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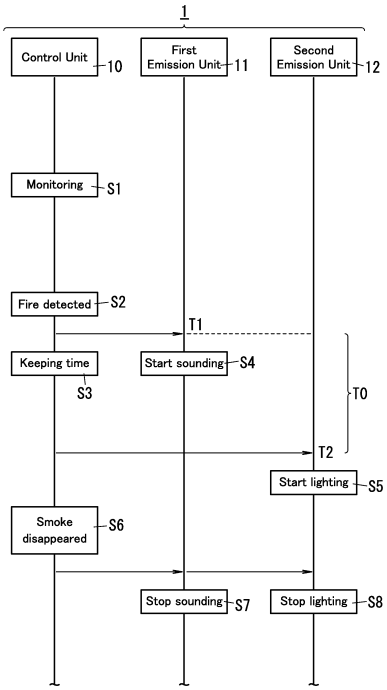
(54) ACOUSTIC DEVICE, CONTROL METHOD, AND PROGRAM

(57) An object of the present disclosure is to contribute to evacuating a person in an even shorter time. An audio device (1) is to be installed in a structural component. The audio device (1) includes a control unit (10), a first emission unit (11), and a second emission unit (12). The control unit (10) determines, in accordance with information provided about a particular event, whether or not the particular event is present. The first emission unit (11) emits, when the control unit (10) determines that the particular event be present, a sound to alert a person to the presence of the particular event. The second emission unit (12) emits light in accordance with the information. A time lag (T0) is provided between a first timing (T1) when the sound starts being emitted and a second timing (T2) when the light starts being emitted.

FIG. 3



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Description

Technical Field

[0001] The present disclosure generally relates to an audio device, a control method, and a program, and more particularly relates to an audio device configured to alert the user to the presence of a particular event, and a method and program for controlling such an audio device.

Background Art

[0002] Patent Literature 1 discloses a known residential fire alarm. The residential fire alarm includes a smoke detecting unit with a smoke inlet, which is provided at the center of its cover, and detects the outbreak of a fire when the concentration of smoke produced by a fire reaches a predetermined concentration. The residential fire alarm further has sound holes on a lower left-hand side of the smoke detecting unit on the cover. A loudspeaker is arranged behind the sound holes to emit an alarm sound and a voice warning message. The residential fire alarm may be installed on, for example, the wall surface of a resident's room or bedroom in a dwelling house to detect, in the event of the outbreak of a fire, the fire and start sounding a fire warning.

Citation List

Patent Literature

[0003] Patent Literature 1: JP 2010-49604 A

Summary of Invention

[0004] There has been an increasing demand for residential fire alarms (typically in the form of audio devices) that could evacuate, when a particular event such as a fire breaks out, residents of a house in an even shorter time after they have learned about the presence of the particular event.

[0005] In view of the foregoing background, it is therefore an object of the present disclosure to provide an audio device, a control method, and a program, all of which are configured or designed to contribute to evacuating residents in an even shorter time.

[0006] An audio device according to an aspect of the present disclosure is to be installed in a structural component. The audio device includes a control unit, a first emission unit, and a second emission unit. The control unit determines, in accordance with information provided about a particular event, whether or not the particular event is present. The first emission unit emits, when the control unit determines that the particular event be present, a sound to alert a person to the presence of the particular event. The second emission unit emits light in accordance with the information. A time lag is provided between a first timing when the sound starts being emitted and a second timing when the light starts being emitted.

[0007] A control method according to another aspect of the present disclosure is a method for controlling an audio device installed in a structural component. The method includes a decision step, a first emission step, and a second emission step. The decision step includes determining, in accordance with information provided about a particular event, whether or not the particular event is present. The first emission step includes making, when a decision is made that the particular event be present, a first emission unit emit a sound to alert a person to the presence of the particular event. The second emission step includes making a second emission unit emit light in accordance with the information. A time lag is provided between a first timing when the sound starts being emitted and a second timing when the light starts being emitted.

[0008] A program according to still another aspect of the present disclosure is designed to cause a computer system to carry out the control method described above.

Brief Description of Drawings

[0009]

FIG. 1 illustrates the appearance of an audio device according to an exemplary embodiment;
FIG. 2 is a block diagram illustrating a configuration for the audio device;
FIG. 3 is a sequence chart illustrating how the audio device operates;
FIGS. 4A and 4B illustrate how the audio device works when installed in a bedroom;
FIG. 5 illustrates a first variation of the audio device and also illustrates schematic configurations for external devices;
FIG. 6 is a sequence chart illustrating how a second variation of the audio device operates; and
FIGS. 7A and 7B illustrate the appearance of a fourth variation of the audio device.

Description of Embodiments

(1) Overview

[0010] Note that the embodiment to be described below is only an exemplary one of various embodiments of the present disclosure and should not be construed as limiting. Rather, the exemplary embodiment to be described below may be readily modified in various manners depending on a design choice or any other factor without departing from the scope of the present disclosure. The drawings to be referred to in the following description of embodiments are all schematic representations. That is to say, the ratio of the dimensions (including thicknesses) of respective constituent elements illustrated on the drawings does not always reflect their actual

dimensional ratio.

[0011] As shown in FIGS. 4A and 4B, an audio device 1 according to this embodiment is to be installed in a structural component C1 (i.e., a building component such as a ceiling or a wall). The audio device 1 includes a control unit 10, a first emission unit 11, and a second emission unit 12 as shown in FIG. 2. The control unit 10 determines, in accordance with information provided about a particular event, whether or not the particular event is present.

[0012] In this example, the "particular event" is supposed to be a fire, for example. Therefore, the audio device 1 may be implemented as, for example, a fire alarm that emits an alarm sound or any other type of sound at the outbreak of the fire. However, this is only an example of the present disclosure and should not be construed as limiting. Alternatively, the particular event does not have to be a fire but may also be gas leakage, a tsunami, an earthquake, or intrusion of a suspicious person as long as the event requires sounding an alarm.

[0013] As shown in FIG. 2, the audio device 1 according to this embodiment includes a photoelectric sensor (as a detecting unit 2) for detecting smoke as a built-in component thereof. However, this is only an example of the present disclosure and should not be construed as limiting. Alternatively, the detecting unit 2 may also be a fixed temperature sensor for detecting heat. Optionally, the detecting unit 2 may also be provided separately from the audio device 1. In that case, the control unit 10 of the audio device 1 may be provided with information about the fire by communicating with another audio device (fire alarm) including the detecting unit.

[0014] The audio device 1 may be installed on a surface (such as a ceiling surface or wall surface) of a structural component C1 such as a resident's room, a bedroom, stairs, or a hallway in a dwelling house. The dwelling house may be a single-family dwelling house or a multi-family dwelling house (i.e., what is called a "mansion" in Japan). Alternatively, the audio device 1 may also be installed (on the ceiling surface or wall surface) in a non-residential structural component C1, instead of those dwelling houses. Examples of such non-dwelling structural components include office buildings, theaters, movie theaters, public halls, amusement facilities, complex facilities, restaurants, department stores, schools, hotels, inns, hospitals, nursing homes for the elderly, kindergartens, libraries, museums, art museums, underground shopping malls, railway stations, and airports.

[0015] When the control unit 10 determines that a fire as the particular event should be present, the first emission unit 11 emits an alarm sound to alert the user to the presence of the fire. Meanwhile, the second emission unit 12 emits light in accordance with the information about the fire. In the following description, the light emitted from the second emission unit 12 will be hereinafter referred to as "illuminating light." Note that the light emitted from the second emission unit 12 has lower intensity than illuminating light emitted from a general light fixture and may be bright enough to indicate an evacuation route. As used herein, the "light" is supposed to be illuminating light that irradiates the surrounding region R1 as an example. However, the light does not have to be such illuminating light but may also be the light emitted from an indicating lamp that either lights or flickers when the alarm is sounded (i.e., when activated). Also, the "surrounding region R1" may be, if the audio device 1 is installed on a ceiling surface, a region that faces the ceiling surface (such a floor surface). On the other hand, if the audio device 1 is installed on a wall surface, the surrounding region R1 may be a region (such as another wall surface) that faces the former wall surface.

[0016] In addition, according to this embodiment, a time lag T0 is provided between a first timing T1 when the sound starts being emitted and a second timing T2 when the light starts being emitted (see FIG. 3).

[0017] According to this configuration, not only a sound but also light are emitted and a time lag T0 is provided between the timing when the sound starts being emitted and the timing when the light starts being emitted. This allows the user (such as the resident 100) to recognize the current situation where the particular event is present and follow the evacuation procedure more quickly. Consequently, this contributes to evacuating the user in an even shorter time when a particular event is present.

(2) Details

(2.1) Overall configuration

[0018] Next, an overall configuration for an audio device 1 according to this embodiment will be described in detail. In this embodiment, the audio device 1 may be implemented as, for example, a battery-operated fire alarm. However, this is only an example of the present disclosure and should not be construed as limiting. Alternatively, the audio device 1 may also be implemented as a fire alarm which is electrically connected to an external power supply (such as a commercial power grid) and which is operated by converting AC power (with an effective voltage of 100 V, for example) supplied from the external power supply into a direct current.

[0019] In the example to be described below, the audio device 1 is supposed to be installed on a ceiling surface (which is an exemplary surface of the structural component C1) of a bedroom in a resident's 100 dwelling house as shown in FIGS. 4A and 4B. Thus, the arrangement and operation of respective constituent elements of the audio device 1 in upward, downward, rightward, and leftward directions will be described as being defined by the up, down, right, and left arrows shown in FIG. 1. Note that the arrows indicating these directions are just shown there as an assistant to description and are insubstantial ones. It should also be noted that these directions do not define the direction in which the audio device 1 should be used.

[0020] As shown in FIG. 2, the audio device 1 includes

not only the control unit 10, the first emission unit (sound emission unit) 11, the second emission unit (light emitting unit) 12, and the detecting unit 2 but also a battery 13, an operating unit 3, a housing 4, and a light-transmitting portion 5 (see FIG. 1) as well. In the following description, the audio device 1 is supposed to be implemented as an independently operating fire alarm with no capability of communicating with other fire alarms.

(2.2) Housing

[0021] The housing 4 houses the control unit 10, the first emission unit 11, the second emission unit 12, the battery 13, the detecting unit 2, and a circuit board (not shown) on which the control unit 10 and other circuit components that form various other circuits are assembled together. Although not shown, as used herein, the various other circuits include an audio circuit, a first lighting circuit, a second lighting circuit, and a power supply circuit as will be described later.

[0022] The housing 4 is made of a synthetic resin and may be made of flame-retardant ABS resin, for example. The housing 4 is formed in the shape of a generally compressed cylinder. The housing 4 includes, on the upper surface thereof, a mounting portion, with which the housing 4 is mounted on one surface (installation surface) of the structural component C1.

[0023] As shown in FIG. 1, the housing 4 has holes 401, which are provided through a peripheral wall 400 thereof to let smoke flow into a labyrinth inside the housing 4. The housing 4 includes a partition wall that partitions the interior space thereof into upper and lower parts. The labyrinth and the detecting unit 2 are provided in the upper, first space and the control unit 10, the first emission unit 11, the second emission unit 12, the circuit board, and other components are provided in the lower, second space.

[0024] The housing 4 further has a slit window hole 403, which is provided through a lower wall (cover) 402 and elongated in one direction (e.g., rightward/leftward direction in FIG. 1). The window hole 403 is arranged to face the first emission unit 11 housed inside the housing 4. The window hole 403 is provided to let the sound, emitted from the first emission unit 11, come out of the housing 4.

[0025] In addition, the housing 4 supports the light-transmitting portion 5 on a lower wall 402 thereof such that the lower surface of the light-transmitting portion 5 is exposed on the outer surface of the housing 4. The light-transmitting portion 5 is a disk member with a light-transmitting property. The light-transmitting portion 5 is made of a material such as an acrylic resin or glass. The light-transmitting portion 5 is arranged to face an illuminating unit 120 (to be described later) of the second emission unit 12 housed inside the housing 4. The light-transmitting portion 5 lets the light (illuminating light), emitted from the illuminating unit 120, come out of the housing 4. Optionally, the light-transmitting portion 5 may include a lens portion, of which the outer surface is formed in a convex shape to direct the light emitted from the illuminating unit 120 toward the surrounding region R1. If necessary, a light guide member for efficiently guiding the light emitted from the illuminating unit 120 toward the light-transmitting portion 5 may be provided between the light-transmitting portion 5 and the illuminating unit 120.

[0026] The housing 4 further supports, on the lower wall 402, the operating unit 3 such that the lower surface of the operating unit 3 is exposed on the outer surface of the housing 4. The operating unit 3 accepts an operating command entered externally. The operating unit 3 is configured to be pushed upward by the user with one of his or her fingers, for example. The operating unit 3 is a disk member with a light-transmitting property and is arranged to face the indicating lamp 121 (to be described later) of the second emission unit 12 housed inside the housing 4. In addition, the operating unit 3 is configured to press down a push button switch (not shown) housed inside the housing 4 when subjected to a push operation.

[0027] In this embodiment, when the lower surface of the lower wall 402 is looked up to from under the housing 4, the window hole 403 and the operating unit 3 are arranged in line in one direction (e.g., in the rightward/leftward direction in FIG. 1) such that the center of the lower surface of the lower wall 402 is interposed between the window hole 403 and the operating unit 3, for example. Furthermore, when the lower surface of the lower wall 402 is looked up to from under the housing 4, the light-transmitting portion 5 is located closer to the front end with respect to the center of the lower surface of the lower wall 402.

(2.3) First emission unit

[0028] The first emission unit 11 emits a sound (i.e., an acoustic wave). When the control unit 10 determines that a fire should be present, the first emission unit 11 emits an alarm sound to alert the user to the presence of the fire. A timing when the first emission unit 11 starts emitting the alarm sound will be hereinafter sometimes referred to as a "first timing T1."

[0029] The first emission unit 11 may be implemented as a loudspeaker that transduces an electrical signal into a sound. The loudspeaker includes a diaphragm and emits an alarm sound by mechanically vibrating the diaphragm in accordance with the electrical signal. The loudspeaker is formed in the shape of a circular disk in a front view. The first emission unit 11 emits an alarm sound (such as a beep) under the control of the control unit 10. The first emission unit 11 suitably emits an alarm sound, of which the loudness (i.e., the sound pressure level) is variable. For example, the alarm sound may include a sweep sound that is swept from a low-frequency sound to a high-frequency sound. Optionally, the alarm sound may be accompanied with a voice warning message such as "Fire! Fire!" In this embodiment, the alarm sound is supposed to be made up of the sweep sound and the

voice warning message continuous with the sweep sound.

[0030] On the circuit board described above, circuit components that form an acoustic circuit, for example, may be assembled together. The acoustic circuit includes a low-pass filter and an amplifier, for example. On receiving a pulse width modulation (PWM) signal corresponding to the alarm sound and generated by the control unit 10 at the outbreak of a fire, the acoustic circuit makes the low-pass filter transform the PWM signal into an audio signal with a sinusoidal waveform, makes the amplifier amplify the audio signal, and then makes the first emission unit 11 output the amplified signal as an alarm sound.

[0031] The first emission unit 11 also emits the alarm sound tentatively even when subjected to an operation check test. The first emission unit 11 emits a voice warning message such as "Operating normally" or "Operating abnormally" according to the condition of the audio device 1. The operation check test may be carried out by either operating the operating unit 3 or pulling a pull string (not shown) extended from the housing 4. Optionally, the first emission unit 11 may emit a voice warning message notifying the user that it is about time the battery 13 was replaced. The battery 13 may be a lithium-ion battery, for example.

(2.4) Second emission unit

[0032] The second emission unit 12 emits light. As shown in FIG. 2, the second emission unit 12 according to this embodiment corresponds to the illuminating unit 120 and the indicating lamp 121. The second emission unit 12 emits light in accordance with information provided about the fire under the control of the control unit 10. A timing when the second emission unit 12 starts emitting the light will be hereinafter sometimes referred to as a "second timing T2." A time lag T0 is provided between the first timing T1 and the second timing T2. In this embodiment, the second timing T2 is later than the first timing T1 as an example.

[0033] Optionally, either the illuminating unit 120 or the indicating lamp 121 may correspond to the second emission unit 12. In other words, when the illuminating unit 120 starts emitting the light at the second timing T2, for example, the indicating lamp 121 may start emitting the light at the same timing (i.e., the first timing T1) as the first emission unit 11, instead of starting emitting the light at the second timing T2.

[0034] The illuminating unit 120 includes, as a light source, a single or a plurality of illuminating white light-emitting diodes (LEDs) 120A mounted on the circuit board (see FIG. 2). The illuminating unit 120 is OFF normally (i.e., while monitoring to see if any fire is present) and is turned ON (i.e., starts lighting) at the second timing T2 in accordance with information provided about the fire under the control of the control unit 10.

[0035] The LED 120A may be implemented as a package LED in which at least one LED chip is mounted at the center of the mounting surface of a flat plate mounting board. The LED chip may be, for example, a blue light-emitting diode that radiates a blue ray out of the light-emitting surface thereof. In addition, the mounting surface of the board including the LED chip is coated with an encapsulation resin to which a fluorescent material is added to convert the wavelength of the blue ray emitted from the LED chip. The LED 120A is configured to emit the white illuminating light from the light-emitting surface thereof when DC voltage is applied between the anode electrode and cathode electrode thereof. The color of the illuminating light does not have to be white but may also be any other color. Nevertheless, the color of the illuminating light is suitably different from the color of the light emitted from the indicating lamp 121.

[0036] On the circuit board described above, mounted are circuit components of the first lighting circuit for turning ON the LEDs 120A of the illuminating unit 120. The first lighting circuit turns the LEDs 120A ON with the DC power discharged from the battery 13 under the control of the control unit 10. If the audio device 1 is electrically connected to a commercial power grid, then the first lighting circuit turns the LEDs 120A ON by converting the AC power supplied from the power grid into a DC current.

[0037] The light (illuminating light) emitted from the illuminating unit 120 is transmitted through the light-transmitting portion 5 to come out of the housing 4 and irradiate the surrounding region R1 (e.g., the floor surface and bed in the bedroom in this example). The illuminating unit 120 also emits light tentatively even when subjected to an operation check test. Just like the first emission unit 11, the illuminating unit 120 may also be subjected to an operation check test by either operating the operating unit 3 or pulling a pull string.

[0038] The indicating lamp 121 includes, as its light source, a red LED 120B mounted on the circuit board. The indicating lamp 121 is OFF normally (i.e., while monitoring to see if there is any fire present) but starts flickering (or is turned ON) at the second timing T2 in accordance with information about the fire under the control of the control unit 10.

[0039] On the circuit board described above, mounted are circuit components of the second lighting circuit for flickering the LED 120B of the indicating lamp 121. The second lighting circuit flickers the LED 120B with the DC power discharged from the battery 13 under the control of the control unit 10. If the audio device 1 is electrically connected to a commercial power grid, then the second lighting circuit flickers the LED 120B by converting the AC power supplied from the power grid into a DC current.

[0040] The light emitted from the indicating lamp 121 is transmitted through the operating unit 3 with a light transmitting property to come out of the housing 4. The resident 100 is allowed to learn, by seeing the operating unit 3 flickering in red, that the audio device 1 is now in operation (i.e., detecting a fire). The indicating lamp 121 also flickers when subjected to an operation check test. The operation check test of the indicating lamp 121 may

be carried out by either operating the operating unit 3 or pulling a pull string, just like the first emission unit 11. In addition, the indicating lamp 121 also flickers when it is about time the battery 13 was replaced or when the audio device 1 is out of order. If the operating unit 3 is operated while the indicating lamp 121 is flickering, the first emission unit 11 emits a voice warning message that it is about time the battery was replaced or that the audio device 1 has gone out of order.

(2.5) Detecting unit

[0041] The detecting unit 2 detects the outbreak of a fire as a particular event. In this embodiment, the detecting unit 2 may be implemented as, for example, a photoelectric sensor for detecting smoke. As shown in FIG. 2, the detecting unit 2 includes a light-emitting unit 21 such as an LED and a photodetector unit 22 such as a photodiode, for example. The light-emitting unit 21 and the photodetector unit 22 are arranged in the labyrinth of the housing 4 such that the photosensitive plane of the photodetector unit 22 is off the optical axis of the light emitted from the light-emitting unit 21. In the event of the outbreak of a fire, smoke may flow into the labyrinth through the holes 401 provided through the peripheral wall 400 of the housing 4.

[0042] If there is no smoke in the labyrinth of the housing 4, then the light emitted from the light-emitting unit 21 hardly reaches the photosensitive plane of the photodetector unit 22. On the other hand, if there is any smoke in the labyrinth of the housing 4, then the light emitted from the light-emitting unit 21 is scattered by the smoke, thus causing some of the scattered light to reach the photosensitive plane of the photodetector unit 22. That is to say, the detecting unit 2 makes the photodetector unit 22 receive the light emitted from the light-emitting unit 21 which has been scattered by the smoke.

[0043] The detecting unit 2 is electrically connected to the control unit 10. The detecting unit 2 transmits an electrical signal (detection signal), indicating a voltage level corresponding to the quantity of the light received by the photodetector unit 22, to the control unit 10. In response, the control unit 10 determines, by converting the quantity of light represented by the detection signal received from the detecting unit 2 into the concentration of smoke (as an exemplary event level), whether or not any fire is present. Alternatively, the detecting unit 2 may convert the quantity of the light received by the photodetector unit 22 into a smoke concentration and then transmit a detection signal indicating a voltage level corresponding to the smoke concentration to the control unit 10. Still alternatively, the detecting unit 2 may determine, based on the quantity of the light received at the photodetector unit 22, that a fire (smoke) should be present and then transmit a detection signal, including information about the outbreak of the fire, to the control unit 10.

(2.6) Control unit

[0044] The control unit 10 may be implemented as, for example, a microcomputer including, as major constituent elements, a central processing unit (CPU) and a memory. That is to say, the control unit 10 is implemented as a computer including a CPU and a memory. The computer performs the function of the control unit 10 by making the CPU execute a program stored in the memory. In this embodiment, the program is stored in advance in the memory. However, this is only an example and should not be construed as limiting. The program may also be downloaded via a telecommunications line such as the Internet or distributed after having been stored in a non-transitory storage medium such as a memory card.

[0045] The control unit 10 controls the first emission unit 11, the acoustic circuit, the second emission unit 12 (including the illuminating unit 120 and the indicating lamp 121), the first lighting circuit, the second lighting circuit, the detecting unit 2, and other units. In addition, the control unit 10 also controls a power supply circuit for generating, based on the DC power supplied from the battery 13, operating power for various types of circuits.

[0046] The control unit 10 is configured to determine, in accordance with information provided about a fire as a particular event, whether or not any fire is present. Specifically, the control unit 10 monitors the level of the detection signal (information) received from the detecting unit 2 to determine whether or not the event level included in the detection signal has exceeded a threshold value. The event level may be, for example, the converted smoke concentration as described above. Alternatively, the event level may also be the quantity of light.

[0047] The control unit 10 stores the threshold value in its own memory. The control unit 10 may determine, at regular time intervals, whether or not the smoke concentration has exceeded the threshold value, and may determine, when finding the smoke concentration greater than the threshold value at least once, that a fire should be present. The regular time interval may be 5 seconds, for example. Alternatively, the control unit 10 may count the number of times the smoke concentration has exceeded the threshold value consecutively, and may determine, on finding the number of times reaching a predetermined number of times, that a fire should be present. Naturally, the control unit 10 may directly determine, on receiving a detection signal including information about the outbreak of a fire from the detecting unit 2, that a fire should be present.

[0048] On determining, based on the smoke concentration, that a fire should be present, the control unit 10 makes the first emission unit 11 start emitting an alarm sound at the first timing T1. Specifically, the control unit 10 generates a PWM signal corresponding to a sweep sound, of which the frequency changes linearly with the passage of time, and outputs the PWM signal to the acoustic circuit. The PWM signal is converted by the acoustic circuit into an audio signal so that a sweep sound

(as an alarm sound) is emitted from the first emission unit 11. In addition, the control unit 10 also generates, based on message data stored in its own memory, a PWM signal corresponding to the voice warning message and outputs the PWM signal to the acoustic circuit. The PWM signal is converted by the acoustic circuit into an audio signal so that a voice warning message (with an alarm sound) is emitted from the first emission unit 11.

[0049] In addition, the control unit 10 makes the second emission unit 12 (including the illuminating unit 120 and the indicating lamp 121) start emitting light at a second timing T2, which is later than the first timing T1 by a time lag T0. Specifically, the control unit 10 transmits a control signal for lighting (i.e., turning ON) the illuminating unit 120 and a control signal for flickering the indicating lamp 121 to the first lighting circuit and the second lighting circuit, respectively. In this embodiment, the time lag T0 is set at a constant time. The constant time may be 4 seconds, for example. That is to say, the control unit 10 starts keeping, using its own timer, the time at the first timing T1 and transmits the control signal at a point in time (i.e., the second timing T2) when a certain amount of time has passed since then. On receiving the control signal from the control unit 10, the first light circuit lights the illuminating unit 120 with constant brightness. On receiving the control signal from the control unit 10, the second light circuit flickers the indicating lamp 121.

[0050] The control unit 10 also continues determining the smoke concentration even while the fire alarm is being sounded (i.e., while an alarm sound is being emitted). When finding the smoke concentration equal to or less than a reference value while the fire alarm is being sounded, the control unit 10 stops generating the PWM signal to instruct the first emission unit 11 to stop emitting the alarm sound. In addition, the control unit 10 also transmits a stop signal to the first lighting circuit and the second lighting circuit to stop emitting light from the illuminating unit 120 and the indicating lamp 121. On determining that the fire (smoke) should be no longer present, the control unit 10 automatically stops emitting the alarm sound and stops emitting the light.

[0051] In addition, on detecting that the push button switch is turned ON in the housing 4 through a push operation performed on the operating unit 3 while the fire alarm is being sounded, the control unit 10 stops emitting the alarm sound. If the resident 100 determines that the alarm should be being sounded by the audio device 1 by mistake, then he or she may stop emitting the alarm sound by performing the push operation on the operating unit 3. The resident 100 may also stop emitting the alarm sound by pulling the pull string.

[0052] On the other hand, when the push button switch is turned ON in the housing 4 by a push operation performed on the operating unit 3 while the fire alarm is not being sounded, the control unit 10 carries out a predetermined type of test to check the operation. The operation check test includes, for example, a sound emission test on the first emission unit 11, and a light emission test on the second emission unit 12 (including the illuminating unit 120 and the indicating lamp 121). The operation check test may also be performed by pulling the pull string.

(2.7) How this audio device works

[0053] Next, it will be described how the audio device 1 installed in a bedroom as shown in FIGS. 4A and 4B works following the sequence shown in FIG. 3 at the outbreak of a fire. In example shown in FIGS. 4A and 4B, the resident 100 is supposed to be sleeping in bed in the bedroom at midnight when the fire breaks out.

[0054] The control unit 10 of the audio device 1 repeatedly determines, at regular intervals of 5 seconds, for example, whether or not the smoke concentration has exceeded a threshold value (in Step S1 (monitoring) shown in FIG. 3). On determining that a fire should be present (in Step S2 (fire detected) shown in FIG. 3), the control unit 10 outputs a PWM signal (at the first timing T1). In addition, the control unit 10 also starts keeping the time using a timer (in Step S3 (keeping time) shown in FIG. 3). Next, the first emission unit 11 receives an audio signal, to which the PWM signal has been transformed by the acoustic circuit, to starts emitting an alarm sound (in Step S4 (start sounding) shown in FIG. 3). As a result, the fire alarm is sounded in the bedroom, even though it is in almost complete darkness in the bedroom as shown in FIG. 4A.

[0055] Thereafter, when a certain amount of time passes, the control unit 10 outputs a control signal to the first lighting circuit and the second lighting circuit (at the second timing T2). In response, the illuminating unit 120 of the second emission unit 12 turns ON, and at the same time, the indicating lamp 121 of the second emission unit 12 starts flickering (in Step S5 (start lighting) shown in FIG. 3). A time lag T0 (of 4 seconds, for example) is provided between the first timing T1 and the second timing T2. As a result, in the bedroom which has been in almost complete darkness, the surrounding region R1 is illuminated as shown in FIG. 4B with the illuminating light cast from the illuminating unit 120 when the time lag T0 passes since the start of sounding the alarm. Thereafter, on determining that the smoke concentration has decreased to a reference value or less (in Step S6 (smoke disappeared) shown in FIG. 3), the control unit 10 makes the first emission unit 11 stop emitting the alarm sound (in Step S7 (stop sounding) shown in FIG. 3) and also makes the second emission unit 12 stop emitting the light (in Step S8 (stop lighting) shown in FIG. 3).

[0056] In this case, if a fire breaks out in a house at midnight, for example, then the resident 100, sleeping in his or her bedroom of the house, may jump out of the bed in almost complete darkness at the alarm sound. In such a situation, it may be difficult for him or her to instantly sense the route and direction from the bed to the door leading to the hallway. Meanwhile, in such an emergency situation, the resident 100 may attempt to grope

around in the darkness to reach for the wall switch to turn the bedroom light ON. Such an attempt to turn the wall switch ON could cause a significant delay in evacuation. In addition, if the resident 100 is a hearing-impaired person, then he or she could be unaware of the outbreak of the fire at the alarm sound only. To overcome these problems, the audio device 1 emits not only the alarm sound but also the illuminating light from the illuminating unit 120, thus increasing the chances of the resident 100 instantly sensing the route (evacuation route) from the bed to the door leading to the hallway and saving him or her the time and effort to turn the bedroom light ON. Besides, the illuminating light emitted from the illuminating unit 120 and the red flickering light emitted from the indicating lamp 121 increase the chances of even a resident 100 who is a hearing-impaired person sensing the presence of a fire.

[0057] A fire and other emergency situations are not events that may break out frequently in daily life environments for the resident 100. Thus, even when learning that the audio device 1 is sounding, it will be often difficult for the resident 100 to instantly accept the fact that a fire is actually present before him or her in his or her own house. It could be much less easy for the resident 100 who has been sleeping and who has just woken up at the fire warning, for example, to promptly understand what the light and sound emitted from the audio device 1 means because his or her brain is still foggy in such a state. Thus, providing the time lag T0 between the first timing T1 and the second timing T2 allows the resident 100 some time to think sequentially and discretely what the sound emitted means and then think what the light emitted means. This facilitates him or her understanding what is happening now before him or her and following the evacuation procedure promptly without wasting time. Consequently, this contributes to evacuating the resident 100 in an even shorter time in the event of the outbreak of a fire (which is a typical example of a particular event).

[0058] For example, if the second timing T2 is earlier than the first timing T1, then the resident 100 who has been sleeping would wake up at the intense illuminating light and would find the illuminating light glaring and uncomfortable. This could cause a significant delay in his or her evacuation. In contrast, according to this embodiment, the second timing T2 is later than the first timing T1. Therefore, the resident 100 who has been sleeping would wake up at the alarm sound, not the intense light, which reduces the unbeneficial effect of the glaring light.

(3) Variations

[0059] Next, some variations will be enumerated one after another. In the following description, the exemplary embodiment described above will be hereinafter referred to as a "basic example." Note that each of the variations to be described below may be adopted in combination with the basic example described above and/or any other one(s) of the variations.

(3.1) First variation

[0060] The audio device 1 according to the basic example is a fire alarm that operates independently. That is to say, the audio device 1 according to the basic example does not have the capability of communicating with other fire alarms. However, this is only an example of the present disclosure and should not be construed as limiting. Alternatively, the audio device 1 may also be an interconnected fire alarm with the capability of communicating with other fire alarms. In addition, the audio device 1 may also be configured to have the capability of communicating with various types of devices other than fire alarms.

[0061] FIG. 5 illustrates an audio device 1A according to a first variation. The audio device 1A includes not only every function of the audio device 1 according to the basic example but also a communications unit 14 with the capability of communicating with external devices 8. Examples of the external devices 8 include another audio device (fire alarm) X1, a mobile telecommunications device (such as a smartphone) X2 carried by the resident 100 with him or her, and a security monitoring device X3 installed in a house. The communications unit 14 includes a communications interface to communicate wirelessly with the audio device X1, the mobile telecommunications device X2, and the security monitoring device X3. Communication with the audio device X1 does not have to be wireless but may also be established via cables.

[0062] The audio device 1A is one of a plurality of audio devices installed in respective rooms, doorways, and main entrance in a dwelling house and is supposed to be a master device in this example. However, this is only an example of the present disclosure and should not be construed as limiting. Alternatively, the audio device 1A may also be a slave device. Also, the audio device X1 is supposed to be one of a plurality of audio devices and serve as a slave device. In other words, the audio device 1A and the audio device X1 may have substantially the same configuration, even though one of these two audio devices 1A, X1 serves as a master device and the other serves as a slave device. The control unit 10 of the audio device 1A serving as a master device includes a memory that stores in advance identification information of every audio device serving as a slave device.

[0063] Suppose a fire breaks out in a room where the audio device 1A is installed. Then, the audio device 1A immediately starts emitting an alarm sound at the first timing T1 and then starts emitting the illuminating light and flickering light at the second timing T2 after the time lag T0.

[0064] In addition, the audio device 1A outputs a coordination signal, including a first piece of information indicating the outbreak of a fire, to the audio device X1 at the first timing T1. Furthermore, the audio device 1A outputs an auxiliary signal, including a second piece of information indicating the emission of light, to the audio device X1 at the second timing T2. In the same way, the

audio device 1A also outputs the coordination signal and the auxiliary signal to the other audio devices as well.

[0065] On determining, in accordance with the first piece of information included in the coordination signal received, that a fire should be present, the audio device X1 and the other audio devices immediately start emitting the alarm sound, if the audio devices have not started sounding yet.

[0066] In addition, in accordance with the second piece of information included in the auxiliary signal received, the audio device X1 and the other audio devices make the second emission unit 12 (including the illuminating unit 120 and the indicating lamp 121) emit light.

[0067] The communications unit 14 of the audio device 1A transmits the first piece of information and the second piece of information to not only the other audio devices but also the mobile telecommunications device X2 and the security monitoring device as well. Note that if the operating unit 3 or pull string is operated or pulled in any of the audio device 1A, the audio device X1 and the other audio devices while the alarm sound is being emitted, every audio device in the house stops sounding the alarm.

[0068] As can be seen from the foregoing description, providing the audio device 1A with such a communications unit 14 having the capability of communicating with the external devices 8 allows the audio device 1A to share the first piece of information and the second piece of information with the external devices 8.

(3.2) Second variation

[0069] In the basic example described above, the second timing T2 when the light starts being emitted is supposed to be later than the first timing T1 when the alarm sound starts being emitted. However, this is only an example of the present disclosure and should not be construed as limiting. Alternatively, as long as the time lag T0 is provided between the first timing T1 and the second timing T2, the second timing T2 may also be earlier than the first timing T1.

[0070] The control unit 10 of the audio device 1 according to this (second) variation is configured to make not only comparison using a threshold value to determine, by the smoke concentration (event level), whether or not a fire is present (such a threshold value will be hereinafter referred to as a "first threshold value") but also comparison using a second threshold value as well. Nevertheless, the second threshold value is set at a value smaller than the first threshold value. For example, if the first threshold value corresponds to smoke concentration at Level 10, then the second threshold value may be set at a value corresponding to somewhat lower smoke concentration at Level 5. The first threshold value according to this variation is the same as the threshold value for use in the basic example to determine that a fire should be present.

[0071] Therefore, according to this variation, when the smoke concentration exceeds the first threshold value, the decision is also made that a fire should be present, and as soon as the decision is made that the fire should be present, an alarm sound starts being emitted at the first timing T1 as in the basic example. However, unlike the basic example, on determining that the smoke concentration should have exceeded the second threshold value that is lower than the first threshold value, the control unit 10 according to this variation makes the second emission unit 12 start emitting light at the second timing T2 immediately. That is to say, according to this variation, the illuminating unit 120 and the indicating lamp 121 start emitting the illuminating light and the flickering light, respectively, as an early warning before the alarm is sounded to alert the resident 100 to the presence of a fire, which is a main function of the audio device 1.

[0072] Next, it will be described with reference to the sequence chart of FIG. 6 how the audio device 1 according to this variation operates when a fire breaks out.

[0073] The control unit 10 repeatedly determines, at regular intervals of 5 seconds, for example, whether or not the smoke concentration has exceeded the second threshold value (in Step S11 (monitoring) shown in FIG. 6). On determining, during monitoring, that the smoke concentration should have exceeded the second threshold value (in Step S12 (early warning determined) shown in FIG. 6), the control unit 10 outputs a control signal to the first lighting circuit and the second lighting circuit (at the second timing T2). In response to the control signal, the illuminating unit 120 of the second emission unit 12 turns ON, and at the same time, the indicating lamp 121 of the second emission unit 12 starts flickering (in Step S13 (start lighting) shown in FIG. 6).

[0074] Thereafter, on determining that the smoke concentration should have exceeded the first threshold value (in Step S14 (fire detected) shown in FIG. 6), the control unit 10 outputs a PWM signal (at the first timing T1). Next, the first emission unit 11 receives an audio signal, to which the PWM signal has been transformed by the acoustic circuit, to start emitting an alarm sound (in Step S15 (start sounding) shown in FIG. 6). Note that the operation of the audio device 1 when the smoke concentration has decreased to a reference value or less is the same as in the basic example, and description thereof will be omitted herein.

[0075] As can be seen, making the second timing T2 earlier than the first timing T1 allows the resident 100 to learn about the presence of a fire by the light emitted as an early warning before the alarm is sounded. Particularly, if the resident 100 has been sleeping, he or she would be surprised at the loud alarm sound emitted suddenly without notice. In addition, it would often be difficult for the resident 100 to accept the fact that a fire is present before him or her even if he or she heard the alarm sounding suddenly. Taking these respects into consideration, having the resident 100 sequentially recognize the flashing light (as an early warning) and then the alarm sound would make it easier for him or her to accept the presence

of the fire and follow the evacuation procedure quickly without wasting time. Furthermore, irradiating the resident 100 with the illuminating light emitted from the illuminating unit 120 increases the chances of waking him or her up even if he or she has been sleeping. Once the resident 100 has woken up, he or she would have highly likely confirmed the route from the bed to the door when the alarm sound is emitted following the flashing light. In addition, making decisions using the two threshold values allows the emission of the flashing light to precede the emission of the alarm sound more appropriately.

[0076] Note that the second threshold value is suitably close enough to the first threshold value so that the smoke concentration will exceed the first threshold value within a few seconds to several ten seconds after the smoke concentration has exceeded the second threshold value. In other words, setting the second threshold value at a smoke concentration much lower than the first threshold value would increase the chances of the smoke concentration not exceeding the first threshold value, even though the light has been emitted from the second emission unit 12 at the second timing T2, thus allowing an unwanted situation where the alarm sound fails to be emitted to persist. In view of this consideration, the second threshold value is suitably set such that the light is emitted as an early warning before the alarm is sounded.

(3.3) Third variation

[0077] The audio device 1 according to the second variation is configured to make the second timing T2 earlier than the first timing T1 by using the second threshold value that is set at a value smaller than the threshold value (first threshold value). However, this is only an example of the present disclosure and should not be construed as limiting. Alternatively, the second timing T2 may be made earlier than the first timing T1 by any other configuration, not just using the second threshold value.

[0078] The control unit 10 of the audio device 1 according to this variation (third variation) is configured to compare the smoke concentration (event level) with a threshold value at regular time intervals and count the number of times that the smoke concentration has exceeded the threshold value consecutively. The regular time intervals may be 5 seconds, for example. The threshold value for use in this variation may be the same as, for example, the threshold value for use in the basic example to determine that a fire should be present.

[0079] The control unit 10 determines, when finding that the number of times has reached a first predetermined number of times, that a fire should be present. Also, when finding that the number of times has reached a second predetermined number of times smaller than the first predetermined number of times, the control unit 10 makes the second emission unit 12 emit light. The first predetermined number of times may be three times, for example, and the second predetermined number of times may be twice, for example.

[0080] That is to say, according to this variation, the illuminating unit 120 and the indicating lamp 121 start emitting illuminating light and flickering light, respectively, as in the second variation, as an early warning before the alarm is sounded to alert the resident 100 to the presence of a fire, which is a main function of the audio device 1.

[0081] As can be seen, making the second timing T2 earlier than the first timing T1 allows the resident 100 to be alerted in advance to the presence of a fire by the light as an early warning before the alarm is sounded. In addition, counting the number of times the smoke concentration has exceeded the threshold value consecutively allows the emission of the flashing light to precede the emission of the alarm sound more appropriately.

(3.4) Fourth variation

[0082] Optionally, the audio device 1 may have the structure shown in FIGS. 7A and 7B (according to a fourth variation). The audio device 1 according to this variation includes an annular slit 9, which is recessed upward and provided through one surface 40 (e.g., the lower surface in FIG. 7A) of the housing 4. The slit 9 is provided to extend along the circular outer periphery of the housing 4 when the housing 4 is looked up to from under the housing 4. The center of the annular slit 9 substantially agrees with the center of the circular outer periphery of the housing 4. The slit 9 has, on its inner space (e.g., its inner bottom surface), a sound hole H1 that allows the alarm sound to come out of the housing 4 and a window hole H2 that allows the illuminating light to come out of the housing 4. The first emission unit 11 (such as a loudspeaker) is housed in the housing 4 to face the sound hole H1. The illuminating unit 120 of the second emission unit 12 is housed in the housing 4 to face the window hole H2.

[0083] According to this variation, the sound hole H1 and the window hole H2 are provided through an inner surface of the slit 9, thus making these holes less conspicuous. This allows the resident to be evacuated in an even shorter time while reducing the chances of affecting the appearance of the audio device 1.

(3.5) Other variations

[0084] The functions of the audio device 1 (mainly the control unit 10 thereof) according to the basic example may also be implemented as a control method, a computer program, or a non-transitory storage medium that stores the program. In this case, the audio device 1 or the agent that carries out the control method includes a computer system. The computer system includes, as principal hardware components, a processor and a memory. The functions of the audio device 1 or the agent that carries out the control method may be performed by making the processor execute a program stored in the memory of the computer system. The program may be stored

in advance in the memory of the computer system. Alternatively, the program may also be downloaded through a telecommunications line or be distributed after having been recorded in some non-transitory storage medium such as a memory card, an optical disc, or a hard disk drive, any of which is readable for the computer system. The processor of the computer system may be made up of a single or a plurality of electronic circuits including a semiconductor integrated circuit (IC) or a largescale integrated circuit (LSI). Those electronic circuits may be either integrated together on a single chip or distributed on multiple chips, whichever is appropriate. Those multiple chips may be integrated together in a single device or distributed in multiple devices without limitation.

[0085] In particular, according to the basic example described above, the control unit 10 not only determines whether or not a fire is present but also generates the PWM signal to be output to the acoustic circuit and a control signal to be output to the first lighting circuit, for example. However, this is only an example of the present disclosure and should not be construed as limiting. Alternatively, these functions may also be separately performed by two or more processors. Furthermore, the first lighting circuit and the second lighting circuit may also be implemented as a single lighting circuit.

[0086] Also, the audio device 1 according to the basic example is implemented as a single device. However, this is only an example of the present disclosure and should not be construed as limiting. Alternatively, at least one of the respective functions to be performed by the control unit 10, the first emission unit 11, the second emission unit 12, the detecting unit 2, the operating unit 3, the first lighting circuit, the second lighting circuit, the acoustic circuit, the power supply circuit and other units or circuits of the audio device 1 may also be distributed in two or more devices. Optionally, at least some of the functions of the audio device 1 may also be performed by a cloud computing system.

(4) Advantages

[0087] As can be seen from the foregoing description, an audio device (1, 1A) according to a first aspect is to be installed in a structural component (C1). The audio device (1, 1A) includes a control unit (10), a first emission unit (11), and a second emission unit (12). The control unit (10) determines, in accordance with information provided about a particular event, whether or not the particular event is present. The first emission unit (11) emits, when the control unit (10) determines that the particular event be present, a sound to alert a person to the presence of the particular event. The second emission unit (12) emits light in accordance with the information. A time lag (T0) is provided between a first timing (T1) when the sound starts being emitted and a second timing (T2) when the light starts being emitted. According to the first aspect, not only a sound but also light are emitted and a time lag (T0) is provided between a timing when the sound starts being emitted and a timing when the light starts being emitted. This allows the person (such as a resident) to recognize the current situation where the particular event is present and follow the evacuation procedure more quickly. Consequently, this contributes to evacuating the person in an even shorter time when a particular event is present.

[0088] In an audio device (1, 1A) according to a second aspect, which may be implemented in conjunction with the first aspect, the second timing (T2) is suitably later than the first timing (T1). For example, if the second timing (T2) were earlier than the first timing (T1), then a person who is sleeping would wake up with the light and find it glaring and uncomfortable, which could cause a significant delay before he or she carries out his or her evacuation procedure. In contrast, since the second timing (T2) is later than the first timing (T1) according to the second aspect, the person who is sleeping would wake up at the alarm sound, thus reducing unbeneficial effect caused by the glare.

[0089] In an audio device (1, 1A) according to a third aspect, which may be implemented in conjunction with the second aspect, the time lag (T0) is suitably set at a constant time. According to the third aspect, the time lag (T0) may be provided simply by keeping the time.

[0090] In an audio device (1, 1A) according to a fourth aspect, which may be implemented in conjunction with the first aspect, the second timing (T2) is suitably earlier than the first timing (T1). The fourth aspect allows the person to be alerted in advance to the presence of a particular event by the flashing light as an early warning that precedes the (alarm) sound, which is a main function of the audio device (1, 1A).

[0091] In an audio device (1, 1A) according to a fifth aspect, which may be implemented in conjunction with the fourth aspect, the control unit (10) suitably determines, when an event level included in the information exceeds a first threshold value, that the particular event be present. The second emission unit (12) suitably emits the light when the event level exceeds a second threshold value that is less than the first threshold value. The fifth aspect enables the emission of light to precede the emission of sound more appropriately by making decisions using two threshold values.

[0092] In an audio device (1, 1A) according to a sixth aspect, which may be implemented in conjunction with the fourth aspect, the control unit (10) suitably makes comparison between the event level included in the information and the threshold value at regular time intervals and suitably counts the number of times the event level exceeds the threshold value consecutively. The control unit (10) suitably determines, when the number of times reaches a first predetermined number of times, that the particular event be present. The second emission unit (12) suitably emits the light when the number of times reaches a second predetermined number of times that is smaller than the first predetermined number of times.

The sixth aspect enables the emission of light to precede the emission of sound more appropriately by counting the number of times the event level exceeds the threshold value consecutively.

[0093] In an audio device (1, 1A) according to a seventh aspect, which may be implemented in conjunction with any one of the first to sixth aspects, the light is suitably illuminating light, and the second emission unit (12) suitably irradiates a surrounding region (R1). The seventh aspect allows the light to not only alert the person to the presence of a particular event but also indicate the evacuation route as well. In particular, if the particular event breaks out while the user is sleeping in his or her bedroom, the user will attempt to turn the bedroom light ON, which could cause a significant delay in evacuation. Emitting the illuminating light reduces the chances of the time being wasted in such a conduct, thus contributing to evacuating the user in an even shorter time.

[0094] An audio device (1A) according to an eighth aspect, which may be implemented in conjunction with any one of the first to seventh aspects, suitably further includes a communications unit (14) with the ability to communicate with an external device (8). The communications unit (14) suitably transmits, to the external device (8), a first piece of information indicating that the control unit (10) has determined that the particular event be present and a second piece of information indicating that the second emission unit (12) has emitted the light. The eighth aspect allows the audio device (1A) to share information with the external device (8) (such as a mobile telecommunications device that the user carries with him or her or another audio device).

[0095] In an audio device (1, 1A) according to a ninth aspect, which may be implemented in conjunction with any one of the first to eighth aspects, the particular event may be a fire. The audio device (1, 1A) suitably further includes a detecting unit (2) to detect outbreak of the fire. The control unit (10) suitably determines whether or not the fire is present by being provided, as the information, with a result of detection by the detecting unit (2). The ninth aspect provides an audio device (1, 1A) with the detecting unit (2), which contributes to evacuating the person in an even shorter time in the event of the outbreak of a fire.

[0096] A control method according to a tenth aspect is a method for controlling an audio device (1, 1A) installed in a structural component (C1). The control method includes a decision step, a first emission step, and a second emission step. The decision step includes determining, in accordance with information provided about a particular event, whether or not the particular event is present. The first emission step includes making, when a decision is made that the particular event be present, a first emission unit (11) emit a sound to alert the person to the presence of the particular event. The second emission step includes making a second emission unit (12) emit light in accordance with the information. A time lag (T0) is provided between a first timing (T1) when the sound starts being emitted and a second timing (T2) when the light starts being emitted. The tenth aspect provides a control method that contributes to evacuating the person in an even shorter time in the event of the outbreak of a particular event.

[0097] A program according to an eleventh aspect is designed to cause a computer system to carry out the control method according to the tenth aspect. The eleventh aspect provides a capability that contributes to evacuating a person in an even shorter time in the event of the outbreak of a particular event. Optionally, a non-transitory computer-readable medium may store the program. In that case, when executing the program, the computer system may carry out the control method according to the tenth aspect.

[0098] Note that constituent elements according to the second to ninth aspects are not essential constituent elements for the audio device (1, 1A) but may be omitted as appropriate.

Reference Signs List

[0099]

1, 1A	Audio Device
10	Control Unit
11	First Emission Unit
12	Second Emission Unit
14	Communications Unit
2	Detecting Unit
8	External Device
C1	Structural Component
R1	Surrounding Region
T0	Time Lag
T1	First Timing
T2	Second Timing

Claims

1. An audio device to be installed in a structural component, the audio device comprising:

a control unit configured to determine, in accordance with information provided about a particular event, whether or not the particular event is present;
a first emission unit configured to emit, when the control unit determines that the particular event be present, a sound to alert a person to the presence of the particular event; and
a second emission unit configured to emit light in accordance with the information,
a time lag being provided between a first timing when the sound starts being emitted and a second timing when the light starts being emitted.

2. The audio device of claim 1, wherein

the second timing is later than the first timing.

3. The audio device of claim 2, wherein
the time lag is set at a constant time.

4. The audio device of claim 1, wherein
the second timing is earlier than the first timing.

5. The audio device of claim 4, wherein
the control unit is configured to determine, when an event level included in the information exceeds a first threshold value, that the particular event be present, and
the second emission unit is configured to emit the light when the event level exceeds a second threshold value that is less than the first threshold value.

6. The audio device of claim 4, wherein
the control unit is configured to make comparison between the event level included in the information and the threshold value at regular time intervals and count the number of times the event level exceeds the threshold value consecutively,
the control unit is configured to determine, when the number of times reaches a first predetermined number of times, that the particular event be present, and
the second emission unit is configured to emit the light when the number of times reaches a second predetermined number of times that is smaller than the first predetermined number of times.

7. The audio device of any one of claims 1 to 6, wherein
the light is illuminating light, and
the second emission unit is configured to irradiate a surrounding region.

8. The audio device of any one of claims 1 to 7, further comprising a communications unit with the ability to communicate with an external device, wherein
the communications unit is configured to transmit, to the external device, a first piece of information indicating that the control unit has determined that the particular event be present and a second piece of information indicating that the second emission unit has emitted the light.

9. The audio device of any one of claims 1 to 8, wherein
the particular event is a fire,
the audio device further includes a detecting unit configured to detect outbreak of the fire, and
the control unit is configured to determine whether or not the fire is present by being provided, as the information, with a result of detection by the detecting unit.

10. A method for controlling an audio device installed in a structural component, the method comprising:

a decision step including determining, in accordance with information provided about a particular event, whether or not the particular event is present;
a first emission step including making, when a decision is made that the particular event be present, a first emission unit emit a sound to alert a person to the presence of the particular event; and
a second emission step including making a second emission unit emit light in accordance with the information,
a time lag being provided between a first timing when the sound starts being emitted and a second timing when the light starts being emitted.

11. A program designed to cause a computer system to carry out the method of claim 10.

FIG. 1

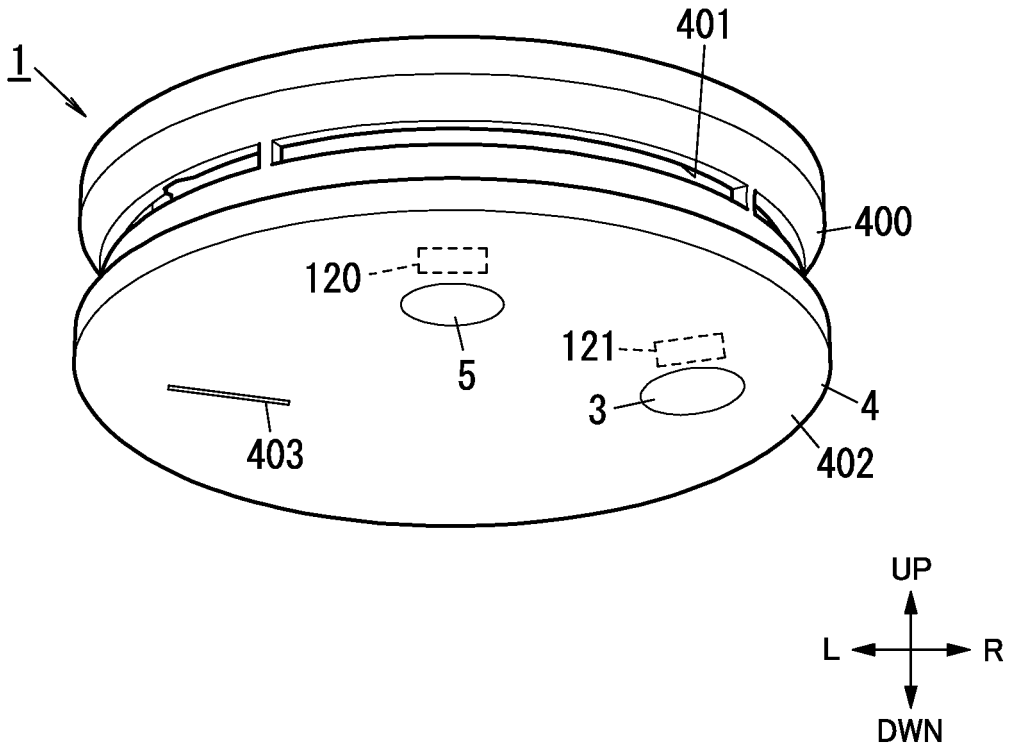


FIG. 2

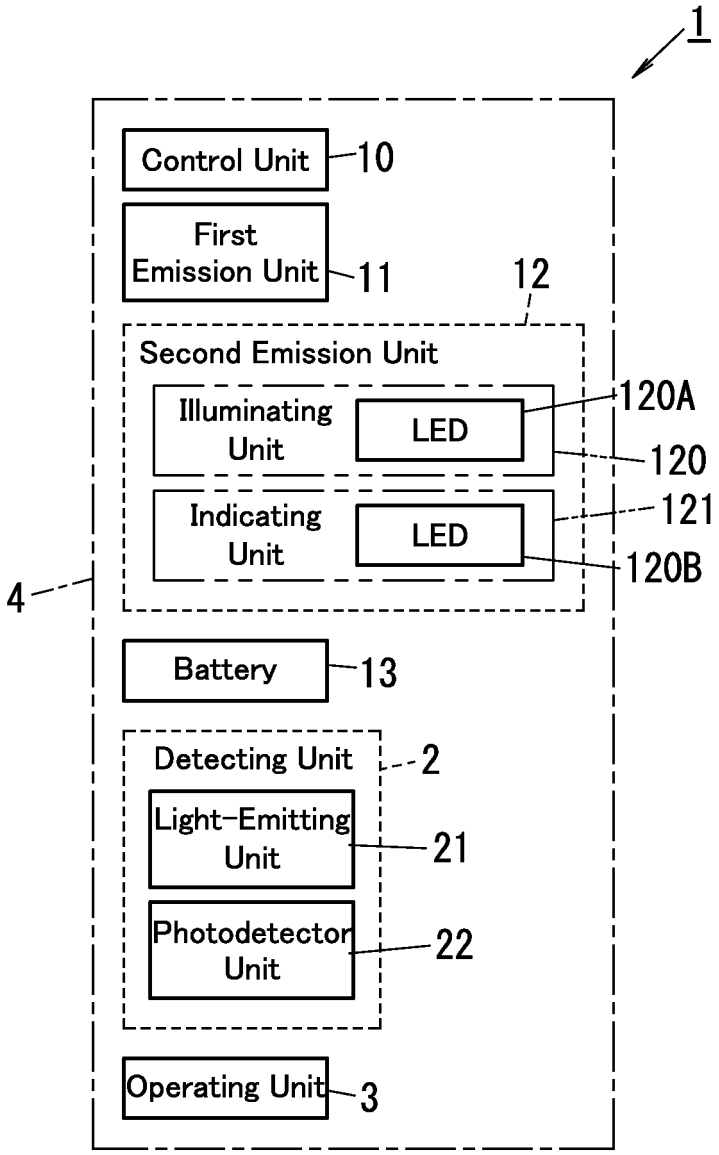

1
Control Unit
10
First Emission Unit
11
12
Second Emission Unit
Illuminating Unit
LED
120A
120
Indicating Unit
LED
121
120B
4
Battery
13
Detecting Unit
2
Light-Emitting Unit
21
Photodetector Unit
22
Operating Unit
3

FIG. 3

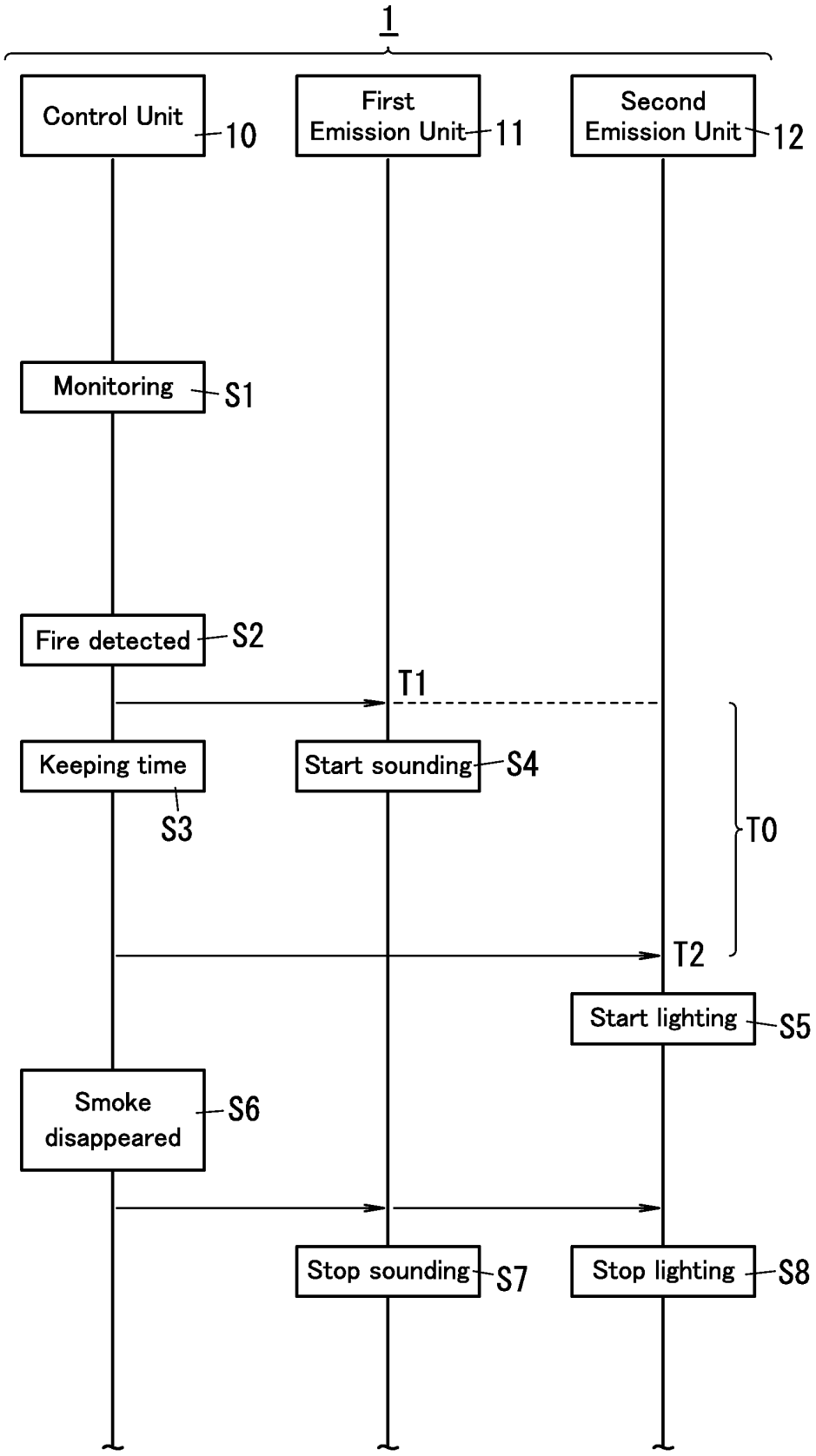

1
Control Unit
10
First Emission Unit
11
Second Emission Unit
12
Monitoring
S1
Fire detected
S2
T1
Keeping time
S3
Start sounding
S4
T0
T2
Start lighting
S5
Smoke disappeared
S6
Stop sounding
S7
Stop lighting
S8

FIG. 4A

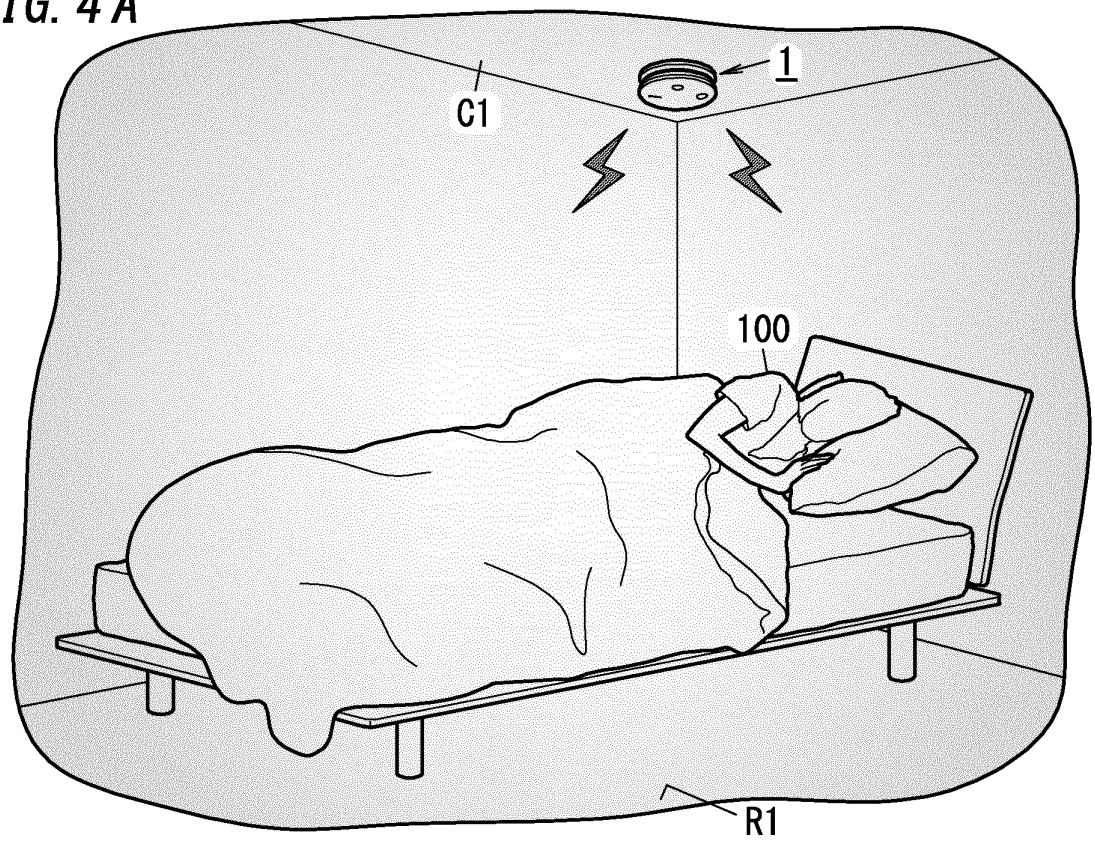


FIG. 4B

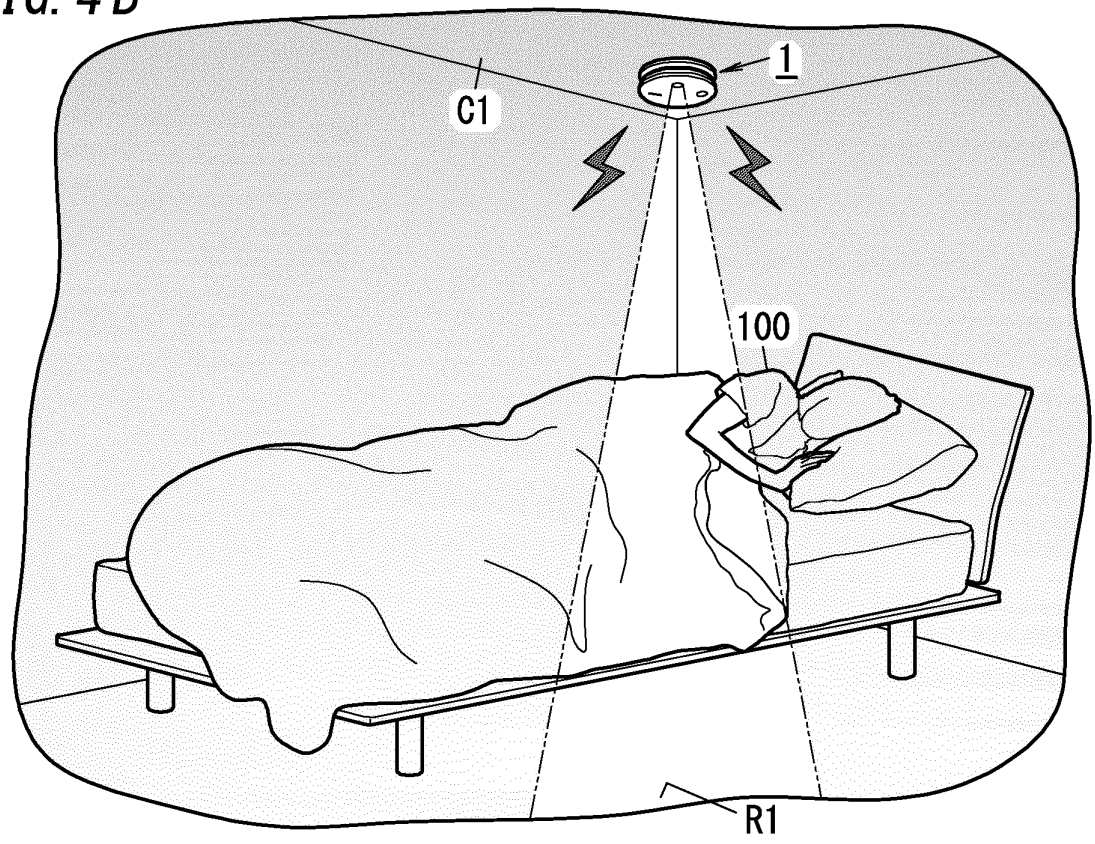


FIG. 5

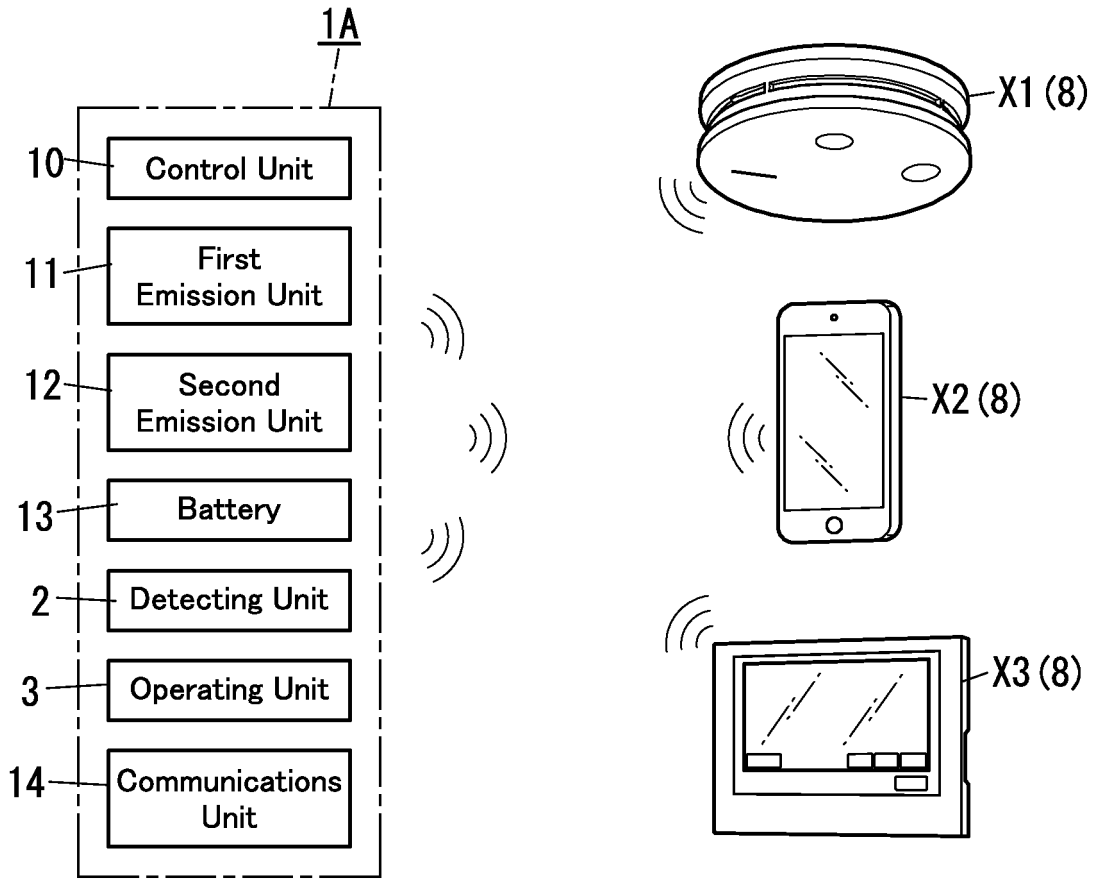

1A
10
Control Unit
11
First Emission Unit
12
Second Emission Unit
13
Battery
2
Detecting Unit
3
Operating Unit
14
Communications Unit
X1 (8)
X2 (8)
X3 (8)

FIG. 6

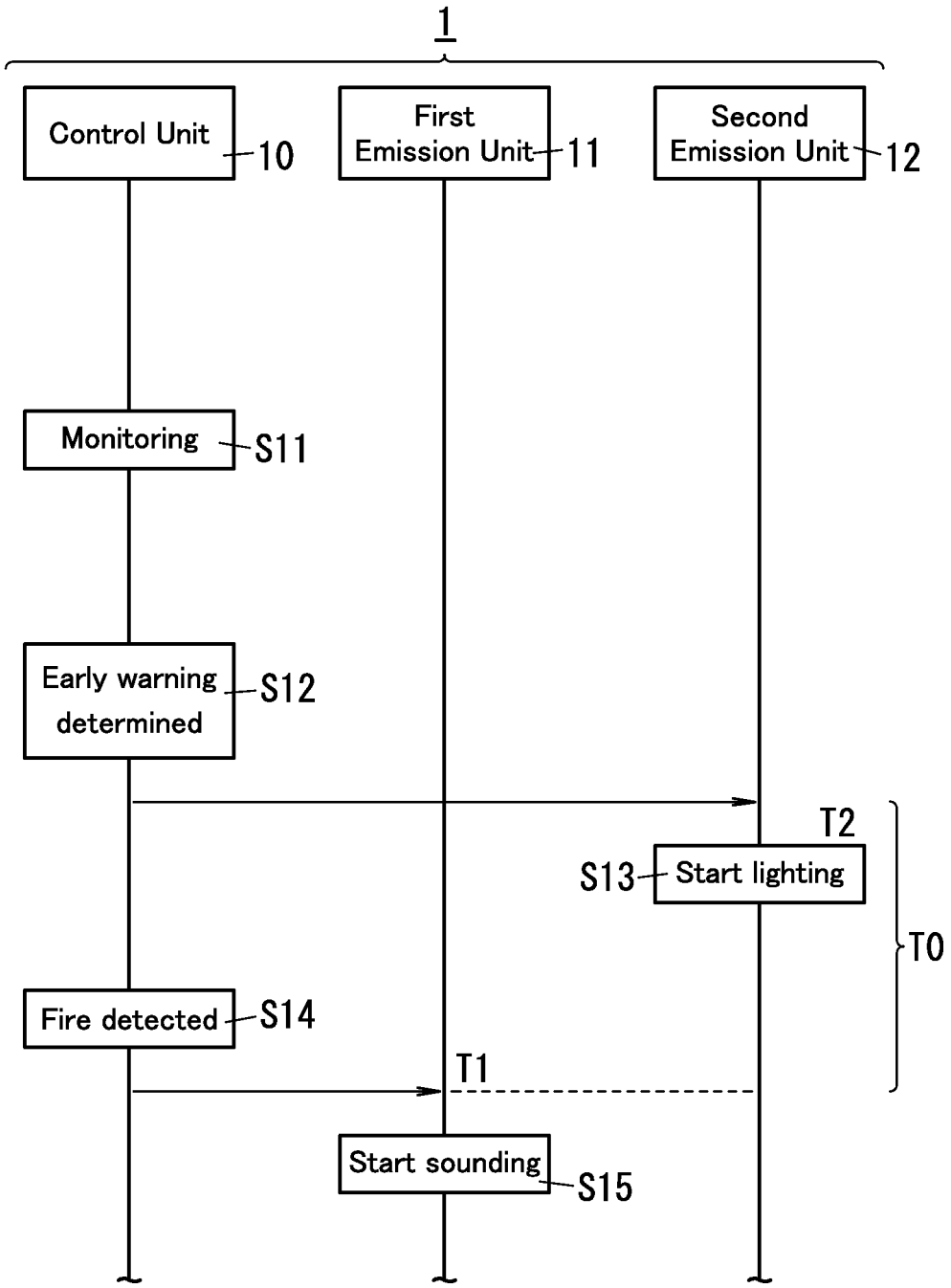

1
Control Unit
10
First Emission Unit
11
Second Emission Unit
12
Monitoring
S11
Early warning determined
S12
T2
S13
Start lighting
T0
Fire detected
S14
T1
Start sounding
S15

FIG. 7A

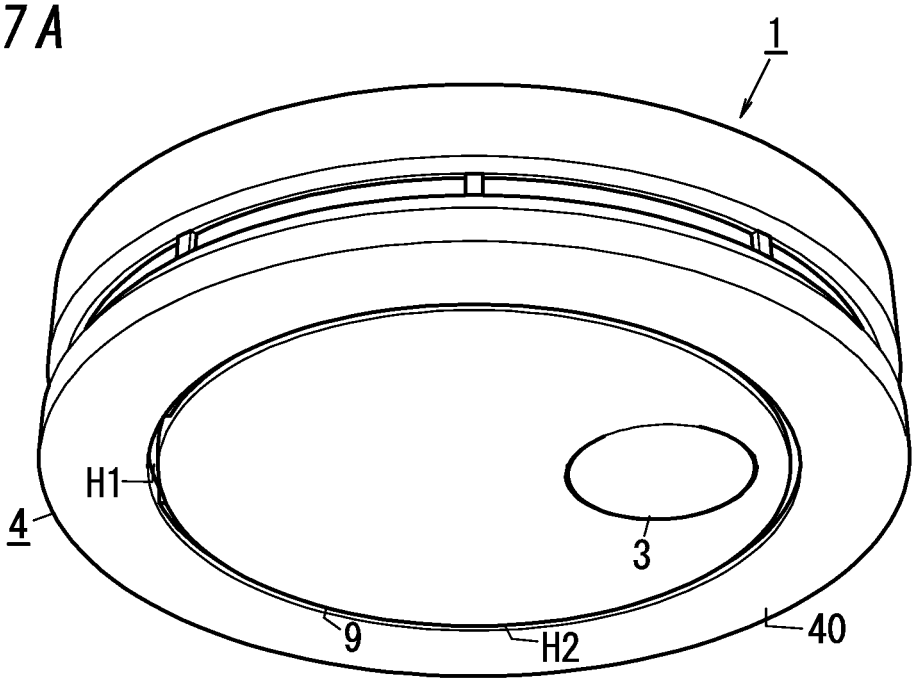
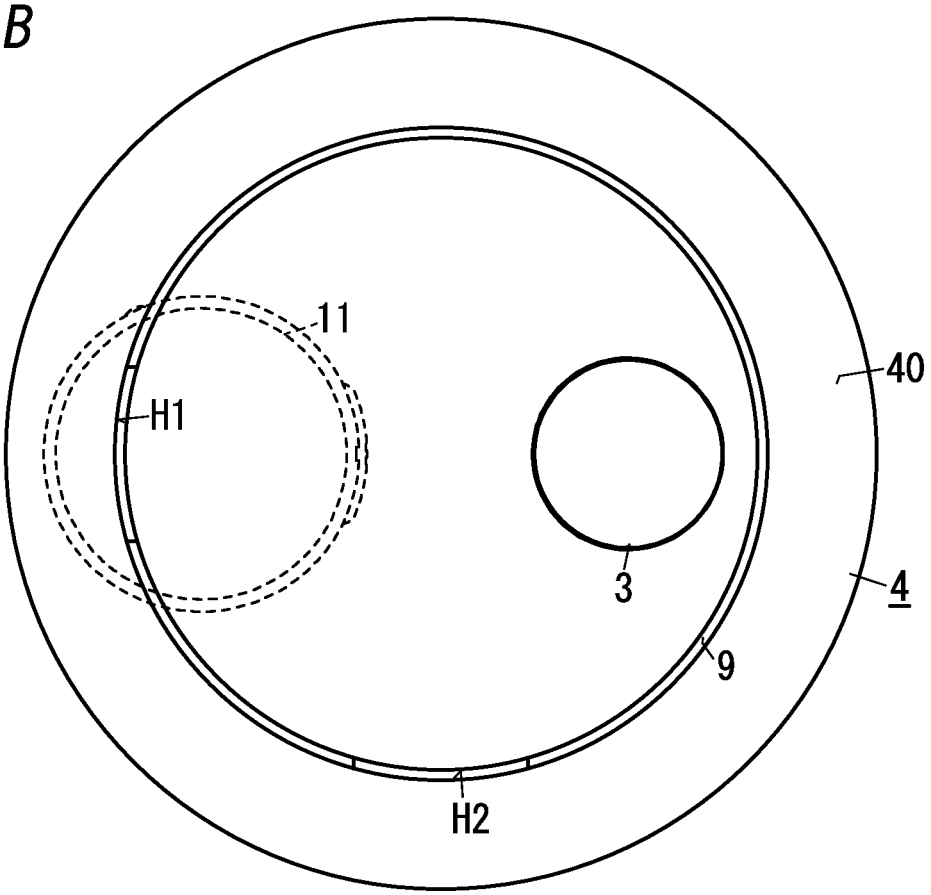


FIG. 7B



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/010868

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. G08B23/00(2006.01)i, G08B17/00(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)
Int.Cl. G08B17/00-31/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2019
Registered utility model specifications of Japan 1996-2019
Published registered utility model applications of Japan 1994-2019

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 2006-268132 A (TEMPEARL IND CO., LTD.) 05 October 2006, paragraphs [0032], [0037] (Family: none)	1-4, 7, 9-11 5, 8 6
Y	JP 2005-017243 A (TEMPEARL IND CO., LTD.) 20 January 2005, paragraphs [0038], [0039], fig. 4 (Family: none)	5
Y	JP 2013-058067 A (HOCHIKI CORP.) 28 March 2013, paragraphs [0087], [0088] (Family: none)	8
Y	JP 2008-204393 A (MATSUSHITA ELECTRIC WORKS, LTD.) 04 September 2008, paragraphs [0048], [0049] (Family: none)	8

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

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"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	Date of mailing of the international search report
24.05.2019	04.06.2019
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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Patent documents cited in the description

- JP 2010049604 A **[0003]**