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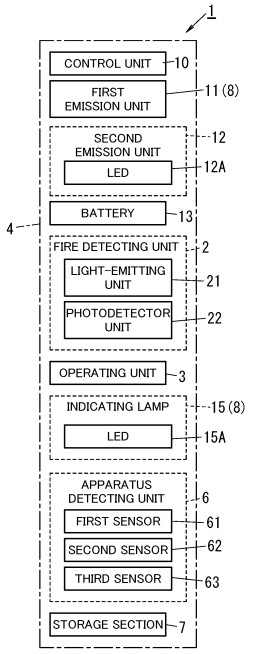
(54) ALARM, CONTROL METHOD, AND PROGRAM

(57) An object of the present disclosure is to improve reliability relating to an alert. An alarm (1) is to be installed in a structural component. The alarm (1) includes an apparatus detecting unit (6), a control unit (10), and an alert unit (8). The apparatus detecting unit (6) is configured to detect first information corresponding to an internal event relating to the alarm (1) itself. The control unit (10) is configured to receive the first information to determine the presence or absence of the internal event. The control unit (10) is configured to receive second information relating to an external event that requires emission of an alarm sound to determine the presence or absence of the external event. The alert unit (8) is configured to issue an alert concerning the presence of the internal event and the presence of the external event. The internal event at least includes a time for replacement of the alarm (1). The control unit (10) is configured to cause the alert unit (8) to issue an alert concerning the external event with priority over an alert concerning the time for replacement.

FIG. 2



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Description

Technical Field

[0001] The present disclosure generally relates to alarms, control methods, and programs, and specifically, to an alarm configured to alert people to the presence of an external event such as a fire, and a method and program for controlling such an alarm.

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] Incidentally, examples of an event to which the residential fire alarm (alarm) should alert a resident include a variety of events (internal events) that may take place in the residential fire alarm itself in addition to a fire (an external event). However, when time periods during which a plurality of events take place overlap each other, the resident may not be appropriately informed of the events.

[0005] In view of the foregoing, it is an object of the present disclosure to provide an alarm, a control method, and a program which are configured to improve the reliability relating to an alert.

[0006] An alarm according to one aspect of the present disclosure is to be installed in a structural component. The alarm includes an apparatus detecting unit, a control unit, and an alert unit. The apparatus detecting unit is configured to detect first information corresponding to an internal event relating to the alarm itself. The control unit is configured to receive the first information to determine a presence or absence of the internal event and is configured to receive second information relating to an external event that requires emission of an alarm sound to determine a presence or absence of the external event. The alert unit is configured to issue an alert concerning a presence of the internal event and a presence of the external event. The internal event at least includes a time for replacement of the alarm. The control unit is configured to cause the alert unit to issue an alert concerning the external event with priority over an alert concerning the time for replacement.

[0007] A control method according to one aspect of the present disclosure is a method for controlling an alarm installed in a structural component. The method includes a detecting step, a first determination step, a second determination step, and an alert step. The detection step includes detecting first information corresponding to an internal event relating to the alarm itself. The first determination step includes receiving the first information to determine a presence or absence of the internal event. The second determination step includes receiving second information relating to an external event that requires emission of an alarm sound to determine a presence or absence of the external event. The alert step includes issuing an alert concerning a presence of the internal event and a presence of the external event. The internal event at least includes a time for replacement of the alarm. The alert step includes issuing an alert concerning the external event with priority over an alert concerning the time for replacement.

[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 is an external view illustrating an alarm according to an embodiment;
FIG. 2 is a block diagram illustrating a configuration for the alarm;
FIG. 3 illustrates how the alarm works when installed in a bedroom;
FIG. 4 is a flowchart illustrating operation of the alarm;
FIG. 5 is a flowchart illustrating the operation of the alarm; and
FIGS. 6A and 6B are external views illustrating a third variation of an audio device of the alarm

Description of Embodiments

(1) Summary

[0010] 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 the embodiment 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 FIG. 3, an alarm 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). As illustrated in FIG. 2, the alarm 1 includes an apparatus detecting unit 6, a control unit 10, and an alert unit 8. The apparatus detecting unit 6 is configured to detect first information corresponding to an internal event relating to the alarm 1 itself. The control unit 10 receives the first information to determine the presence or absence of the internal event. The control unit 10 further receives second information relating to an external event that requires emission of an alarm sound to determine the presence or absence of the external event. The alert unit 8 issues an alert concerning the presence of the internal event and the presence of the external event.

[0012] As used herein, the "internal event" includes, for example, at least a time for replacement of the alarm 1. The internal event may include a failure in the alarm 1 and battery exhaustion in addition to the time for replacement.

[0013] Moreover, the "external event" is supposed to be, for example, a fire. Therefore, the alarm 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 external 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.

[0014] As shown in FIG. 2, the alarm 1 according to this embodiment further includes a photoelectric sensor (as a fire 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 fire detecting unit 2 may also be a fixed temperature sensor for detecting heat. Optionally, the fire detecting unit 2 may also be provided as a member separate from the alarm 1. In that case, the control unit 10 of the alarm 1 may be provided with the second information about the fire by communicating with another alarm (a fire alarm) including the fire detecting unit 2.

[0015] The alarm 1 may be installed on a surface (such as a ceiling surface or wall surface) of the 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 alarm 1 may also be installed (on the ceiling surface or wall surface) in a non-residential structural component C1, instead of the 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.

[0016] The control unit 10 is configured to cause the alert unit 8 to issue an alert concerning the fire with priority over an alert concerning the time for replacement of the alarm 1. With this configuration, the alert concerning the fire is issued before the alert concerning the time for replacement is issued. This reduces cases where the fire that requires emission of an alarm sound is present, but the alert concerning the time for replacement with a low emergency level is being issued, and a user can thus not be notified of the presence of the fire. Thus, reliability relating to the alert can be improved.

(2) Details

(2.1) Overall Configuration

[0017] Next, an overall configuration for the alarm 1 according to this embodiment will be described in detail. In this embodiment, the alarm 1 is, for example, a battery-type fire alarm. However, this is only an example of the present disclosure and should not be construed as limiting. Alternatively, the alarm 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.

[0018] In the example to be described below, the alarm 1 is supposed to be installed on a ceiling surface (which is an exemplary surface of the structural component C1) of a room in a resident's 100 dwelling house as shown in FIG. 3. Thus, the arrangement and operation of respective constituent elements of the alarm 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 alarm 1 should be used.

[0019] As illustrated in FIG. 2, the alarm 1 further includes, for example, a second emission unit 12, a battery 13, an operating unit 3, a housing 4, and a light-transmitting portion 5 (see FIG. 1) in addition to the control unit 10, the apparatus detecting unit 6, the alert unit 8 (a first emission unit 11 and an indicating lamp 15), and the fire detecting unit 2. The alarm 1 further includes a storage section 7. In the following description, the alarm 1 is supposed to be implemented as an independently operating fire alarm with no capability of communicating with other fire alarms.

(2.2) Housing

[0020] The housing 4 houses the control unit 10, the apparatus detecting unit 6, the first emission unit 11, the second emission unit 12, the battery 13, the fire detecting unit 2, the indicating lamp 15, the storage section 7, the control unit 10, and a circuit board (not shown) on which 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.

[0021] 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 cylindrical shape. 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.

[0022] 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 two, upper and lower parts. The labyrinth and the fire 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 indicating lamp 15, the circuit board, and other components are provided in the lower, second space.

[0023] The housing 4 further has a window hole 403 which has a slit shape and 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.

[0024] In addition, the housing 4 supports the light-transmitting portion 5 on the lower wall 402 thereof such that a lower surface of the light-transmitting portion 5 is exposed on an 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 the second emission unit 12 housed inside the housing 4. The light-transmitting portion 5 lets the light, emitted from the second emission unit 12, come out of the housing 4. In the following description, the light emitted from the second emission unit 12 will be hereinafter also 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 is bright enough to indicate an evacuation route. 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 second emission unit 12 toward a surrounding region R1 such as a floor surface. If necessary, a light guide member for efficiently guiding the light emitted from the second emission unit 12 toward the light-transmitting portion 5 may be provided between the light-transmitting portion 5 and the second emission unit 12.

[0025] 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. The operating unit 3 is arranged to face the indicating lamp 15 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.

[0026] 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) Alert Unit

[0027] The alert unit 8 alerts a person to the presence of internal events which are a time for replacement of the alarm 1 (hereinafter simply referred to as a "time for replacement"), and a failure in the alarm 1 (hereinafter simply referred to as a "failure") and battery exhaustion (a state where the residual capacity of the battery 13 is small). The battery 13 may be a lithium-ion battery, for example. The alert unit 8 alerts a person to the presence of the presence of a fire which is an external event. In this embodiment, both of the first emission unit 11 and the indicating lamp 15 correspond to the alert unit 8, but only one of them may correspond to the alert unit 8.

[0028] The first emission unit 11 has a function of alerting a person to the presence of the internal events and a function of alerting a person to the presence of a fire. 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 a person to the presence of the fire.

[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 preferably emits the 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 audio circuit, for example, may be assembled together. The audio 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 audio 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] When the control unit 10 determines that any internal event is present, the first emission unit 11 emits a sound to alert a person to the presence of the internal event. This sound is hereinafter also referred to as an "alert sound" to distinguish this sound from the alarm sound at the outbreak of a fire.

[0032] The alert sound relating to the time for replacement includes a voice warning message, for example, "Beep, it is time for replacement of the alarm". An alert sound relating to a failure includes a voice warning message, for example, "Beep, a failure is caused in 'XX"'. An alert sound relating to battery exhaustion includes a voice warning message, for example, "Beep, please replace the battery".

[0033] The alert sound is emitted at a volume of about 60 to 70% of the volume of the alarm sound. The alert sound is periodically repeatedly emitted, for example, at hourly intervals until the corresponding internal event is resolved. The first emission unit 11 emits a message such as "Beep, please replace the battery" two or three times continuously every hour and thereafter emits a beep sound every 40 seconds until one hour elapses.

[0034] The first emission unit 11 also emits the alarm sound and the alert sound tentatively even when subjected to an operation check test. The operation check test may be carried out by either pushing the operating unit 3 or pulling a pull string (not shown) extended from the housing 4.

[0035] In the present embodiment, when the operating unit 3 externally receives an operation input during warning (during emission of the alarm sound), the first emission unit 11 stops emitting the alarm sound.

[0036] The indicating lamp 15 has a function of alerting a person to the presence of the internal events and a function of alerting a person to the presence of a fire. The indicating lamp 15 includes, as a light source, a red light-emitting diode (LED) 15A mounted on the circuit board. The indicating lamp 15 is OFF normally (i.e., while monitoring to see if there is any fire present) but starts flickering (or is turned ON) when the control unit 10 determines that a fire should be present. The flickering for alerting a person to the presence of the fire is hereinafter also referred to as an "actuation flickering". The actuation flickering stops under the control of the control unit 10 when the emission of the alarm sound stops.

[0037] On the circuit board described above, mounted are circuit components of the first lighting circuit for flickering the LED 15A of the indicating lamp 15. The first lighting circuit flickers the LED 15A with DC power discharged from the battery 13 under the control of the control unit 10. If the alarm 1 is electrically connected to a commercial power grid, then the first lighting circuit flickers the LED 15A by converting the AC power supplied from the power grid into a DC current.

[0038] The light emitted from the indicating lamp 15 is transmitted through the operating unit 3 with 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 alarm 1 is now in operation (i.e., detecting a fire).

[0039] The indicating lamp 15 flickers, when the control unit 10 determines that any internal event be present, to alert a person to the presence of the internal event. The flickering in this case is hereinafter also referred to as "alert flickering". The indicating lamp 15 performs the alert flickering in all cases of the time for replacement, failure, and the battery exhaustion without distinguishing them from one another. However, when an operation is given to the operating unit 3 during the alert flickering, the first emission unit 11 emits an alert sound corresponding to an internal event which is actually present.

[0040] The indicating lamp 15 also flickers when subjected to an operation check test. The operation check test of the indicating lamp 15 may be carried out by either pushing the operating unit 3 or pulling a pull string just like the first emission unit 11.

(2.4) Second Emission Unit

[0041] The second emission unit 12 emits illuminating light that irradiates the surrounding region R1 in accordance with information provided about the fire under the control of the control unit 10. The second emission unit 12 includes, as a light source, a single or a plurality of illuminating white LEDs 12A mounted on the circuit board (see FIG. 2). The second emission unit 12 is OFF normally and is turned ON (i.e., starts emitting the illuminating light) when the control unit 10 determines that a fire should be present. Thus, for example, also when a fire breaks out in a midnight time zone in which the resident 100 is sleeping, the resident 100 can evacuate by immediately viewing an evacuation pathway by using the illumination light of the second emission unit 12 without giv-

ing an ON operation to the wall switch to turn ON the lighting fixture.

[0042] The LED 12A 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 is suitably 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 12A 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 15.

[0043] On the circuit board described above, mounted are circuit components of the second lighting circuit for turning ON the LEDs 12A of the second emission unit 12. The second lighting circuit turns the LEDs 12A ON with the DC power discharged from the battery 13 under the control of the control unit 10. If the alarm 1 is electrically connected to a commercial power grid, then the second lighting circuit turns ON the LED 12A by converting the AC power supplied from the power grid into a DC current.

[0044] The light (illuminating light) emitted from the second emission unit 12 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 second emission unit 12 also emits light tentatively even when subjected to an operation check test. The operation check test of the second emission unit 12 may be carried out by either pushing the operating unit 3 or pulling a pull string just like the first emission unit 11.

(2.5) Apparatus Detecting Unit

[0045] The apparatus detecting unit 6 is configured to detect first information corresponding to an internal event relating to the alarm 1 itself. As described above, the internal event includes at least the time for replacement of the alarm 1, and as other events in addition to the time for replacement, a failure in the alarm 1 and battery exhaustion. Thus, the first information includes used hours corresponding to the time for replacement, information about the electric or thermal physical quantity corresponding to the failure, the residual capacity of the battery 13 corresponding to the battery exhaustion, and the like. As illustrated in FIG. 2, the apparatus detecting unit 6 includes a first sensor 61, a second sensor 62, and a third sensor 63. The first to third sensors 61 to 63 are electrically connected to the control unit 10.

[0046] The first sensor 61 includes a timer for counting the used hours corresponding to the time for replacement. Here, the used hours are for example, 10 years. The first sensor 61 counts the used hours and outputs information about the used hours as the first information to the control unit 10. Based on the information about the used hours, the control unit 10 determines whether or not it is the time for replacement.

[0047] The second sensor 62 senses, for example, the electrical physical quantity corresponding to the failure. The second sensor 62 may sense the thermal physical quantity in addition to the electrical physical quantity. As used herein, the "failure" is, for example, a failure of the fire detecting unit 2, a failure of the audio circuit, a failure of the first and second lighting circuits, and breakage of an electric wire in the apparatus. The breakage of the electric wire is, for example, breakage of an electric wire from an audio circuit to the first emission unit 11. The second sensor 62 senses the electrical physical quantity (current or voltage) in a prescribed electric path and outputs an electric signal including the physical quantity as the first information to the control unit 10. The control unit 10 determines whether or not a failure occurs based on the information about the physical quantity.

[0048] The third sensor 63 senses the residual capacity of the battery 13. The third sensor 63 senses, for example, the battery voltage of the battery 13 corresponding to the residual capacity and outputs an electric signal including the battery voltage as the first information to the control unit 10. Based on the information about the battery voltage, the control unit 10 determines whether or not the battery is exhausted.

(2.6) Fire Detecting Unit

[0049] The fire detecting unit 2 senses the second information relating to a fire (an external event) that requires emission of an alarm sound. In this embodiment, the fire detecting unit 2 may be implemented as, for example, a photoelectric sensor for detecting smoke. Thus, the second information includes, for example, information about smoke. As shown in FIG. 2, the fire 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.

[0050] 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 fire 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.

[0051] The fire detecting unit 2 is electrically connected to the control unit 10. The fire 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 fire detecting unit 2 into the concentration of smoke (as an exemplary event level), whether or not any fire is present. Alternatively, the fire 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 fire 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.

(2.7) Control unit and Storage Section

[0052] 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 network such as the Internet or distributed after having been stored in a non-transitory storage medium such as a memory card.

[0053] The control unit 10 controls the first emission unit 11, the audio circuit, the second emission unit 12, the indicating lamp 15, the first lighting circuit, the second lighting circuit, the fire detecting unit 2, the apparatus detecting unit 6, the storage section 7 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. The storage section 7 is a rewritable memory and is preferably a nonvolatile memory. The storage section 7 may be a memory of the control unit 10 itself.

[0054] The control unit 10 is configured to determine, in accordance with information (the second information) provided about a fire from the fire detecting unit 2, whether or not any fire is present. The determination as to whether or not any fire is present will be described in detail below.

[0055] The control unit 10 monitors the level of the detection signal (information) received from the fire detecting unit 2 to determine whether or not the event level included in the detection signal has exceeded a threshold value. The event level is, for example, smoke concentration after conversion as described above. Alternatively, the event level may also be the quantity of light.

[0056] The control unit 10 stores the threshold value in the storage section 7 or 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 predetermined time interval is, for example, 5 seconds. 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 fire detecting unit 2, that a fire should be present.

[0057] 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. 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 audio circuit. The PWM signal is converted by the audio 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 the storage section 7 or its own memory, a PWM signal corresponding to the voice warning message and outputs the PWM signal to the audio circuit. The PWM signal is converted by the audio circuit into an audio signal so that a voice warning message (with an alarm sound) is emitted from the first emission unit 11.

[0058] Moreover, on determining that a fire is present, the control unit 10 transmits a control signal for flickering the indicating lamp 15 to the first lighting circuit, and a control signal for turning ON the second emission unit 12 to the second lighting circuit. On receiving the control signal from the control unit 10, the first lighting circuit causes the indicating lamp 15 to perform the actuation flickering. On receiving the control signal from the control unit 10, the second lighting circuit turns ON the second emission unit 12 with a certain level of brightness.

[0059] 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 second emis-

sion unit 12 and the indicating lamp 15. That is to say, on determining that the fire (smoke) should be no longer present, the control unit 10 automatically stops emitting the alarm sound, stops emitting the illuminating light, and stops flickering the indicating lamp 15.

[0060] 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 alarm 1 by mistake, then he or she may stop emitting the alarm sound by performing the push operation on the operating unit 3. Emitting the alarm sound may also be stopped by the resident 100 pulling the pull string.

[0061] 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, a light emission test on the second emission unit 12, and a flickering light test on the indicating lamp 15. The operation check test may also be performed by pulling the pull string.

[0062] In this embodiment, the control unit 10 is configured to receive information (the first information) relating to the internal event from the apparatus detecting unit 6 to determine the presence or absence of the internal event. The determination as to the presence or absence of the internal event will be described in detail below.

[0063] The control unit 10 monitors the used hours received from the first sensor 61. The used hours correspond to, for example, hours for which power supply is ON and the alarm 1 is in an operating state. The control unit 10 accumulates and stores the used hours received from the first sensor 61 in the storage section 7 or in its memory. The control unit 10 determines that it is the time for replacement when accumulated used hours amount to 10 years, and the control unit 10 causes the indicating lamp 15 which is the alert unit 8 to issue an alert. That is, the indicating lamp 15 starts performing the alert flickering. The time for replacement is low in emergency level as compared to the battery exhaustion and the failure, and replacement of the alarm 1 depends on the availability of the resident 100. Therefore, the control unit 10 does not cause the first emission unit 11 to emit a voice warning message for notification of the time for replacement immediately after the determination, but only when the resident 100 gives a push operation to the operating unit 3 during the alert flickering.

[0064] The control unit 10 monitors the electrical physical quantity received from the second sensor 62. The control unit 10 determines that a wire is broken, for example, when the current value of a current flowing from the audio circuit to the first emission unit 11 is an abnormal value (e.g., zero or a value close to zero). Moreover, when the voltage value of a prescribed electric path of at least one circuit of a various types of circuits is an abnormal value, the control unit 10 determines that a failure is present in the at least one circuit. The control unit 10 may monitor information such as the temperature received from the second sensor 62 and may determine that a failure is present when heat is abnormally generated in at least one of the various types of circuits. When the control unit 10 determines that the failure is present, the control unit 10 causes the first emission unit 11 and the indicating lamp 15 which are the alert units 8 to issue an alert. That is, a voice warning message for notification of the failure is emitted from the first emission unit 11, and the indicating lamp 15 starts performing the alert flickering. Note that in the case of breakage of a wire between the audio circuit and the first emission unit 11, issuing an alert from the first emission unit 11 is impossible, and therefore, an alert is issued only from the indicating lamp 15.

[0065] The control unit 10 monitors information which is about the battery voltage of the battery 13 and which is received from the third sensor 63. The control unit 10 stores characteristic data including the battery voltage and the capacity of the battery 13 associated with each other in the storage section 7 or its memory in advance, and when a residual capacity corresponding to the battery voltage received is less than 10% of the capacity, the control unit 10 determines that the battery is exhausted. When the control unit 10 determines that the battery is exhausted, the control unit 10 causes the first emission unit 11 and the indicating lamp 15 which are the alert units 8 to issue an alert. That is, the first emission unit 11 emits a voice warning message for notification of the battery exhaustion, and the indicating lamp 15 starts performing the alert flickering.

[0066] The control unit 10 determines the presence or absence of the internal event at a predetermined period. The determination as to the internal event is performed, for example, once a day at 0:00.

[0067] Note that regarding the voice warning message that alerts a person to the presence of the internal event, the control unit 10 generates the PWM signal based on the message data stored in the storage section 7 or its memory and outputs the corresponding voice warning message via the audio circuit from the first emission unit 11.

[0068] 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 alarm 1 emits not only the alarm sound but also the illuminating light from the second emission unit 12, 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 second emission unit 12 increases the chances of even a resident 100 who is a hearing-impaired person sensing the presence of a fire. In short, the alarm 1 contributes to evacuating the resident 100 in a shorter time by emitting not only the alarm sound but also the illuminating light as well.

(2.8) Priority Degree of Events

[0069] Incidentally, any two or more of the fire, the time for replacement, the failure, and the battery exhaustion may be present at substantially the same timing. For example, during emission of an alarm about the presence of the fire, it may become the time for replacement. Alternatively, while an alarm about the occurrence of the battery exhaustion is sounding, a fire may break out. Alternatively, during issuance of an alert concerning the presence of any one event of the internal events, another event of the internal events may occur.

[0070] Therefore, the control unit 10 gives order-of-alert priorities to these events, and causes the alert unit 8 to alert a person to an event which is high in the order of alert priorities. The control unit 10 is configured to cause the alert unit 8 to issue an alert concerning the fire with priority over an alert concerning the time for replacement. Moreover, the control unit 10 is configured to cause the alert unit 8 to issue the alert concerning the fire with priority over an alert concerning any internal event. Furthermore, the control unit 10 is configured to cause the alert unit 8 to issue an alert concerning a failure and an alert concerning the battery exhaustion other than the alert concerning the time for replacement of the internal events with priority over the alert concerning the time for replacement.

[0071] That is, when the control unit 10 determines that a plurality of events of the fire, the time for replacement, the failure, and the battery exhaustion are present, the control unit 10 sequentially performs an alert response to the events in descending order of priority. The priority degree (priority rank), for example, descends in the order of the fire, the failure, the battery exhaustion, and the time for replacement. The storage section 7 stores priority information, for example, that the fire corresponds to rank A, the failure corresponds to rank B, the battery exhaustion corresponds to rank C, and the time for replacement corresponds to rank D in advance. Rank A is the highest priority degree, and rank D is the lowest priority degree.

[0072] When an event corresponding to a priority rank higher than the priority rank of an event concerning which an alert is currently issued or is to be issued occurs after the event concerning which an alert is currently issued or is to be issued, the control unit 10 interrupts issuance of the alert concerning the event corresponding to the higher priority rank, allows an interruption by the alert concerning the event corresponding to the lower priority rank, and issues the alert concerning the event corresponding to the higher priority rank. When an event corresponding to a priority rank lower than the priority rank of the event concerning which an alert is currently issued or is to be issued occurs after the event concerning which an alert is currently issued or is to be issued, the control unit 10 continues or starts issuing the alert concerning the event corresponding to the higher priority rank, does not immediately issue the alert concerning the event corresponding to the lower priority rank, and causes the alert concerning the event corresponding to the lower priority rank to enter a standby state.

[0073] In particular, when determining that an internal event occurs, the control unit 10 stores an occurrence flag in the storage section 7. The storage section 7 includes storage areas of respective three occurrence flags corresponding to, for example, the time for replacement, the failure, and the battery exhaustion. When the control unit 10 determines that it is the time for replacement, the control unit 10 writes an occurrence flag "1" to "0" in the storage area corresponding to the time for replacement.

[0074] When the occurrence flag "1" is present in the storage section 7 at the end of an alert response to the fire ends, the control unit 10 starts an alert response to the internal event. When two or more occurrence flags "1" are present in the storage section 7, the control unit 10 starts issuing the alert concerning the event corresponding to the higher priority rank. A situation in which "the alert response to the fire ends" is, for example, a situation in which it is found that an alarm is sounded by mistake and the resident 100 pushes the operating unit 3 to stop emission of the alarm sound or a situation in which the concentration of smoke is lower than or equal to the reference value and emission of the alarm sound is automatically stopped. The occurrence flag in the storage section 7 is erased ("1" is rewritten to "0") when the alert response to the internal event ends. The situation in which "the alert response to the internal event ends" is, for example, a situation in which the battery 13 is replaced and a situation in which breakage of a wire is repaired.

(2.9) Description of Operation

[0075] Operation of the alarm 1 when, for example, when "fire" and "battery exhaustion" and "time for replacement" are present at substantially the same timing will be described below. Note that since the "battery exhaustion" is highly possibly determined at 0:00 once a day, an alert concerning the battery exhaustion is preferably issued with a delay of about six hours after the battery exhaustion is determined and the occurrence flag is stored, but in this embodiment, for convenience of ex-

planation, the delay is not taken into consideration.

[0076] First, an example in which the "fire", the "battery exhaustion", and the "time for replacement" occurs in this order will be described with reference to FIG. 4.

[0077] When the control unit 10 determines the outbreak of the "fire" (step S1), the control unit 10 starts alarming about the "fire" (step S2). It is assumed that the control unit 10 determines that the "battery exhaustion" also occurs while the alarm sound is emitted (step S3). In a state where the residual capacity of the battery 13 is initially small, emission of the alarm sound may rapidly increase power consumption, and during the emission of the alarm sound, the residual capacity may well become less than 10%. However, since the control unit 10 is alarming about the presence of the "fire" corresponding to the highest rank A, the control unit 10 foregoes issuance of the alert concerning the occurrence of the "battery exhaustion", stores only the occurrence flag of the "battery exhaustion" in the storage section 7 (step S4), and causes the alert to enter the standby state.

[0078] It is assumed that the control unit 10 subsequently determines that it is also the "time for replacement" during the emission of the alarm sound (step S5). However, since the control unit 10 is alarming about the presence of the "fire" corresponding to the highest rank A, the control unit 10 foregoes issuance of the alert concerning that it is the "time for replacement", stores only the occurrence flag of the "time for replacement" in the storage section 7 (step S6), and causes the alert to enter the standby state.

[0079] If it is found that the alarm is sounded by mistake, and the resident 100 pushes the operating unit 3 (step S7), the control unit 10 stops emitting the alarm sound (step S8). Here, at the end of the alert response to the fire, two occurrence flags are present in the storage section 7, and therefore, the control unit 10 starts issuing alerts concerning these events. However, since the "battery exhaustion" corresponding to rank C is at a higher degree of priority than the "time for replacement" corresponding to rank D, the control unit 10 starts issuing the alert concerning the "battery exhaustion" (step S9).

[0080] When the 100 notices the "battery exhaustion" and replaces the battery 13 (step S10), the control unit 10 ends the alert response to the "battery exhaustion" and erases the occurrence flag of the "battery exhaustion" (step S11). At the end of the alert response to the battery exhaustion, the occurrence flag of the "time for replacement" is present in the storage section 7, and therefore, the control unit 10 starts issuing the alert concerning the time for replacement (step S12). However, since the "time for replacement" is less urgent, only the alert flickering of the indicating lamp 15 starts, and only when an operation is given to the operating unit 3 flickering in red, a voice warning message is emitted. Note that also regarding to the alert concerning the "battery exhaustion", only the alert flickering of the indicating lamp 15 starts, and only when an operation is given to the operating unit 3, a voice warning message may be output.

[0081] Next, an example in which "battery exhaustion", "time for replacement", "fire" occur in this order will be described with reference to the flowchart in FIG. 5.

[0082] When the control unit 10 determines that the "battery exhaustion" occurs (step S21), the control unit 10 starts issuing the alert concerning the "battery exhaustion" (step S22) and stores the occurrence flag of the "battery exhaustion" in the storage section 7 (step S23). It is assumed that the control unit 10 determines that it is also the "time for replacement" during the issuance of the alert concerning the "battery exhaustion" (step S24). However, since the control unit 10 is issuing the alert concerning the occurrence of the "battery exhaustion" corresponding to rank C, the control unit 10 foregoes issuance of the alert concerning that it is the "time for replacement" corresponding to rank D, stores only the occurrence flag of the "time for replacement" in the storage section 7 (step S25), and causes the alert to enter the standby state.

[0083] It is assumed that the control unit 10 subsequently determines that a "fire" is also present during the issuance of the alert concerning the "battery exhaustion" (step S26). The control unit 10 interrupts the alert concerning the "battery exhaustion" corresponding to rank C, allows interruption by the alarm about the "fire" corresponding to rank A, starts the alarm about the "fire" (step S27), and causes the alert concerning the "battery exhaustion" to enter in the standby state.

[0084] If it is found that the alarm is sounded by mistake, and the resident 100 pushes the operating unit 3 (step S28), the control unit 10 stops emitting the alarm sound (step S29). Here, at the end of the alert response to the fire, two occurrence flags are present in the storage section 7, and therefore, the control unit 10 starts issuing alerts concerning these events. However, since the "battery exhaustion" corresponding to rank C is at a higher degree of priority than the "time for replacement" corresponding to rank D, the control unit 10 resumes issuance of the alert concerning the "battery exhaustion" (step S30).

[0085] When the 100 notices the "battery exhaustion" and replaces the battery 13 (step S31), the control unit 10 ends the alert response to the "battery exhaustion" and erases the occurrence flag of the "battery exhaustion" (step S32). At the end of the alert response to the battery exhaustion, the occurrence flag of the "time for replacement" is present in the storage section 7, and therefore, the control unit 10 starts issuing the alert concerning this event (step S33).

[0086] As described above, in this embodiment, the alert concerning the fire is issued before the alert concerning the time for replacement is issued. This reduces cases where the fire that requires emission of an alarm sound is present, but the alert concerning the time for replacement is being issued, and the resident 100 can thus not be notified of the presence of the fire. Thus, reliability relating to the alert can be improved. In particular, since the alert concerning the fire corresponds to

the highest priority and is thus issued before an alert concerning any internal event is issued, setting the alert concerning the fire to the highest rank among events including the internal events improves the reliability relating to the alert concerning the fire.

[0087] Moreover, the alert concerning the failure and the alert concerning the battery exhaustion other than the alert concerning the time for replacement are issued before the alert concerning the time for replacement. The alert concerning the time for replacement of the internal events which corresponds to a relatively low emergency level is set to the lowest priority rank, thereby improving the reliability relating to the alerts concerning the other events.

[0088] Moreover, in the present embodiment, when it is determined that an internal event is present, an occurrence flag is stored. Therefore, even if a fire breaks out immediately before or during issuance of the alert concerning the presence of the internal event and interruption by an alert concerning the outbreak of the fire is allowed, the alert concerning the internal event can be resumed after the alert response to the fire ends. Alternatively, even if the internal event occurs during the issuance of the alert concerning the presence of a fire, the alert concerning the internal event is issued after the end of the alert response to the fire.

(3) Variations

[0089] Next, some variations will be enumerated one after another. In the following description, the 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

[0090] When the occurrence flag is present in the storage section 7 at the end of the alert response to a fire ends, the control unit 10 of the basic example starts the alert response to the internal event. That is, the control unit 10 of the basic example at least once determines that internal events are present, and the control unit 10 sequentially issues alerts concerning the internal events without abandoning the alerts. However, sequentially issuing the alerts concerning the internal events is not essential even when the occurrence flags are present.

[0091] A control unit 10 of the present variation is configured to forego starting of an alert response to the internal event and forcibly erase an occurrence flag of the internal event even when the occurrence flag is present in a storage section 7 at the end of an alert response to a fire. The outbreak of a fire may be a more severe mental load for a resident 100 than the occurrence of any internal event. For example, if after the alarm about the fire is found to be sounded by mistake and the resident 100 is relieved and stops the alarm sound, an alert concerning an internal event with a lower emergency level than the fire is sequentially issued, the resident 100 may feel discomfort or anxiety. Therefore, only when the alert response concerning the fire ends, an alert response to the internal event is not started, and the occurrence flag is forcibly erased, thereby reducing discomfort or anxiety of the resident 100. When it is assumed that the control unit 10 makes a determination as to the internal event, for example, every one hour, the alert concerning the internal event is not issued until the next scheduled determination process.

[0092] Note that at the end of the alert response to an internal event, an occurrence flag of another internal event may be present, and in this case, the control unit 10 does not erase the occurrence flag and starts issuing an alert concerning the occurrence of the another internal event.

[0093] Incidentally, storing the occurrence flag in the storage section 7 is not an essential configuration for the alarm 1. For example, even when the control unit 10 determines that it is the "time for replacement" corresponding to the lowest priority rank, the occurrence flag of the "time for replacement" does not have to be stored in the storage section 7.

(3.2) Second Variation

[0094] The alarm 1 according to the basic example is a fire alarm that operates independently. That is to say, the alarm 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 alarm 1 may also be an interconnected fire alarm with the capability of communicating with other fire alarms. In that case, the communication may be established either wirelessly or via cables, whichever is appropriate.

[0095] Optionally, the alarm 1 may also be configured to communicate various types of devices other than fire alarms. Examples of those devices other than fire alarms include cellphones (such as smartphones) carried by the resident 100 with him or her and security monitoring devices installed in the house. The alarm 1 may notify a portable terminal, a security monitoring apparatus, and the like of the presence of a fire, the occurrence of an internal event, and the like. In this case, dedicated application software is installed in the portable terminal, the security monitoring apparatus, and the like in advance.

(3.3) Third Variation

[0096] Optionally, the alarm 1 may have the structure shown in FIGS. 6A and 6B (according to a third variation). The alarm according to this variation includes a slit 9, which is annular, recessed upward, and provided through one surface 40 (e.g., the lower surface in FIG. 6A) 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 slit 9, which is annular, 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 HI 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 HI. The second emission unit 12 is housed in the housing 4 to face the window hole H2.

[0097] According to this variation, the sound hole HI 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 alarm.

(3.4) Other Variations

[0098] The functions of the alarm 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 alarm 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 alarm 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.

[0099] 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 makes a determination as to an internal event, generates the PWM signal to be output to the audio circuit and a control signal to be output to the 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.

[0100] Also, the alarm 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. For example, at least one function of functions as the control unit 10, the first emission unit 11, the second emission unit 12, the fire detecting unit 2, the operating unit 3, the indicating lamp 15, the apparatus detecting unit 6, the storage section 7, the various types of circuit, and the like of the alarm 1 may be distributed in two or more devices. Optionally, at least some of the functions of the alarm 1 may also be performed by a cloud computing system.

(4) Advantages

[0101] As can be seen from the foregoing description, an alarm (1) according to a first aspect is to be installed in a structural component (C1). The alarm (1) includes an apparatus detecting unit (6), a control unit (10), and an alert unit (8). The apparatus detecting unit (6) is configured to detect first information corresponding to an internal event relating to the alarm (1) itself. The control unit (10) is configured to receive the first information to determine a presence or absence of the internal event. The control unit (10) is configured to receive second information relating to an external event that requires emission of an alarm sound to determine a presence or absence of the external event. The alert unit (8) is configured to issue an alert concerning the presence of the internal event and the presence of the external event. The internal event at least includes a time for replacement of the alarm (1). The control unit (10) is configured to cause the alert unit (8) to issue an alert concerning the external event with priority over an alert concerning the time for replacement. The first aspect reduces cases where the external event that requires emission of an alarm sound occurs, but the alert concerning the time for replacement is being issued, and a user can thus not be informed of the presence of the external event. Thus, reliability relating to the alert can be improved.

[0102] In an alarm (1) according to a second aspect referring to the first aspect, the internal event preferably further includes one or more other events in addition to the time for replacement. The control unit (10) is preferably configured to cause the alert unit (8) to issue an alert concerning the one or more other events before the alert concerning the time for replacement. According to the second aspect, the alert concerning the time for replacement of the internal events which corresponds to a relatively low emergency level is set to the lowest priority rank, thereby improving the reliability relating to the alerts concerning the other events.

[0103] In an alarm (1) of a third aspect referring to the first or second aspect, the external event is preferably a fire. The control unit (10) is preferably configured to cause the alert unit (8) to issue an alert concerning the fire with

priority over an alert concerning any internal event. According to the third aspect, setting the alert concerning the fire to the highest rank among events including the internal events improves the reliability relating to the alert concerning the fire.

[0104] An alarm (1) of a fourth aspect referring to any one of the first to third aspects preferably further includes a storage section (7). The control unit (10) is preferably configured to, when determining that the internal event occurs, store an occurrence flag in the storage section (7). The control unit (10) is preferably configured to, when the occurrence flag is present in the storage section (7) at the end of an alert response to the external event, start an alert response to the internal event. According to the fourth aspect, even if an interruption by an alert concerning the presence of an external event is allowed immediately before or during issuance of an alert concerning the presence of the internal event, the alert concerning the internal event is issued after the alert response to the external event ends. Alternatively, even if the internal event occurs during the issuance of the alert concerning a presence of the external event, the alert concerning the internal event is issued after the alert response to the external event ends.

[0105] An alarm (1) of a fifth aspect referring to any one of the first to third aspects preferably further includes a storage section (7). The control unit (10) is preferably configured to, when determining that the internal event occurs, store an occurrence flag in the storage section (7). The control unit (10) is preferably configured to forego starting of an alert response to the internal event and forcibly erase an occurrence flag of the internal event even when the occurrence flag is present in the storage section 7 at the end of an alert response to the external event. According to the fifth aspect, discomfort or anxiety for a user is reduced as compared to a case where, for example, an alarm concerning an internal event with a lower emergency level than the external event is sequentially issued after issuance of the alert concerning the external event ends.

[0106] In an alarm (1) of a sixth aspect referring to any one of the first to fourth aspects, the control unit (10) is preferably configured to, when determining that a plurality of events of the external event and the internal event occur, perform alert responses to the plurality of events in the order of higher priority. The internal event preferably further includes a failure in the alarm (1) and battery exhaustion of a battery (a battery 13) in the alarm (1) as the plurality of events other than the time for replacement. In decreasing order of priority, the external event, the failure, the battery exhaustion, and the time for replacement are preferably defined in this order. According to the sixth aspect, alerts concerning all of the events that occur are sequentially issued, and therefore, the reliability relating to the alert is further improved.

[0107] In an alarm (1) according to a seventh aspect referring to any one of the first to sixth aspects, the external event is preferably a fire. The alarm (1) preferably further includes a fire detecting unit (2) configured to detect the outbreak of the fire. The control unit (10) preferably receives, as the information, a result of detection by the fire detecting unit (2) to determine whether or not the fire is present. According to the seventh aspect, the alarm (1) including the fire detecting unit (2) with improved reliability relating to the alert.

[0108] A control method according to an eighth aspect is a method for controlling an alarm (1) installed in a structural component (C1). The method includes a detecting step, a first determination step, a second determination step, and an alert step. The detection step includes detecting first information corresponding to an internal event relating to the alarm (1) itself. The first determination step includes receiving the first information to determine a presence or absence of the internal event. The second determination step includes receiving second information relating to an external event that requires emission of an alarm sound to determine a presence or absence of the external event. The alert step includes issuing an alert concerning a presence of the internal event and a presence of the external event. The internal event at least includes a time for replacement of the alarm (1). The alert step includes issuing an alert concerning the external event with priority over an alert concerning the time for replacement. According to the eighth aspect, the control method with improved reliability relating to the alert is provided.

[0109] A program of a ninth aspect is designed to cause a computer system to carry out the control method of the eighth aspect. According to the ninth aspect, a function with improved reliability relating to the alert is provided. Optionally, a non-transitory computer-readable medium may store the program. In that case, when the program is executed by a computer system, the computer system may carry out the control method of the eighth aspect.

[0110] The configurations of the second to seventh aspects are not essential for the alarm (1) and may be omitted accordingly.

Reference Signs List

[0111]

1	ALARM
2	FIRE DETECTING UNIT
6	APPARATUS DETECTING UNIT
7	STORAGE SECTION
8	ALERT UNIT
10	CONTROL UNIT
13	BATTERY (BATTERY)
C1	STRUCTURAL COMPONENT

Claims

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

an apparatus detecting unit configured to detect first information corresponding to an internal event relating to the alarm itself;
a control unit configured to receive the first information to determine a presence or absence of the internal event and is configured to receive second information relating to an external event that requires emission of an alarm sound to determine a presence or absence of the external event; and
an alert unit configured to alert to a presence of the internal event and a presence of the external event,
the internal event at least including a time for replacement of the alarm,
the control unit being configured to cause the alert unit to issue an alert concerning the external event with priority over an alert concerning the time for replacement.

2. The alarm of claim 1, wherein
the internal event further includes one or more other events in addition to the time for replacement, and
the control unit is configured to cause the alert unit to issue an alert concerning the one or more other events before the alert concerning the time for replacement.

3. The alarm of claim 1 or 2, wherein
the external event is a fire, and
the control unit is configured to cause the alert unit to issue an alert concerning the fire with priority over an alert concerning any internal event.

4. The alarm of any one of claims 1 to 3, further comprising a storage section, wherein
the control unit is configured to, when determining that the internal event occurs, store an occurrence flag in the storage section, and
the control unit is configured to, when the occurrence flag is present in the storage section at the end of an alert response to the external event, start an alert response to the internal event.

5. The alarm of any one of claims 1 to 3, further comprising a storage section, wherein
the control unit is configured to, when determining that the internal event occurs, store an occurrence flag in the storage section, and
the control unit is configured to forego starting of an alert response to the internal event and forcibly erase an occurrence flag of the internal event even when the occurrence flag is present in the storage section at the end of an alert response to the external event.

6. The alarm of any one of claims 1 to 4, wherein
the control unit is configured to, when determining that a plurality of events of the external event and the internal event occur, perform alert responses to the plurality of events in the order of higher priority,
the internal event further includes a failure in the alarm and battery exhaustion of a battery in the alarm as the plurality of events other than the time for replacement, and
in decreasing order of priority, the external event, the failure, the battery exhaustion, and the time for replacement are defined in this order.

7. The alarm of any one of claims 1 to 6, wherein
the external event is a fire,
the alarm further includes a fire detecting unit configured to detect the fire, and
the control unit receives, as the second information, a result of detection by the fire detecting unit to determine whether or not the fire is present.

8. A method for controlling an alarm to be installed in a structural component, the method comprising:

a detection step of detecting first information corresponding to an internal event relating to the alarm itself;
a first determination step of receiving the first information to determine a presence or absence of the internal event;
a second determination step of receiving second information relating to an external event that requires emission of an alarm sound to determine a presence or absence of the external event; and
an alert step of alerting to a presence of the internal event and a presence of the external event,
the internal event at least including a time for replacement of the alarm,
the alert step including issuing an alert concerning the external event with priority over an alert concerning the time for replacement.

9. A program designed to make a computer system execute the method of claim 8.

FIG. 1

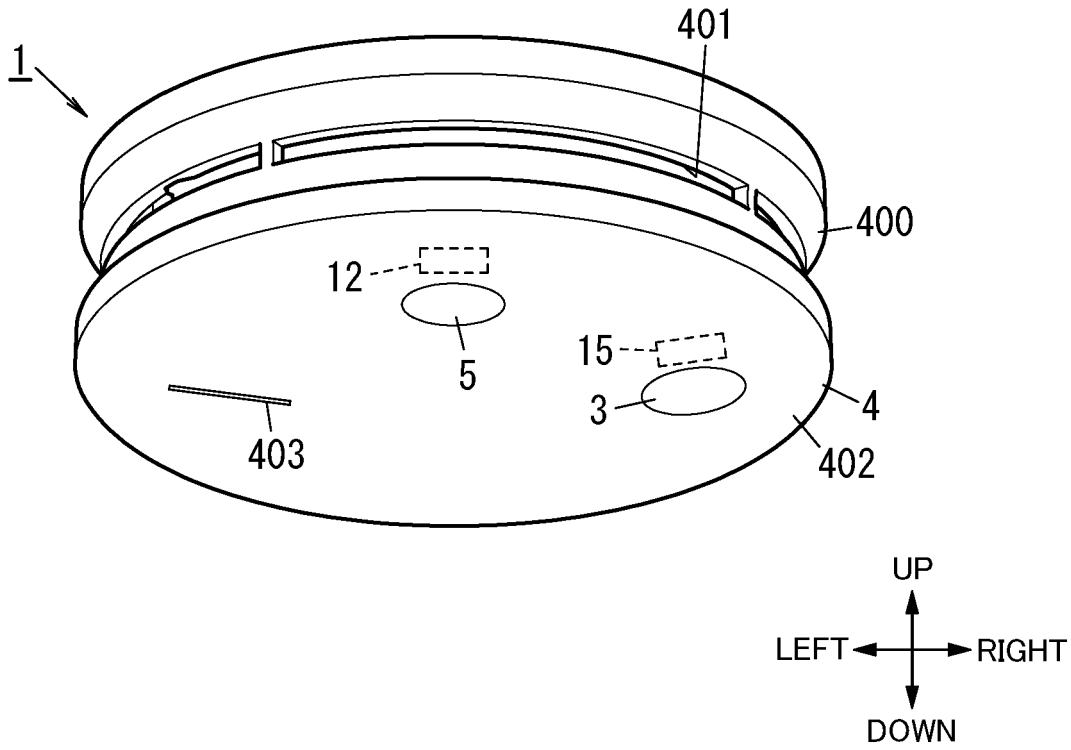


FIG. 2

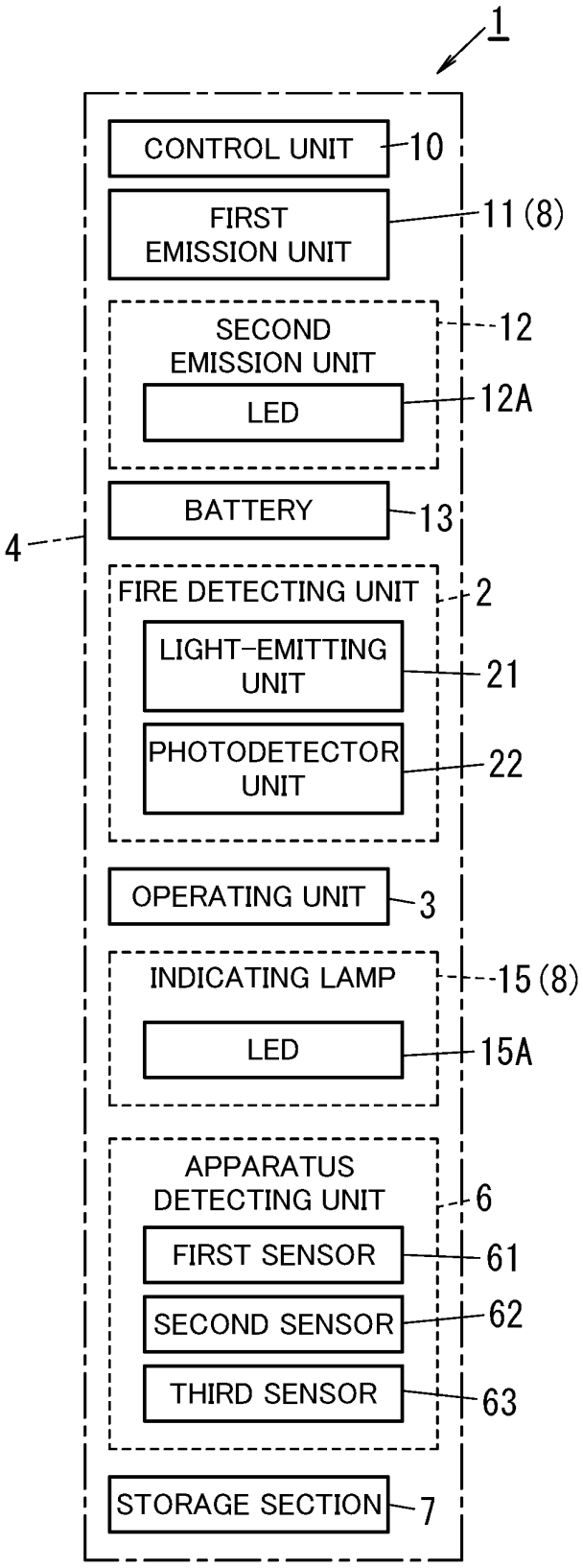

1
CONTROL UNIT
10
FIRST EMISSION UNIT
11 (8)
SECOND EMISSION UNIT
12
LED
12A
BATTERY
13
4
FIRE DETECTING UNIT
2
LIGHT-EMITTING UNIT
21
PHOTODETECTOR UNIT
22
OPERATING UNIT
3
INDICATING LAMP
15 (8)
LED
15A
APPARATUS DETECTING UNIT
6
FIRST SENSOR
61
SECOND SENSOR
62
THIRD SENSOR
63
STORAGE SECTION
7

FIG. 3

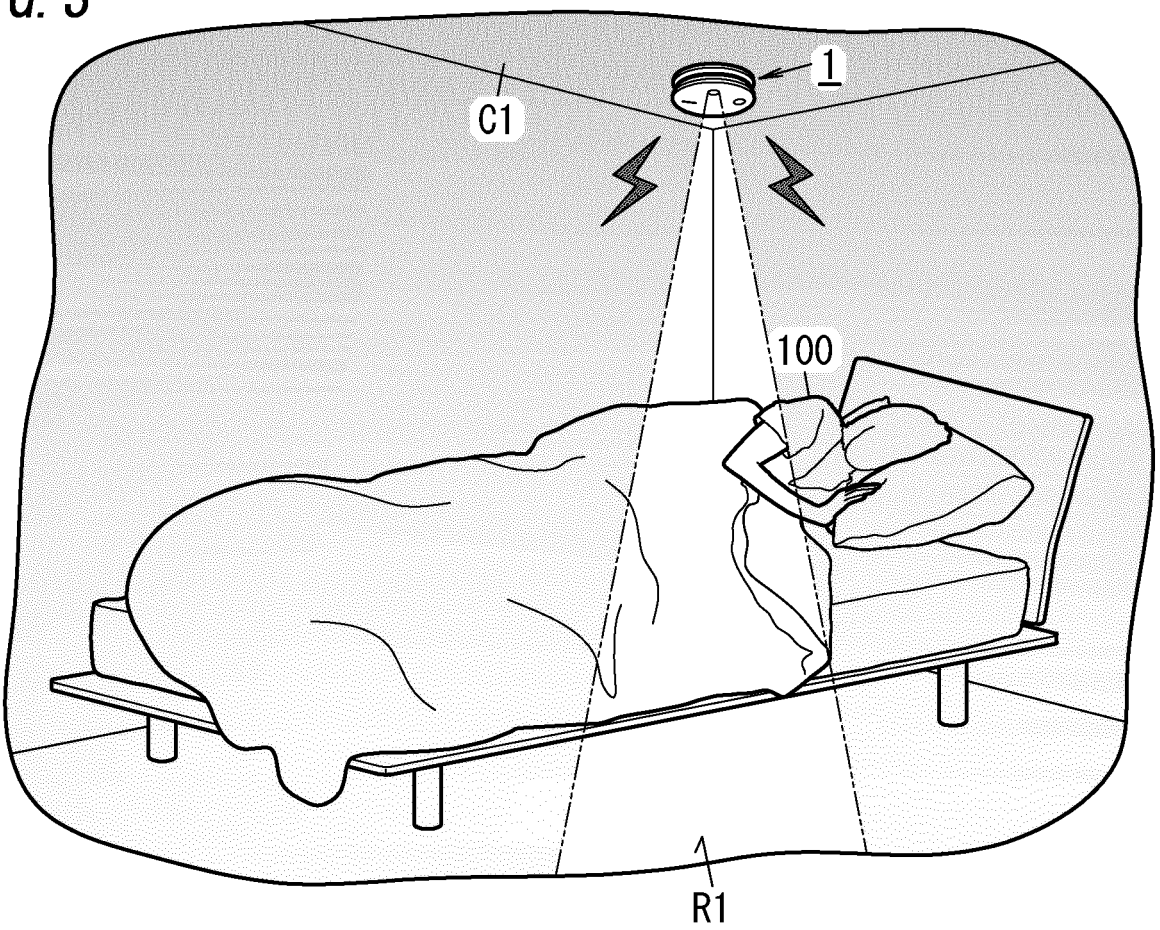


FIG. 4

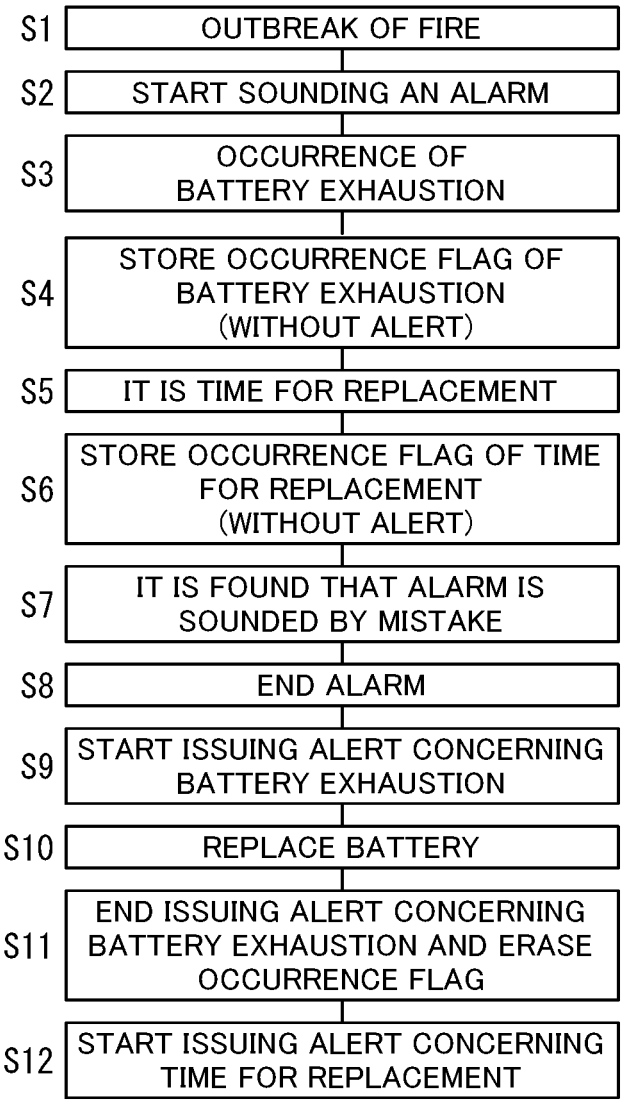

S1
OUTBREAK OF FIRE
S2
START SOUNDING AN ALARM
S3
OCCURRENCE OF BATTERY EXHAUSTION
S4
STORE OCCURRENCE FLAG OF BATTERY EXHAUSTION (WITHOUT ALERT)
S5
IT IS TIME FOR REPLACEMENT
S6
STORE OCCURRENCE FLAG OF TIME FOR REPLACEMENT (WITHOUT ALERT)
S7
IT IS FOUND THAT ALARM IS SOUNDED BY MISTAKE
S8
END ALARM
S9
START ISSUING ALERT CONCERNING BATTERY EXHAUSTION
S10
REPLACE BATTERY
S11
END ISSUING ALERT CONCERNING BATTERY EXHAUSTION AND ERASE OCCURRENCE FLAG
S12
START ISSUING ALERT CONCERNING TIME FOR REPLACEMENT

FIG. 5

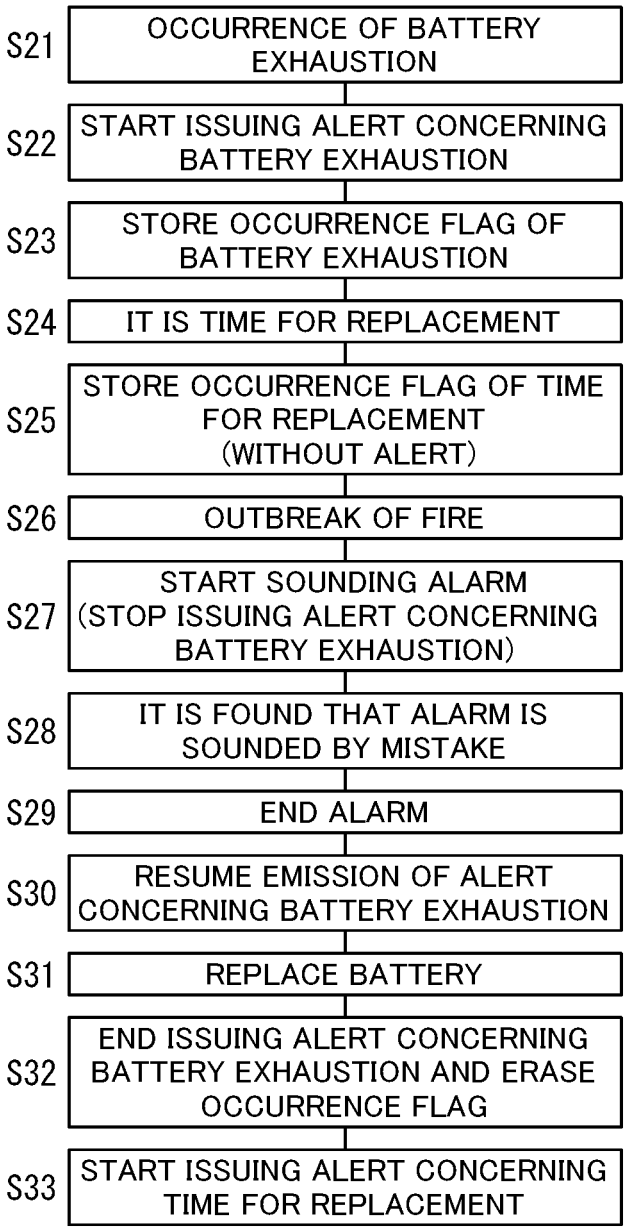

S21
OCCURRENCE OF BATTERY EXHAUSTION
S22
START ISSUING ALERT CONCERNING BATTERY EXHAUSTION
S23
STORE OCCURRENCE FLAG OF BATTERY EXHAUSTION
S24
IT IS TIME FOR REPLACEMENT
S25
STORE OCCURRENCE FLAG OF TIME FOR REPLACEMENT (WITHOUT ALERT)
S26
OUTBREAK OF FIRE
S27
START SOUNDING ALARM (STOP ISSUING ALERT CONCERNING BATTERY EXHAUSTION)
S28
IT IS FOUND THAT ALARM IS SOUNDED BY MISTAKE
S29
END ALARM
S30
RESUME EMISSION OF ALERT CONCERNING BATTERY EXHAUSTION
S31
REPLACE BATTERY
S32
END ISSUING ALERT CONCERNING BATTERY EXHAUSTION AND ERASE OCCURRENCE FLAG
S33
START ISSUING ALERT CONCERNING TIME FOR REPLACEMENT

FIG. 6A

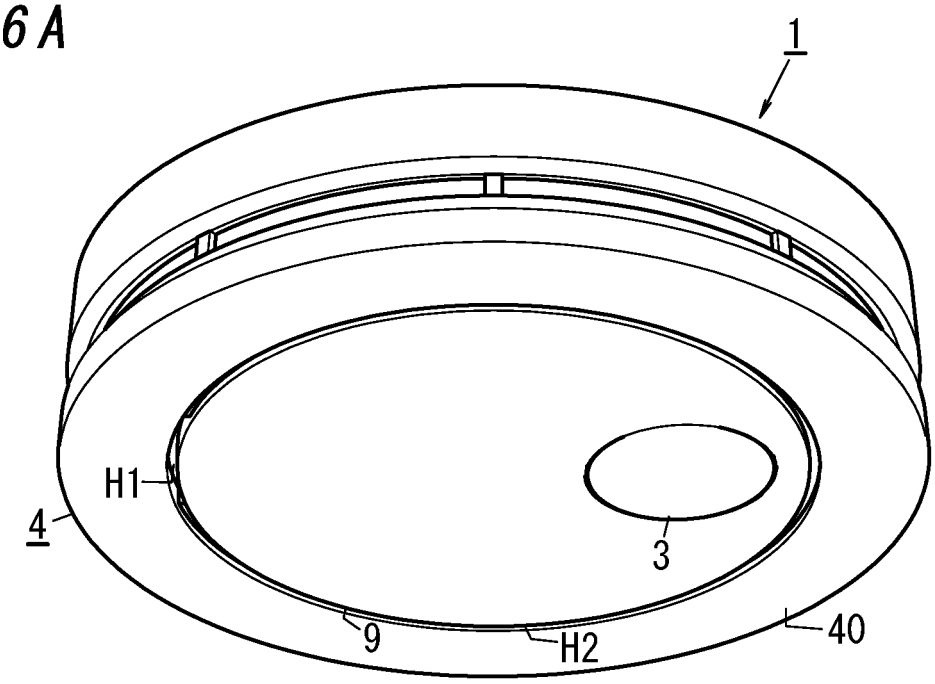
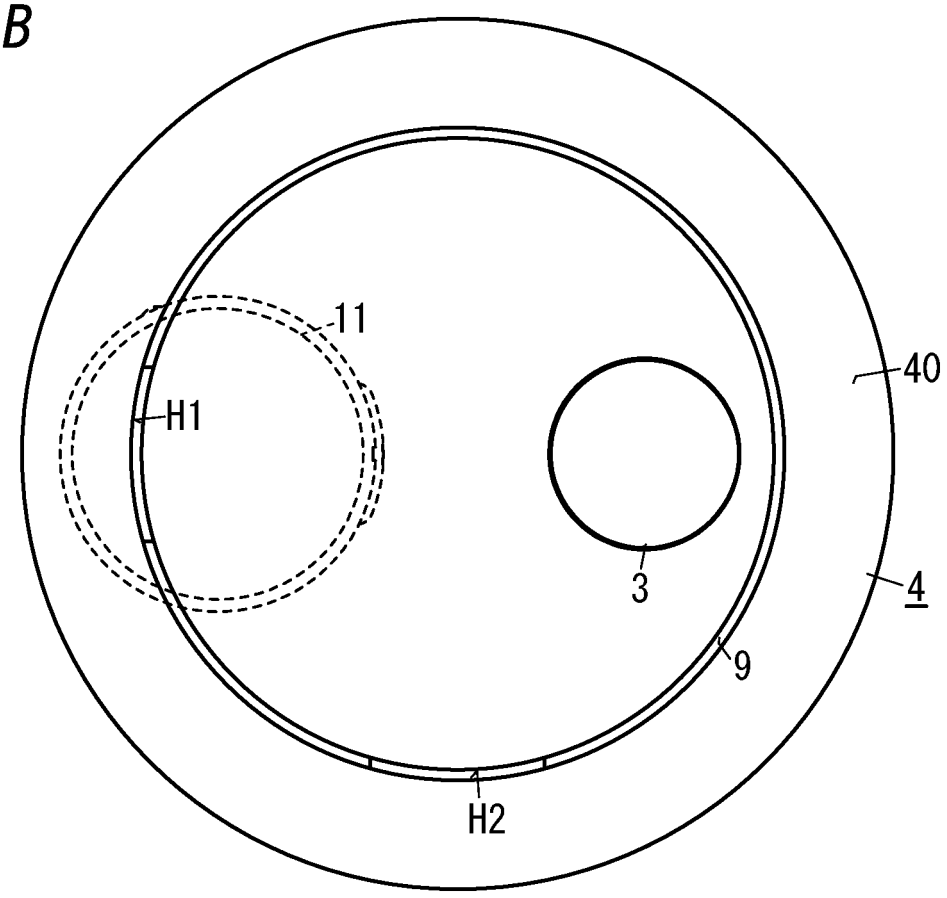


FIG. 6B



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/010869

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. G08B17/00(2006.01)i, G08B17/107(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, G08B17/107

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.
Y	JP 2008-217824 A (YAZAKI CORPORATION) 18 September 2008, paragraphs [0024], [0069]-[0075] & JP 2005-107557 A	1-9
Y	JP 2011-209837 A (NOHMI BOSAI LTD.) 20 October 2011, paragraphs [0010]-[0023] (Family: none)	1-9
Y	JP 2000-259959 A (NITTAN CO., LTD.) 22 September 2000, paragraphs [0009], [0043] (Family: none)	4-5

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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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
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"&" document member of the same patent family

Date of the actual completion of the international search 13.05.2019	Date of mailing of the international search report 28.05.2019
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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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/010869

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2000-188787 A (NOHMI BOSAI LTD.) 04 July 2000, entire text, all drawings (Family: none)	1-9
A	JP 2005-293204 A (NOHMI BOSAI LTD.) 20 October 2005, entire text, all drawings (Family: none)	1-9
A	JP 2005-251135 A (NOHMI BOSAI LTD.) 15 September 2005, entire text, all drawings (Family: none)	1-9

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010049604 A **[0003]**