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(54) Title: BONE CONDUCTION SPEAKER

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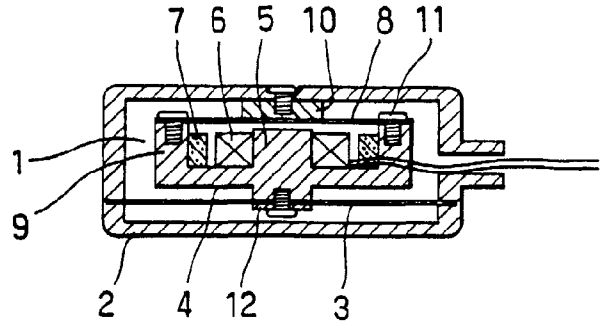

(57) Abstract: A bone conduction speaker in which sound quality is improved sufficiently by suppressing unnecessary vibration of a vibration system and preventing generation of abnormal sound due to abnormal resonance, comprising a bone conduction speaker unit comprising a yoke, a voice coil, a magnet, a diaphragm and a vibration block integrated therewith, and a housing for containing it and serving as a vibration part, characterized in that the vibration block of the bone conduction speaker unit is secured to the upper surface in the housing and the yoke is supported by a brake member installed in the housing.

(57) 要約:

振動系の不必要な振動が抑制されて異常共振による異音の発生が防止され、十分に音質改善がなされる骨導スピーカを提供することを課題とするものであって、ヨークとボイスコイルとマグネットと振動板及びそれと一体となった振動ブロックとから成る骨導スピーカユニットと、それを収容して振動部となるハウジングとから成り、骨導スピーカユニットの振動ブロックをハウジング内部の上面に固定すると共に、ヨークを、ハウジング内部に設置した制動材によって支持させて成ることを特徴とする。

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SPECIFICATION

BONE CONDUCTION SPEAKER

The present invention relates to a bone conduction speaker, and more particularly to a bone conduction speaker including a vibrating plate.

In general, a conventional bone conduction speaker has a construction shown in each of Figs. 6 and 7. The conventional bone conduction speaker shown in Fig. 6 is constructed of a yoke 23, which is provided with a voice coil 21 and a magnet 22, wherein: through a diaphragm or vibrating plate 25 fixedly mounted on an upper surface of the yoke 23 and a vibrating block 27, the yoke 23 is mounted on a ceiling surface of the interior of a housing 24 in a suspending manner.

The above construction of the conventional bone conduction speaker is advantageous in that it is easily assembled and capable of obtaining a relatively large output. On the other hand, the conventional bone conduction speaker is disadvantageous in that: since the yoke 23 is suspended from the vibrating plate 25, a value of "Q" (a sharpness of resonance, which is directly proportional to an equivalent mass of the vibrating system) of a resonance portion which is determined by a mass of a vibrating system and the like

increases to have a curve of the frequency characteristics of the bone conduction speaker be out of a flat shape. As a result, a reproduced sound having a minimum resonance frequency becomes loud to impair the sound in tone quality, which the user often feels as an unfavorable vibration. Further, due to the above construction, when the sound varies in frequency, an abnormal resonance of the vibrating plate tends to occur, which leads to an abnormal sound reproduced at a frequency of the resonance. This is a problem inherent in the conventional bone conduction speaker.

On the other hand, the other one (shown in Fig. 7) of the conventional bone conduction speakers has a construction in which: the yoke 23 provided with the voice coil 21 and the magnet 22 is fixedly mounted on a bottom surface of the interior of the housing 24 which is provided with an opening 28 in its upper surface; the vibrating plate 25 is fixedly mounted on an upper surface of the yoke 23; and, a vibrating portion 26 is vibrated in operation, fixedly mounted on the vibrating plate 25 through the vibration block 27, and exposed to the outside through the opening 28 of the housing 24, wherein the vibrating portion 26 is held in abutting contact with a head portion of a user in use.

Also in this case, as is in the above-described bone conduction speaker, since the vibrating system is suspended, there is the same problem as that described in the above more or less.

Further, in the case of this construction, since an air gap or opening 28 is disposed adjacent to an outer peripheral portion of the vibrating portion 26, there is a fear that some foreign material such as dust, the user's sweat and like foreign materials enters the housing 24, which often causes a failure of the conventional bone conduction speaker.

Since the conventional bone conduction speaker suffers from the above-mentioned problems, it is desired to provide a bone conduction speaker free from the above problems, or at least provide a useful alternative.

In accordance with the present invention, there is provided a bone conduction speaker comprising:

a bone conduction speaker unit constructed of a yoke, a voice coil, a magnet, a vibrating plate and a vibration block integrated with said vibrating plate; and

a housing which contains said bone conduction speaker unit to function as a vibrating portion, wherein:

said vibration block of said bone conduction speaker unit is fixedly mounted on an upper surface of the interior of said housing;

said yoke is supported by a damping member which is disposed inside said housing;

said damping plate is constructed of a leaf spring which is fixedly mounted on a side surface of the interior of said housing and said leaf spring has an outer peripheral portion fixedly embedded in said side surface;

said yoke is fixedly mounted on said leaf spring through a leaf-spring mounting portion of said yoke; and

said leaf-spring mounting portion is provided in a central portion of a rear surface of said yoke.

The present invention also provides a bone conduction speaker comprising:

a bone conduction speaker unit constructed of a yoke, a voice coil, a magnet, a vibrating plate and a vibration block integrated with said vibrating plate; and

a housing which contains said bone conduction speaker unit to function as a vibrating portion, wherein:

said vibration block of said bone conduction speaker unit is fixedly mounted on an upper surface of the interior of said housing and said yoke is suspended from said vibrating plate and supported by a damping member which is disposed inside said housing, wherein:

said damping member is constructed of an elastic block made of rubber, plastics or like elastic materials;

said elastic block is mounted on a bottom surface of the interior of said housing; and

said yoke has its rear surface fixedly mounted on an upper surface of said elastic block.

Preferred embodiments of the present invention are herein described, by way of example only, with reference to the accompanying drawings, wherein:

Fig. 1 is a longitudinal sectional view of an embodiment of the bone conduction speaker of the present invention.

Fig. 2 is a longitudinal sectional view of another embodiment of the bone conduction speaker of the present invention.

Fig. 3 is a diagram illustrating the relationship between an input frequency and the strength of an output.

Fig. 4 is a graph illustrating the impedance characteristics of the bone conduction speaker not provided with any damping member.

Fig. 5 is a graph illustrating the impedance characteristics of the bone conduction speaker provided with a damping member.

Fig. 6 is a longitudinal sectional view of an example of a conventional type of a bone conduction speaker.

Fig. 7 is a longitudinal sectional view of another example of the conventional type of the bone conduction speaker.

With reference to the accompanying drawings, a plurality of embodiments of the present invention will be described. Each of Figs. 1 and 2 shows a longitudinal sectional view of each of embodiments of a bone conduction speaker of the present invention. The bone conduction speaker of the present invention comprises:

a bone conduction speaker unit 1; a housing 2 for containing the speaker unit 1; and, a damping member for supporting the bone conduction speaker unit 1, wherein the damping member is disposed in the housing 2.

In general, the bone conduction speaker unit 1 is constructed of: a yoke 4 provided with a central magnetic pole 5; a doughnut-shaped voice coil 6 which is wound around the central magnetic pole 5; a magnet 7 disposed outside the voice coil 6; a diaphragm or vibrating plate 8 mounted on an upper surface of a diaphragm-mounting portion 9, which portion 9 is formed in an upper surface of an outer peripheral portion of the yoke 4; and, a vibration block 10 fixedly mounted on the upper surface of the vibrating plate 8.

In the bone conduction speaker unit 1, the vibration block 10 is fixedly mounted on a ceiling surface of the interior of the housing 2 through a plurality of screws 11 and like fastening means. In the present invention, the bone conduction speaker unit 1 is further supported by the damping member, which is disposed inside the housing 2.

The damping member shown in Fig. 1 is constructed of a leaf spring 3. This leaf spring 3 has its outer peripheral portion fixedly embedded in an inner surface of the housing 2, and has its central portion fixedly mounted a lower surface of a central portion 12 of the yoke 4, wherein the central portion 12 serves as a leaf-spring mounting portion.

This leaf spring 3 functions to damp the vibrations of the bone conduction speaker unit 1, and prevents the same unit 1 from being excessively vibrated. As for a damping force exerted by the leaf spring 3, it is possible to control such a damping force by appropriately selecting the material, thickness and like properties

of the leaf spring 3.

The damping member shown in Fig. 2 is constructed of an elastic block 3a, which is made of rubbers, plastics and like elastic materials. This elastic block 3a is any one of rubber blocks, plastic blocks and like elastic blocks, and fixedly mounted on an inner bottom surface of the housing 2. On the other hand, an upper surface of this elastic block 3a is fixedly mounted on a lower surface of the central portion of the yoke 4. As is in the case of the leaf spring 3, this elastic block 3a also functions to damp the vibrations of the bone conduction speaker unit 1.

It is needless to say that it is an object of the damping member to prevent the bone conduction speaker unit 1 from being excessively vibrated. At the same time, it must be noted that the vibration of the bone conduction speaker unit 1 is not excessively damped.

Fig. 3 shows a diagram illustrating the relationship between an input frequency and the strength of an output in various conditions, for example, in the presence or absence the damping member, in a condition in which the damping member has its elasticity vary.

A curve "A" in Fig. 3 shows the relationship between an input frequency and an output of a conventional type of a bone conduction speaker, which is not provided with any damping member. In Fig. 3, at an input frequency of 650 (Hz), the curve "A" reaches its peak. As shown in this curve "A", when the curve "A" is out of a flat shape, the resonance curve "A" forms its peak. Around this peak of the curve "A", resonance of the sound is strengthened so that the sound is deteriorated in tone quality. Particularly, in the case of the bone conduction speaker, an increase in loudness of the sound means an increase in vibration of the sound. Due to this, a user of the bone conduction speaker often feels such an

increase in loudness of the sound uncomfortable.

A curve "B" in Fig. 3 shows the relationship between an input frequency and an output of the bone conduction speaker of the present invention, wherein the bone conduction speaker is provided with a damping member, which is large in elasticity. In this embodiment, the curve "B" is smaller in intensity of resonance than the curve "A". However, since the damping member of this embodiment is large in elasticity, it is impossible for this embodiment to prevent the resonance of the bone conduction speaker from occurring. This results in an excessive increase of the output of the bone conduction speaker of the embodiment, as a whole.

A curve "D" in Fig. 3 shows the relationship between an input frequency and an output of the bone conduction speaker of the present invention, wherein the bone conduction speaker is provided with a damping member, which is small in elasticity. In this embodiment, since the elasticity of the damping member is too small, vibrations of the entire bone conduction speaker excessively decrease in amplitude.

A curve "C" in Fig. 3 shows the relationship between an input frequency and an output of the bone conduction speaker of the present invention, wherein each of damping members 3, 3a of this embodiment is controlled in elasticity so as to have the curve "C" to approach an ideal curve. In this embodiment, it is recognized that the curve "C" is remarkably improved in building-up transient characteristics when a large input is inputted to this embodiment.

A curve in Fig. 4 shows the impedance characteristics of the conventional type of the bone conduction speaker in

which any damping member is not provided. In this conventional bone conduction speaker, since its vibrating plate or diaphragm suffers from an abnormal resonance, the frequency characteristics thereof excessively vary in a range of from 1 KHz to 2 KHz so that an abnormal sound is issued.

A curve in Fig. 5 shows the impedance characteristics of the bone conduction speaker provided with a damping member of the present invention. As is clear from this curve, in comparison with the conventional bone conduction speaker not provided with any damping member, the bone conduction speaker of the present invention is remarkably improved in frequency characteristics, which prevents such an abnormal sound of the conventional bone conduction speaker from being issued.

Incidentally, in construction, each of components of the bone conduction speaker of the present invention may have any desired shapes and dimensions. For example, it is also possible to divide each of the diaphragm-mounting portion 9 of the yoke 4 and the magnet 7 into a plurality of diametrically-opposed pair of pieces which are disposed on the same diameter circle a center of which is coincident with a center of the central magnetic pole 5, so that the entire size of the bone conduction speaker unit 1 is minimized (as is in the prior art described in Japanese Patent No. 2967777).

The bone conduction speaker unit is employed in the bone conduction speaker described above, and supported by the damping member having an appropriate elasticity. This

prevents the bone conduction speaker from being excessively vibrated. Due to this, it is possible for the bone conduction speaker to improve the bone conduction speaker in frequency characteristics and therefore in tone quality, which enable the user to clearly catch the sound. Further, the damping member of the bone conduction speaker is also capable of functioning as a shock absorber for absorbing any mechanical shock produced when the bone conduction speaker is vibrated or drops out of the user's head. Due to this, in effect, there is no fear that the bone conduction speaker fails or breaks.

Many modifications will be apparent to those skilled in the art without departing from the scope of the present invention as herein described with reference to the accompanying drawings.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A bone conduction speaker comprising:

a bone conduction speaker unit constructed of a yoke, a voice coil, a magnet, a vibrating plate and a vibration block integrated with said vibrating plate; and

a housing which contains said bone conduction speaker unit to function as a vibrating portion, wherein:

said vibration block of said bone conduction speaker unit is fixedly mounted on an upper surface of the interior of said housing;

said yoke is supported by a damping member which is disposed inside said housing;

said damping plate is constructed of a leaf spring which is fixedly mounted on a side surface of the interior of said housing and said leaf spring has an outer peripheral portion fixedly embedded in said side surface;

said yoke is fixedly mounted on said leaf spring through a leaf-spring mounting portion of said yoke; and

said leaf-spring mounting portion is provided in a central portion of a rear surface of said yoke.

2. A bone conduction speaker comprising:

a bone conduction speaker unit constructed of a yoke, a voice coil, a magnet, a vibrating plate and a vibration block integrated with said vibrating plate; and

a housing which contains said bone conduction speaker unit to function as a vibrating portion, wherein:

said vibration block of said bone conduction speaker unit is fixedly mounted on an upper surface of the interior of said housing and said yoke is suspended from said vibrating plate and supported by a damping member which is

disposed inside said housing, wherein:

said damping member is constructed of an elastic block made of rubber, plastics or like elastic materials;

said elastic block is mounted on a bottom surface of the interior of said housing; and

said yoke has its rear surface fixedly mounted on an upper surface of said elastic block.

3. A bone conduction speaker substantially as hereinbefore described with reference to the accompanying drawings.

DATED this 6th day of June 2006

TEMCO JAPAN CO., LTD.
By its Patent Attorneys
DAVIES COLLISON CAVE

FIG. 1

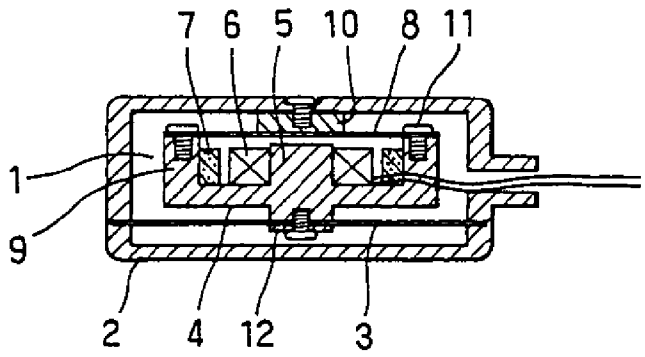


FIG. 2

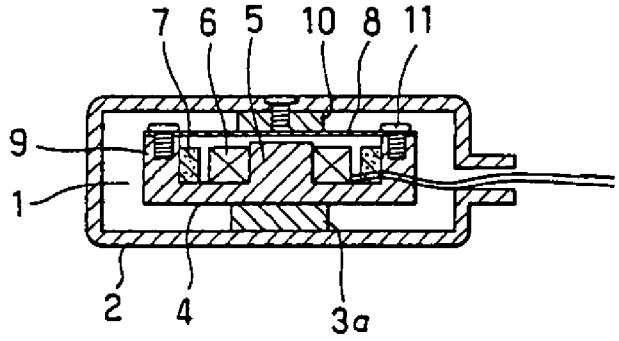


FIG. 3

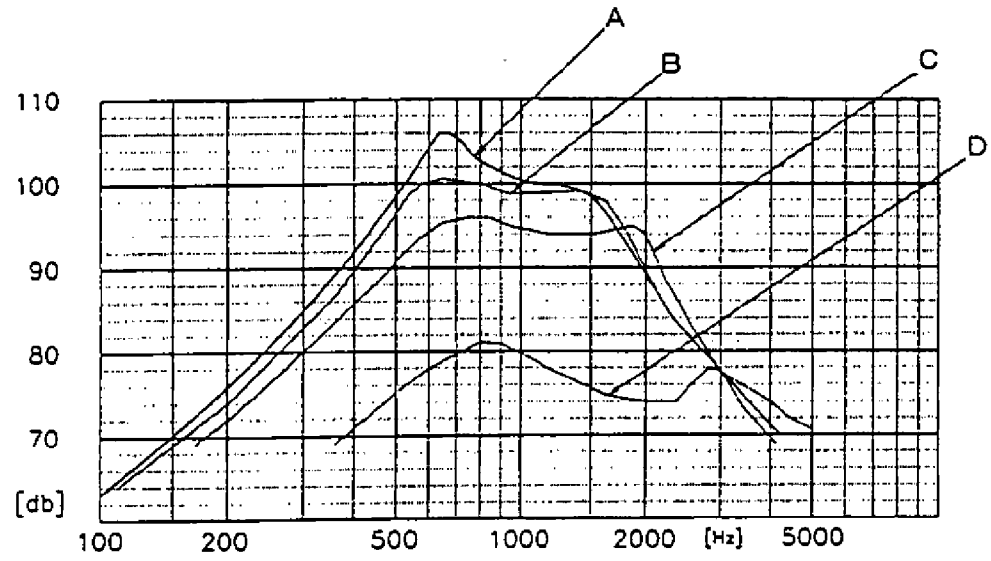
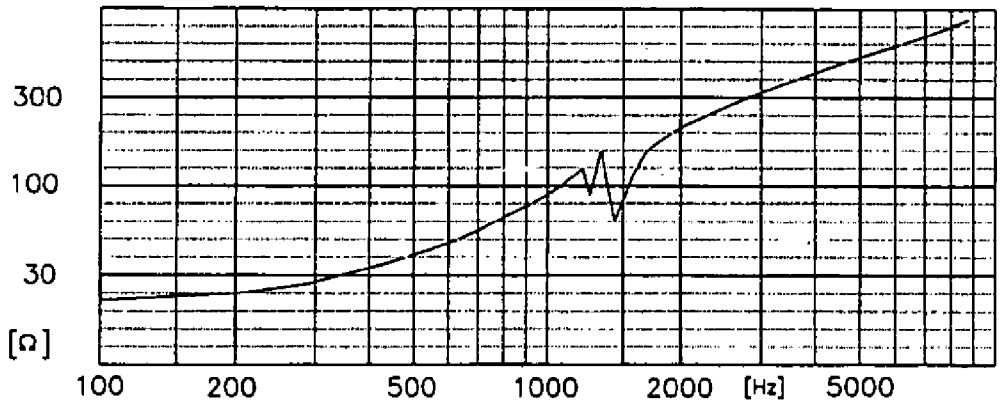

A
B
C
D
110
100
90
80
70
[db]
100
200
500
1000
2000
[Hz]
5000

FIG. 4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30
[Ω]
100
200
500
1000
2000
[Hz]
5000

FIG. 5

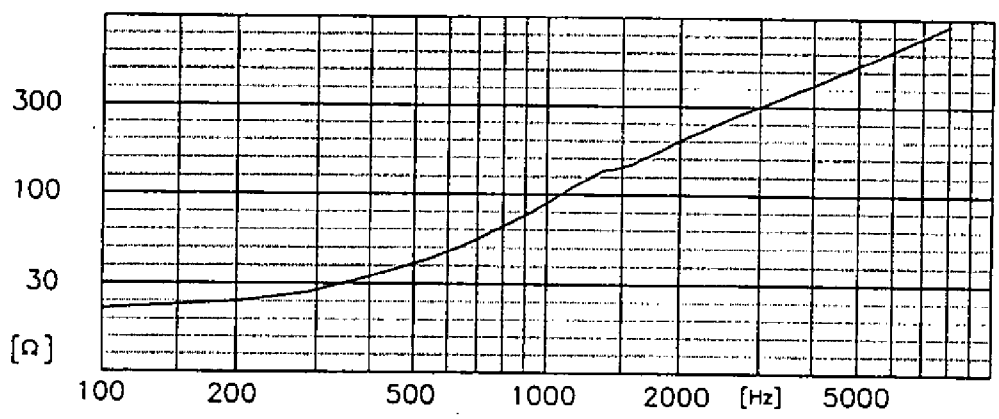

FIG. 6

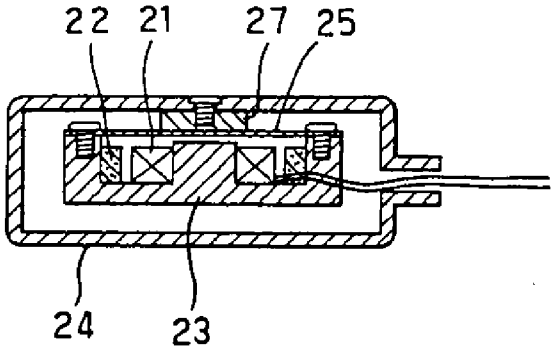

FIG. 7