



(11)

EP 3 448 061 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.02.2019 Bulletin 2019/09

(51) Int Cl.:
H04R 9/02 (2006.01) **H04R 9/06 (2006.01)**
H04R 1/24 (2006.01)

(21) Application number: **18190740.3**

(22) Date of filing: **24.08.2018**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **25.08.2017 US 201762550362 P**

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(54) **COAXIAL DUAL VOICE COIL SPEAKER**

(57) A coaxial dual voice coil speaker includes a yoke, a ring-shaped magnet, a first plate, a second plate, a first voice coil, a second voice coil, and an isolating ring. The yoke includes a base and a column, where the column extends from one end of the base, and the column has a protruding portion and a ring-shaped flange. The ring-shaped flange surrounds the protruding portion. A ring-shaped groove is located between the ring-shaped flange and the protruding portion. The ring-shaped magnet is sleeved on the yoke, and the first plate is disposed on the ring-shaped magnet. The isolating ring is disposed in the ring-shaped groove. The second plate is disposed on the isolating ring. A first magnetic gap is located between the second plate and the first plate, and a second magnetic gap is located between the second plate and the protruding portion.

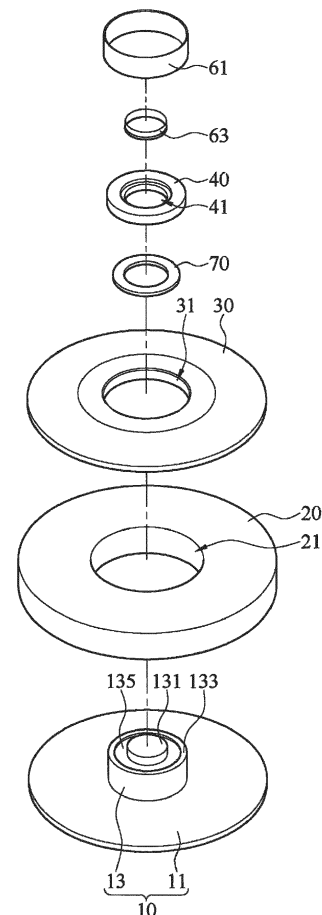


FIG. 1

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Description

BACKGROUND

Technical Field

[0001] The present invention relates to the electroacoustic field, and in particular, to the electroacoustic field of coaxial dual voice coil speakers.

Related Art

[0002] When an electrical signal passes through a voice coil it induces a magnetic field and interacts with a magnetic field of a permanent magnet to drive a diaphragm to vibrate air, a moving-coil speaker having the permanent magnet and the diaphragm implements electroacoustic conversion. In the prior art, the moving-coil speaker generally has a single diaphragm and a single voice coil, that is, in all audio sections, electroacoustic conversion is implemented through vibration of the single diaphragm.

[0003] However, the single diaphragm is not easy to balance a low frequency and a high frequency at the same time, and generally cannot satisfy a frequency range of 20 Hz to 20 kHz that is audible to human ears. Therefore, a design in which bass and treble are separate is used, and respective bands are separately replayed. A coaxial speaker means that a bass speaker and a treble speaker are placed at the same axis, and because the two speakers are located at the same axis and their physical positions are close to a point source, sound field positioning of replayed music is very ideal, and sound resolution is high.

[0004] In addition, generally, when treble and bass voice coils are disposed, the speaker drives the two voice coils respectively by using two magnetic circuit systems. Therefore, the volume is greater than that of the one magnetic circuit of the single voice coil, and more magnets are required.

SUMMARY

[0005] To improve the prior art described above, a coaxial dual voice coil speaker is provided herein. The coaxial dual voice coil speaker includes a yoke, a ring-shaped magnet, a first concentrating flux plate, a second concentrating flux plate, a first voice coil, a second voice coil, and an isolating ring.

[0006] The yoke may include a base and a column, where the column extends from one end of the base, and one end of the column away from the base has a protruding portion and a ring-shaped flange. The ring-shaped flange and the protruding portion are located in a same plane of the column, the ring-shaped flange surrounds the protruding portion, and there is a ring-shaped groove between the ring-shaped flange and the protruding portion. The ring-shaped magnet includes a first cen-

tral axial hole, where the column passes through the first central axial hole, so that the ring-shaped magnet is sleeved on the yoke and comes into contact with the base.

5 [0007] The first concentrating flux plate includes a first central through hole, where the column passes through the first central through hole, so that the first concentrating flux plate is disposed on the ring-shaped magnet. The protruding portion passes through the isolating ring, so that the isolating ring is disposed in the ring-shaped groove. The second concentrating flux plate includes a second central through hole, where the second central through hole and the first central through hole have a same central axis. The protruding portion passes through the second central through hole, so that the second concentrating flux plate is disposed on the isolating ring. There is a first magnetic gap between the second concentrating flux plate and the first concentrating flux plate, and there is a second magnetic gap between the second concentrating flux plate and the protruding portion.

10 [0008] The first voice coil is located in the first magnetic gap. The second voice coil is located in the second magnetic gap.

15 [0009] In some embodiments, the isolating ring is an aluminum ring. The height of the isolating ring is higher than that of the ring-shaped flange, the height of the protruding portion is higher than that of the ring-shaped flange, and there is a separating part between the second concentrating flux plate and the ring-shaped flange.

20 [0010] In some embodiments, the first concentrating flux plate and the second concentrating flux plate are substantially located at a same horizontal height.

25 [0011] In some embodiments, there is a separating space between the ring-shaped magnet and the column.

30 [0012] In some embodiments, the base of the yoke has a thickness gradually decreasing from an area close to the protruding portion to a periphery.

35 [0013] In some embodiments, the first concentrating flux plate has a thickness gradually decreasing from an area close to the first central through hole to a periphery.

40 [0014] In some embodiments, the second concentrating flux plate further includes a step portion, and the step portion is neighboring to the second central through hole.

45 [0015] In some embodiments, the first voice coil is a bass voice coil, and the second voice coil is a treble voice coil.

[0016] In some embodiments, the width of the isolating ring is greater than the width of the ring-shaped flange.

50 [0017] In some embodiments, the height of the ring-shaped magnet is substantially equal to the height from the base to a top end of the ring-shaped flange.

55 [0018] In this case, the coaxial dual voice coil speaker can independently perform driving in high frequency and low frequency bands by using the first voice coil and the second voice coil, achieve a better sound parsing effect in the high frequency and low frequency parts, and can further achieve an effect of light weight, simple structure, and rapidness in assembling by reducing overall compo-

nents by using a design in which the yoke is shared. In addition, the density of magnetic lines can be adjusted by adjusting a distance between the first concentrating flux plate and the second concentrating flux plate, a distance between the second concentrating flux plate and the protruding portion, and the widths and heights of the ring-shaped flange and the isolating ring, and a required frequency response is satisfied.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

FIG. 1 is a partially three-dimensional exploded view of a coaxial dual voice coil speaker;

FIG. 2 is a partially cross-sectional view of a coaxial dual voice coil speaker;

FIG. 3 is an enlarged diagram of an area B in FIG. 2; and

FIG. 4 is a diagram of distribution of magnetic lines of a coaxial dual voice coil speaker.

DETAILED DESCRIPTION

[0020] The following describes preferred implementations of the present invention with reference to the accompanying drawings. A person skilled in the art should understand that, the implementations are merely used to explain the technical principle of the present invention, and are not intended to limit the protection scope of the present invention.

[0021] FIG. 1 is a partially three-dimensional exploded view of a coaxial dual voice coil speaker; and FIG. 2 is a partially cross-sectional view of a coaxial dual voice coil speaker. FIG. 3 is an enlarged diagram of an area B in FIG. 2. As shown in FIG. 1 to FIG. 3, the coaxial dual voice coil speaker 1 includes a yoke 10, a ring-shaped magnet 20, a first concentrating flux plate 30, a second concentrating flux plate 40, a first voice coil 61, a second voice coil 63, and an isolating ring 70. The yoke 10, the ring-shaped magnet 20, the first concentrating flux plate 30, the second concentrating flux plate 40, the first voice coil 61, the second voice coil 63, and the isolating ring 70 have a same central axis A, and are coaxially disposed.

[0022] The first concentrating flux plate 30 and/or the second concentrating flux plate 40 may be made of a magnetic material, which has high magnetic saturation, large magnetic permeability, and low coercivity. Further, the concentrating flux plates may be made of soft magnetic material that has a narrow hysteresis curve and rapidly magnetization and demagnetization.

[0023] The magnetic reluctance of the magnetic material of each of the the concentrating flux plates 30, 40 is much smaller than the magnetic reluctance of the air.

Normally, the magnetic permeability of the air is 1, and that of the soft magnetic material is 20,000. The concentrating flux plates 30, 40 using the magnetic material described above may have a uniform strong magnetic field in a necessary space, which is the path of the magnetic line and required for the magnetic circuit.

[0024] For example, the concentrating flux plates 30, 40 may be made from low-carbon steel such that the concentrating flux plates have a high saturation of magnetic induction intensity, a high permeability and a low coercivity. In particular, The high permeability means that the magnetic flux can more readily and easily pass through the concentrating flux plates 30, 40 than through air, and tends to condense the magnetic flux through these parts of the driver. Furthermore, the high saturation of magnetic induction intensity means that the concentration flux plates can be used to build a strong magnetic field in and around the voice coils to improve their movement during driving.

[0025] The yoke 10 is a T-shaped yoke, including a base 11 and a column 13. The column 13 extends upward from one end of the base 11, and the other end of the column 13 away from the base 11 has a protruding portion 131 and a ring-shaped flange 133. In other words, the base 11 of the yoke 10 may be plate-shaped, hemispherical, or dish-shaped, and has a column 13 protruding from a center thereof. The ring-shaped flange 133 is located at a periphery of the protruding portion 131 and surrounds the protruding portion 131. There is a ring-shaped groove 135 between the ring-shaped flange 133 and the protruding portion 131. Viewed from a cross section of FIG. 2, the overall yoke 10 is substantially an inverted T-shaped.

[0026] The ring-shaped magnet 20 includes a first central axial hole 21. The column 13 passes through the first central axial hole 21, so that the ring-shaped magnet 20 is sleeved on the yoke 10. The ring-shaped magnet 20 comes into contact with the base 11 of the yoke 10. In this case, the height of the ring-shaped magnet 20 is substantially equal to the height from the base 11 to a top end of the ring-shaped flange 133. The first concentrating flux plate 30 includes a first central through hole 31, and the column 13 passes through the first central through hole 31, so that the first concentrating flux plate 30 is disposed on the ring-shaped magnet 20.

[0027] The isolating ring 70 may be an aluminum ring. The protruding portion 131 passes through the centre hole of the isolating ring 70, so that the isolating ring 70 is disposed in the ring-shaped groove 135. The second concentrating flux plate 40 includes a second central through hole 41, where the second central through hole 41 and the first central through hole 31 also have a same central axis A. The protruding portion 131 passes through the second central through hole 41 and abuts against the isolating ring 70. That is, the second concentrating flux plate 40 is sleeved on the column 13 above the isolating ring 70. In other words, the second concentrating flux plate 40 is not directly placed on the yoke 10. The first

concentrating flux plate 30 has a diameter greater than that of the second concentrating flux plate 40, the second concentrating flux plate 40 is located in a position surrounded by the first central through hole 31 of the first concentrating flux plate 30, and the first concentrating flux plate 30 and the second concentrating flux plate 40 are arranged in a form of a concentric circle.

[0028] With reference to FIG. 3: there is a first magnetic gap 431 between the second concentrating flux plate 40 and the first concentrating flux plate 30, and there is a second magnetic gap 433 between the second concentrating flux plate 40 and the protruding portion 131. The height of the isolating ring 70 is higher than that of the ring-shaped flange 133, so that there is a separating part 137 between the second concentrating flux plate 40 and the ring-shaped flange 133. Further, the first concentrating flux plate 30 and the second concentrating flux plate 40 are substantially located at a same height, when viewed along the axis A.

[0029] The first voice coil 61 is located in the first magnetic gap 431, and the second voice coil 63 is located in the second magnetic gap 433. In one embodiment, although not shown in the figure, a person of ordinary skill in the art may understand that, the first voice coil 61 and the second voice coil 63 may be fixed by using a holder and can be connected to a diaphragm, so that when the first voice coil 61 and the second voice coil 63 receive signals, the first voice coil 61 and the second voice coil 63 interact with a magnetic force of the ring-shaped magnet 20, to drive the diaphragm vibrating and make a sound. In one embodiment, the radius of the first voice coil 61 is greater than that of the second voice coil 63. The first voice coil 61 may be a bass voice coil, which generates a low frequency sound when driving the diaphragm to vibrate. The second voice coil 63 may be a treble voice coil, which generates a high frequency sound when driving the diaphragm to vibrate. The first voice coil 61 and the second voice coil 63 may each be connected to a diaphragm, or may be connected to a same diaphragm. The first voice coil 61 is connected to an outer edge area of the diaphragm (not shown), and the second voice coil 63 is connected to a central area of the diaphragm. Although a channel is not shown in the yoke 10 in FIG. 1. Referring to FIG. 2, the column 13 may further include two channels 138 through which leading lines (not shown) of the voice coils can pass, so that impact caused by a touch of other components to the voice coils is avoided. In addition, the channels 138 can further improve heat dissipation effects.

[0030] Further, referring to FIG. 2 again, in some embodiments, there is a separating space 35 between the ring-shaped magnet 20 and the column 13. In one embodiment, the radius of the ring-shaped magnet 20 may be adjusted, and intensity of magnetic lines in the first magnetic gap 431, the second magnetic gap 433, or the separating part 137 between the second concentrating flux plate 40 and the ring-shaped flange 133 may be further adjusted. In addition, a buffer material such as

sound-absorbing cotton may further be filled in the separating space 35, to avoid impact caused by vibration of the coaxial dual voice coil speaker 1.

[0031] Further, referring to FIG. 2 again, in some embodiments, the base 11 of the yoke 10 has a thickness gradually decreasing from an area close to the protruding portion 13 to a periphery. The shape of the base 11 is not limited in this application, and may also be adjusted in combination with the shape of an overall horn cavity.

[0032] In addition, in some embodiments, the first concentrating flux plate 30 has a thickness gradually decreasing from an area close to the first central through hole 31 to a periphery. In this way, the first concentrating flux plate 30 and the base 11 of the yoke 10 may present a vertically symmetrical change in thicknesses, so that the overall structure is dish-shaped, and the overall size is further reduced.

[0033] FIG. 4 is a diagram of distribution of magnetic lines of a coaxial dual voice coil speaker. As shown in FIG. 4, the magnetic lines may be radiated out from one end (a top end) of the ring-shaped magnet 20 to the other end (a bottom end), pass through the base 11 of the yoke 10 and reach the column 13 of the yoke 10, and then go back to the ring-shaped magnet 20 (a top end) sequentially through the second magnetic gap 433, the second concentrating flux plate 40, the first magnetic gap 431, and the first concentrating flux plate 30. In one embodiment, most magnetic lines are radiated out from the protruding portion 131 of the yoke 10 passing through the second magnetic gap 433 (i.e. corresponding to a high frequency gap of the first voice coil 63), and after entering the second concentrating flux plate 40, then come to the first magnetic gap 431 (that is, corresponding to a low frequency of the first voice coil 61). Finally, the magnetic lines go back to the ring-shaped magnet 20 from the first concentrating flux plate 30. In one embodiment, the second magnetic gap 433 is located between the protruding portion 131 and the second concentrating flux plate 40, and the first magnetic gap 431 is located between the first concentrating flux plate 30 and the second concentrating flux plate 40. Therefore, provided that the widths of the first magnetic gap 431 and the second magnetic gap 433 are adjustable, the density of the magnetic lines between the first magnetic gap 431 and the second magnetic gap 433 can be adjusted, so that an interaction effect between a magnetic force generated by the ring-shaped magnet 20, and the first voice coil 61 and the second voice coil 63 after a signal is received is indirectly adjusted, and a frequency response of the coaxial dual voice coil speaker 1 is further adjustable.

[0034] In addition, referring to FIG. 2 and FIG. 3 again, in some embodiments, the second concentrating flux plate 40 further includes a step portion 45. The step portion 45 is neighboring to the second central through hole 41, and the step portion 45 close to the first magnetic gap 431 is relatively higher than at the second magnetic gap 433. Based on this structure, the magnetic lines can better centrally enter the second magnetic gap 433.

[0035] In addition, as shown in FIG. 4, of magnetic lines radiated out by one end of the ring-shaped magnet 20, some magnetic lines pass by entering the first magnetic gap 431 through the ring-shaped flange 133 of the yoke 10 and the separating part 137, and then going back to the ring-shaped magnet 20 through the concentrating flux plate 30. The density of the magnetic lines in the first magnetic gap 431 may be increased by using the ring-shaped flange 133, so that an interaction effect of a magnetic force after the first voice coil 61 receives a signal is enhanced, and a relatively large bass resonance effect is achieved.

[0036] In this case, the isolating ring 70 is made of a nonpermeable material and is, for example, an aluminum ring. Because the isolating ring 70 is made of a high magnetoresistant nonpermeable material, only a few magnetic lines pass through the isolating ring 70. In one embodiment, the width of the isolating ring 70 is greater than the width of the ring-shaped flange 133. Therefore, the density of magnetic lines passing through the second magnetic gap 433 may be adjusted by adjusting the width of the ring-shaped flange 133, the height and the width of the isolating ring 70, and the width or the height of the separating part 137. Therefore, a density ratio of magnetic lines between the first magnetic gap 431 and the second magnetic gap 433 can be adjusted by adjusting a distance between the first concentrating flux plate 30 and the second concentrating flux plate 40, a distance between the protruding portion 131 and the second concentrating flux plate 40, and the widths and heights of the ring-shaped flange 133 and the isolating ring 70, and a required frequency response can further be satisfied according to customized requirements.

[0037] In short, the coaxial dual voice coil speaker 1 can be driven independently in high frequency and low frequency bands by using the first voice coil 61 and the second voice coil 63, and achieve a better sound parsing effect in the high frequency and low frequency parts. In addition, the coaxial dual voice coil speaker 1 can further achieve an effect of light weight, simple structure, and rapidness in assembling by reducing overall components by using a design in which the yoke 10 is shared. Further, the density of magnetic lines can be adjusted by adjusting a distance between the first concentrating flux plate 30 and the second concentrating flux plate 40, a distance between the protruding portion 131 and the second concentrating flux plate 40, and the widths and heights of the ring-shaped flange 133 and the isolating ring 70, and a required frequency response can further be satisfied according to customized requirements.

[0038] Hitherto, the technical solution of the present invention is already described with reference to the preferred implementations shown in the accompanying drawings. However, a person skilled in the art may easily understand that the protection scope of the present invention is not limited to the specific implementations. A person skilled in the art may make equivalent modifications and replacements to related technical features with-

out departing from the principle of the present invention, and a technical solution obtained after the modifications and replacements shall fall within the protection scope of the present invention.

Claims

1. A speaker comprising:

a yoke comprising a base and a column, wherein the column extends from one end of the base, the other end of the column away from the base has a protruding portion and a ring-shaped flange, the ring-shaped flange surrounds the protruding portion, and a ring-shaped groove is located between the ring-shaped flange and the protruding portion;

a ring-shaped magnet comprising a first central axial hole, wherein the column passes through the first central axial hole, so that the ring-shaped magnet is sleeved on the yoke;

a first flux plate comprising a first central through hole, wherein the column passes through the first central through hole, so that the first flux plate is disposed on the ring-shaped magnet;

an isolating ring, wherein the protruding portion passes through the isolating ring, so that the isolating ring is disposed in the ring-shaped groove;

a second flux plate comprising a second central through hole, wherein the second central through hole and the first central through hole have a same central axis, the protruding portion passes through the second central through hole, the second concentrating flux plate is disposed on the isolating ring, a first magnetic gap is located between the second flux plate and the first flux plate, and a second magnetic gap is located between the second flux plate and the protruding portion;

a first voice coil located in the first magnetic gap; and

a second voice coil located in the second magnetic gap.

2. The speaker according to claim 1, wherein the isolating ring is an aluminum ring, the height of the isolating ring is higher than that of the ring-shaped flange, the height of the protruding portion is higher than that of the ring-shaped flange, and a separating part is located between the second flux plate and the ring-shaped flange.

3. The speaker according to either of claim 1 or claim 2, wherein the first flux plate and the second flux plate are substantially located at a same horizontal height.

4. The speaker according to any one of the previous claims, wherein the diameter of the first central axial hole is greater than the diameter of the column, so that a separating space is formed between the ring-shaped magnet and the column. 5 demagnetization, for example low-carbon steel.
5. The speaker according to any one of the previous claims, wherein the base has a thickness gradually decreasing from an area close to the protruding portion to a periphery. 10
6. The speaker according to any one of the previous claims, wherein the first flux plate has a thickness gradually decreasing from an area close to the first central through hole to a periphery. 15
7. The speaker according to any one of the previous claims, wherein the second flux plate further comprises a step portion, and the step portion is neighboring to the second central through hole. 20
8. The speaker according to any one of the previous claims, wherein the first voice coil is a bass voice coil, and the second voice coil is a treble voice coil. 25
9. The speaker according to any one of the previous claims, wherein the width of the isolating ring is greater than the width of the ring-shaped flange. 30
10. The speaker according to any one of the previous claims, wherein the height of the ring-shaped magnet is substantially equal to the height from the base to a top end of the ring-shaped flange. 35
11. The speaker according to any one of the previous claims, wherein the speaker is a coaxial dual voice coil speaker. 40
12. The speaker according to any one of the previous claims, wherein the first and second flux plates are each concentrating flux plates 45
13. The speaker according to any one of the previous claims, wherein the first and second flux plates comprise a magnetic material, which has high magnetic saturation, large magnetic permeability, and low coercivity. 50
14. The speaker according to any one of the previous claims, wherein the first and second flux plates are made of soft magnetic material that has a narrow hysteresis curve and has rapid magnetization and 55

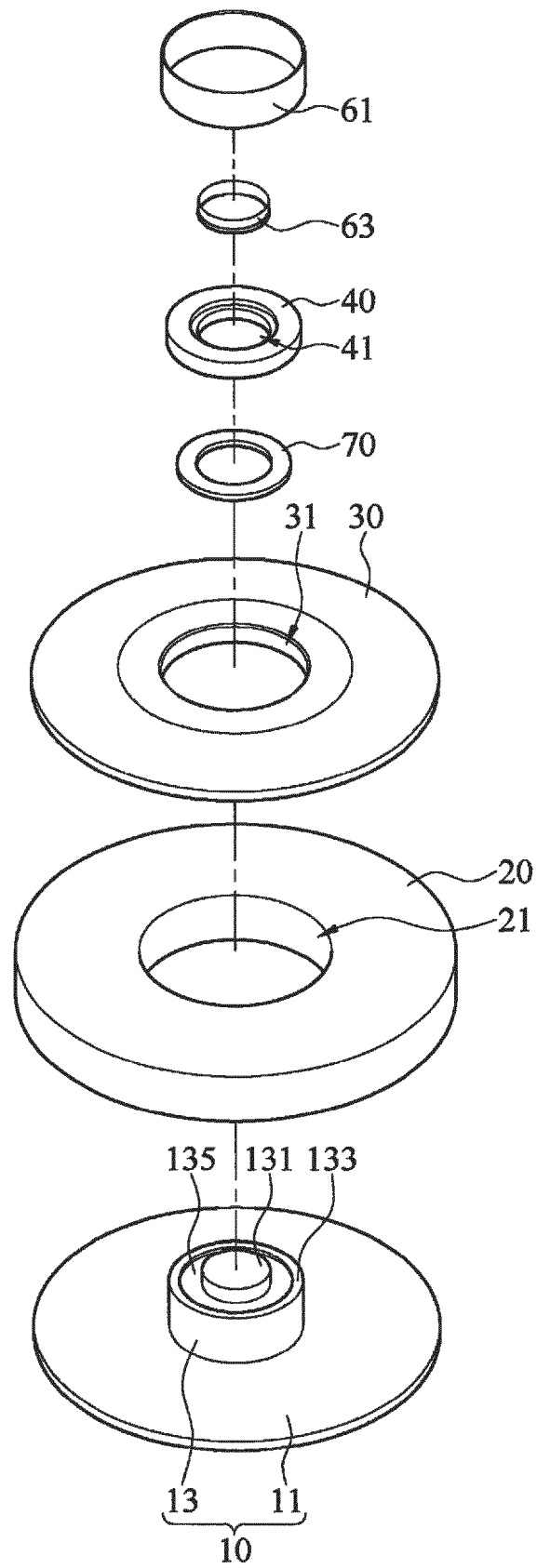


FIG. 1

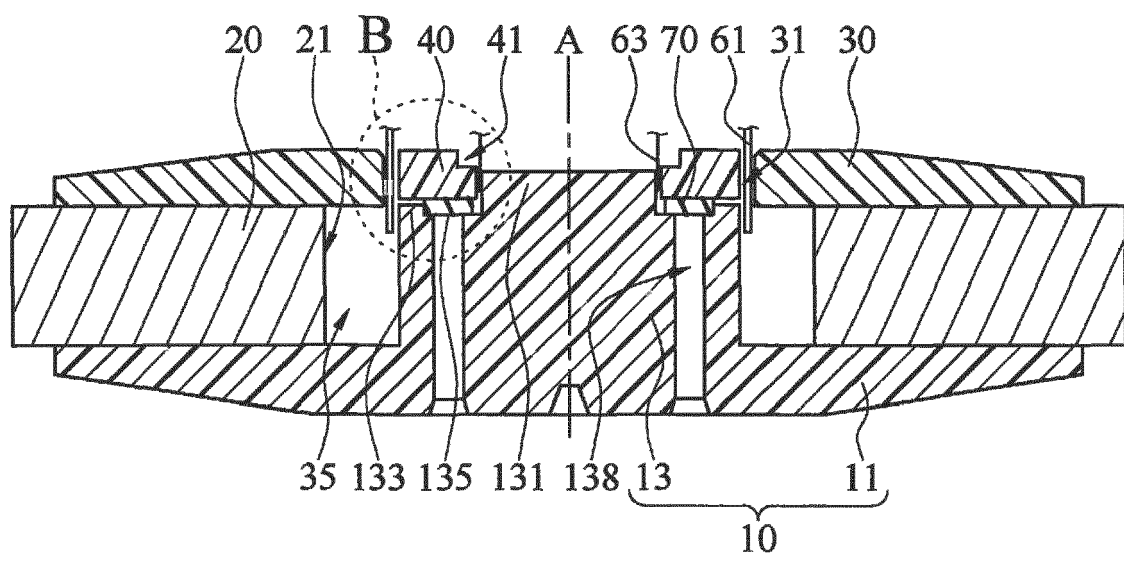


FIG. 2

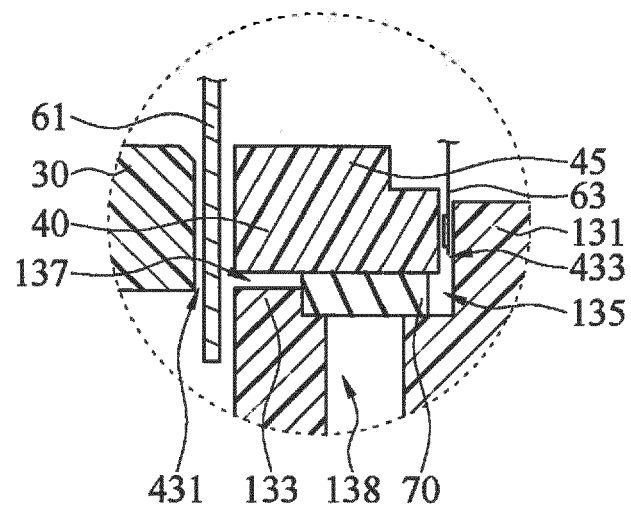


FIG. 3

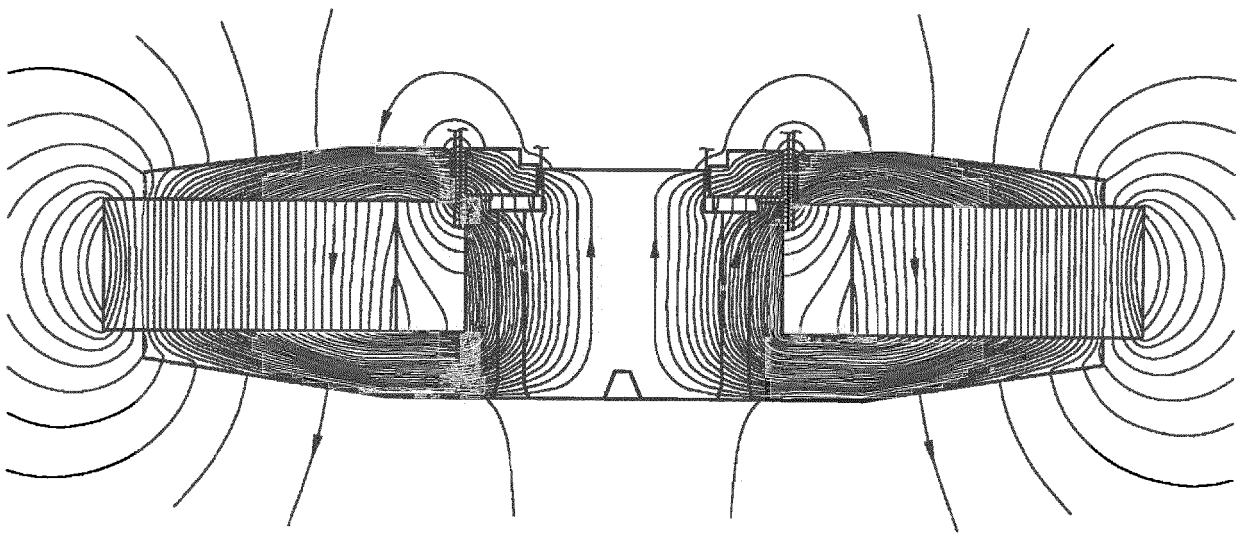


FIG. 4



EUROPEAN SEARCH REPORT

Application Number
EP 18 19 0740

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2014/286524 A1 (ROBINEAU PHILIPPE JEAN-BAPTISTE [GB]) 25 September 2014 (2014-09-25) * paragraph [0031] - paragraph [0036]; figures 1; 2a-2c *	1-14	INV. H04R9/02 H04R9/06 ADD. H04R1/24
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			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 11 January 2019	Examiner Guillaume, Mathieu
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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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