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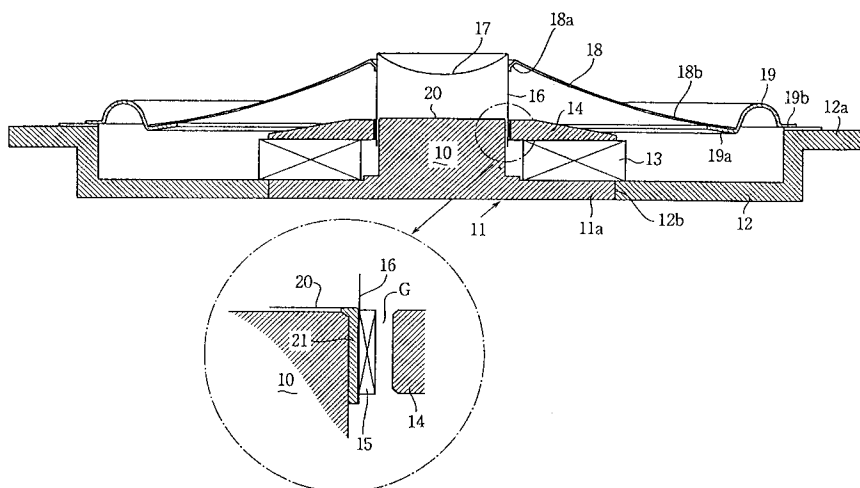
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(54) **Structure for supporting a vibrating system of a loudspeaker.**

(57) A loudspeaker has a yoke base (11a), a center pole (10) formed on the yoke base (11a), an annular magnet mounted (13) on the yoke base (11a), and an annular plate (14) mounted on the magnet (13) so as to form a gap (G) between an inside wall thereof and an outer wall of the center pole (10). A cap (20) made of resin and having a cylindrical portion (20a)

is securely mounted on the top of the center pole (10). The cylindrical portion (20a) is disposed in the gap (G). A plurality of projections (21) is formed on the cylindrical portion (20a), each of which extends axially. A voice coil bobbin (16) is disposed between the projections (21) and the inside wall of the annular plate (14).

FIG.1**EP 0 624 048 A1**

BACKGROUND OF THE INVENTION

The present invention relates to a structure for supporting a vibrating system of a loudspeaker, and more particularly to a supporting structure for a voice coil bobbin having a voice coil wound thereon for vibrating a diaphragm by the magnetic reaction between the voice coil and a magnet.

In a loudspeaker for a car stereo, the place for disposing the loudspeaker is limited to a small space so that it is desired to have a loudspeaker which has a small thickness.

Japanese Patent Publication 55-42559 discloses a loudspeaker structure which is designed with a reduced thickness. Fig. 20 shows the loudspeaker. The loudspeaker has a center pole 2 formed on a yoke and an annular magnet 1, thereby forming a magnetic circuit. A voice coil bobbin 4 provided with a voice coil 3 thereon is disposed in a magnetic gap formed between the center pole 2 and the magnet 1. An inner edge of a diaphragm 5 is secured to the voice coil bobbin 4 at the outer periphery thereof. On the inner periphery of the voice coil bobbin 4, a bearing 6 is provided and slidably mounted along the outer periphery of the center pole 2. Thus, in such a loudspeaker, a damper is omitted which is conventionally provided for supporting the coil bobbin 4.

When supplied with an audio current, the voice coil 3 generates a magnetic force, which moves the voice coil bobbin 4 itself in the axial direction. The diaphragm 5 is thus caused to vibrate to produce sound waves. The voice coil bobbin 4 is guided along the center pole 2 through the bearing 6 so that the axial movement of the coil bobbin is stabilized.

A loudspeaker having such a structure is advantageous in that the thickness of the loudspeaker is reduced because of the elimination of a damper. However, the contact area between the bearing 6 and the center pole 2 is considerably large. Hence, when reciprocating on the center pole 2, the bearing 6 makes rubbing noises, causing a deterioration of quality of sound.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a loudspeaker which has a structure with a small thickness and without deteriorating the sound quality of the loudspeaker.

According to the present invention, there is provided a structure for supporting a vibrating system of a loudspeaker having a yoke base, a center pole formed on the yoke base, an annular magnet mounted on the yoke base, and an annular plate mounted on the magnet so as to form a gap between an inside wall thereof and an outer wall of

the center pole.

The structure comprises a cap made of resin, having a cylindrical portion, and securely mounted on a top of the center pole so that the cylindrical portion is disposed in the gap, guide means provided on the cylindrical portion of the cap, and a voice coil bobbin disposed between the guide means and the inside wall of the annular plate.

The guide means comprise a plurality of projections, each of which extends axially.

Other objects and features of this invention will be readily apparent from the following description with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

- | | |
|----------------|---|
| Fig. 1 | is a sectional view of a loudspeaker to which the present invention is applied; |
| Fig. 2 | is a sectional side view showing a magnetic circuit of the loudspeaker; |
| Fig. 3 | is a perspective explanatory view showing a film cap and a center pole; |
| Fig. 4 | is an enlarged plan view partly showing the film cap; |
| Figs. 5 to 10 | are illustrations showing assembling steps of the loudspeaker; |
| Fig. 11 | is a sectional side view showing another embodiment of the present invention; |
| Figs. 12 to 19 | are illustrations showing assembling steps of the embodiment; and |
| Fig. 20 | is a sectional view partly showing a conventional loudspeaker. |

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Fig. 1, a loudspeaker of the present invention has a yoke 11 having an integral center pole 10 and a yoke base 11a, an annular frame 12 having an upper flange 12a and secured to the yoke base 11a, an annular magnet 13 mounted on the yoke base 11a, and an annular plate 14 mounted on the magnet 13.

A film cap 20 made of resin having a good heat resistance is mounted on the top of the center pole 10. As shown in Figs. 3 and 4, the film cap 20 has a cylindrical portion 20a extending downwardly from the top. A plurality of projections 21 are formed on the cylindrical portion 20a. The respective projections 21 have a triangular shape in cross section and extend axially. The film cap 20 is

mounted on the center pole 10 such that the projections 21 are disposed in a magnetic gap G formed between the center pole 10 and the annular plate 14.

As a material for the film cap 20, resins having a good heat resistance are used such as polyimide (PI), polyetherimide (PEI), polyetheretherketone (PEEK), polycarbonate (PC), polyphenylenesulfide (PPS), polyethersulfone (PES), polysulfone (PSF), and/or polyester.

A voice coil bobbin 16 provided with a voice coil 15 is disposed in the magnetic gap G and mounted on the center pole 10 by means of the film cap 20 as shown in Fig. 1. Thus, the inner peripheral portion of the voice coil bobbin 16 is engaged with the projections 21 of the film cap 20 at linear contacts as shown in Fig. 4. A conical diaphragm 18 made of paper, for example, is secured to the voice coil bobbin 16 at an upper portion thereof and supported by an edge 19 connected to the upper flange 12a of the frame 12. A center cap 17 is mounted on the voice coil bobbin 16 at an upper end portion thereof.

The assembling method of the loudspeaker will be described hereinafter.

As shown in Fig. 2, an inner periphery 12b of the frame 12 is secured to an outer periphery of the yoke base 11a of the yoke 11. The annular magnet 13 is secured to the yoke base 11a, and the annular plate 14 is secured to the magnet 13, thereby forming a magnetic circuit. As shown in Fig. 3, an adhesive 27 is coated on the top of the center pole 10 to adhere the film cap 20 thereto. As shown in Fig. 5, the voice coil bobbin 16 having the voice coil 15 is mounted on the center pole 10 by means of a voice gauge 30 through the cap 20.

Thereafter, the diaphragm 18 is mounted on the frame 12 and the coil bobbin 16 as shown in Fig. 6. As shown in Fig. 1, an outer edge 18b of the diaphragm 18 is secured to an inside edge 19a of the edge 19. An outer edge 19b of the edge 19 is adhered to the upper flange 12a of the frame 12. As shown in Fig. 7, an inner edge 18a of the diaphragm 18 is engaged with the upper portion of the voice coil bobbin 16 and adhered thereto by the adhesive 27.

As shown in Fig. 8, an end of a lead 25 of the voice coil 15 is connected to an end of a Litz wire 26 which is exposed from the diaphragm 18 and secured thereto by a solder 28. The other end of the Litz wire 26 is connected to an external terminal (not shown).

As shown in Fig. 9, adhesives 27 are coated on a laid portion of the lead 25 so as to reinforce the lead 25. Another lead (not shown) of the voice coil 15 is also connected in the same manner as the lead 25. As shown in Fig. 10, the voice gauge 30 is removed from the voice coil bobbin 16 and the

center cap 17 is adhered to the upper end of the voice coil bobbin 16.

When the voice coil 15 is supplied with the audio current, the voice coil 15 generates a magnetic force, which moves the voice coil bobbin 16 itself. The diaphragm 18 is thus caused to vibrate in order to produce sound waves. Hence, an electric signal is converted into an acoustic signal by a magnetic flux generated by the magnet 13 and a magnetic force caused by the electric signal.

The voice coil bobbin 16 reciprocates axially on the projections 21 with a small friction.

In accordance with the present invention, the film cap 20 made of resin is provided on the yoke 11 so as to be linearly engaged with the voice coil bobbin 16 at the projections 21 thereof. Since the contact area of the projections 21 is very small, noises caused by rubbing of the voice coil bobbin 16 are reduced and minimized, thereby preventing a deterioration of the sound quality.

Fig. 11 shows another embodiment of the present invention. A loudspeaker of this embodiment is provided with a film cap 22 having a cylindrical portion 22a and an outside cylindrical portion 23 which is formed by bending the cylindrical portion 22a outwardly at a lower portion thereof. Thus a slight gap is formed between the cylindrical portions 22a and 23. The outside cylindrical portion 23 is disposed in the magnetic gap G and engaged with the inner periphery of the voice coil bobbin 16.

Other structures are the same as in the first embodiment and the same parts thereof are identified with the same reference numerals as in Fig. 1.

Concerning the assembling method of the loudspeaker, as shown in Fig. 12, the magnetic circuit is assembled in the same manner as in the first embodiment of Fig. 5. Then, the voice coil bobbin 16 provided with the voice coil 15 is mounted on the center pole 10 with the voice gauge 30 as shown in Fig. 13. As shown in Figs. 14 to 17, the diaphragm 18 and the lead 25 are assembled in the same manner as in the first embodiment of Figs. 6 to 9. As shown in Fig. 18, the voice gauge 30 is removed from the voice coil bobbin 16, and the film cap 22 is inserted into the voice coil bobbin 16 and adhered to the center pole 10 by an adhesive 27. As shown in Fig. 19, the center cap 17 is secured to the voice coil bobbin 16.

In this embodiment, the outside cylindrical portion 23 engaged with the voice coil bobbin 16 can be deflected to the cylindrical portion 22a, thereby absorbing lateral vibrations of the voice coil bobbin 16.

While preferred embodiments of the present invention have been shown and described, it is to be understood that these disclosures are for the

purpose of illustration only and that various changes and modifications may be made without departing from the scope of the invention.

Claims

1. A structure for supporting a vibrating system of a loudspeaker having a yoke base (11a), a center pole (10) formed on the yoke base (11a), an annular magnet (13) mounted on the yoke base (11a), and an annular plate (14) mounted on the magnet (13) so as to form a gap (G) between an inside wall thereof and an outer wall of the center pole (10), comprising:
 - a cap (20, 22) made of resin, having a cylindrical portion (20a, 22a), and securely mounted on the top of the center pole (10) so that the cylindrical portion (20a, 22a) is disposed in the gap (G);
 - guide means (21, 23) provided on the cylindrical portion (20a, 22a) of the cap (20, 22); and
 - a coil bobbin (16) disposed between the guide means (21, 23) and the inside wall of the annular plate (14).
2. The structure according to claim 1, wherein the guide means (21) comprise a plurality of projections (21), each of which extends axially of the cap (20).
3. The structure according to claim 2, wherein each of the projections (21) has a triangular shape in cross-section.
4. The structure according to claim 1, wherein the guide means (23) comprise an outside cylindrical portion (23) formed by bending a cylindrical portion of the cap (22) upwardly at a lower portion thereof.
5. The structure according to any of claims 1 to 4, wherein the cap (20, 22) is made of a resin having a good heat resistance selected from the group of the following materials: polyimide (PI), polyetherimide (PEI), polyetheretherketone (PEEK), polycarbonate (PC), polyphenylenesulfide (PPS), polyethersulfone (PES), polysulfone (PSF), and polyester.

FIG.1

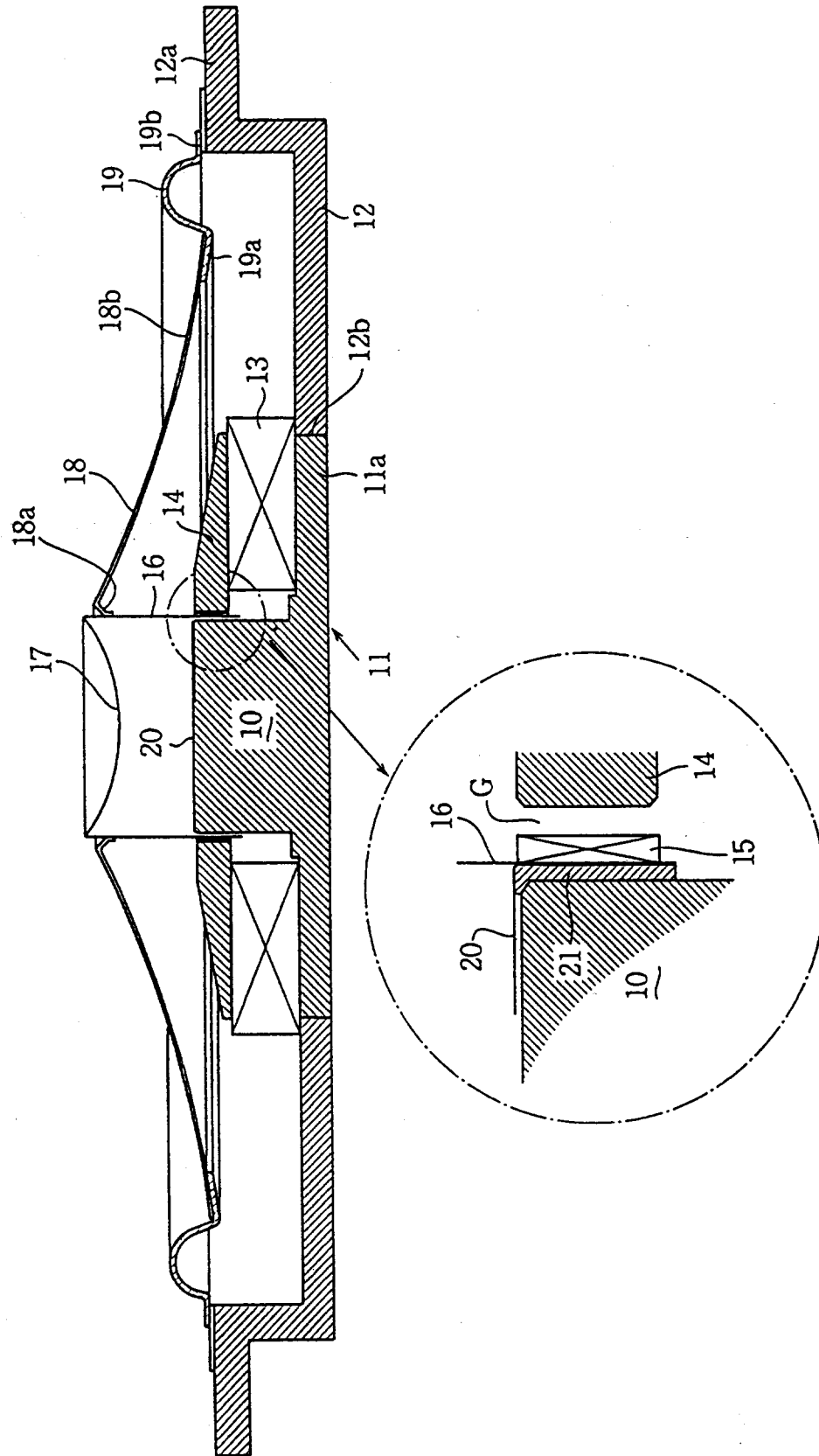


FIG.2

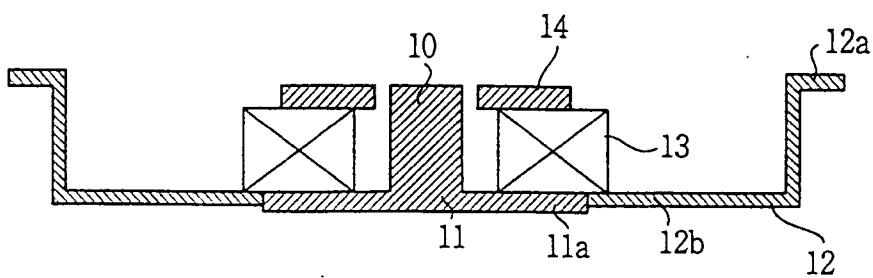


FIG.3

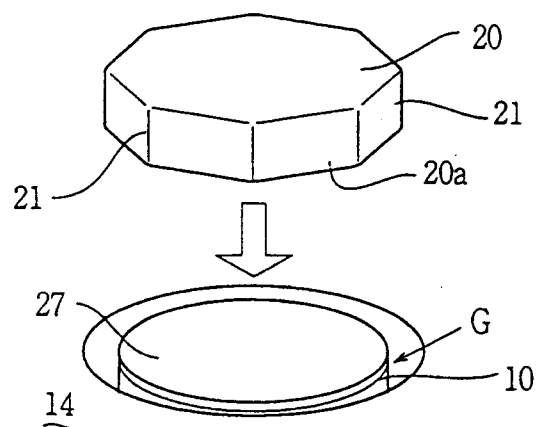


FIG.4

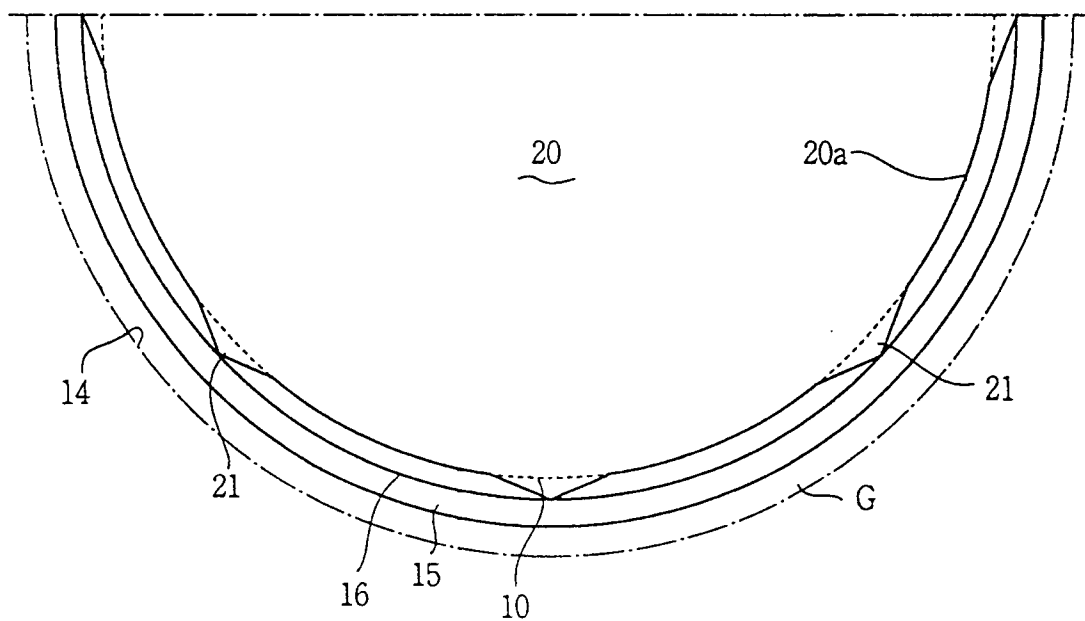


FIG.5

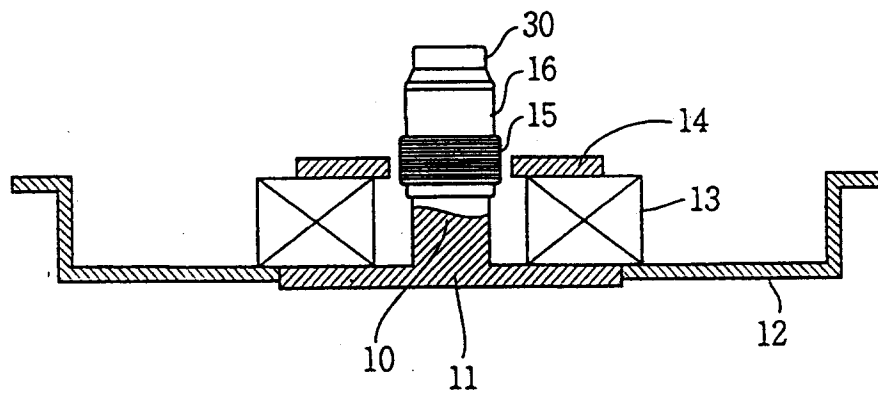


FIG.6

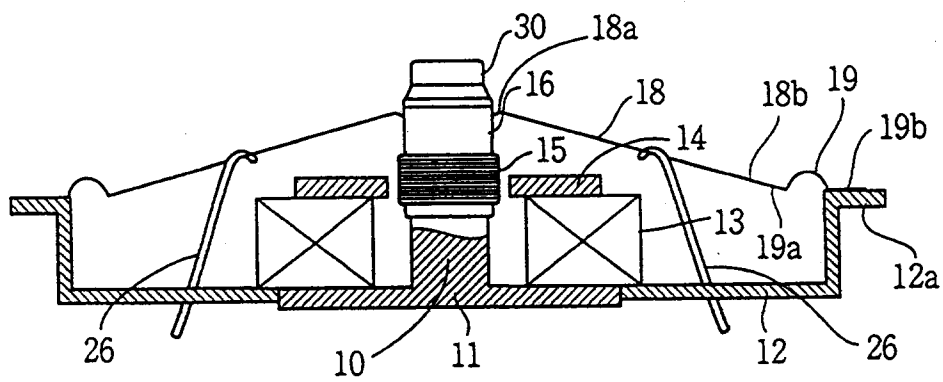


FIG.7

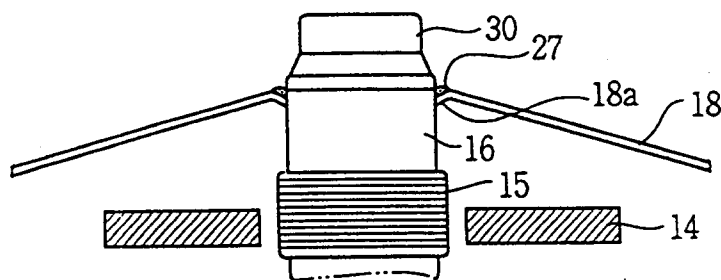


FIG.8

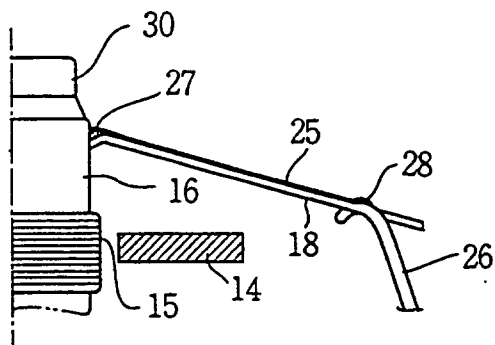


FIG.9

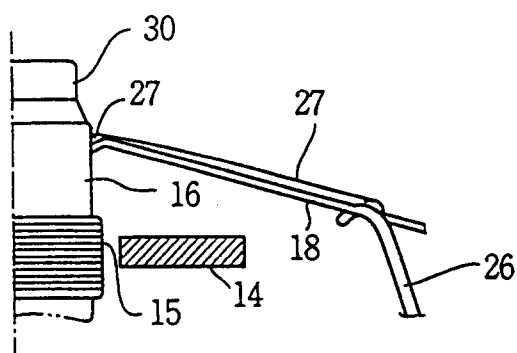


FIG.10

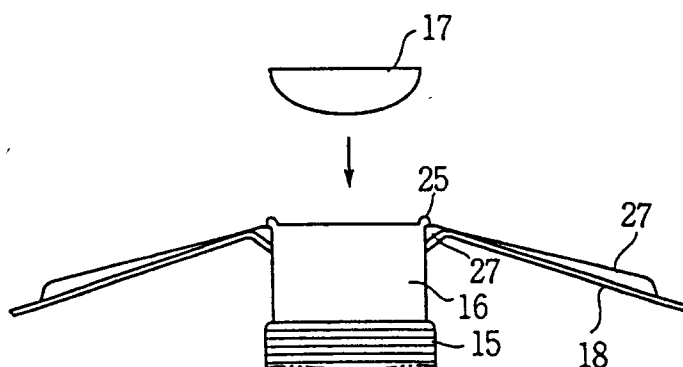


FIG.11

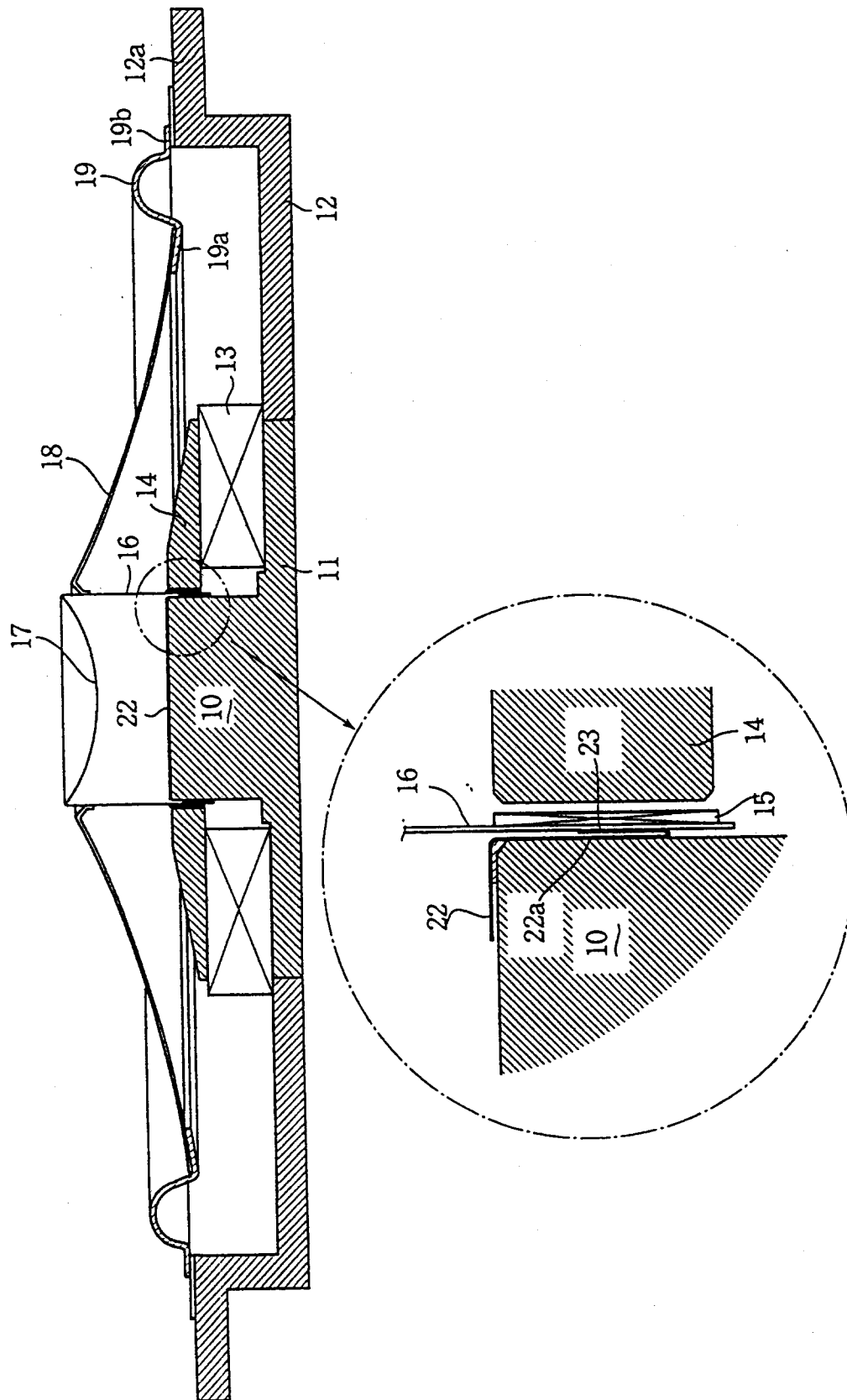


FIG.12

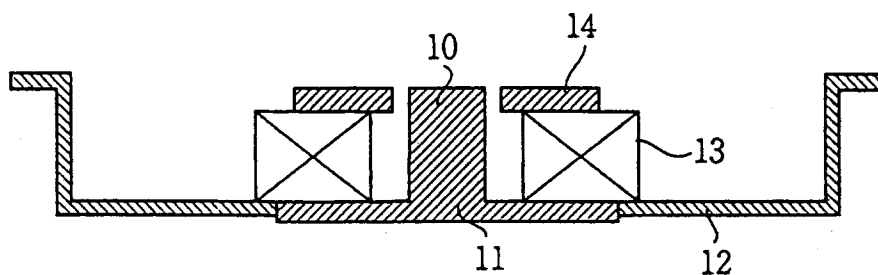


FIG.13

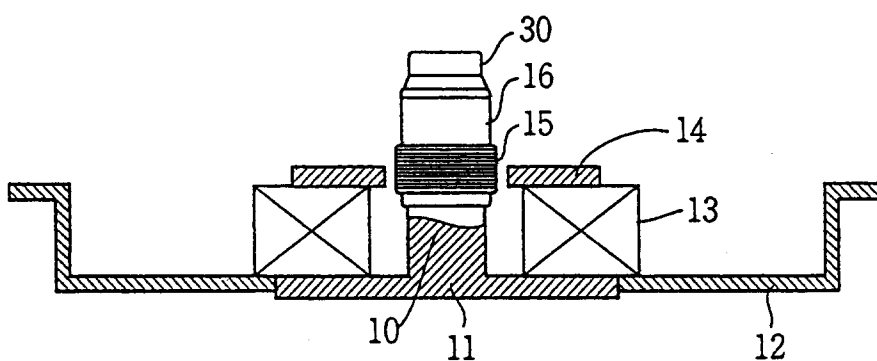


FIG.14

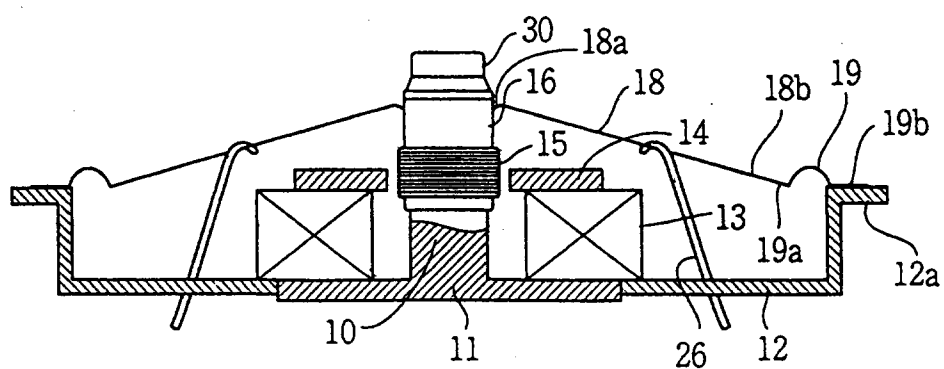


FIG.15

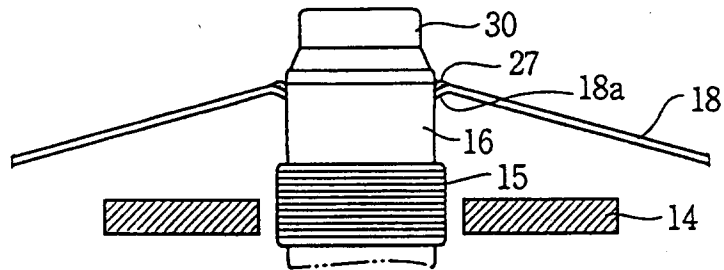


FIG.16

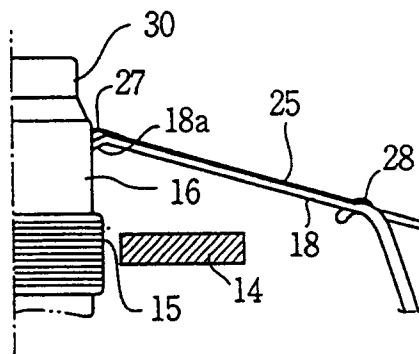


FIG.17

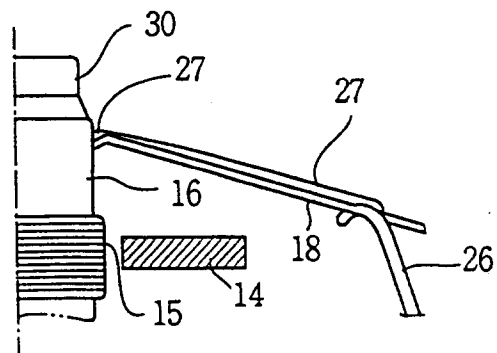


FIG.18

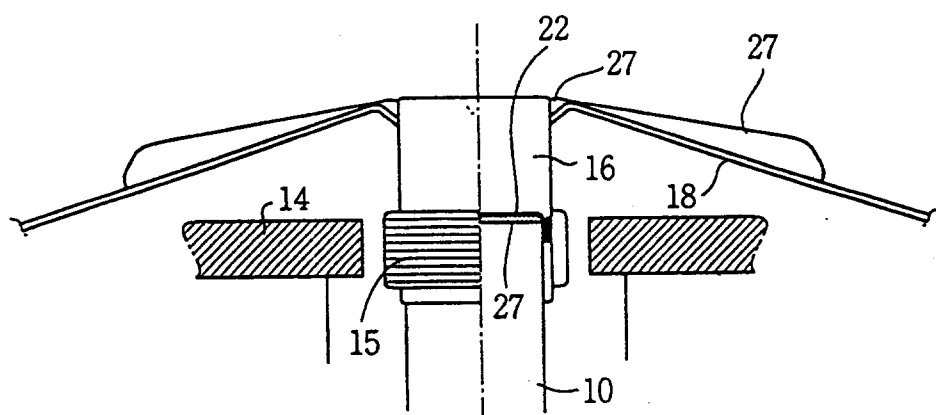


FIG.19

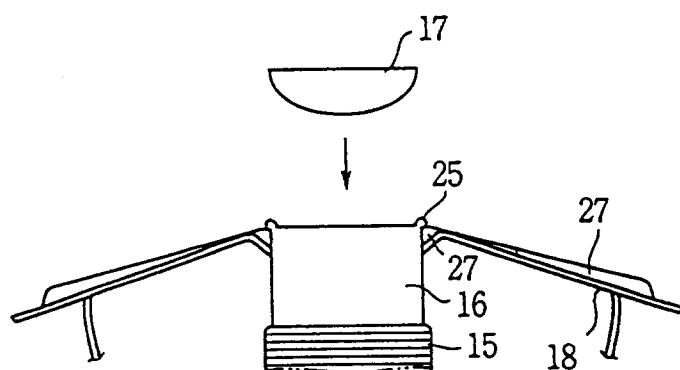
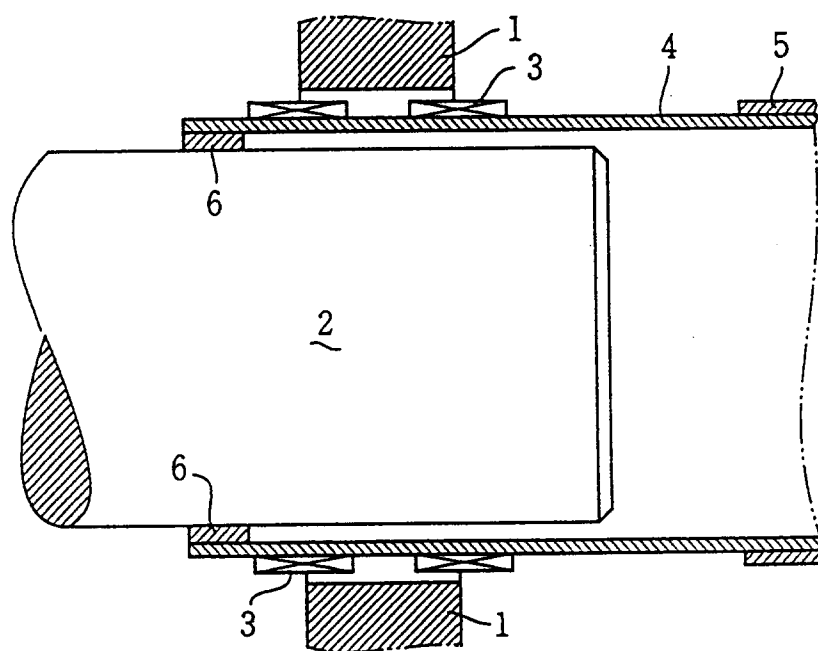


FIG.20

PRIOR ART





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 94 10 7075

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
Y	US-A-4 115 667 (BABB) * column 1, line 3 - line 7 * * column 3, line 48 - line 68; figure 3 * * column 4, line 1 - line 10; figure 4 * * column 4, line 11 - line 22; figure 5 *	1	H04R9/04 H04R31/00
A	* column 5, line 5 - line 15; figure 5 *	2,3	
A	* column 4, line 1 - line 5 * * column 11, line 19 - line 26 * ---	5	
Y	US-A-3 983 337 (BABB) * column 14, line 32 - line 48 * ---	1	
A	DE-A-30 46 551 (ISOPHON-WERKE GMBH) * page 7, line 5 - line 12; figure 3 * ---	1	
A	PATENT ABSTRACTS OF JAPAN vol. 004, no. 117 (E-022) (599) 20 August 1980 & JP-A-55 073 196 (MATSUSHITA DENKI SANGYO K.K.) * abstract * ---	1	
A	WO-A-91 17636 (GRUNBERG) * page 6, line 19 - line 34; figure 4 * ---	4	TECHNICAL FIELDS SEARCHED (Int.Cl.5) H04R
A	US-A-4 531 025 (DANLEY ET AL.) * column 3, line 31 - line 43; figure * -----	1	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 19 August 1994	Examiner Gastaldi, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application I : document cited for other reasons & : member of the same patent family, corresponding document			