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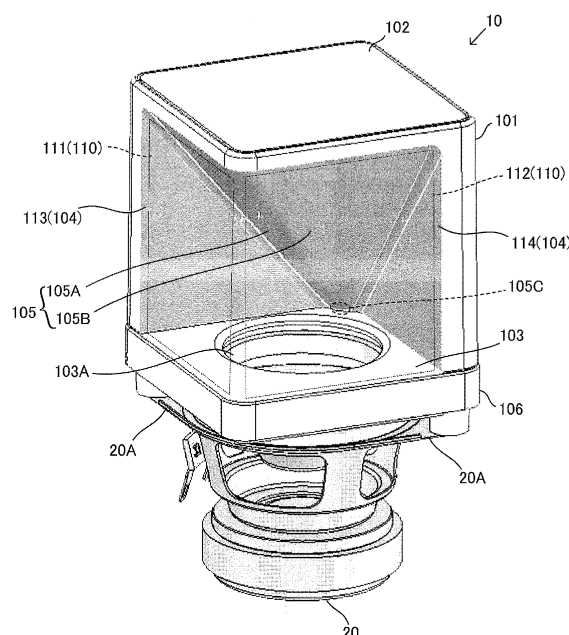
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(54) **SPEAKER DEVICE, AND HEAD PIECE**

(57) A speaker device capable of emitting a sound to a user located in front of the speaker device with good sound quality and increased flexibility of design is provided. The speaker device includes: a speaker unit oriented upward; a head piece provided on an upper side of the speaker unit; and a light emitting element provided between the speaker unit and the head piece at a position where the light emitting element does not interfere with propagation of the sound. The head piece includes a reflector configured to reflect the sound emitted by the speaker unit, in a horizontal direction. The light emitting element is oriented toward the reflector. The reflector may be a surface having a shape obtained by joining two triangles each connecting between a lower end corner of a back board and an upper edge of a sound emission opening.

FIG.2



Description

TECHNICAL FIELD

[0001] This invention relates to a speaker device and a head piece in which a speaker unit is provided so as to be oriented upward.

BACKGROUND ART

[0002] Many common speaker devices have a box shape in which a speaker unit is mounted on a front surface of the speaker device which faces a user. Thus, the speaker unit is exposed on the front surface which is viewed by the user, or the front surface is covered with a front grille shaped like a net. The front surface cannot be provided with many decorations so as not to interfere with propagation of a sound emitted by the speaker unit. Thus, the conventional speaker devices have little decorativeness. The following documents disclose speaker devices which are known as the conventional speaker devices.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0003]

Patent Document 1: Japanese Patent Application Publication No. 2007-274313
 Patent Document 2: Japanese Patent Application Publication No. 09-098495
 Patent Document 3: Japanese Patent Application Publication No. 2007-037058
 Patent Document 4: Japanese Patent Application Publication No. 11-075277

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] In the case where a speaker unit is provided on, e.g., an upper surface or a side surface of a speaker device, the front surface which is viewed by a user can be freely decorated. In this case, however, a sound emitted from the speaker unit provided on the upper or side surface cannot travel to the user with good quality. A component for reflecting the sound emitted upward or sideward, in a front direction can be provided, but the component on the contrary may deteriorate decorativeness of the speaker device. That is, there is still room for improvements in decorating the speaker device while ensuring acoustic performance of the speaker device.

[0005] The object of this invention is to decorate a speaker device while ensuring acoustic performance of the speaker device, and in particular to provide: a speaker device capable of propagating a sound to a user in front

of the device with good sound quality and increased flexibility of design; and a head piece used for the speaker device.

5 MEANS FOR SOLVING PROBLEM

[0006] A speaker device according to the present invention comprises: a first speaker unit installed so as to be oriented upward; a head piece provided on an upper side of the first speaker unit and comprising a reflector configured to reflect a sound emitted by the first speaker unit, in a direction comprising a horizontal component; and a light emitting element installed between the first speaker unit and the head piece so as to be oriented toward the reflector.

[0007] As another form of the present invention, the speaker device may be configured such that the head piece comprises: a main body comprising a substantially cubic shape; and a skirt formed so as to surround a lower portion of the main body, that a bottom plate of the main body is formed with an opening comprising a diameter substantially identical to that of an opening of the first speaker unit, that a sound emission opening is formed in adjacent two side surfaces of four side surfaces of the main body, and a back board configured to limit a direction of propagation of the sound is formed at other two side surfaces of the four side surfaces which are different from the adjacent two side surfaces, and that the light emitting element is installed at a sound-emission-opening-side corner portion inside the skirt between the bottom plate and the first speaker unit.

[0008] The reflector may comprise a surface comprising a shape formed by joining two triangles together, and each of the two triangles connects between a lower end corner of the back board and an upper edge of the sound emission opening.

[0009] The light emitting element may be installed at a position nearer in plan view to the sound-emission-opening-side corner portion than the opening formed in the bottom plate.

[0010] The speaker device according to the present invention may further comprise: a second speaker unit and a third speaker unit disposed under the first speaker unit and arranged in a vertical direction so as to be oriented in different directions, and signals in different channels may be respectively input to the second speaker unit and the third speaker unit.

[0011] The speaker device may be configured such that the second speaker unit and the third speaker unit are stored in one speaker box and that the one speaker box comprises a bass reflex port disposed such that the bass reflex port, the second speaker unit, and the third speaker unit are arranged in the vertical direction, and the bass reflex port opens in an intermediate direction between the different directions of orientation of the second speaker unit and the third speaker unit.

[0012] The second speaker unit and the third speaker unit may be installed between a listener and a wall sur-

face configured to reflect a sound emitted by each of the second speaker unit and the third speaker unit, and the second speaker unit and the third speaker unit are installed so as to be oriented toward the wall surface.

[0013] The speaker device according to the present invention may further comprise a second speaker unit installed in a back portion of a housing and provided so as to be oriented in a back direction, and the back portion may be oriented toward at least one wall configured to reflect a sound emitted from the second speaker unit.

[0014] The speaker device according to the present invention may be installed at a corner of a room such that the sound emitted by the second speaker unit is reflected off adjacent two walls as the at least one wall.

[0015] The speaker device according to the present invention may be installed such that the sound emitted by the second speaker unit is reflected off one wall as the at least one wall.

[0016] The reflector may be configured to reflect and propagate the sound emitted by the first speaker unit, in directions which form an angle greater than that in a case where the sound emitted by the first speaker unit travels straight.

[0017] A speaker device according to the present invention may be disposed spaced apart from a wall surface and comprise: a speaker grille provided on a surface of a housing, the surface facing the wall surface, the speaker grille being formed with a plurality of holes; a speaker unit disposed on an inner side of the speaker grille to emit a sound toward the wall surface; and a light emitter disposed on an inner side of the speaker grille to emit light toward the wall surface over the speaker grille.

[0018] The speaker grille may be formed of one of expanded metal and punching metal.

[0019] The speaker device may be configured such that the housing comprises a substantially quadrangular prism shape and that the speaker grille is provided over adjacent two side surfaces of the housing.

[0020] The speaker device may be configured such that the light emitter comprises a plurality of light emitting elements and that the plurality of light emitting elements are arranged along a shared edge of the adjacent two side surfaces.

[0021] A head piece according to the present invention comprises: a main body comprising a substantially cubic shape and comprising a bottom plate formed with an opening comprising a diameter substantially identical to that of an opening of the speaker unit; a skirt formed between the main body and the speaker unit; and a reflector configured to reflect a sound emitted by the speaker unit, and the head piece is installed on an upper side of a speaker unit oriented upward and is configured such that a sound emission opening is formed in adjacent two side surfaces of four side surfaces of the main body, and a back board configured to limit a direction of propagation of the sound is formed at other two side surfaces of the four side surfaces which are different from the adjacent two side surfaces and that the reflector comprises a sur-

face comprising a shape formed by joining two triangles together, and each of the two triangles connects between a lower end corner of the back board and an upper edge of the sound emission opening.

EFFECT OF THE INVENTION

[0022] According to this invention, though the speaker unit is not oriented toward a front side of the user, the sound can be reflected so as to travel toward the user, and the surface for reflecting the sound can be decoratively illuminated with light.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Figs. 1(A) and 1(B) are views each illustrating an external appearance of a speaker device according to a first embodiment of the present invention.

Fig. 2 is a perspective view of a head piece and a speaker unit in the first embodiment of the present invention.

Figs. 3(A) through 3(C) are trihedral views of the head piece and the speaker unit.

Fig. 4 is a perspective view of the head piece.

Fig. 5 is a view illustrating a direction of travel of sound emitted from the speaker unit and a direction of travel of light emitted from an LED.

Figs. 6(A) through 6(C) are views each illustrating an external appearance of a speaker device according to a second embodiment of the present invention. Fig. 7 is a view illustrating an internal structure of the speaker device.

Fig. 8 is a rear view of the speaker device, with a speaker grille removed.

Fig. 9 is a plan view illustrating examples of an installation position of the speaker device.

Fig. 10 is a block diagram illustrating an electronic circuit of the speaker device.

Fig. 11 is a perspective view illustrating one example of an installation position of a speaker device according to a third embodiment of the present invention.

Fig. 12 is a perspective view of the head piece.

Figs. 13(A) through 13(C) are views each illustrating an external appearance of a speaker device according to a fourth embodiment of the present invention. Figs. 14(A) and 14(B) are views each illustrating an external appearance of a speaker device, with a speaker grille removed.

Figs. 15(A) and 15(B) are views each illustrating one example of a mesh shape of the speaker grille.

Fig. 16 is a view illustrating one example of an installation position of the speaker device.

Fig. 17 is a view illustrating overlaps of shadows which are projected when light emitted from LEDs travels through the speaker grille.

Fig. 18 is a view illustrating one example of a shadow

projected from the speaker device onto a wall.

Fig. 19 is a view illustrating one example of a shadow projected from the speaker device onto the wall.

Fig. 20 is a view illustrating one example of a shadow projected from the speaker device onto the wall.

EMBODIMENTS OF THE INVENTION

[First Embodiment]

[0024] Hereinafter, there will be described a speaker and a head piece to which the present invention is applied, by reference to the drawings.

[0025] Fig. 1 is a view illustrating an external appearance of a speaker 1 according to a first embodiment of the present invention. Fig. 1(A) is a front elevational view, and Fig. 1(B) is a left side view. In this embodiment, the term "speaker" means a device including a speaker unit as a sound producer, and a housing (speaker box) for accommodating the speaker unit.

[0026] As illustrated, a housing 11 of the speaker 1 is shaped like a substantially quadrangular prism which slightly tapers in width toward an upper end thereof. That is, the housing 11 has a quadrangular-pyramidal trapezoid shape, accurately. The angle of inclination of a side surface of the housing 11 with respect to a vertical plane is 2%. As illustrated in the figures, this speaker 1 is installed in a state in which not the surface but an edge (the edge line) is oriented toward a front side (user side). Speaker units 20, 21, 22 are provided not at a front portion (front side) but at upper and back portions (back side) of the housing 11. Decorative illuminating elements such as LEDs are provided at the front portion (user side) instead of the speaker units. A pillow 13 having a rod shape is provided at a bottom portion of the housing 11. The speaker 1 is supported by the pillow 13 and a base 14 shaped like a round board and provided on a lower end of the pillow 13. As described above, the speaker includes the housing 11 elongated vertically and is installed in the state in which not the surface but the edge line (a corner) is located at the front portion (user side). Such a speaker has a characteristic shape and is fit in a corner of the room.

[0027] A speaker grille 12 is provided at a back portion of the housing 11 to cover speakers 21, 22 provided at the back portion. The speaker unit 20 (as one example of a first speaker unit) is oriented upward and secured to an upper end of a speaker box 30 which serves as a space formed in an upper portion of the housing 11. A head piece 10 according to the present invention is provided on an upper side of the speaker unit 20. The speaker unit 20, the speaker box 30, and the head piece 10 constitute a speaker device according to the present invention.

[0028] Fig. 2 is a perspective view of the head piece 10 and the speaker unit 20 removed from the speaker 1. Fig. 3(A) is a plan view of the head piece 10 and the speaker unit 20, Fig. 3(B) is a front elevational view of

the head piece 10 and the speaker unit 20, and Fig. 3(C) is a right side view of the head piece 10 and the speaker unit 20. Fig. 4 is a perspective view of the head piece 10 and illustrates a circuit board 40 disposed therein. In the following explanation, a right and left direction is defined based on a state in which the speaker 1 is viewed from a user from a front side of the speaker 1. Also, an up and down direction of the head piece 10 is defined based on a state in which the head piece 10 is installed above a front side of the speaker unit 20 oriented upward.

[0029] As illustrated in Fig. 2, the head piece 10 has a substantially rectangular parallelepiped shape. However, since the head piece 10 is shaped integrally with the housing 11, the head piece 10 slightly tapers upward, whereby the outside diameter of a top board 102 (the length of a diagonal line) is slightly less than that of a bottom board 103. It is noted that the head piece 10 is constituted by: a main body 101, as an upper portion, having a sound emission opening 110; and a skirt 106 as a lower portion. The main body 101 is substantially shaped like a cube. The bottom board 103 of the head piece 10 has a round opening 103A at its central portion. The diameter of the opening 103A is substantially equal to that of the speaker unit 20.

[0030] The main body 101 shaped substantially like a cube has four side surfaces, front two of which are side surfaces 111, 112 each having a cutout serving as the sound emission opening 110. Back two of the four side surfaces are side surfaces 113, 114 each provided with a wall board which serves as a back board 104 for preventing a sound from spreading rearward. A reflector 105 (105A, 105B) is formed in the main body 101. This reflector 105 is constituted by two triangle surfaces each connecting between (a) a vertex 105C located at a lower portion (a lower end) of sides interposed between the two side surfaces 113, 114 serving as the back board 104 and (b) a corresponding one of upper sides of the two side surfaces 111, 112 serving as the cutout or the sound emission opening 110 (upper edges of the sound emission opening 110). Since the main body 101 is shaped substantially like a cube, each of the left and right surfaces 105A, 105B of the reflector 105 forms an angle of about 45 degrees with respect to a horizontal plane such as the bottom board 103.

[0031] As described above, the skirt 106 extending downward is formed around the bottom board 103 of the head piece 10. The height of the skirt 106 is about one-fourth of the height of the entire head piece 10. The skirt 106 is assembled such that its lower end is held in contact with a flange 20A of the speaker unit 20. A central axis of the speaker unit 20 and that of the head piece 10 coincide with each other in the assembled state.

[0032] The head piece 10 and the speaker unit 20 are screwed together and secured to the housing 11. As a result, the speaker unit 20 is mounted on the upper end of the speaker box 30. The upper end of the speaker box 30 has an opening shaped like the flange 20A of the speaker unit 20. When the speaker unit 20 is mounted

on the speaker box 30, the opening is closed so as to form a closed space therein.

[0033] A space 120 equal in height to the skirt 106 is formed between the speaker unit 20 and the bottom board 103 of the head piece 10. The circuit board 40 is provided in the space 120. The circuit board 40 is provided near a lower portion of a front left portion, i.e., the opening of the left side surface 111, so as to avoid the positions of the speaker unit 20 and the opening 103A of the bottom board 103. An LED 41 is provided on the circuit board 40. The LED 41 is provided on a central portion of a front portion of the head piece 10, i.e., a front end portion of the head piece 10. The LED 41 provided at this position cannot be directly viewed from the user. If the user is to look into the head piece 10, the user cannot view the LED 41 due to the top board 102.

[0034] Fig. 5 is a view illustrating directions of travel of sound and light propagating in the head piece 10. The speaker unit 20 is disposed under the head piece 10 so as to be oriented upward vertically while sharing the central axis with the head piece 10, and the angle of inclination of each surface of the reflector 105 of the head piece 10 is about 45 degrees. Thus, as indicated by arrows 201, the sound emitted upward from the speaker unit 20 is reflected off the reflector 105 and propagates so as to spread in front right and left directions (as one example of a horizontal direction and a direction including a horizontal component). With this construction, even in the case where the sound is emitted upward from the speaker unit 20, the sound can be reflected off the reflector 105 and propagate in the front right and left directions with little loss. Furthermore, this construction can eliminate the need for providing a speaker grille on the front surface, resulting in improvement in flexibility of design of the front surface.

[0035] The head piece 10 including the reflector 105 is formed of resin, and the head piece 10 is smooth but does not have a mirror-finished surface. That is, regular reflection can be considered to be caused by sound waves, but diffuse reflection is considered to be caused by waves having a short wavelength such as light. The diffuse reflection is a phenomenon in which an incident light is reflected in all directions, which makes the area appear bright (to glow). Provided in front of the space 120 formed under the bottom board 103, the LED 41 is never viewed by the user. When the LED 41 is lit, the LED 41 illuminates the interior of the head piece 10 as indicated by arrows 202 in the figure, that is, the LED 41 illuminates the top board 102, the back board 104, and the reflector 105. The reflector 105, in particular, receives the greatest amount of light among them, so that the diffuse reflection occurs on the reflector 105, resulting in bright illumination (noted that illustration of arrows indicating scattered light is omitted in the figure). As a result, the speaker 1 can not only reproduce sounds but also create a decorative atmosphere.

[0036] It is noted that the shapes of the speaker 1 and the head piece 10 are not limited to those described

above. The speaker 1 and the head piece 10 may be modified, without departing from the spirit of the present invention. For example, the speaker 1 may be configured such that the speaker unit 20 is oriented downward, and the head piece 10 is disposed under the speaker unit 20 oriented downward. In the case where the speaker unit 20 and the head piece 10 are arranged as described above, the reflector 105 has two triangle surfaces each connecting between an upper end corner of the back boards and a corresponding one of lower sides of the left side surface 111 and the right side surface 112. With this construction, even in the case where the sound is emitted downward from the speaker unit 20, the sound can be reflected off the reflector 105 and propagate in the front right and left directions with little loss. The head piece 10 may be configured not to include the LED 41.

[Second Embodiment]

[0037] There will be next explained a second embodiment. It is noted that the same reference numerals as used in the first embodiment are used to designate the corresponding elements of the second embodiment, and an explanation of which is dispensed with.

[0038] Here, the second embodiment is created based on the following findings.

[0039] Common stereo speaker systems include speaker boxes for right and left channels, and these speaker boxes are arranged in the right and left direction (see Patent Document 2, for example). This construction requires a large footprint, making it difficult to install the speaker system at a corner of a room, leading to low flexibility in design.

[0040] To solve this problem, there is disclosed an invention of a speaker device including: an elongated housing shaped like a quadrangular prism and standing upright; and a plurality of speaker units provided on all respective four side surfaces of the housing (see Patent Document 3, for example). This speaker device delays and adjusts the timing at which each of the speaker units outputs an audio signal, to output a sound beam as a sound wave with directivity. This speaker device outputs the sound beams toward a floor and a ceiling of a room to cause the sound beams to be reflected a plurality of times, and accordingly indirect sounds reach a listener from many directions. This configuration achieves an effect in which the listener does not feel an accurate position of the speaker device.

[0041] Also in the speaker device disclosed in Patent Document 2, the speaker rows for the respective right and left channels are provided separately, which limits reduction in width of the housing. Furthermore, in the speaker device disclosed in Patent Document 3, since the plurality of speaker units are provided on all the respective four side surfaces of the housing as described above, there is no room for decoration, resulting in limitation of a design of the speaker device.

[0042] Therefore, the present embodiment is devel-

oped to provide a speaker device capable of emitting sounds in stereo with a slim external appearance.

[0043] Fig. 6 illustrates an external appearance of the speaker device according to the second embodiment. Fig. 6(A) is a front elevational view, Fig. 6(B) is a right side view, and Fig. 6(C) is a rear view. Fig. 7 is a view illustrating an internal structure of the speaker device. Fig. 8 is a rear view illustrating the speaker device, with the speaker grille removed.

[0044] A speaker device 1a according to the embodiment of the present invention includes: the housing 11 for accommodating a plurality of speakers; the base 14 shaped like a round board and provided on a floor surface to support the housing 11; and the pillow 13 shaped like a rod and connecting the housing 11 and the base 14 to each other. The housing 11 is supported by the pillow 13 and the base 14 and provided upright in the vertical direction.

[0045] The housing 11 is shaped like a substantially quadrangular prism which slightly tapers in width toward an upper end thereof. That is, the housing 11 has a quadrangular-pyramidal trapezoid shape (a shape obtained by horizontally cutting out a vertex portion or a head portion from a quadrangular pyramid in a plane with a bottom surface of the pyramid), accurately. The angle of inclination of the side surface of the housing 11 with respect to the vertical line is 2%.

[0046] As illustrated in Fig. 6(C), the speaker grille 12 is provided across an edge line portion 18 of the housing. In the following explanation, a direction directed from the center of the housing to the edge line portion 18 illustrated in Fig. 6(C) is defined as a back direction, and a direction directed from the center to the edge line portion 19 illustrated in Fig. 6(A) and opposed to the edge line portion 18 is defined as a front direction. However, any of the edge line portions may be set on a front side (a user side). In the following explanation, it is assumed that the front direction of the speaker device is referred to as a front direction, and the back direction is referred to as a rear direction. Also, a right and left direction is defined based on a state in which the speaker device 1a is viewed from the user located on a front side.

[0047] The interior of the housing 11 is divided by two partition plates into three spaces in the up and down direction. The three spaces include: an upper space as the speaker box 30, for middle range, which accommodates the speaker unit 20 (as another example of the first speaker unit); a central space as a stereo speaker box 31 for accommodating speaker units 21a, 22a; and a lower space as a circuit box 32 for accommodating an electronic circuit 15.

[0048] Fig. 7 is a view illustrating an internal structure of the speaker device, with a front portion of the housing 11 cut out. Fig. 8 is a rear view of the speaker device, with the speaker grille 12 removed. As illustrated in Figs. 7 and 8, the stereo speaker box 31 is open in its back surface, and a baffle board 24 is provided in this opening. This baffle board 24 is not flat but curved in the right and

left direction so as to match the quadrangular prism shape of the housing 11. The speaker units 21a, 22a are mounted on the baffle board 24, and a bass reflex port 23 is formed in the baffle board 24. The speaker unit 21a (as one example of a second speaker unit) is a speaker unit for a right channel and mounted so as to be oriented in an obliquely right and rear direction. The speaker unit 22a (as one example of a third speaker unit) is a speaker unit for a left channel and mounted so as to be oriented in an obliquely left and rear direction. Each of the speaker units 21a, 22a is mounted at an angle of about 45 degrees in the right and left direction with respect to the back direction. The bass reflex port 23 is formed so as to extend rearward and communicate with the interior of the stereo speaker box 31 via a duct 125. The bass reflex port 23 is formed principally for emphasizing low sounds, and accordingly there is a small need of considering channels and directivity. Thus, the bass reflex port 23 is opened for both of the right and left channels so as to be oriented toward a midway point between the right and left channels. The baffle board 24 is covered with the speaker grille 12. The speaker grille 12 is formed of a metal mesh and as illustrated in Fig. 6(B) is substantially flush with the housing 11.

[0049] An upper surface of the speaker box 30 for middle range has an opening in which the speaker unit 20 is mounted so as to be oriented upward. The head piece 10 is provided on the upper side of the speaker unit 20 such that sounds emitted from the speaker unit 20 are reflected off the head piece 10 in the front direction.

[0050] Fig. 9 is a plan view illustrating an installation position of the speaker device 1a. Fig. 9(A) is a view illustrating a situation in which the speaker device 1a is installed such that its back side, i.e., the speaker units 21a, 22a are oriented toward the front side (the user side). Fig. 9(B) is a view illustrating a situation in which the speaker device is installed such that its front side is oriented toward the front side (user side), and the speaker units 21a, 22a are oriented toward a wall 300 located at a rear of the speaker device. In any of the situations, sound signals in different channels (the right and left channels in this embodiment) are input to the respective speaker units 21a, 22a.

[0051] In the installation position in Fig. 9(A), a sound emitted from the speaker unit 21a propagates in an obliquely left and front direction, and a sound emitted from the speaker unit 22a propagates in an obliquely right and front direction. The sounds propagate leftward and rightward and are thereby given spatial impression. Also, since the sounds propagating leftward and rightward are in respective different channels, stereophonic audibility can be given to the user.

[0052] In the case where the speaker units 21a, 22a are oriented toward the wall 300 as in Fig. 9(B), a sound emitted from the speaker units 21a propagates while spreading in the right and rear direction and is reflected off an area 301 of the wall surface 300, and a sound emitted from the speaker units 22a propagates while

spreading in the left and rear direction and is reflected off an area 302 of the wall surface 300. The reflected sounds propagate frontward and reach the user. As a result, the sounds in the right and left channels, which are emitted from the speaker units 21a, 22a arranged in the vertical direction with small horizontal width in arrangement, propagate to the user as if the sounds are emitted from the areas 301, 302 having a horizontal width on the wall surface 300, so that the user can listen to stereo sounds with spatial impression.

[0053] In Fig. 6, the electronic circuit 15 is disposed in the circuit box 32 of the housing 11. Fig. 10 is a block diagram illustrating main portions of the electronic circuit 15. The electronic circuit 15 includes a controller 50, a signal processor 51, an audio amplifier 52, an input selector 53, a Bluetooth (registered trademark) communication circuit 54, and a cable connector 55.

[0054] The controller 50 is constituted by a microcomputer. A light receiving circuit 40a is connected to the controller 50, and this light receiving circuit 40a receives an infrared signal transmitted from an infrared remote control, not shown. The light receiving circuit 40a includes a light receiving element 42 which is provided on a front portion of the housing 11 to convert the received infrared signal to an electronic signal and input it to the controller 50. Based on the signals received from the light receiving circuit 40a, the controller 50 selects an input signal in the input selector 53, adjusts sound quality in the signal processor 51, adjusts a sound volume in the audio amplifier 52, and turns on and off the Bluetooth communication circuit 54, for example.

[0055] The signal processor 51 adjusts sound quality of an audio signal (a two-channel stereo signal) input from the input selector 53. Also, the signal processor 51 extracts components in a middle range, from signals in the right and left channels, and synthesizes the extracted components to output the obtained signal as an audio signal in a third channel. That is, the signal processor 51 functionally includes band-pass filters 66, 67 and a mixer 68. The audio amplifier 52 functionally includes amplifier circuits 64, 65, 69 for three channels which respectively amplify audio signals in the left channel, the right channel, and the middle range. The amplifier circuit 64 amplifies a sound signal in the left channel to output it to the speaker 22a. The amplifier circuit 65 amplifies a sound signal in the right channel to output it to the speaker 21a.

[0056] In this electronic circuit 15, the sound signal in the right channel is input to the speaker unit 21a, and the sound signal in the left channel is input to the speaker unit 22a. That is, the right and left channels are assigned for the case where the speaker units 21a, 22a are oriented toward the wall 300 (toward an opposite side from the user) as illustrated in Fig. 9(B), but the assignment of the right and left channels may be reversed in the case where the speaker units 21a, 22a are arranged as illustrated in Fig. 9(A). A reverse switch may be provided to flip channel of sound signals that are input from the input selector 53 to the amplifier circuits 64, 65 and the band-pass filters

66, 67.

[0057] As described above, the speaker unit 20 provided on the upper surface of the housing 11 reinforces the sound in the middle range. The band-pass filter 66 extracts sound signals in the middle range (e.g., 100Hz-7kHz) from those in the left channel to output the extracted signals to the mixer 68. Likewise, the band-pass filter 67 extracts sound signals in the middle range from those in the right channel to output the extracted signals to the mixer 68. The mixer 68 synthesizes the input sound signals in the middle range in the left channel and the input sound signals in the middle range in the right channel to output the synthesized signals to the amplifier 69. The amplifier 69 amplifies the synthesized signals in the middle range to output them to the speaker unit 20. Accordingly, the speaker unit 20 emits synthesized sounds in the middle range in the right and left channels. The range to be extracted by the band-pass filters 66, 67 is not limited to the middle range. Even in the case where the speaker unit 20 emits sounds in a range different from the middle range, an effect corresponding to the range can be obtained.

[0058] In the above-described embodiment, the two speaker units 21a, 22a are vertically arranged on the baffle board 24, but the number of speaker units is not limited to two. Also, the number of channels for sounds to be input to the speaker units is not limited to two.

[0059] It is noted that the shape of the housing 11 of the speaker device 1a is not limited to the quadrangular-pyramidal trapezoid shape and may be any shape as long as the housing 11 is shaped generally like a column such as a conical trapezoid shape, a circular cylindrical shape, and a prism shape. The elements in this embodiment may be modified, without departing from the spirit of the present invention.

[0060] The LED 41 may be provided in the head piece 10 of the speaker device 1a as illustrated in Fig. 4 as in the first embodiment and may not be provided in the head piece 10.

[Third Embodiment]

[0061] There will be next explained a third embodiment. It is noted that the same reference numerals as used in the first and second embodiments are used to designate the corresponding elements of the third embodiment, and an explanation of which is dispensed with.

[0062] Here, the third embodiment is created based on the following findings.

[0063] The speaker unit is generally a point sound source, but in the case where the speaker unit and a user are spaced apart from each other, sounds emitted from the speaker unit spread to form an acoustic space called a sound field. To form this sound field, a distance equal to or greater than a certain amount is required between the speaker device and the user as a listener.

[0064] In the case of the stereo system, the speakers for the respective right and left channels need to be

spaced apart from each other at a certain distance for stereo sound localization of the sounds in the right and left channels. For achieving this configuration, a speaker device (a speaker box) having a large width in the right and left direction is required as disclosed in Patent Document 2, for example.

[0065] However, not enough distance may be ensured between the user and the speaker device in, e.g., a small room, in which case enough spatial impression cannot be provided for the emitted sounds. Also, the right and left speaker boxes cannot be arranged at enough distance therebetween in some case due to a space of an installation area or the structure of the housing, for example, in which case stereo sound localization and spatial impression cannot be achieved sufficiently. Also, in the case where the housing of the speaker device is designed attaching an importance to arrangement of the speaker units, flexibility of design is reduced, not leading to a speaker device having a novel design.

[0066] Therefore, the present embodiment is developed to provide a speaker device having a width small enough to be installed in a space-limited area and capable of emitting sounds with spatial impression.

[0067] The speaker device 1b according to the third embodiment has the same structure as that of the speaker device 1a according to the second embodiment. Fig. 6(A) is the front elevational view, Fig. 6(B) is the right side view, and Fig. 6(C) is the rear view. Fig. 8 is the rear view of the speaker device 1b, with the speaker grille 12 removed.

[0068] Fig. 11 is a perspective view illustrating one example of an installation position of the speaker device 1b. As illustrated in Fig. 11, the speaker device 1b is installed in a state in which the edge line portion 19 interposed between the two side surfaces is located on a front side (a user side). In the following explanation, the front direction of the speaker device is referred to as a front direction, and the back direction is referred to as a rear direction. Also, a right and left direction is defined based on a state in which the speaker device 1b is viewed from the user located on a front side.

[0069] In this speaker device 1b, the speaker units 21a, 22a are oriented in respective obliquely rear directions. Thus, as illustrated in Figs. 6(B) and 6(C), the speaker grille 12 is provided on a back portion (back side) of the housing 11. As illustrated in Fig. 6(C), the speaker grille 12 is provided across the edge line portion 18 of the housing.

[0070] Fig. 12 is a perspective view of the head piece 10. The head piece 10 includes: the main body 101, as the upper portion, having the sound emission opening 110; the top board 102 disposed on an upper side of the main body 101; and the skirt 106 as the lower portion. The main body 101 is shaped substantially like a cube. The bottom board 103 of the head piece 10 has the round opening 103A at its central portion. The diameter of the opening 103A is substantially equal to that of the speaker unit 20 (as another example of the first speaker unit).

[0071] The reflector 105 (105A, 105B) is formed in the main body 101. This reflector 105 is constituted by the two triangle surfaces each connecting between (a) the lower vertex 105C of the sides interposed between the two side surfaces 113, 114 serving as the back board 104 and (b) the corresponding one of the upper sides of the two side surfaces 111, 112 serving as the sound emission opening 110 (the cutout). Since the main body 101 is shaped substantially like a cube, each of the left and right surfaces 105A, 105B of the reflector 105 forms an angle of about 45 degrees with respect to the horizontal plane such as the bottom board 103.

[0072] A sound emitting surface of the speaker unit 20 is disposed under the head piece 10 so as to be oriented upward vertically while sharing the central axis with the head piece 10. Also, each surface of the reflector 105 of the head piece 10 faces the sound emitting surface of each surface of the speaker unit 20, and the angle of inclination of each surface of the reflector 105 is about 45 degrees. Thus, as indicated by arrows 201a in Fig. 12, the sound emitted upward from the speaker unit 20 is reflected off the reflector 105 and propagates so as to spread in front right and left directions. With this construction, the sound can be emitted upward from the speaker unit 20, reflected off the reflector 105, and propagate so as to spread in the front right and left directions from front portions of the side surfaces of the housing 11 with little loss for a short distance.

[0073] As illustrated in Fig. 11, the speaker device 1b is installed in front of one wall 80 (as one example of at least one wall) in a state in which a rear portion of the speaker device 1b faces the wall 80. A front portion of the speaker device 1b is not provided with the speaker units or the speaker grille, resulting in high decorative flexibility on a surface which can be viewed by the user.

[0074] As illustrated in Fig. 9(B), each of the speaker units 21a, 22a is oriented toward the wall 300 (as one example of the at least one wall) but inclined in the right and left direction with respect to a direction perpendicular to the surface of the wall 300. Sound signals in the left channel are input to the speaker unit 22a (as another example of the second speaker unit), and sound signals in the right channel are input to the speaker unit 21a (as another example of the second speaker unit). Sounds emitted from the speaker units 22a, 21a propagate while spreading in the rear left and rear directions and are reflected off the respective areas 302, 301 of the wall surface 300. The reflected sounds propagate frontward and reach the user. As a result, the sounds in the left and right channels emitted from the speaker units 22a, 21a propagate to the user via the respective speaker units 22a, 21a and the respective areas 302, 301. That is, the sounds reach the user after traveling for a longer distance than in the case where the sounds travel directly to the user. With this configuration, the sounds are emitted with more spatial impression than in the case where the sounds travel directly to the user. Also, since the sounds in the left and right channels are reflected off the respec-

tive areas 302, 301 of the wall surface 300, positions at which sounds in the respective left and right channels are produced are imaginarily localized to the respective areas 302, 301. Consequently, the sounds travel to the user like sounds emitted from the areas 302, 301, so that the user can listen to stereo sounds with spatial impression. Here, the wall 300 is not limited to a wall of a building as long as the wall 300 is generally a vertical planar surface which reflects sounds.

[0075] As described above, the sounds emitted from the speaker units 21a, 22a are reflected off the wall surface 300 and propagate toward the user, and the sounds emitted from the speaker unit 20 are reflected off the reflector 105 of the head piece 10 and propagate toward the user. Accordingly, even in the case where the distance between the speaker device 1b and the user is short, the user can listen to sounds with more spatial impression than that provided if the sounds travel to the user directly for the distance. The LED 41 may be provided in the head piece 10 of the speaker device 1a as illustrated in Fig. 4 as in the first embodiment and may not be provided in the head piece 10.

[Fourth Embodiment]

[0076] There will be next explained a fourth embodiment. It is noted that the same reference numerals as used in the first to third embodiments are used to designate the corresponding elements of the fourth embodiment, and an explanation of which is dispensed with.

[0077] Here, the fourth embodiment is created based on the following findings.

[0078] Use of the speaker device for not only an acoustic device but also a decorative illuminating device has been proposed. For example, Patent Document 4 discloses an invention of an audio system having a structure in which a light source and a rotor are provided in a speaker box, and light reflected off a surface of the rotor is illuminated to the outside of the speaker box through an opening formed in the speaker box.

[0079] In the speaker device disclosed in Patent Document 4, light emitted from the speaker box revolves to emitted sounds, thereby achieving a decorative effect. However, the speaker device is configured such that the rotor and a motor are provided in the speaker box, and the motor rotates the rotor, resulting in increase in size and complication of the device.

[0080] Therefore, the present embodiment is developed to provide a speaker device capable of performing decorative illumination with a simple construction.

[0081] Fig. 13 illustrates an external appearance of the speaker device 1c according to the fourth embodiment. Fig. 13(A) is a front elevational view, Fig. 13(B) is a right side view, and Fig. 13(C) is a rear view. Fig. 14 illustrates an external appearance of the speaker device, with the speaker grille removed. Fig. 14(A) is a right side view, and Fig. 14(B) is a rear view.

[0082] The speaker device 1c according to the embod-

iment of the present invention includes: the housing 11 for accommodating a plurality of speakers; the base 14 shaped like a round board and provided on a floor surface to support the housing 11; and the pillow 13 shaped like a rod and connecting the housing 11 and the base 14 to each other. The housing 11 is supported by the pillow 13 and the base 14 and provided upright in the vertical direction.

[0083] The speaker device 1c is installed in a state in which the edge line portion 19 interposed between the two side surfaces is located on a front side (a user side). In the following explanation, the front direction of the speaker device is referred to as a front direction, and the back direction is referred to as a rear direction. Also, a right and left direction is defined based on a state in which the speaker device 1c is viewed from the user located on a front side.

[0084] In this speaker device 1c, the speaker units are oriented not in the front direction but in the rear direction. Thus, as illustrated in Figs. 13(B) and 13(C), the speaker grille 12 is provided on a back portion of the housing 11. As a result, the speaker grille 12 need not be provided on a front portion of the speaker device 1c, and decorative LEDs 16 are provided on the edge line portion 19 of the front surface of the housing 11.

[0085] The back speaker box 31 is open in its adjacent two back side surfaces, and the baffle board 24 is provided in the opening. This baffle board 24 is not flat but curved in the right and left direction so as to match the shape of the housing 11 in the opening. The speaker units 21a, 22a, the bass reflex port 23, and a plurality of LEDs 25 are mounted on the baffle board 24. The speaker unit 21a is a speaker unit for the right channel and mounted so as to be oriented in an obliquely right and rear direction. The speaker unit 22a is a speaker unit for the left channel and mounted so as to be oriented in an obliquely left and rear direction. The bass reflex port 23 is formed so as to extend and communicate with the interior of the stereo speaker box 31 via the duct. The plurality of LEDs 25 are arranged vertically on an edge line portion (a front portion viewed from the rear side) of the baffle board 24. In this figure, the five LEDs 25 are provided as an example.

[0086] The baffle board 24 is covered with the speaker grille 12. As illustrated in Fig. 13, the speaker grille 12 is substantially flush with the housing 11 and curved in the right and left direction. The speaker grille 12 is provided principally for protecting the speaker units 21a, 22a and is a mesh plate having a plurality of holes. For example, the speaker grille 12 is formed of expanded metal illustrated in Fig. 15(A), punching metal illustrated in Fig. 15(B), or other similar material.

[0087] The upper surface of the speaker box 30 has an opening in which the speaker unit 20 is mounted so as to be oriented upward. The head piece 10 is provided on the upper side of the speaker unit 20 such that sounds emitted from the speaker unit 20 are reflected off the head piece 10 in the front direction. The head piece 10

contains the LED 41 as illustrated in Fig. 4. During operation of the speaker device 1c, the LED 41 is lit to illuminate an inner surface of the head piece 10 decoratively.

[0088] Fig. 16 is a view illustrating one example of an installation position of the speaker device 1c. Fig. 17 is a view for explaining a configuration in which light emitted from the LEDs 25 travels through the speaker grille 12. As illustrated in Fig. 16, the speaker device 1c is installed at a corner of a room or near a wall surface in a state in which a back portion of the speaker device 1c faces the wall 80. Since the LEDs 16 are provided decoratively on the front portion without the speaker units and the speaker grille, and the LEDs 25 provided in the speaker grille 12 emit light toward the wall 80, the shape of the speaker grille 12 is projected onto the wall 80. That is, the speaker device 1c functions also as a decorative interior unlike common speaker devices.

[0089] When the plurality of (five) LEDs 25 provided on an inner side of the speaker grille 12 are lit, the light emitted from each of the LEDs 25 travels through the mesh of the speaker grille 12, forming a pattern (shape) of light and shadow. As illustrated in Fig. 17, the patterns formed by the respective LEDs 25 are projected onto the wall 80 while overlapping each other. In Fig. 17, the speaker grille 12 is illustrated by a single line. However, as illustrated in Fig. 13, the speaker grille 12 is curved in the right and left direction so as to match the housing 11, whereby the patterns projected on the wall 80 are made more complicated, resulting in higher decorativeness.

[0090] Figs. 18-20 are views each illustrating patterns of light and shadow projected on the wall 80 using light emitted from the LEDs 25 of the speaker device. Fig. 18 illustrates an example in which the expanded metal in the lateral position is used as the speaker grille 12. Fig. 19 illustrates an example in which the expanded metal in the vertical position is used as the speaker grille 12. Fig. 20 illustrates an example in which the punching metal in the lateral position is used as the speaker grille 12.

[0091] In the case where the expanded metal is used in the lateral position, as illustrated in Fig. 15(A), the speaker grille 12 has a pattern of openings each having a horizontal rhombus shape. When lights traveling through the pattern of openings overlap each other, a pattern of light and shadow as illustrated in Fig. 18 is projected on the wall 80, and the pattern is extended in an obliquely lateral direction with intersecting light and shadow.

[0092] In the case where the expanded metal is used in the vertical position, the speaker grille 12 has a pattern of openings each having a vertical rhombus shape obtained by rotating the shape illustrated in Fig. 15(A) by 90 degrees. When lights traveling through the pattern of openings overlap each other, a pattern of light and shadow as illustrated in Fig. 19 is projected on the wall 80, and the pattern is extended in an obliquely vertical direction with intersecting light and shadow.

[0093] In the case where the punching metal is used, as illustrated in Fig. 15(B), the speaker grille 12 has a

pattern of round openings arranged regularly. When lights traveling through the pattern of openings overlap each other, a pattern of light and shadow which is repeated vertically and laterally as illustrated in Fig. 20 is projected on the wall 80.

[0094] It is noted that the LEDs 25 may be spaced at regular or irregular intervals. All the plurality of LEDs 25 may be lit at all times, but the LEDs 25 may be kept blinking successively at different timings. This configuration can change patterns to be projected.

[0095] It is noted that the shape of the housing 11 of the speaker device 1c is not limited to the quadrangular-pyramidal trapezoid shape and may be a column shape such as a conical trapezoid shape, a circular cylindrical shape, and a prism shape and may be a shape such as a rectangular parallelepiped shape. The shape of the housing 11 may be any shape, without departing from the spirit of the present invention. The technical scope of the invention also contains a speaker device in which speaker units and an illuminating device (a light emitter) are disposed in a front portion of the speaker device and which is disposed in a state in which the front portion faces a wall surface.

[0096] The LED 41 may be provided in the head piece 10 of the speaker device 1a as illustrated in Fig. 4 as in the first embodiment and may not be provided in the head piece 10.

EXPLANATION OF REFERENCE NUMERALS

[0097] 1: Speaker (Device), 10: Head Piece, 11: Housing, 12: Speaker Grille, 20: Speaker Unit, 40: Circuit Board, 41: LED, 101: Main Body; 102: Top Board, 103: Bottom Board, 103A: Opening, 104: Back Board, 105: Reflector, 1a: Speaker Device, 21a: Speaker Unit, 22a: Speaker Unit, 23: Bass Reflex Port, 300: Wall Surface, 1b: Speaker Device, 80: Wall Surface, 1c: Speaker Device, 25: LED

Claims

1. A speaker device, comprising:

a first speaker unit installed so as to be oriented upward;
a head piece provided on an upper side of the first speaker unit and comprising a reflector configured to reflect a sound emitted by the first speaker unit, in a direction comprising a horizontal component; and
a light emitting element installed between the first speaker unit and the head piece so as to be oriented toward the reflector.

2. The speaker device according to claim 1, wherein the head piece comprises: a main body comprising a substantially cubic shape; and a skirt

- formed so as to surround a lower portion of the main body,
 wherein a bottom plate of the main body is formed with an opening comprising a diameter substantially identical to that of an opening of the first speaker unit, wherein a sound emission opening is formed in adjacent two side surfaces of four side surfaces of the main body, and a back board configured to limit a direction of propagation of the sound is formed at other two side surfaces of the four side surfaces which are different from the adjacent two side surfaces, and wherein the light emitting element is installed at a sound-emission-opening-side corner portion inside the skirt between the bottom plate and the first speaker unit.
3. The speaker device according to claim 2, wherein the reflector comprises a surface comprising a shape formed by joining two triangles together, and each of the two triangles connects between a lower end corner of the back board and an upper edge of the sound emission opening.
 4. The speaker device according to claim 2 or 3, wherein the light emitting element is installed at a position nearer in plan view to the sound-emission-opening-side corner portion than the opening formed in the bottom plate.
 5. The speaker device according to any one of claims 1 through 4, further comprising: a second speaker unit and a third speaker unit disposed under the first speaker unit and arranged in a vertical direction so as to be oriented in different directions, wherein signals in different channels are respectively input to the second speaker unit and the third speaker unit.
 6. The speaker device according to claim 5, wherein the second speaker unit and the third speaker unit are stored in one speaker box, and wherein the one speaker box comprises a bass reflex port disposed such that the bass reflex port, the second speaker unit, and the third speaker unit are arranged in the vertical direction, and the bass reflex port opens in an intermediate direction between the different directions of orientation of the second speaker unit and the third speaker unit.
 7. The speaker device according to claim 5 or 6, wherein the second speaker unit and the third speaker unit are installed between a listener and a wall surface configured to reflect a sound emitted by each of the second speaker unit and the third speaker unit, and the second speaker unit and the third speaker unit are installed so as to be oriented toward the wall surface.
 8. The speaker device according to any one of claims 1 through 4, further comprising a second speaker unit installed in a back portion of a housing and provided so as to be oriented in a back direction, wherein the back portion is oriented toward at least one wall configured to reflect a sound emitted by the second speaker unit.
 9. The speaker device according to claim 8, wherein the speaker device is installed at a corner of a room such that the sound emitted by the second speaker unit is reflected off adjacent two walls as the at least one wall.
 10. The speaker device according to claim 8, wherein the speaker device is installed such that the sound emitted by the second speaker unit is reflected off one wall as the at least one wall.
 11. The speaker device according to any one of claims 8 through 10, wherein the reflector is configured to reflect and propagate the sound emitted by the first speaker unit, in directions which form an angle greater than that in a case where the sound emitted by the first speaker unit travels straight.
 12. A speaker device disposed spaced apart from a wall surface, the speaker device comprising:
 - a speaker grille provided on a surface of a housing, the surface facing the wall surface, the speaker grille being formed with a plurality of holes;
 - a speaker unit disposed on an inner side of the speaker grille to emit a sound toward the wall surface; and
 - a light emitter disposed on an inner side of the speaker grille to emit light toward the wall surface over the speaker grille.
 13. The speaker device according to claim 12, wherein the speaker grille is formed of one of expanded metal and punching metal.
 14. The speaker device according to claim 12 or 13, wherein the housing comprises a substantially quadrangular prism shape, and wherein the speaker grille is provided over adjacent two side surfaces of the housing.
 15. The speaker device according to claim 14, wherein the light emitter comprises a plurality of light emitting elements, and wherein the plurality of light emitting elements are arranged along a shared edge of the adjacent two side surfaces.
 16. A head piece installed on an upper side of a speaker

unit oriented upward, the head piece comprising:

a main body comprising a substantially cubic shape and comprising a bottom plate formed with an opening comprising a diameter substantially identical to that of an opening of the speaker unit; 5
a skirt formed between the main body and the speaker unit; and
a reflector configured to reflect a sound emitted by the speaker unit, 10
wherein a sound emission opening is formed in adjacent two side surfaces of four side surfaces of the main body, and a back board configured to limit a direction of propagation of the sound 15
is formed at other two side surfaces of the four side surfaces which are different from the adjacent two side surfaces, and
wherein the reflector comprises a surface comprising a shape formed by joining two triangles 20
together, and each of the two triangles connects between a lower end corner of the back board and an upper edge of the sound emission opening. 25

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FIG.1

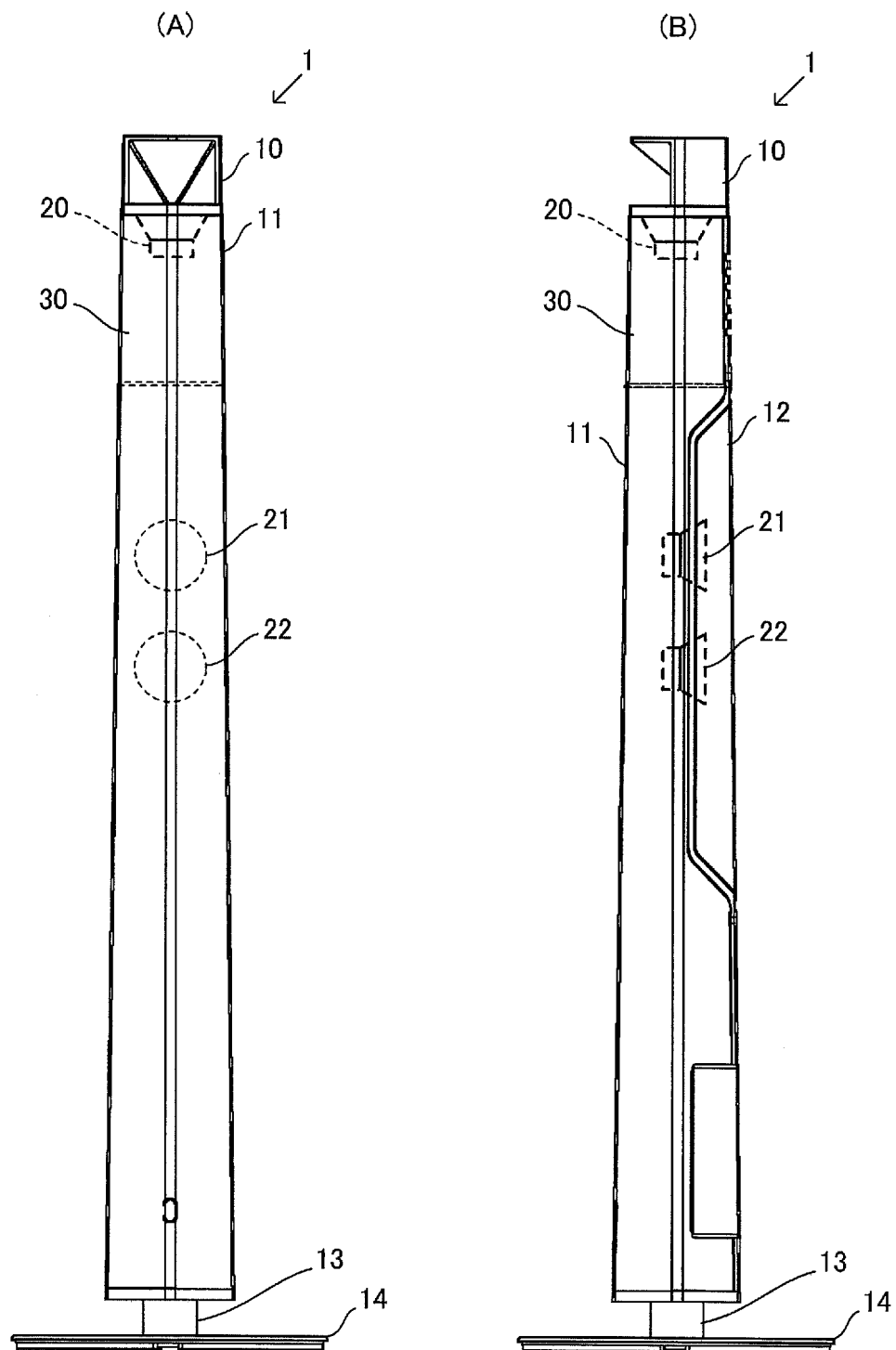


FIG.2

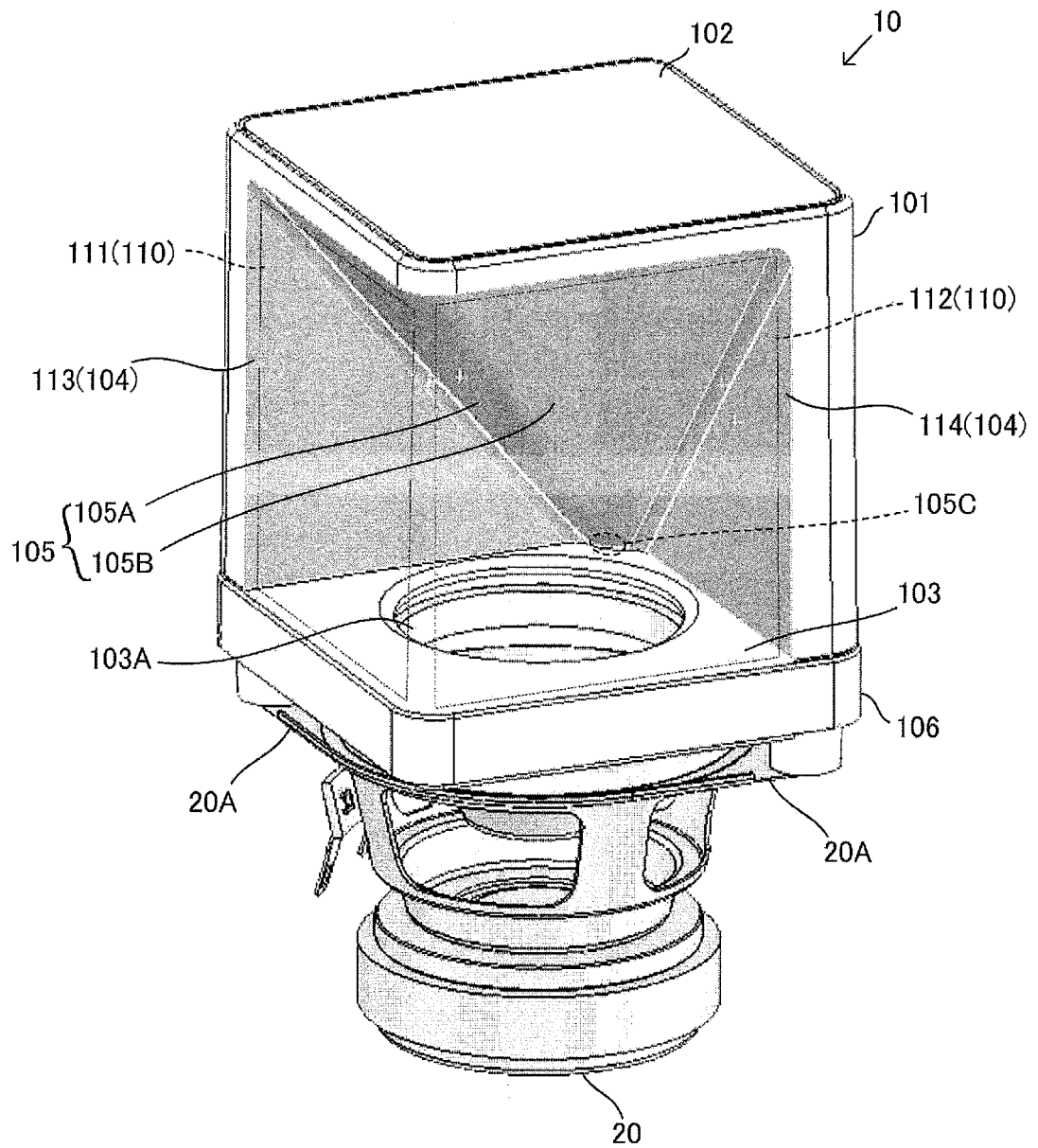


FIG.3

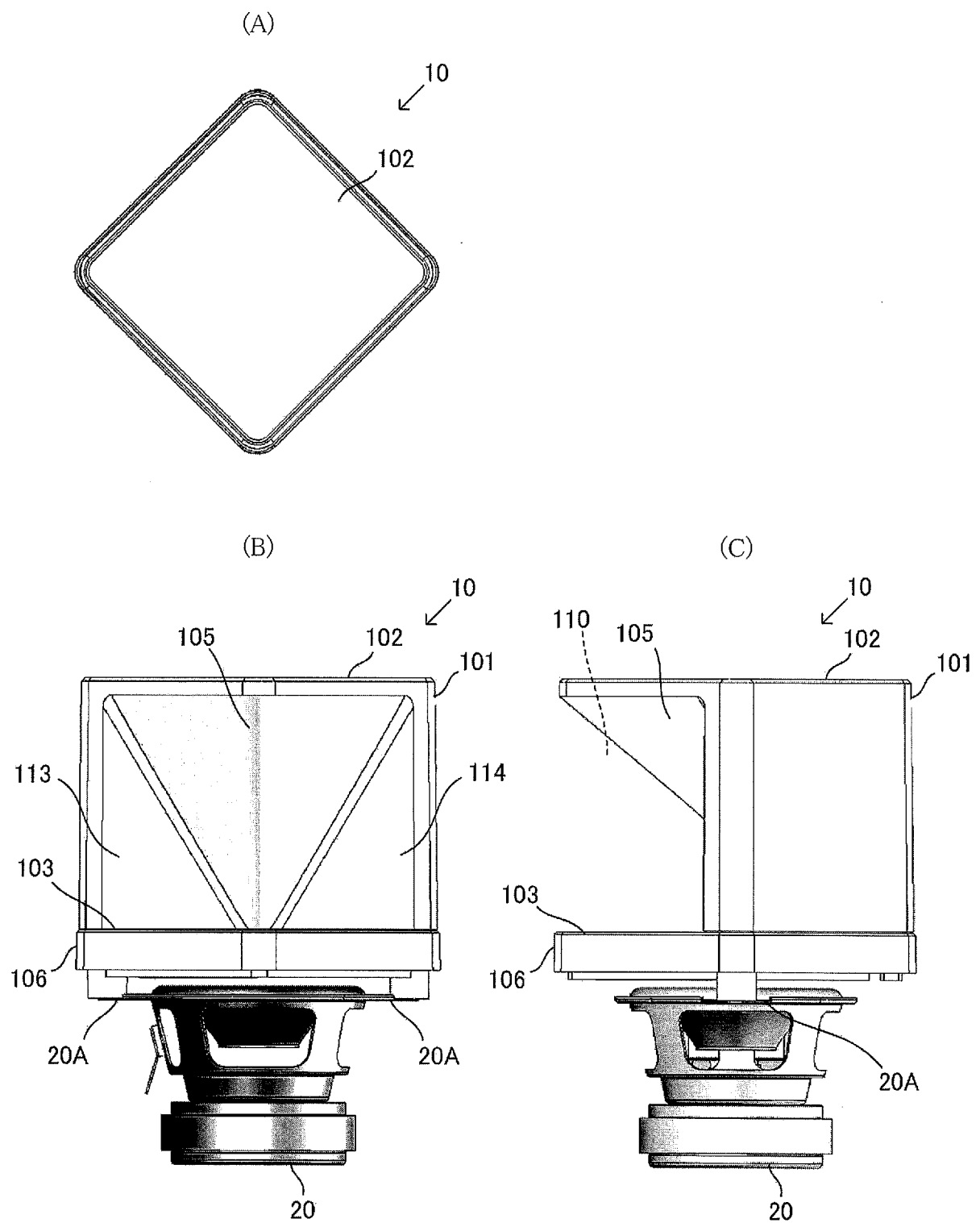


FIG.4

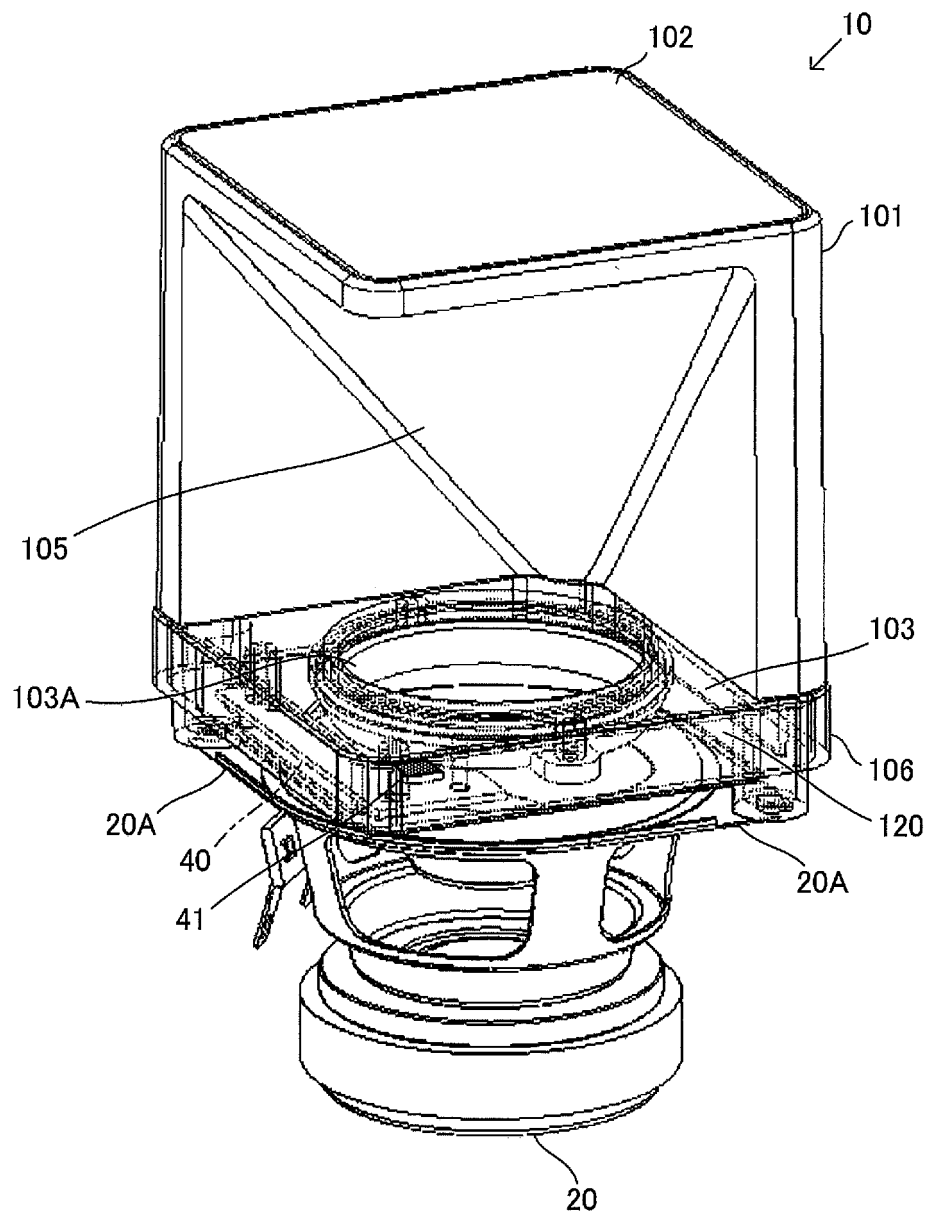


FIG.5

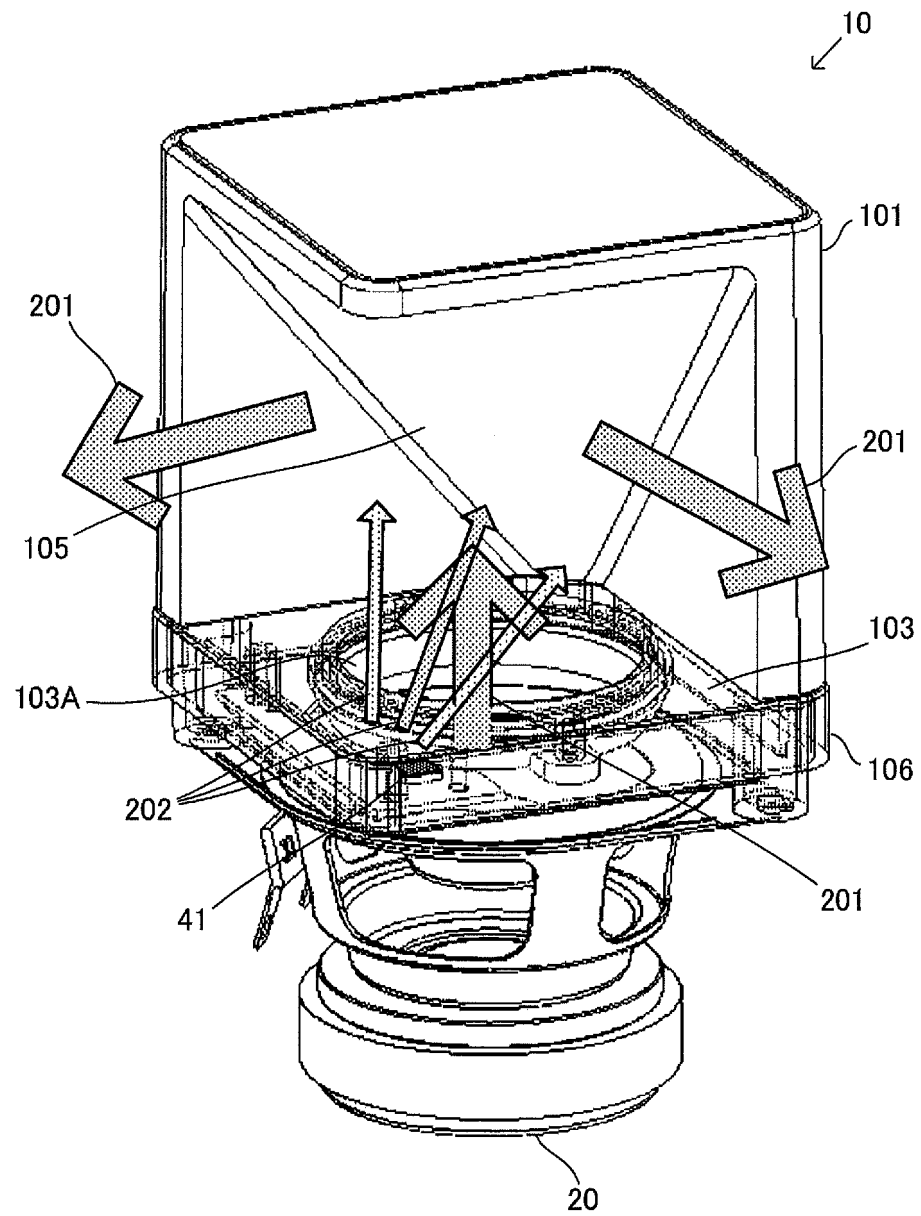


FIG.6

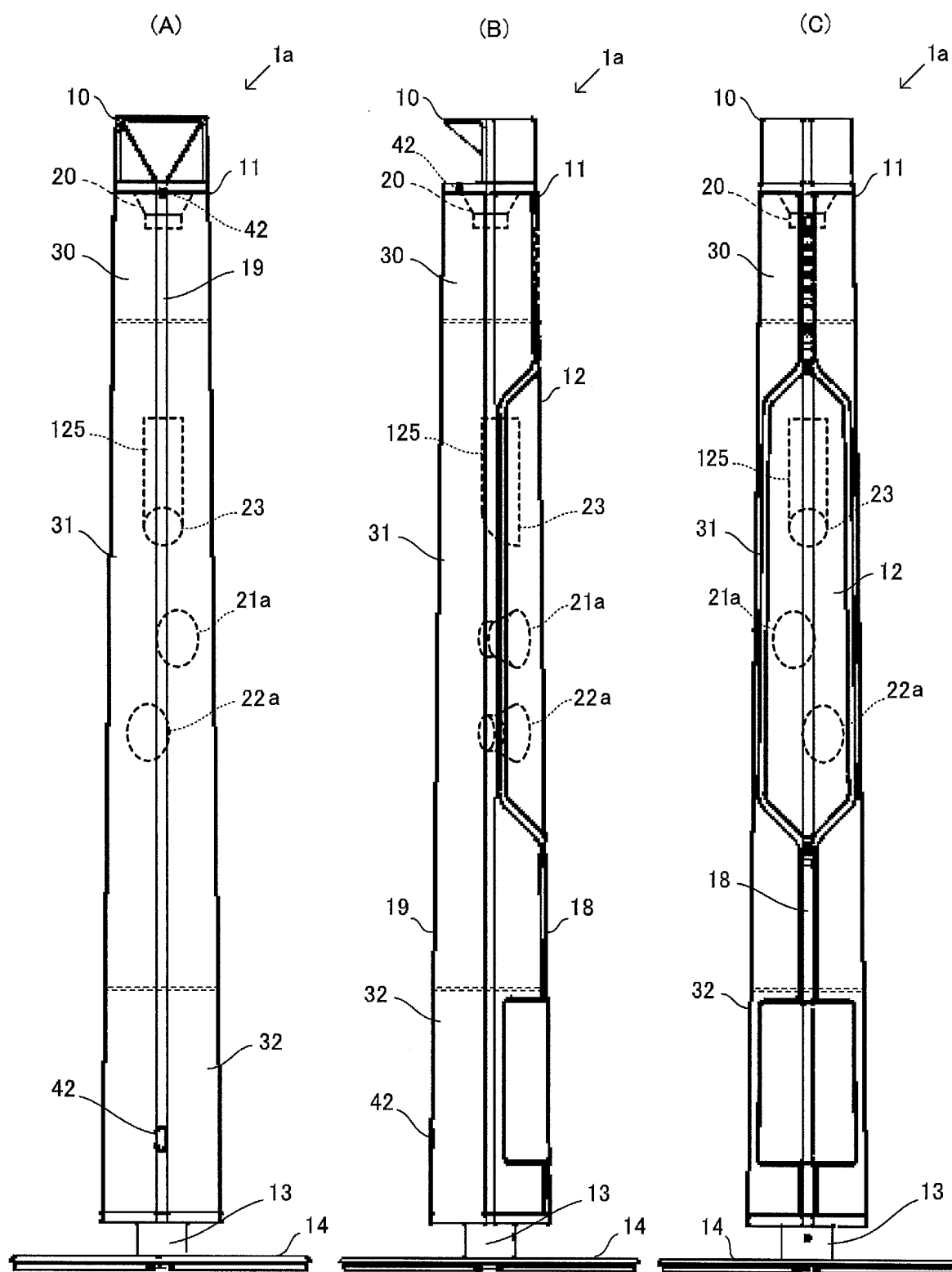


FIG.7

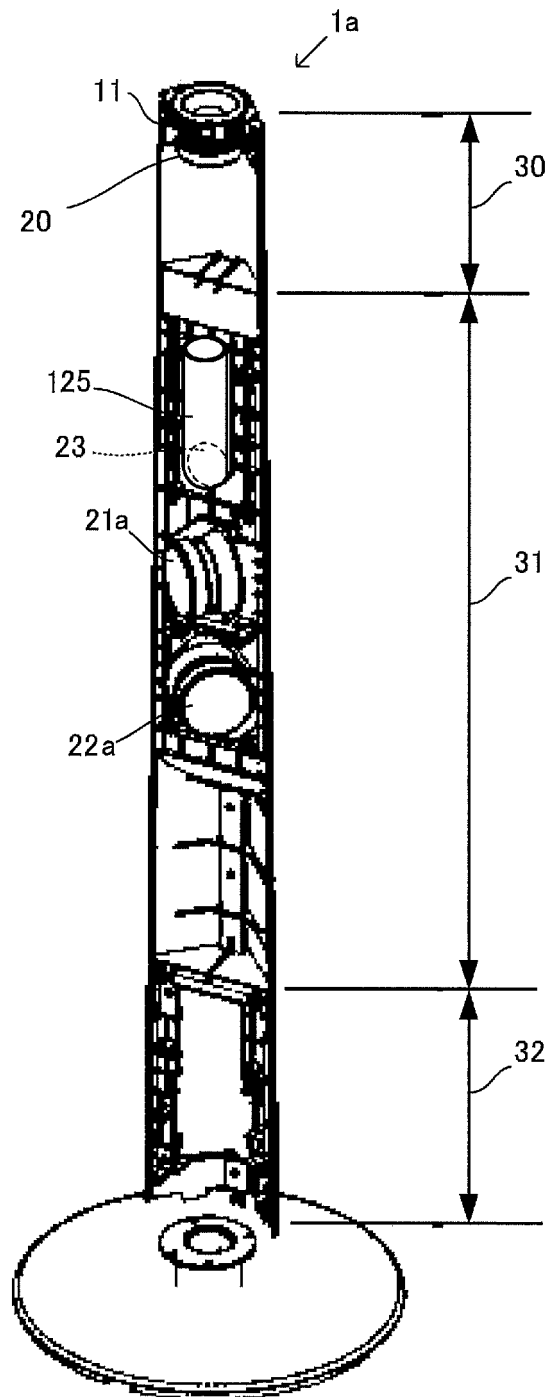


FIG.8

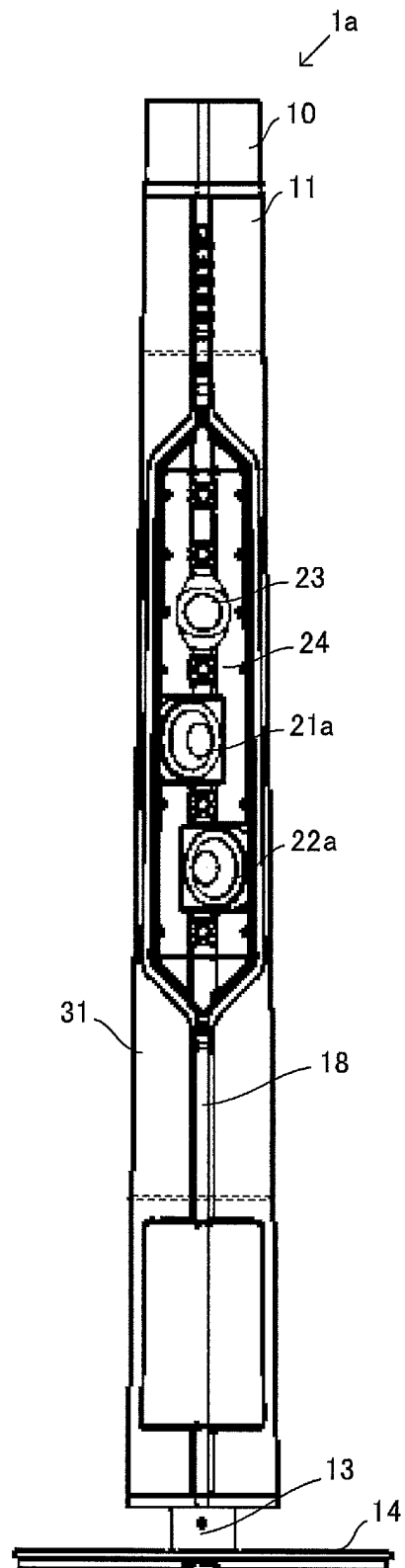


FIG.9

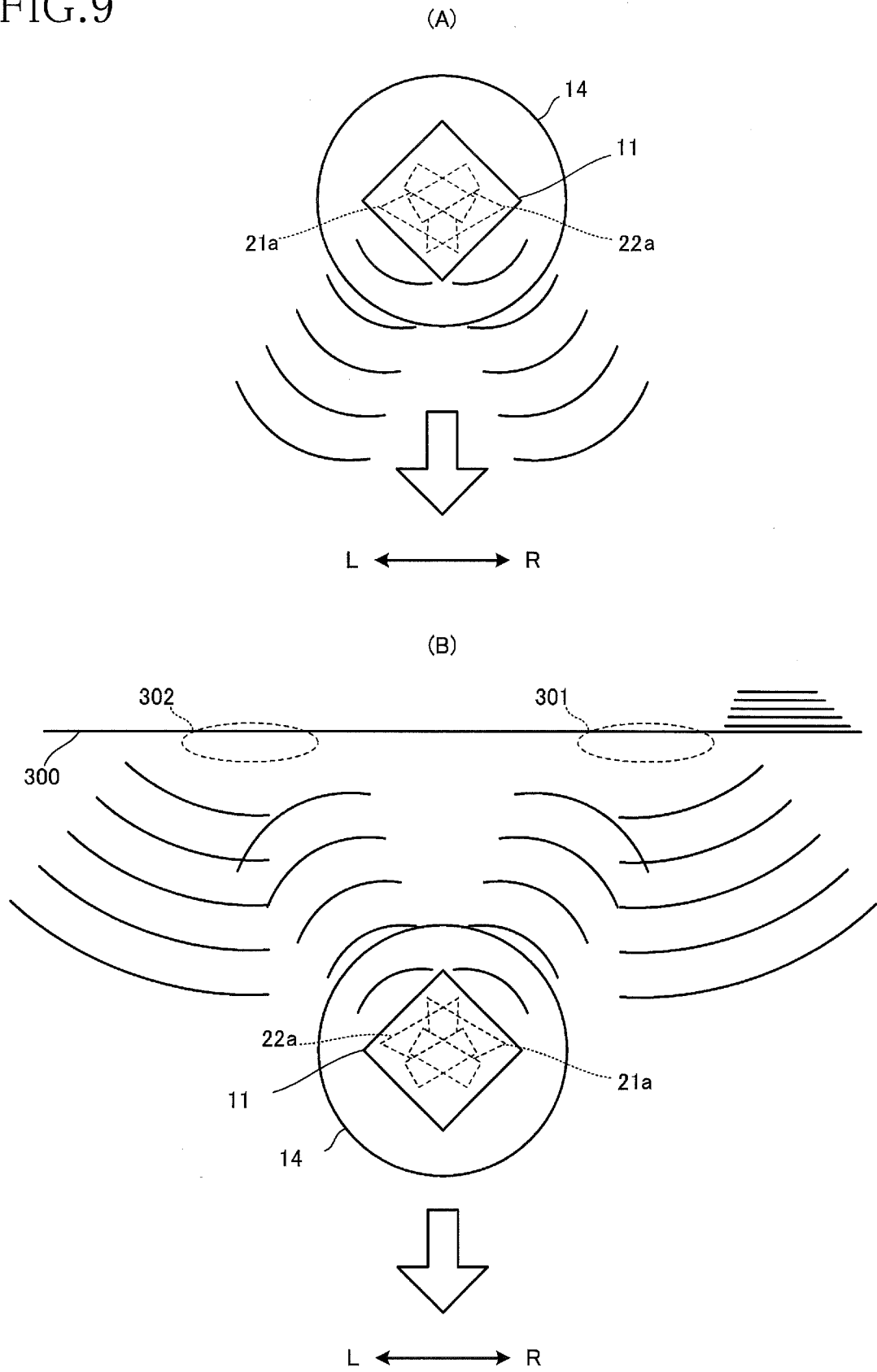


FIG.10

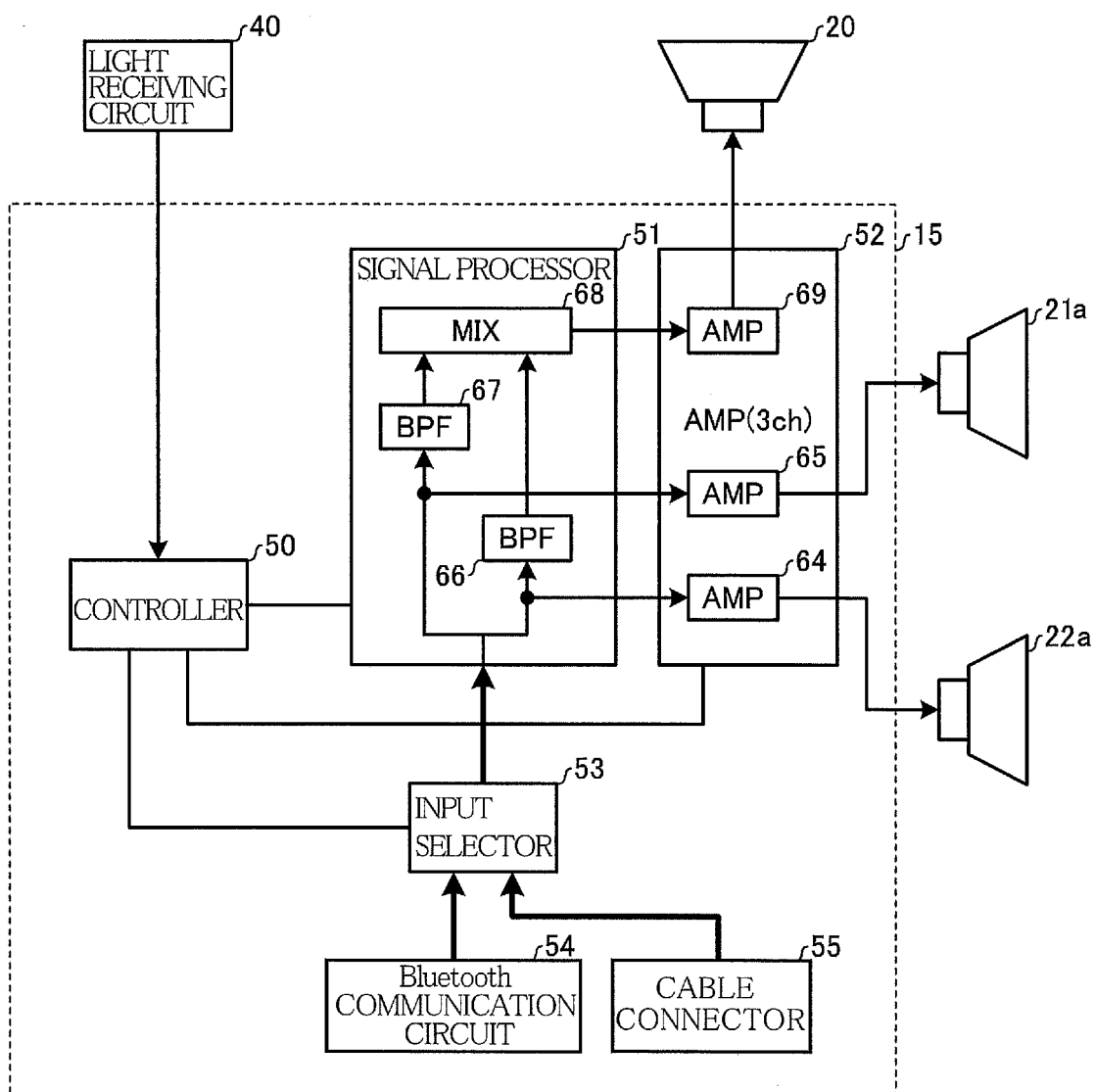


FIG.11

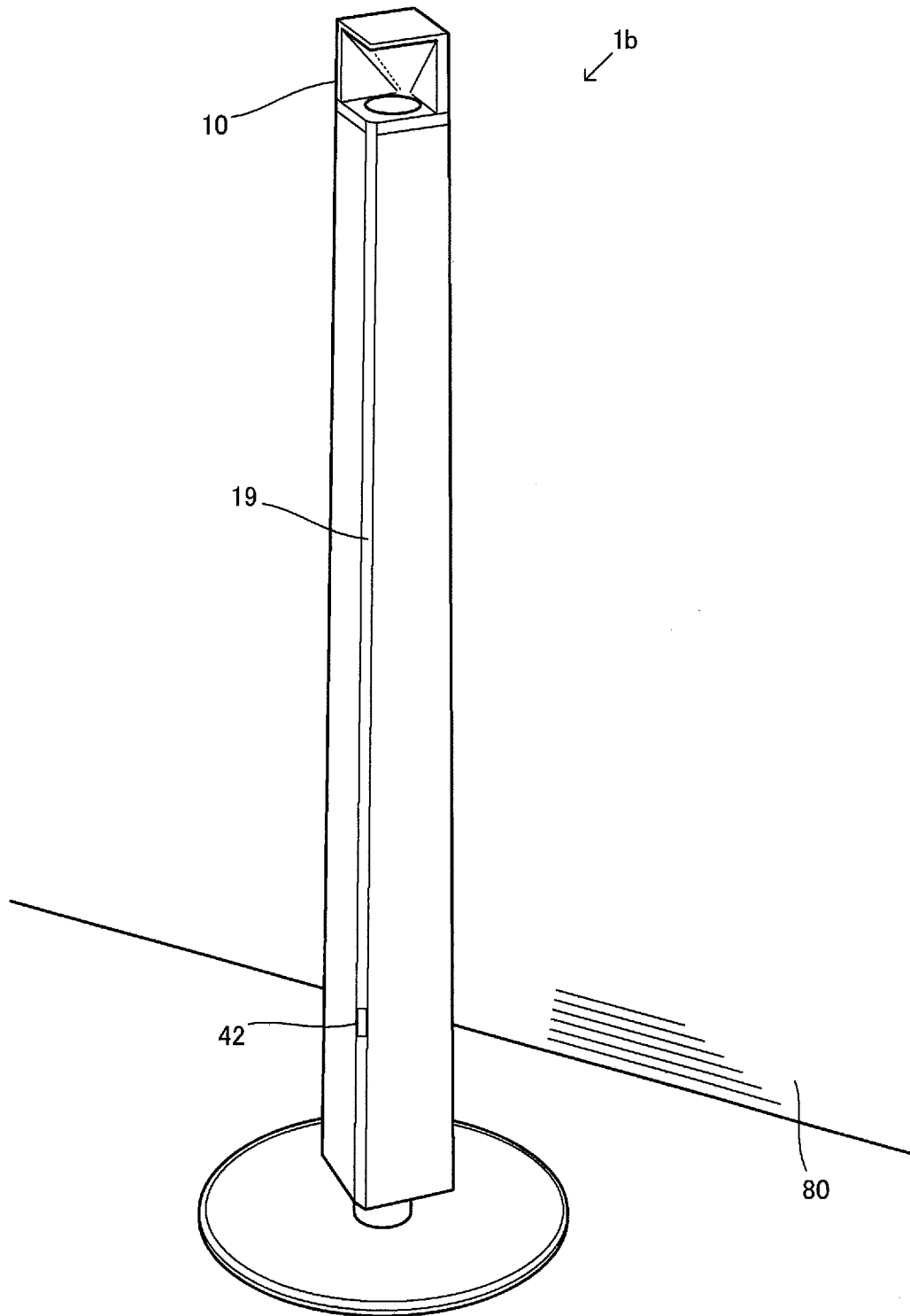


FIG.12

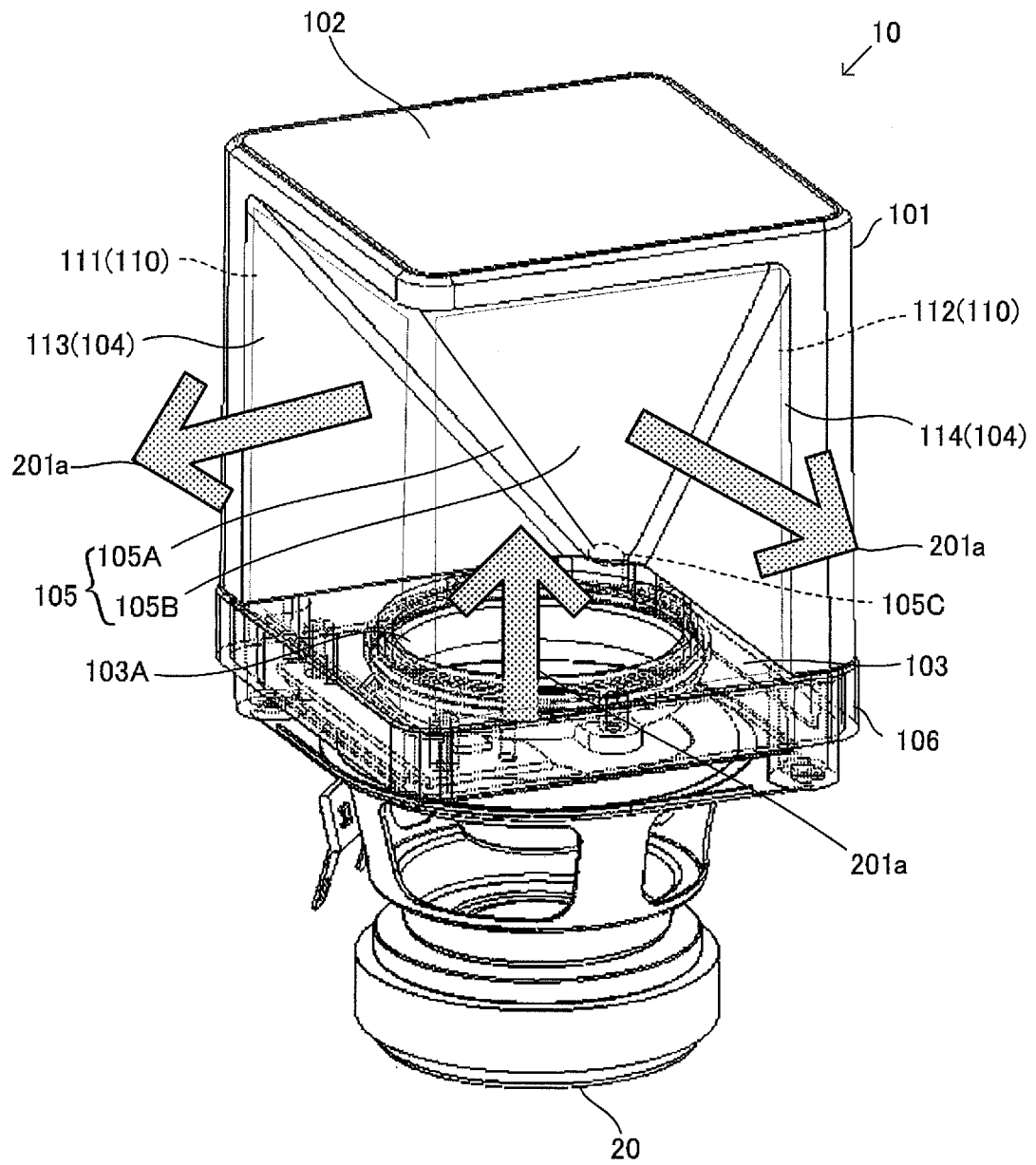


FIG.13

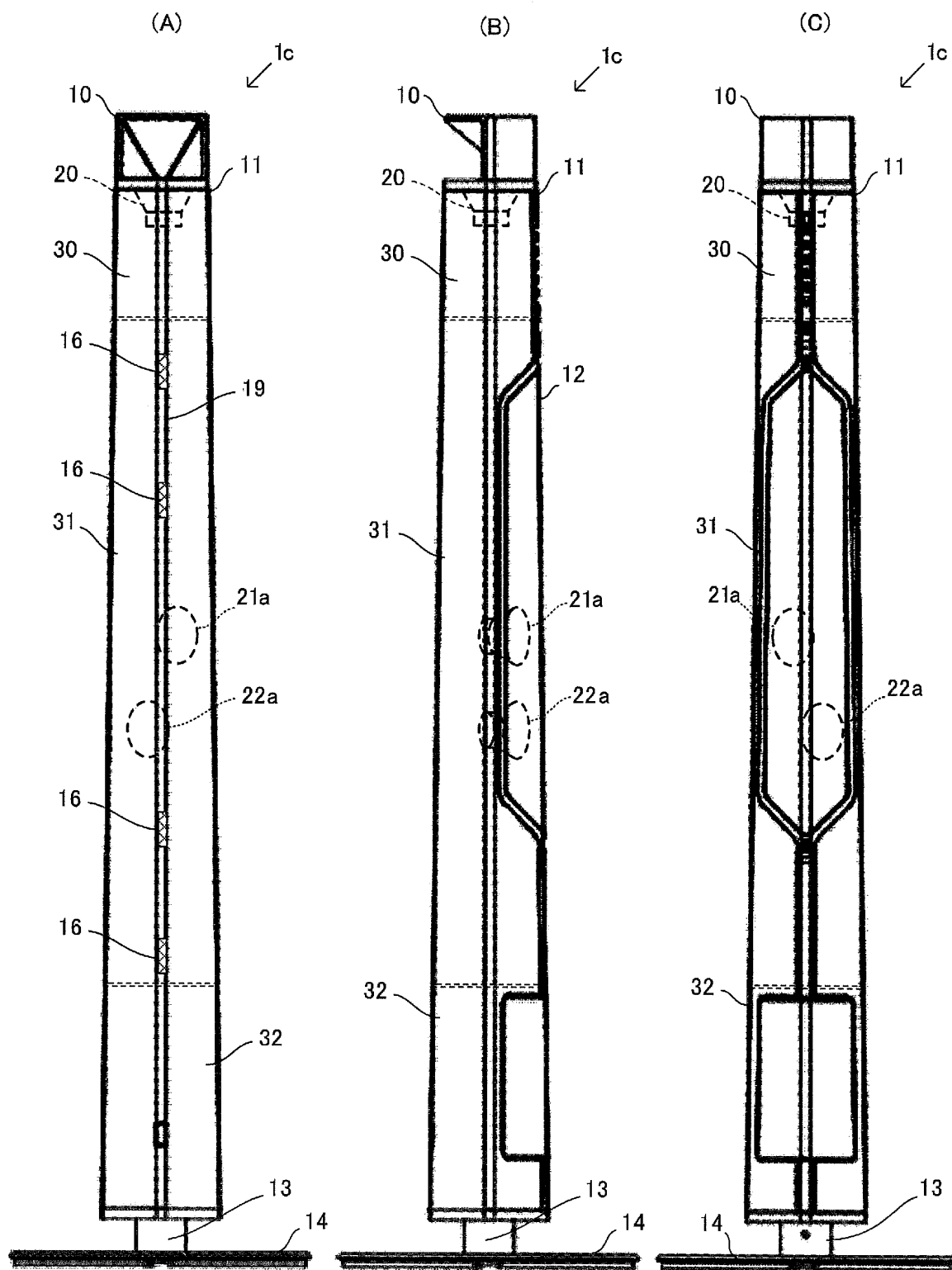


FIG.14

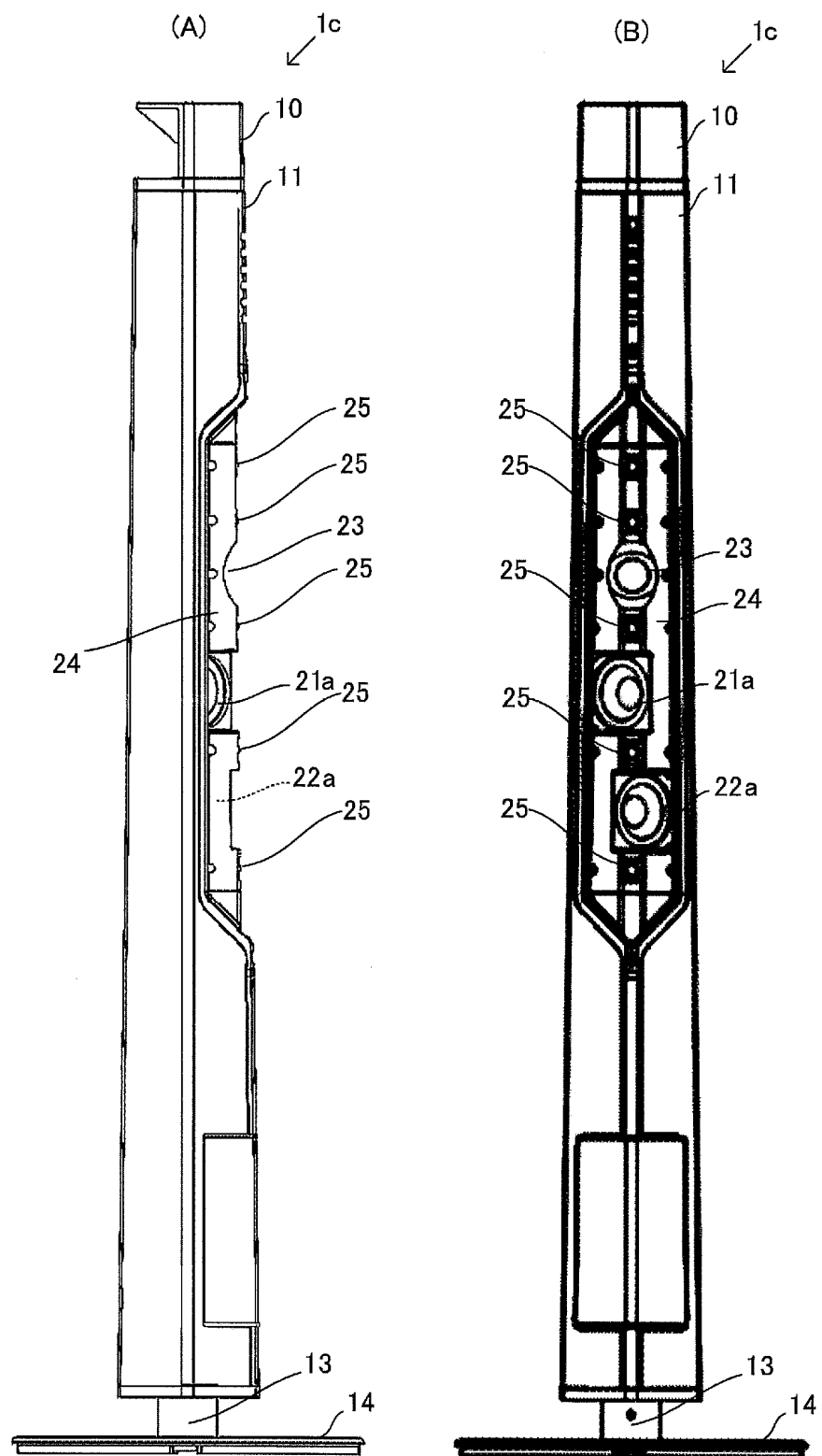
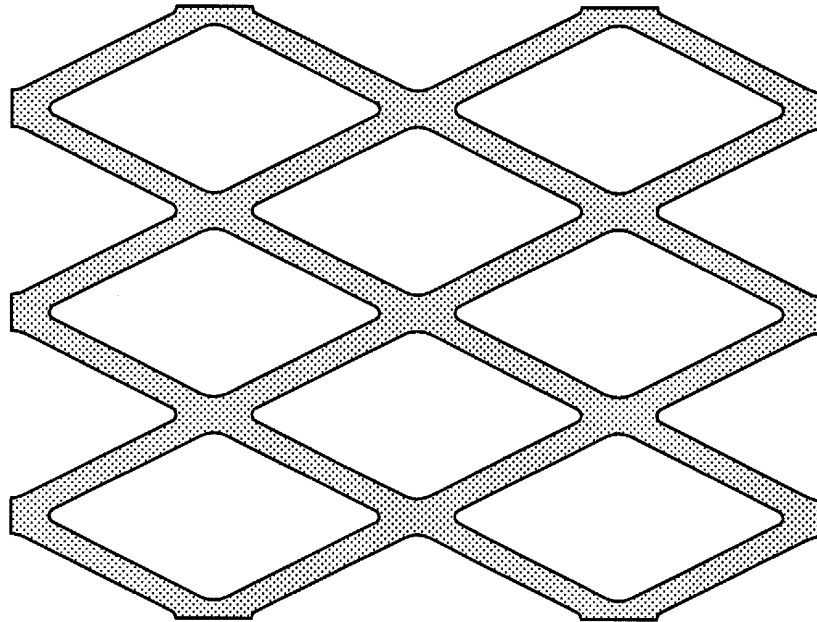


FIG.15

(A)



(B)

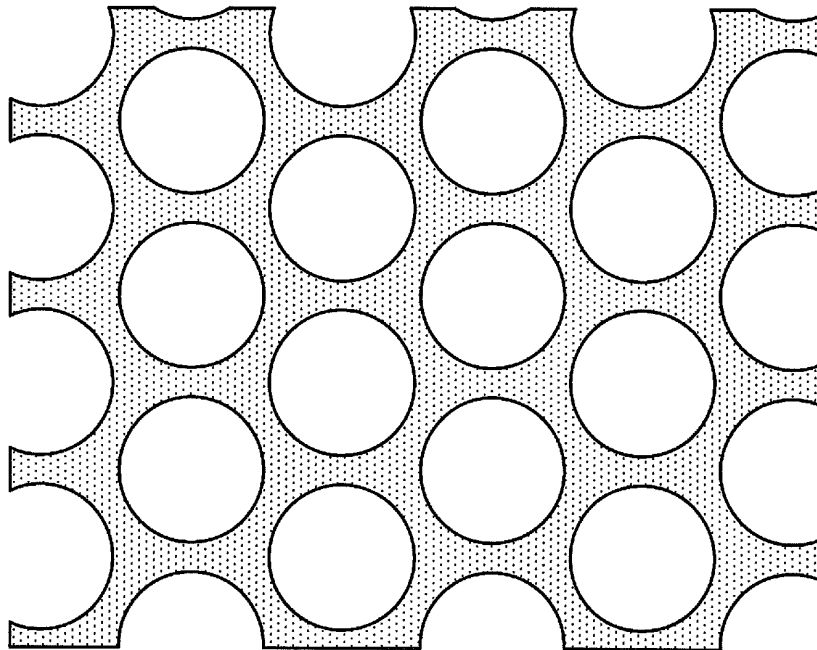


FIG.16

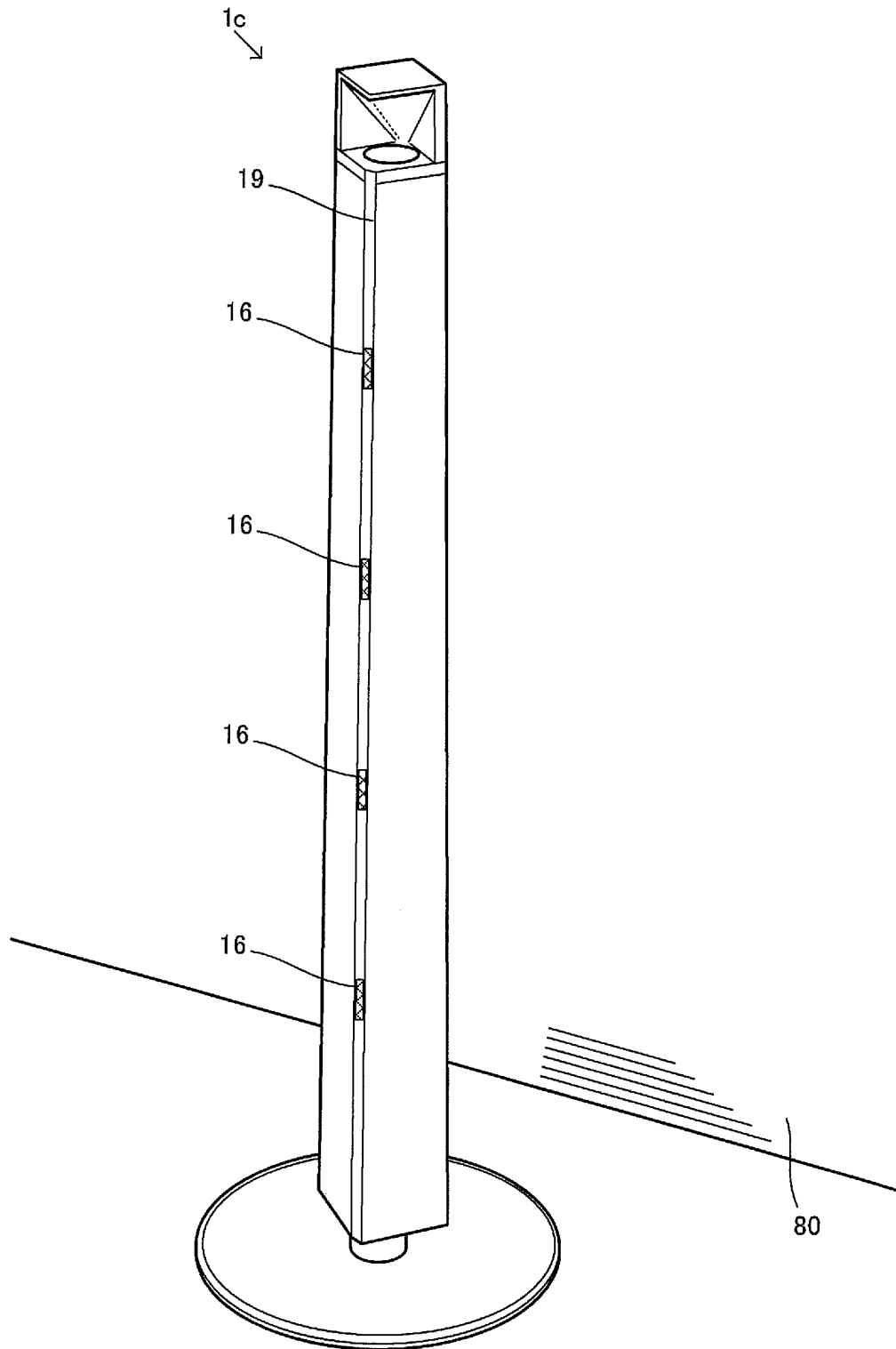


FIG.17

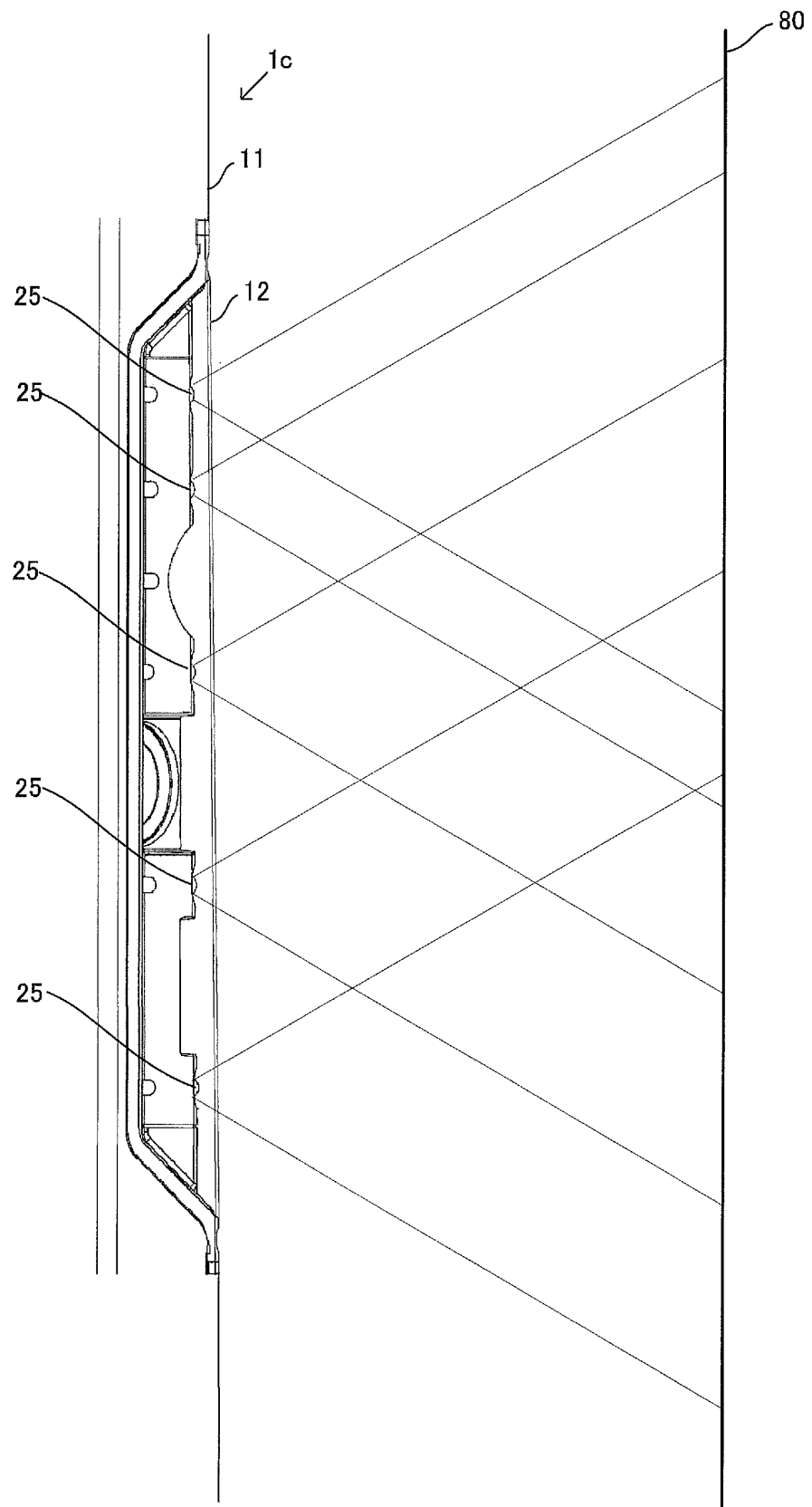


FIG.18

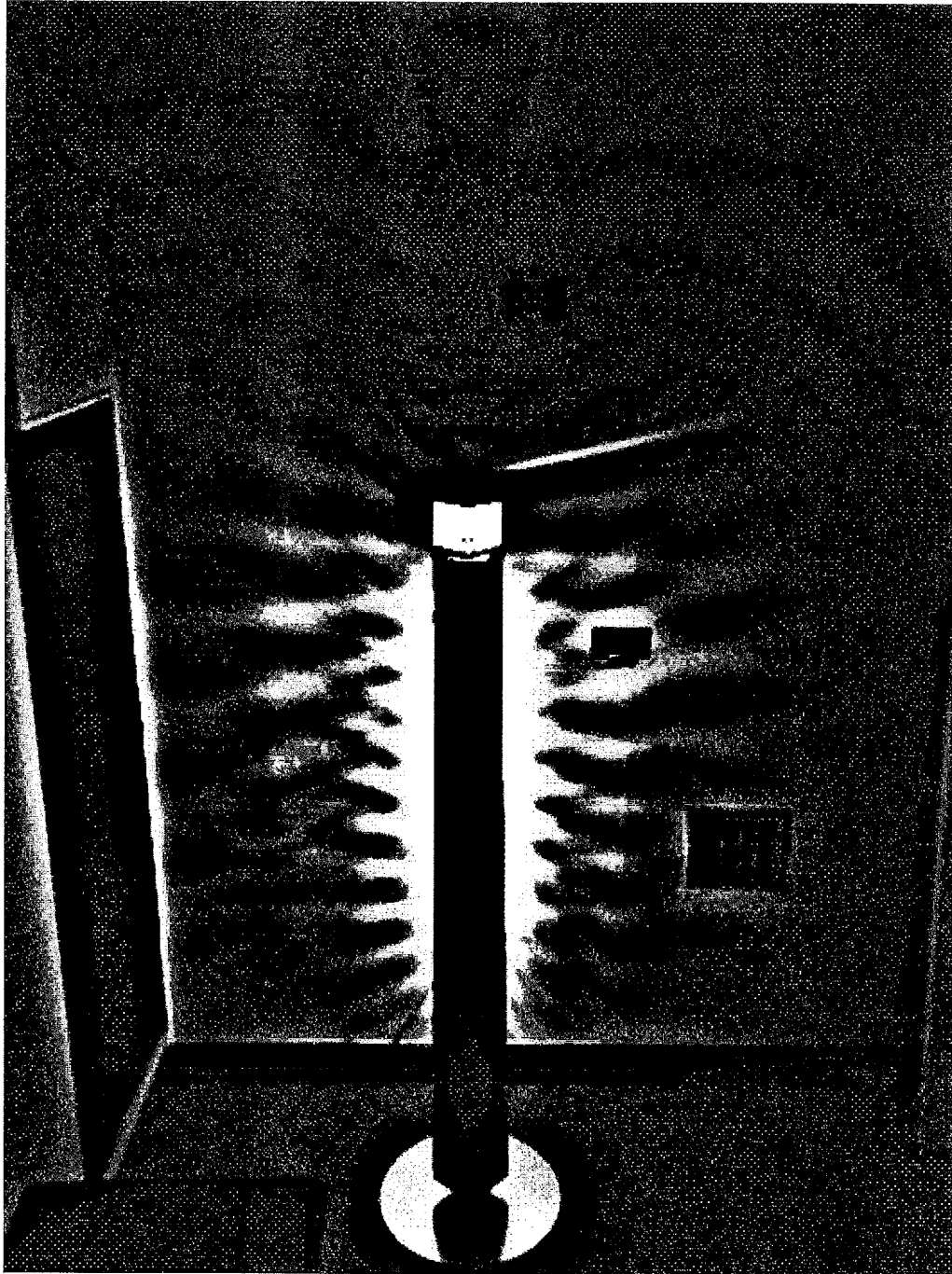


FIG.19

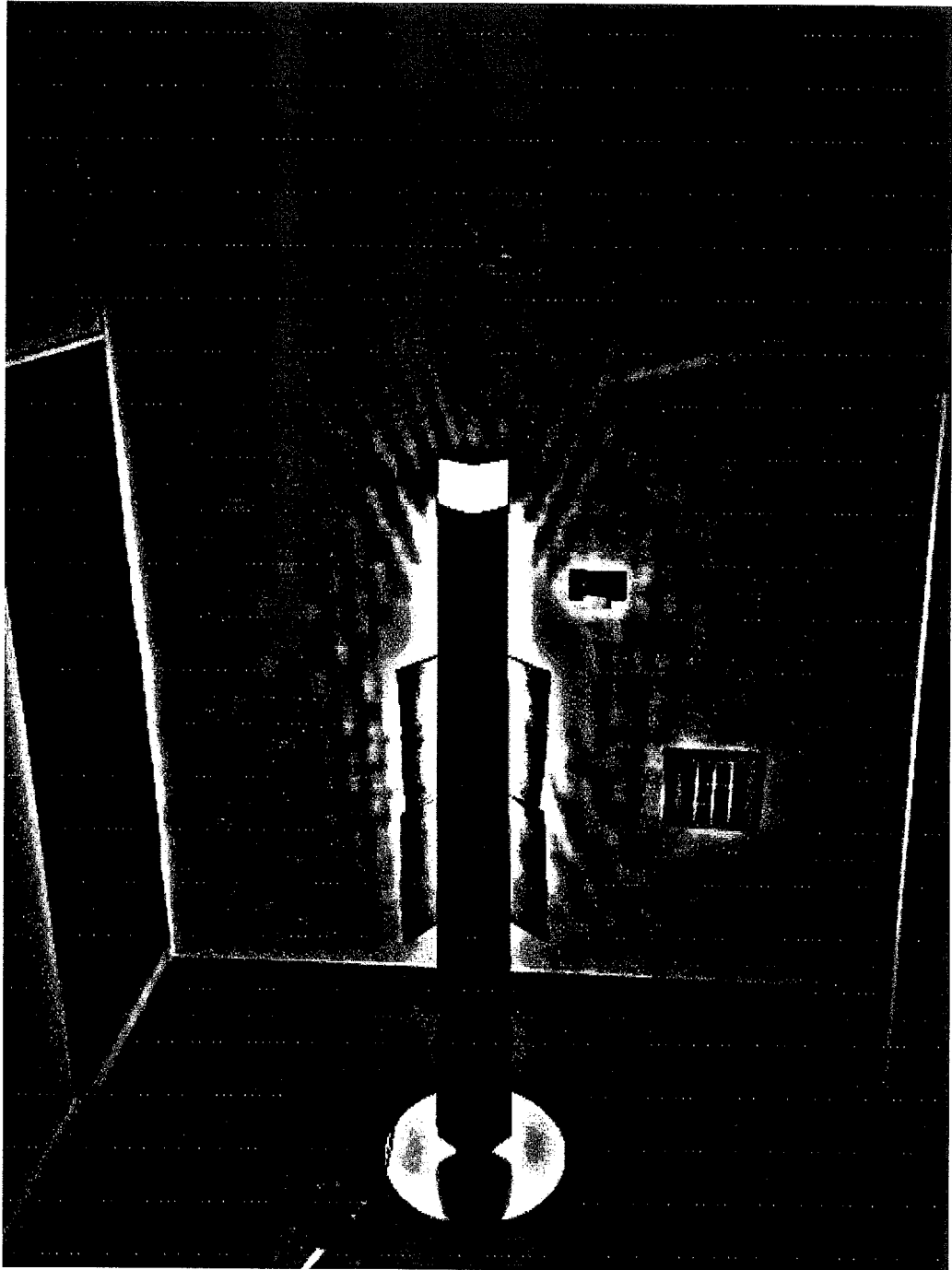


FIG.20



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/061059

A. CLASSIFICATION OF SUBJECT MATTER

H04R1/02(2006.01) i, H04R1/34(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04R1/02, H04R1/34

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2009-213103 A (Kimio HACHIRO), 17 September 2009 (17.09.2009), entire text; all drawings (Family: none)	1, 12, 13 5-11, 14, 15 2-4, 16
Y A	"L1^(TM) Compact System", Bose Kabushiki Kaisha, 10 November 2012 (10.11.2012), <URL:http://web. archive.org/web/20121110113910/http://www.bose. co.jp/jp_jp?url=/consumer_audio/musicians/ l1_systems/l1_compact/l1_compact_features.jsp>, retrieval date 16 July 2014 (16.07.2014)	5-11, 14, 15 2-4, 16



Further documents are listed in the continuation of Box C.



See patent family annex.

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"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

16 July, 2014 (16.07.14)

Date of mailing of the international search report

29 July, 2014 (29.07.14)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

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Form PCT/ISA/210 (second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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- JP 2007037058 A [0003]
- JP 11075277 A [0003]