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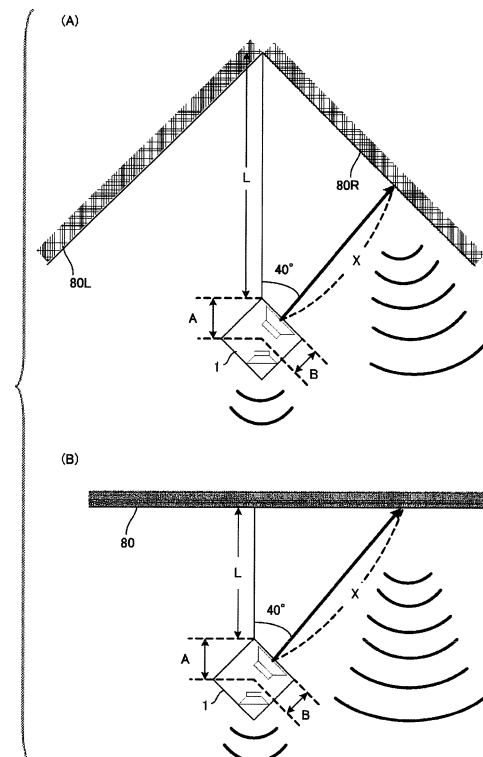
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(54) **SPEAKER DEVICE, AUDIO REPRODUCTION SYSTEM, AND PROGRAM**

(57) The present invention addresses the problem of providing an audio reproduction system capable of adjusting the timings of arrival of a sound emitted from a back surface and a sound emitted from a front surface at a user. An audio reproduction system comprises a speaker device (1) and a remote control device. The speaker device (1) is provided with a first speaker unit (210) provided in the back surface of a housing (11), a second speaker unit (211 C) provided in the upper surface or the front surface of the housing (11), and a delay unit (231 C) which delays a sound emitted from the second speaker unit (211C). The remote control device accepts inputs of an installation mode of the speaker device (1) and a back surface distance to a wall (80), calculates the delay time of the delay unit (211 C) on the basis of the inputted installation mode and back surface distance, and transmits the delay time to the speaker device (1). The speaker device (1) sets the delay time received from the remote control device in the delay unit (211C).

FIG. 7



Description

Technical Field

[0001] The present invention relates to adjustment of timing in which sounds emitted from a plurality of speaker units arrive to a user.

Background Art

[0002] In Patent Literature 1, speaker units are proposed which are capable of controlling sound emission timings (delay time) of the respective speaker units according to a plurality of installation modes such as corner installment in which the speaker units are backed by the corner of a room and wall installment in which the speaker units are backed by the wall of the room.

Citation List

Patent Literature

[0003] Patent Literature 1: JP-A-2006-340302

Summary of Invention

Technical Problem

[0004] In Patent Literature 1, settings of the corner installment (corner placement) and the wall installment (wall placement) are performed but settings of the delay times of the respective speaker units are performed through measurement, and thus a microphone for separate measurement, a measurement circuit, and the like are necessary. In addition, in order to perform novel design for a speaker device, it is considered that some speaker units are provided on a back surface side. However, in Patent Literature 1, the entirety of speaker units are arranged to face a front side, and the control of timings, in which speaker units installed to face a back surface and speaker units installed to face an upper surface or a front surface emit sounds, is not taken into consideration.

[0005] Here, an object of the present invention is to provide a speaker device, an audio reproduction system, and a program which are capable of adjusting timings in which sounds emitted from the back surface and sounds emitted from the front surface or the upper surface arrive to the user.

Solution to Problem

[0006] A speaker device according to an aspect of the present invention is configured by including: a housing having an opening section on a back surface, and an opening section on an upper surface or a front surface; a first speaker unit provided in the opening section on the back surface; a second speaker unit provided in the

opening section on the upper surface or the front surface; a delay section adapted to delay sounds emitted from the second speaker unit; manipulation reception means for receiving inputs of an installation mode which indicates an arrangement of the housing for a wall in a back surface direction of the housing and a back surface distance which is a distance from the wall; calculation means for calculating delay time of the delay section based on the installation mode and the back surface distance input from the manipulation reception means; and setting means for setting the delay time calculated by the calculation means into the delay section.

[0007] An audio reproduction system according to an aspect of the present invention includes a speaker device and a remote controller. The speaker device includes: a housing having an opening section on a back surface, and an opening section on an upper surface or a front surface; a first speaker unit provided in the opening section on the back surface; a second speaker unit provided in the opening section on the upper surface or the front surface; a delay section adapted to delay sounds emitted from the second speaker unit; and a communication unit adapted to communicate with the remote controller. The remote controller includes: a communication unit adapted to communicate with the speaker device; manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives inputs of an installation mode indicating arrangement of the housing for a wall in a back surface direction of the housing, and a back surface distance indicating a distance from the wall; and transmission means for transmitting the installation mode and the back surface distance input from the manipulation reception means to the speaker device. The speaker device further includes: calculation means for calculating delay time of the delay section based on the installation mode and the back surface distance received from the remote controller; and setting means for setting the delay time calculated by the calculation means into the delay section.

[0008] An audio reproduction system according to an aspect of the present invention includes a speaker device and a remote controller. The speaker device includes: a housing having an opening section on a back surface, and an opening section on an upper surface or a front surface; a first speaker unit provided in the opening section on the back surface; a second speaker unit provided in the opening section on the upper surface or the front surface; a delay section adapted to delay sounds emitted from the second speaker unit; and a communication unit adapted to communicate with the remote controller. The remote controller includes: a communication unit adapted to communicate with the speaker device; manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives inputs of an installation mode indicating arrangement of the housing for a wall in a back surface direction of the housing, and a back surface distance indicating a distance from the wall; calculation means for calculating delay time

of the delay section based on the installation mode and the back surface distance input from the manipulation reception means; and transmission means for transmitting the delay time calculated by the calculation means to the speaker device. The speaker device further includes setting means for setting the delay time received from the remote controller into the delay section.

[0009] The speaker device may further include: a middle tone range filter adapted to extract a middle tone range component signal including a human voice from an audible frequency band of an input audio signal, and to supply the middle tone range component signal to the second speaker unit; a low tone range filter and a high tone range filter adapted to extract a low tone range component signal and a high tone range component signal other than the middle tone range component signal, and to supply the low tone range component signal and the high tone range component signal to the first speaker unit; and an equalizer adapted to independently control respective gains of output signals of the low tone range filter, the middle tone range filter, and the high tone range filter.

[0010] In this case, a middle tone range speaker, in which sound emission characteristics of the low tone range are suppressed, may be used as the second speaker unit, and the middle tone range filter may be a low-pass filter adapted to extract signal components lower than the middle tone range including the low tone range component.

[0011] The remote controller may further include: second manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives an input of a type of the wall; gain correction means for correcting the gain of the equalizer according to the type of the wall input by the second manipulation reception means; and second transmission means for transmitting the corrected gain to the speaker device, and the speaker device may set the gain received from the remote controller into the equalizer.

[0012] The manipulation screen of the remote controller may display a plurality of installation modes which respectively indicates different arrangements of the housing for the wall in the back surface direction of the housing, and the manipulation reception means may receive the manipulation of the user selecting one installation mode from among the plurality of installation modes.

[0013] A program according to an aspect of the present invention causes a computer of a mobile phone capable of communicating with a speaker device to function as: manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives inputs of an installation mode indicating arrangement of a housing of the speaker device for a wall in a back surface direction of the housing, and a back surface distance indicating a distance from the wall; and transmission means for transmitting the installation mode and the back surface distance input from the manipulation

reception means to the speaker device.

[0014] A program according to an aspect of the present invention causes a computer of a mobile phone capable of communicating with a speaker device to function as: manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives inputs of an installation mode indicating arrangement of a housing of the speaker device for a wall in a back surface direction of the housing, and a back surface distance indicating a distance from the wall; calculation means for calculating delay time of a delay section of the speaker device based on the installation mode and the back surface distance input from the manipulation reception means; and transmission means for transmitting the delay time calculated by the calculation means to the speaker device.

[0015] A program according to an aspect of the present invention causes a computer of a mobile phone capable of communicating with a speaker device to function as: manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives inputs of an installation mode indicating arrangement of a housing of the speaker device for a wall in a back surface direction of the housing, and a back surface distance indicating a distance from the wall; calculation means for calculating delay time of a delay section of the speaker device based on the installation mode and the back surface distance input from the manipulation reception means; transmission means for transmitting the delay time calculated by the calculation means to the speaker device; second manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives an input of a type of the wall; gain correction means for correcting a gain of an equalizer of the speaker device according to the type of the wall input by the second manipulation reception means; and second transmission means for transmitting the corrected gain to the speaker device.

Advantageous Effects of Invention

[0016] According to the present invention, the user can set the delay time of a second speaker unit by only inputting the installation mode and the back surface distance of the speaker device to the remote controller.

Brief Description of Drawings

[0017]

Fig. 1 is an appearance view illustrating a speaker device according to an embodiment of the present invention.

Fig. 2 is a perspective view illustrating a head piece which is provided on the upper end of the speaker device.

Fig. 3 illustrates examples of the installation modes of the speaker device.

Fig. 4 is a block diagram illustrating the electronic circuit of the speaker device.

Fig. 5 is a block diagram illustrating the signal processing unit and the speaker driver of the speaker device.

Fig. 6 is a graph illustrating the characteristics of the filters which are provided in the speaker device.

Fig. 7 illustrates a method of calculating delay time of sounds emitted from speaker units which are provided in the back surface direction.

Fig. 8 is a block diagram illustrating a mobile phone which functions as the remote controller of the speaker device.

Fig. 9 is a functional block diagram illustrating a remote controller (DTA controller) which is configured in cooperation with the mobile phone and an application program.

Fig. 10 illustrates the tree structure of the display screen of the remote controller.

Fig. 11 illustrates an option screen and an equalizer screen.

Fig. 12 illustrates a sound environment setting screen.

Fig. 13 illustrates a wall selection screen.

Fig. 14 illustrates a gain correction table.

Description of Embodiments

[0018] A speaker device according to an embodiment of the present invention will be described with reference to the accompanying drawings. Fig. 1 is an appearance view illustrating a speaker device 1, in which Fig. 1(A) is a front view, Fig. 1(B) is a right side view, and Fig. 1(C) is a back side view.

[0019] The speaker device 1 includes a housing 11 in which a plurality of speakers is accommodated, a disk shaped base 14 which supports the housing 11 from a floor surface, and a stick shaped pillow 13 which connects the housing 11 to the base 14. The housing 11 is supported by the pillow 13 and the base 14, and is founded in the vertical direction.

[0020] The housing 11 has an approximately quadrangular prism form, and has a width which is slightly narrow on the front side in the upper direction. That is, the housing 11 accurately has a square pyramid form (form acquired by cutting the side of the apex (head) of a quadrangular pyramid by a surface which is parallel to the bottom surface). The side surface of the housing 11 is 2 percent inclined to a vertical line. The speaker device 1 is installed in such a way that a ridge line section 19 interposed between two-side surfaces becomes the front (user direction). In the description below, a front surface direction is called the front side and a back surface direction is called the back side. In addition, the direction when the user in the front direction views the speaker device 1 is used as the left and right direction.

[0021] In the speaker device 1, speaker units 210L and 210R are provided to face backward, and a speaker grill

12 is provided on the back surface side of the housing 11, as illustrated in Figs. 1(B) and 1(C). Therefore, it is not necessary to provide the speaker grill 12 on the front side of the speaker device 1.

[0022] The inside of the housing 11 is partitioned by two partition plates, and has a structure which has three spaces in the vertical direction. The housing 11 is used as a speaker box 30 for a middle tone range, in which an upper space accommodates a speaker unit 211C, a stereo speaker box 31 in which a central space accommodates speaker units 210L and 210R, and a circuit box 32 in which a lower space accommodates an electronic circuit 15.

[0023] In addition, the speaker box 30 for the middle tone range includes an upper surface which has an opening, and the speaker unit 211C is attached to the opening section to face upward. Ahead piece 10, which reflects sounds emitted from the speaker unit 211C to the front side, is further provided on the speaker unit 211C.

[0024] The speaker units 210L and 210R are full range speaker units for respective left and right channels which are in charge of sound emission in the low tone range and the high tone range. The speaker unit 211C is a middle range speaker unit which is common to the left and right channels which are in charge of sound emission in the middle tone range. Here, the middle tone range is a frequency band which mainly covers a human voice, and corresponds to, for example, a range of 100 Hz to 7000 Hz. Meanwhile, the middle tone range is not limited thereto, and may be, for example, 300 to 3400 Hz which is a band used for a telephone. The high tone range is a higher frequency band than the middle tone range, and the low tone range is a lower frequency band than the middle tone range. Hereinafter, the lower limit frequency of the middle tone range is referred to as FL, and the upper limit frequency of the middle tone range is referred to as FH.

[0025] Fig. 2 is a perspective view illustrating the head piece. The head piece 10 includes an upper part main body section 101 which has a sound emission opening 110, a top plate 102 which is arranged on the upper surface of the main body section 101, and a lower part skirt 106. The form of the main body section 101 is approximately a cube. A circular opening section 103A is formed at the central part of the bottom plate 103 of the head piece 10. The caliber of the opening section 103A is substantially the same as the caliber of the speaker unit 211C.

[0026] On the inner side of the main body section 101, two reflectors 105 (105A and 105B) are formed which are triangular surfaces and connect an apex 105C on the lower side of an edge interposed between two side surfaces 113 and 114 which are back plate 104 and the upper edge of two side surfaces 111 and 112 which correspond to the (cut-out) sound emission opening 110. Since the main body section 101 is approximately a cube, the left and right surfaces 105A and 105B of the reflectors 105 form an angle of approximately 45° for horizontal

surfaces such as the bottom plate 103.

[0027] The sound emission surface of the speaker unit 211C is disposed upright on the lower side of the head piece 10 at the same central axis. In addition, the surface of the reflector 105 of the head piece 10 is arranged to face the sound emission surface of the speaker unit 211C, and the inclined angle is approximately 45°. Therefore, sound, which is emitted from the speaker unit 211C in the upper direction, is propagated to be reflected in the reflector 105 and is propagated in diagonally front sides in the left and right direction as arrows 130 shown in Fig. 2. Therefore, even when sounds are emitted upward from the speaker unit 211C, the sounds are reflected in the reflector 105, and thus it is possible to propagate the sounds to the left and right direction on the front side from the front surface side of the side surfaces of the housing 11 without loss.

[0028] Fig. 3 illustrates examples of the installation modes of the speaker device 1. Fig. 3(A) illustrates an example in which the speaker device 1 is installed while being backed by the corner of the room (corner) 81. In the installation mode, the left and right walls 80L and 80R of the corner 81 are located behind the speaker device 1 as reflection surfaces at an angle of approximately 45° from the forth and back direction of the speaker device 1. In addition, Fig. 3(B) illustrates an example in which the speaker device 1 is installed while being backed by a wall 80. In the installation mode, the wall 80 is located behind the speaker device 1 as a reflection surface at an angle of approximately 90° from the forth and back direction of the speaker device 1.

[0029] When a sound signal is input to the speaker device 1, sounds of the left and right channels are respectively emitted from the speaker units 210L and 210R. The speaker units 210L and 210R are provided in the back surface direction (to face the wall). Therefore, when the speaker device 1 is installed as shown in Fig. 3, sounds of the left and right channels, which are emitted from the speaker units 210L and 210R, are reflected in the wall 80 (L and R) in the back surface direction and are propagated to the front side (indoor direction). Therefore, the sounds, which are emitted from the speaker units 210L and 210R, are emitted from the speaker unit 211C on the upper surface, and thus time in which distance reflected in the wall 80 is late compared to sounds which are directly propagated to the front side. Here, in the signal processing unit 201 (refer to Fig. 5) of the speaker device 1, an audio signal which is input to the speaker unit 211C coincides with timing in which the sounds emitted by the speaker units 210L and 210R and the speaker unit 211C arrive to the user by delaying time corresponding to a distance reflected in the wall 80.

[0030] In addition, when the speaker device 1 is installed as shown in Fig. 3, sounds of the left and right channels, which are emitted from the speaker units 210L and 210R, are reflected in the wall 80 (L and R) in the back surface direction and are propagated to the front side (indoor direction). The sounds in the high tone range

from among sounds emitted from the speaker units 210L and 210R have strong straightness, and thus the sounds in the high tone range excellently reflects in the walls, thereby contributing to give stereo feeling to a listener. In addition, sounds in the low tone range do not have strong sense of localization in hearing sense. Therefore, even when sounds are heard in the vicinity of a wall surface, the sense of incongruity is small for a user (listener). In contrast, sounds in the middle tone range correspond to a tone range which includes a talking voice or a singing voice of a person. Therefore, when sounds are reflected in the wall surface, the sounds are largely attenuated and become so-called "withdrawal" thereby deteriorating the clarity of sound. Here, the speaker device 1 extracts components in the middle tone range from the sounds of the left and right channels, and emits the sounds of the middle tone range from the speaker unit 211C which faces upward. Although the speaker unit 211C faces upward, the emitted sounds of the middle tone range are favorably propagated to the front side due to the head piece 10 which is provided on the speaker unit 211C. Therefore, it is possible to cause the sounds from the low tone range to the high tone range to be clearly heard to the user without feeling uncomfortable.

[0031] The electronic circuit 15 is built in the circuit box 32 of the housing 11. Fig. 4 is a block diagram illustrating the main part of the electronic circuit 15. In addition, Fig. 5 is a block diagram illustrating the details of the signal processing unit 201 and the speaker driver 202 of the electronic circuit 15. In Fig. 4, the electronic circuit 15 includes a controller 50, a signal processing unit 201, a speaker driver 202, an input selector 53, a Bluetooth (tone ranged trademark) communication circuit 54, and a cable connector 55.

[0032] The controller 50 includes an icon. The Bluetooth communication circuit 54 is connected to the controller 50. The Bluetooth communication circuit 54 receives inputs of a command, which is received from a machine, such as a multifunction mobile phone (smart phone), having a controller function, to the controller 50. The controller 50 performs the setting of the signal processing unit 201 and selection of a signal which is input by the input selector 53 based on the command which is input from the Bluetooth communication circuit 54. The Bluetooth communication circuit 54 and the cable connector 55 are connected to the input selector 53. The input selector 53 selects any one of the Bluetooth communication circuit 54 and the cable connector 55 according to a selection signal which is input from the controller 50, and inputs an audio signal which is input from the selected circuit to the signal processing unit 201.

[0033] The signal processing unit 201 adjusts the sound quality of the (2 channel stereo) audio signal which is input from the input selector 53, extracts and composes the components of the middle tone range from the signals of the left and right channels, and outputs a resulting signal as the audio signal of a third channel (central channel). In addition, the signal processing unit 201 makes

time, in which sounds emitted from the respective speaker units 210L, 210R, and 211C arrive to the user, coincide by delaying the audio signal of the central channel. In Fig. 5, the speaker driver 202 includes amplifiers 226L and 226R and an amplifier 229 of three channels, amplifies the respective audio signals of a left channel, a right channel, and the middle tone range, and outputs the amplified signals to the respective speaker units 210L, 210R, and 211C. The details of the signal processing unit 201 and the speaker driver 202 will be described with reference to Fig. 5.

[0034] Fig. 5 is a block diagram illustrating the signal processing unit 201 and the speaker driver 202 of the speaker device 1. In the block diagram, the signal processing unit 201 includes low-pass filters 220L, 220R, 227L, and 227R, high-pass filters 221L and 221R, gain adjustment sections 223L, 223R, 224L, 224R, 228L, and 228R, adders 225L, 225R, and 230C, and a delay section 231C. In addition, the speaker driver 202 includes the amplifiers 226L, 226R, and 229C.

[0035] The left channel audio signal input section 212L inputs the audio signal of the left channel and supplies the audio signal of the left channel to the low-pass filters 220L and 227L and the high-pass filter 221L. The low-pass filter 220L is a filter which causes a signal that is equal to or lower than the lower limit frequency FL in the middle tone range to pass. The frequency characteristics of the low-pass filter 220L are illustrated in Fig. 6(B). A left-side curved line LPF indicates the characteristics of the low-pass filter 220L. The gain of the audio signal of the low tone range which passes through the low-pass filter 220L is adjusted at the gain adjustment section 223L, and the audio signal is input to the adder 225L. The high-pass filter 221L is a filter which causes a signal that is equal to or higher than the upper limit frequency FH in the middle tone range to pass. The frequency characteristics of the high-pass filter 221L are shown in Fig. 6(B). A right-side curved line HPF indicates the characteristics of the high-pass filter 221L. The gain of the audio signal of the high tone range which passes through the high-pass filter 221L is adjusted at the gain adjustment section 224L, and the audio signal is input to the adder 225L. The adder 225L adds and composes the audio signals of the low tone range and the high tone range of the left channel. An audio signal, which is acquired through addition and composition, is amplified by the amplifier 226L and supplied to the speaker unit 210L. Meanwhile, the gain adjustment sections 223L and 224L may be included in the low-pass filter 220L and the high-pass filter 221L, respectively.

[0036] The audio signal of the right channel is input to the right channel audio signal input section 212R, and the right channel audio signal input section 212R supplies the audio signal of the right channel to the low-pass filters 220R and 227R and the high-pass filter 221R.

[0037] The low-pass filter 220R is a filter which causes a signal that is equal to or lower than the lower limit frequency FL in the middle tone range to pass. The frequency

characteristics of the low-pass filter 220R are also shown in the left side of Fig. 6(B) similarly to the low-pass filter 220L. The gain of the audio signal of the low tone range which passes through the low-pass filter 220R is adjusted at the gain adjustment section 223R, and the audio signal is input to the adder 225R. The high-pass filter 221R is a filter which causes a signal that is equal to or higher than the upper limit frequency FH in the middle tone range to pass. The frequency characteristics of the high-pass filter 221R are also shown in the right side of Fig. 6(B) similarly to the high-pass filter 221L. The gain of the audio signal of the high tone range which passes through the high-pass filter 221R is adjusted at the gain adjustment section 224R, and the audio signal is input to the adder 225R. The adder 225R adds and composes the audio signals of the low tone range and the high tone range of the right channel. An audio signal, which is acquired through addition and composition, is amplified by the amplifier 226R and supplied to the speaker unit 210R. Meanwhile, the gain adjustment sections 223R and 224R may be included in the low-pass filter 220R and the high-pass filter 221R, respectively.

[0038] In addition, the low-pass filter 227L of the left channel is a filter which causes a signal that is equal to or lower than the upper limit frequency FH in the middle tone range to pass. The frequency characteristics of the low-pass filter 227L are also shown in Fig. 6(A). The gain of the audio signal, which passes through the low-pass filter 227L, is adjusted at the gain adjustment section 228L, and the audio signal is input to the adder 230C. The low-pass filter 227R of the right channel is a filter which causes a signal that is equal to or lower than the upper limit frequency FH in the middle tone range to pass. The frequency characteristics of the low-pass filter 227R are also shown in Fig. 6(A) similarly to the low-pass filter 227L. The gain of the audio signal, which passes through the low-pass filter 227R, is adjusted at the gain adjustment section 228R, and the audio signal is input to the adder 230C. The adder 230C adds and composes the audio signals of the middle tone range of the left and right channels.

[0039] An audio signal, which is acquired through addition and composition, is input to the delay section 231C. The delay section 231C delays the audio signal for only predetermined delay time and outputs the audio signal. The delay time is set to time in which sounds emitted from the speaker units 210L and 210R are reflected in the wall 80 and returns to the vicinity of the location where the speaker device 1 is installed. Therefore, it is possible to cause timing in which the sounds emitted from the speaker units 210L and 210R arrive to the user to coincide with timing in which the sounds emitted from the speaker unit 211C arrive to the user. The audio signal, which is delayed by the delay section 231C, is amplified by the amplifier 229C and supplied to the speaker unit 211C. Meanwhile, the gain adjustment sections 228L and 228R may be included in the low-pass filter 227L and the low-pass filter 227R, respectively.

[0040] The components of the low tone range are included in the audio signals which are output from the low-pass filters 227L and 227R. However, the speaker unit 211C is a midrange speaker unit and has a characteristic in that sounds in the low tone range are not emitted, and thus the sounds emitted from the speaker unit 211C become sounds in only the middle tone range, which are acquired by correcting the above-described filter characteristics in Fig. 2(A) by speaker characteristics expressed by dotted line. Meanwhile, the low-pass filters 227L and 227R may be band-pass filters of the middle tone range.

[0041] Meanwhile, the delay amount (delay time) of the delay section 231C and the gains of the gain adjustment sections 223L, 223R, 224L, 224R, 228L, and 228R are set by the controller 50. When the gains of the gain adjustment sections 223L and 223R which adjust the gain of the low tone range, the gain adjustment sections 224L and 224R which adjust the gain of the high tone range, and the gains of the gain adjustment sections 228L and 228R which adjust the gain of the middle tone range are independently controlled, it is possible to cause the gain adjustment sections 223L and 223R, the gain adjustment sections 224L and 224R, and the gain adjustment sections 228L and 228R to function as an equalizer. Sounds of adjacent tone ranges are emitted from individual speaker units. Therefore, when the gains of the high tone range, the middle tone range and the low tone range are adjusted, sounds in which the gains are adjusted are independently emitted without affecting the adjacent tone ranges.

[0042] As described above, when the component signal of the low tone range and the component signal of the high tone range are amplified by the same amplifier and emitted from the same speaker units 210 and when the component signal of the middle tone range and the component signal of the low tone range are amplified by separate amplifiers and emitted from separate speaker units, it is possible to separate the high tone range, the middle tone range, and the low tone range by a two-way speaker device, and thus it is easy to independently adjust gains. In addition, in a speaker device according to the related art which divides a system into a middle-low tone and a high tone, when, for example, the low tone range is boosted, the middle tone range is affected by the boosting of the low tone range, with the result that the gain increases and the sound quality of the middle tone range changes, and thus loads are applied to an amplifier which amplifies a middle-low tone. However, in the speaker device 1 according to the embodiment, even when the low tone range is boosted, the middle tone range is not affected, and thus the sound quality is not changed and loads are not applied to the speaker units.

[0043] Fig. 7 illustrates a method of calculating the delay amount (delay time) which is set in the delay section 231C. Fig. 7(A) illustrates a method of calculating the delay amount when the installation mode is "corner placement" and Fig. 7(B) illustrates a method of calculating the delay amount when the installation mode is

"wall placement". Here, reference symbol A indicates a length of 1/2 of a diagonal line of a plane form (approximately square) of the speaker device 1, reference B indicates a length from the center of the plane form of the speaker device 1 to the speaker unit 210(L/R), and $B=A*\cos 40^\circ$. That is, the speaker unit 210 is provided toward a direction which is inclined by 40° from the diagonal line of the forth and back direction of the housing 11.

[0044] The plane sizes A and B of the speaker device 1 are stored in advance. In addition, a distance L to the wall 80 (corner 81) behind the speaker device 1 and the installation mode are input by the user. When the installation mode and the distance L to the wall 80 are input, a distance X between the speaker unit 210 and the wall surface is calculated using an operation equation below. Equation 1 is an operation equation used in a case of the corner placement and Equation 2 is an operation equation in a case of the wall placement. The distance X corresponds to a distance until sounds emitted from the speaker unit 210 arrive to the wall 80.

$$X=((L+A)/\cos 45^\circ)/\cos 5^\circ \quad \text{.. (Equation 1)}$$

$$X=((L+A)/\cos 40^\circ) \quad \text{.. (Equation 2)}$$

[0045] Further, in the embodiment, it is assumed that twice (2X) the calculated distance X is approximately distance difference between a path until the sounds emitted from the speaker unit 210 arrives to the user and a path until the sounds emitted from the speaker units 211 arrives to the user, and delay time D which is taken to cancel the distance difference 2X is calculated and is set in the delay section 231C. Meanwhile, a method of calculating delay time to cancel "the distance difference between the path until the sounds emitted from the speaker unit 210 arrives to the user and the path until the sounds emitted from the speaker units 211 arrives to the user" is not limited to the method described with reference to Fig. 7.

[0046] The installation mode and the distance L to the wall 80 are input by the user using a remote controller which communicates with the speaker device 1 through Bluetooth. For example, a multifunction mobile phone (smart phone), in which a controller application program is installed, is used as the remote controller. Based on the installation mode and the distance L which are input by the user, the calculation of the distance X and the delay time D may be performed by the remote controller or may be performed by the controller 50 of the speaker device 1. In addition, the operations may be shared by the remote controller and the controller 50.

[0047] Fig. 8 is a block diagram illustrating a mobile phone 300 in which a DTA controller application program 350 is executed that communicates with a multifunction mobile phone (hereinafter, simply referred to as a mobile

phone) speaker device 1 having a remote control function through Bluetooth and that performs sound setting. Meanwhile, the mobile phone 300 in which the DTA controller application program 350 is executed functionally forms a DTA controller 400 shown in Fig. 9.

[0048] The mobile phone 300 includes a controller 320, a manipulator 330, a media interface 331, a 3G/4G communication circuit 332, a Bluetooth communication circuit 333, and a Wi-Fi communication circuit 334 on a bus 326. The controller 320 includes a CPU 321, a ROM (flash memory) 322, a RAM 323, an image processor 324 and a sound processor 325. The image processor 324 is connected to a Video RAM (VRAM) 340, and the VRAM 340 is connected to a display part 341. The display part 341 includes a liquid crystal display, and displays a standby screen, a telephone number, and the like. In addition, the screen of the DTA controller 400 is also displayed on the display part 341. The sound processor 325 is connected to an amplifier 342 which includes a D/A converter, and the amplifier 342 is connected to a speaker 316.

[0049] The image processor 324 includes a Graphics Processing Unit (GPU) which generates various images such as the standby screen and the telephone number. When the DTA controller application program 350 starts, the image processor 324 generates an image of the DTA controller as shown in Figs. 11 to 13 according to an instruction of the CPU 321, and deploys the image on the VRAM 340. The image which is deployed on the VRAM 340 is displayed on the display part 341.

[0050] The sound processor 325 has a Digital Signal Processor (DSP) which encodes/decodes telephone call sound. The sound processor 325 outputs decoded/generated sounds to the amplifier 342. The amplifier 342 amplifies the sound signal and outputs a resulting sound signal to the speaker 316.

[0051] The 3G/4G communication circuit 332 performs voice communication and data communication through a mobile telephone communication network. The application program of the DTA controller or the like is downloaded through the data communication. Meanwhile, the application program may be acquired through Wi-Fi communication or an interface, such as a USB, in addition to the downloading in the 3G/4G communication.

[0052] The Bluetooth communication circuit 333 communicates with a machine which is selected and set (paired) as an opposite party apparatus. The DTA controller application program 350 (DTA controller 400) communicates with the speaker device 1, and transmits the above-described installation mode and the distance L.

[0053] The Wi-Fi communication circuit 334 performs wireless communication with a wireless access point in conformity with IEEE802.11g standard. The communication with the speaker device 1 may be performed in a Digital Living Network Alliance (DLNA).

[0054] The manipulator 330 includes a touch panel which is formed on the display part 341, and detects touch manipulation and click manipulation on the touch panel. The media interface 331 is connected to a memory card

315. The memory card 315 is, for example, a micro SD card. The application program, which is downloaded from a server by the 3G/4G communication circuit 332, is maintained in the memory card 315 or the ROM 322. In the mobile phone 300, the DTA controller application program 350 is maintained in the memory card 315, as shown in Fig. 8. Meanwhile, the DTA controller application program 350 includes data, which is necessary to execute the program, in addition to a program body. The data which is necessary to execute the program includes, for example, image data for displaying the screen shown in Figs. 11 to 13 and a gain correction table shown in Fig. 14.

[0055] In the ROM 322, a basic program for executing the telephone call and the application program of the mobile phone 300 is stored. In addition, the ROM 322 is a flash memory, and is capable of storing a downloaded application program in addition to the basic program. In the RAM 323, a work area which is used when the DTA controller application program 350 is executed by the CPU 320 is set.

[0056] The mobile phone 300 forms the DTA controller 400 as shown in Fig. 9 by cooperating with the DTA controller application program 350 which is maintained in the memory card 315, and controls the speaker device 1 by transmitting a message to the speaker device 1 through Bluetooth.

[0057] The DTA controller 400, which is realized in such a way that the DTA controller application program 350 is read by the mobile phone 300 (hardware), will be described with reference to the functional block diagram of Fig. 9. The DTA controller 400 includes a manipulation screen display part 410, a manipulation detection section 420, a message edit and transmission section 430, and a state acquisition section 440.

[0058] The manipulation screen display part 410 is realized by the cooperation of the controller 320, the VRAM 340, display part 341, and the DTA controller application program 350, and displays various manipulation screens on the display part 341 of the mobile phone 300. In addition, the manipulation detection section 420 is realized by the cooperation of the controller 320, the manipulator 330, and the DTA controller application program 350, and detects manipulation (for example, selection manipulation of the installation mode and input manipulation of the distance L) for the manipulation screen which is displayed on the display part 341. The detected manipulation information is input to the manipulation screen display part 410, the message edit and transmission section 430, and the like.

[0059] The message edit and transmission section 430 is realized by the cooperation of the controller 320, the Bluetooth communication circuit 333, and the DTA controller application program 350. The message edit and transmission section 430 edits a message corresponding to the manipulation information based on the manipulation information such as the installation mode and the distance L which are input from the manipulation detec-

tion section 420. Further, the message edit and transmission section 430 transmits the message to the speaker device 1. When the DTA controller 400 performs an operation on the distance X and the delay time D based on the installation mode and the distance L, the message includes the delay time D (and the distance X). When the operation is performed by the controller 50 of the speaker device 1, the message includes the installation mode and the distance L.

[0060] The state acquisition section 440 is realized by the cooperation of the controller 320, the Bluetooth communication circuit 333, and the DTA controller application program 350. The state acquisition section 440 inquires of the speaker device 1, and acquires the operation state of the speaker device 1. The operation state includes the installation mode, the distance L, and content which are set by the equalizer which includes the above-described gain adjustment sections 223L and 223R, the gain adjustment sections 224L and 224R, and the gain adjustment sections 228L and 228R. The acquired operation state is reflected into the initial value of the manipulation screen shown in Fig. 12 or the like.

[0061] Fig. 10 illustrates the tree structure of the display screen of the DTA controller 400. Figs. 11 to 13 are views illustrating examples of option screens of the display screen.

[0062] In Fig. 10, when the DTA controller 400 starts, a top screen 501 is formed on the display part 341 by the manipulation screen display part 410. On the top screen 501, a reproduction button 502, a schedule button 503, and a setting button 504 are displayed. When the reproduction button 502 is tapped (briefly push-down manipulation) on the top screen 501, a screen which is formed on the display part 341 is transitioned from the top screen 501 to a reproduce screen 510. On the reproduce screen 510, a source machine selection window 511 and a manipulation button group 512 are displayed. In the source machine selection window 511, a plurality of source machines (for example, a machine selected through Bluetooth and a machine which is connected through a cable connector 55) are displayed. The user taps and selects a desired machine from among the machines. If so, the manipulation button group 512 for manipulating the selected machine is displayed on the display part 341.

[0063] In addition, an option button 513 is also displayed on the reproduce screen 510. The option button 513 is a button for transitioning the screen to an option screen 530 for inputting the above-described installation mode and the distance L. When the option button 513 is tapped, a screen which is formed on the display part 341 is transitioned from the reproduce screen 510 to the option screen 530.

[0064] Meanwhile, when the schedule button 503 is tapped on the top screen 501, the screen which is formed on the display part 341 is transitioned from the top screen 501 to a schedule screen 520 in which the reproduction and illumination schedule of the speaker device 1 are set by the week. In addition, when the setting button 504 is

tapped on the top screen 501, the screen which is formed on the display part 341 is transitioned from the top screen 501 to the setting screen 521 for performing a pairing process of Bluetooth and synchronization of clocks.

[0065] Fig. 11(A) illustrates the option screen 530 which is formed on the display part 341. On the option screen 530, a sound environment button 531, an EQ (sound adjustment) button 532, and a return button 533 are displayed. The sound environment button 531 is a button for transitioning the screen formed on the display part 341 to a sound environment setting screen 540 shown in Fig. 12. The sound environment setting screen 540 is a screen for inputting the above-described installation mode and the distance L. The EQ button 532 is a button for transitioning the screen formed on the display part 341 to an equalizer screen 560 shown in Fig. 11(B). In addition, the return button 533 is a button for returning the screen formed on the display part 341 to the reproduce screen 510.

[0066] In Fig. 11(B), on the equalizer screen 560, a low tone range gain adjustment section 561, a middle tone range gain adjustment section 562, a high tone range gain adjustment section 563, and a flat button 564 are displayed. The low tone range gain adjustment section 561 includes a bar graph 561A which indicates the set gain, an up button 561U, and a down button 561D. When the push-down manipulation is performed on the up button 561U by the user, the gain of the low tone range increase according to manipulation time or the number of times of manipulation, and thus the colored parts of the bar graph 561A extend in a upward direction or the colored parts which extend in a downward direction are shrank. When the push-down manipulation is performed on the down button 561D by the user, the gain of the low tone range decreases according to manipulation time or the number of times of manipulation, and thus the colored parts of the bar graph 561A extend in the downward direction or the colored parts which extend in the upward direction are shrank. The configurations and operations of the middle tone range gain adjustment section 562 and the high tone range gain adjustment section 563 are the same as those of the low tone range gain adjustment section 561. In addition, when the flat button 564 is tapped, all the gains of the low tone range, the middle tone range, and the high tone range are reset to 0 dB (center of the graph). When the equalizer screen is manipulated by the user, the message edit and transmission section 430 transmits the gains, which are set through the manipulation, to the speaker device 1 in real time.

[0067] In Fig. 12, on the sound environment setting screen 540, arrangement selection buttons 541 (541A, 541B, and 541C), a distance input section 542, a wall selection button 544, and a return button 545 are displayed. The arrangement selection buttons 541 (541A, 541B, 541C) are buttons for inputting the installation mode of the speaker device 1, and are displayed by, for example, predetermined icons. The button 541A is tapped by the user in the case of corner placement of

the speaker device 1 shown in Fig. 7(A). The button 541C is tapped by the user in the case of wall placement of the speaker device 1 shown in Fig. 7(B). In addition, the button 541B is a button which is tapped when the speaker device 1 is installed in a case of middle placement between the corner placement and the wall placement, that is, backed by the wall at the corner of a room. When any one of the arrangement selection buttons 541 are tapped, the manipulation screen display part 410 displays a plane view 543 of the selected installation mode on the sound environment setting screen 540. The plane view 543 of Fig. 12 illustrates an example displayed when the button 541A of the corner placement is tapped.

[0068] In Fig. 12, the plane view 543 indicates the distance L from the speaker device 1 to a certain location of the wall 80 (corner 81). The distance input section 542 includes a bar graph 542A, a +button 542U, and a -button 542D which indicate the distance L. When the push-down manipulation is performed on the +button 542U by the user, the distance L increases according to the manipulation time or the number of times of manipulation, and thus the colored part of the bar graph 542A extends in the right direction. In addition, when the push-down manipulation is performed on the -button 542D by the user, the distance L decreases according to the manipulation time or the number of times of manipulation, and thus the colored part of the bar graph 542A is shrank in the left direction. When the screen formed on the display part 341 is separated from the sound environment setting screen 540 through the manipulation performed by the user, the installation mode and the distance L which are input on the sound environment setting screen 540 are determined.

[0069] When the DTA controller 400 calculates the distance X and the delay time D, the manipulation detection section 420 calculates the distance X and the delay time D based on the input installation mode and the distance L, and the message edit and transmission section 430 transmits the delay time D to the speaker device 1. In the speaker device 1, the Bluetooth communication circuit 54 receives the delay time D and inputs the delay time D to the controller 50, and the controller 50 sets the delay time D in the delay section 231C of the signal processing unit 201.

[0070] When the controller 50 of the speaker device 1 calculates the distance X and the delay time D, the message edit and transmission section 430 of the DTA controller 400 transmits the input installation mode and the distance L as a message to the speaker device 1 without change. In the speaker device 1, the Bluetooth communication circuit 54 receives the installation mode and the distance L and inputs the installation mode and the distance L to the controller 50, and the controller 50 calculates the distance X and the delay time D and sets the delay time D in the delay section 231C of the signal processing unit 201.

[0071] In addition, when the wall selection button 544 is tapped on the sound environment setting screen 540,

the screen formed on the display part 341 performs transition from the sound environment setting screen 540 to the wall selection screen 550 shown in Fig. 13. On the wall selection screen 550, a wall selection button 551 and a low tone range gain adjustment section 552 are displayed. Since sound reflection efficiency differs according to the type of the wall, the wall selection screen 550 is a screen for causing the user to input the type of the wall 80 behind the speaker device 1, thereby correcting the equalizer. For example, the wall selection screen 550 is a screen for causing the speaker device 1 to perform a process of emphasizing low sounds when the selected wall is formed of a material of low reflectance and suppressing the emphasis of the low sounds when the wall is formed of a material of high reflectance.

[0072] The wall selection button 551 is a button for selecting the type (material) of the wall behind the speaker device 1, and includes 4 types of buttons below, that is, a "dividing wall and door" button 551A which indicates a hollow wall, a "concrete wall" button 551B which indicates a solid hard wall, a "fusuma (Japanese style sliding door) and shoji (papered sliding door)" button 551C which indicates a partition formed of paper or cloth, and an etc button 551D which is manipulated in a case of the other walls or an unclear case.

[0073] Further, the DTA controller 400 (message edit and transmission section 430 or the state acquisition section 440) stores the gain correction table as shown in Fig. 14. In the gain correction table, the correction values of the gains of the low tone range, the middle tone range, and the high tone range of the equalizer are written according to the type of the wall 80 behind the speaker device 1. When the wall selection button 551 is manipulated by the user and the type of the wall is selected, the DTA controller 400 reads the gain correction value according to the type of the wall, performs correction by adding the gain correction value to the set value of the equalizer screen 560 in Fig. 11(B), and transmits the corrected set value to the speaker device 1.

[0074] In addition, the low tone range gain adjustment section 552 is a manipulator for further adjusting the gain of the low tone range according to the preference of the user, and is the same as the low tone range gain adjustment section 561 of the equalizer screen in Fig. 11(B). The low tone range gain adjustment section 552 includes a bar graph 552A, a +button 552U, and a -button 552D which indicates the gain of the low tone range. When the push-down manipulation is performed on the +button 552U by the user, the gain of the low tone range increases according to the manipulation time or the number of times of manipulation, and the colored part of the bar graph 552A extends in the right direction. In addition, when the push-down manipulation is performed on the -button 552D by the user, the gain of the low tone range decreases according to the manipulation time or the number of times of manipulation, and the colored part of the bar graph 552A is shrank in the left direction. When the equalizer screen is manipulated by the user, the message edit

and transmission section 430 transmits the gain, which is set through the manipulation, to the speaker device 1 in real time.

[0075] Meanwhile, the form of the housing 11 of the speaker device 1 is not limited to the square pyramid form. The housing 11 may have a general columnar shape, such as a truncated cone form, a columnar shape or a polygonal pillar shape, and may have any form if a necessary part, such as a speaker unit, is assembled. Any of the components of the embodiment may be freely modified in a range which does not damage the gist of the present invention. Meanwhile, the speaker unit 211C for the middle tone range may be provided to face the front surface instead of facing upward.

[0076] This application is based on Japanese Patent Application No. 2013-176231 filed August 28, 2013, and the content of which is incorporated herein by reference.

Reference Signs List

[0077]

1: speaker device
10: head piece
11: housing
15: electronic circuit
201: signal processing unit
202: speaker driver
210L, 210R, 211C: speaker unit
300: mobile phone
400: DTA controller

Claims

1. A speaker device comprising:

a housing having an opening section on a back surface, and an opening section on an upper surface or a front surface;
a first speaker unit provided in the opening section on the back surface;
a second speaker unit provided in the opening section on the upper surface or the front surface;
a delay section adapted to delay sounds emitted from the second speaker unit;
manipulation reception means for receiving inputs of an installation mode which indicates an arrangement of the housing for a wall in a back surface direction of the housing and a back surface distance which is a distance from the wall;
calculation means for calculating delay time of the delay section based on the installation mode and the back surface distance input from the manipulation reception means; and
setting means for setting the delay time calculated by the calculation means into the delay section.

2. An audio reproduction system which includes a speaker device and a remote controller, wherein the speaker device includes:

a housing having an opening section on a back surface, and an opening section on an upper surface or a front surface;
a first speaker unit provided in the opening section on the back surface;
a second speaker unit provided in the opening section on the upper surface or the front surface;
a delay section adapted to delay sounds emitted from the second speaker unit; and
a communication unit adapted to communicate with the remote controller,

wherein the remote controller includes:

a communication unit adapted to communicate with the speaker device;
manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives inputs of an installation mode indicating arrangement of the housing for a wall in a back surface direction of the housing, and a back surface distance indicating a distance from the wall; and
transmission means for transmitting the installation mode and the back surface distance input from the manipulation reception means to the speaker device, and
wherein the speaker device includes:

calculation means for calculating delay time of the delay section based on the installation mode and the back surface distance received from the remote controller; and
setting means for setting the delay time calculated by the calculation means into the delay section.

3. An audio reproduction system which includes a speaker device and a remote controller, wherein the speaker device includes:

a housing having an opening section on a back surface, and an opening section on an upper surface or a front surface;
a first speaker unit provided in the opening section on the back surface;
a second speaker unit provided in the opening section on the upper surface or the front surface;
a delay section adapted to delay sounds emitted from the second speaker unit; and
a communication unit adapted to communicate with the remote controller,

wherein the remote controller includes:

- a communication unit adapted to communicate with the speaker device;
- manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives inputs of an installation mode indicating arrangement of the housing for a wall in a back surface direction of the housing, and a back surface distance indicating a distance from the wall;
- calculation means for calculating delay time of the delay section based on the installation mode and the back surface distance input from the manipulation reception means; and
- transmission means for transmitting the delay time calculated by the calculation means to the speaker device, and
- wherein the speaker device includes setting means for setting the delay time received from the remote controller into the delay section.
4. The audio reproduction system according to claim 2 or 3, wherein the speaker device further includes:
- a middle tone range filter adapted to extract a middle tone range component signal including a human voice from an audible frequency band of an input audio signal, and to supply the middle tone range component signal to the second speaker unit;
- a low tone range filter and a high tone range filter adapted to extract a low tone range component signal and a high tone range component signal other than the middle tone range component signal, and to supply the low tone range component signal and the high tone range component signal to the first speaker unit; and
- an equalizer adapted to independently control respective gains of output signals of the low tone range filter, the middle tone range filter, and the high tone range filter.
5. The audio reproduction system according to claim 4, wherein
- a middle tone range speaker, in which sound emission characteristics of the low tone range are suppressed, is used as the second speaker unit, and the middle tone range filter is a low-pass filter adapted to extract signal components lower than the middle tone range including the low tone range component.
6. The audio reproduction system according to claim 4 or 5, wherein
- the remote controller further includes:
- second manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives an input of
- a type of the wall;
- gain correction means for correcting the gain of the equalizer according to the type of the wall input by the second manipulation reception means; and
- second transmission means for transmitting the corrected gain to the speaker device, and the speaker device sets the gain received from the remote controller into the equalizer.
7. The audio reproduction system according to any one of claims 4 to 6, wherein
- the manipulation screen of the remote controller displays a plurality of installation modes which respectively indicates different arrangements of the housing for the wall in the back surface direction of the housing, and the manipulation reception means receives the manipulation of the user selecting one installation mode from among the plurality of installation modes.
8. A program causing a computer of a mobile phone capable of communicating with a speaker device to function as:
- manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives inputs of an installation mode indicating arrangement of a housing of the speaker device for a wall in a back surface direction of the housing, and a back surface distance indicating a distance from the wall; and
- transmission means for transmitting the installation mode and the back surface distance input from the manipulation reception means to the speaker device.
9. A program causing a computer of a mobile phone capable of communicating with a speaker device to function as:
- manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives inputs of an installation mode indicating arrangement of a housing of the speaker device for a wall in a back surface direction of the housing, and a back surface distance indicating a distance from the wall;
- calculation means for calculating delay time of a delay section of the speaker device based on the installation mode and the back surface distance input from the manipulation reception means; and
- transmission means for transmitting the delay time calculated by the calculation means to the speaker device.
10. A program causing a computer of a mobile phone

capable of communicating with a speaker device to function as:

manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives inputs of an installation mode indicating arrangement of a housing of the speaker device for a wall in a back surface direction of the housing, and a back surface distance indicating a distance from the wall; 5
calculation means for calculating delay time of a delay section of the speaker device based on the installation mode and the back surface distance input from the manipulation reception means; 10
transmission means for transmitting the delay time calculated by the calculation means to the speaker device; 15
second manipulation reception means for receiving manipulation of a user by displaying a manipulation screen which receives an input of a type of the wall; 20
gain correction means for correcting a gain of an equalizer of the speaker device according to the type of the wall input by the second manipulation reception means; and 25
second transmission means for transmitting the corrected gain to the speaker device.

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FIG. 1

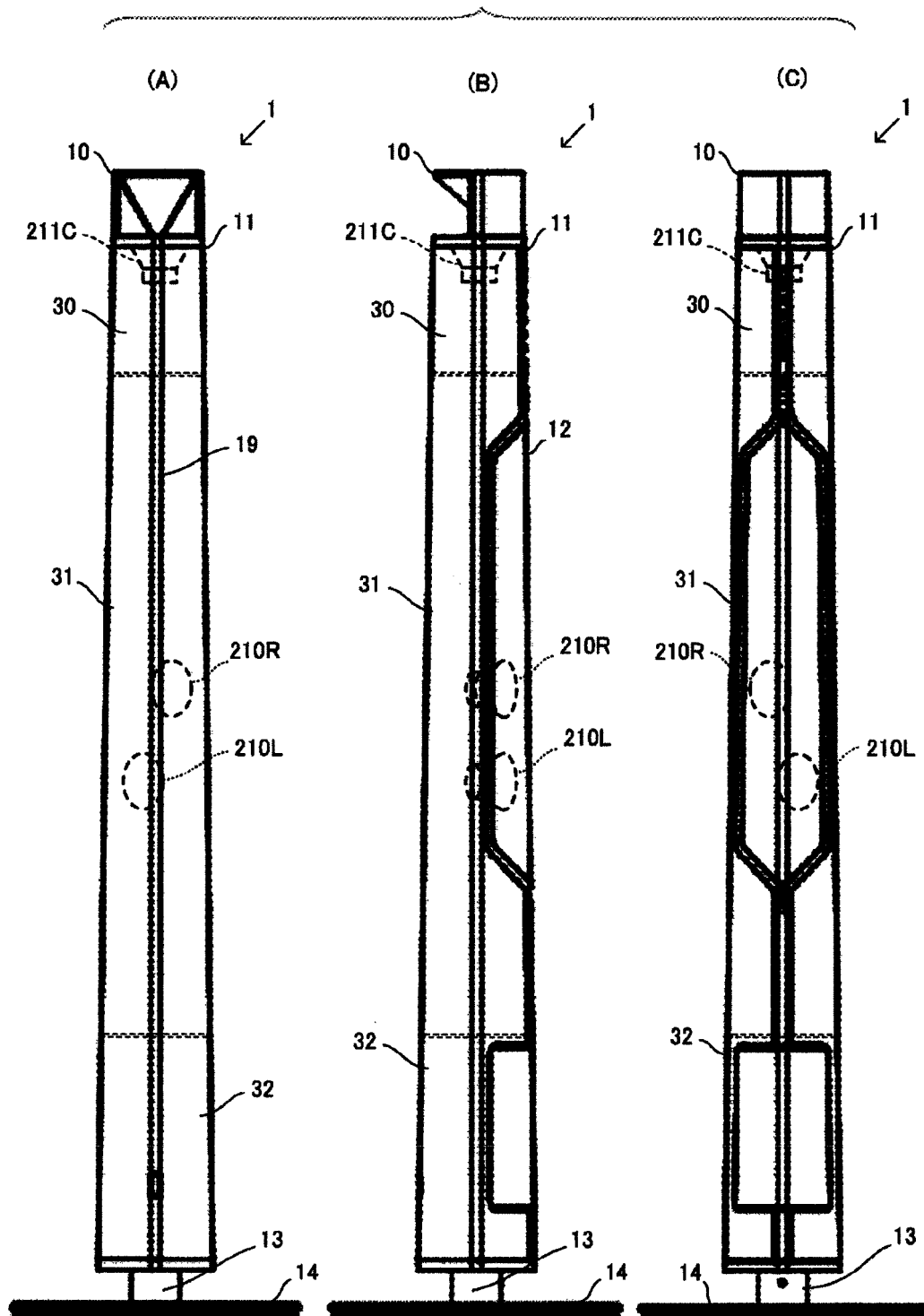


FIG. 2

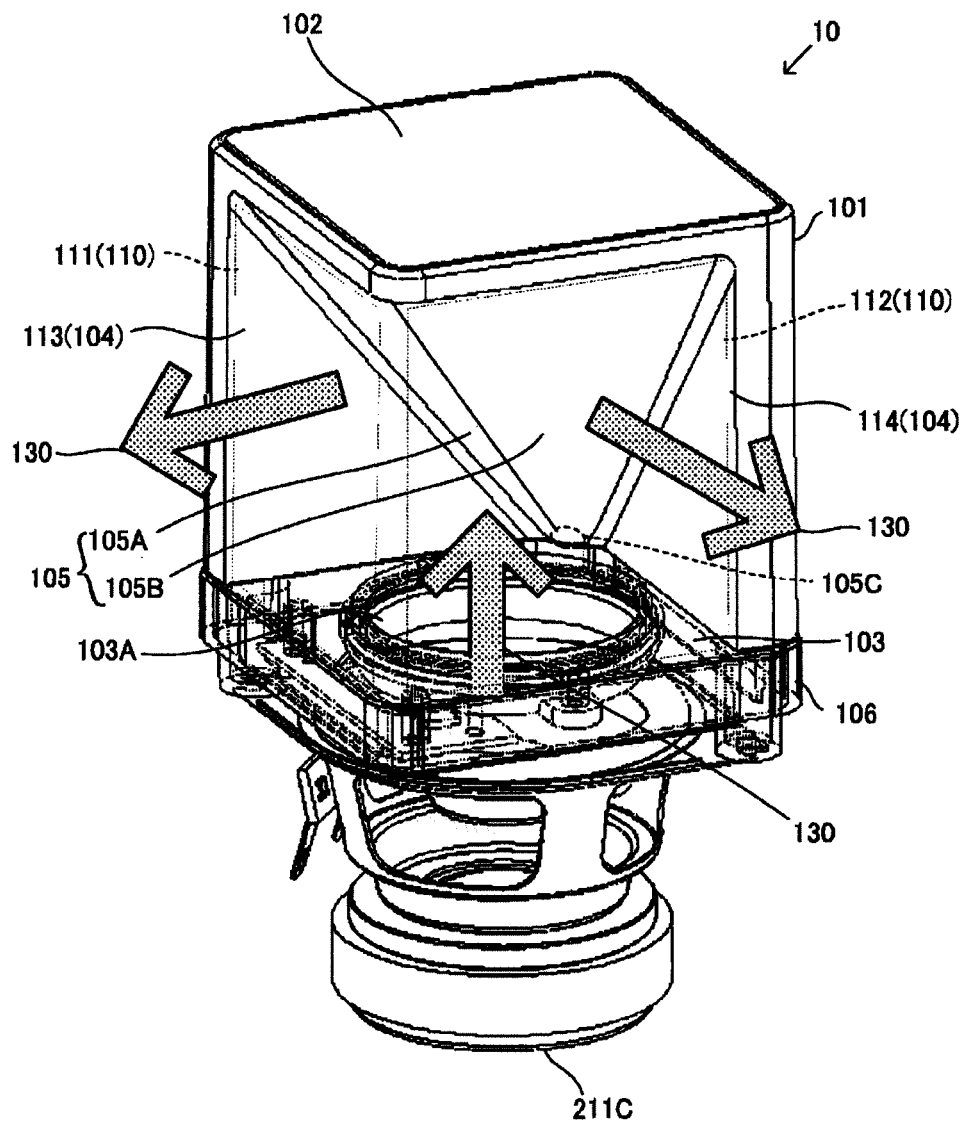


FIG.3

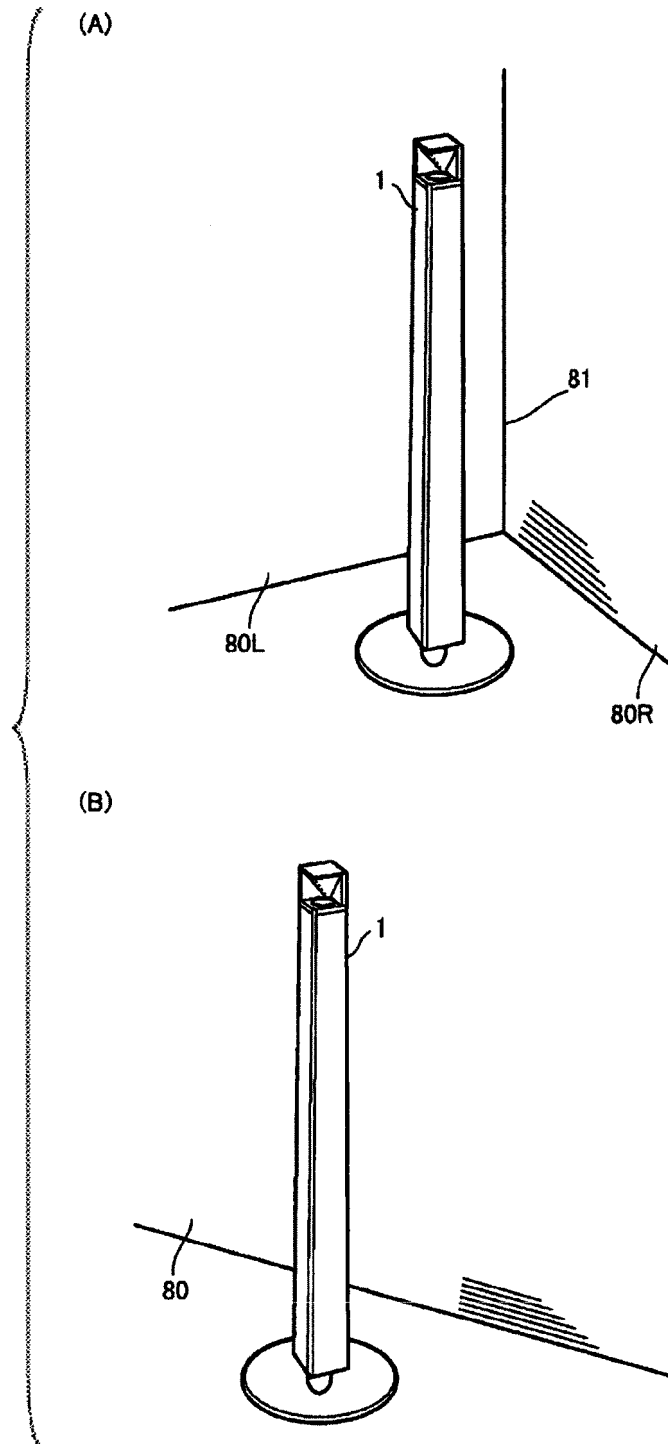


FIG. 4

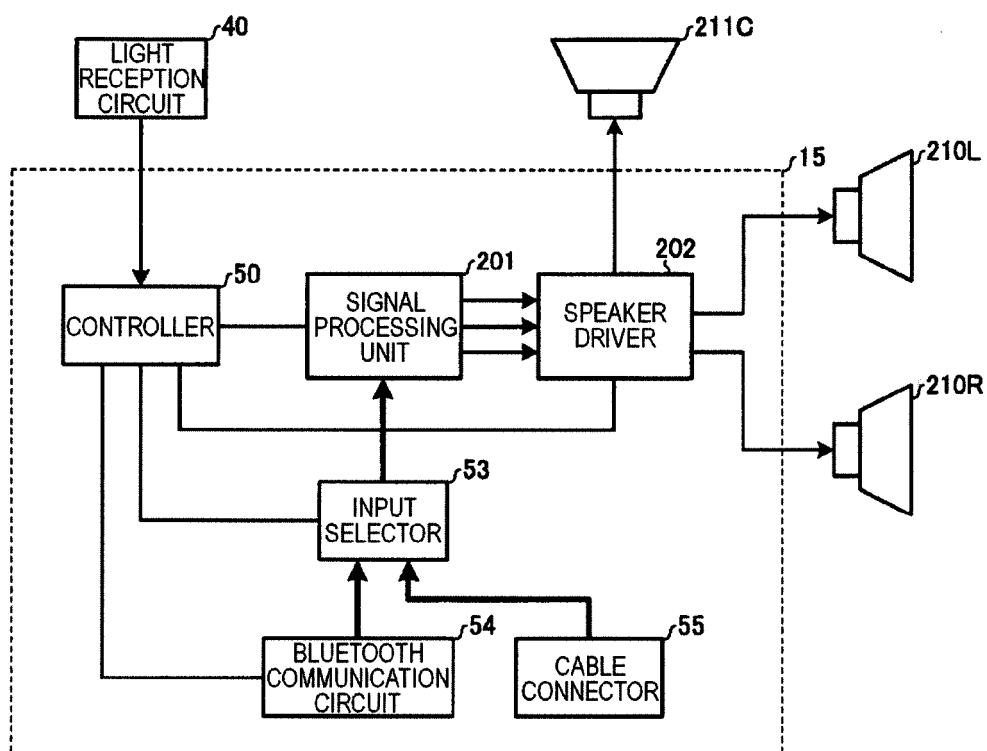


FIG. 5

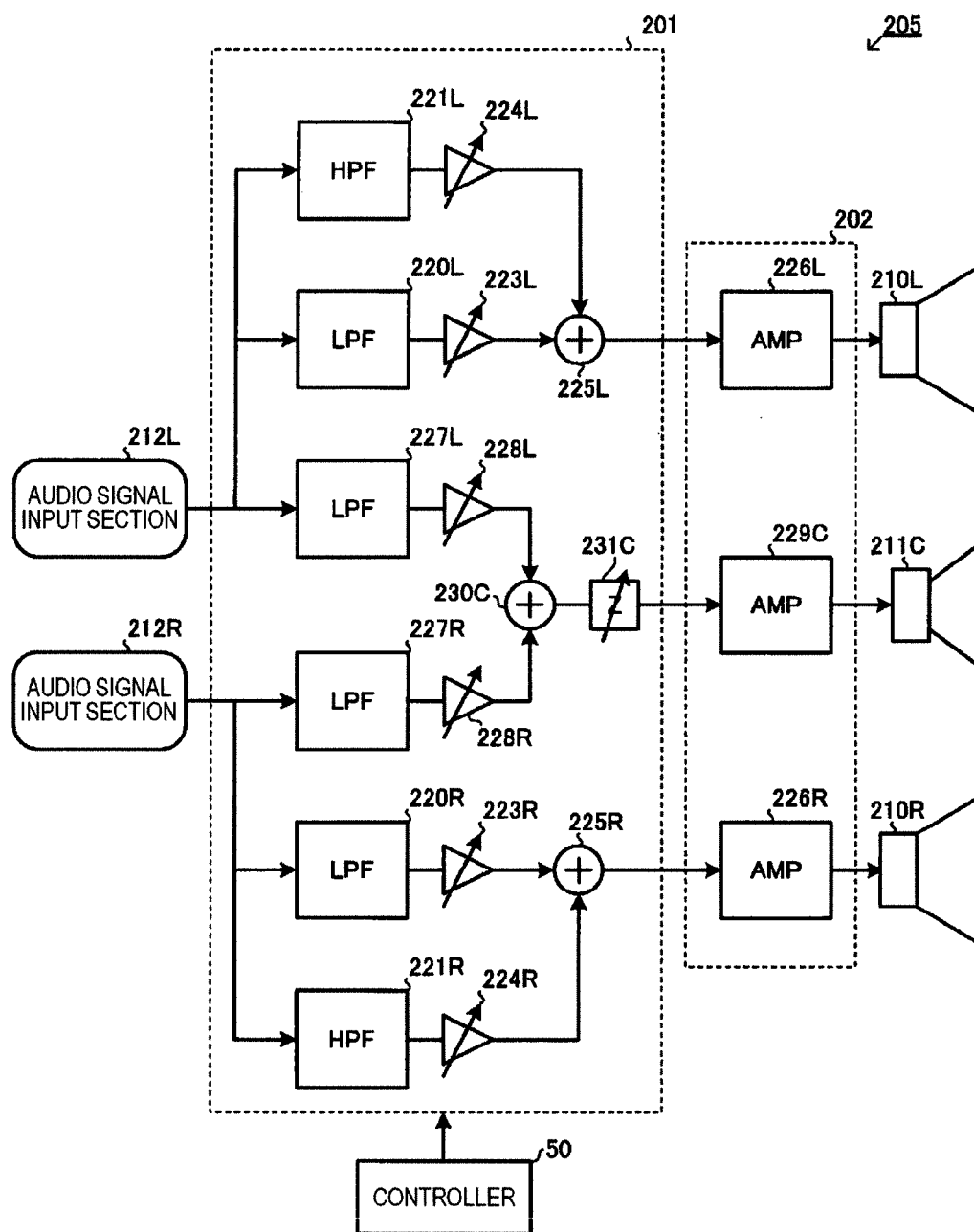


FIG. 6

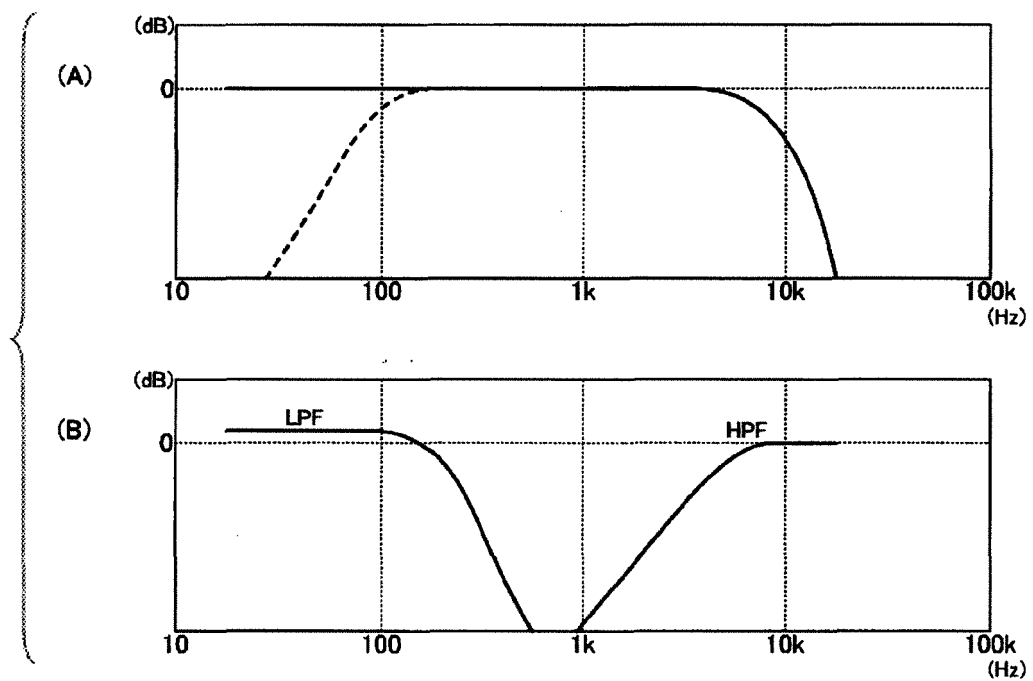


FIG. 7

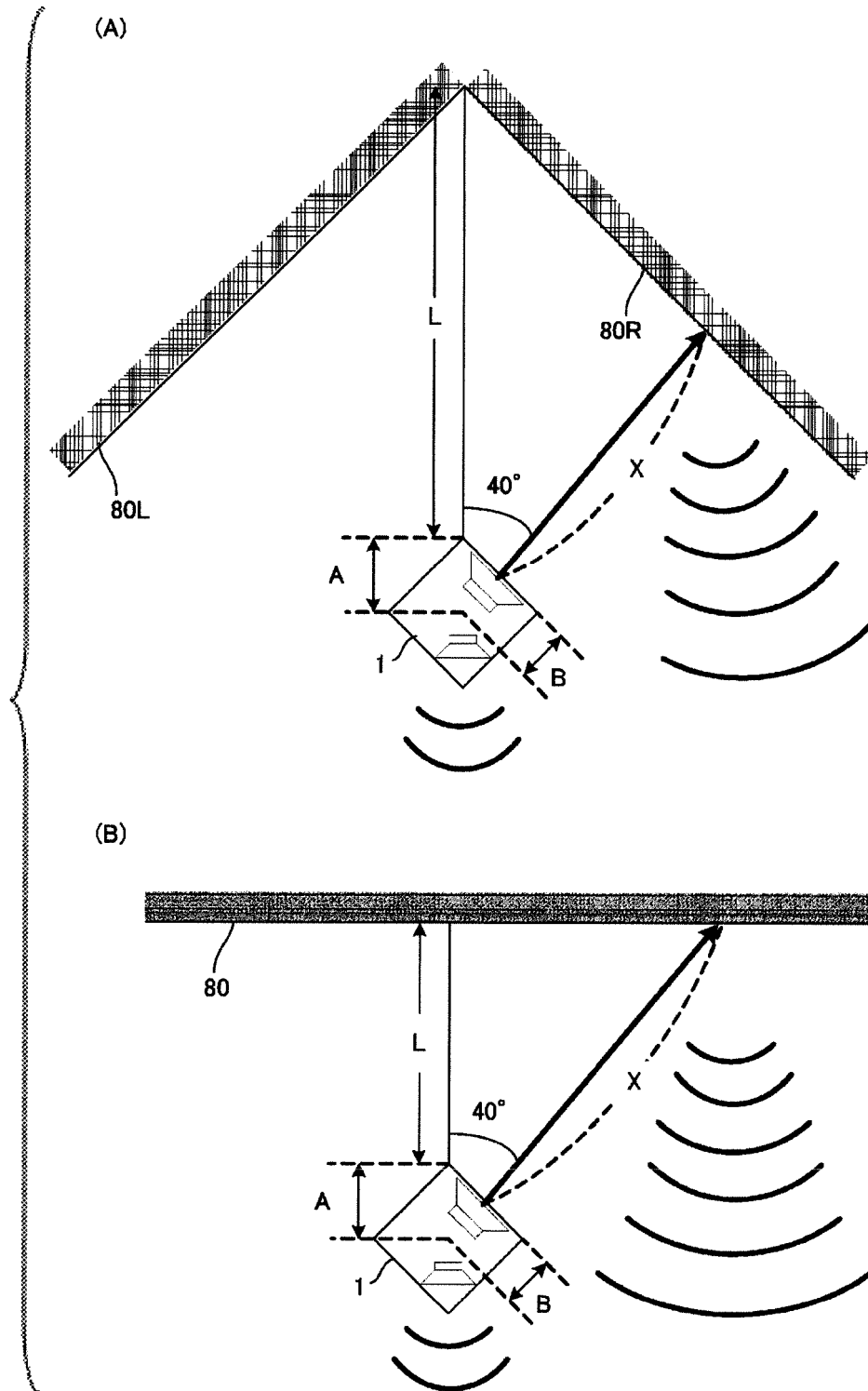


FIG. 8

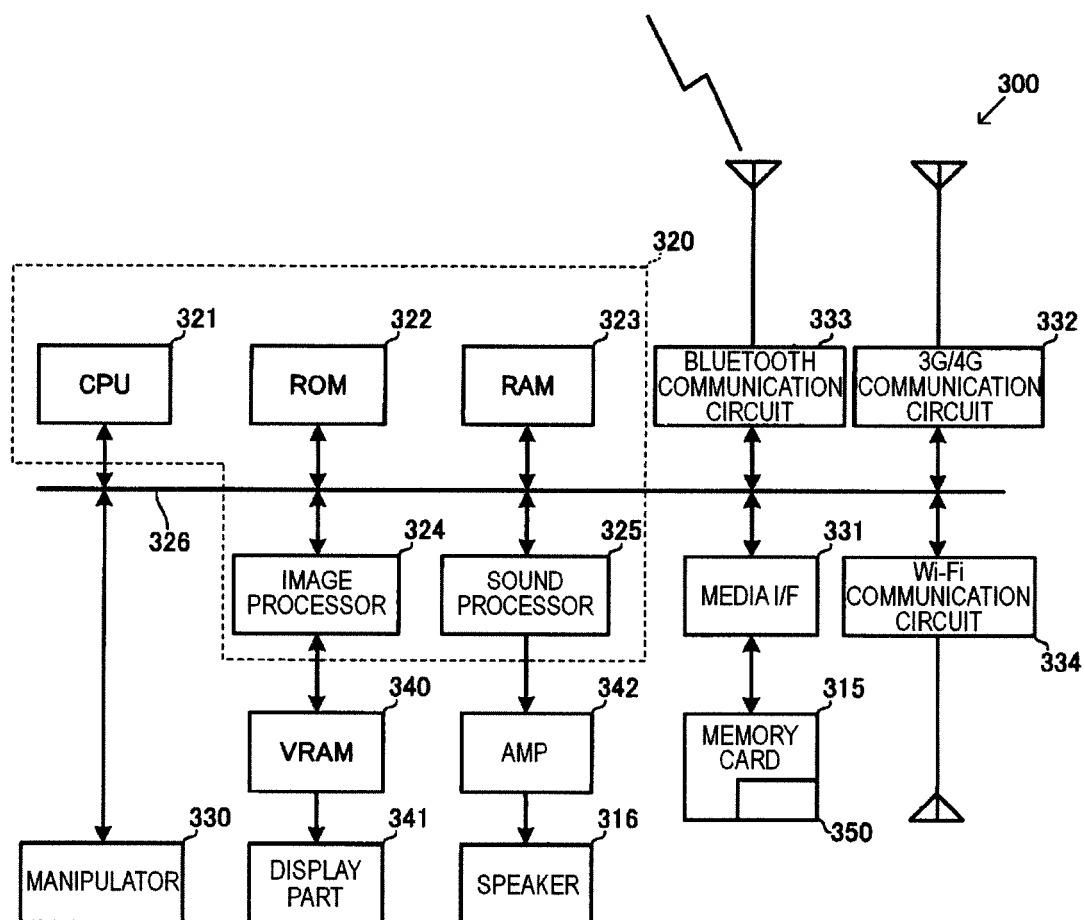


FIG.9

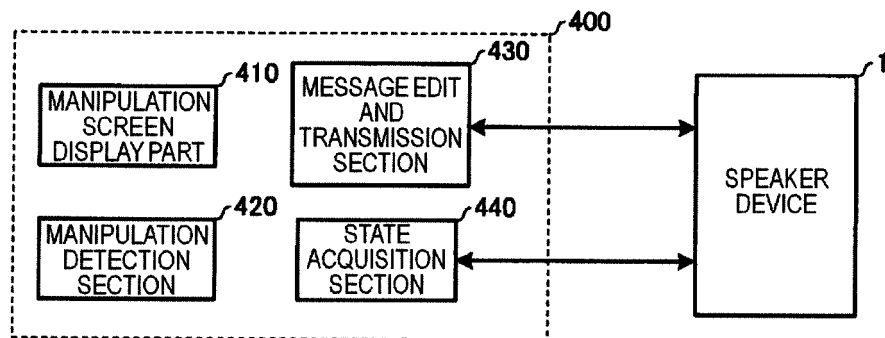


FIG. 10

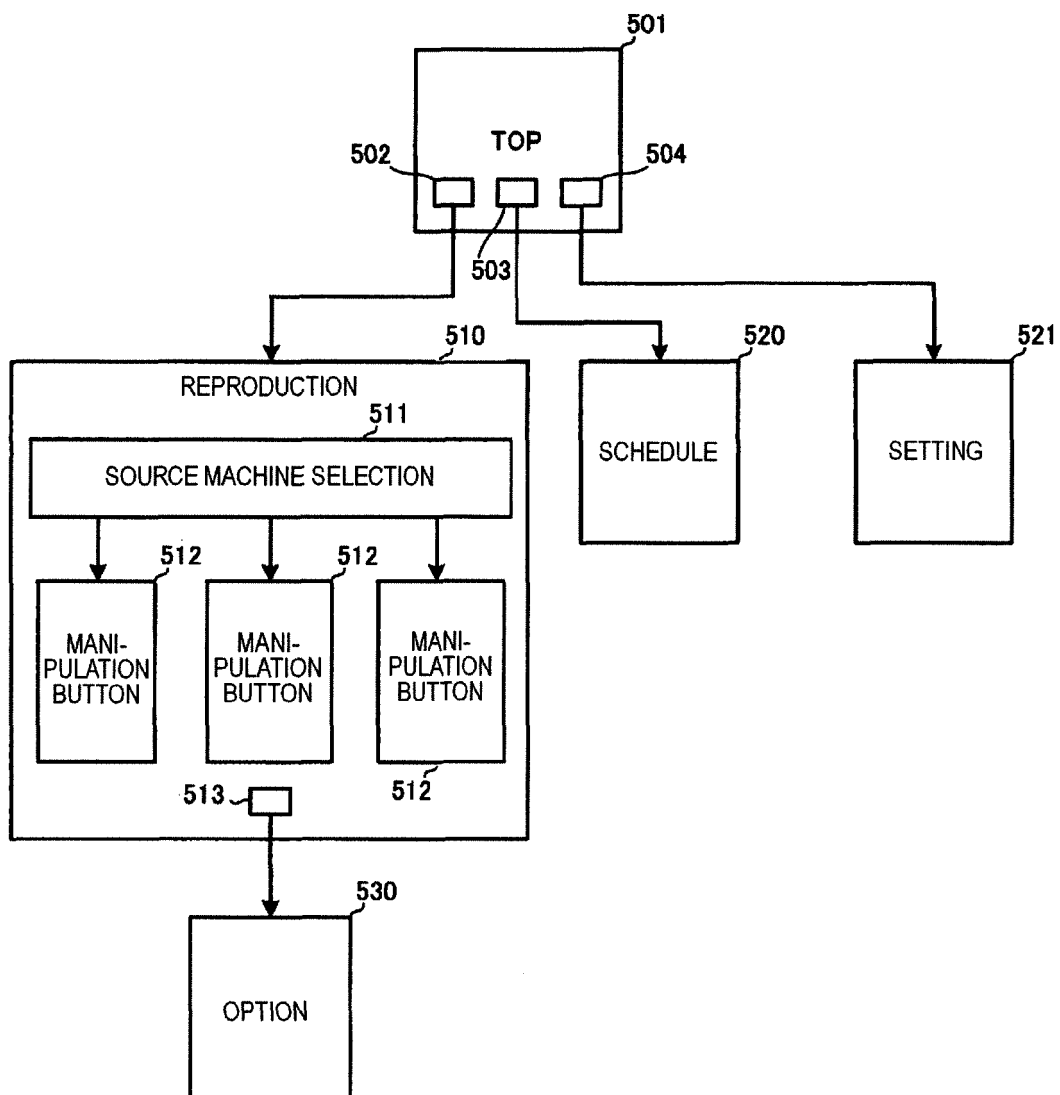


FIG. 11

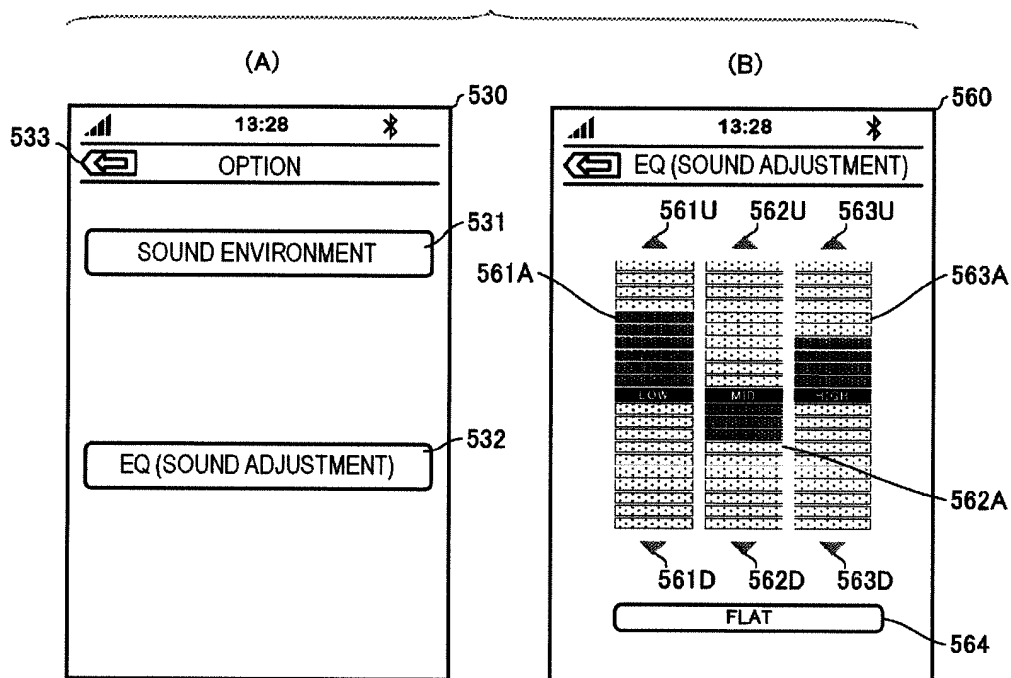


FIG. 12

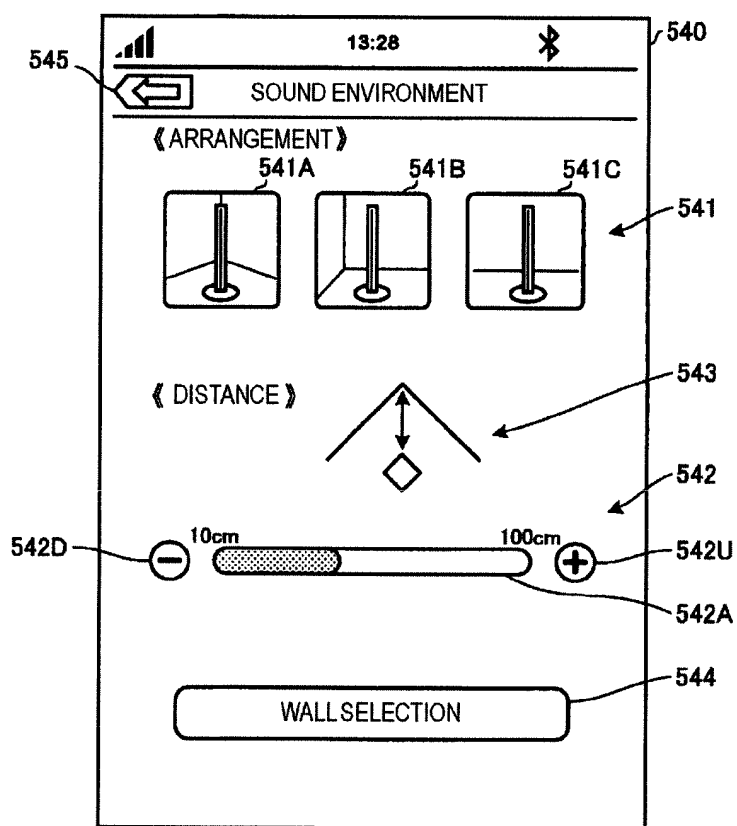


FIG. 13

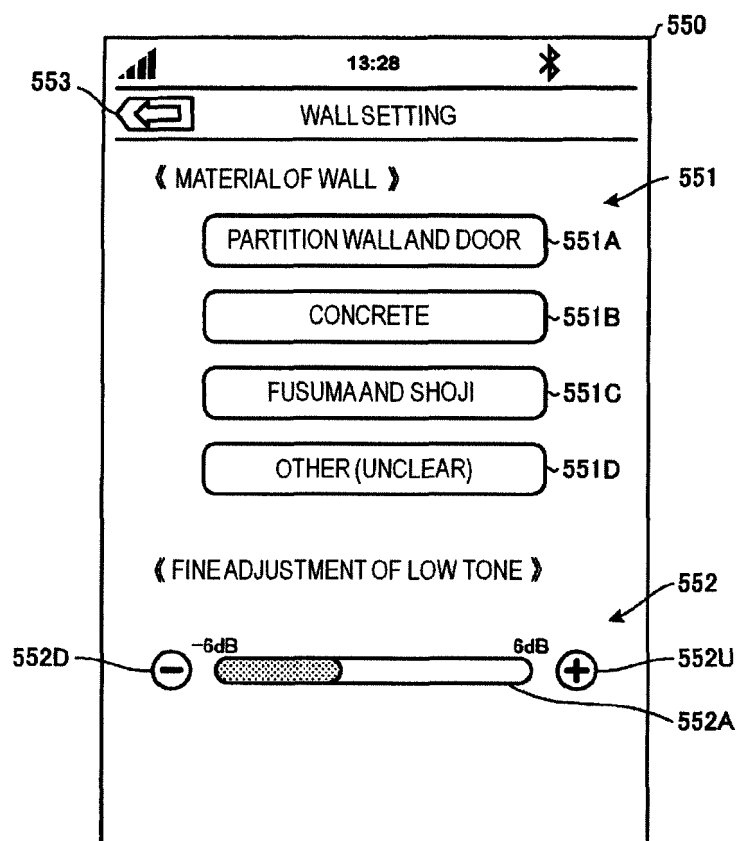


FIG. 14

MATERIAL OF WALL	L	M	H
PARTITION WALL AND DOOR	+2	0	-1
CONCRETE	0	-1	-1
FUSUMA AND SHOJI	+3	+2	+1
OTHER (UNCLEAR)	0	0	0

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/071895

A. CLASSIFICATION OF SUBJECT MATTER

H04S7/00(2006.01)i, H04Q9/00(2006.01)i, H04R1/34(2006.01)i, H04R3/00(2006.01)i, H04R5/02(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)

H04S7/00, H04Q9/00, H04R1/34, H04R3/00, H04R5/02

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.
Y	JP 2003-37888 A (Kabushiki Kaisha Mechanical Research), 07 February 2003 (07.02.2003), paragraphs [0006] to [0008], [0013], [0015] to [0016]; fig. 1 to 2, 5 to 6 & US 2003/0016830 A1	1-10
Y	JP 2002-171600 A (Sony Corp.), 14 June 2002 (14.06.2002), paragraphs [0020], [0038] to [0040], [0052], [0070]; fig. 1 to 2, 4 (Family: none)	1-10

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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
10 September, 2014 (10.09.14)

Date of mailing of the international search report
22 September, 2014 (22.09.14)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/071895

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 10-69279 A (Toshiba Corp.), 10 March 1998 (10.03.1998), claims 5 to 8; paragraphs [0024] to [0033]; fig. 1 (Family: none)	2-10
Y	JP 2001-352600 A (Marantz Japan, Inc.), 21 December 2001 (21.12.2001), paragraph [0044]; fig. 1, 3 & US 2003/0043051 A1 & EP 1254588 A & WO 2001/095669 A2 & CN 1476736 A	3-10
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