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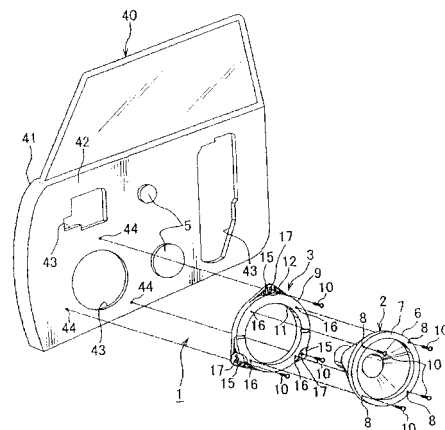
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(54) **SPEAKER MOUNTING MEMBER AND SPEAKER UNIT FIXING STRUCTURE**

(57) A speaker unit mounting member which can provide a desirable acoustic characteristic of a speaker unit and a speaker unit fixing structure including the speaker unit mounting member are provided. The speaker unit fixing structure 1 includes a speaker unit 2 and a speaker mounting member 3. The speaker mounting member 3 includes a housing 9 which is formed into a frame-like shape and which is provided with an opening part 13 therein extending along a circumference of the housing.

FIG. 1



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Description

BACKGROUND

Field of the Invention

[0001] The present invention relates to a speaker mounting member for mounting for example a speaker unit to a structural object such as a door panel of a motor vehicle and a speaker unit fixing structure having the speaker mounting member.

Description of Related Art

[0002] Conventionally, when a speaker unit cannot be directly mounted to a structural object such as a door panel of a motor vehicle, various speaker mounting members (hereinafter called mounting member, refer to Japanese Patent Application Publication No. 2003-274473, 2004-320265, 2003-111178 and 2003-111179) have been employed. Such a speaker mounting member is disposed between the speaker unit and the structural object. Being mounted to both of the speaker unit and the structural object, the speaker mounting member fixes the speaker unit to the structural object.

[0003] When employing the mounting member disclosed for example in the above-mentioned Japanese Patent application publications, the mounting member is structured with a solid material. As a vibration of a diaphragm of the speaker unit transfers to the structural object especially from a frame of the speaker unit, the structural object vibrates (due to eigen vibration or resonant vibration). The structural object contacts with the mounting member, and an unwanted noise is generated from therebetween.

[0004] There is also a problem that the structural object vibrates and generates an unwanted noise by the sound wave radiated from the speaker. Furthermore, propagation of the vibration from the speaker unit to the structural object induces resonant vibration of the structural object and the speaker unit. Therefore, the sound wave radiated from the diaphragm of the speaker unit will coexist with a sound wave radiated from parts other than the diaphragm (such as a frame) and from the mounting member and the structural object. Thus, there is a problem of providing acoustic characteristic which is different from the proper acoustic characteristic of the speaker unit. As described above, there is a problem when employing the mounting member of the prior art, that desirable acoustic characteristic cannot be obtained.

[0005] Furthermore, it is possible to improve a vibration-damping property by employing a mounting member made of a rigid and/or heavy material. However, when employing such material to the door panel, there is a problem that the weight of the door panel will increase and the weight of the vehicle itself will increase.

SUMMARY OF THE INVENTION

[0006] The present invention aims to solve for example the above-described problems. An object of the present invention is to provide a speaker mounting member which can inhibit the vibration generated at a speaker unit to propagate to a structural body and which can provide desirable acoustic characteristic of the speaker unit, without using a rigid and/or heavy material, and also to provide a speaker unit fixing structure having the speaker mounting member.

[0007] For achieving the object, a speaker mounting member of the present invention described in claim 1 is a speaker mounting member for mounting a speaker unit to a structural object, including a housing, wherein the housing is formed into a frame-like shape, and an opening part extending along a circumference of the housing is provided in the housing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is an exploded perspective view of the speaker unit fixing structure of the present invention according to a first embodiment;

[0009] FIG. 2A is a plane view of the housing of the mounting member of the fixing structure shown in FIG. 1;

[0010] FIG. 2B is a cross-sectional view along IIB-IIB line shown in FIG. 2A;

[0011] FIG. 2C is a back view of the housing shown in FIG. 2A;

[0012] FIG. 3 is an exploded perspective view of a speaker unit fixing structure of the present invention according to a second embodiment;

[0013] FIG. 4 is a perspective view of a housing and a cover of the fixing structure shown in FIG. 3;

[0014] FIG. 5 is a perspective back view of the housing and the cover of the fixing structure shown in FIG. 4;

[0015] FIG. 6A is a cross-sectional view of the fixing structure shown in FIG. 3;

[0016] FIG. 6B is an enlarged view of a portion indicated by VIB in FIG. 6A;

[0017] FIG. 7A is a plane view of the housing of the mounting member of the fixing structure shown in FIG. 3;

[0018] FIG. 7B is a cross-sectional view along VIIB-VIIB line shown in FIG. 7A;

[0019] FIG. 7C is a back view of the housing shown in FIG. 7A;

[0020] FIG. 8A is a plane view of one cover component of the cover the speaker mounting member of the fixing structure shown in FIG. 3;

[0021] FIG. 8B is a plane view of the other cover component of the cover of the speaker mounting member of the fixing structure shown in FIG. 3;

[0022] FIG. 9 is an exploded perspective view of a speaker unit fixing structure of the present invention according to a third embodiment;

[0023] FIG. 10 is a perspective view of a housing and a cover of the fixing structure shown in FIG. 9;

[0024] FIG. 11 is a perspective back view of the housing and the cover of the fixing structure shown in FIG. 9;

[0025] FIG. 12A is a cross-sectional view of the fixing structure shown in FIG. 9;

[0026] FIG. 12B is an enlarged view of a portion indicated by XIIB in FIG. 12A;

[0027] FIG. 13A is a plane view of the housing of the mounting member of the fixing structure shown in FIG. 9;

[0028] FIG. 13B is a cross-sectional view along XIIB-XIIB line in FIG. 13A;

[0029] FIG. 13C is a back view of the housing shown in FIG. 13A;

[0030] FIG. 14 is a plane view of one cover component of the cover of the mounting member shown in FIG. 3;

[0031] FIG. 15A is a front plane view of a housing of a speaker unit fixing structure of the present invention according to a forth embodiment;

[0032] FIG. 15B is a back plane view of the housing shown in 15A;

[0033] FIG. 15C is a cross-sectional view along XVC-XVC line shown in FIG. 15B;

[0034] FIG. 16A is a front plane view of cover components of a cover of the speaker unit fixing structure of the present invention according to the forth embodiment;

[0035] FIG. 16B is a back plane view of the cover components of the cover shown in 16A;

[0036] FIG. 17A is a cross-sectional view of the mounting member of the fixing structure of the present invention according to the forth embodiment;

[0037] FIG. 17B is an enlarged view of a portion indicated by XVIIB in FIG. 17A;

[0038] FIG. 18 is a cross-sectional view of a modified example of the mounting member shown in FIG. 6B;

[0039] FIG. 19 is a cross-sectional view of another modified example of the mounting member shown in FIG. 6B;

[0040] FIG. 20A is a perspective view of a modified example of the housing and the cover of the fixing structure shown for example in FIG. 4;

[0041] FIG. 20B is a perspective view of a tightening member of the fixing structure shown in FIG. 20A;

[0042] FIG. 21 is a graph showing damping of vibration of a mounting member of a comparative example 1, the mounting member is wooden and solid;

[0043] FIG. 22 is a graph showing damping of vibration of a mounting member of a comparative example 2, the mounting member is resin and is provided with opening parts;

[0044] FIG. 23 is a graph showing damping of vibration of a mounting member of present invention 1, the mounting member is aluminum and is provided with opening parts; and

[0045] FIG. 24 is a graph showing damping of vibration of a mounting member of present invention 2, the mounting member is provided with the opening parts of the present invention 1 arranged to receive sand particles therein.

DETAILED DESCRIPTION OF THE INVENTION

[0046] A speaker mounting member of the present invention according to a first embodiment will be explained below. The speaker mounting member according to a first embodiment (hereinafter called the mounting member) includes a hollow housing having an opening part, thereby reducing a weight of the housing, or the mounting member itself, at the same time improving the rigidity of the housing, or the mounting member. In this manner, the mounting member serves to prevent the vibration of a diaphragm of a speaker unit propagating to a structural object, preventing generation of an unwanted noise from between the mounting member and the structural object. Thus, a desirable acoustic characteristic of the speaker unit can be obtained.

[0047] Furthermore, the mounting member may include a cover which can be mounted to the housing so as to cover the opening part. In this case, since the opening part is formed at an inside of the housing, or the mounting member, the mounting member will have sufficient contact area with the structural object. As a result, creation of a space between the mounting member and the structural object can be prevented, and thus the generation of the rattle motion of the mounting member with respect to the structural object can be prevented.

[0048] The housing and the cover may be made of mutually different materials. In this case, it is especially desired that the housing and the cover are made of mutually different metal materials. In this case, the housing and the cover can have mutually different resonance frequencies. Furthermore, by allowing the housing and the cover to contact with respect to each other, the vibration of the housing and the vibration of the cover can cancel out. Thus, the propagation of the vibration of the speaker unit toward the structural object can be prevented.

[0049] A plurality of opening parts may be provided. In this case, a space in the housing is separated, thus the housing will have greater rigidity than the housing having one circumferentially and continuously formed opening part.

[0050] The housing may include a main body part having the opening part and a flange part projecting from an outer circumferential surface of the main body part. In this case, the speaker unit can be mounted to one of the main body part and the flange part, and the structural object can be mounted to the other one of the main body part and the flange part. Thus, the speaker unit can be easily mounted to the structural object via the mounting member.

[0051] The main body part may have a speaker mounting portion, and the flange part may have a structural object mounting portion. In this case, a predetermined distance will be provided between positions to which the speaker unit and the structural object are mounted. Thus, the vibration generated from the speaker unit can effectively be damped at the housing.

[0052] That is, one possible propagation path of the

vibration generated at the speaker unit can be a path through which the vibration propagates from the frame of the speaker unit to the housing via the speaker mounting portion of the main body part of the housing, and from the housing to the structural object via the structural object mounting portion of the flange part. In this path, by increasing a distance between the speaker mounting portion and the structural object mounting portion, the vibration can be damped as much as possible within the housing. Therefore, the propagation of the vibration to the structural object can be inhibited.

[0053] The speaker mounting portions may be disposed with a space between each other, so do the structural object mounting portions. In this case, the mounting member can connect with both the speaker unit and the structural object in the condition of inhibiting the rattle motion. Thus, generation of an unwanted noise from between the mounting member and the structural object can be prevented.

[0054] A tightening member(s) which penetrates through the housing and the cover to fix the housing and the cover with respect to each other can be provided. In this case, the tightening member is made of a material different from both the housing and the cover so as to differentiate the resonant frequency of the tightening member from that of the housing and the cover. Thus, the propagation of the vibration of the speaker unit to the structural object can be inhibited.

[0055] The opening part may receive therein an internal constituent member constructed with a material different from that of the housing. In this case, when the speaker unit is driven, the vibration propagating to the structural object via the mounting member will damp within the housing. Thus, the generation of the unwanted noise radiated by the structural object behaving as a diaphragm can be prevented. And when the structural object vibrates, the generation of the unwanted noise caused by the contact between the structural object and the mounting member can be prevented.

[0056] The internal constituent member may be constructed with particles. In this case, even if the mounting member tries to vibrate, the vibration propagated to the mounting member damps within the housing. Thus, the generation of the unwanted noise caused by the contact between the mounting member and the structural object can be prevented.

[0057] The internal constituent member may be constructed with the particles and elastic resin. In this case, the speaker unit, the mounting member and the structural object hardly resonate with respect to each other from a low-frequency range to a middle-frequency range or from a middle-frequency range to a high-frequency range.

[0058] The internal constituent member may be constructed with the particles and a foamed material. In this case, even if the mounting member tries to vibrate, the vibration propagating to the mounting member will damp within the housing. Thus, the generation of the unwanted noise caused by the contact between the structural object

and the mounting member can be prevented.

[0059] By increasing the weight of the internal constituent member, the mounting member itself will be resistant to vibration. For example, it is inhibited that the vibration of the speaker unit propagating to the structural object. However, there is a contradiction that such heavy mounting member is difficult to be mounted to the structural object, especially to a door panel of the motor vehicle; but on the other hand, if the weight of the mounting member is small, the vibration of the speaker unit will easily propagate to the structural object.

[0060] Therefore, it is preferred that the internal constituent member include a combination of for example sand (particles) and the elastic body, or sand (particles) and the foamed material, so that the weight of the internal constituent member in the housing can be adjustable, in order to inhibit the propagation of the vibration and inhibit the generation of the unwanted noise caused by the contact between the structural object and the mounting member.

[0061] The housing may be constructed with a non-magnetic material. In this case, when the housing, or the mounting member, is made of a magnetic material, a leak of the magnetic flux in proximity of the magnetic circuit of the speaker unit into the housing, or the mounting member, can be prevented.

[0062] Furthermore, the opening part may receive therein the internal constituent member including the elastic body constructed with a material different from that of the housing and the cover. In this case, when the speaker unit is driven, the vibration propagated to the structural object via the mounting member will damp within the housing. Thus, the generation of the unwanted noise caused by the structural object behaving as the diaphragm can be prevented, and the generation of the unwanted noise caused by the contact between the vibrating structural object and the mounting member can be prevented. Furthermore, the internal constituent member can be constructed with adhesive connecting the housing with the cover. In this case, even if the mounting member tries to vibrate, the vibration propagated to the mounting member will damp within the housing. Thus, the generation of the unwanted noise caused by the contact between the structural object and the mounting member can be prevented, as well as the generation of unwanted noise from between the mounting member and the structural object can be prevented.

[0063] Furthermore, since the speaker unit fixing structure according to this embodiment includes the above-described mounting member, the generation of the unwanted noise from between the mounting member and the structural object can be prevented, so the desirable acoustic characteristic of the speaker unit can be obtained.

[0064] Furthermore, it is preferred to connect damping member to the structural object. In this case, the vibration of the structural object due to the sound wave radiated from the speaker unit and such can be inhibited.

First embodiment

[0065] A first embodiment of the present invention will be explained below with reference to the FIG. 1 and FIG. 2. As shown in FIG. 1, a speaker unit fixing structure 1 of the present invention according to the first embodiment (hereinafter called the fixing structure) includes: a door panel 40, as a structural object, constituting a body of a motor vehicle, as a moving body; a speaker unit 2; a speaker mounting member 3 (hereinafter called the mounting member) mounted to both the speaker unit 2 and the door panel 40 for mounting the speaker unit 2 to the door panel 40; and damping member 5 mounted to the door panel 40. In other words, the motor vehicle includes the fixing structure 1.

[0066] The door panel 40, as shown in FIG. 1, includes for example an outer panel 41 and an inner panel 42 attached to the outer panel 41. The panels 41 and 42 are obtained by roll forming steel plates. A door glass, not shown, is arranged between the panels 41 and 42. The door panel 40 is attached to the body of the motor vehicle so as to be supported rotatably around a hinge. The door panel 40 can be rotated around the hinge to open/close a compartment of the vehicle.

[0067] The speaker unit 2, an electronic power window motor not shown, and a door lock actuator not shown, as electronic devices, are mounted to the inner panel 42. The inner panel 42 includes a plurality of opening 43 to house the speaker unit 2, the electronic power window motor and a door lock actuator. Also, the inner panel 42 includes screw holes 44 for fixing a member arranged around the opening 43 to house the speaker unit 2.

[0068] The speaker unit 2, as shown in FIG. 1, includes a frame 6, a vibrating portion and a magnetic circuit portion to cause the diaphragm having the vibrating portion to vibrate. The frame 6 has a conical cone-like, tube-like appearance, and the vibrating portion and the magnetic circuit are housed at an inner side thereof. The frame 6 has a ring-like flange part 7 formed integrally therewith. The flange part 7 includes a hole 8 for passing later-described screws 10 therethrough. In an exemplary drawing, the four (plurality of) holes 8 are disposed along a circumference of the flange part 7 with an interval.

[0069] When voice current is supplied to a voice coil connected to the diaphragm of the speaker unit 2, electromagnetic force (Lorenz force) will act on the voice coil, and the diaphragm vibrates thereby radiating sound wave.

[0070] The mounting member 3 includes a housing 9 shown in FIG. 2A through FIG. 2C and a plurality of screws 10 (shown in FIG. 1), corresponding to tightening member.

[0071] The housing 9 constructed with a metal (material) which is similar to or different from the material of the flange part 7 of the frame 6 of the speaker unit 2. The housing 9 is also made of a non-magnetic material. As shown in FIG. 2A to FIG. 2C, the housing 9 includes a ring-like main body part 11 and a flange part 12. The

main body part 11 is formed into substantially the same shape and substantially the same size with the flange part 7 of the speaker unit 2. In the present invention, a word frame-like shape includes a ring-like shape, a rectangular-like shape or other various shapes of an outer periphery. Thus, the main body part 11, or the housing 9, is formed into the frame-like shape.

[0072] The main body part 11 includes a plurality of opening parts 13. The opening part 13 has a shape formed to be concave with respect to one surface of the main body part 11. The opening parts 13 are spaces provided in the main body part 11 which are separated by partitions 14, and are disposed along the circumference of the main body part 11 with an interval between each other. Also, the opening part 13 is formed to be a circular arc, so as to be curved along the main body part 11. In other words, the respective opening parts 13 are formed into a groove extending along the circumference of the main body part 11.

[0073] The flange part 12 includes a plurality of flange parts 15. The respective flange parts 15 are formed into a plate projecting from a circumferential surface of the main body part 11 to a radial direction of the main body part 11. The flange parts 15 are for example disposed along the circumference of the main body part 11 with similar interval. Also, the flange parts 15 may be disposed along the circumference of the main body part 11 with an unequal interval. In an exemplary drawing, three flange parts 15 are provided.

[0074] The housing 9 includes a screw hole 16, corresponding to speaker mounting portion, and a threaded screw hole 17, corresponding to structural object mounting portion. The respective screw holes 16 are arranged to penetrate the other surface of the main body part 11, as shown in FIG. 2A, and are provided to the partitions 14 separating the adjacent opening parts 13, as shown in FIG. 2C. The screw holes 16 and the holes 8 are the same in number, thus four (plurality of) screw holes 16 are provided in the exemplary drawing, and the screw holes 16 are disposed along the circumference of the main body part 11 with an interval between each other. The screw holes 16 is arranged so as when the flange part 7 of the frame 6 of the speaker unit 2 is overlapped with the other surface of the housing 9, the screw holes 16 will overlap with the holes 8 described above. The screws 10 are passed through the holes 8 and are screwed into the screw holes 16.

[0075] The threaded screw holes 17 are provided to respective flange parts 15 of the flange part 12, and are, of course, penetrating through the respective flange parts 15. In the exemplary drawing, one threaded screw hole 17 is provided to the respective flange parts 15. Thus, the plurality of threaded screw holes 17 are formed at the respective flange parts 12 and are disposed with an interval.

[0076] The threaded screw holes 17 are disposed so as when the housing 9 is overlapped to an inner surface of the inner panel 42, the threaded screw holes 17 will

overlap with respect to the screw holes 44 of the inner panel 42. The screws 10 are passed through the threaded screw holes 17 and are screwed into the screw holes 44.

[0077] The screws 10 are made of a metal material which is similar to or different from both the material of the mounting member 3 and the flange part 7 of the frame 6 of the speaker unit 2.

[0078] The damping member 5, made of a known sound-absorbing material or a known damping material, are formed into a predetermined shape and are provided to a suitable position at the inner panel 42 of the door panel 40. The damping member 5 will damp the vibration of the door panel 40.

[0079] For the mounting member 3 structured as described above, the speaker unit 2 is passed through the inner side of the main body part 11 of the housing 9, then the flange part 7 of the frame 6 of the speaker unit 2 is placed over one surface of the main body part 11, and the screws 10 are passed through the holes 8 and screwed into the screw holes 16, to mount the mounting member 3 to the speaker unit 2.

[0080] Then, the speaker unit 2 is passed through the opening 43 and the one surface of the main body part 11 of the mounting member 3 is placed over the inner surface of the inner panel 42. The screws 10 are passed through the threaded screw holes 17 and screwed into the screw holes 44. In this manner, the speaker unit 2 is mounted to the inner panel 42, or the door panel 40, with the mounting member 3, and the fixing structure 1 is assembled.

[0081] According to this embodiment, the housing 9 includes the opening part 13 thereby forming the housing 9 to be hollow. Therefore, the weight of the housing 9, or the mounting member 3 itself, can be reduced, at the same time the rigidity of the housing 9, or the mounting member 3, can be improved. In this manner, the mounting member 3 inhibits the vibration of the diaphragm of the speaker unit 2 to propagate to the door panel 40, preventing the generation of the unwanted noise from between the mounting member 3 and the door panel 40. Thus, a desirable acoustic characteristic of the speaker unit 2 can be obtained.

[0082] A space in the housing 9 is separated by a plurality of opening parts 13. Thus, the housing 9 will have greater rigidity than the housing having one circumferentially and continuously formed opening part 13.

[0083] The housing 9 includes the main body part 11 having the opening part 13 and the flange part 12 projecting from an outer circumferential surface of the main body part 11. Thus, the speaker unit 2 can be mounted to one of the main body part 11 and the flange part 12, and the door panel 40 can be mounted to the other one of the main body part 11 and the flange part 12. Thus, the speaker unit 2 can be easily mounted to the door panel 40 with the mounting member 3.

[0084] The screw hole 16, corresponding to the speaker mounting portion, is provided to the main body part 11, and the threaded screw hole 17, corresponding to

the structural object mounting portions, is provided to the flange part 12. Thus, a predetermined distance will be provided between positions to which the speaker unit 2 and the door panel 40 are mounted. Thus, the vibration generated at the speaker unit 2 can effectively be damped at the housing 9.

[0085] That is, one possible propagation path of the vibration generated at the speaker unit 2 would be a path through which the vibration propagates from the frame 6 of the speaker unit 2 to the housing 9 via the screws hole 16 as the speaker mounting portion provided to the main body part 11 of the housing 9, and propagates from the housing 9 to the door panel 40 via the threaded screw hole 17 as the structural object mounting portion provided to the flange part 12. In this path, by increasing the distance between the screws hole 16 as the speaker mounting portion and the threaded screw hole 17 as the structural object mounting portion, the vibration can be damped as much as possible within the housing 9. Therefore, the propagation of the vibration to the door panel 40 can be inhibited.

[0086] The screw holes 16 as the speaker mounting portions are disposed with an interval between each other, so do the threaded screw holes 17 as the structural object mounting portions. Thus, the mounting member 3 can be securely mounted to both the speaker unit 2 and the door panel 40. Thus, the generation of the unwanted noise from between the mounting member 3 and the door panel 40 can be prevented.

[0087] Furthermore, the screw 10 as the tightening member is made of the material different from the housing 9 and the frame 6 of the speaker unit 2. Thus, the resonant frequency of the screw 10 as the tightening member can be different for example from the housing 9. Also, the propagation of the vibration of the speaker unit 2 to the door panel 40 is prevented.

[0088] The housing 9 may be made of a non-magnetic material. In this case, even if the housing 9, or the mounting member 3, is made of a magnetic material, a leak of the magnetic flux in proximity of the magnetic circuit of the speaker unit 2 into the housing 9, or the mounting member 3, can be prevented.

[0089] Furthermore, since the fixing structure 1 of the speaker unit 2 according to this embodiment includes the above-described mounting member 3, the generation of the unwanted noise from between the mounting member 3 and the door panel 40 and such can be prevented, and the desirable acoustic characteristic of the speaker unit 2 can be obtained.

[0090] Furthermore, since the damping member 5 is attached to the door panel 40, the vibration of the door panel 40 due to the sound wave generated by the speaker unit 2 can be inhibited.

55 Second embodiment

[0091] A second embodiment of the present invention will be explained with reference to FIG. 3 through FIG.

8B. The same numerical references used in the first embodiment are used for the same components, thus explanation thereof are eliminated. A speaker unit fixing structure 1 of the present invention according to the second embodiment (hereinafter called the fixing structure) includes, as shown in FIG. 3 to FIG. 6B, the above-described housing 9, the screw 10, a cover 18 and an internal constituent member 19 (FIG. 6A and FIG. 6B).

[0092] The cover 18 includes two cover components 20, as shown in FIG. 8A and FIG. 8B. The cover components 20, or the cover 18, are made of a material different from that of the housing 9 or/and the frame 6 of the speaker unit 2. The cover component 20 is formed into a semi-ringshaped plate, as shown in FIG. 8A and FIG. 8B. The cover component 20 includes threaded hole 21 to pass the screw 10 therethrough. The cover component 20 is overlapped with the one surface of the housing 9 and covers the opening part 13. The screw 10 is passed through the threaded hole 21 and screwed into the screw hole 16, thereby the cover component 20 is mounted to the housing 9 (FIG. 7A to FIG. 7C) so as to cover over the opening parts 13.

[0093] The internal constituent member 19 is constructed with a material different from the housing 9 and is made of only a particle material made of any one of sand, metal such as iron, or resin. The internal constituent member 19 is received in the opening parts 13 of the housing 9 shown in FIG. 7A and FIG. 7B. As described, the opening parts 13 receive the internal constituent member 19 which is made of a different material from the material of the housing 9, as shown in FIG. 6A and FIG. 6B.

[0094] In this embodiment, the cover components 20 of the cover 18 cover the opening parts 13 after receiving the internal constituent member 19 in the opening parts 13. After that, the flange part 7 of the frame 6 of the speaker unit 2 is overlapped with the cover components 20, and then the screws 10 are passed through the holes 8 and the threaded holes 21 and screwed into the screw holes 16 so the speaker unit 2, the cover 18 and the housing 9 are fixed to each other. Then, in the same manner described for the first embodiment, the mounting member 3 is mounted to the door panel 40 to assemble the above-described fixing structure 1.

[0095] According to this embodiment, as with the first embodiment, the housing 9 is formed to be hollow by providing thereto the opening parts 13. Thus, the weight of the housing 9, or the mounting member 3, can be reduced, at the same time the rigidity of the housing 9, or the mounting member 3, can be improved. As a result, the mounting member 3 can prevent the propagation of the vibration of the diaphragm of the speaker unit 2 to the door panel 40. The mounting member 3 inhibits the generation of the unwanted noise from between the mounting member 3 and the door panel 40. Thus, desirable acoustic characteristic of the speaker unit 2 can be obtained.

[0096] Furthermore, since the mounting member 3 in-

cludes the cover 18 which is mounted to the housing 9 so as to cover the opening parts 13, and since the opening parts 13 are formed in the housing 9, or the mounting member 3, the mounting member 3 will have sufficient contact area for contacting with the door panel 40. As a result, creation of a space between the mounting member 3 and the door panel 40 can be prevented, and thus the generation of the rattle motion of the mounting member 3 with respect to the door panel 40 can be prevented.

[0097] Furthermore, the housing 9 and the cover 18 may be made of mutually different materials. Especially, it is desired that the housing 9 and the cover 18 are made of mutually different metal materials. In this case, the housing 9 and the cover 18 can have mutually different resonance frequencies. Furthermore, by allowing the housing 9 and the cover 18 to contact with respect to each other, vibrations of the housing 9 and the vibration of the cover 18 will cancel out. Thus, the vibration of the speaker unit 2 from propagating to the door panel 40 can be prevented.

[0098] The opening parts 13 receive therein the internal constituent member 19 made of a different material from the housing 9. Thus, when the speaker unit 2 is driven, the vibration propagating to the door panel 40 via the mounting member 3 will damp within the housing 9, so the generation of the unwanted noise caused by the vibration of the door panel 40 can be prevented. And when the door panel 40 vibrates, generation of the unwanted noise caused by the contact between the door panel 40 and the mounting member 3 can be prevented.

[0099] Since the internal constituent member 19 is made of the particles, even if the mounting member 3 tries to vibrate, the vibration propagating to the mounting member 3 will create frictions between the particles, so the vibration will damp within the housing 9 by the frictions. Therefore, the generation of the unwanted noise caused by the contact between the mounting member 3 and the door panel 40 can be prevented.

Third embodiment

[0100] A third embodiment of the present invention will be explained with reference to FIG. 9 through FIG. 14. The same numerical references used in the first and the second embodiments are used for the same components, thus explanation thereof are eliminated. A speaker unit fixing structure 1 of the present invention according to the third embodiment (hereinafter called the fixing structure) includes, as shown in FIG. 9 to FIG. 12 and FIG. 14, the above-described cover 18 constituted of one cover component 20. The housing 9 includes a fixing screw 22 for mounting the cover component 20 to the housing 9 and a screw hole 23 passing the screws 22 therethrough.

[0101] In this embodiment, the cover component 20, or the cover 18, is made of a material different from both the housing 9 (FIG. 13A to FIG. 13C) and the frame 6 of the speaker unit 2. The cover component 20 is formed

into a ring-like plate. The screw hole 21 for the screw 22 penetrates the cover component 20. The cover component 20 is overlapped with one surface of the housing 9 to cover the opening part 13. The screws 22 are screwed into the screw holes 23. And the cover component 20 is mounted to the housing 9 so as to cover the opening part 13.

[0102] In this embodiment, as shown in FIG. 13C, the partitions 14 are not provided between the opening parts 13 so one opening part 13 is provided along the whole circumference of the main body part 11 of the housing 9 (that is, the opening part 13 extends in a circumferential direction of the main body part 11 of the housing 9). Also, the internal constituent member 19 is received in the opening part 13.

[0103] In this embodiment, the cover component 20 of the cover 18 covers the opening part 13 after receiving the internal constituent member 19 in the opening part 13. After that, the flange part 7 of the frame 6 of the speaker unit 2 is overlapped with the other surface of the main body part 11 of the housing 9. Then, the screws 10 are screwed into the screw holes 16 to fix the speaker unit 2 to the housing 9, and the screws 22 are screwed into the screw holes 23 to fix the cover component 20 to the cover 18. Then, in the same manner described for the first and the second embodiment, the mounting member 3 is mounted to the door panel 40 to assemble the above-described fixing structure 1.

[0104] According to this embodiment, as with the first embodiment, the housing 9 is formed to be hollow by providing thereto the opening part 13. Thus, the weight of the housing 9, or the mounting member 3, can be reduced, at the same time the rigidity of the housing 9, or the mounting member 3, can be improved. As a result, the mounting member 3 can prevent the propagation of the vibration of the diaphragm of the speaker unit 2 to the door panel 40, preventing the generation of the unwanted noise from between the mounting member 3 and the door panel 40. Thus, desirable acoustic characteristic of the speaker unit 2 can be obtained.

[0105] Furthermore, since the mounting member 3 includes the cover 18 which is mounted to the housing 9 so as to cover the opening parts 13, and since the opening parts 13 are formed in the housing 9, or the mounting member 3, the mounting member 3 will have sufficient contact area for contacting with the door panel 40. As a result, creation of a space between the mounting member 3 and the door panel 40 can be prevented, and thus the generation of the rattle motion of the mounting member 3 with respect to the door panel 40 can be prevented.

[0106] Furthermore, the housing 9 and the cover 18 are made of mutually different materials. Especially, it is desirable that the housing 9 and the cover 18 are made of different metal materials. As a result, the resonant frequencies of the housing 9 and the cover 18 can be different. Also, by allowing the housing 9 and the cover 18 to contact each other, the vibration of the housing 9 and the vibration of the cover 18 will cancel out, inhibiting the

propagation of the vibration of the speaker unit 2 to the door panel 40.

[0107] The opening part 13 receives therein the internal constituent member 19 made of a different material from the housing 9. Thus, when the speaker unit 2 is driven, the vibration propagating to the door panel 40 via the mounting member 3 will damp within the housing 9, so the generation of the unwanted noise caused by the vibration of the door panel 40 can be prevented. And when the door panel 40 vibrates, the generation of the unwanted noise caused by the contact between door panel 40 and the mounting member 3 can be prevented.

[0108] Since the internal constituent member 19 is made of the particles, even if the mounting member 3 tries to vibrate, the vibration propagating to the mounting member 3 will create frictions between the particles, so the vibration will damp within the housing 9 by the frictions. Therefore, the generation of the unwanted noise caused by the contact between the mounting member 3 and the door panel 40 can be prevented.

Fourth embodiment

[0109] A forth embodiment of the present invention will be explained with reference to FIG. 15 through FIG. 17. The same numerical references used in the first through the third embodiments are used for the same components, thus explanation thereof is eliminated. In a speaker unit fixing structure 1 of the present invention according to the fourth embodiment (hereinafter called the fixing structure), as described in the second embodiment: the cover 18 is constituted of two cover components 20, as shown in FIG. 16A, FIG. 16B and FIG. 17A; the threaded hole 21 is provided to the housing 9, as shown in FIG. 15A and FIG. 15B; the screw hole 16 is provided to the cover components 20, as shown in FIG. FIG. 16A and FIG. 16B; and the threaded screw hole 17 is provided to the cover components 20, as shown in FIG. 16A and FIG. 16B.

[0110] Furthermore, the housing 9 includes a pair of narrow portions 25 provided across a center of the housing 9 and a pair of broad portions 26 formed integrally therewith which is arranged to be continuous with the narrow portions 25 and broader than the narrow portions 25. A planar shape of a profile of outer peripheries of the housing 9 is formed into an oval shape. The above-described opening part 13 is provided to the respective broad portions 26 of the housing 9, as shown in FIG. 15C.

[0111] Furthermore, in this embodiment, the cover component 20 includes a protrusion 27 formed to have a shape projecting from a surface of the cover component 20 to the housing 9, the surface of the cover component 20 is overlapped with the broad portion 26 of the housing 9. A planer shape of the protrusion 27 is formed along the opening part 13. When the cover component 20 is mounted to the housing 9, the protrusion 27 will be inserted into the opening part 13, as shown in FIG. 17A and FIG. 17B.

[0112] In this embodiment, when mounting the cover component 20 to the housing 9, adhesive 30 (shown in FIG. 17A and FIG. 17B), as the internal constituent member, connecting the cover components 20 to the housing 9 is applied to the opening parts 13 and the protrusions 27. This adhesive 30 is made of a material different from that of the housing 9 and the cover components 20 of the cover 18. The adhesive 30 is made of an elastic and deformable material.

[0113] In this embodiment, the housing 9 and the cover component 20 are bonded by the adhesive 30, or the internal constituent member, and fixed to each other by inserting the screw 10 into the screw hole 16 of the cover component 20 and into the screw hole 21 of the housing 9. Then, the flange part 7 of the frame 6 of the speaker unit 2 is overlapped with the housing 9 and the screw 10 is screwed into screw hole 50 of the housing 9 and further into screw hole 51 (having a screw-cut on an inner surface) of the cover component 20, so that the speaker unit 2, the housing 9 and the cover 18 are fixed to each other. Then, the cover component 20 of the cover 18 is overlapped with the door panel 40, and then the screw 10 is passed through the threaded screw hole 17 and through the screw hole 44 to mount the mounting member 3 to the door panel 40, so that the above-described fixing structure 1 is assembled. The opening parts 13 provided to the housing 9 may be formed to the cover component 20, and the protrusion 27 provided to the cover component 20 may be formed to the housing 9 or changed suitably.

[0114] According to this embodiment, as with the first embodiment, the housing 9 is formed to be hollow by providing thereto the opening parts 13, thus the weight of the housing 9, or the mounting member 3 itself, can be reduced, at the same time the rigidity of the housing 9, or the mounting member 3, can be improved. As a result, the mounting member 3 prevents the propagation of the vibration of the diaphragm of the speaker unit 2 to the door panel 40, preventing the generation of the unwanted noise from between the mounting member 3 and the door panel 40. Thus, desirable acoustic characteristic of the speaker unit 2 can be obtained.

[0115] Furthermore, in this embodiment, the opening parts 13 receive therein the internal constituent member, the elastic body made of a material different from the housing 9 and the cover 18. Thus, when the speaker unit 2 is driven, the vibration propagating to the door panel 40 via the mounting member 3 will damp within the housing 9, so the generation of the unwanted noise caused by the vibrating door panel 40 as well as by the contact between the vibrating door panel 40 and the mounting member 3 can be prevented. In addition, the internal constituent member is made of the adhesive 30 adhering the housing 9 and the cover 18. Thus, even if the mounting member 3 tries to vibrate, the vibration propagating to the mounting member 3 will damp within the housing 9, preventing the generation of the unwanted noise caused by the contact between the door panel 40 and the mount-

ing member 3. Also, the generation of the unwanted noise from between the housing 9 and the cover 18 can be prevented.

[0116] The inventor of the present invention has examined the effect of the invention. The results are shown in FIG. 21 through FIG. 24. FIG. 21 shows a damping of the vibration of a solid mounting member made of a wooden material as a comparative example 1, FIG. 22 shows a damping of the vibration of a hollow mounting member made of a resin as a comparative example 2, FIG. 23 shows a damping of the vibration of an mounting member 3 having the opening part 13 made of an aluminum, called invention 1, according to the present invention, and FIG. 24 shows a damping of the vibration of the mounting member 3 of the invention 1 receiving sand particles in the opening part 13, called invention 2. For FIG. 21 through FIG. 24, each of the comparative examples 1, 2 and the invention 1, 2 are fixed to a vibration-isolation table with a spacer and such, and the vibration amplitude of when force is applied to each of the comparative examples 1, 2 and the invention 1, 2, is measured. The horizontal axis and the vertical axis of FIG. 21 through FIG. 24 indicate elapsed time and vibration acceleration, respectively.

[0117] According to the measurement results, for the invention 1 and 2 of FIG. 23 and FIG. 24, the vibration damped far faster than for the comparative examples 1 and 2 of FIG. 21 and FIG. 22, showing that there is apparent suppression of propagation of the vibration of the speaker unit 2 to the door panel 40.

[0118] In the above-described embodiments, the speaker unit 2 is mounted to the door panel 40. However, according to the present invention, it should be apparent that the structural object to which the speaker unit 2 is mounted may include various objects other than the door panel 40.

[0119] Furthermore, in the above-described second and third embodiment, the internal constituent member 19 is made of only particles. However, according to the present invention, the internal constituent member may be made of the particles and elastic resin with particles dispersed therein, as shown in FIG. 18, as well as the particles and foamed material with particles dispersed therein, as shown in FIG. 19. In these cases, even if the mounting member 3 tries to vibrate, the vibration propagated to the mounting member 3 will damp within the housing 9, thus the mounting member 3 and the door panel 40 hardly resonate with each other from a low-frequency range to a middle-frequency range or from the middle-frequency range to a high-frequency range. Thus, the generation of the unwanted noise caused by the contact between the mounting member 3 and the door panel 40 can be prevented.

[0120] Furthermore, the tightening member 24 may be inserted into the housing 9, the tightening member 24 includes a screw hole 16 communicating with the threaded hole 21 of the cover component 20, as shown in FIG. 20. The tightening member 24 is, in the exemplary draw-

ing, as shown in FIG. 20B, a quadrangular-prism-like nut, and inserted into the housing 9 and mounted thereto. Also, the tightening member 24 is preferably formed of a material different from the cover component 20 or the frame 7 of the speaker unit 2, or, a material different from both of the cover component 20 and the frame 7 of the speaker unit 2. The tightening member 24 is made of a material different from the housing 9 and/or the frame 6 of the speaker unit 2 so that the tightening member 24 and the housing 9 will have mutually different resonant frequencies and also the vibration of the speaker unit 2 will cancel out. Thus, the propagation of the vibration to the door panel 40 can be inhibited. In FIG. 20A and FIG. 20B, the same numerical references are used for the same components used in the above-described embodiments, thus eliminating the explanation thereof.

[0121] In summary, in the present invention, the mounting member 3 itself is arranged to be resistant to vibration by increasing the weight of the internal constituent member 19, inhibiting for example vibration of the speaker unit 2 propagating to the door panel 40. However, there exists a consideration that, such heavy mounting member 3 is difficult to mount to the door panel 40 and such, but on the other hand, light-weighted mounting member 3 easily allows the vibration of the speaker unit 2 to propagate to the door panel 40.

[0122] Therefore, it is preferred that the weight of the internal constituent member 19 within the housing 9 is adjusted and the propagation of the vibration is inhibited, and that the internal constituent member 19 is made of a combination of for example sand (particles) and elastic body, or sand (particle) and foamed material, is disposed in the housing 9, so as to inhibit the generation of unwanted noise caused by the mounting member 3 contacting with the door panel 40 and such.

[0123] Furthermore, in the above-described embodiments, although the main body part 11 of the mounting member 3 is formed into a ring-like shape, the present invention is not limited to this, but a frame-like outer periphery may have a rectangular frame-like shape.

[0124] According to the above-described embodiments, the below-described speaker unit mounting member 3 can be provided.

[0125] (Additional statement) A speaker unit mounting member 3 for mounting a speaker unit 2 to a door panel 40, including a housing 9, wherein the housing 9 is formed into a frame-like shape, and an opening part 13 extending along a circumference of the housing 9 is provided in the housing 9.

[0126] According to the additional statement, by forming the housing 9 to be hollow by providing the opening parts 13 therein, the weight of the housing 9, or the mounting member 3 itself, can be reduced, as the same time the rigidity of the housing 9, or the speaker unit mounting member 3, can be improved. Thus, the mounting member 3 can inhibit the vibration of the diaphragm of the speaker unit 2 from propagating to the door panel 40, and also inhibit the generation of unwanted noise from between

the mounting member 3 and the door panel 40 and such, providing the desirable acoustic characteristic of the speaker unit 2.

[0127] The above-described embodiments are just the representative embodiments, and the present invention is not limited to these embodiment. That is, the present invention can be modified and performed within the scope of the invention.

Claims

1. A speaker mounting member for mounting a speaker unit to a structural object, comprising a housing, wherein the housing is formed into a frame-like shape, and an opening part extending along a circumference of the housing is provided in the housing.
2. The speaker mounting member according to claim 1, comprising a cover mounted to the housing, wherein the cover covers the opening part.
3. The speaker mounting member according to claim 2, wherein the housing and the cover are made of mutually different materials.
4. The speaker mounting member according to any one of claims 1 to 3, comprising a plurality of the opening parts.
5. The speaker mounting member according to any one of claims 1 to 4, wherein the housing includes:
 - a frame-like main body part having the opening part therein; and
 - a flange part projecting from an outer circumferential surface of the main body part in a radial direction of the main body part.
6. The speaker mounting member according to claim 5, wherein the main body part includes a speaker mounting portion for mounting the speaker unit, wherein the flange part includes a structural object mounting portion to be mounted to the structural object.
7. The speaker mounting member according to claim 6, comprising a plurality of the speaker mounting portions and a plurality of structural object mounting portions, wherein the speaker mounting portions are provided at the main body part with an interval between each other, and the structural object mounting portions are provided at the flange part with an interval between each other.

8. The speaker mounting member according to any one of claims 2 to 7, comprising tightening member, wherein the tightening member penetrates through the housing and the cover and fixes the housing and the cover together. 5
9. The speaker mounting member according to any one of claims 1 to 8, comprising an internal constituent member, wherein the internal constituent member constructed of a different material from the housing is received within the opening part. 10
10. The speaker mounting member according to claim 9, wherein the internal constituent member is constructed of particles. 15
11. The speaker mounting member according to claim 9, wherein the internal constituent member is constructed of the particles and an elastic resin. 20
12. The speaker mounting member according to claim 9, wherein the internal constituent member is constructed of the particles and a foamed body.
13. The speaker mounting member according to any one of claims 1 to 12, wherein the housing is constructed of a non-magnetic material. 25
14. The speaker mounting member according to claim 2, wherein 30
the internal constituent member is an elastic body constructed of a different material from both of the housing and the cover, wherein the elastic body is received within the opening part. 35
15. The speaker mounting member according to claim 14, wherein the internal constituent member is constructed of adhesive connecting the housing and the cover with respect to each other. 40
16. The speaker mounting member according to claim 15, wherein the cover includes a protrusion formed projectingly towards the housing along the opening part. 45
17. A speaker unit fixing structure, comprising: a speaker unit; a structural object; and a speaker mounting member mounted to both of the speaker unit and the structural object for mounting the speaker unit to the structural object, wherein the speaker mounting member is the speaker mounting member according to any one of claims 1 to 16. 50
18. The speaker unit fixing structure according to claim 17, comprising a damping member mounted to the structural object. 55
19. A motor vehicle comprising the speaker unit fixing structure according to claim 17.

FIG. 1

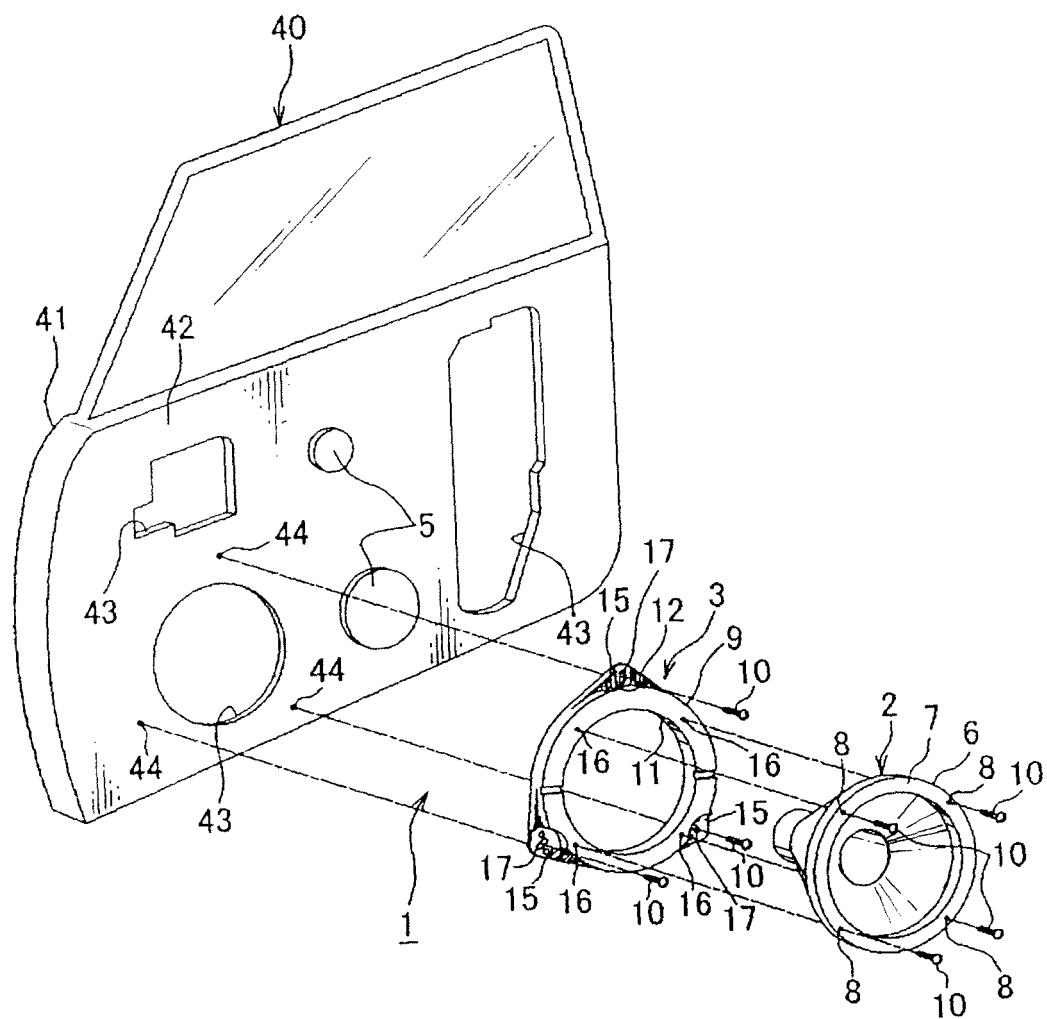


FIG. 2A

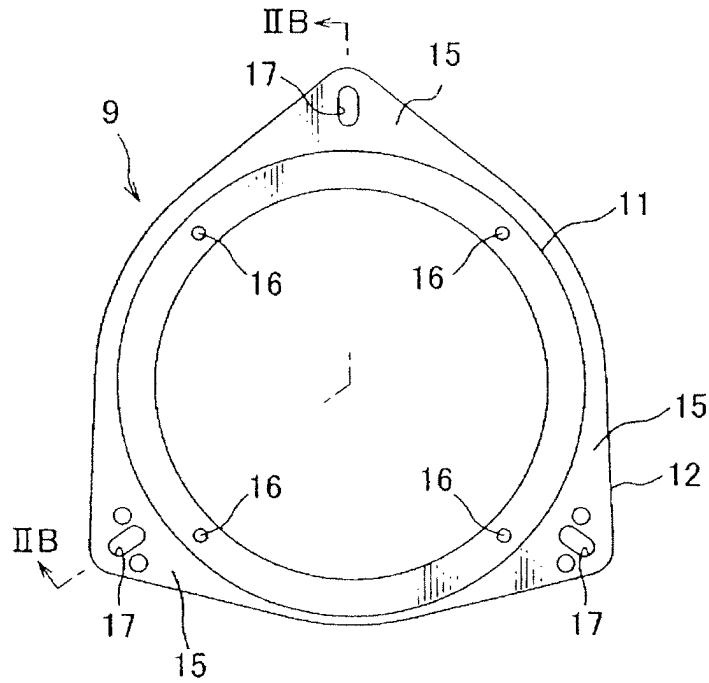


FIG. 2B

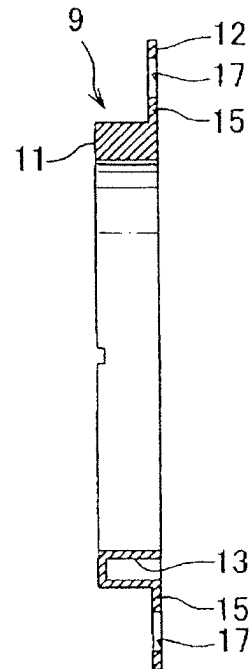


FIG. 2C

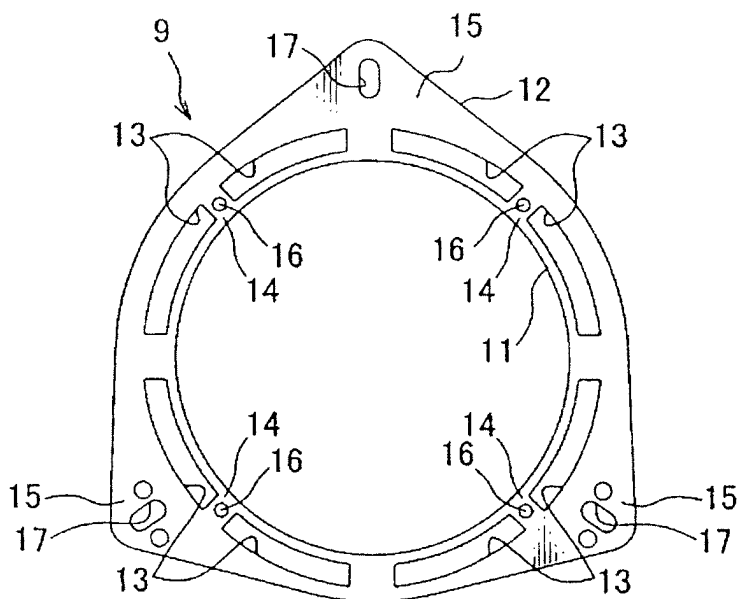


FIG. 3

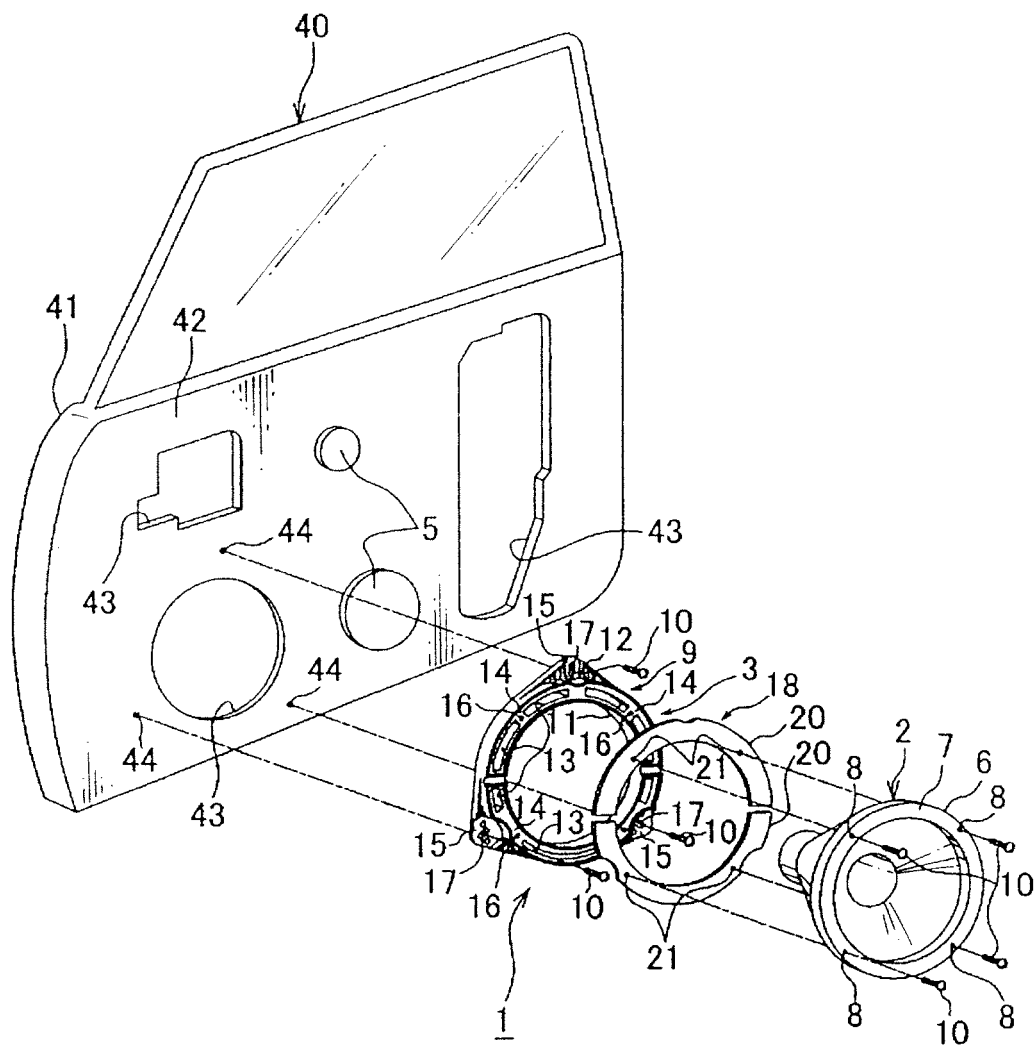


FIG. 4

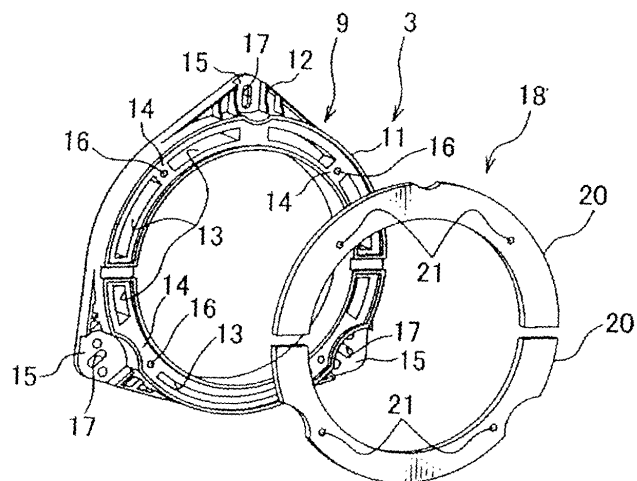


FIG. 5

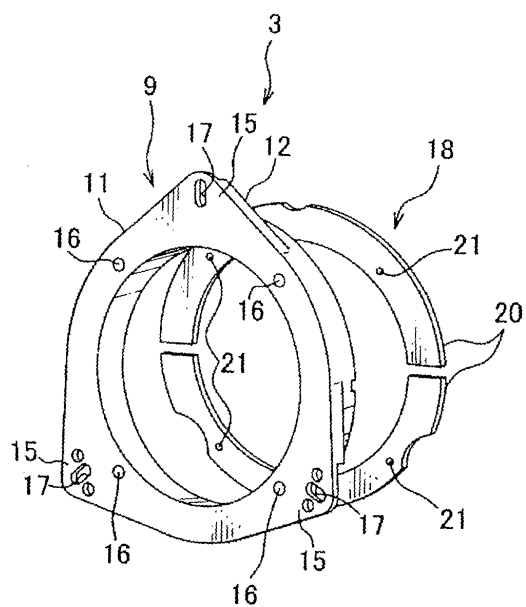


FIG. 6A

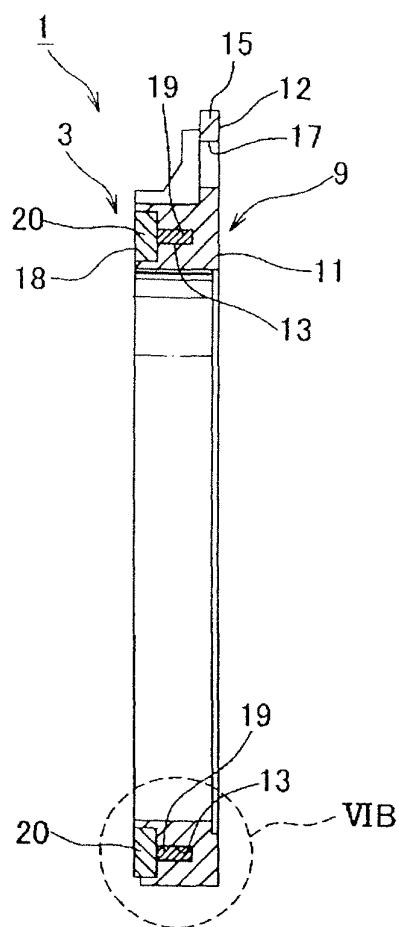


FIG. 6B

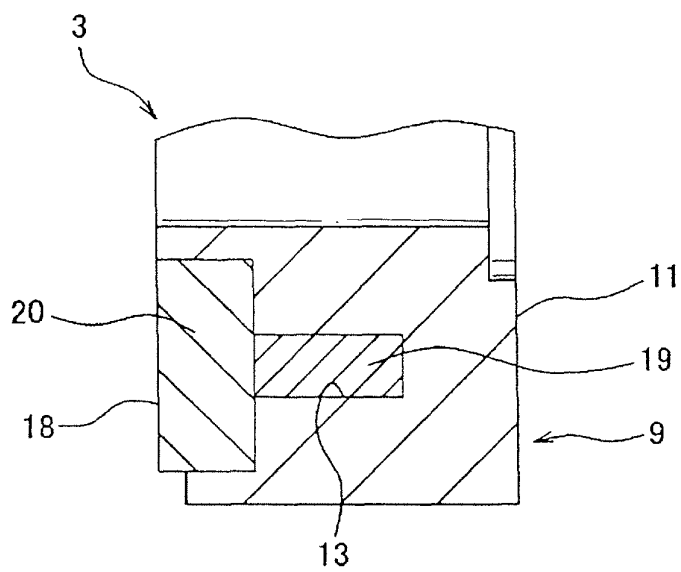


FIG. 7A

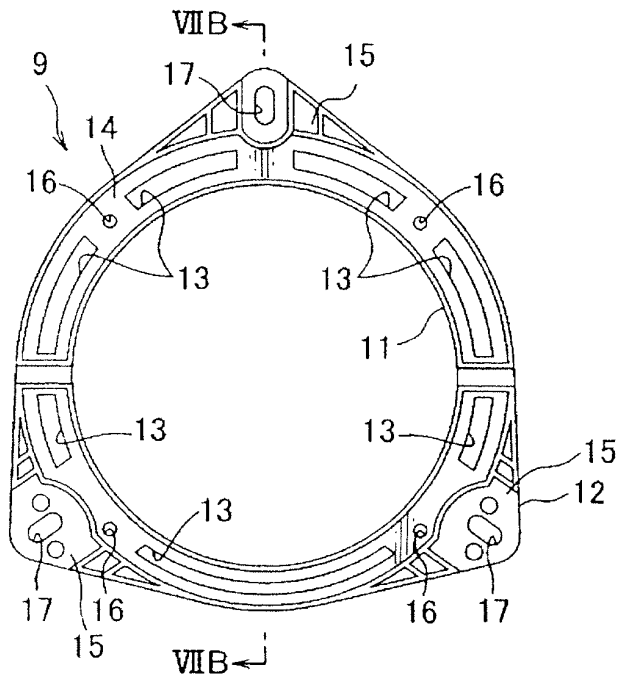


FIG. 7B

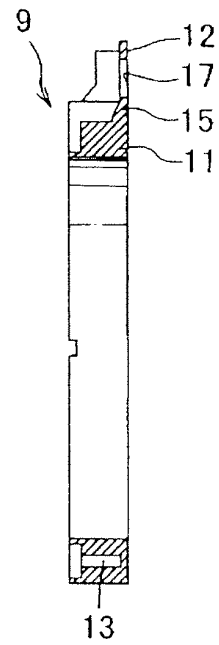


FIG. 7C

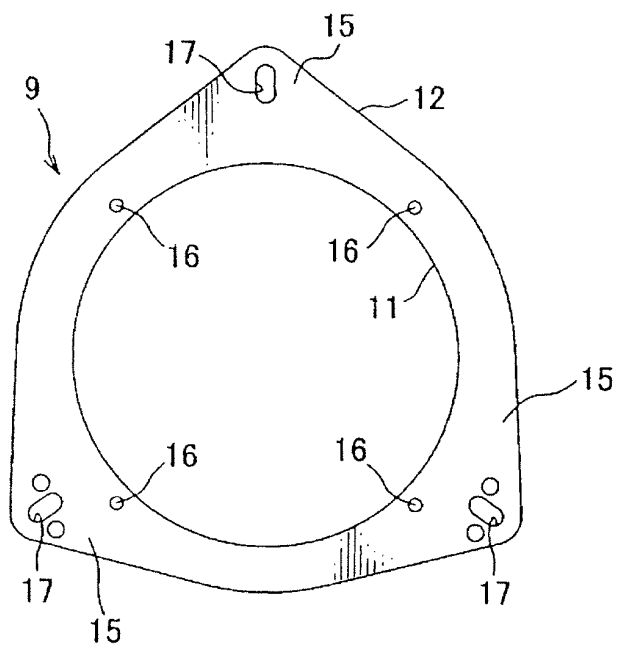


FIG. 8A

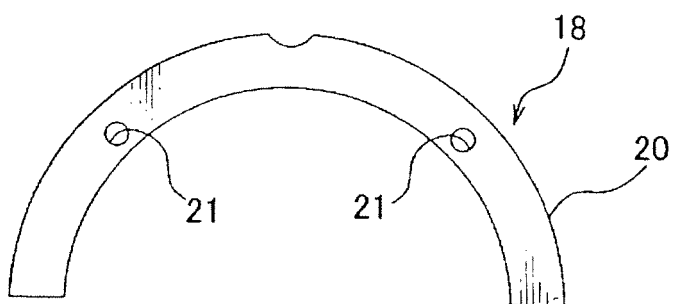


FIG. 8B

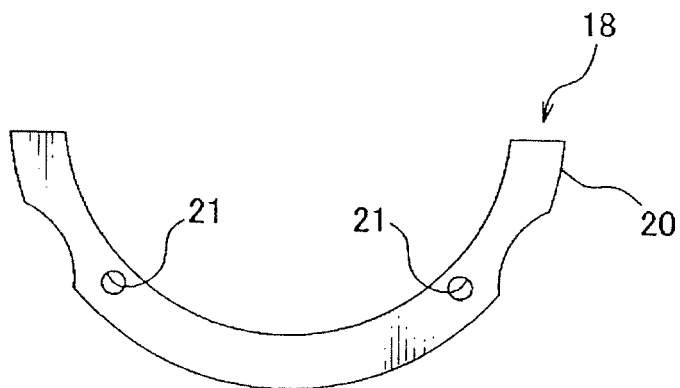


FIG. 9

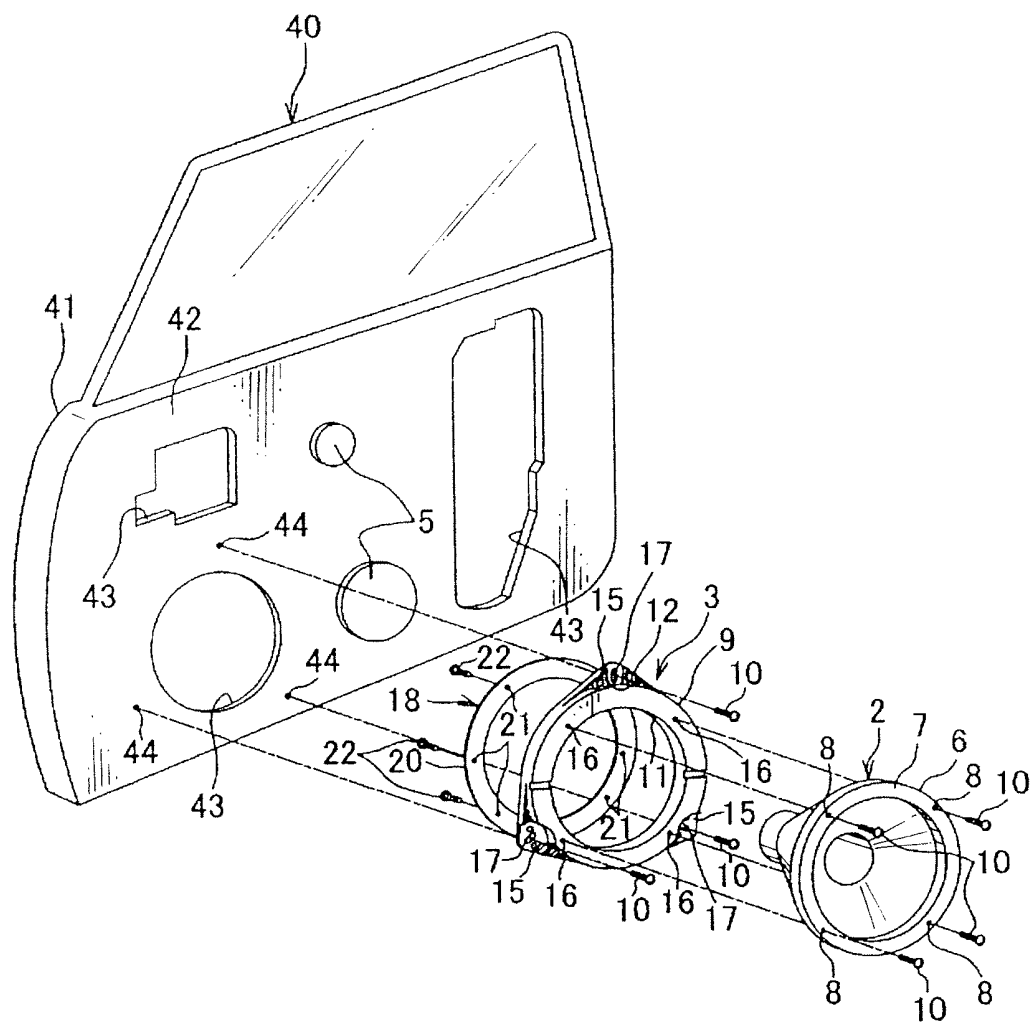


FIG. 10

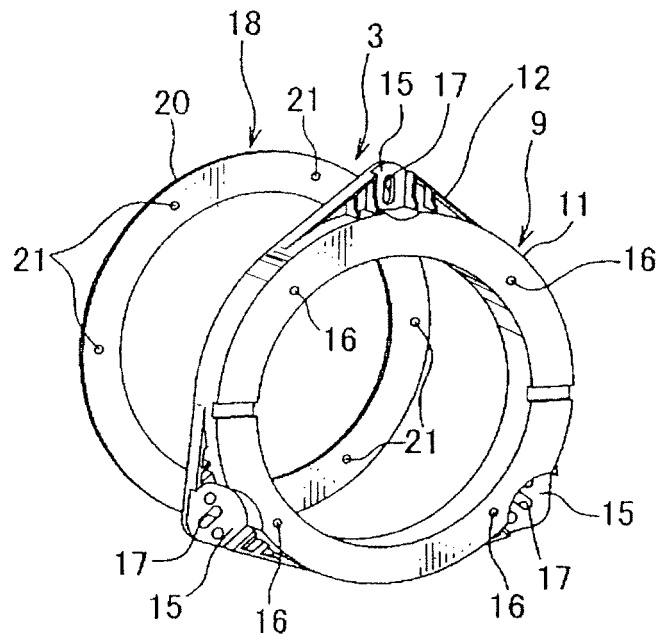


FIG. 11

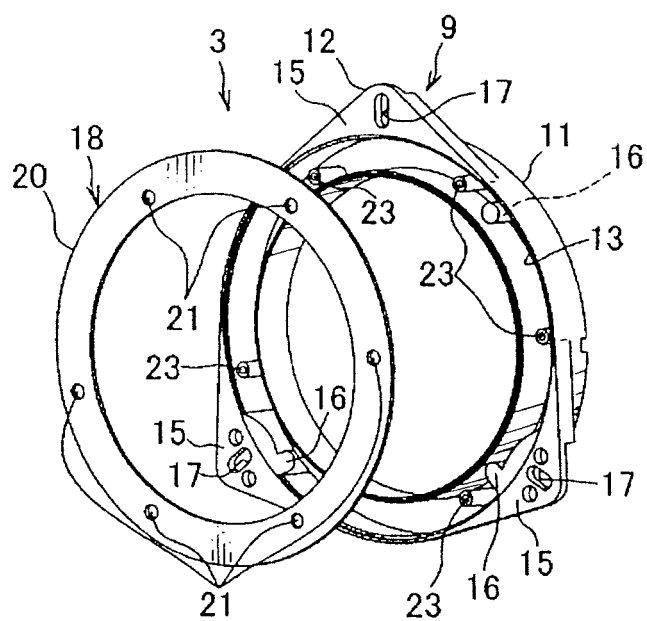


FIG. 12A

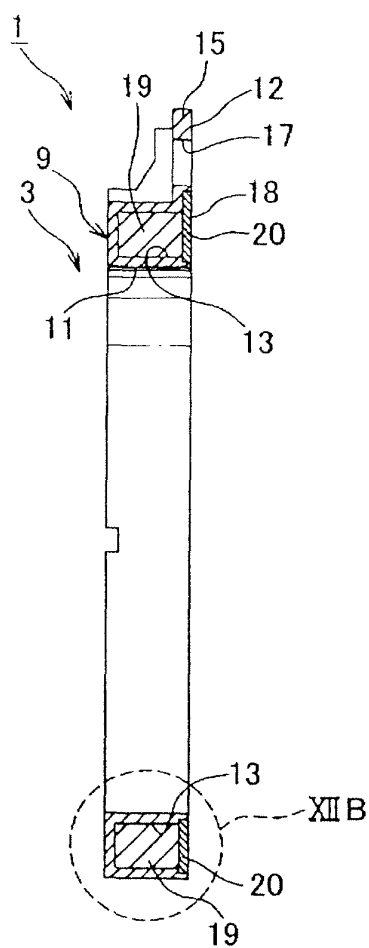


FIG. 12B

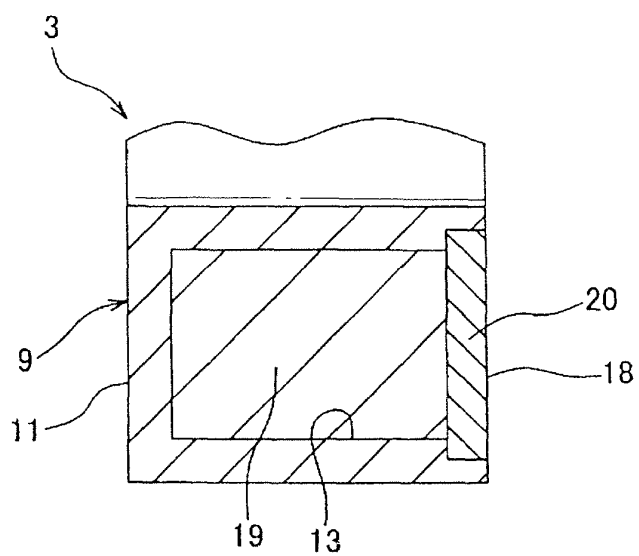


FIG. 13A

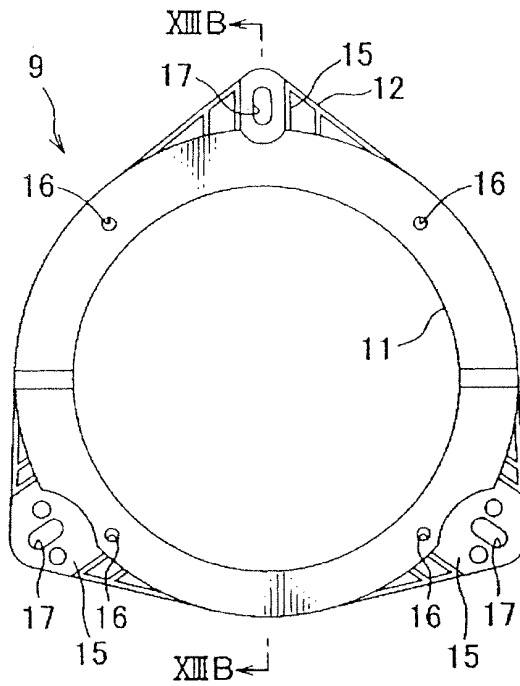


FIG. 13B

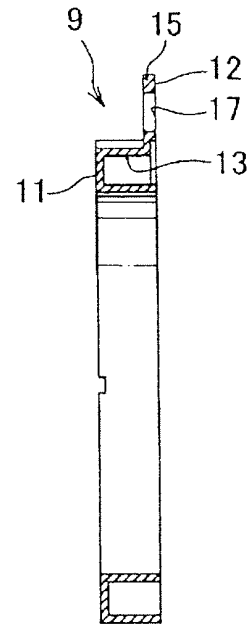


FIG. 13C

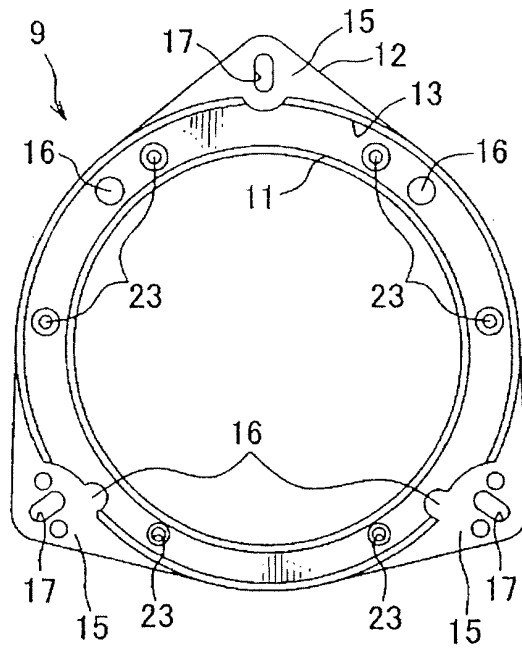


FIG. 14

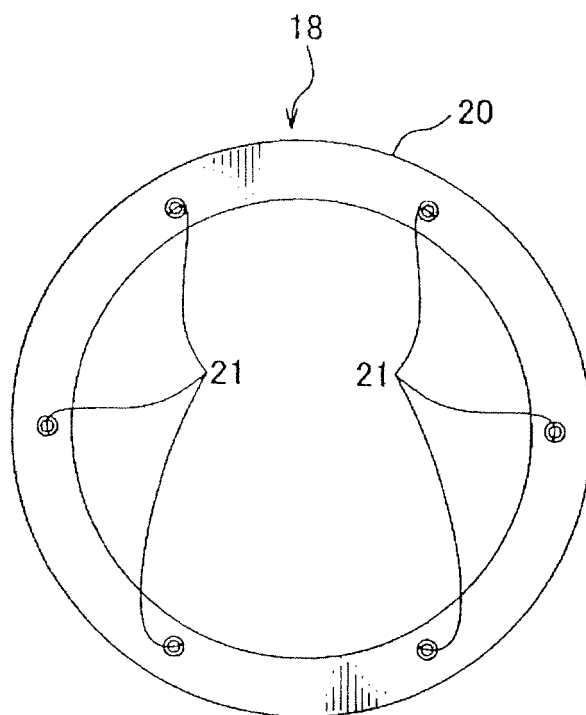


FIG. 15A

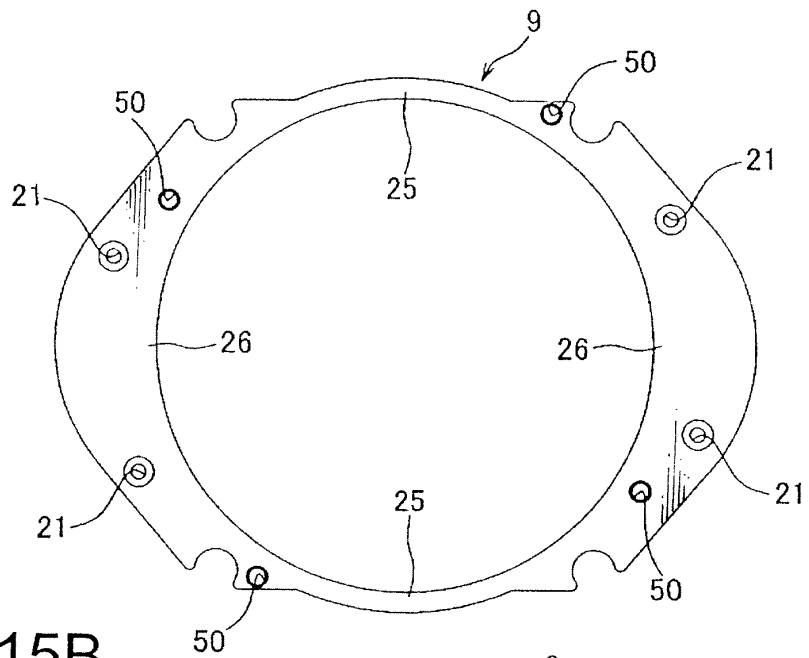


FIG. 15B

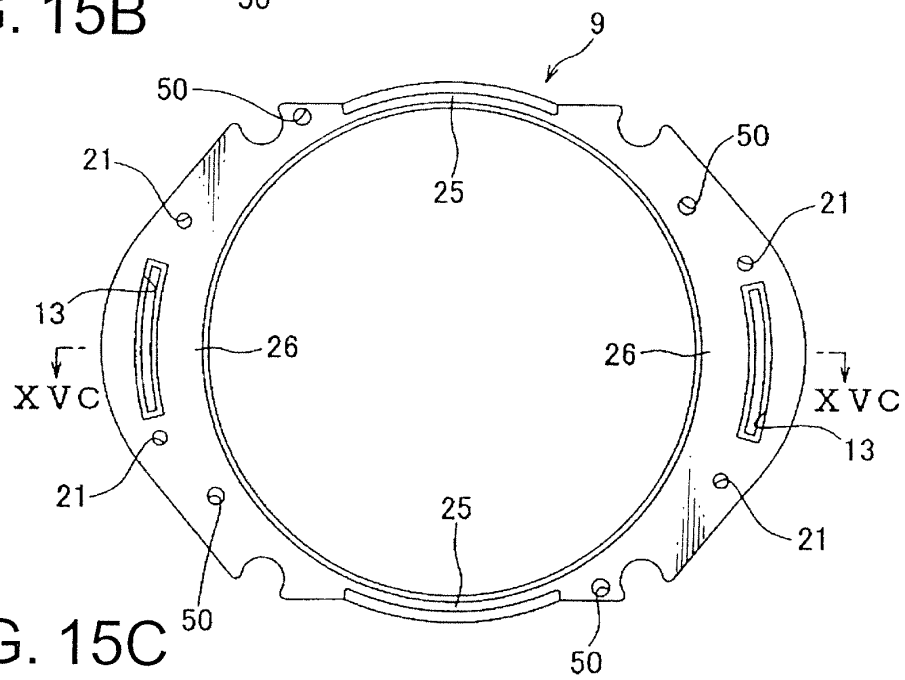


FIG. 15C

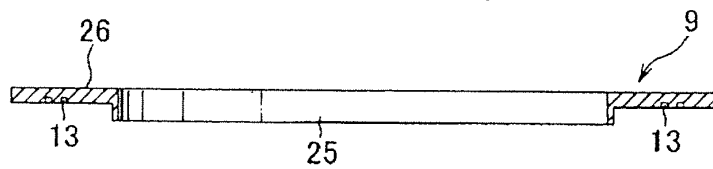


FIG. 16A

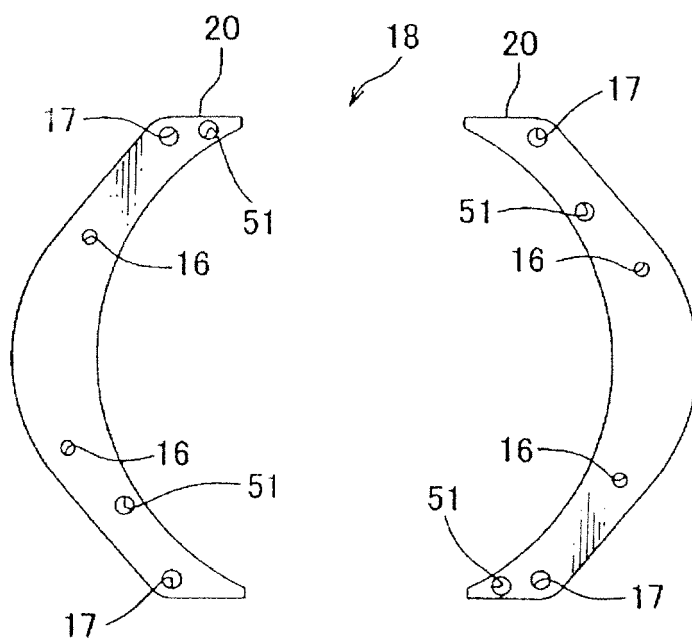


FIG. 16B

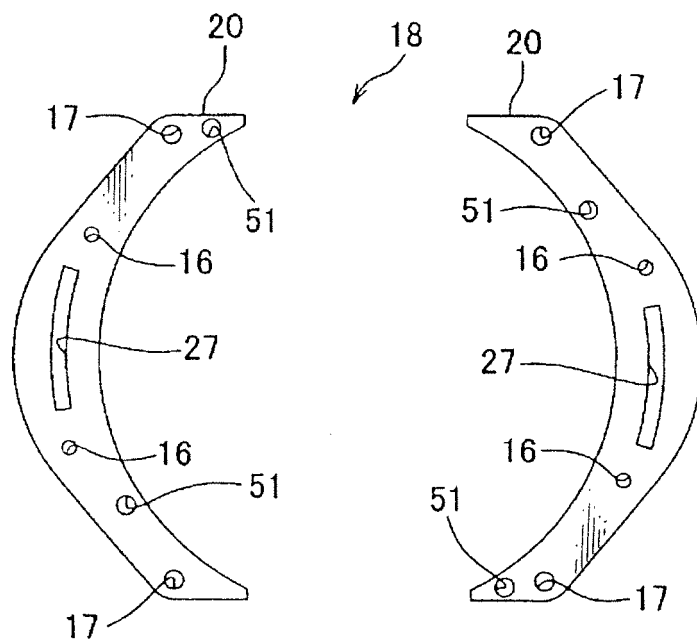


FIG. 17A

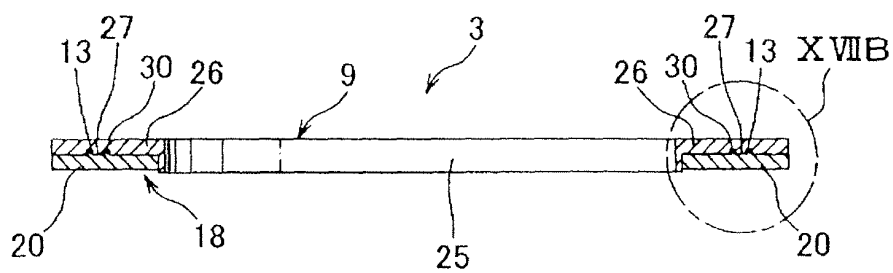


FIG. 17B

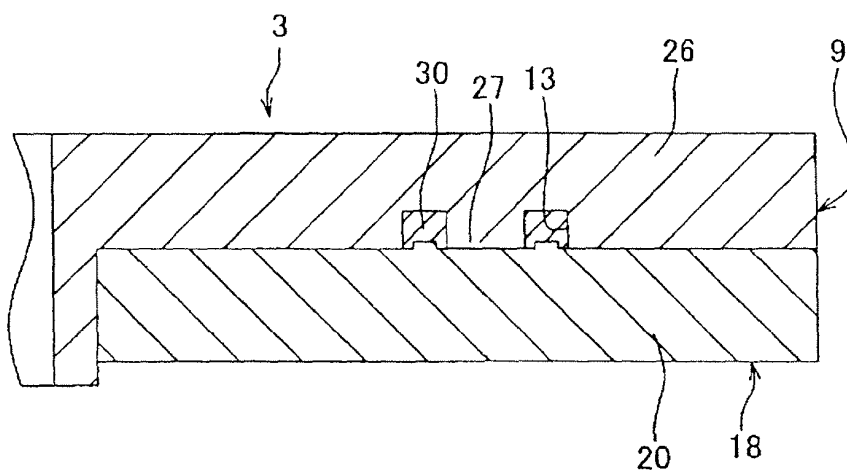


FIG. 18

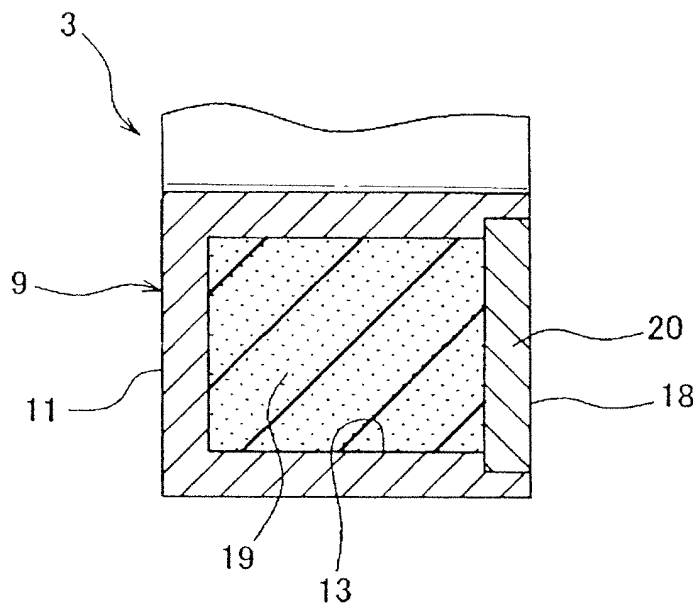


FIG. 19

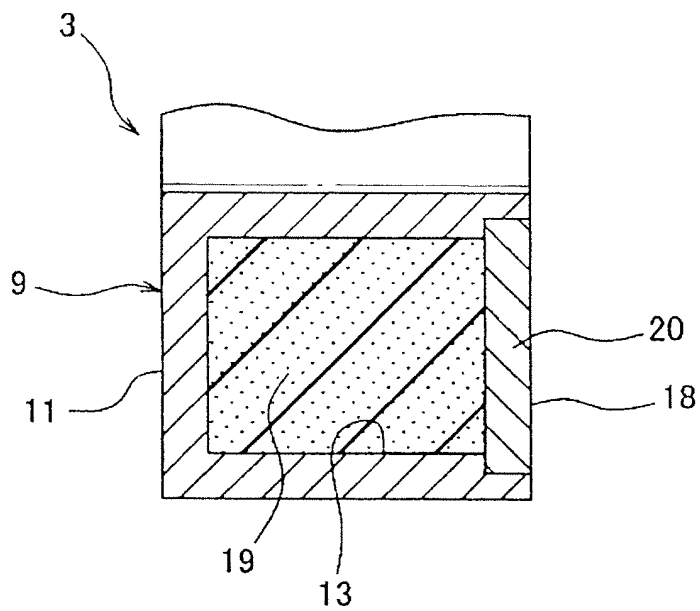


FIG. 20A

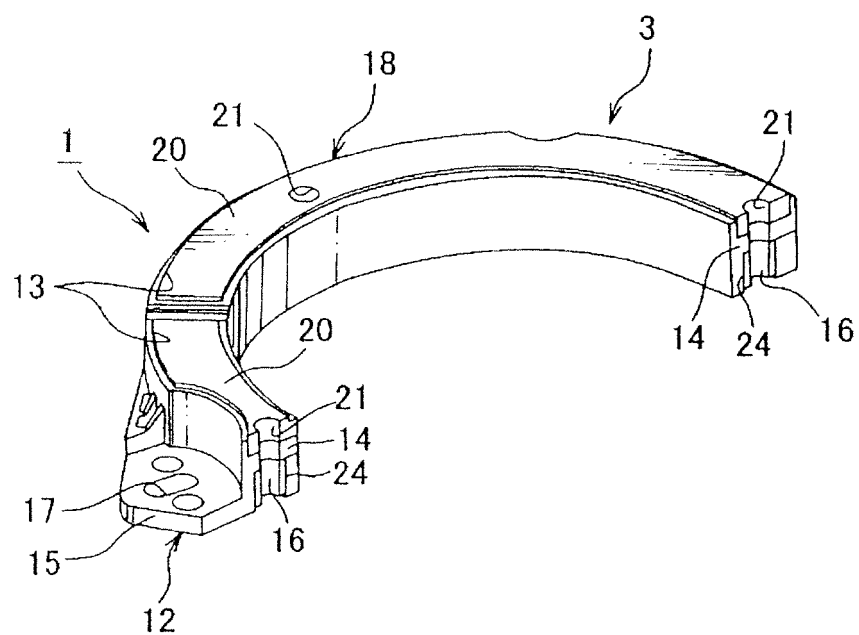


FIG. 20B

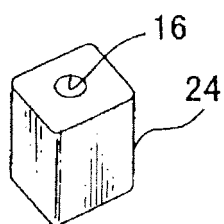


FIG. 21

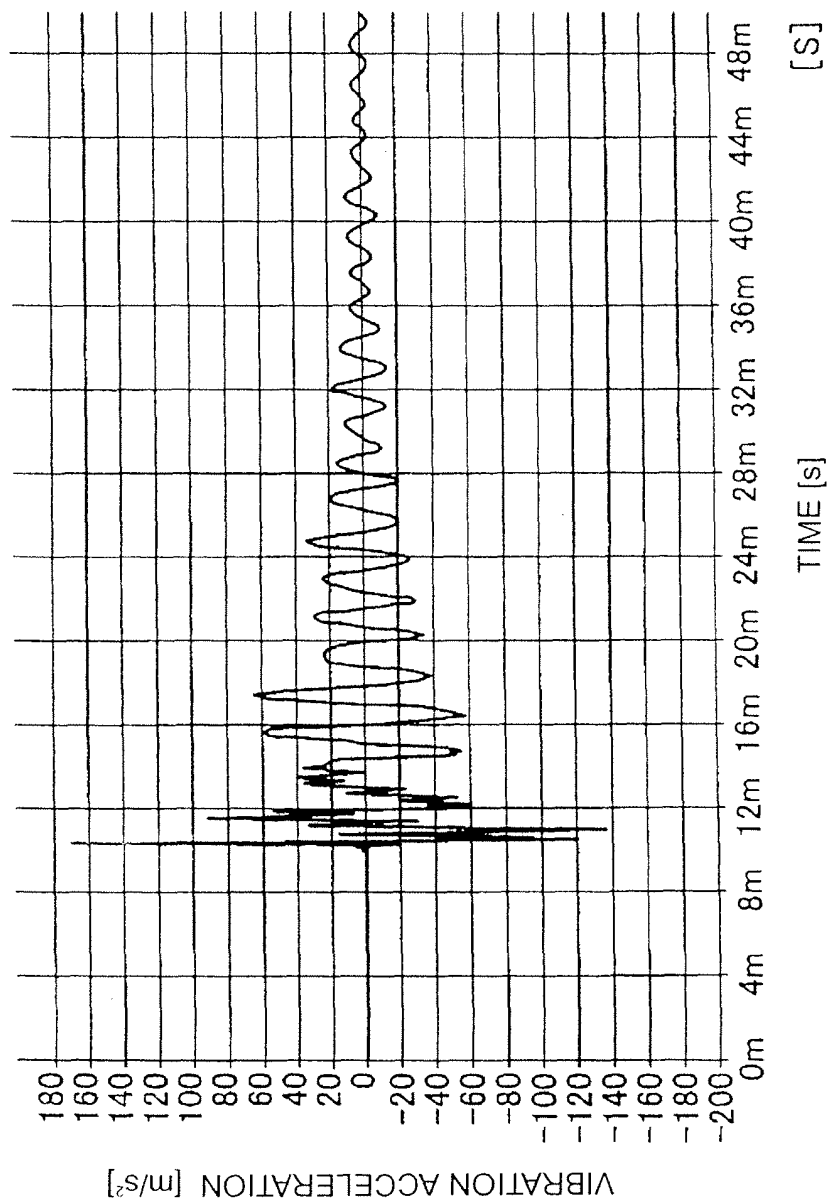


FIG. 22

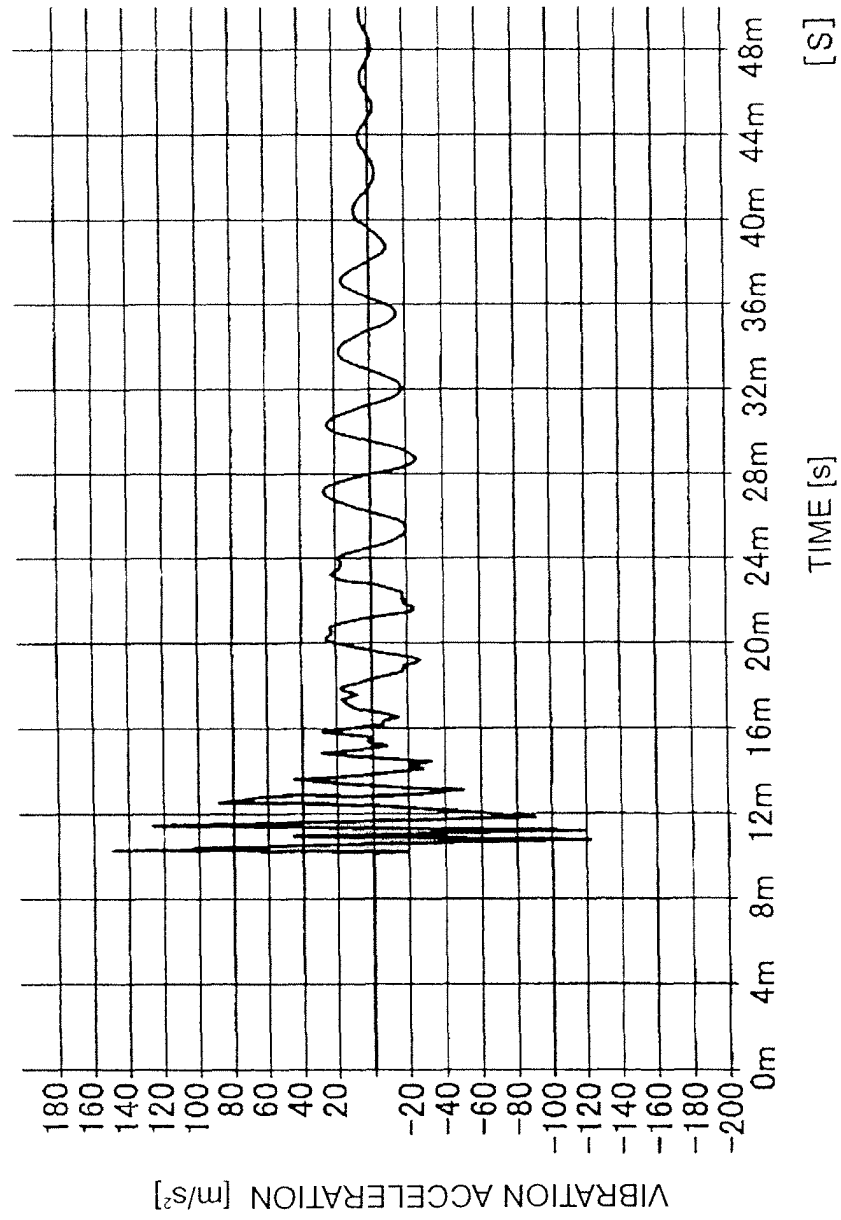


FIG. 23

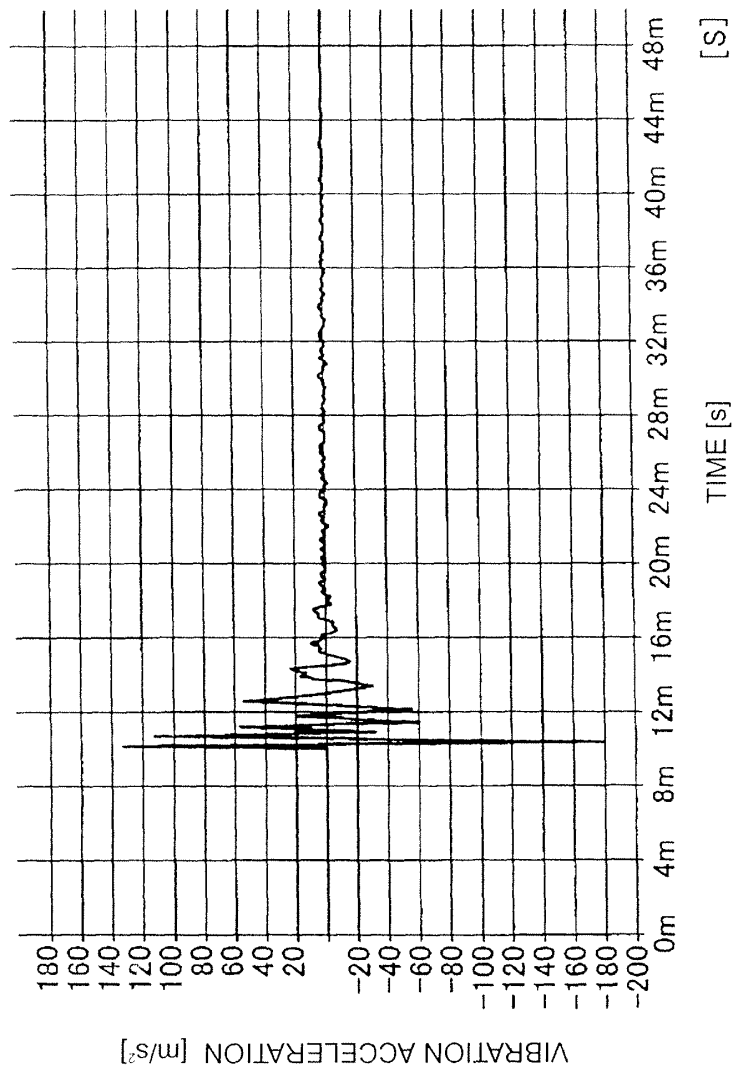
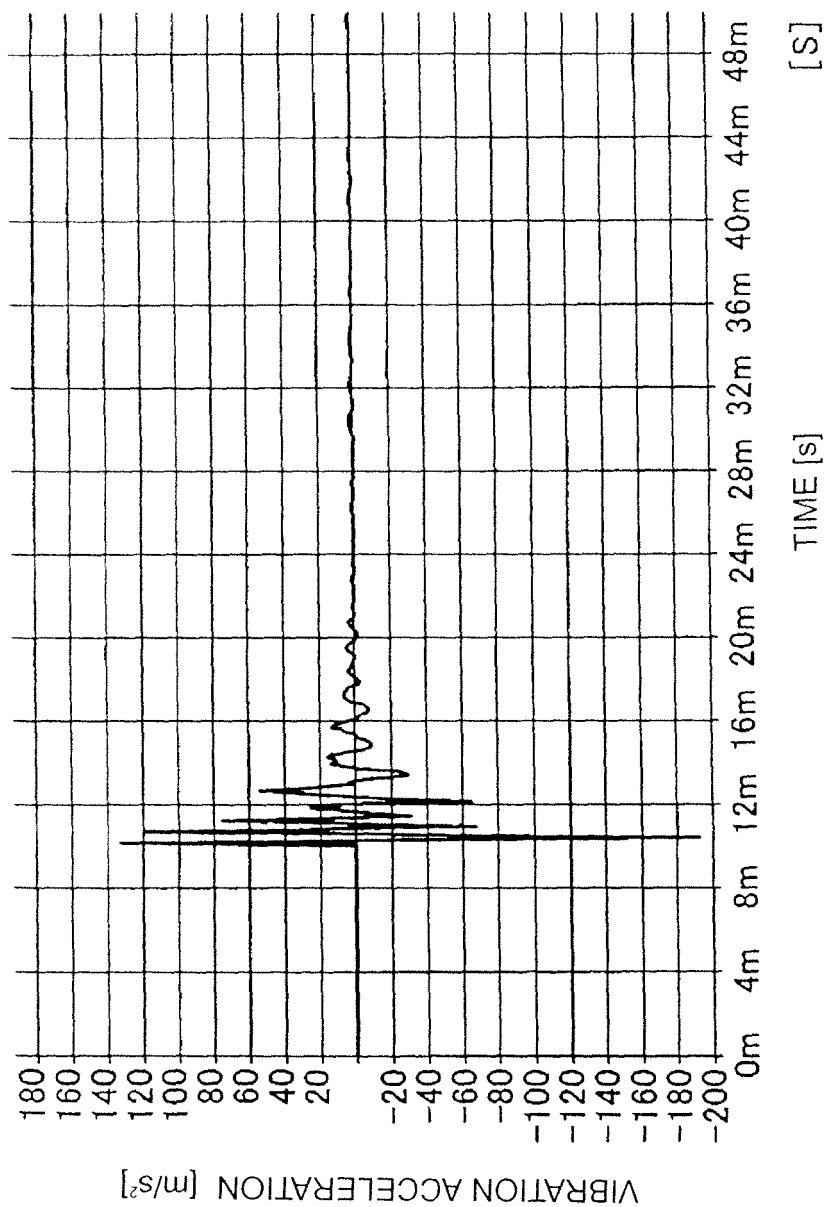


FIG. 24



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/064812

A. CLASSIFICATION OF SUBJECT MATTER 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) H04R1/02		
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 1996-2008 Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 90135/1992 (Laid-open No. 47055/1994)	1, 4, 7, 13, 17, 19
Y	(Minebea Co., Ltd.), 28 June, 1994 (28.06.94), Full text; all drawings (Family: none)	2-3, 5-6, 8, 18
Y	JP 2006-229522 A (Pioneer Corp.), 31 August, 2006 (31.08.06), Full text; all drawings & US 2006/0188123 A1	2-3, 8
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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