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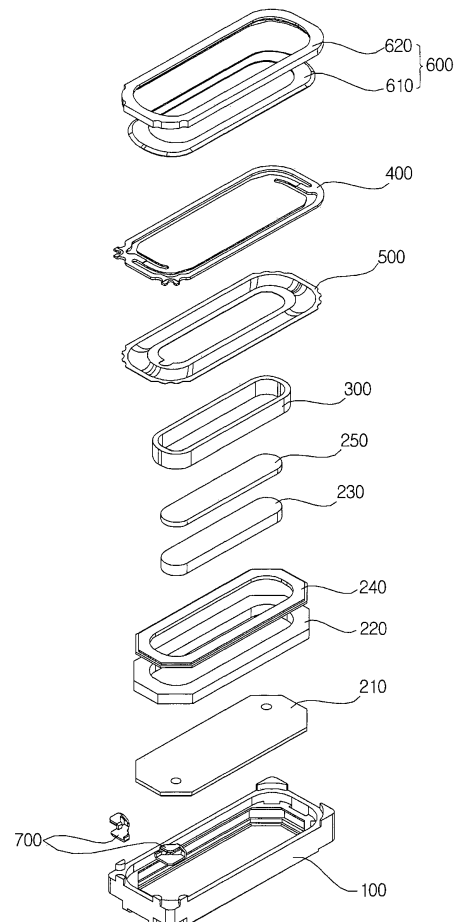
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(54) **Slim width microspeaker**

(57) The present invention relates to a slim width microspeaker. The present invention discloses a slim width microspeaker including: a frame; a yoke coupled to the bottom of the frame; an inner magnet attached to the top of the yoke; an outer ring magnet attached to the top of the yoke with a predetermined gap from the inner magnet; a voice coil having a lower end positioned in the gap between the inner magnet and the outer ring magnet; a diaphragm vibrating together with the vibration of the voice coil to produce a sound; and a suspension guiding a vibrating direction of the diaphragm and the voice coil and having a center portion to which the voice coil is attached, a ring-shaped outer peripheral portion disposed with a predetermined gap from the center portion, and a connecting portion connecting the center portion to the outer peripheral portion and performing a damping function, wherein the microspeaker is generally formed in a rectangular shape having a pair of short sides and a pair of long sides, and the connecting portion of the suspension is disposed in a pair on the short sides to connect the short side of the center portion to the short side of the outer peripheral portion.

[Fig.3]



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**Description**TECHNICAL FIELD

**[0001]** The present invention relates to a slim width microspeaker.

BACKGROUND ART

**[0002]** FIG. 1 is an exploded perspective view showing a conventional microspeaker, and FIG. 2 is a sectional view showing the conventional microspeaker. In the conventional microspeaker, a yoke 21, an inner magnet 23, an outer ring magnet 22, an inner ring top plate 25 and an outer ring top plate 24 are disposed in a frame 10, and a voice coil 30 is disposed in an air gap between the inner magnet 23 and the outer ring magnet 22 and vibrates vertically when power is applied to the voice coil 30. The voice coil 30 is mounted on the bottom surface of a suspension 50, and a side diaphragm 41 and a center diaphragm 42 are disposed on the top and bottom surfaces of the suspension 50 and vibrate together with the vibration of the voice coil 30 to produce a sound. A protector 60 is coupled to the top of the suspension 50 to protect all the components located inside the speaker. The protector 60 includes a ring-shaped steel portion 61 with an opening 63 at the center to emit a sound, and a ring-shaped injection portion 62 into which the steel portion 61 is inserted injection-molded and which is stacked on the frame 10, the outer peripheral portion of the side diaphragm 41, and the outer peripheral portion of the suspension 50.

**[0003]** In order to enable power to be supplied from the outside to the voice coil 30, there is a terminal pad 70 attached to the bottom of the frame 10 to provide a connection point with an external terminal. The terminal pad 70 is inserted during the injection molding of the frame 10 and coupled to the frame 10 by the insert injection molding.

**[0004]** In a recent mobile device, such as a Smartphone, which is equipped with the microspeaker, a width of an upper portion of a display unit is gradually reduced, so a width of the microspeaker needs to be reduced. However, the width of the speaker has a great influence on the performance of the speaker. The smaller the width is, the worse the sound characteristic is.

DISCLOSURE OF THE INVENTION

**[0005]** An object of the present invention is to provide a microspeaker configured to minimize a width, while maximizing a sound characteristic.

**[0006]** According to an aspect of the present invention, there is provided a slim width microspeaker including: a frame; a yoke coupled to the bottom of the frame; an inner magnet attached to the top of the yoke; an outer ring magnet attached to the top of the yoke with a predetermined gap from the inner magnet; a voice coil hav-

ing a lower end positioned in the gap between the inner magnet and the outer ring magnet; a diaphragm vibrating together with the vibration of the voice coil to produce a sound; and a suspension guiding a vibrating direction of the diaphragm and the voice coil and having a center portion to which the voice coil is attached, a ring-shaped outer peripheral portion disposed with a predetermined gap from the center portion, and a connecting portion connecting the center portion to the outer peripheral portion and performing a damping function, wherein the microspeaker is generally formed in a rectangular shape having a pair of short sides and a pair of long sides, and the connecting portion of the suspension is disposed in a pair on the short sides to connect the short side of the center portion to the short side of the outer peripheral portion.

**[0007]** In addition, the long sides of the center portion of the suspension are extended more outwardly than the voice coil-attached position.

**[0008]** Moreover, the long sides of the center portion of the suspension are positioned on the outer ring magnet.

**[0009]** Additionally, the edges of the long sides of the center portion of the suspension are bent to be obliquely inclined in an upward direction.

**[0010]** Further, the frame includes a ventilation path, which is formed by removing an outer portion of the outer ring magnet on the short side, and a ventilation hole, which is formed by removing part of an outer portion of the frame to communicate with the ventilation path, the ventilation hole being provided at a lower position than a lower end of the outer ring magnet.

**[0011]** Furthermore, the center portion of the suspension takes the place of a center diaphragm, and the diaphragm is an inverted-dome shaped side diaphragm having a downwardly-protruding dome portion.

**[0012]** Still furthermore, an inner peripheral portion of the side diaphragm is attached to the center portion of the suspension, an outer peripheral portion of the side diaphragm is attached to the outer peripheral portion of the suspension, a land portion for soldering to a lead wire of the voice coil is provided at the center portion of the suspension, and a groove for avoiding the lead wire of the voice coil is provided at the inner peripheral portion of the side diaphragm.

**[0013]** The slim width microspeaker as disclosed in the present invention can minimize a width, while minimizing degradation of the sound characteristic and maximizing the sound characteristic in the same size by enlarging the effective area of the diaphragm by extending the center portion of the suspension, which takes the place of the center diaphragm, more outwardly than the voice coil-attached position.

BRIEF DESCRIPTION OF THE DRAWINGS

**[0014]**

FIG. 1 is an exploded perspective view showing a conventional microspeaker.

FIG. 2 is a sectional view showing the conventional microspeaker.

FIG. 3 is an exploded perspective view showing a slim width microspeaker according to a first embodiment of the present invention.

FIG. 4 is a view showing a suspension provided in the slim width microspeaker according to the first embodiment of the present invention.

FIG. 5 is a sectional perspective view showing the slim width microspeaker according to the first embodiment of the present invention, when cut away in a short axis direction.

FIG. 6 is a sectional perspective view showing the slim width microspeaker according to the first embodiment of the present invention, when cut away in a long axis direction.

FIG. 7 is a view showing the combined structure of a diaphragm and a voice coil of the slim width microspeaker according to the first embodiment of the present invention.

FIG. 8 is a sectional perspective view showing a slim width microspeaker according to a second embodiment of the present invention, when cut away in a short axis direction.

#### BEST MODE FOR CARRYING OUT THE INVENTION

**[0015]** FIG. 3 is an exploded perspective view showing a slim width microspeaker according to a first embodiment of the present invention. The microspeaker according to the embodiment of the present invention includes a frame 100, a magnetic circuit disposed in the frame 100, a vibrating body vibrating due to a mutual electromagnetic force with the magnetic circuit, a protector 600 coupled to the top of the frame 100 to protect the magnetic circuit and the vibrating body, and a terminal pad 700 insert injection-molded into the frame 100.

**[0016]** The magnetic circuit includes a yoke 210 coupled to the frame 100, an inner magnet 220 attached to the top of the yoke 210, an outer ring magnet 230 attached to the top of the yoke 210 with a predetermined gap from the inner magnet 220, an inner ring top plate 240 covering the inner magnet 220 and assisting in forming a magnetic flux, and an outer ring top plate 250 covering the outer ring magnet 230 and assisting in forming a magnetic flux. The gap between the inner magnet 220 and the outer ring magnet 230 is also called an air gap. A lower end of a voice coil of the vibrating body discussed later is disposed in this air gap. When a current flows through the voice coil, the voice coil vibrates vertically due to the mutual electromagnetic force with the magnetic circuit.

**[0017]** The vibrating body is composed of a voice coil 300, a diaphragm 400, and a suspension 500. As described above, when an electrical signal is applied to the voice coil 300, the voice coil vibrates due to the mutual

electromagnetic force with the magnetic circuit. Here, the suspension 500 guides the voice coil 300 to vibrate only in the vertical direction. The voice coil 300 and the diaphragm 400 are attached to the suspension 500, and the diaphragm 400 vibrates together with the vibration of the voice coil 300 to produce a sound.

**[0018]** In order to protect the magnetic circuit and the vibrating body, a protector 600 is coupled to the frame 100. The protector 600 is composed of a steel portion 610 for providing rigidity and an injection portion 620 for preventing a short of the suspension 500 and the terminal pad 700.

**[0019]** When the general shape of the microspeaker is described based on the orthogonal axes, a length in one axis direction is long and a length in the other axis direction is short. As the general shape of the microspeaker has a short length in one axis direction and a long length in the other axis direction which is orthogonal to the one axis direction, a frame 100, a magnetic circuit, a voice coil 300, a suspension 400, a diaphragm 500 and a protector 600 also have a short length in one axis direction and a long length in the other axis direction which is orthogonal to the one axis direction. Hereinafter, the axis direction of the long length is called a long axis direction, while the axis direction of the short length is called a short axis direction. In addition, a side parallel to the axis direction of the long length is called a long side, while a side parallel to the axis direction of the short length is called a short side. When it is assumed that the short axis direction is a width direction and the long axis direction is a length direction, the microspeaker has a much smaller width than a length.

**[0020]** FIG. 4 is a view showing the suspension provided in the slim width microspeaker according to the first embodiment of the present invention. The suspension 400 includes a center portion 410, a ring-shaped outer peripheral portion 420 disposed with a predetermined gap from the center portion 410, and a connecting portion 430 connecting the center portion 410 to the outer peripheral portion 420. As described above, the suspension 400 is formed in a rectangular shape having a pair of short sides which are parallel to the short axis direction and have a short length and a pair of long sides which are parallel to the long axis direction and have a long length. As the length of the suspension 400 in the short axis direction gets smaller, it becomes difficult to dispose the connecting portion 430 in the short axis direction. That is, it becomes difficult to dispose the connecting portion 430 connecting the long side of the center portion 410 of the suspension 400 to the long side of the outer peripheral portion 420. Accordingly, the connecting portion 430 of the suspension 430 is disposed only in the long axis direction. In other words, there are only a pair of connecting portions 430 of the suspension 400 that connect the short side of the center portion 410 to the short side of the outer peripheral portion 420. As a result, the length in the short axis direction can be reduced by removing the connecting portion disposed in the short

axis direction, which makes it possible to minimize the width of the microspeaker.

**[0021]** In the meantime, the suspension 400 is made of an FPCB to transfer electrical signals from the terminal pad 700 to the voice coil 300. To this end, a pair of land portions 440 for soldering to the terminal pad 700 are provided at both ends of one side of the suspension 400. In addition, a land portion (not shown) for soldering to a lead wire of the voice coil 300 is provided at the center portion 410.

**[0022]** FIG. 5 is a sectional perspective view showing the slim width microspeaker according to the first embodiment of the present invention, when cut away in the short axis direction.

**[0023]** In the microspeaker according to the embodiment of the present invention, the center portion 410 of the suspension 400 takes the place of the center diaphragm, as described above. Here, as the width, i.e., the length in the short axis direction is reduced to minimize the entire width of the microspeaker, the size of the center portion 410, which takes the place of the center diaphragm, is inevitably reduced. However, the smaller the size of the center diaphragm is, the worse the sound characteristic is. In order to solve this problem, according to the present invention, the effective area of the center portion 410 which takes the place of the center diaphragm is enlarged by removing the connecting portion disposed in the short axis direction, as described above, and simultaneously by extending the center portion 410 more outwardly than the voice coil 300-attached position.

**[0024]** That is, the voice coil 300 is attached to the center portion 410 of the suspension 400, with its lower end being positioned in a gap between the inner magnet 220 and the outer ring magnet 230. As the length of the suspension 400 in the short axis direction is extended, the long side of the center portion 410 of the suspension 400 is positioned on the outer ring magnet 230.

**[0025]** FIG. 6 is a sectional perspective view showing the slim width microspeaker according to the first embodiment of the present invention, when cut away in the long axis direction.

**[0026]** In the slim width microspeaker according to the first embodiment of the present invention, the frame 100 has a ventilation structure for smooth vibration of the diaphragm. In order to reduce the length in the short axis direction (width), this ventilation structure is not provided in the short axis direction but in the long axis direction. In other words, the ventilation structure is not provided on the long sides of the frame 100 but on the short sides of the frame 100. In the frame 100 of the microspeaker according to the first embodiment of the present invention, a ventilation path 110 is formed outside of the outer ring magnet 230 by removing an injection material, and a ventilation hole 120 is formed by removing an injection material from the outermost periphery of the frame 100 to the ventilation path 110. It is preferable that the ventilation hole 120 should be provided at a lower position than a lower end of the outer ring magnet 230. The frame

100 is formed by injection molding, and the yoke 210, the outer ring magnet 230, the terminal pad 700 and the like are insert injection-molded during the injection molding. The injection material-removed portions such as the ventilation hole 120 and the ventilation path 110 outside of the outer ring magnet 230 are the portions where the injection material has not been formed due to the shape of the mold in the process. Here, the injection material outside of the outer ring magnet 230 is formed very thin to allow for the ventilation path 110. Therefore, a cavity for the inflow of the injection material on the mold is very small, so the inflow of the injection material is not smooth. As a result, part of the outer ring magnet 230 may be exposed to the outside due to inefficient formation of the injection material. In order to enable the exposed outer ring magnet 230 to be covered, it is preferable that the ventilation hole 120 should be provided at a lower position than the lower end of the outer ring magnet 230.

**[0027]** FIG. 7 is a view showing the combined structure of the diaphragm and the voice coil of the slim width microspeaker according to the first embodiment of the present invention.

**[0028]** The diaphragm 500 of the microspeaker according to the first embodiment of the present invention includes an inner peripheral portion 510 attached to the center portion 410 (see FIG. 4) of the suspension 400 (see FIG. 4), an outer peripheral portion 520 attached to the outer peripheral portion 420 (see FIG. 4) of the suspension 400 and seated on the frame 100, and a dome portion 530 disposed between the inner peripheral portion 510 and the outer peripheral portion 520. The dome portion 530 has an inverted dome shape protruding in a downward direction. The stacked order of the suspension 400 and the voice coil 300 is the suspension 400, the diaphragm 500 and the voice coil 300 from the top, which are attached to one another.

**[0029]** As described above, the suspension 400 is made of an FPCB to transfer electrical signals from the terminal pad 700 to the voice coil 300. To this end, the land portion (not shown) is provided at the center portion 410 of the suspension 400, and the lead wire 310 of the voice coil 300 is soldered to the land portion (not shown).

**[0030]** Here, when the lead wire 310 of the voice coil 300 is taken out to the land portion (not shown), it may interfere with the inner peripheral portion 510 of the diaphragm 500. In order to prevent this problem, a groove 512 for avoiding interference with the lead wire is provided at the inner peripheral portion 510 of the diaphragm 500.

**[0031]** FIG. 8 is a sectional perspective view showing a slim width microspeaker according to a second embodiment of the present invention, when cut away in a short axis direction. The slim width microspeaker according to the second embodiment of the present invention is identical to the slim width microspeaker according to the first embodiment except for the shape of a suspension 400'. Thus, a detailed explanation thereof will be omitted.

**[0032]** The suspension 400' provided in the micro-

speaker according to the second embodiment of the present invention includes a center portion 410', an outer peripheral portion 420', and a connecting portion (not shown) as in the first embodiment, the connecting portion being disposed only in the long axis direction. In addition, the long sides are extended more outwardly than the voice coil 300-mounted position. That is, the center portion 410' of the suspension 400' is extended in the short axis direction so that the length of the center portion 410' in the short axis direction can be greater than the length of the voice coil 300 in the short axis direction.

**[0033]** The suspension 400' provided in the micro-speaker according to the second embodiment of the present invention includes a bent portion 412' such that the edge of the long side is obliquely inclined in an upward direction.

**Claims**

1. A slim width microspeaker, comprising:

- a frame;
  - a yoke coupled to the bottom of the frame;
  - an inner magnet attached to the top of the yoke;
  - an outer ring magnet attached to the top of the yoke with a predetermined gap from the inner magnet;
  - a voice coil having a lower end positioned in the gap between the inner magnet and the outer ring magnet;
  - a diaphragm vibrating together with the vibration of the voice coil to produce a sound; and
  - a suspension guiding a vibrating direction of the diaphragm and the voice coil and having a center portion to which the voice coil is attached, a ring-shaped outer peripheral portion disposed with a predetermined gap from the center portion, and a connecting portion connecting the center portion to the outer peripheral portion and performing a damping function,
- wherein the microspeaker is generally formed in a rectangular shape such that a length in one axis direction is short and a length in the other axis direction which is orthogonal to the one axis direction is long, and the connecting portion of the suspension is disposed in a pair on the short sides to connect the short side of the center portion to the short side of the outer peripheral portion.

2. The slim width microspeaker as claimed in claim 1, wherein the long sides of the center portion of the suspension are extended more outwardly than the voice coil-attached position.

3. The slim width microspeaker as claimed in claim 1, wherein the long sides of the center portion of the

suspension are positioned on the outer ring magnet.

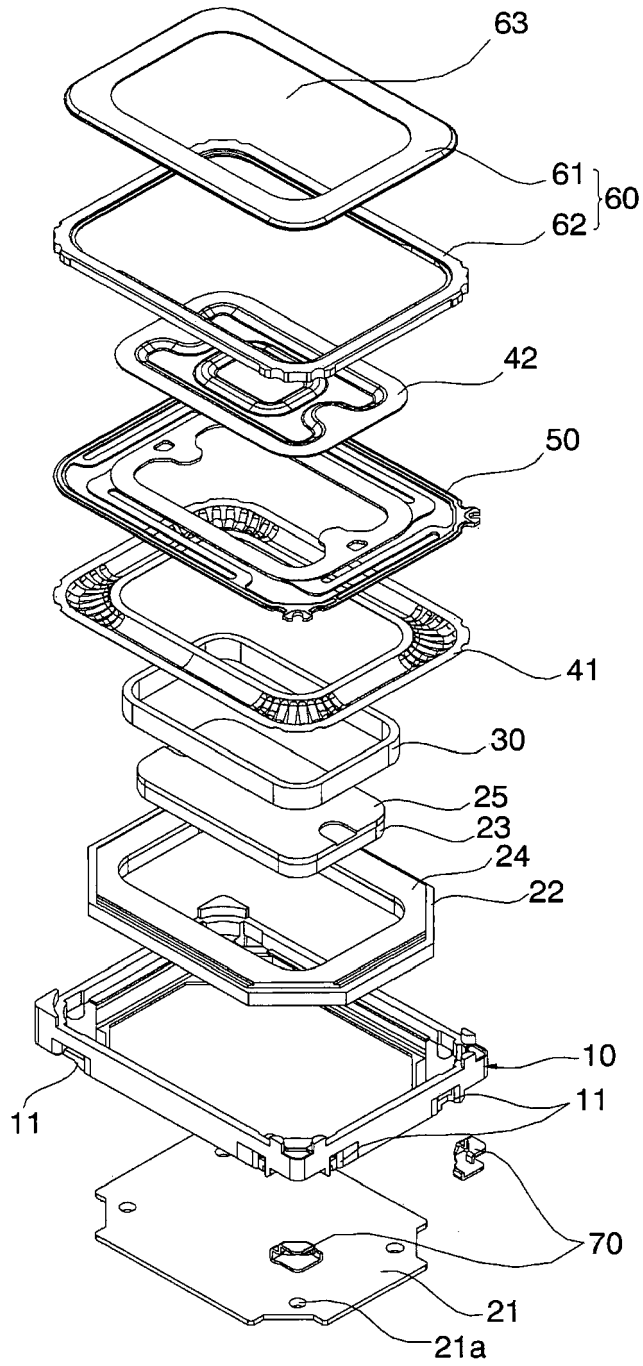
4. The slim width microspeaker as claimed in any one of claims 1 to 3, wherein the edges of the long sides of the center portion of the suspension are bent to be obliquely inclined in an upward direction.

5. The slim width microspeaker as claimed in claim 1, wherein the frame includes a ventilation path, which is formed by removing an outer portion of the outer ring magnet on the short side, and a ventilation hole, which is formed by removing part of an outer portion of the frame to communicate with the ventilation path, the ventilation hole being provided at a lower position than a lower end of the outer ring magnet.

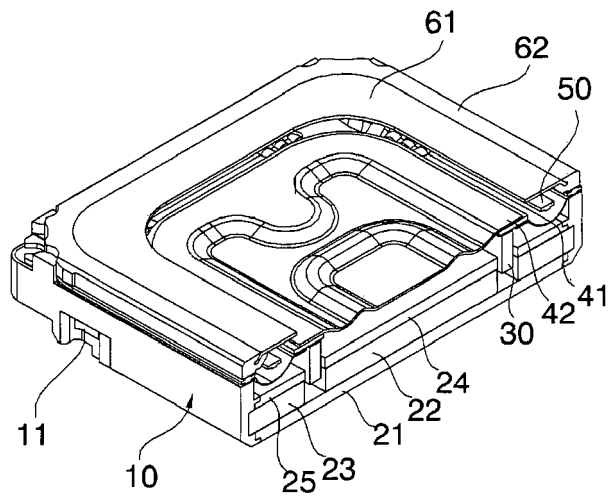
6. The slim width microspeaker as claimed in claim 1, wherein the center portion of the suspension takes the place of a center diaphragm, and the diaphragm is an inverted-dome shaped side diaphragm having a downwardly-protruding dome portion.

7. The slim width microspeaker as claimed in claim 6, wherein an inner peripheral portion of the side diaphragm is attached to the center portion of the suspension, an outer peripheral portion of the side diaphragm is attached to the outer peripheral portion of the suspension, a land portion for soldering to a lead wire of the voice coil is provided at the center portion of the suspension, and a groove for avoiding the lead wire of the voice coil is provided at the inner peripheral portion of the side diaphragm.

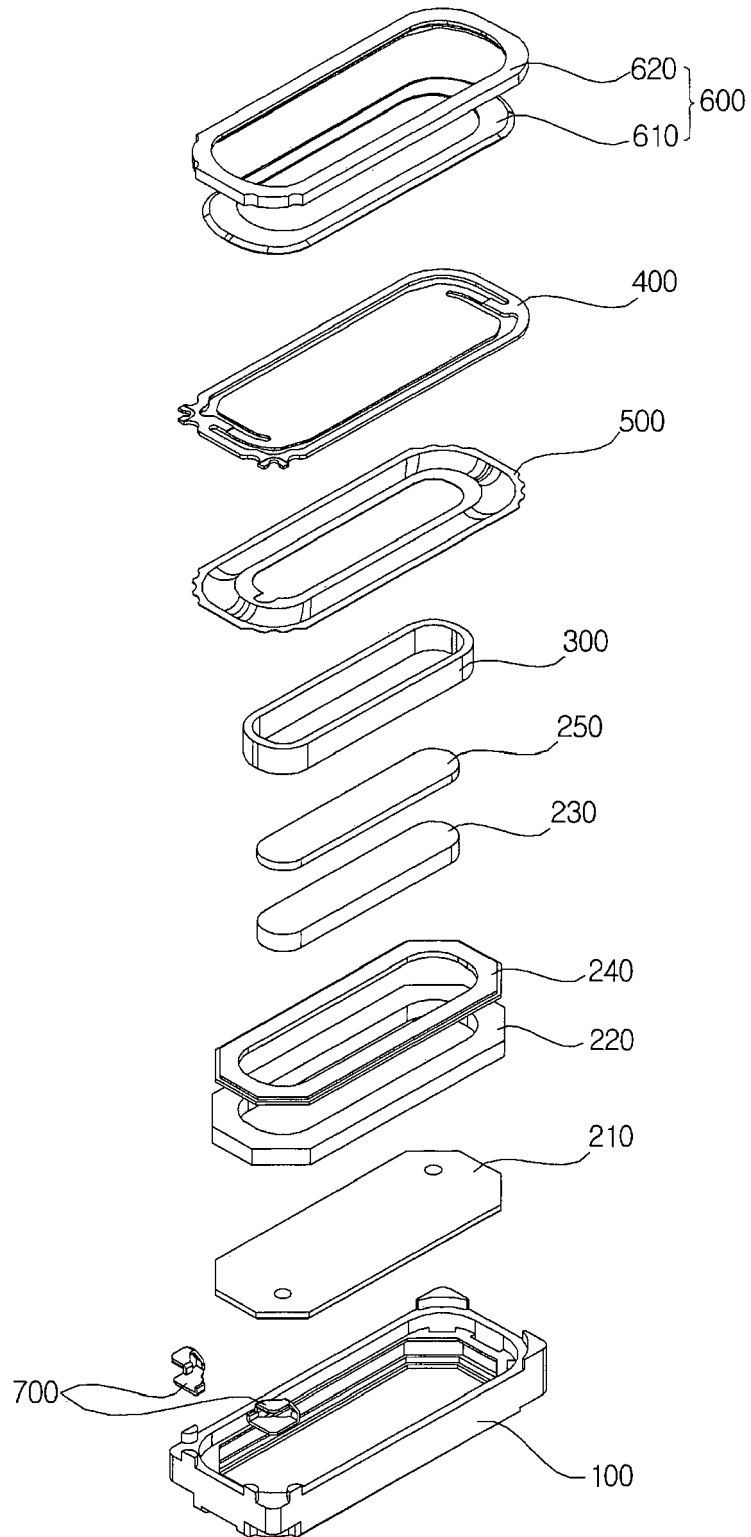
[Fig.1]



[Fig.2]

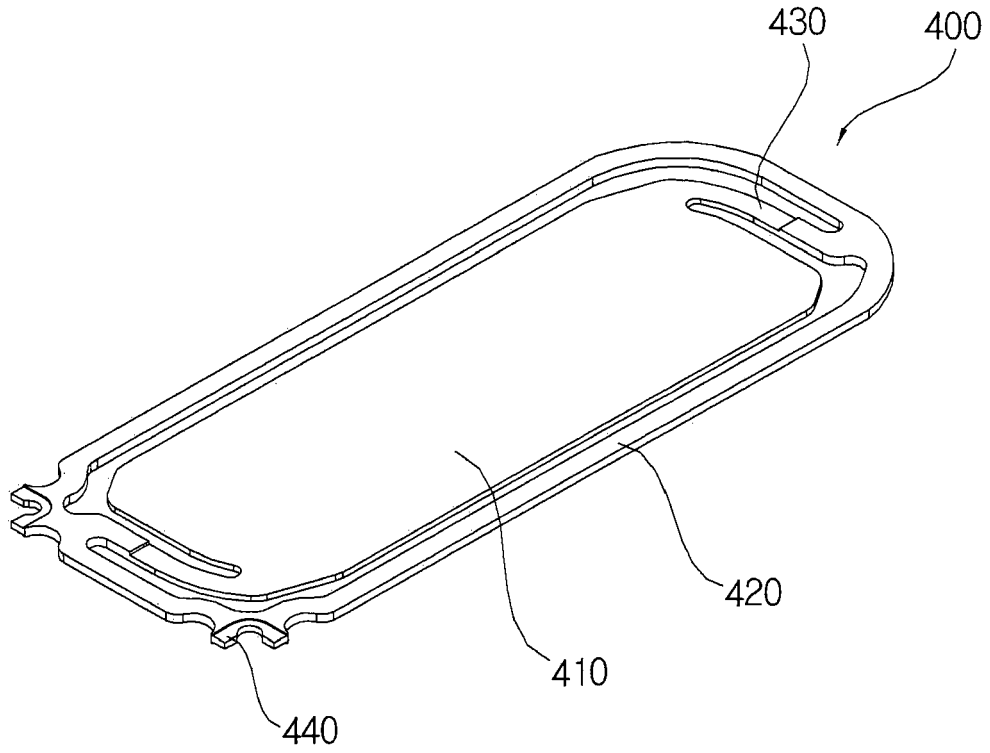


[Fig.3]

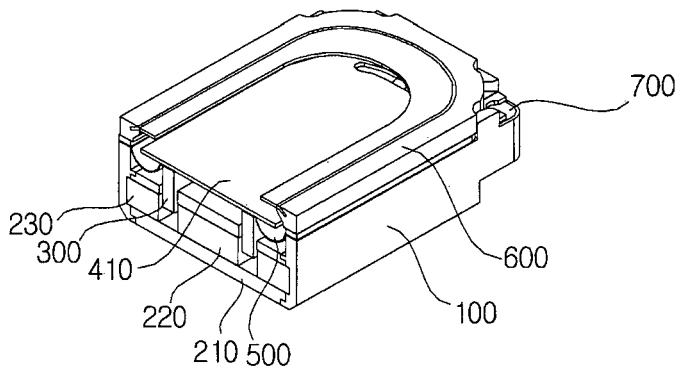




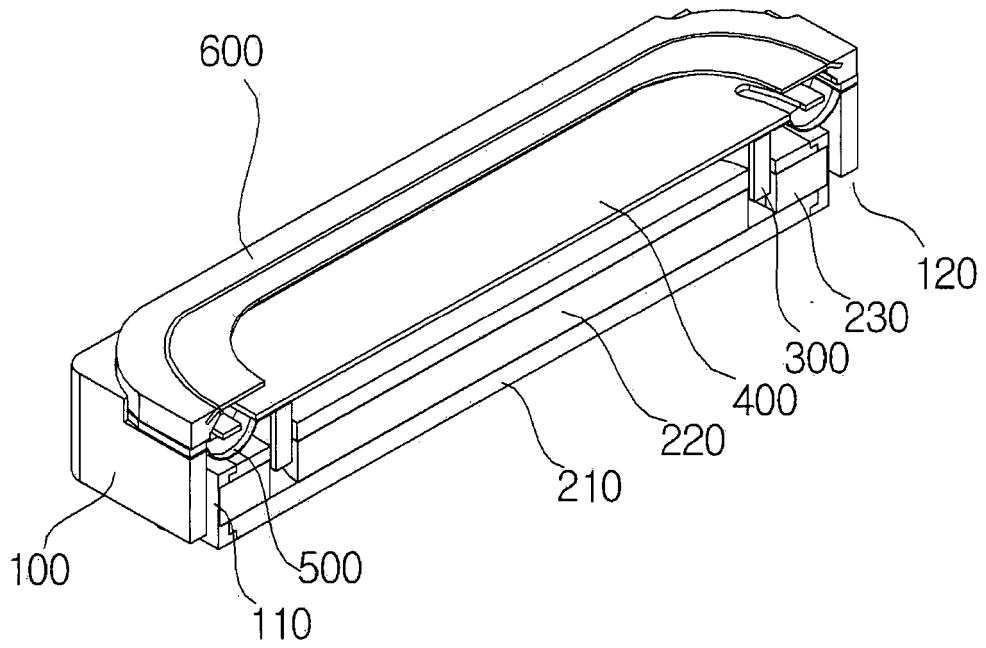
[Fig.4]



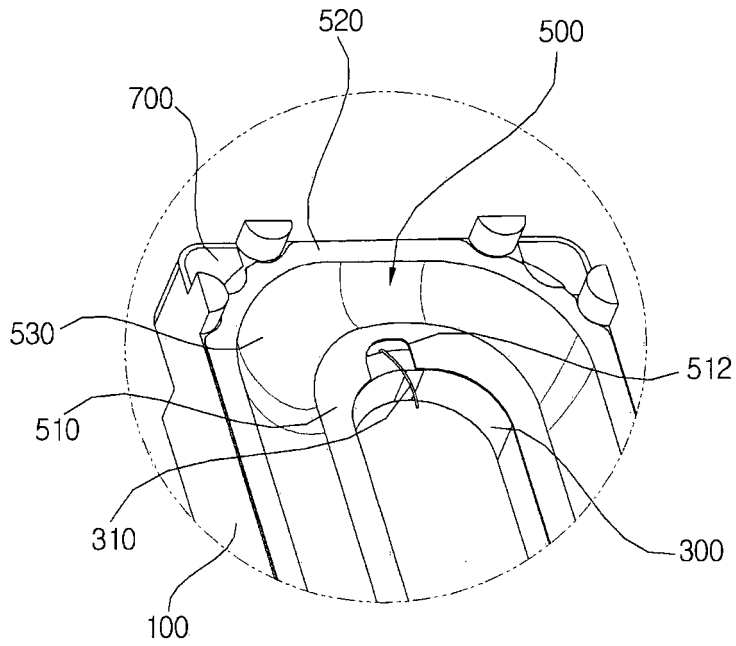
[Fig.5]



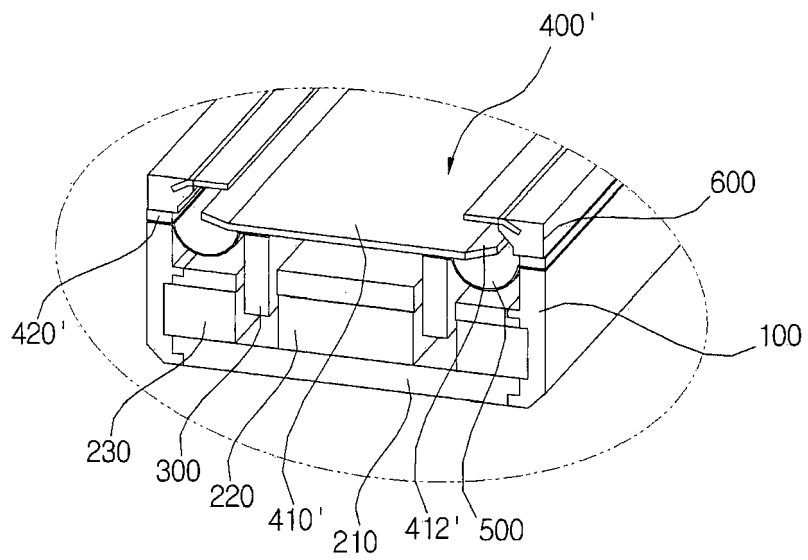
[Fig.6]



[Fig.7]



[Fig.8]





EUROPEAN SEARCH REPORT

Application Number  
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