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(54) **SYMMETRIC DUAL SUSPENSION SPEAKER STRUCTURE**

(57) A symmetric dual suspension speaker structure is herein disclosed, comprising a basin frame, a U-shaped iron, a magnet permeability ferrite ring, a corrugated rim, a diaphragm, a sound coil, a damper clamped between the magnet permeability ferrite ring and the U-shaped iron, as well as a magnet, wherein the peripheral edge around the upper surface of the diaphragm can be stretched in the vertical direction to form

a barrel component, and the corrugated rim is used to bond and fix the top end of the barrel component while the damper is used to bond and fix the bottom end of the barrel component, such that the sound coil can bring the barrel component of the diaphragm to vertically vibrate thus improving the instability existing in the bonding of the conventional diaphragm and the coil framework.

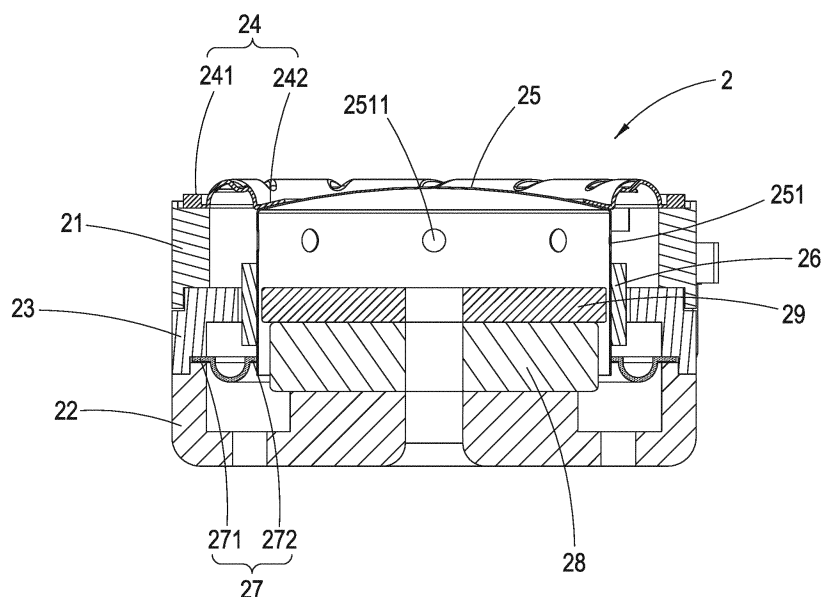


FIG. 4

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention generally relates to a symmetric dual suspension speaker structure; in particular, it relates to a speaker structure capable of improving the vertical centering ability for coil vibrations, increasing sound coil strokes, as well as lessening sound coil frictions and distortions.

2. Description of Related Art

[0002] A conventional electric speaker 1 is shown in Figure 1, mainly comprising a magnetic circuit system, a vibration system, and a suspension system for supporting the vibration system. It can be seen that the magnetic circuit system includes a washer 11, a magnet 12 and a U-shaped iron 13, the vibration system has a sound coil 14, a framework 15 and a diaphragm 16, and the suspension system essentially includes a corrugated rim 17 located at the outer periphery of the speaker diaphragm 16 and a damper 18 for fixing the sound coil 14.

[0003] Herein the sound coil 14 moves in the magnetic gap created by the magnetic circuit system. The operational principle of the above-mentioned speaker can be roughly explained as below: transferring alternating current implicitly comprising audio signals to the sound coil 14 in order to cause the sound coil 14 to vibrate vertically in the magnetic gap, and the vibrations of the sound coil 14 bring the diaphragm 16 to move by means of the framework 15 such that the diaphragm 16 vibrates and compresses the air to reproduce the sound.

[0004] However, in practice, certain drawbacks do exist in such speakers of conventional structures. For example, the suspension system is located at the top end of the coil, so that, when the sound coil vibrates up and down in the magnetic gap, the lower end of the sound coil may easily sway and chafes the inner and outer walls of the magnetic gap thus resulting in unwanted noises.

[0005] Hence, in the trend of modern audio development, the increasing requirements for thinner profiles, lighter weights and withstanding more power or the like make the above-mentioned speakers of conventional structure designs fail to completely satisfy the demands.

[0006] Therefore, it would be an optimal solution if it is possible to provide a type of symmetric dual suspension speaker structure which allows to let the diaphragm vertically extend downwards to form a barrel component, and bond and fix the upper and lower ends of the barrel component by means of the corrugated rim and the damper, thus enabling the sound coil to bring the barrel component of the diaphragm to vibrate vertically so as to reduce the instability existing in the bonding between the conventional diaphragm and the coil framework.

SUMMARY OF THE INVENTION

[0007] A symmetric dual suspension speaker structure according to the present invention is disclosed, comprising: a basin frame, configured with an opening; a U-shaped iron, internally combined with a magnetic assembly; a magnetic permeability ferrite ring, installed between the basin frame and the U-shaped iron, with the top end thereof being in contact with the bottom end of the basin frame and the center thereof having a ring opening;

a corrugated rim, installed at the opening of the base frame; a diaphragm, in which the diaphragm upper surface is connected to the corrugated rim, and the peripheral edge of the diaphragm upper surface can be stretched in the vertical direction to form a barrel component, and the barrel component of the diaphragm penetrates the opening of the basin frame and the ring opening of the magnetic permeability ferrite ring; a sound coil, winding around the outer surface of the barrel component and closing the opening;

a damper, including a damper outer ring and a damper inner ring, in which the damper inner ring is used to connected with the outer bottom edge around the barrel component of the diaphragm, while the damper outer ring is fixedly clamped between the top end of the U-shaped iron and the bottom end of the magnetic permeability ferrite ring.

[0008] More specifically, the diaphragm and the barrel component are integrally designed.

[0009] More specifically, the corrugated rim is used to bond and fix the top end of the barrel component and the damper is used to bond and fix the bottom end of the barrel component, such that the sound coil can bring the barrel component of the diaphragm to vertically vibrate.

[0010] More specifically, the outer surface of the barrel component includes multiple holes.

[0011] The symmetric dual suspension speaker structure according to Claim 1, wherein the magnetic assembly includes a magnet and a washer.

[0012] The symmetric dual suspension speaker structure according to Claim 5, wherein the magnet is installed inside the U-shaped iron, and the washer is installed at the top side of the magnet in order to fit with the U-shaped iron thereby clamping in package the magnet.

[0013] The symmetric dual suspension speaker structure according to Claim 1, wherein the corrugated rim includes a corrugated rim outer ring and a corrugated rim inner ring.

[0014] The symmetric dual suspension speaker structure according to Claim 7, wherein the corrugated rim outer ring is installed at the opening of the basin frame thereby closing the opening.

[0015] The symmetric dual suspension speaker structure according to Claim 7, wherein the corrugated rim inner ring is connected to the upper surface of the diaphragm.

[0016] The symmetric dual suspension speaker struc-

ture according to Claim 1, wherein the sound coil is set up between the corrugated rim and the damper.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Figure 1 shows a cross-sectioned structural view of a conventional speaker structure;

Figure 2 shows a disassembled structural view of the symmetric dual suspension speaker structure according to the present invention;

Figure 3 shows an assembled structural view of the symmetric dual suspension speaker structure according to the present invention;

Figure 4 shows a cross-sectioned structural view of the symmetric dual suspension speaker structure according to the present invention;

Figure 5 shows an operational implementation view of the symmetric dual suspension speaker structure according to the present invention;

Figure 6 shows a temperature test diagram for the sound coil of the symmetric dual suspension speaker structure according to the present invention;

Figure 7 shows a relative total harmonic distortion test diagram of the symmetric dual suspension speaker structure according to the present invention; and

Figure 8 shows a symmetry test diagram of the symmetric dual suspension speaker structure according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Other technical contents, aspects and effects in relation to the present invention can be clearly appreciated through the detailed descriptions concerning the preferred embodiments of the present invention in conjunction with the appended drawings.

[0019] Refer first to Figures 2-4, wherein a disassembled structural view, an assembled structural view and a cross-sectioned structural view of the symmetric dual suspension speaker structure according to the present invention are respectively shown. As shown, it can be appreciated that the symmetric dual suspension speaker structure 2 comprises a basin frame 21, a U-shaped iron 22, a magnet permeability ferrite ring 23, a corrugated rim 24, a diaphragm 25, a sound coil 26, a damper 27 and a magnet 28.

[0020] Herein the basin frame 21 is configured with an opening 211, the U-shaped iron 22 is an element having a basin-wise appearance, and the magnetic permeability ferrite ring 23 is installed between the basin frame 21 and the U-shaped iron 22, in which the top end of the magnetic permeability ferrite ring 23 is in contact with the bottom end of the basin frame 21, and also the center of the magnetic permeability ferrite ring 23 has a ring opening

231.

[0021] In addition, the corrugated rim 24 includes a corrugated rim outer ring 241 and a corrugated rim inner ring 242, in which the corrugated rim outer ring 241 is installed at the opening 211 of the basin frame 21, the upper surface of the diaphragm 25 is connected to the corrugated rim inner ring 241, and the peripheral edge around the upper surface of diaphragm 25 can be stretched in the vertical direction to form a barrel component 251 (herein the diaphragm 25 and the barrel component 251 are integrally designed); also, the sound coil 26 is winding installed around the outer surface of the barrel component.

[0022] Further, the damper 27 includes a damper outer ring 271 and a damper inner ring 272, in which, after the barrel component 251 of the diaphragm 25 penetrates through the opening 211 of the basin frame 21 and the ring opening 231 of the magnetic permeability ferrite ring 23, the outer bottom edge of the barrel component 251 can be connected with the damper inner ring 272, while the damper outer ring 271 is fixedly clamped between the top end of the U-shaped iron 22 and the bottom end of the magnetic permeability ferrite ring 23.

[0023] Moreover, the magnet 28 is set up inside the U-shaped iron 22, and the top end of the magnet 28 is further installed with a washer 29 thereby clamping in package the magnet 28 in cooperation with the U-shaped iron 22.

[0024] Seeing that the corrugated rim 24 is used to bond and fix the top end of the barrel component 251 and the damper 27 is used to bond and fix the bottom end of the barrel component 251, once the sound coil 26 placed within the magnetic gap is provided with electric power, as shown in Figure 5, it can vertically vibrate under the magnetic field effect, thereby driving the diaphragm 25 to generate and spread sounds; accordingly, it can be appreciated that the corrugated rim 24 and the damper 27 may act as a suspension system to support and balance the vibrations thereof.

[0025] Also, the outer surface of the barrel component 251 includes multiple holes 2511 thereby providing an enhanced heat dissipation feature.

[0026] Next, as shown in Figure 6, with respect to a 10-Watt power test, the present invention is compared with the general speaker in terms of sound coil temperature, and it can be clearly seen that, after the 3-hour test, the sound coil temperature of the speaker according to the present invention rises up 29 degrees, while the sound coil temperature in the general speaker greatly ascends 104 degrees, indicating a comparatively smaller temperature increase in the sound coil of the speaker according to the present invention (the above-mentioned temperature increase represents a variation value in comparison with the static state; i.e., ambient temperature); therefore, the speaker can withstand higher power and its sound coil may not burn out easily.

[0027] Subsequently, as shown in Figure 7, it illustrates a Relative Total Harmonic Distortion test on the present invention and the general speaker, and clearly demon-

strates that the distortion rate of the speaker according to the present invention is significantly reduced at lower frequencies.

[0028] Furthermore, as shown in Figure 8, a symmetry test (i.e., Stiffness of Suspension $K_{ms}(X)$) has been performed on the present invention and the general speaker, in which the $K_{ms}(X)$ mainly describes the non-linear relationship between the K_{ms} (rigidity / symmetry / stiffness) of the speaker's suspension system and the displacement of the sound coil thereof (herein "coil in" represents the length that the sound coil moves towards the inside of the magnetic gap, and "coil out" the length that the sound coil moves towards the outside of the magnetic gap), and the unit of K_{ms} is [N/mm]. From the Figure, it can be observed that the K_{ms} of the present invention is better than the general speaker, so, upon signals of larger power, the rigidity / symmetry may significantly ascend as the displacement increases, thus generating bigger restoration force, so the suspension system (i.e., the corrugated rim and the damper) in the present invention may be stretched, with better K_{ms} performance facilitating lower distortion rate.

[0029] In comparison with other conventional technologies, the symmetric dual suspension speaker structure according to the present invention provides the following advantages:

(1) The peripheral edge around the upper surface of the diaphragm in the present invention may be stretched in the vertical direction to form a barrel component, and the corrugated rim and the damper respectively bond and fix the upper and lower end of the barrel component, thereby allowing the sound coil to bring the barrel component of the diaphragm to vibrate vertically so as to reduce the instability existing in the bonding between the conventional diaphragm and the coil framework.

(2) The symmetric dual suspension speaker structure according to the present invention can reduce the height and size of the speaker and provide many advantages, such as improving the vertical centering ability of the sound coil vibrations, extending the voice coil strokes, lowering voice coil frictions and distortions, simplifying the structure for convenient implementations, etc.

[0030] It should be noticed that, although the present invention has been disclosed through the detailed descriptions of the aforementioned embodiments, such illustrations are by no means used to restrict the scope of the present invention; that is, skilled ones in relevant fields of the present invention can certainly devise any applicable alternations and modifications after having comprehended the aforementioned technical characteristics and embodiments of the present invention without departing from the spirit and scope thereof. Hence, the scope of the present invention to be protected under patent laws should be delineated in accordance with the

claims set forth hereunder in the present specification.

Claims

1. A symmetric dual suspension speaker structure, comprising:

a basin frame (21), configured with an opening (211);
 a U-shaped iron (22), internally combined with a magnetic assembly;
 a magnetic permeability ferrite ring (23), installed between the basin frame (21) and the U-shaped iron (22), with the top end thereof being in contact with the bottom end of the basin frame (21) and the center thereof having a ring opening (231);
 a corrugated rim (24), installed at the opening (211) of the base frame (21) and closing the opening (211);
 a diaphragm (25), in which the upper surface of the diaphragm (25) is connected to the corrugated rim (24), and the peripheral edge around the upper surface of the diaphragm (25) can be stretched in the vertical direction to form a barrel component (251), and the barrel component (251) of the diaphragm (25) penetrates the opening (211) of the basin frame (21) and the ring opening (231) of the magnetic permeability ferrite ring (23);
 a sound coil (26), winding around the outer surface of the barrel component (251);
 a damper (27), including a damper outer ring (271) and a damper inner ring (272), in which the damper inner ring (272) is used to be connected with the outer bottom edge around the barrel component (251) of the diaphragm (25), while the damper outer ring (271) is fixedly clamped between the top end of the U-shaped iron (22) and the bottom end of the magnetic permeability ferrite ring (23).

2. The symmetric dual suspension speaker structure according to Claim 1, wherein the diaphragm (25) and the barrel component (251) are integrally designed.

3. The symmetric dual suspension speaker structure according to Claim 1, wherein the corrugated rim (24) is used to bond and fix the top end of the barrel component (251) and the damper (27) is used to bond and fix the bottom end of the barrel component (251), such that the sound coil (26) can bring the barrel component (251) of the diaphragm (25) to vertically vibrate.

4. The symmetric dual suspension speaker structure

according to Claim 1, wherein the outer surface of the barrel component (251) includes multiple holes (2511).

5. The symmetric dual suspension speaker structure according to Claim 1, wherein the magnetic assembly includes a magnet (28) and a washer (29). 5
6. The symmetric dual suspension speaker structure according to Claim 5, wherein the magnet (28) is installed inside the U-shaped iron (22), and the washer (29) is installed at the top side of the magnet (28) in order to fit with the U-shaped iron (22) thereby clamping in package the magnet (28). 10
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7. The symmetric dual suspension speaker structure according to Claim 1, wherein the corrugated rim (24) includes a corrugated rim outer ring (241) and a corrugated rim inner ring (242). 20
8. The symmetric dual suspension speaker structure according to Claim 7, wherein the corrugated rim outer ring (241) is installed at the opening (211) of the basin frame (21) thereby closing the opening (211). 25
9. The symmetric dual suspension speaker structure according to Claim 7, wherein the corrugated rim inner ring (242) is connected to the upper surface of the diaphragm (25). 30
10. The symmetric dual suspension speaker structure according to Claim 1, wherein the sound coil (26) is set up between the corrugated rim (24) and the damper (27). 35
11. The symmetric dual suspension speaker structure according to Claim 1, wherein the sound coil (26) corresponds to the ring opening (231) of the magnetic permeability ferrite ring (23) or the magnetic assembly. 40
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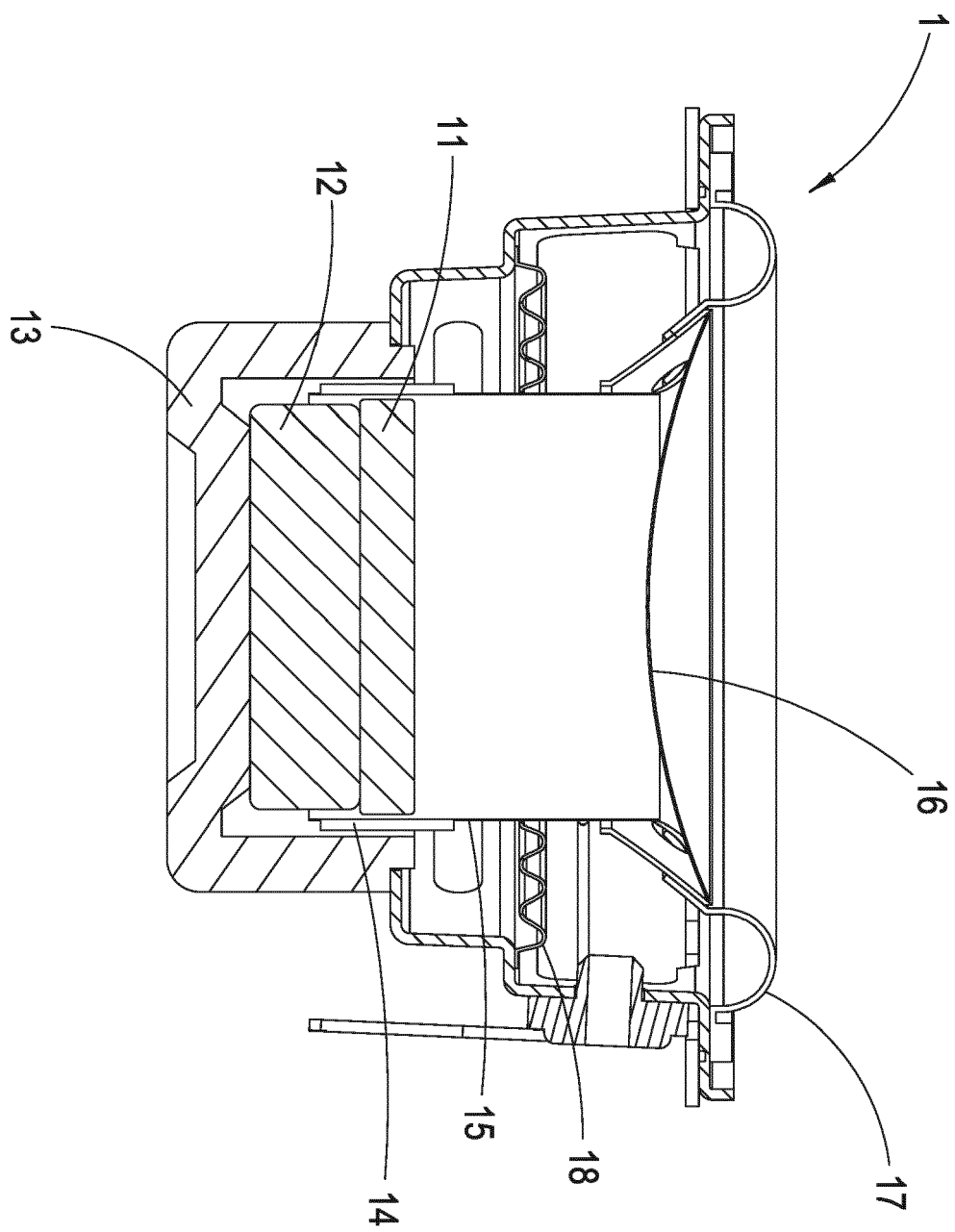


FIG. 1

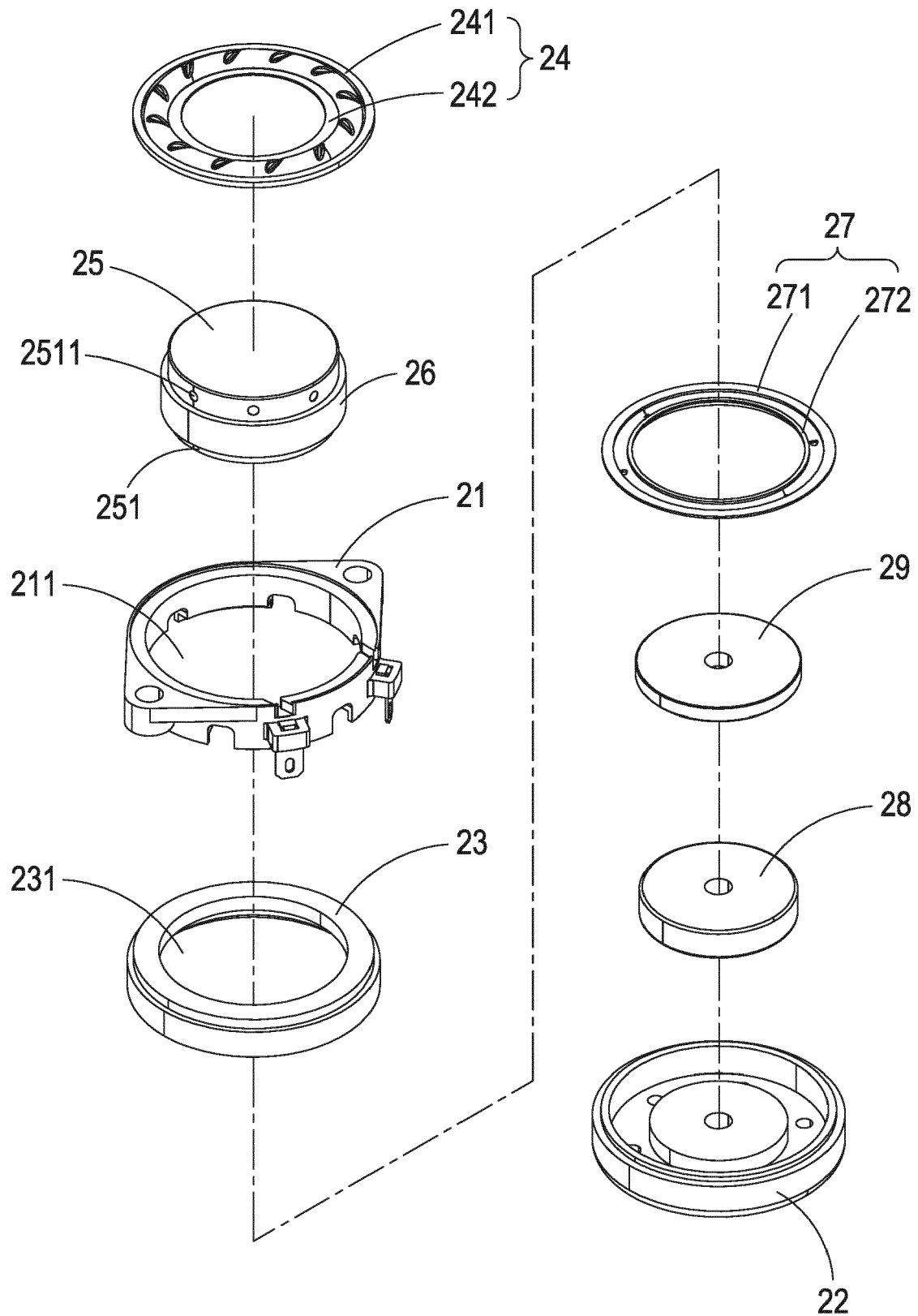


FIG. 2

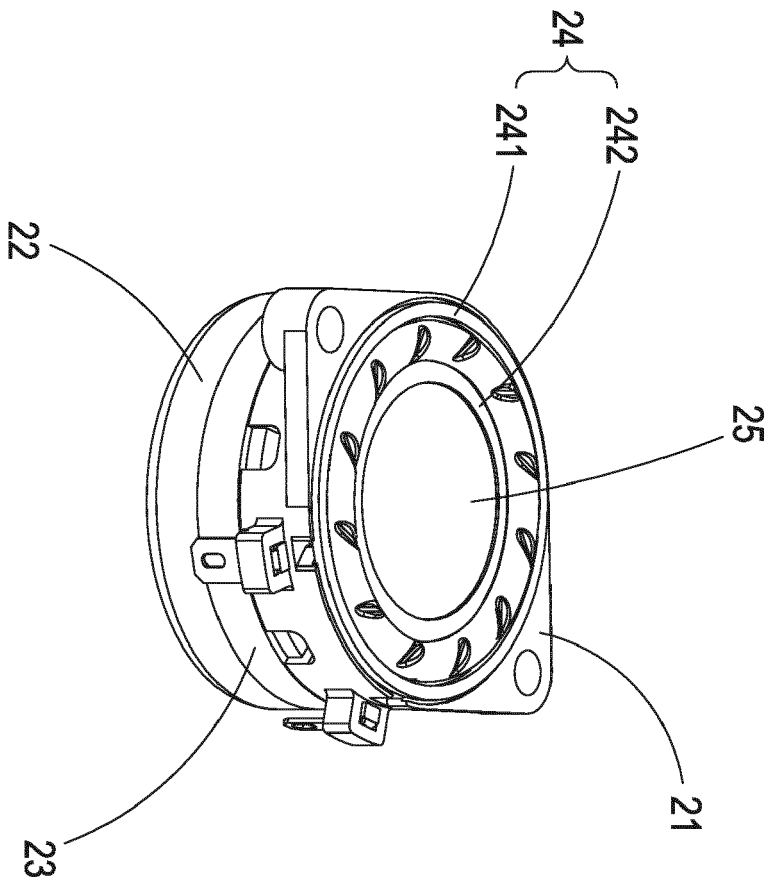


FIG. 3

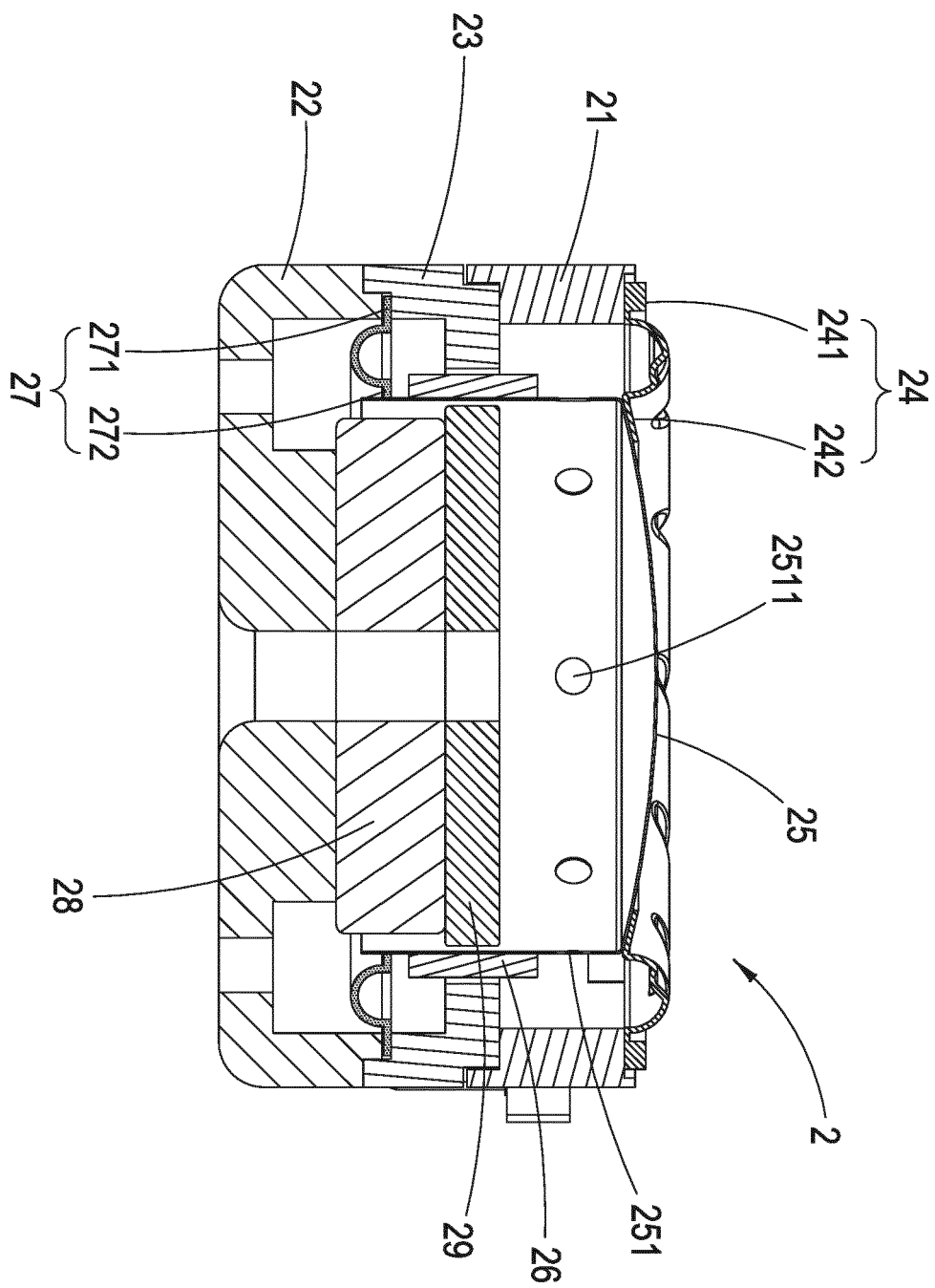


FIG. 4

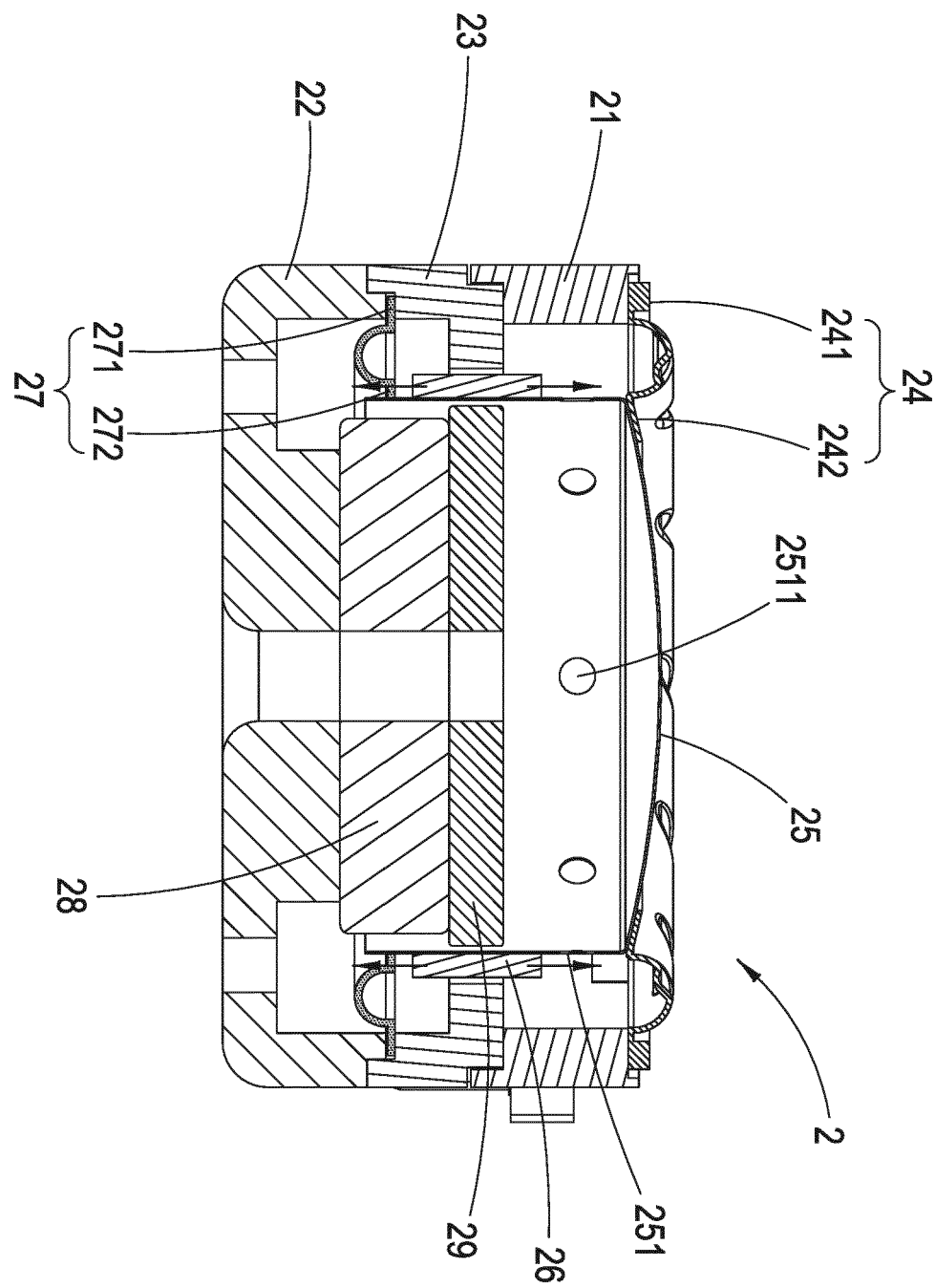


FIG. 5

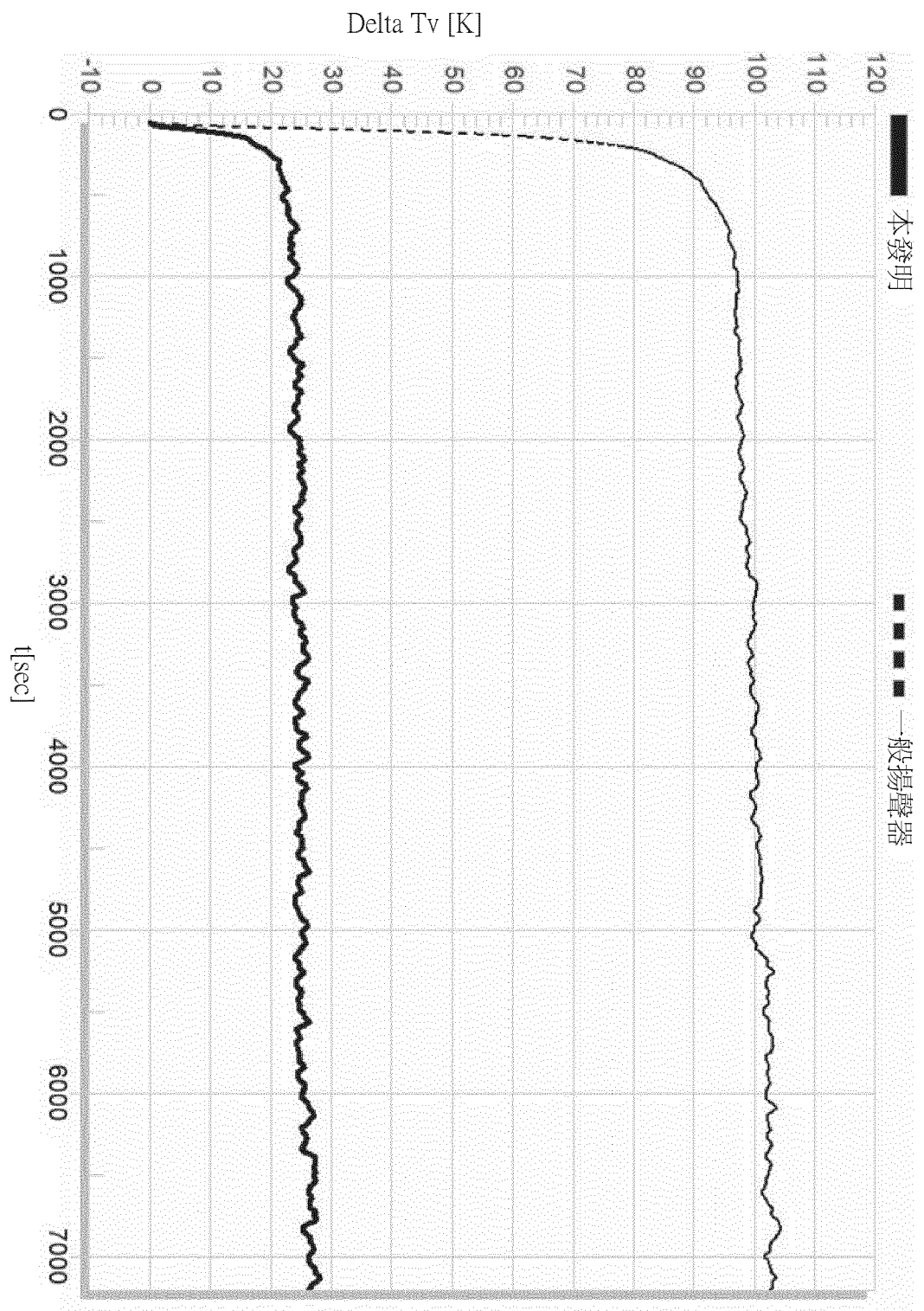


FIG.6

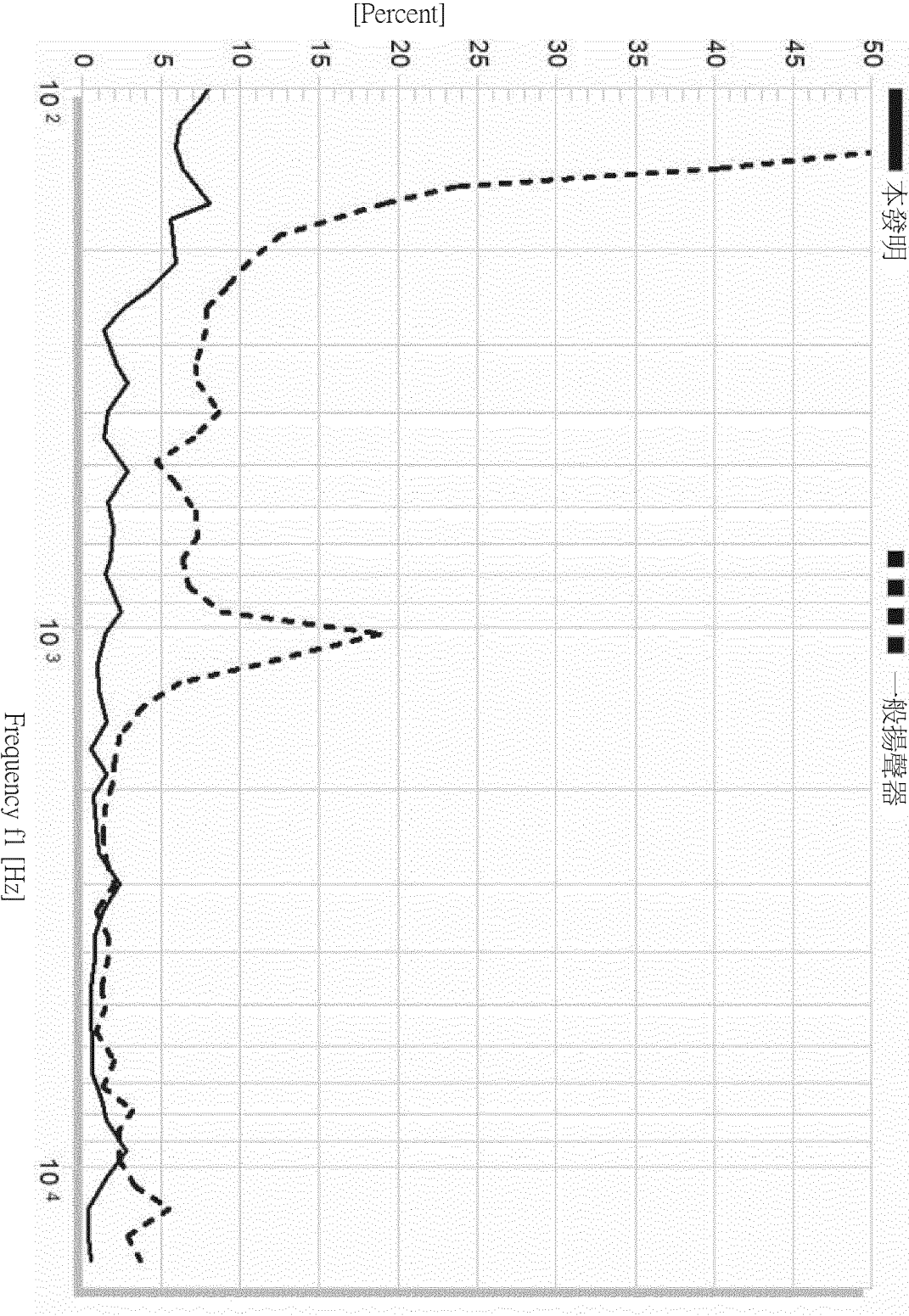


FIG.7

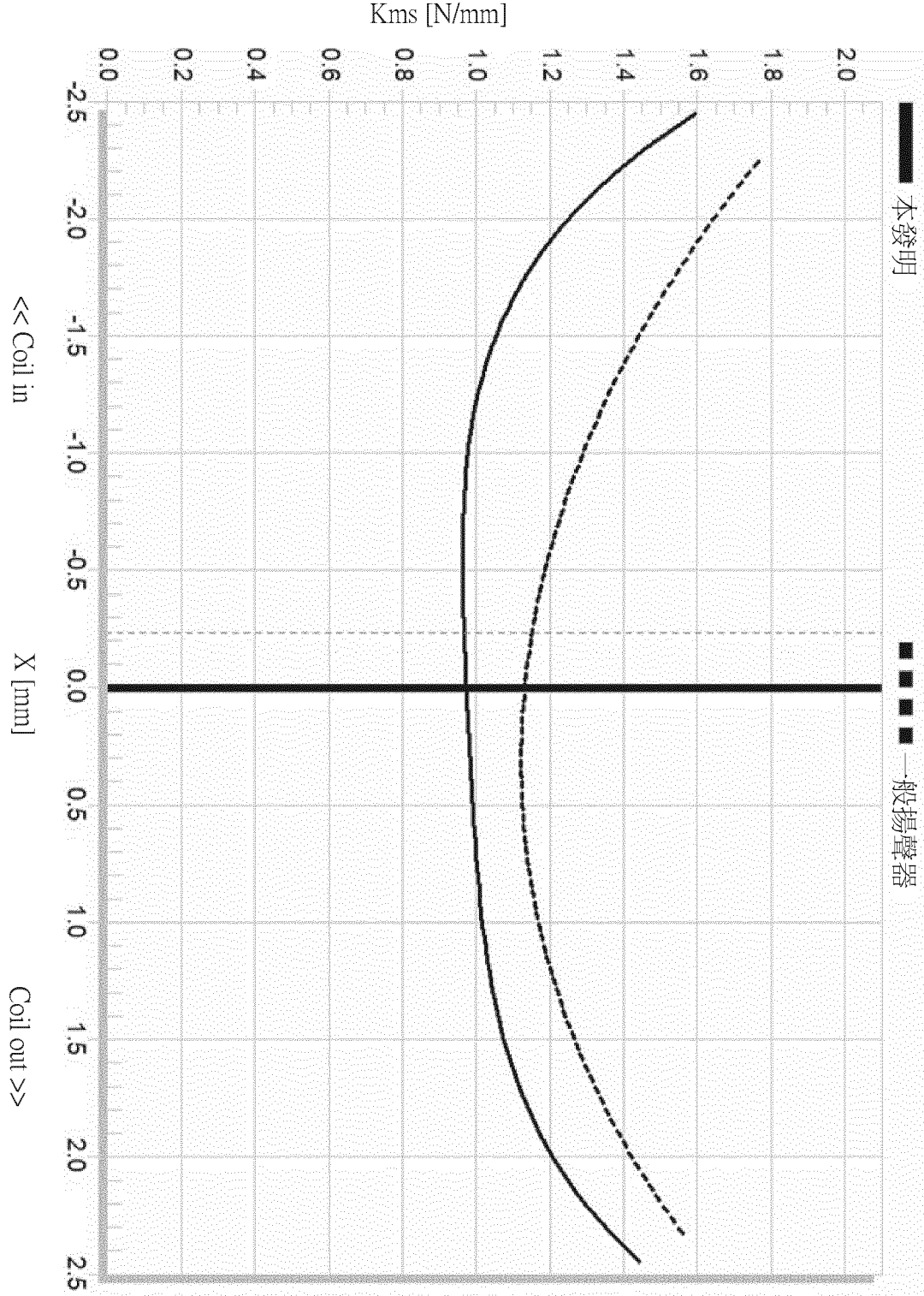


FIG.8



EUROPEAN SEARCH REPORT

 Application Number
 EP 19 19 5921

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Y	* the whole document *	4	ADD. H04R9/06
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A	* paragraphs [0026] - [0033]; figures 1-4 *	2-11	
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A	* paragraphs [0024] - [0037]; figures 1-4 *	1-3,5-11	
			TECHNICAL FIELDS SEARCHED (IPC)
			H04R
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 March 2020	Examiner Fruhmann, Markus
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 EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82