

TITLE OF THE INVENTION

MICROPHONE HOLDING STRUCTURE AND ELECTRONIC
DEVICE

5 **BACKGROUND OF THE INVENTION**

1. Field of the Invention

0001

The disclosures herein generally relate to
holding structure of a microphone and an electronic
10 device.

2. Description of the Related Art

0002

A conference system for conducting a remote
15 conference with a remote location via a communication
network such as the Internet is popular. In such a
conference system, for example, images or voices of
participants or the like of the remote conference are
acquired by terminal devices for conference,
20 converted into digital data, and sent to a terminal
device of a communication destination. The terminal
device of the communication destination displays the
image of the participant that is received and outputs
the voice of the participant. Such processes are
25 performed bi-directionally, and thereby, the
participants of the remote conference can conduct a
video conference with the remote location in a state
near an actual conference.

0003

30 For example, when a speaker and a
microphone are installed in a small-sized chassis of
a terminal device used in such a conference system,
there is a problem that a vibration of the speaker

due to the sound output propagates to the chassis of the terminal device, and furthermore the vibration propagates from the chassis to the microphone. When the terminal device has an echo canceller, in a usual case, even if a voice reproduced from a speaker is input into a microphone, according to the function of the echo canceller, an echo component is removed. However, when the microphone picks up a vibration of the chassis, as described above, a distorted reproduction sound from the speaker is input to the microphone. That is, a path for transmitting voice from the speaker to the microphone is non-linear, and an echo may not be removed sufficiently.

0004

As a technique for suppressing such propagation of a vibration of the chassis to the microphone, a technique of holding the microphone in a floating state is known. For example, a holding structure for microphone is known, in which a microphone is held in a floating state using a magnetic force to block an environmental vibration or noise (See, for example, Patent document 1). Moreover, an electronic device in which a microphone is elastically supported inside a cabinet, a rear side of the microphone is covered with a back cover formed of a rubber-like elastic body, and the back cover is fixed to the cabinet using a fixation screw is known (See, for example, Patent document 2). Furthermore, an attachment mechanism for microphone having an elastic member for covering a side face of a microphone with an approximately cylindrical shape and a retention member for retaining the microphone by engaging with the elastic member is known (See,

for example, Patent document 3).

SUMMARY OF THE INVENTION

[Technical Problem]

5 0005

The technique disclosed in Patent document 1 is a floating structure using a magnetic force, and has a problem of low incorporating property and high cost. Moreover, the technique disclosed in Patent document 2 requires screwing from the rear side, and incorporating or replacing a microphone within a limited space of a small electronic device or the like is quite difficult. Moreover, in the technique disclosed in Patent document 3, because a contact area of a microphone and a chassis via an elastic member is great, suppressing the propagation of vibration from a chassis to the microphone is difficult.

0006

20 In this way, in the conventional technique, incorporating a microphone in a limited space of an electronic device or the like, at low cost, while preventing a vibration from propagating from a chassis to the microphone is quite difficult.

25 0007

In view of the above, providing a holding structure for a microphone, in which incorporating the microphone in a limited space of an electronic device or the like at low cost, while preventing a vibration from propagating from a chassis to the microphone is easy, is desirable.

[Solution to Problem]

0008

According to an embodiment, a holding structure for holding a microphone includes a chassis configured to be separated into at least a first chassis and a second chassis; an elastic member
5 formed of an elastic material and having a holding unit configured to hold the microphone and an attachment portion provided in a periphery of the holding unit; a retention member configured to retain the attachment portion at a predetermined position of
10 the first chassis; and the second chassis configured to fix the retention member to the first chassis, the retention member being fixed to the first chassis by the second chassis in a state where the second chassis is attached to the first chassis.

15 [Advantageous effect of Invention]
0009

According to at least one embodiment, a holding structure for a microphone is provided, in which incorporating the microphone in a limited space
20 of an electronic device or the like at low cost, while preventing a vibration from propagating from a chassis to the microphone, is easy.

BRIEF DESCRIPTION OF THE DRAWINGS

25 0010

[FIG. 1]

FIG. 1 is an external view depicting a conference apparatus according to an embodiment.

[FIG. 2]

30 FIG. 2 is a diagram depicting an example configuration of a chassis of the conference apparatus according to the embodiment.

[FIG. 3]

FIG. 3 is a perspective view depicting a holding structure for a microphone according to the embodiment.

[FIG. 4A]

5 FIG. 4A is a diagram depicting an example of a microphone rubber according to the embodiment.

[FIG. 4B]

FIG. 4B is a diagram depicting an example of the microphone rubber according to the embodiment.

10 [FIG. 4C]

FIG. 4C is a diagram depicting an example of the microphone rubber according to the embodiment.

[FIG. 4D]

15 FIG. 4D is a diagram depicting an example of the microphone rubber according to the embodiment.

[FIG. 5]

FIG. 5 is a diagram depicting an example attachment of a microphone holder to a chassis upper cover according to the embodiment.

20 [FIG. 6]

FIG. 6 is a diagram depicting a relation between a chassis lower cover and the microphone holder according to the embodiment.

[FIG. 7A]

25 FIG. 7A is a diagram for explaining a fixation of the microphone holder by the chassis lower cover according to the embodiment.

[FIG. 7B]

30 FIG. 7B is a diagram for explaining the fixation of the microphone holder by the chassis lower cover according to the embodiment.

[FIG. 8]

FIG. 8 is a cross-sectional view of a

holding structure of the microphone according to the embodiment.

[FIG. 9]

FIG. 9 is a diagram depicting a position of
5 a rib for fixing holder of the chassis lower cover according to the embodiment.

[FIG. 10]

FIG. 10 is an enlarged view of the position
of the rib for fixing holder of the chassis lower
10 cover according to the embodiment.

[FIG. 11]

FIG. 11 is a diagram depicting an example
of a rib for fixing holder according to the
embodiment.

15 [FIG. 12]

FIG. 12 is a diagram depicting an example
of a shape of a boss portion according to the
embodiment.

[FIG. 13]

20 FIG. 13 is a diagram depicting an example
of a microphone rubber arranged at the boss portion
according to the embodiment.

[FIG. 14]

FIG. 14 is a diagram of the boss portion
25 viewed from a side surface according to the
embodiment.

[FIG. 15]

FIG. 15 is a cross-sectional view depicting
a space anterior to the microphone according to the
30 embodiment.

[FIG. 16]

FIG. 16 is a diagram depicting an example
of frequency characteristic of the microphone

according to the embodiment.

[FIG. 17]

FIG. 17 is a diagram depicting an example of change in the frequency characteristic due to the space anterior to the microphone according to the
5 embodiment.

[FIG. 18]

FIG. 18 is a diagram depicting an example of a notch of a boss portion according to a first
10 embodiment.

[FIG. 19]

FIG. 19 is a diagram of the boss portion viewed from a side surface according to the first
embodiment.

15 [FIG. 20]

FIG. 20 is a diagram depicting an example of change in frequency characteristic due to the notch according to the first embodiment.

[FIG. 21]

20 FIG. 21 is a diagram depicting an example of a sound pickup hole according to a second embodiment.

[FIG. 22]

FIG. 22 is a diagram depicting another
25 example of the sound pickup hole according to the second embodiment.

[FIG. 23]

FIG. 23 is a diagram depicting a variation of the sound pickup hole according to the second
30 embodiment.

[FIG. 24A]

FIG. 24A is a diagram for explaining a difference in a length of a sound pickup hole

according to a third embodiment.

[FIG. 24B]

FIG. 24B is a diagram for explaining the
difference in the length of the sound pickup hole
5 according to the third embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

0011

In the following, embodiments of the
10 present invention will be described with reference to
the accompanying drawings.

0012

<Configuration example of electronic
device>

15 FIG. 1 is an external view depicting a
conference apparatus according to an embodiment. The
conference apparatus 10 illustrated in FIG. 1 is an
example of electronic devices disclosed in the
present application, and is a terminal device used in
20 a remote conference system. The electronic devices
disclosed in the present application include various
electronic devices provided with a microphone in a
chassis, such as a mobile phone apparatus, a
telephone apparatus, an intercom apparatus, a picture
25 recorder, and an imaging device, for example.

0013

In FIG. 1, the conference apparatus 10
includes a chassis 1100, an arm 1200 and a camera
housing 1300. Among them, a front side wall 1110 of
30 the chassis 1100 has an inlet face (not illustrated)
including a plurality of inlet holes, and a rear side
wall 1120 of the chassis 1100 has an exhaust face
1121 on which a plurality of exhaust holes are formed.

Accordingly, by driving a cooling fan included in the chassis 1100, air anterior to the conference apparatus 10 can be taken in via the inlet face (not illustrated) and exhausted to the rear of the conference apparatus 10 via the exhaust face 1121. On a right-side wall 1130 of the chassis 1100 a sound pickup hole 1131 is formed, and a microphone incorporated in the chassis 1100 is capable of picking up an ambient sound, such as voice or sound.

10 0014

An operation panel 1150 is formed toward the right-side wall 1130 on an upper face of the chassis 1100. The operation panel 1150 is provided with a plurality of operation buttons (108a through 108e), a power switch 109, an alarm lamp 119, and the like. Moreover, the operation panel 1150 is also provided with a sound output face 1151, which is formed of a plurality of sound output holes for allowing output sound from a built-in speaker 115 to pass through. In addition, an accommodation portion 1160 serving as a recess for accommodating the arm 1200 and the camera housing 1300 is formed toward a left-side wall 1140 on the upper face of the chassis 1100.

25 0015

A plurality of connection ports (1132a through 1132c) for connecting cables, such as a wired LAN (Local Area Network) or a USB (Universal Serial Bus) are provided on the right-side wall 1130 of the chassis 1100. In contrast, a connection port (not illustrated) for connecting a cable for a display device is provided toward the left-side wall 1140 of the chassis 1100.

30

0016

Next, the arm 1200 is attached to the chassis 1100 via a torque hinge 1210 and is configured to be rotatable in the vertical direction within a range of a tilt angle θ_1 of 135 degrees with respect to the chassis 1100. FIG. 1 indicates a state in which the tilt angle θ_1 is 90 degrees.

0017

The camera housing 1300 is provided with a built-in camera 1021, and can capture an image of a user, a document, a room, or the like. In addition, the camera housing 1300 has a torque hinge 1310. The camera housing 1300 is attached to the arm 1200 via the torque hinge 1310. The camera housing 1300 is attached to the arm 1200 via the torque hinge 1310. Moreover, the camera housing 1300 is configured to be rotatable in the vertical and horizontal directions within a range of a pan angle θ_2 of from 180 degrees to +180 degrees and a tilt angle θ_3 of from -45 degrees to +45 degrees with respect to the arm 1200, where the state illustrated in FIG. 1 is 0 degrees.

0018

The above-described sound pickup hole 1131, the sound output face, the plurality of operation buttons (108a through 108e), the power switch 109 of the like can be arranged at an arbitrary position on the chassis 1100. Moreover, ranges of motion of the tilt angle θ_1 , the pan angle θ_2 , and the tilt angle θ_3 are an example. The ranges of motion can be arbitrarily set.

0019

FIG. 2 is a diagram depicting an example configuration of a chassis of the conference

apparatus according to the embodiment. As illustrated in FIG. 2, the chassis 1100 of the conference device 10 has, for example, a chassis upper cover 201 (first chassis) and a chassis lower cover 202 (second chassis) which can be separated in the thickness direction from each other. On the chassis upper cover 201, the sound pickup hole 1131, described as above, is provided. As a material of the chassis 1100, for example, a hard resin or the like, such as a plastic, is used. In addition, the chassis 1100 may be separated into not two but three or more pieces.

0020

<Holding structure of microphone>

FIG. 3 is a perspective view depicting a holding structure for a microphone according to the embodiment. A holding structure of the microphone according to the embodiment includes a microphone 301, a microphone rubber 302 (elastic member) arranged around the microphone 301, and a microphone holder 303 (retention member) retaining the microphone 301 and the microphone rubber 302.

0021

The microphone 301 is a device converting a picked up sound into an electric signal. The microphone 301 has a shape of, for example, an approximately cylindrical form, and picks up voice/sound from the front, to output a voice signal converted into an electric signal from the rear surface by a cable or the like.

0022

The microphone rubber 302 is an elastic member formed of an elastic material such as a

silicone rubber or a butyl rubber, for example. The microphone rubber 302 includes a holding unit 309 for retaining the microphone 301 and a flange portion (attachment portion) 310 arranged around the holding unit 309.

5 0023

FIGs. 4A through 4D are diagrams depicting an example of a microphone rubber according to the embodiment. FIG. 4A is a top view of the microphone rubber 302. FIG. 4B is a side view, and FIG. 4C is a bottom view. FIG. 4D is a cross-sectional view cut along A-A in FIG. 4A.

10 0024

The holding unit 309 of the microphone rubber 302 is formed, for example, so as to cover the microphone 301. On an upper face of the holding unit 309 an opening 401 for picking up sound is provided, and on a lower face a hole 402 for drawing out a cable is provided. Moreover, an inner wall of the holding unit 309 is formed, for example, approximately in contact with a periphery of the microphone 301, and retains the microphone 301. FIGs. 4A through 4D illustrate a configuration that retains the microphone 301 by the entire inner wall of the holding unit 309. However, the configuration is an example. The configuration may be, for example, forming a plurality of projection portions on the inner wall of the holding unit 309 and retaining the microphone 301 by the projection portions or the like.

15 20 25 30 0025

When the microphone 301 is incorporated into the microphone rubber 302, the opening 401 is expanded using the elasticity of the microphone

rubber 302, and the microphone 301 can be engaged with the holding unit 309 of the microphone rubber 302.

0026

5 The flange portion 310 of the microphone rubber 302 is arranged around the holding unit 309, as illustrated in FIGs. 4A through 4D, and is an attachment portion projected from the holding unit 309.

10 0027

 The elastic member used for the microphone rubber 302 preferably exhibits low transmissibility upon resonance (resonance magnification) occurring. That is, the greater the loss factor of a material is, 15 the higher the vibration insulation effect is. Moreover, a resonance point can be adjusted depending on hardness of the material of the microphone rubber 302. When the hardness of the material is low, the resonance point (resonance frequency) is low, and 20 when the hardness is great, the resonance point is great.

0028

 The resonance point of the microphone rubber 302 is preferably different from frequency of 25 an excitation source (oscillation source). For example, in the conference apparatus 10, the excitation source is a speaker, and the reproduction frequency is, for example, 300 Hz through 12000 Hz, which is a wide bandwidth. Therefore, setting the 30 resonance frequency of the microphone rubber 302 outside the reproduction frequency of the speaker is difficult. However, if possible, the resonance frequency of the microphone rubber 302 is preferably

less than 300 Hz or greater than 12000 Hz. However,
even when the microphone rubber resonates, in a case
of employing a material having a great loss factor,
because the resonance magnification is small, and
5 propagation of oscillation from the chassis can be
suppressed.

0029

Here, returning to FIG. 3, the explanation
for the holding structure of the microphone will be
10 continued.

0030

The microphone holder 303 is a retention
member for retaining the flange portion 310 of the
microphone rubber 302 that retains the microphone 301
15 at a predetermined position of the chassis 1100, and
thereby retaining the microphone 301 in a floating
state. The microphone holder 303 is formed of, for
example, a material having elasticity, a plastic or
the like. The microphone holder 303 may hold the
20 flange portion 310 between the chassis 1100 and the
microphone holder 303 in a state of being attached to
the chassis 1100, and thereby retaining the flange
portion 310 at a predetermined position of the
chassis 1100. The flange portion 310 is projected
25 from the holding unit 309, and the flange portion 310
that is the projected portion may be held between the
chassis 1100 and the microphone holder 303, and
thereby the flange portion 310 is retained at a
predetermined position of the chassis 110.

30 0031

The microphone holder 303 is formed so as
to cover the microphone rubber 302 on the side
surface 304 and on the rear surface 305. Therefore,

transmission of noise by a fan or the like inside the chassis 1100 to the microphone 301 is reduced.

Moreover, the microphone holder 303 includes an attachment shaft 306, a cable drawing out unit 307, claw portions 308a, 308b, a notch unit 311 for positioning, or the like. Upon assembling, for example, after the microphone 301 is placed in the microphone rubber 302, the microphone rubber 302 is put on the microphone holder 303. Then, the microphone holder 303 is attached to the chassis upper cover 201.

0032

FIG. 5 is a diagram depicting an example attachment of the microphone holder to the chassis upper cover according to the embodiment. The chassis upper cover 201 includes bearing portions 502a, 502b for supporting the attachment shaft 306 of the microphone holder 303, a projection portion 503 for positioning the microphone holder 303, first rib portions 504a, 504b arranged corresponding to the claw portions 308a, 308b, or the like.

0033

In FIG. 5, the microphone holder 303 is rotatable around the attachment shaft 306, with respect to the chassis upper cover 201. Upon being attached to the chassis upper cover 201, in a state where the microphone holder 303 is inclined with respect to the right side wall 1130 of the of the chassis upper cover 201 (See FIG. 1), the attachment shaft 306 is engaged with the bearing portions 502a, 502b of the chassis upper cover 201. Next, the microphone holder 303 is rotated around the attachment shaft 306 toward the right side wall 1130,

and the claw parts 308a, 308b of the microphone holder 303 are locked at the rib portions 504a, 504b. In the embodiment, the notch 311 for positioning the microphone holder 303 is fitted to the projection
5 portion 503 for positioning the chassis upper cover 201, and thereby enhancing accuracy of attachment position of the microphone 301 and the microphone holder 303. Moreover, in the embodiment, because the microphone holder 303 is attached to the chassis
10 upper cover 201 by the claw portions 308a, 308b, screw clamping becomes unnecessary, and a configuration where attachment and detachment for the microphone 301 within a limited space is easy can be provided.

15 0034

A cable harness that outputs sound signals from the microphone 301 can be drawn through the hole for cable drawing 402 of the microphone rubber 302 and the cable drawing unit 307 of the microphone
20 holder 303.

0035

FIG. 6 is a diagram depicting a relation between the chassis lower cover and the microphone holder according to the embodiment. In the
25 embodiment, a structure is provided, in which after the microphone holder 303, on which the microphone 301 and the microphone rubber 302 are mounted, is attached to the chassis upper cover 201, as illustrated in FIG. 5, the chassis lower cover is
30 closed (attached). When the chassis lower cover 202 is closed, for example, the chassis upper cover 201 may be placed with the opening 401 facing upward so that the chassis lower cover 202 is attached from

above, or the chassis upper cover 201 may be attached on the chassis lower cover 202.

0036

Moreover, the chassis lower cover 202 is provided with second rib portions 601a, 601b for fixing the microphone holder 303 arranged so as to contact the inside of the claw portions 308a, 308b of the microphone holder 303 when the chassis lower cover 202 is closed. Accordingly, a structure in which when the chassis lower cover 202 is closed, the claw portions 308a, 308b of the microphone holder 303 open outward by the second rib portions 601a, 601b, is provided. Moreover, on upper faces of the second rib portions 601a, 601b of the chassis lower cover 202, for example, inclined surfaces facing outward are provided, as illustrated in FIG. 6. Accordingly, the second rib portions 601a, 601b smoothly contact the inside of the claw portions 308a, 308b of the microphone holder 303.

20 0037

FIGs. 7A and 7B are diagrams for explaining a fixation of the microphone holder by the chassis lower cover according to the embodiment. FIG. 7A depicts a state of the claw portion 308b of the microphone holder 303 and the second rib portion 601b of the chassis lower cover 202 before the chassis lower cover 202 is closed (state of FIG. 5). Moreover, FIG. 7B depicts a state of the claw portion 308b of the microphone holder 303 and the second rib portion 601b of the chassis lower cover 202 after the chassis lower cover 202 is closed from the state of FIG. 5.

0038

When the chassis lower cover 202 is closed from the state of FIG. 7B, the second rib portion 601b of the chassis lower cover 202 contacts the inside (right side in FIG. 7) of the claw portion 308b for fixing the microphone holder 303, and presses the claw portion 308b toward the side of the first rib portion 504b of the chassis upper cover 201. In this way, the claw portions 308a, 308b are pressed against the rib portions 504a, 504b of the chassis upper cover 201, and thereby the microphone holder 303 is fixed to the chassis upper cover 201 (chassis 1100). Thus, in the embodiment, when the chassis lower cover 202 is closed, according to elastic force of the claw portions 308a, 308b of the microphone holder 303, the microphone holder 303 is tightly and accurately fixed to the chassis upper cover 201.

0039

In the embodiment, when the chassis lower cover 202 is detached from the chassis upper cover 201, the claw portion 308b of the microphone holder 303 is restored from the state of FIG. 7B to the state of FIG. 7A, and becomes a state where the microphone holder 303 can be detached. Therefore, according to the embodiment, not only attachment of the microphone 301, but also detachment or replacement of the microphone 301 can be performed easily.

0040

FIG. 8 is a cross-sectional view of a holding structure of the microphone according to the embodiment. FIG. 8 is a cross-sectional view of a state where after the microphone 301, the microphone rubber 302 and the microphone holder 303 are attached

to the chassis upper cover 201, the chassis lower cover 202 is closed.

0041

On the inner wall of the chassis upper
5 cover 201, for example, a boss portion is arranged in
a circular shape about the sound pickup hole 1131 so
as to contact the flange portion of the microphone
rubber 302. In addition, the boss portion 801
arranged in a circular shape is an example, and the
10 boss portion 801 has a shape depending on an
attachment portion of the microphone rubber 302
(flange portion 310 or the like).

0042

As illustrated in FIG. 8, the microphone
15 301 is supported by the holding unit 309 of the
microphone rubber 302. Moreover, the microphone
rubber 302 is retained at a predetermined position of
the chassis 1100 (See FIG. 1) by the flange portion
310 of the microphone rubber 302 held between the
20 microphone holder 303 and the boss portion 801
arranged on the chassis upper cover 201 so as to be
opposed to the microphone holder 303.

0043

In the embodiment, the flange portion 310
25 of the microphone rubber 302 is fixed to the chassis
1100 (chassis upper cover 201), but the holding unit
309 is not directly fixed to the chassis 1100.
Moreover, a predetermined gap is provided between the
holding unit 309 of the microphone rubber 302 and the
30 microphone holder 303 and the chassis 1100, and
thereby a floating structure of the microphone 301 is
enabled, and propagation of vibration from the
chassis 1100 to the microphone 301 is reduced.

0044

In addition, preferably a gap is provided between a portion other than the flange portion 310 of the microphone rubber 302 (holding unit 309 or the like) and the microphone holder 303 and the chassis 1100. However, the portion other than the flange portion 310 of the microphone rubber 302 may have a part that contacts the microphone holder 303 or the chassis 1100, if the portion other than the flange portion 310 of the microphone rubber 302 is substantially in a floating state with respect to the microphone holder 303 and the chassis 1100.

0045

Moreover, because on the rear side of the microphone 301, the rear surface portion 305 of the microphone holder 303 is arranged, the rear surface portion 305 serves as a wall, and reduces noise reaching the microphone 301 from inside the chassis 1100.

20 0046

FIG. 9 is a diagram depicting a position of a rib for fixing a holder of the chassis lower cover according to the embodiment. In an area 901 corresponding to the attachment position of the microphone holder 303 in the chassis upper cover 201 illustrated in FIG. 6, the second rib portions for fixing the microphone holder 303 are arranged.

0047

FIG. 10 is an enlarged view of the rib for fixing holder of the chassis lower cover according to the embodiment. As illustrated in FIG. 10, in the area 901 of the chassis lower cover 202, the second rib portions 601a, 601b for fixing the microphone

holder 303 are provided.

0048

FIG. 11 is a diagram depicting an example
of a rib for fixing a holder of the chassis lower
5 cover according to the embodiment. As described
above, when the chassis lower cover 202 is closed
with respect to the microphone holder 303 attached to
the chassis upper cover 201, the second rib portions
601a, 601b of the chassis lower cover 202 contact the
10 inside of the claw portions 308a, 308b of the
microphone holder 303, respectively. Accordingly,
the claw portions 308a, 308b of the microphone holder
303 open outward, and the microphone holder 303 is
fixed to the chassis upper cover 201 tightly and
15 accurately.

0049

As illustrated in FIGs. 9 through 11, the
chassis lower cover 202 according to the embodiment
only has to be provided with the second rib portions
20 601a, 601b inside thereof, and thereby the microphone
holder 303 can be fixed to the chassis 1100 (chassis
upper cover 201) without increasing the number of
parts or without increasing the cost substantially.

0050

25 In addition, the flange portion 310 of the
microphone rubber 302 according to the embodiment is
an example of the attachment portion. In the
embodiment, in order to simplify a shape of the
microphone rubber 302, the microphone rubber 302
30 illustrated in FIG. 4 is employed. However, the
attachment portion of the microphone rubber 302 may
have another shape.

0051

For example, in the holding unit 309 of the microphone rubber 302, suppressing effect for propagation of vibration becomes higher as a contact area with the chassis 1100 is reduced. Moreover, in order to offer a sound pickup performance of the microphone 301, preferably a central portion of the sound pickup hole 1131 arranged in the chassis 1100 and a central portion of the microphone 301 accurately coincide with each other. The attachment portion of the microphone rubber 302, for example, may have a shape that retains the holding unit 309 at three points so as to satisfy the above-described two conditions.

0052

Moreover, the embodiment is described that after the microphone holder 303 is attached to the chassis upper cover 201, the chassis lower cover 202 is attached. However, the embodiment does not restrict the range of the present invention. For example, the chassis lower cover 202 has a sound pickup hole 1131, and after the microphone holder 303 is attached to the chassis lower cover 202, the chassis upper cover 201, which is provided with the second rib portions 601a, 601b, is attached.

25 0053

<Regarding resonance>

Next, resonance of a space anterior to the microphone 301 will be described.

0054

FIG. 12 is a diagram depicting an example of a shape of a boss portion according to the embodiment. The boss portion 801 is arranged on the inner wall of the chassis upper cover 201, for

example, in a circular shape about the sound pickup hole 1131 so as to contact the flange portion 310 of the microphone rubber 302. Accordingly, the boss portion 801, opposed to the microphone holder 303,
5 can retain the flange portion 310 of the microphone rubber 302.

0055

In the above description, the case where the boss portion 801 has, for example, a circular shape about the sound pickup hole 1131 is explained.
10 However, the boss portion 801 with a circular shape is an example, and the boss portion 801 may have a shape of, for example, an ellipse, a polygon or the like depending on a shape of the microphone rubber
15 302.

0056

FIG. 13 is a diagram depicting an example of a microphone rubber arranged at the boss portion according to the embodiment. As illustrated in FIGs.
20 12, 13, the shape of the boss portion 801 corresponds to a shape of the flange portion 310 of the microphone rubber 302. Therefore, the boss portion 801 illustrated in FIG. 12 is configured so as to contact the flange portion 310 of the microphone
25 rubber 302 over the entire circumference.

0057

FIG. 14 is a diagram of the boss portion viewed from a side surface according to the embodiment. As illustrated in FIG. 14, the boss
30 portion 801 has a predetermined height "h" with respect to the inner wall of the chassis upper cover 201, and is arranged so as to contact the flange portion 310 of the microphone rubber 302.

0058

FIG. 15 is a cross-sectional view depicting a space anterior to the microphone according to the embodiment. When the microphone 301 is attached to the microphone rubber 302, the microphone rubber 302 is retained by the microphone holder 303 and the chassis lower cover 202 is closed, spaces (gaps) appear anterior to and posterior to the microphone 301, as illustrated in FIG. 15. In the embodiment, according to the spaces anterior to and posterior to the microphone 301, a floating structure for the microphone 301 is enabled.

0059

At this time, the space 1501 appearing anterior to the microphone 301 and space inside the chassis are sealed by the boss portion 801 and the flange portion 30 of the microphone rubber. Therefore, in the embodiment, there is an effect that noise generated inside the chassis (e.g. sound from the cooling fan) and picked up by the microphone 301 is reduced.

0060

In contrast, the space 1501 appearing anterior to the microphone 301 and the space inside the chassis are sealed, and thereby the space 1501 has an opening (sound pickup hole 1131). In the space 1501, resonance (Helmholtz resonance) may occur, and affect a frequency characteristic of the microphone 301.

30 0061

FIG. 16 is a diagram depicting an example of the frequency characteristic of the microphone according to the embodiment. FIG. 16 illustrates an

example of the frequency characteristic when the microphone 301 is not incorporated in the chassis.

0062

In the conference apparatus 10 according to the embodiment, the frequency characteristic of the microphone 301 is preferably as flat as possible so that voice sound uttered by a user can be transmitted correctly to a conference apparatus of the communication destination. In the example of FIG. 16, the frequency characteristic 1601 of the microphone 301 preferably falls between a template indicating an upper limit of the frequency characteristic 1602 and a template indicating a lower limit of the frequency characteristic 1603.

15 0063

FIG. 17 is a diagram depicting an example of change in the frequency characteristic due to the space anterior to the microphone according to the embodiment. FIG. 17 illustrates an example of a case where the microphone 301 is incorporated in the chassis as illustrated in FIG. 15, and thereby resonance (sympathetic vibration) occurs in the space 1501 anterior to the microphone 301, and a peak appears at around 8 to 10 kHz. In the example of FIG. 17, due to the resonance in the space 1501 anterior to the microphone 301, the frequency characteristic of the microphone 301 does not fall between the template indicating the upper limit 1602 and the template indicating the lower limit 1603.

30 0064

Here, a measure to reduce the influence by the peak to the frequency characteristic of the microphone 301 will be described.

0065

[First embodiment]

In the embodiment, a notch is provided in the boss portion 801, and thereby the sealing
5 structure between the space 1501 anterior to the microphone 301 and the space inside the chassis is eliminated and the resonance is prevented.

0066

FIG. 18 is a diagram depicting an example
10 of a notch in a boss portion according to a first embodiment. In the example of FIG. 18, a part of the boss portion 801 is removed to provide a notch (open portion) 1801. The configuration illustrated in FIG. 18 is an example, and a number of notches may be two
15 or more.

0067

FIG. 19 is a diagram of the boss portion viewed from a side surface according to the first embodiment. According to the notch 1801, air can
20 move freely between the space 1501 anterior to the microphone 301 and the space inside the chassis. Because Helmholtz resonance in which air in a space having an opening plays a role as a spring and resonates, by causing air in the space 1501 to move
25 freely, the resonance can be prevented.

0068

FIG. 20 is a diagram depicting an example of change in frequency characteristic due to the notch according to the first embodiment. With
30 respect to the frequency characteristic 2001 in the case where there is not a notch in the boss portion 801, in the frequency characteristic 2002 in the case where there is a notch 1801 in the boss portion 801,

the peak due to the resonance is eliminated.

0069

In the embodiment, the space 1501 anterior to the microphone 301 and the space inside the chassis are not sealed, so the microphone 301 may be easily affected by noise from a cooling fan, a speaker or the like. Therefore, in the embodiment, a partition is preferably provided between the space 1505 anterior to the microphone 301 and the fan, speaker or the like inside the chassis to perform sound insulation.

0070

Alternately, noise of the fan may be removed by a noise canceller or the like.

15 0071

As described above, according to the embodiment, the boss portion is provided with a notch, and thereby resonance in the space 1501 anterior to the microphone 301 is prevented and an influence on the frequency characteristic of the microphone 301 can be prevented.

0072

[Second embodiment]

In the embodiment, the opening (sound pickup hole 1131) anterior to the microphone 301 is changed, and thereby the resonance (sympathetic vibration) frequency of the space 1501 anterior to the microphone 301 is moved, for example, to the outside of the frequency band used in electronic devices such as the conference apparatus 10.

0073

The resonance (sympathetic vibration) frequency of the space 1501 anterior to the

microphone 301 can be expressed by the following formula (mathematical expression for Helmholtz resonance)

0074

5 [Formula 1]

$$f = \frac{c}{2\pi} \sqrt{\frac{S}{VL}}$$

10 In the above expression, f corresponds to resonance frequency, c corresponds to a sound velocity, S corresponds to an opening area of the opening (sound pickup hole 1131), V corresponds to a volume of inside (space 1501), and L corresponds to a length of the opening (sound pickup hole 1131).

15 0075

According to the formula, the resonance frequency f is found to be able to be increased, for example, by increasing the area of the opening of the sound pickup hole 1131.

20 0076

FIG. 21 is a diagram depicting an example of a sound pickup hole according to a second embodiment. The sound pickup hole 1131 is a through hole arranged approximately at a center of a circumference corresponding to the boss portion 801 and having a predetermined inner diameter (e.g. 1.5 mm). For example, by changing the inner diameter of the sound pickup hole 1131, the resonance frequency of the space 1501 can be changed.

25 0077

FIG. 22 is a diagram depicting another example of the sound pickup hole according to the

second embodiment. In the example of FIG. 22, the inner diameter of the sound pickup hole 1131 is not changed, but additional sound pickup holes 2201, 2202 are provided, and thereby the opening area S of the opening of the space 1501 is substantially increased. The number of the additional sound pickup holes 2201, 2202 is an example, and may be another number. Moreover, the inner diameter of the additional sound pickup holes 2201, 2202 may not be the same as the sound pickup hole 1131.

0078

FIG. 23 is a diagram depicting a variation of the sound pickup hole according to the second embodiment. In the example of FIG. 23, the inner diameter of the sound pickup hole 1131 is increased (e.g. 2 mm), and moreover, additional sound pickup holes 2201, 2202 are provided, and thereby the change in the resonance frequency becomes greater than the example of FIG. 22. In addition, in the example of FIG. 23, the inner diameter of the additional sound pickup holes 2201, 2202 is the same as the sound pickup hole 1131. However, the inner diameter of the additional sound pickup holes 2201, 2202 may be different from the inner diameter of the sound pickup hole 1131. Moreover, the number of the additional sound pickup holes 2201, 2202 may be another number.

0079

In the above description, the explanation is made assuming that the openings of the sound pickup hole 1131 and the additional sound pickup holes 2201, 2202 have circular shapes. But, the shape does not restrict the scope of the invention. For example, the openings of the sound pickup hole

1131 and the additional sound pickup holes 2201, 2202 may have a shape of an ellipse, a polygon or the like. Moreover, regarding the change in the area of the openings of the sound pickup hole 1131 and the
5 additional sound pickup holes 2201, 2202, the explanation is made assuming the inner diameter is changed. However, the area of the openings may be changed by changing sizes other than the inner diameter (e.g. a longitudinal length, a transverse
10 length, or an aspect ratio).
0080

As described above, according to the embodiment, by changing the inner diameter of the sound pickup hole 1131 and/or adding sound pickup
15 holes, the resonance frequency of the space 1501 anterior to the microphone 301 is changed, and thereby the influence on the frequency characteristic of the microphone 301 can be reduced.
0081

20 Moreover, in the embodiment, because the state where the space 1501 anterior to the microphone 301 and the space inside the chassis are sealed by the boss portion 801 is retained, the influence of the resonance of the space 1501 can be reduced while
25 maintaining the sound insulation.
0082

[Third embodiment]

In the embodiment, for example, the chassis anterior to the microphone 301 is made thinner or the
30 length of the sound pickup hole 1131 is made shorter, and thereby the resonance (sympathetic vibration) frequency of the space 1501 anterior to the microphone 301 is moved to the outside of the

frequency band used in electronic devices such as the conference apparatus 10. According to the above-described mathematical expression for Helmholtz resonance, the resonance frequency by the space 1501
5 is found to be able to be made greater by shortening the length L of the sound pickup hole 1131.

0083

FIGs. 24A and 24B are diagrams for explaining a difference in a length of a sound pickup
10 hole according to a third embodiment. FIG. 24A depicts a state before taking measures. The thickness of the chassis anterior to the microphone 301 is assumed to be t_1 (e.g. 2 mm). Moreover, FIG. 24B depicts a state after taking measures according
15 to the embodiment. The thickness of the chassis anterior to the microphone 301 is assumed to be t_2 (e.g. 1.5 mm), which is thinner than the chassis in FIG. 24A.

0084

20 Therefore, the length of the sound pickup hole 1131 in FIG. 24B is less than the length of the sound pickup hole 1131 in FIG. 24A. In this way, by changing the thickness of the chassis anterior to the microphone 301, the resonance frequency of the space
25 1501 can be changed.

0085

In the example of FIGs. 24A and 24B, the thickness of the chassis anterior to the microphone 301 is reduced. However, it goes without saying that
30 only a part around the sound pickup hole 1131 may be made thinner.

0086

According to the embodiment, the resonance

frequency of the space 1501 anterior to the
microphone 301 can be changed without increasing the
area of the opening of the sound pickup hole 1131 and
the number of the sound pickup holes, and the
5 influence on the frequency characteristic of the
microphone 301 can be reduced.

0087

[Other embodiment]

According to the above-described
10 mathematical expression for Helmholtz resonance, the
resonance frequency of the space 1501 is found to be
able to be changed also by changing the volume V of
the space 1501. For example, by changing the height
15 h of the boss portion 801, illustrated in FIG. 14,
the volume of the space 1501 can be changed.
Specifically, by reducing the height h of the boss
portion 801, the volume V of the space 1501 is
reduced, and thereby the resonance frequency of the
space 1501 is made higher. It goes without saying
20 that the above-described changes of the area S of the
opening of the space 1501, the length L of the
opening, and the volume V can be implemented in
arbitrary combination.

0088

25 Moreover, by correcting the change in the
frequency characteristic of the microphone 301 due to
the resonance of the space 1501 by acoustic
processing, such as an equalizer, the frequency
characteristic can be brought close to flat. However,
30 because adjustment by an equalizer could lead to
voice degradation, the frequency before adjustment is
preferably close to flat.

0089

<Summary>

As described above, the microphone holding structure according to the embodiment includes a holding unit 309 formed of an elastic material for holding a microphone 301; and an elastic member (microphone rubber 302) having an attachment portion (flange portion 310) arranged around the holding unit 309. Moreover, the microphone holding structure includes a retention member (microphone holder 303) for retaining the attachment portion (flange portion 310) at a predetermined position (boss portion 801) of a first chassis (chassis upper cover 201). Furthermore, the microphone holding structure includes a second chassis (chassis lower cover 202) for fixing the retention member (microphone holder 303) to the first chassis (chassis upper cover 201).

0090

According to the above configuration, a floating structure for the microphone 301 is enabled only by the microphone rubber 302, the microphone holder 303 and chassis 1100 (chassis upper cover 201, chassis lower cover 202).

0091

Therefore, according to the embodiment, the microphone holding structure in which a microphone can be easily incorporated into a limited space of an electronic device or the like with a low cost while preventing a vibration from propagating from the chassis to the microphone can be provided.

0092

Moreover, according to the embodiment, by detaching the chassis lower cover 202 from the chassis 1100, detachment, replacement or the like of

the microphone 301 becomes easy. Therefore, the microphone holding structure in which a microphone is attachable/detachable in a limited space of an electronic device or the like with a low cost while preventing a vibration from propagation from the chassis to the microphone can be provided.

0093

Moreover, because the microphone 301 is sealed on the side surface and the rear surface by the microphone rubber 302 and the microphone holder 303 according to the above-described microphone holding structure, sound pickup of noise occurring inside the chassis, such as a fan, can be reduced.

Further, the present invention is not limited to these embodiments, but various variations and modifications may be made without departing from the scope of the present invention.

0094

The present application is based on Japanese Priority Applications No. 2014-033288 filed on February 24, 2014 and No. 2014-104108 filed on May 20, 2014, with the Japanese Patent Office, the entire contents of which are hereby incorporated by reference.

[Reference Signs List]

0095

1100 chassis

201 chassis upper cover (first chassis)

202 chassis lower cover (second chassis)

301 microphone

302 microphone rubber (elastic member)

303 microphone holder (retention unit)
306 attachment shaft (shaft portion)
308a, 308b claw portions
309 holding unit
5 310 flange portion (attachment portion)
502a, 502b bearing portions
503 projection portion
504a, 504b first rib portions
601a, 601b second rib portions
10 801 boss unit
[Citation List]
[Patent Literature]
0096
[PTL 1] Japanese Unexamined Patent Application
15 Publication No. 2004-312094
[PTL 2] Japanese Unexamined Patent Application
Publication No. 2004-304263
[PTL 3] Japanese Unexamined Patent Application
Publication No. 2003-299173
20

WHAT IS CLAIMED IS

5

[Claim 1]

A holding structure for holding a
microphone, comprising:

10 a chassis configured to be separated into
at least a first chassis and a second chassis;
an elastic member formed of an elastic
material, and including a holding unit configured to
hold the microphone and an attachment portion
provided in a periphery of the holding unit; and
15 a retention member fixed to the first
chassis by the second chassis in a state where the
second chassis is attached to the first chassis,
configured to retain the attachment portion at a
predetermined position on the first chassis.

20

[Claim 2]

25 The holding structure according to claim 1,
wherein a gap is provided between the
holding unit and the chassis and the retention member.

30

[Claim 3]

The holding structure according to claim 1

or 2,

wherein the first chassis includes a first rib portion configured to attach the retention member, and a projection portion, and

5 wherein the retention member includes a claw portion corresponding to the first rib portion and a notch portion corresponding to the projection portion.

10

[Claim 4]

15 The holding structure according to claim 3, wherein the second chassis includes a second rib portion that contacts the claw portion of the retention member when the second chassis is attached to the first chassis.

20

[Claim 5]

25 The holding structure according to any one of claims 1 to 4,

 wherein the retention member includes a shaft portion; and

30 wherein the first chassis includes a bearing portion configured to support the shaft portion.

[Claim 6]

The holding structure according to any one
of claims 1 to 5,

5 wherein the first chassis includes a boss
portion opposed to the retention member, configured
to retain the attachment portion.

10

[Claim 7]

An electronic device including the holding
structure for holding a microphone according to any
15 one of claims 1 to 6.