13, wherein a sound emitting part including said first duct and said second duct is arranged between said first housing part and said cap part, and
said outer periphery part of said sound emitting part is arranged on said outer periphery part of said first housing part, and
said first housing part, said cap part and said sound emitting part are formed with different members.

15. The speaker device according to claim 14, wherein said sound emitting part includes an opening part formed between said first duct and said second duct, said opening part of said sound emitting part is closed by said cap part being attached to said sound emitting part.

16. The speaker device according to claim 15, wherein a reinforcing part having protruding shape is formed in the radial direction or in the peripheral direction of said cap part on the surface of said cap part facing said opening part of said sound emitting part.

17. The speaker device according to claim 16, wherein said first speaker unit or said second speaker unit includes
a static part, a vibrating body and a magnetic circuit supported by said static part, and
said vibrating body includes a diaphragm and an edge supporting said diaphragm at said static part, and
said magnetic circuit includes a magnet and a yoke.

18. The speaker device according to claim 17, wherein said vibrating body includes a voice coil and a driving member transmitting the vibration of said voice coil to said diaphragm, and
said diaphragm is formed in a tabular shape.

19. The speaker device according to claim 18, wherein an outer periphery part of said driving member is attached to said diaphragm,
and a recessed part is formed on said outer periphery part of said driving member on the side that faces said diaphragm.

20. The speaker device according to claim 19, wherein at said outer periphery part of said driving member is provided a protrusion part protruding in the sound emission direction outside said recessed part and said outer periphery part of said diaphragm, and
an inner periphery part of said edge is attached on the surface on the side of said magnetic circuit in

said protrusion part.

21. The speaker device according to claim 20, wherein in said outer periphery part of said edge
the thickness of the outer side is formed larger than the thickness of the inner side, and
a given gap is formed between said outer periphery part of said static part and said outer periphery part of said edge.

22. The speaker device according to claim 21, wherein said vibrating body includes a damper supporting said voice coil to said static part, and
an inner periphery part of said driving member and an inner periphery part of said damper are attached to a voice coil support part supporting said voice coil, and
an annular reinforcing part supporting said inner periphery part of said driving member or said inner periphery part of said damper is coupled to an outer periphery side face of said voice coil support part.

23. The speaker device according to claim 22, wherein a regulating device is arranged in said space in said cabinet partitioned by said wall part in order to electrically connect to one or both of said first speaker unit and said second speaker unit.

24. The speaker device according to claim 23, wherein said first speaker unit and said second speaker unit are driven in substantially the same phase.

25. The speaker device according to claim 24, wherein one of said ducts is arranged above said regulating device.

26. The speaker device according to claim 25, wherein a heat releasing fin is provided on said regulating device on the side of said first speaker unit or said second speaker unit.

27. The speaker device according to claim 1, wherein said cabinet is formed in a prescribed shape corresponding to an inner side face of a wheel of a spare tire provided in a vehicle, and
said cabinet has a hole part formed in said central part to insert an attaching member attaching said cabinet and said spare tire integrally to said vehicle.

28. The speaker device according to claim 15, wherein said cabinet is formed in a prescribed shape corresponding to said inner side face of a wheel of a spare tire provided in a vehicle,
said cabinet has a hole part formed in said central part to insert a attaching member attaching said cabinet and said spare tire integrally to said vehicle, and
said opening part of said sound emitting part configures a hole part into which said attaching member

is inserted.

- 29.** The speaker device according to claim 28, wherein said first duct and said second duct include a sound emitting hole at an outer periphery side face of said first cabinet facing an inner periphery side face of said wheel of said spare tire, and a gap guiding to the outside sound waves emitted from said first or said second duct is provided between said outer periphery side face of said cabinet where said sound emitting hole is formed and the wheel of said spare tire.
- 30.** A vehicle comprising: a speaker device according to claim 28, a spare tire in which the speaker device is mounted, and an attaching counterpart to which the spare tire is attached, wherein said speaker device and said spare tire are integrally attached to said attaching counterpart by means of said attaching member.

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Fig. 1

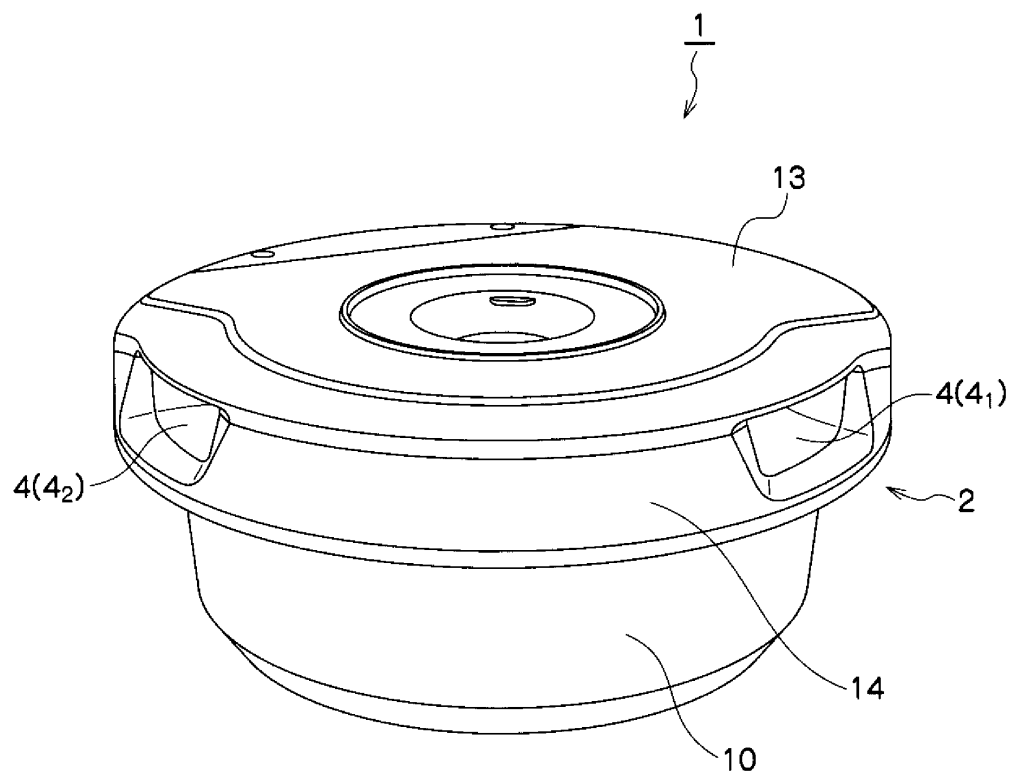


Fig. 2

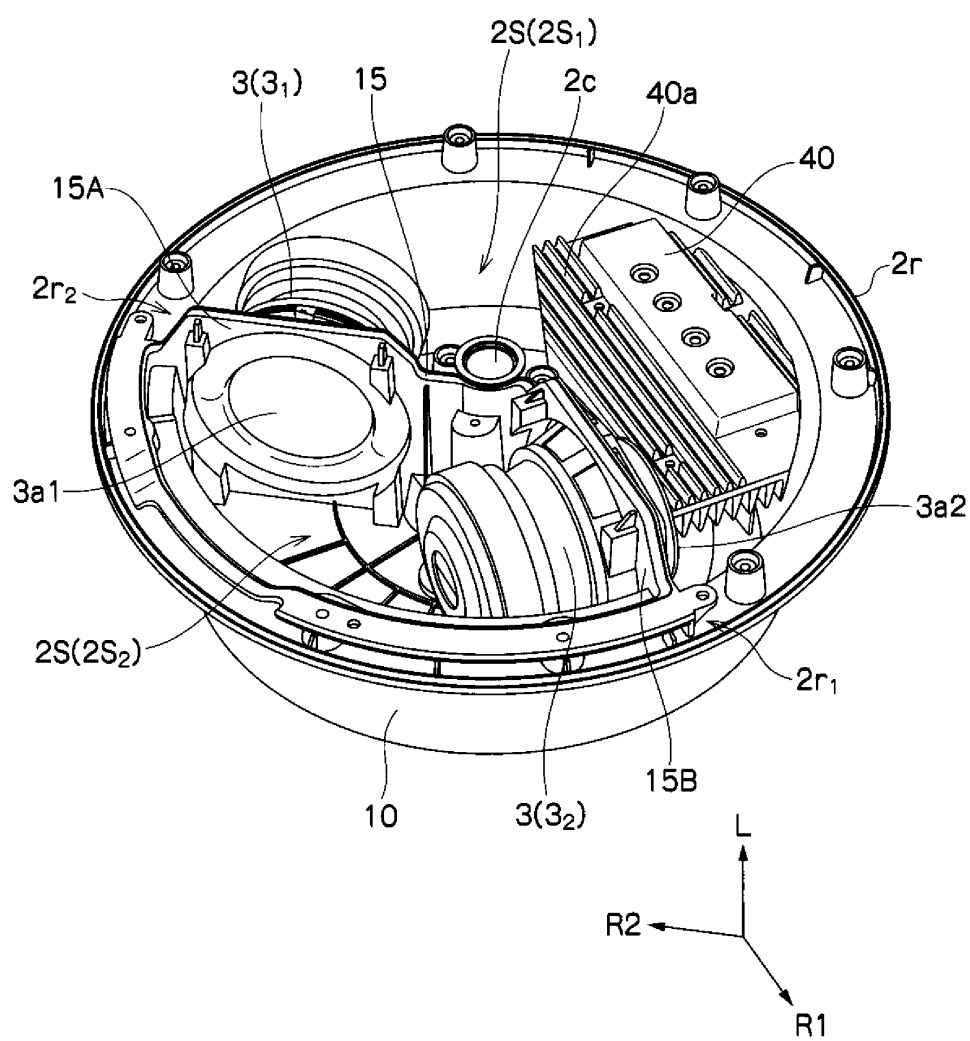


Fig. 3

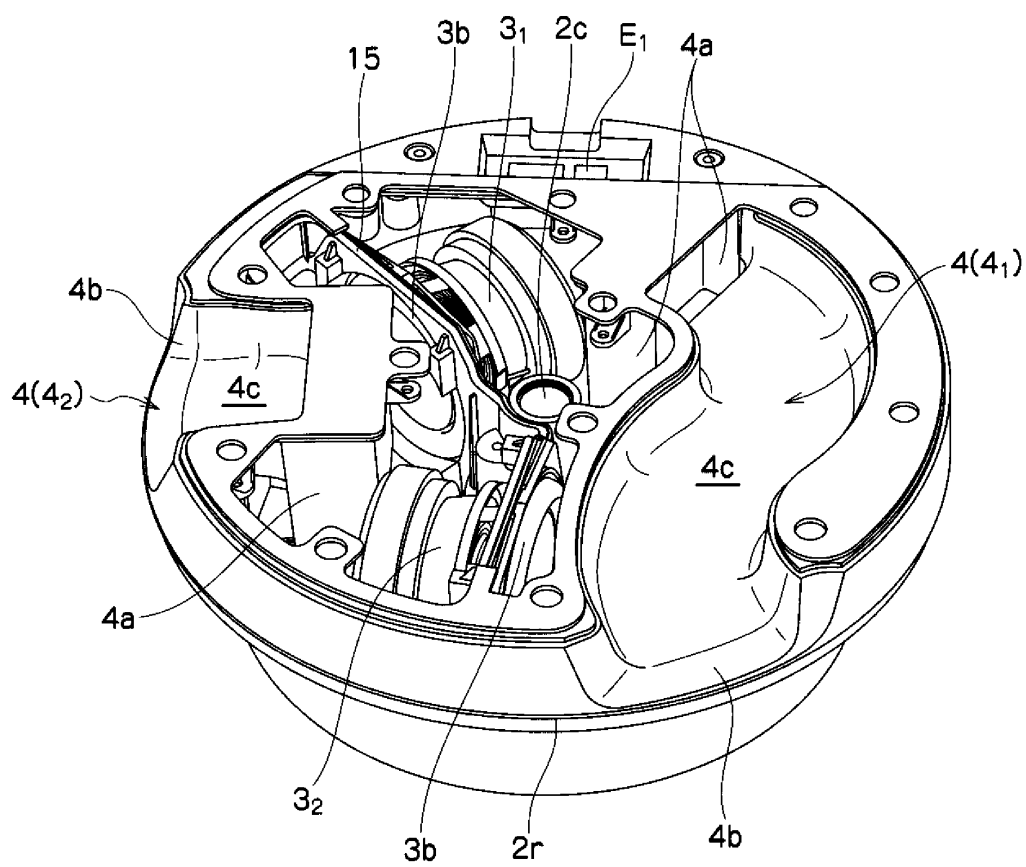


Fig. 4

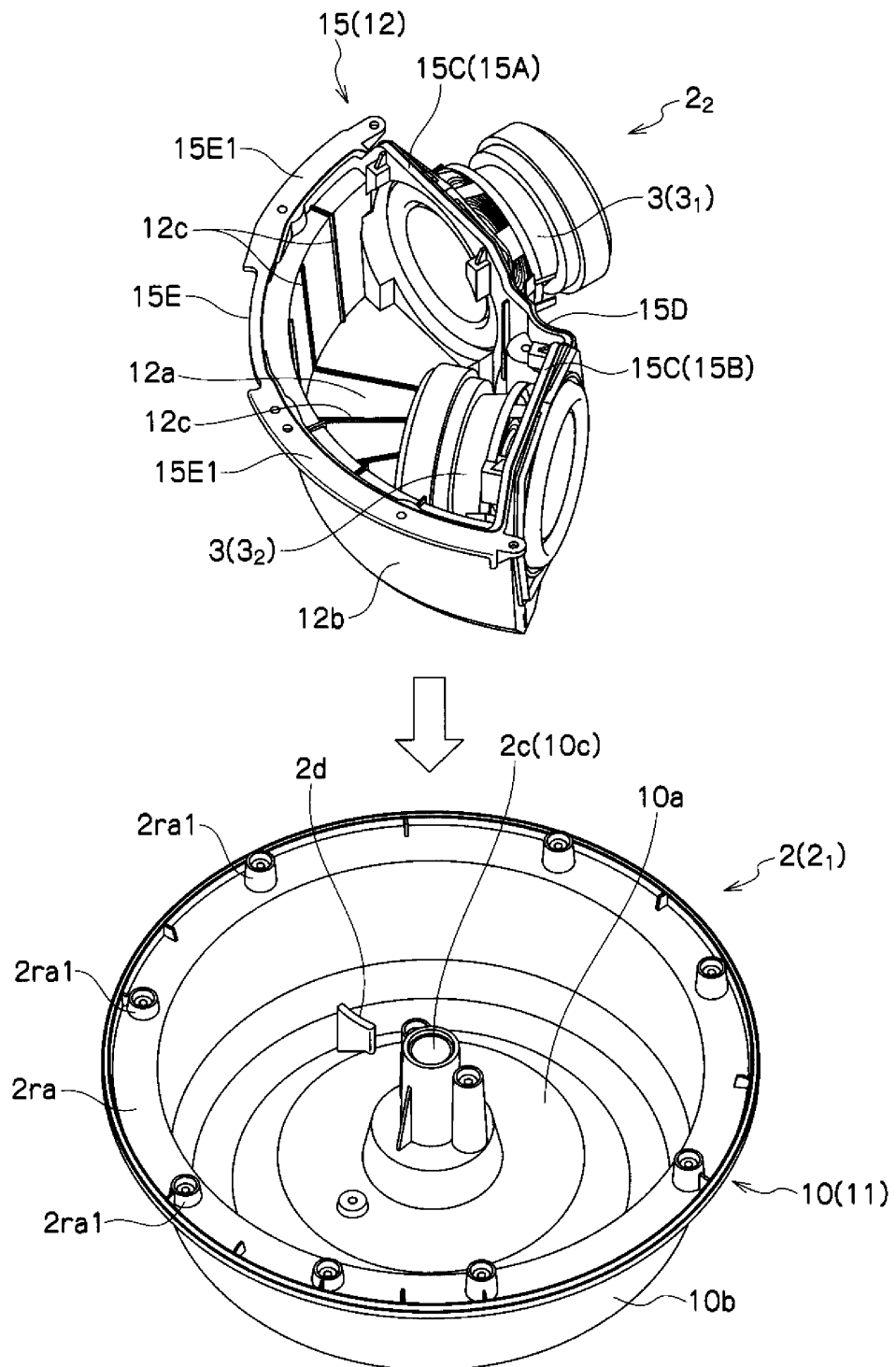


Fig. 5

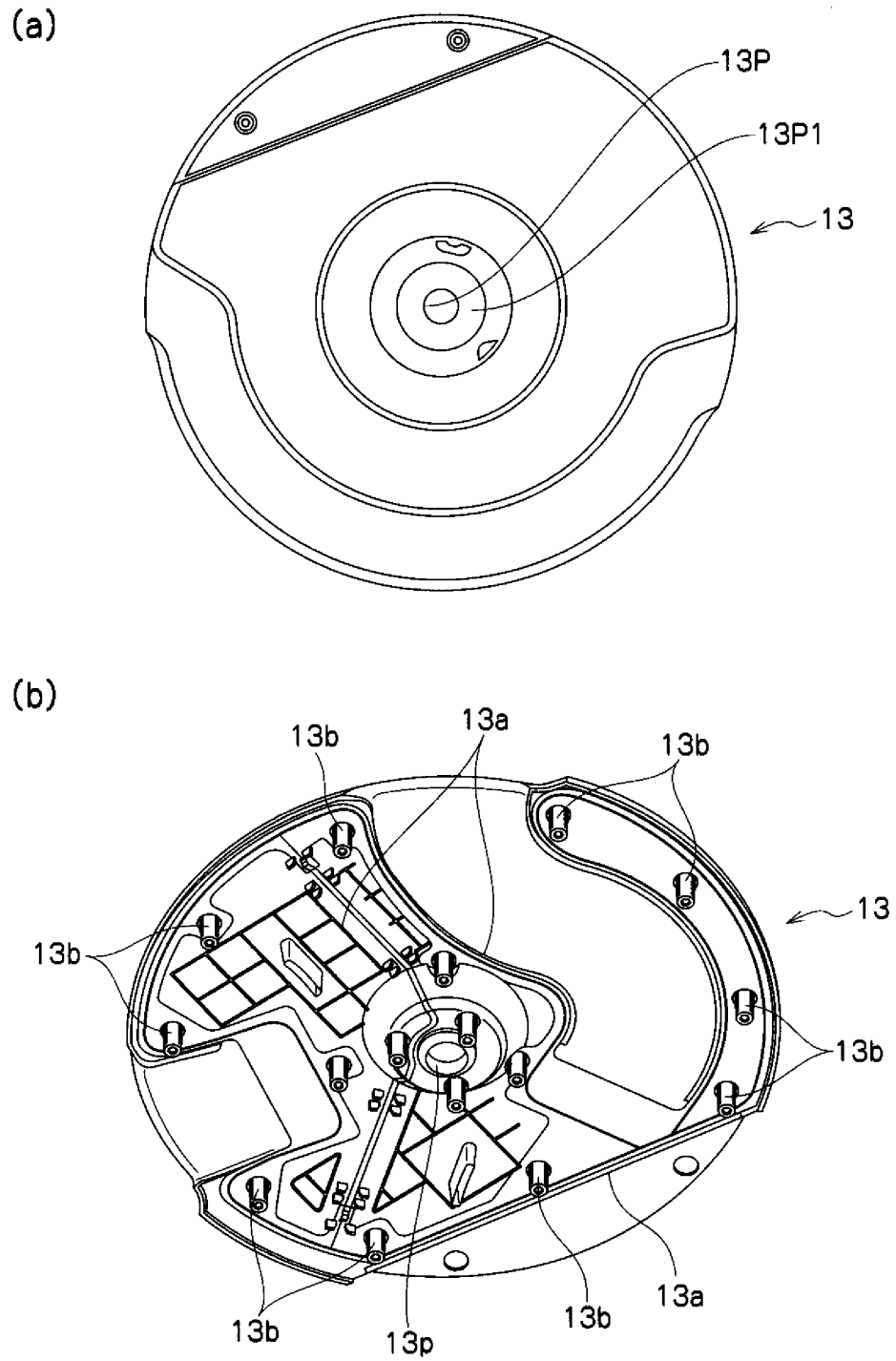


Fig. 6

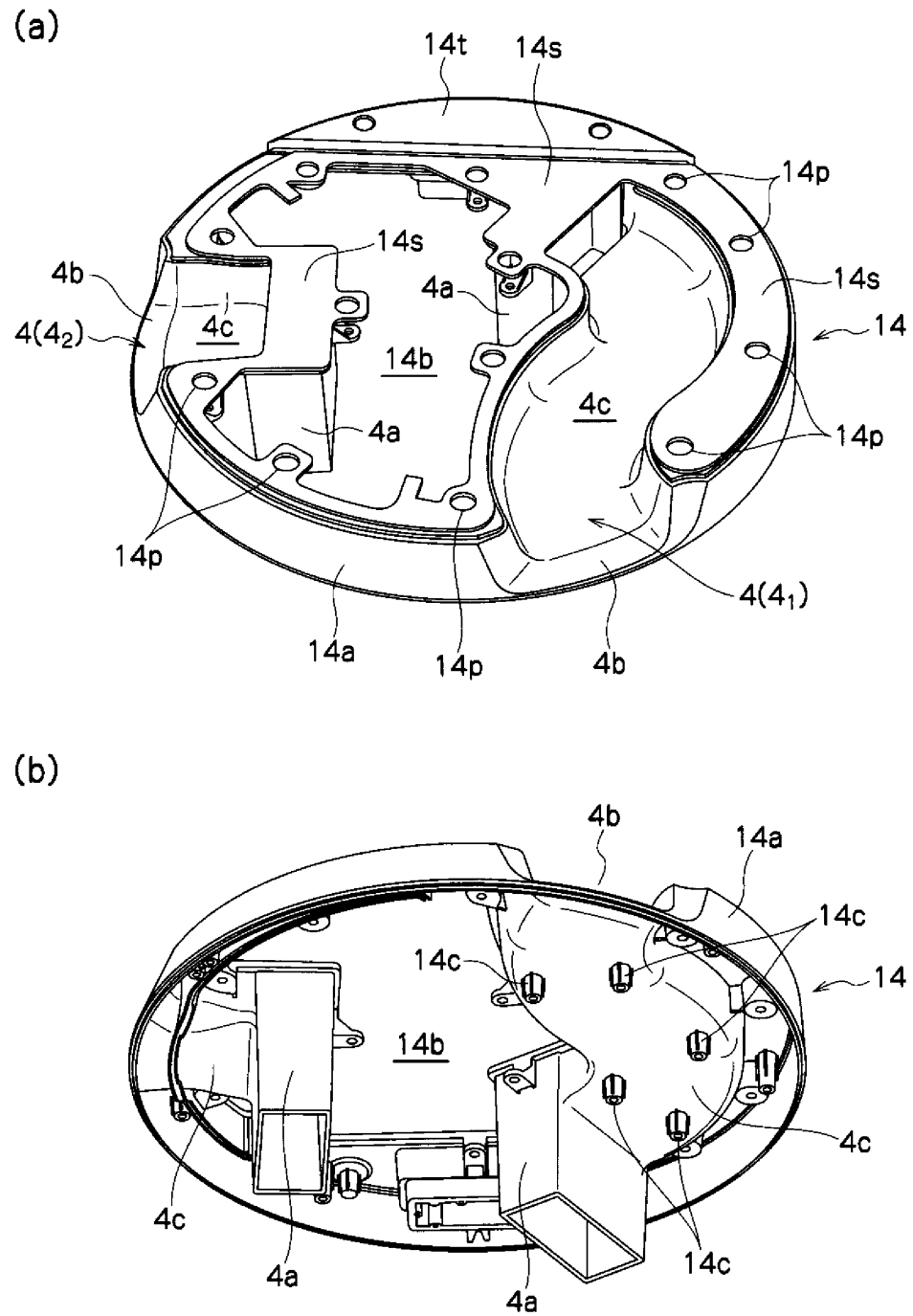
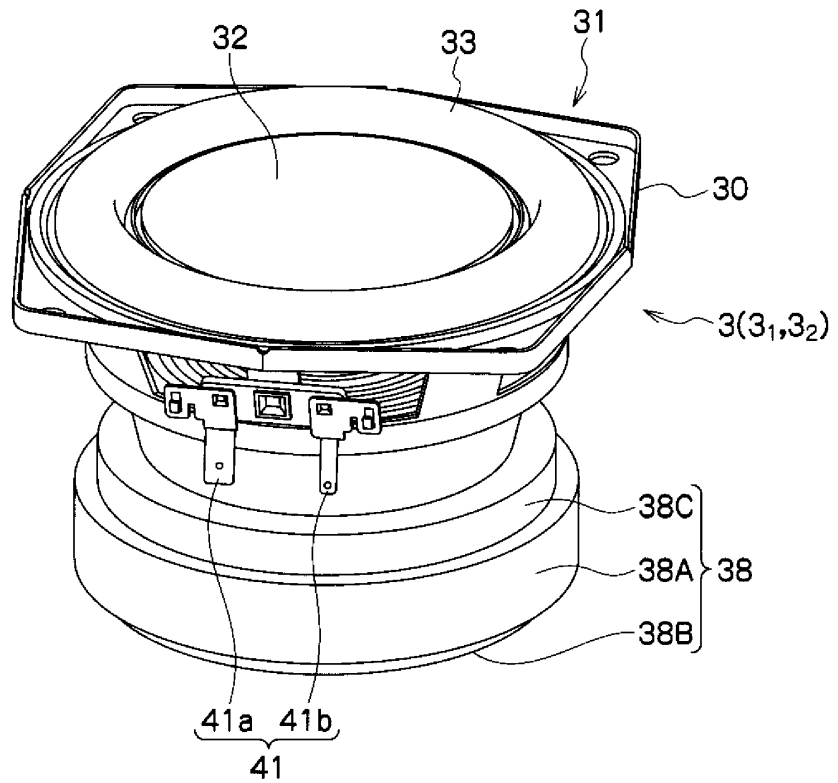


Fig. 7

(a)



(b)

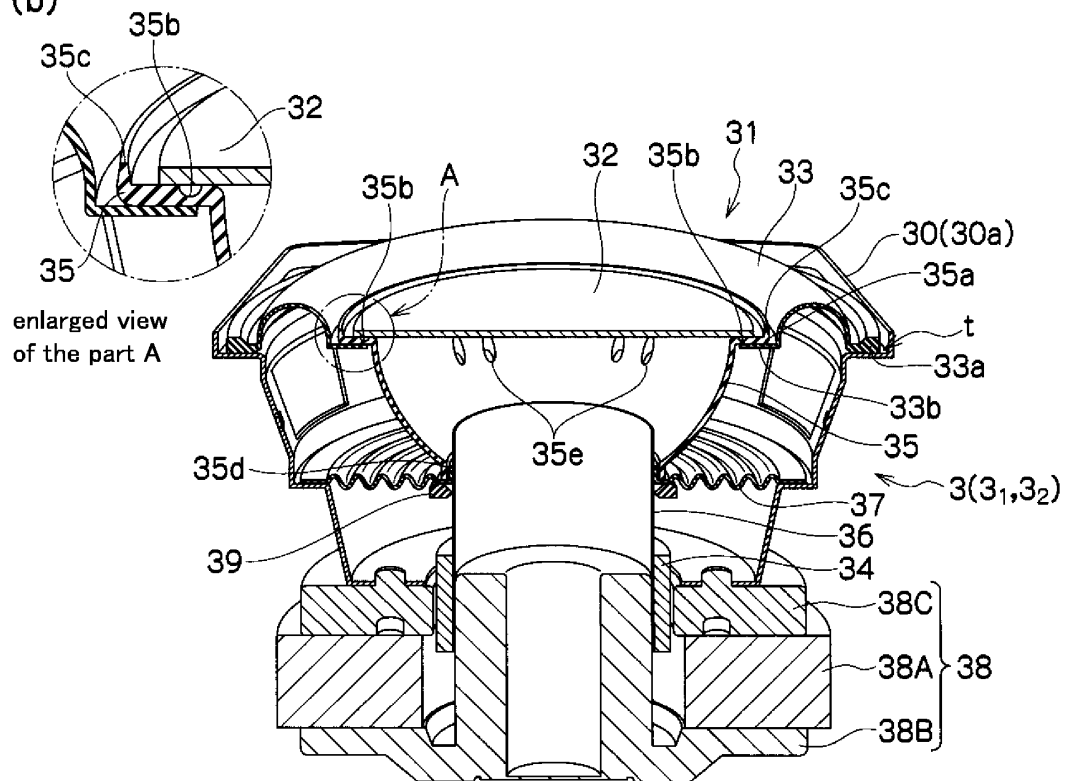


Fig. 8

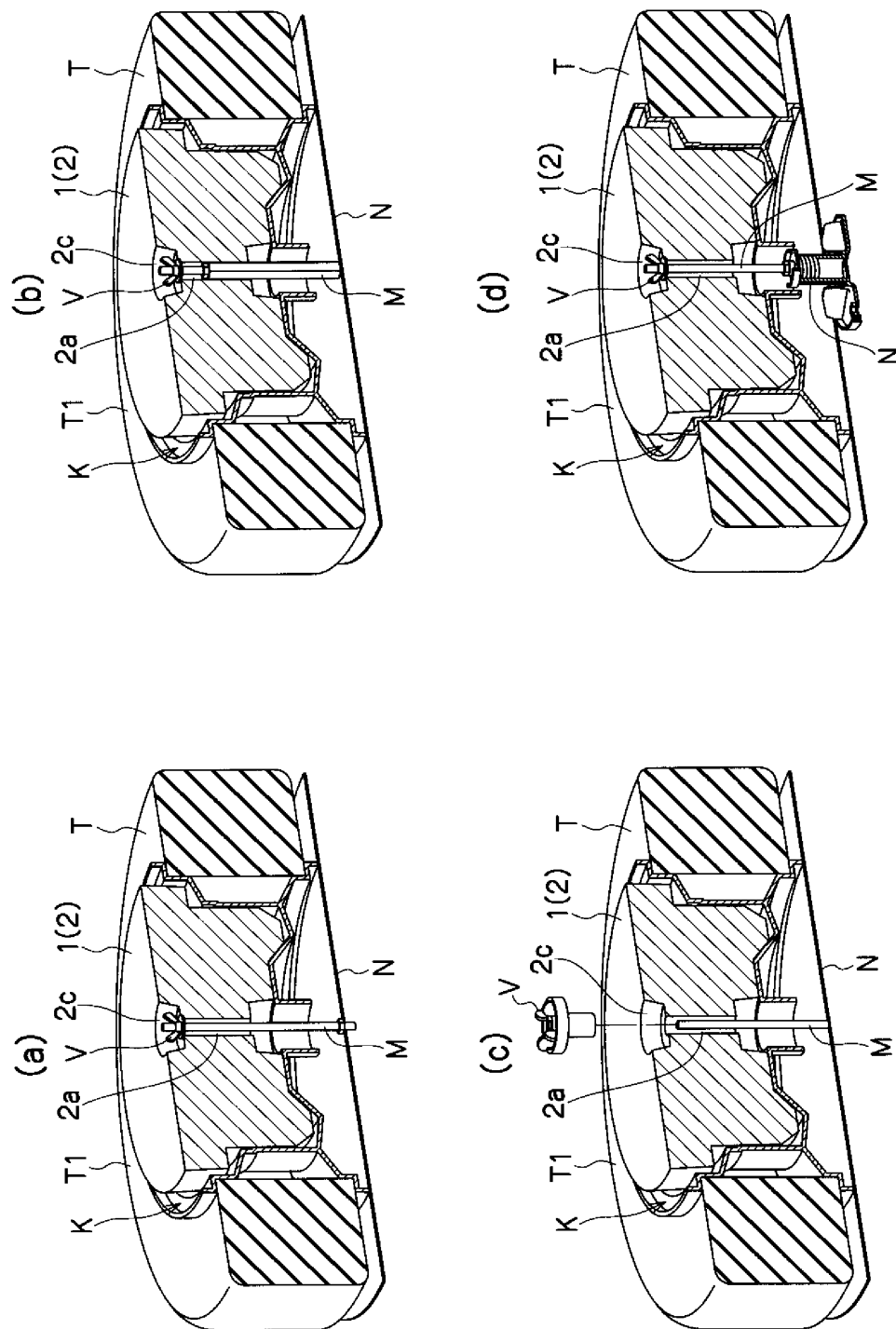
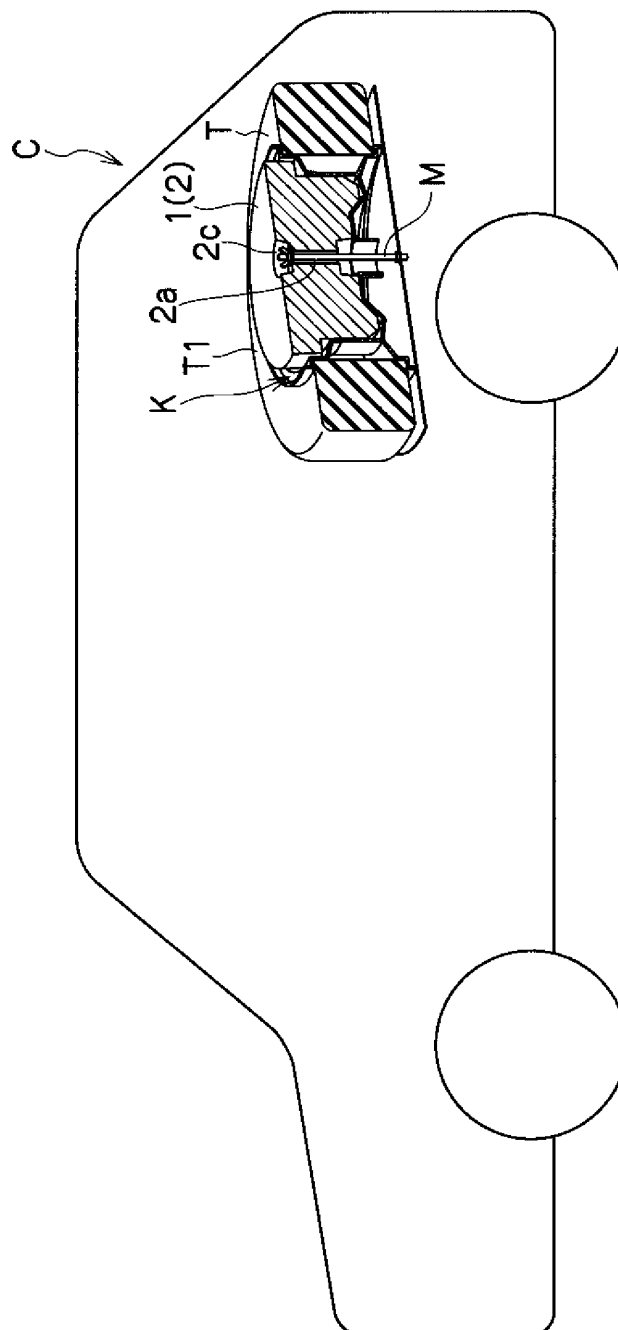


Fig. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/068717

A. CLASSIFICATION OF SUBJECT MATTER

H04R1/28(2006.01) i, H04R1/00(2006.01) i, H04R1/02(2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04R1/28, H04R1/00, H04R1/02

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	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

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	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 100275/1990 (Laid-open No. 57462/1992) (Mitsubishi Electric Corp.), 18 May 1992 (18.05.1992), entire text; all drawings (Family: none)	1-30
A	JP 2006-303577 A (Pioneer Corp.), 02 November 2006 (02.11.2006), entire text; all drawings & EP 001713297 A2	27-30

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

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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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
17 November, 2009 (17.11.09)Date of mailing of the international search report
01 December, 2009 (01.12.09)Name and mailing address of the ISA/
Japanese Patent Office

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 11136786 A [0005]
- JP 3410206 B [0005]