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(54) **SPEAKER UNIT**

(57) A through-hole is formed in a center part of a pole piece of a speaker device, a lamp is mounted so as to be projected forward from the through-hole, and a center cap formed of a transparent resin is provided forward thereof. The lamp is connected in series to a voice coil. Thereby, the speaker device not only produces the sound but also emits light of which brightness varies according to a driving current of the speaker device.

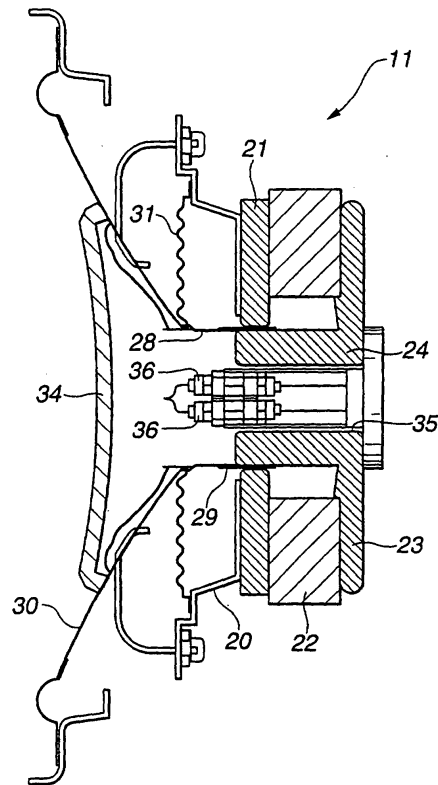


FIG.5

Description

Technical Field

[0001] The present invention relates to a speaker device, and particularly relates to a speaker device for vibrating a diaphragm in response to an electrical signal to produce the sound.

Background Art

[0002] A loudspeaker is widely used as a conversion means for converting an electrical signal into the sound. In particular, a dynamic speaker is designed so that a voice coil wound about a bobbin is disposed within a gap of a magnetic circuit constituting a driving means, the vibration in a direction of axis received by the voice coil is transmitted to the diaphragm, whereby the vibration in response to the electrical signal is produced by the diaphragm to produce the sound in response to the electrical signal.

[0003] The conventional loudspeaker is merely used to produce the sound. A speaker device provided with a lamp or the like as illuminations has been also proposed. In such a speaker device as described, however, a driving circuit such as a lamp is independently of a driving circuit of the speaker, thus requiring an external power source. In such a lamp as described, brightness is not always varied according to a stress of an electrical signal for driving the loudspeaker.

Disclosure of the Invention

[0004] The present invention has been accomplished in view of the actual circumstances as noted above with respect to prior art. It is an object of the present invention to provide a speaker device adapted to produce, along with the sound, light which is varied in brightness in response to an electrical signal for driving a loudspeaker.

[0005] According to the present invention, there is provided a speaker device for vibrating a diaphragm in response to an electrical signal to produce the sound, including a light emitting means which varies in brightness according to a stress of the electrical signal.

[0006] The light emitting means may be disposed here forward of a driving means of the diaphragm. Further, a light guiding plate may be disposed forward of the light emitting means so as to guide light forward through a transparent part of the light guiding plate. Further, a center cap of the loudspeaker is constituted by the light guiding plate, and light from the light emitting means is guided from the interior of the center cap to the outer peripheral side so as to illuminate the diaphragm. Further, the driving means of the diaphragm may be constituted by a voice coil, and a pole piece internally of the voice coil may constitute a reflector of the light emitting means. Furthermore, the light emitting means may be arranged so that the light emitting means

is cooled by an air flow generated by the vibration of the diaphragm. Moreover, the light emitting means may be connected in series to the voice coil constituting the driving means of the diaphragm.

[0007] The speaker device according to the present invention includes a voice coil comprising a plurality of coils, and a protective element connected to each of the coils.

[0008] Further, the speaker device according to the present invention includes a voice coil comprising two coils, a lamp connected to one coil, and a breaker connected to the other coil.

[0009] Furthermore, the speaker device according to the present invention includes a voice coil comprising a plurality of coils, a lamp connected in series to a first coil out of the plurality of coils to serve as a protective circuit, and a changeover switch connected between a second coil out of the plurality of coils and a lamp to switch (changeover) the state into one state that a current flowing through the second coil passes through a lamp, and the other state that it does not pass therethrough.

[0010] In the present invention, the speaker device vibrates a diaphragm in response to an electrical signal to produce the sound, and in which a light emitting means emits light, brightness of which varies according to a stress of the electrical signal.

Brief Description of the Drawings

[0011] FIG. 1 is a side view of the interior of a station wagon showing a mounting of a speaker device.

[0012] FIG. 2 is a perspective view of main parts showing a mounting of a speaker box.

[0013] FIG. 3 is a side view of the interior of a cargo vehicle showing a mounting of a speaker box.

[0014] FIG. 4 is a side view of a mini-van showing a mounting of a speaker box.

[0015] FIG. 5 is a longitudinal sectional view showing a construction of a speaker device.

[0016] FIG. 6 is an external perspective view of a center cap.

[0017] FIG. 7 is a rear elevation of a center cap.

[0018] FIG. 8 is a circuitry view showing a connection between a voice coil and a lamp.

[0019] FIG. 9 is a circuitry view showing a connection between a voice coil and a lamp according to a second embodiment.

[0020] FIG. 10 is a circuitry view showing a connection between a voice coil and a lamp according to a third embodiment.

[0021] FIG. 11 is a circuitry view showing a connection between a voice coil and a lamp according to a modified embodiment.

Best Mode for Carrying out the Invention

[0022] The speaker device according to the present invention will be described hereinafter with reference to

the drawings. The speaker device to which the present invention is applied is designed so that a lamp is connected in series to a voice coil of a loudspeaker, and the lamp emits light while varying brightness in response to a driving current of the loudspeaker. The lamp may be used, here, such that the former is arranged on a pole piece of a magnetic circuit of the loudspeaker, and light is guided forward with the front side of the pole piece being a reflecting surface.

[0023] Further, a center cap of the loudspeaker may be molded from a resin through which light permeates, light is guided forward through a transparent part of the center cap, the center cap serves for a light guiding plate to guide light to the outer peripheral side thereof so as to illuminate a cone part of the speaker. Further, air internally of the center cap may be replaced with open air by the vibration of the speaker, whereby the lamp arranged on the pole piece is cooled.

[0024] The speaker device according to the present invention not only produces the sound but also produce light, and moreover, varies brightness thereof according to a driving current of the loudspeaker. That is, a special circuit for causing brightness of the lamp to vary need not be provided.

[0025] Further, in the speaker device according to the present invention, the voice coil of the loudspeaker is constituted by a plurality of, for example, two coils, to which protective circuits different in specific characteristic are respectively connected. With this arrangement, even if an excessively great electrical signal is applied, the sound is not interrupted. That is, even at the time of an excessively great input, strain of the sound is hard to be sensed, and one can know an excessively great input from the presence of a change in volume or an amount of light.

[0026] Furthermore, in the speaker device according to the present invention, the voice coil of the loudspeaker is constituted by a plurality of, for example, two coils, and a lamp is connected to one voice coil whereas a breaker is connected to the other coil. Then, when the breaker is operated, an amount of light emission increases to thereby notify a person of the operation of protection and notify of the presence of the excessive great input. With respect to the protection of a lamp, the lamp glitters to thereby increase an impedance, that is, the lamp serves for a lamp fuse to prevent an excessively great input relative to the loudspeaker.

[0027] FIGS. 1 and 2 are, in which the present invention is applied to a speaker device for low sound loaded on an automobile, a side view of the interior of a station wagon having the speaker device mounted, and a perspective view of main parts showing a specific mounting form of the speaker device, respectively. The speaker device according to the present invention comprises, as shown in FIGS. 1 and 2, a speaker box 10, and a loudspeaker 11 having a large aperture received into the speaker box 10. It is noted that the speaker box 10 is mounted through metal fittings 15 at the rear of a rear

seat 14 of a station wagon, as shown in FIG. 2, for example.

[0028] It is to be noted that the position of mounting the speaker box 10 is not always limited to such a position, but the speaker box 10 may be mounted at a suitable position within the automobile. For example, as shown in FIG. 3, the speaker box 10 may be mounted on a floor panel 16 at the rear of a rear seat 14 of a cargo vehicle. Or, the speaker box 10 may be mounted below the rear seat 14 of a mini-van, as shown in FIG. 4, for example.

[0029] In the following, the construction of the loudspeaker for low sound 11 described above will be described with reference to FIG. 5. The loudspeaker 11 is provided with, as shown in FIG. 5, a frame 20, and a plate 21 of which center part is open is secured on the proximal end side of the frame 20. On the rear side of the plate 21 is disposed a ring-like magnet 22 formed from a permanent magnet. On the rear side of the magnet 22 is secured a yoke 23. A pole piece 24 is provided, on the yoke 23, so as to be projected toward the center part thereof.

[0030] A bobbin 28 is disposed in an air gap between the outer peripheral surface of the pole piece 24 and the open part of the plate 21. A voice coil 29 is wound about the bobbin 28. The bobbin 28 is connected to a diaphragm 30, and a damper 31 having a concentric zig-zagged pattern is connected between the part of the bobbin 28 on the center side of the diaphragm 30 and the part of the bobbin 28 of the frame 20.

[0031] In the loudspeaker 11 constructed as described above, when a current flows into the voice coil 29 disposed in the air gap of the magnetic circuit comprising the magnet 22, the yoke 23, the pole piece 24, and the plate 21, the bobbin 28 about which the voice coil 29 is wound receives force in a direction of axis thereof accordingly, by which force the bobbin 28 moves in a direction of axis, that is, in a lateral direction. This movement is transmitted to the diaphragm 30 connected with the bobbin 28, whereby the diaphragm 30 vibrates in response to an electrical signal to produce the sound.

[0032] Next, a speaker device, in which a light emitting mechanism for producing light is mounted on the above-described loudspeaker 11, will be described. The speaker device to which the present invention is applied is provided with a center cap 34 on the front side of the diaphragm 30, as shown in FIG. 5. The center cap 34 is formed of a transparent synthetic resin, the rear surface of which is coated with a shielding coating to thereby shield a light. It is to be noted that the shielding coating is not coated on the whole rear surface of the center cap 34, but for example, as shown in FIGS. 6 and 7, the coating is not coated on a fixed region 40 to form a transparent part 40 not coated with a coating, and the transparent part 40 guides light forward, that is, the light permeates through the transparent part 40.

[0033] Further, a through-hole 35 is provided in the

center part of the pole piece 24 disposed in the center part of the loudspeaker 11, and a lamp 36 is received in the through-hole 35. Accordingly, when the lamp 36 emits light, the light permeates forward through the transparent part 40 of the center cap 34. The center cap 34 itself serves as a light guiding means, that is, a light guiding path, and the light is guided thereinto so that the diaphragm 30 glitters.

[0034] The face of the pole piece 24 opposite to the center cap 34 forms a reflector to reflect light, which is radiated in the direction opposite to the center cap 34 from the lamp 36, on the center cap side. The lamp 36 is cooled by an air flow generated by the vibration of the diaphragm 30. For the purpose of enhancing the cooling effect, for example, the transparent part 40 of the center cap 34 serves for a through-hole to form a vent so that air internally of the center cap 24 may be replaced.

[0035] FIG. 8 is a view showing a connecting relationship between lamp 36 and a voice coil 29. The voice coil 29 and the lamp 36 are connected in series with each other, both ends of which are connected to a signal source 43.

[0036] In such a construction as described, when an electrical signal for driving the speaker device is supplied from the signal source. 43 to the voice coil 29, the diaphragm 30 is vibrated by the bobbin 28 wound about the voice coil 29 to produce the sound. Since a current flowing through the voice coil 29 flows through the lamp 36, the lamp 36. emits light.

[0037] The lamp 36 is formed from a lamp of which brightness varies according to the flowing current, and when an amount of current increases, the brightness of the lamp 36 becomes high. Accordingly, brightness of the lamp 36 varies according to a stress of an electrical signal, and the variation of brightness can be confirmed from the front through the transparent part 40 of the center cap 34. That is, the speaker device emits light by which brightness varies along with the sound in response to the electrical signal.

[0038] Next, a second embodiment of the speaker device to which the present invention is applied will be described with reference to FIG. 9. In the speaker device according to this embodiment, the voice coil 29 comprises a first voice coil 29a, and a second voice coil 29b. The first voice coil 29a is higher in impedance than that of the second voice coil 29b. A breaker 42 is connected in series to the voice coil 29a, a lamp 36 is connected in series to the voice coil 29b, and the voice coil 29a and the voice coil 29b are connected in parallel to the signal source 43.

[0039] In the speaker device constructed as described above, when a current value of the electrical signal supplied from the signal source 43 is at a proper level, both the voice coil 29a and 29b are driven. On the other hand, when a driving current exceeds a proper value, the lamp 36 connected to the second voice coil 29b emits light whereby the impedance of the lamp 36 rises. That is, the lamp 36 serves as a lamp fuse so that the

impedance of a circuit having the second voice coil 29b and the lamp 36 connected in series increases. Thereby, a current flowing through the second voice coil 36 decreases, and a current flowing through the first voice coil 29a increases; that is, currents flowing through the first voice coil 29a and the second voice coil 29b are balanced.

[0040] When the driving current from the signal source 43 further increases to be excessively high, the breaker 42 connected to the first voice coil 29a is operated whereby the circuit on the voice coil 29a side is cut off. Thereby, a higher current flows into the second voice coil 29b so that the light emitting amount of the lamp 36 increases, because of which the impedance of the lamp 36 further rises to correspond to the excessively great input. In this case, brightness of the lamp 36 abnormally rises to thereby enable notifying a user of the fact that the protective circuit comprising the breaker 42 is operated

[0041] Where a protective circuit like the breaker 42 is used, even if the breaker 2 is cut off to make the protection active, the second voice coil 29b is driven, and the sound is not interrupted. Further, in such a circuit construction as described, for example, a plurality of lamps 36 is used instead of one, which lamps 36 are connected in series. By doing so, impedance of a circuit comprising a plurality of lamps connected in series can be adjusted to a suitable value.

[0042] Now, a third embodiment of a speaker device to which the present invention is applied will be described with reference to FIG. 10. In the speaker device according to this embodiment, a voice coil 29 comprises a pair of voice coils 29a and 29b, and a lamp 36 is connected in series to one voice coil 29a. Breakers 42a and 42b are respectively connected to opposite ends of the lamp 36, and the other ends of the breakers 42a and 42b are respectively connected to a contact A and a contact B of a changeover switch 46. A fixed contact C of the changeover switch 46 is connected to one end of the other voice coil 29b.

[0043] In the speaker device constructed as described above, when the Exed contact C of the changeover switch 46 is switched to the contact A, only the current flowing through the voice coil 29 flows through the lamp 36, and therefore, the lamp 36 is so low in brightness that the lamp 36 does not glitter powerfully. On the other hand, when the fixed contact C is switched to the contact B, both the currents flowing through the two voice coils 29a and 29b flow through the lamp 36, that is, the sum of the currents flowing through the two voice coils 29a and 29b flows through the lamp 36, whereby the lamp 36 glitters brightly. In other words, the brightness of the lamp 36 can be adjusted according to the switching of the changeover switch 46. The protection against the excessively great input is done by the breaker 42a or the breaker 42b according to the switching of the changeover switch 46.

[0044] In a speaker device shown in FIG. 11, the lamp

36 in the speaker device shown in FIG. 10 is divided into two lamps 36a and 36b, which are connected in series. Other constructions are the same as the speaker device shown in FIG. 10. Accordingly, the impedance of the whole speaker device can be made higher by the lamps 36a and 36b.

Industrial Applicability

[0045] According to the present invention, there is provided a speaker device for vibrating a diaphragm in response to an electrical signal to produce the sound, comprising a light emitting means which varies in brightness according to a stress of an electrical signal. Accordingly, the speaker device not only produces the sound but also produces light. Further, the brightness varies according to a stress of an electrical signal.

[0046] And, a voice coil comprises two coils, a lamp is connected to one coil, and a breaker is connected to the other coil. Accordingly, in the speaker device, the lamp as a light emitting means serves as a protective circuit. Further, even if an excessive high driving current is input to cut off the breaker, the voice coil to which the lamp is connected is driven, and therefore, the sound is not interrupted.

[0047] The speaker device according to the present invention comprises a voice coil comprising a plurality of coils, a lamp connected in series to a first coil out of the plurality of coils to serve as a protective circuit, and a changeover switch connected between a second coil out of the plurality of coils and a lamp to switch (changeover) the state into one state that a current flowing through the second coil passes through a lamp, and the other state that it does not pass therethrough. Accordingly, in this speaker device, the protection of the voice coil can be achieved by the lamp, and the brightness of the lamp can be adjusted according to the switching of the changeover switch.

Claims

1. A speaker device for vibrating a diaphragm in response to an electrical signal to produce the sound, comprising:
a light emitting means which varies in brightness according to a stress of said electrical signal.
2. The speaker device according to claim 1, wherein said light emitting means is disposed forward of a driving means of said diaphragm.
3. The speaker device according to claim 1, wherein a light guiding plate is disposed forward of said light emitting means, and light is guided forward through a transparent part of said light guiding plate.
4. The speaker device according to claim 3, wherein

a center cap of a loudspeaker is constituted by said light guiding plate, and light from said light emitting means is guided from the interior of said center cap to the outer peripheral side so as to allow said diaphragm to glitter.

5. The speaker device according to claim 2, wherein said driving means of the diaphragm is constituted from a voice coil, and a pole piece internally of said voice coil constitutes a reflector of said light emitting means.
6. The speaker device according to claim 2, wherein said light emitting means is arranged so that said light emitting means is cooled by an air flow generated by the vibration of said diaphragm.
7. The speaker device according to claim 1, wherein said light emitting means is connected in series to the voice coil constituting said driving means of said diaphragm.
8. A speaker device comprising:
a voice coil comprising a plurality of coils; and
a plurality of protective circuits connected to said plurality of coils, respectively.
9. A speaker device comprising:
a voice coil comprising two coils;
a lamp connected to one coil; and
a breaker connected to the other coil.
10. A speaker device comprising:
a voice coil comprising a plurality of coils;
a lamp connected in series to a first coil out of the plurality of coils to serve as a protective circuit; and
a changeover switch connected between a second coil out of the plurality of coils and a lamp to switch (changeover) the state into one state that a current flowing through said second coil passes through a lamp, and the other state that it does not pass therethrough.

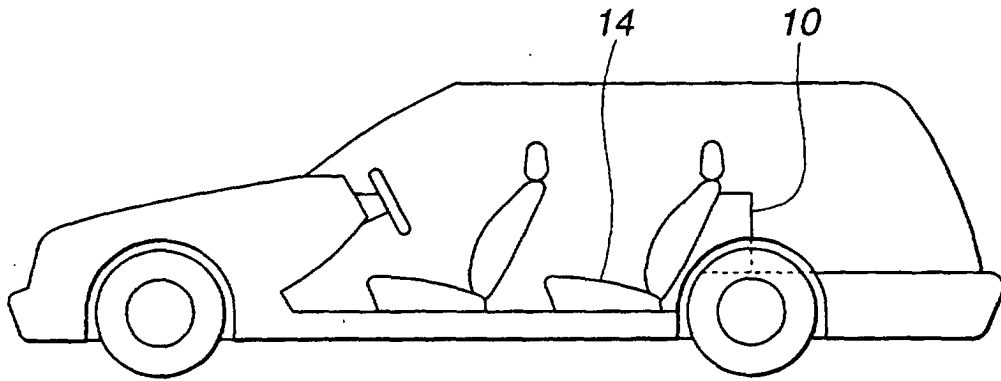


FIG.1

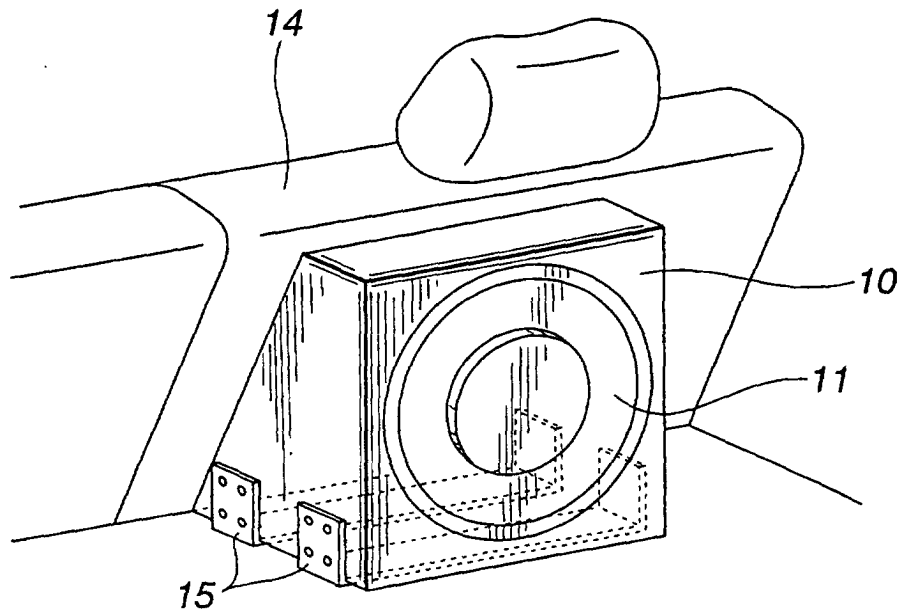


FIG.2

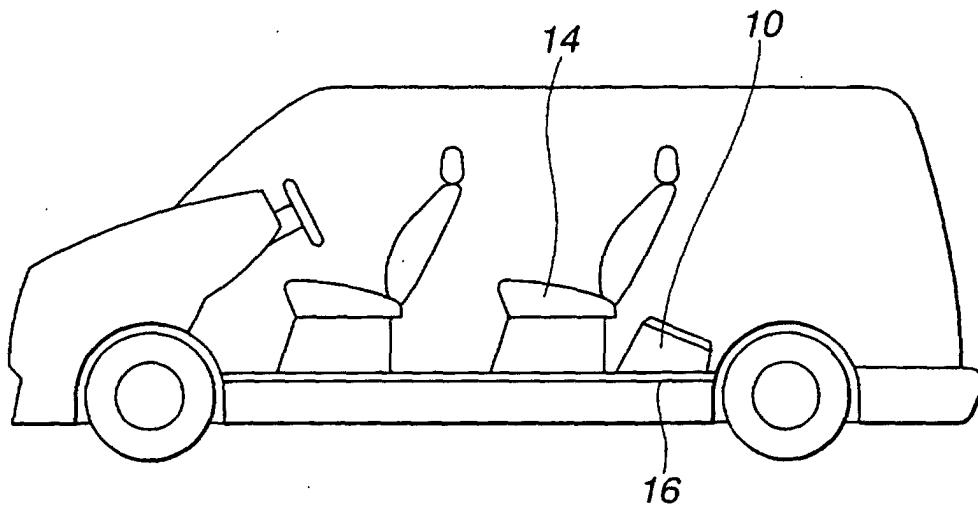


FIG.3

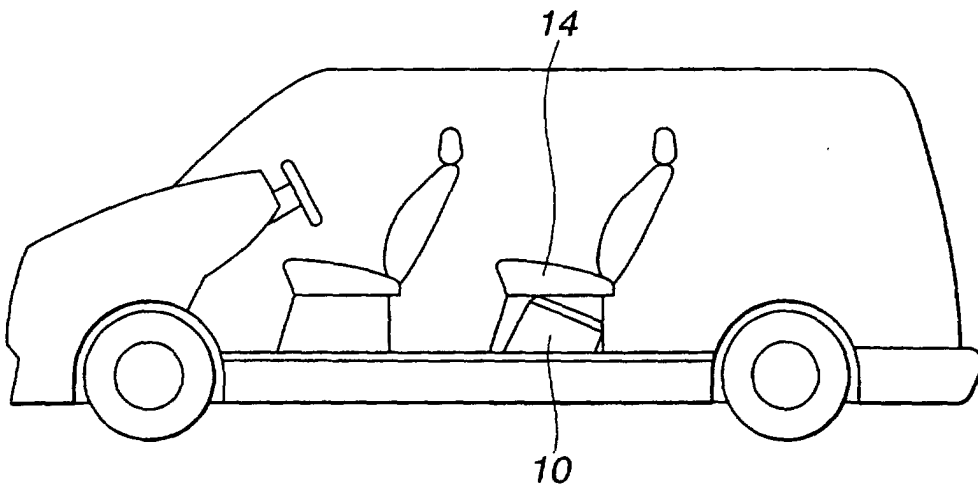


FIG.4

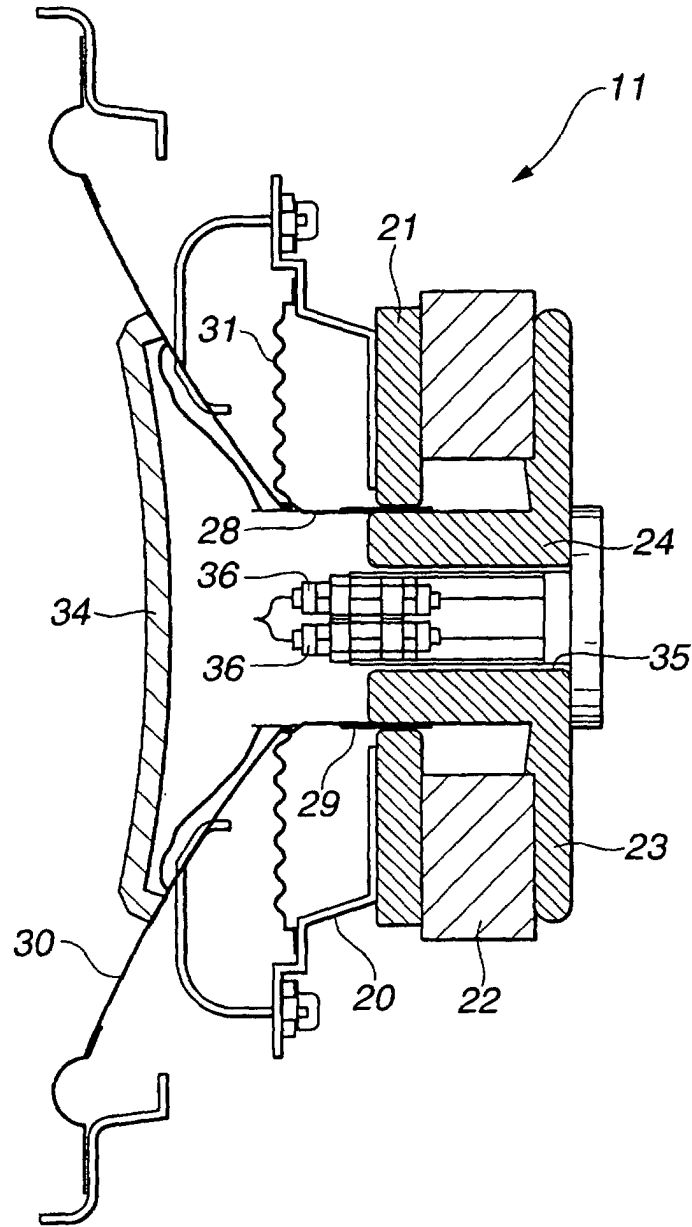


FIG.5

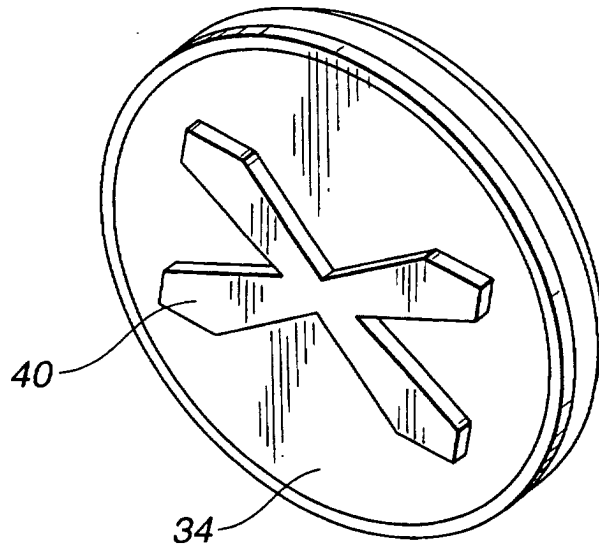


FIG. 6

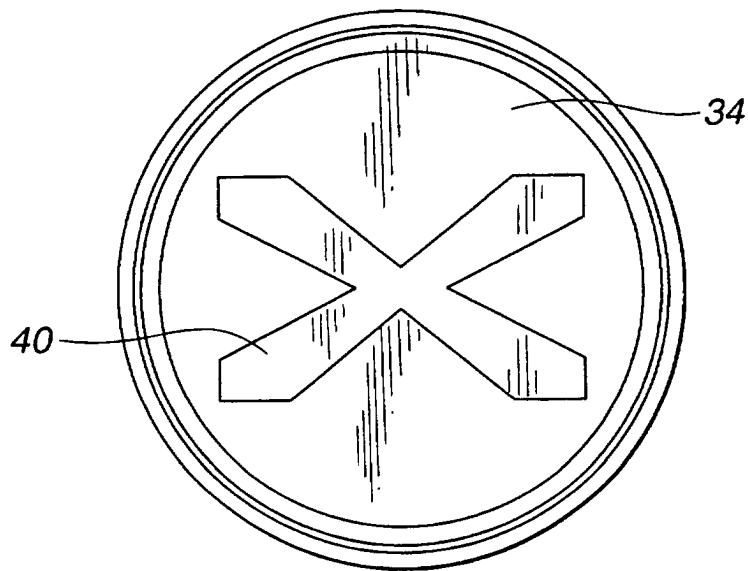


FIG. 7

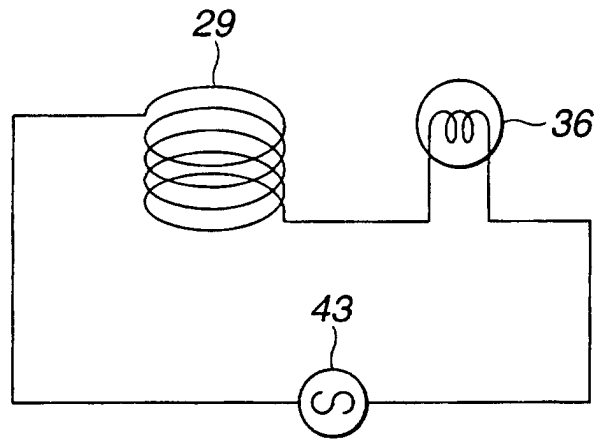


FIG. 8

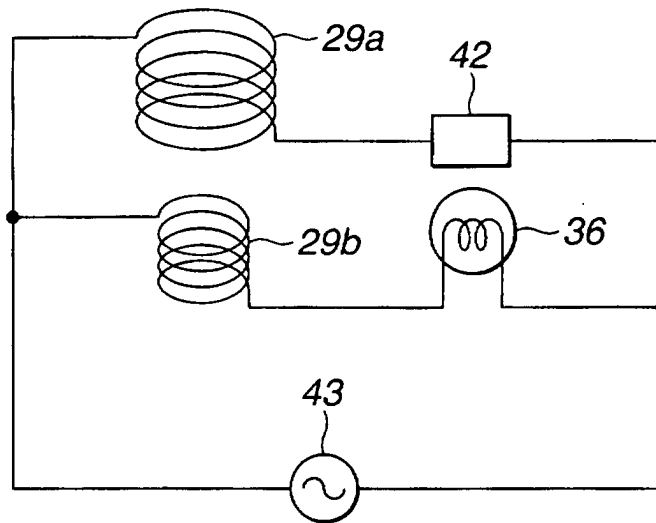


FIG. 9

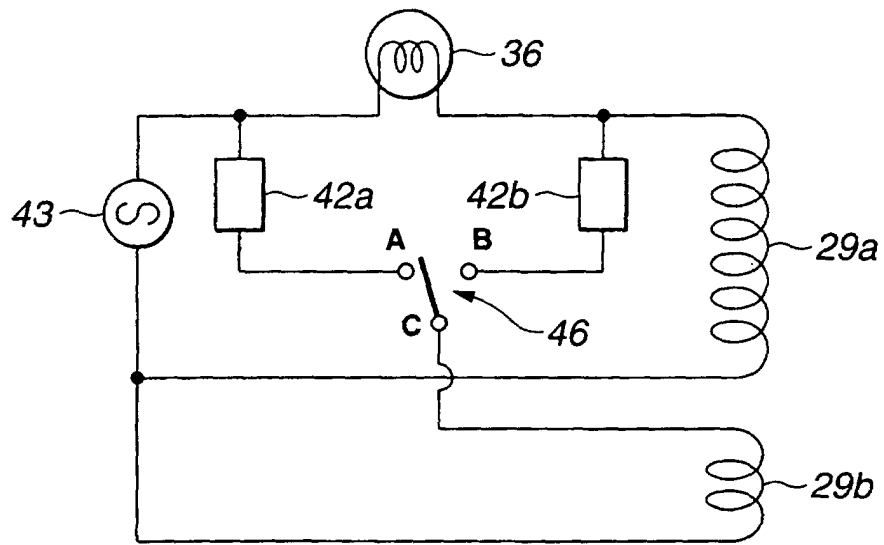


FIG.10

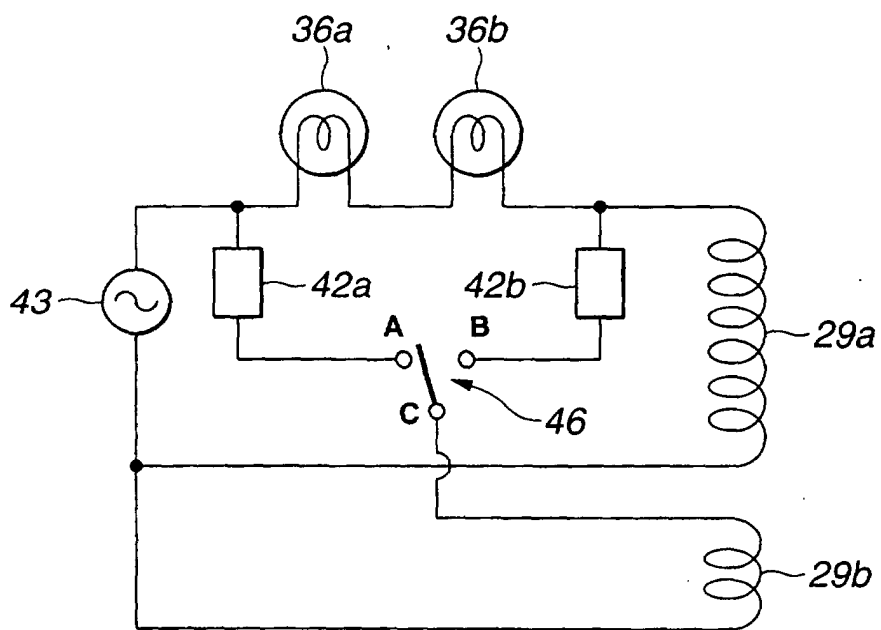


FIG.11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/06917

<p>A. CLASSIFICATION OF SUBJECT MATTER Int.Cl⁷ H04R1/00, H04R3/00</p> <p>According to International Patent Classification (IPC) or to both national classification and IPC</p>																									
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) Int.Cl⁷ H04R1/00, H04R3/00</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2000 Kokai Jitsuyo Shinan Koho 1971-2000 Jitsuyo Shinan Toroku Koho 1996-2000</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)</p>																									
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No.748/1985 (Laid-open No.119488/1986) (Fujitsu Ten Limited), 28 July, 1986 (28.07.86), Full text; Figs. 1, 3</td> <td>1-4, 6</td> </tr> <tr> <td>Y</td> <td>Full text; Figs. 1, 3 (Family: none)</td> <td>5, 7</td> </tr> <tr> <td>X</td> <td>Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No.85450/1988 (Laid-open No.8282/1990) (Poster Electric Co., Ltd.), 19 January, 1990 (19.01.90), Full text; Figs. 1 to 4</td> <td>1-4, 7</td> </tr> <tr> <td>Y</td> <td>Full text; Figs. 1 to 4 (Family: none)</td> <td>5, 6</td> </tr> <tr> <td>X</td> <td>JP, 58-44717, Y2 (Mitsubishi Electric Corporation), 11 October, 1983 (11.10.83), Full text; Fig. 1 (Family: none)</td> <td>1, 7</td> </tr> </tbody> </table> <p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.</p> <p>* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "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 "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family</p> <table border="1"> <tr> <td>Date of the actual completion of the international search 08 November, 2000 (08.11.00)</td> <td>Date of mailing of the international search report 21 November, 2000 (21.11.00)</td> </tr> <tr> <td>Name and mailing address of the ISA/ Japanese Patent Office</td> <td>Authorized officer</td> </tr> <tr> <td>Facsimile No.</td> <td>Telephone No.</td> </tr> </table>		Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No.748/1985 (Laid-open No.119488/1986) (Fujitsu Ten Limited), 28 July, 1986 (28.07.86), Full text; Figs. 1, 3	1-4, 6	Y	Full text; Figs. 1, 3 (Family: none)	5, 7	X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No.85450/1988 (Laid-open No.8282/1990) (Poster Electric Co., Ltd.), 19 January, 1990 (19.01.90), Full text; Figs. 1 to 4	1-4, 7	Y	Full text; Figs. 1 to 4 (Family: none)	5, 6	X	JP, 58-44717, Y2 (Mitsubishi Electric Corporation), 11 October, 1983 (11.10.83), Full text; Fig. 1 (Family: none)	1, 7	Date of the actual completion of the international search 08 November, 2000 (08.11.00)	Date of mailing of the international search report 21 November, 2000 (21.11.00)	Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer	Facsimile No.	Telephone No.
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