(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 432 426 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
23.01.2019 Bulletin 2019/04

(21) Application number: **17766530.4**

(22) Date of filing: **09.03.2017**

(51) Int Cl.:
H01R 31/06 *(2006.01)* ***G08B 13/04*** *(2006.01)*
G08B 25/00 *(2006.01)* ***G08B 25/04*** *(2006.01)*
G08B 25/08 *(2006.01)* ***H01R 13/66*** *(2006.01)*
G08B 13/16 *(2006.01)*

(86) International application number:
PCT/JP2017/009431

(87) International publication number:
WO 2017/159529 (21.09.2017 Gazette 2017/38)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **18.03.2016 JP 2016056044**

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(54) PLUG CONNECTOR

(57) A plug connector which can improve the convenience is provided. A plug connector (1) includes: a sound collector (22) configured to collect a sound around the plug connector and generates a sound signal in form of an electric signal; and a determination processor (24) configured to detect a target sound as a detection target based on the sound signal to determine whether or not an event associated with generation of the target sound occurs. The plug connector (1) is provided with, as the target sound, a plurality of types of target sounds. The determination processor (24) has a first mode and a second mode as operation modes. The determination processor (24) detects a first target sound and a second target sound of the target sounds in the first mode and the second mode respectively. The first target sound and the second target sound are different in type.

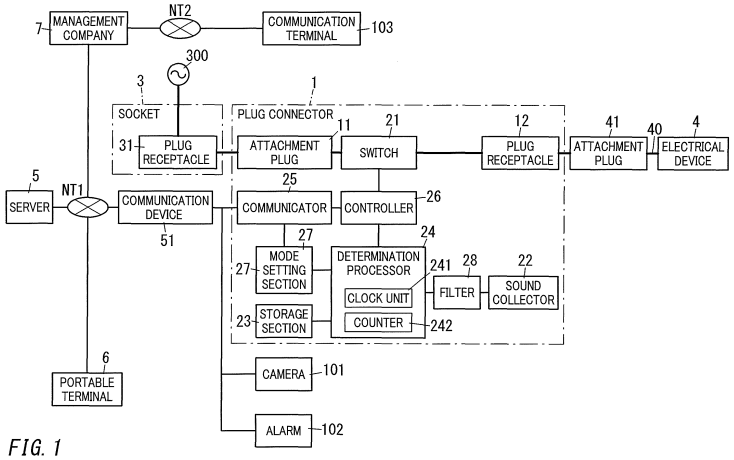

FIG. 1

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Description

Technical Field

[0001] The present invention relates to a plug connector

Background Art

[0002] A multi-functional plug connector having a function in addition to a function as wiring accessories is known (see, for example, Patent Literature 1). The plug connector (a power measurement tap) in Patent Literature 1 measures power supplied to an electrical device connected to the plug connector and transmits power consumption information denoting a measurement result to a wireless adapter by a wireless signal.

[0003] In such a multi-functional plug connector, there is a need for ease of use for a function in addition to a function as wiring accessories, and improvement of convenience is desired.

Citation List

Patent Literature

[0004] Patent Literature 1: JP 2014-185965 A

Summary of Invention

[0005] In view of the foregoing, it is an object of the present invention to provide a plug connector configured to improve convenience.

[0006] A plug connector according to one aspect of the present invention is a plug connector for wiring, including an attachment plug and a plug receptacle. The plug connector includes a sound collector and a determination processor. The sound collector is configured to collect an ambient sound to generate a sound signal in form of an electric signal. The determination processor is configured to detect a target sound as a detection target based on the sound signal to determine whether or not an event associated with generation of the target sound occurs. The plug connector is provided with, as the target sound, a plurality of types of target sounds. The determination processor has a first mode and a second mode as operation modes. The determination processor is configured to detect a first target sound of the plurality of types of target sounds in the first mode and detect a second target sound of the plurality of types of target sounds in the second mode. The type of the first target sound and the type of the second target sound are different from each other.

Brief Description of Drawings

[0007]

FIG. 1 is a block diagram illustrating a plug connector according to one embodiment of the present invention;

FIG. 2A is an exterior perspective view illustrating the plug connector, and FIG. 2B is an exterior perspective view illustrating the plug connector which is connected to a socket and to which a power supply cable is connected;

FIG. 3 is a first example waveform diagram of a sound signal generated by a sound collector of the plug connector; and

FIG. 4 is a second example waveform diagram of the sound signal generated by the sound collector of the plug connector.

Description of Embodiments

[0008] With reference to the drawings, an embodiment of the present invention will be described below. The following embodiment generally relates to plug connectors and more specifically, to a plug connector for wiring, including an attachment plug and a plug receptacle. Note that FIGS. 2A and 2B described in the following embodiment are schematic views, and the dimensional ratio of components in these figures does not necessarily correspond to their actual dimensional ratio.

(Embodiment)

<Schema>

[0009] FIG. 1 is a block diagram illustrating a plug connector 1 of the present embodiment. FIGS. 2A and 2B are exterior perspective views illustrating the plug connector 1. The plug connector 1 is a plug connector (a so-called power supply tap) for wiring, including an attachment plug 11 and a plug receptacle 12. The plug connector 1 serves as a security sensor and a remote controller which are configured to perform prescribed operations when an event causing an impulse sound (target sound) occurs around the plug connector 1. When serving as the security sensor, the plug connector 1 notifies an external apparatus of an abnormality in case of occurrence of an event causing an impulse sound around the plug connector 1. Moreover, when serving as the remote controller, the plug connector 1 controls an electrical device 4 in case of occurrence of an event causing an impulse sound around the plug connector 1.

[0010] In the present embodiment, "impulse sound" refers to a sound whose frequency component is large over a broad bandwidth and whose sound pressure level unexpectedly increases and decreases. Examples of the event causing an impulse sound include hitting a pane of glass, collision of two objects with each other, clapping hands, clicking fingers, and knocking doors or walls. Examples of types of impulse sounds include a sound of hitting a pane of glass, a collision sound, a sound of clapping hands, a sound of clicking fingers, and a knocking

sound. The impulse sounds are different in type depending on events generating the impulse sounds. More specifically, the impulse sounds are different in audio characteristics. As mentioned herein, "audio characteristics" denotes a sound pressure level (SPL), a frequency characteristic, a waveform pattern (a time change characteristic of the sound pressure level), and the like. Note that the above-described impulse sounds and events are mere examples and are not limited to these examples.

<Configuration>

[0011] The configuration of the plug connector 1 according to the present embodiment will be described in detail below.

[0012] The plug connector 1 of the present embodiment includes the attachment plug 11, the plug receptacle 12, a switch 21, a sound collector 22, a storage section 23, a determination processor 24, a communicator 25, a controller 26, a mode setting section 27, and a filter 28. As illustrated in FIGS. 2A and 2B, the plug connector 1 has a housing 10 in the shape of a rectangular parallelepiped.

[0013] The attachment plug 11 includes a pair of contacts 111 protruding from a rear surface of the housing 10 and is connectable to a plug receptacle 31 of a socket 3 (receptacle). FIG. 2B shows a state where the pair of contacts 111 of the attachment plug 11 is connected to the plug receptacle 31 through a pair of insertion holes 311 formed in a front surface of a housing of the socket 3.

[0014] To the plug receptacle 12 is connectable a pair of contacts of an attachment plug 41 provided at one end of a power supply cable 40 of the electrical device 4. FIG. 2B shows a state where the pair of contacts of the attachment plug 41 is connected to the plug receptacle 12 through a pair of insertion holes 121 formed in a front surface of the housing 10. Moreover, in FIG. 2B, a lighting fixture 400 (floor lamp) is shown as an example of the electrical device 4. The electrical device 4 is not limited to the lighting fixture 400 but may be another device.

[0015] The switch 21 includes, for example, a relay. The switch 21 is configured to make and break electrical connection between the attachment plug 11 and the plug receptacle 12. When the switch 21 is in an ON state, the attachment plug 11 and the plug receptacle 12 are electrically connected to each other. When the switch 21 is in an OFF state, the attachment plug 11 and the plug receptacle 12 are electrically disconnected. Thus, in the example shown in FIG. 2B, when the switch 21 is in the ON state, electric power is supplied from a commercial power supply 300 (see FIG. 1) to the electrical device 4 (lighting fixture 400), and when the switch 21 is in the OFF state, electric power is not supplied from the commercial power supply 300 to the electrical device 4. The switch 21 is controlled by the controller 26. Note that the switch 21 is not limited to the relay but may include a semiconductor switch.

[0016] The sound collector 22 includes, for example, a microphone and is disposed in the housing 10. The sound collector 22 is configured to collect a sound generated around the plug connector 1 through a sound collector pore 13 which is round and which is formed in the front surface of the housing 10. The sound collector 22 is configured to convert the sound collected into a sound signal in form of an electric signal. The magnitude of an amplitude of the sound signal increases as the sound pressure level of the sound collected by the sound collector 22 increases. The sound collector 22 is configured to output the sound signal thus generated to the determination processor 24 via the filter 28. Note that the sound collector 22 may output the sound signal as an analog signal or convert the sound signal into a digital signal and output the digital signal.

[0017] The storage section 23 includes, for example, electrically erasable programmable read-only memory (EEPROM) and stores a plurality of pieces of reference data corresponding to a plurality of types of impulse sounds on a one-to-one basis. The pieces of reference data are sound signals obtained through conversion of the impulse sounds.

[0018] The determination processor 24 is configured to detect an impulse sound (target sound) as a detection target based on the sound signal generated by the sound collector 22 to determine whether or not an event associated with generation of the impulse sound occurs. The plug connector is provided with, as the impulse sound, a plurality of types of impulse sounds.

[0019] The determination processor 24 compares the sound signal generated by the sound collector 22 with the plurality of pieces of reference data stored in the storage section 23. More specifically, the determination processor 24 compares the audio characteristic of the sound signal generated by the sound collector 22 with audio characteristics of the plurality of pieces of reference data stored in the storage section 23. Thus, the determination processor 24 distinguishes the type of the impulse sound. If the plurality of pieces of reference data include reference data which matches with the sound signal generated by the sound collector 22, the determination processor 24 determines that a type of impulse sound corresponding to the reference data occurs. However, if the plurality of pieces of reference data includes no reference data which matches with the sound signal generated by the sound collector 22, the determination processor 24 determines that no impulse sound occurs. Note that "reference data which matches with the audio characteristic of the sound signal generated by the sound collector 22" refers to reference data corresponds to an impulse sound which has an audio characteristic similar to that of the sound signal generated by the sound collector 22 and which can be regarded as the same type as the sound collected by the sound collector 22.

[0020] Moreover, the determination processor 24 includes an absence mode (first mode) and a home mode (second mode) as operation modes and is configured to detect different types of impulse sounds (target sounds)

between the absence mode and the home mode.

[0021] In the present embodiment, the detection target in the absence mode is associated with an impulse sound (first target sound) generated due to an unexpectedly occurring event. Examples of the first target sound include a sound of hitting a pane of glass and a crash sound. That is, the determination processor 24 is configured to detect, in the absence mode, a plurality of impulse sounds such as a sound of hitting a pane of glass and a crash sound as first target sounds. Note that the first target sound does not necessarily have to include the plurality of types of impulse sounds (target sounds) but may be one type of impulse sound (target sound).

[0022] Moreover, the detection target in the home mode is associated with an impulse sound (second target sound) generated due to an event intentionally caused by a user. Examples of the second target sound include a sound of clapping hands, a sound of clicking fingers, and a knocking sound. That is, the determination processor 24 is configured to detect, in the home mode, a plurality of types of impulse sounds such as a sound of clapping hands, a sound of clicking fingers, and a knocking sound as second target sounds. Note that the second target sound does not necessarily have to include the plurality of types of impulse sounds (target sounds) but may be one type of impulse sound (target sound).

[0023] The determination processor 24 compares the sound signal generated by the sound collector 22 with reference data. The reference data corresponds to at least one type of impulse sound as the detection target and is included in the plurality of pieces of reference data stored in the storage section 23. The determination processor 24 thus detects the generation of the impulse sound as the detection target. In other words, the determination processor 24 does not detect the generation of the impulse sound other than the detection target.

[0024] The determination processor 24 determines, based on the operation mode and a detecting result of the impulse sound, whether or not an event associated with generation of the impulse sound occurs.

[0025] It is assumed that when the operation mode of the determination processor 24 is the absence mode (first mode), the amplitude of the sound signal reaches or exceeds a threshold Th1 within a determination time T1 after the generation of an impulse sound (first target sound) as the detection target is detected by the determination processor 24 (see FIG. 3). In this case, the determination processor 24 determines that an event associated with generation of the impulse sound (first target sound) as the detection target occurs. FIG. 3 is a waveform diagram schematically illustrating an envelope of the sound signal and illustrates an example in which the sound signal reaches or exceeds the threshold Th1 within the determination time T1. The determination processor 24 includes a clock unit 241 configured to start clocking when the determination processor 24 detects the impulse sound (first target sound), and during a time period until a clocking result by the clock unit 241 reaches the determination time T1, the determination processor 24 monitors the amplitude of the sound signal. The determination time T1 is set to, for example, 30 seconds.

[0026] In the example shown in FIG. 3, the determination processor 24 detects the impulse sound (first target sound) at a time t1, and clocking by the clock unit 241 is started. Due to a sound generated after the generation of the impulse sound (first target sound), the amplitude of the sound signal is higher than the threshold Th1 from a time t2 through a time t3. The determination processor 24 determines that an event associated with generation of the impulse sound (first target sound) occurs at the time t3. In contrast, when the sound signal does not reach or exceed the threshold Th1 within the determination time T1, the determination processor 24 determines that no event associated with generation of the impulse sound (first target sound) occurs. Thus, it is possible to reduce erroneous determinations of whether or not an event associated with generation of the impulse sound (first target sound) as a detection target occurs when the impulse sound is generated once.

[0027] Moreover, it is assumed that when the operation mode of the determination processor 24 is the home mode (second mode), the determination processor 24 detects an impulse sound (second target sound) twice or more within a specified time T2. In this case, the determination processor 24 determines that an event associated with generation of the impulse sound (second target sound) as the detection target occurs (see FIG. 4). FIG. 4 is a waveform diagram schematically illustrating an envelope of the sound signal and illustrates an example in which the impulse sound (second target sound) occurs four times within the specified time T2. The determination processor 24 includes a counter 242 configured to count the number of times the impulse sound (second target sound) is detected. Clocking by the clock unit 241 is started when the determination processor 24 detects the impulse sound (second target sound). The counter 242 is configured to count the number of times of detecting the impulse sound (second target sound) during a time period until the clocking result by the clock unit 241 reaches the specified time T2. When the clock unit 241 is measuring the specified time T2, the clock unit 241 does not reset a measured value even when the impulse sound (second target sound) is detected, but the clock unit 241 resets the measured value when the measured value reaches the specified time T2. The specified time T2 is set, for example, to 3 seconds. Moreover, the determination processor 24 is configured not to detect the impulse sound (second target sound) when the time interval of the impulse sound (second target sound) is shorter than a predetermined time (e.g., 200 ms).

[0028] In the example shown in FIG. 4, the determination processor 24 detects the impulse sound (second target sound) at times t11, t12, tl3, and t14, and the count value of the counter 242 is four (that is, a plurality of number of times), and therefore, the determination proc-

essor 24 determines that an event associated with generation of the impulse sound (second target sound) occurs. In contrast, when the impulse sound (second target sound) is detected once within the specified time T2, the determination processor 24 determines that no event associated with generation of the impulse sound (second target sound) occurs. Thus, it is possible to reduce erroneous determinations of whether or not an event associated with generation of the impulse sound (second target sound) as a detection target occurs when the impulse sound (second target sound) is generated once.

[0029] Moreover, when the count value of the counter 242 exceeds the maximum number of times (e.g., 10), the determination processor 24 determines that no event associated with generation of the impulse sound (second target sound) occurs. Note that the determination processor 24 may be configured to determine, in accordance with whether or not the impulse sound (second target sound) is generated during a time period before the specified time T2 starts and during a time period after the specified time T2 ends, whether or not the event associated with generation of the impulse sound (second target sound) occurs. Specifically, a predetermined time period directly before first detection of the impulse sound (second target sound) detected twice or more within the specified time T2 is defined as a first time period, and a predetermined time period directly after last detection of the impulse sound (second target sound) is defined as a second time period. When detecting an impulse sound (second target sound) during the first time period and the second time period, the determination processor 24 determines that no event associated with generation of the impulse sound (second target sound) occurs.

[0030] That is, when the impulse sound (second target sound) is successively and continuously generated, the specified time T2 is repeatedly measured. In this case, in each one specified time T2, a silent time period during which the impulse sound (second target sound) is not detected is reduced before starting of the specified time T2 and after ending of the specified time T2, and the number of times of detection exceeds the maximum number of times. Thus, the determination processor 24 determines that no event associated with generation of the impulse sound (second target sound) occurs. Thus, the determination processor 24 is suppressed from erroneously determining whether or not an event associated with generation of the impulse sound (second target sound) occurs when the impulse sound (second target sound) is successively and continuously generated over a longer time than the specified time T2.

[0031] Moreover, the determination processor 24 associates the number of times the impulse sound (second target sound) is detected within the specified time T2 with contents of an event. For example, when the determination processor 24 detects an impulse sound (second target sound) generated by clapping hands two times within the specified time T2, the determination processor 24 determines that an event of clapping hands two times occurs.

[0032] Alternatively, the determination processor 24 may be configured to measure the time interval between impulse sounds (second target sounds). When the impulse sound (second target sound) is generated a predetermined number of times at a predetermined time interval, the determination processor 24 determines that an event involving generation of the impulse sound (second target sound) occurs. For example, when the determination processor 24 detects the impulse sound (second target sound) generated by clapping hands three times at a time interval of 0.5 seconds to 1 second and detects no impulse sound (second target sound) during a period of one second after detection of the third impulse sound (second target sound), the determination processor 24 determines that an event of clapping hands three times occurs. Moreover, when the determination processor 24 detects an impulse sound (second target sound) generated at a prescribed rhythm, the determination processor 24 determines that an event of clapping hands at a prescribed rhythm occurs.

[0033] The communicator 25 includes a communication interface and is configured to communicate with a server 5 (external apparatus). Specifically, the communicator 25 communicates with the server 5 via a communication device 51. The communication device 51 is, for example, a modem, an optical network unit (ONU), or the like and is configured to communicate with the server 5 via a telecommunications network NT1 (e.g., Internet network).

[0034] The controller 26 includes a central processing unit (CPU), a micro processing unit (MPU), or the like. The controller 26 is configured to control the switch 21 and the communicator 25 in accordance with the determination result by and the operation mode of the determination processor 24. When the determination processor 24 determines that an event occurs with the operation mode being the absence mode, the controller 26 causes the communicator 25 to transmit a determination result by the determination processor 24 to the server 5. Moreover, when the determination processor 24 determines that an event occurs with the operation mode being the home mode, the controller 26 turns on or off the switch 21 in accordance with the content of the event which occurs. For example, the controller 26 turns on the switch 21 when the determination processor 24 determines that an event of clapping hands two times occurs, and the controller 26 turns off the switch 21 when the determination processor 24 determines that an event of clapping hands four times occurs. Alternatively, the controller 26 may control the switch 21 to be alternately turned on and off, for example, each time the determination processor 24 determines that an event of clapping hands two times occurs.

[0035] The mode setting section 27 sets the operation mode of the determination processor 24 to one of the absence mode and the home mode. The mode setting section 27 is configured to communicate with the server

5 via the communicator 25, and based on a setting signal received from the server 5, the mode setting section 27 sets the operation mode of the determination processor 24 to one of the absence mode and the home mode. Specifically, a user operates, for example, a portable terminal 6 (e.g., a smartphone) to select one of the absence mode and the home mode to which the operation mode of the determination processor 24 is to be set. The portable terminal 6 notifies the server 5 via the telecommunications network NT1 of the operation mode thus selected. The server 5 generates, based on the notification content from the portable terminal 6, a setting signal denoting the operation mode to which the determination processor 24 is to be set. The server 5 transmits the setting signal thus generated to the mode setting section 27 over the telecommunications network NT1. The mode setting section 27 sets, based on the setting signal thus received, the operation mode of the determination processor 24 to one of the absence mode and the home mode. Note that a method for setting the operation mode of the determination processor 24 is not limited to the above-described example. For example, a user may perform an operation to an operation terminal provided to a dwelling house to select the operation mode to cause the mode setting section 27 to set the operation mode of the determination processor 24. Alternatively, the mode setting section 27 may be configured to set the operation mode of the determination processor 24 in accordance with the contents of an operation performed on an operation section (e.g., switch) disposed to the plug connector 1.

[0036] The setting signal transmitted from the server 5 to the mode setting section 27 may include data about the types of impulse sounds corresponding to the absence mode and the types of impulse sounds corresponding to the home mode. The mode setting section 27 sets, based on the setting signal, the types of impulse sounds as detection targets when the determination processor 24 is in the absence mode and the types of impulse sounds as detection targets when the determination processor 24 is in the home mode for the determination processor 24.

[0037] The filter 28 includes a high-pass filter. The filter 28 is configured to remove a low-frequency component from the sound signal output from the sound collector 22 to output a resultant signal to the determination processor 24. The low-frequency component removed by the filter 28 is set to, for example, about 2 kHz. The low-frequency component corresponds to the frequency of a sound sensitively audible by the human ear. An auditory signal and the like of an electrical device in many cases include a frequency component which peaks at this frequency. Removing the low-frequency component by the filter 28 from the sound signal generated by the sound collector 22 reduces erroneous detections of the auditory signal and the like of the electrical device as the impulse sounds of the detection target by the determination processor 24.

[0038] Alternatively, the controller 26 may be configured to control the switch 21 based on the control signal received from the server 5. A user operates, for example, the portable terminal 6 to select ON or OFF of the switch 21. The portable terminal 6 notifies the server 5 via the telecommunications network NT1 of information about ON or OFF of the switch 21 thus selected. The server 5 generates a control signal denoting the information about ON or OFF of the switch 21 based on the notification content from the portable terminal 6 and transmits the control signal to the controller 26. The controller 26 receives the control signal and turns on or off the switch 21 based on the control signal.

<Operation>

[0039] Next, operation of the plug connector 1 according to the present embodiment will be described. First, operation performed when the operation mode of the determination processor 24 is set to the absence mode (first mode) will be described.

[0040] When the operation mode of the determination processor 24 is set to the absence mode, the detection target of the determination processor 24 is the impulse sound (first target sound), such as a sound of hitting a pane of glass and a crash sound, generated due to a suddenly occurring event. When the amplitude of the sound signal reaches or exceeds the threshold Th1 within the determination time T1 from detecting of the generation of the impulse sound (first target sound) as a detection target, the determination processor 24 determines that an event associated with generation of the impulse sound (first target sound) occurs (see FIG. 3).

[0041] Here, an example in which an invader breaks a window glass and invades a dwelling house will be described.

[0042] When an invader hit a window glass to break a window glass, an impulse sound (first target sound) is generated. The determination processor 24 detects the impulse sound (first target sound), and clocking by the clock unit 241 is started.

[0043] The invader who has hit and broken the window glass opens the window, invades and explores in the dwelling house. When the invader explores, various sounds such as a sound of opening and closing windows, doors, drawers, and the like, and a sound of footsteps, a rustle sound of clothes, and the like are generated. That is, when an invader hits and breaks a window glass and invades a dwelling house, a sound other than the impulse sound may be generated due to the movement of the invader after the breaking of the window glass. The determination processor 24 compares the amplitude of the sound signal with the threshold Th1 to detect the generation of the sound caused due to the movement of the invader. When within the determination time T1 from detecting of the impulse sound (first target sound) generated due to hitting the glass window, the determination processor 24 detects a sound generated due to the movement of an invader, the determination processor 24 determines that an event associated with a sound of hitting

a pane of glass (the impulse sound, the first target sound) is generated.

[0044] Since the determination processor 24 determines that the event occurs with the determination processor being in the absence mode, the controller 26 causes the communicator 25 to transmit a determination result by the determination processor 24 to the server 5. Thus, the server 5 is notified of the occurrence of the event of hitting a pane of glass. When the server 5 is notified of the occurrence of the event of hitting a pane of glass, the server 5 notifies the portable terminal 6 of a user of the occurrence of the event of hitting a pane of glass. Moreover, the server 5 is configured to control a camera 101 and an alarm 102 disposed in the dwelling house via the communication device 51 so as to cause the camera 101 to capture images and cause the alarm 102 to rumble. The camera 101 transmits an image or a moving image which is captured to the server 5 and the portable terminal 6. Moreover, the server 5 notifies a management company 7 of the occurrence of the event of hitting a pane of glass. The management company 7 contacts a communication terminal 103 disposed in the dwelling house to confirm safety via a telephone network NT2. The communication terminal 103 preferably has a hands-free function. Note that the operation of the server 5 is a mere example, and server 5 may be configured to perform other operation than the above-described operation.

[0045] Thus, the plug connector 1 functions as a security sensor configured to notify the server 5 of an abnormality when the impulse sound (first target sound) is generated due to an event which suddenly occurs around the plug connector 1 with the operation mode of the determination processor 24 being set to the absence mode (first mode).

[0046] Next, operation in an example in which the operation mode of the determination processor 24 is set to the home mode (second mode) will be described.

[0047] When the operation mode of the determination processor 24 is set to the home mode, the detection target of the determination processor 24 corresponds to types of impulse sounds (second target sounds), such as a sound of clapping hands, a sound of clicking fingers, and a knocking sound caused due to an event intentionally caused by a user. When the number of times an impulse sound (second target sound) is detected within the specified time T2 is two or more but is smaller than the maximum number of times (see FIG. 4), the determination processor 24 determines that an event associated with generation of the impulse sound (second target sound) occurs.

[0048] Here, description is given of, for example, a case where a user present in the dwelling house claps hands two times and a case where a user present in the dwelling house claps hands four times, wherein for both of the cases, the lighting fixture 400 as the electrical device 4 is connected to the plug connector 1 (see FIG. 2B).

[0049] A user claps hands to generate the impulse sound (second target sound). The determination processor 24 detects the impulse sound (second target sound), and the counter 242 counts the number of times the impulse sound (second target sound) is detected within the specified time T2. When the determination processor 24 detects the impulse sound (second target sound) two times generated by clapping hands within the specified time T2, the determination processor determines that an event of clapping hands two times occurs. Moreover, when the determination processor 24 detects the impulse sound (second target sound) four times generated by clapping hands within the specified time T2, the determination processor determines that an event of clapping hands four times occurs.

[0050] The controller 26 determines that the event occurs with the determination processor 24 being in the home mode, and therefore, the controller 26 controls the switch 21 in accordance with the determination result by the determination processor 24. Here, the controller 26 turns on the switch 21 when the determination result by the determination processor 24 is "clapping hands two times". Thus, electric power is supplied from the commercial power supply 300 to the lighting fixture 400, and thus, the lighting fixture 400 is lit. Moreover, when the determination result by the determination processor 24 is "clapping hands four times", the controller 26 turns off the switch 21. Thus, supply of the electric power to the lighting fixture 400 is interrupted, and thus, the lighting fixture 400 is unlit. Note that a relationship between the contents of the event associated with generation of the impulse sound (second target sound) and ON and OFF of the switch 21 is a mere example and is not limited to the above-described example.

[0051] Thus, when the operation mode of the determination processor 24 is set to the home mode (second mode), the plug connector 1 serves as a remote controller configured to control the electrical device 4 by the impulse sound (second target sound) intentionally caused by a user.

<Summary>

[0052] Next, an advantage provided by the plug connector 1 of the present embodiment will be described.

[0053] As described above, a plug connector 1 according to a first aspect is a plug connector for wiring, including an attachment plug 11 and a plug receptacle 12. The plug connector includes a sound collector 22 and a determination processor 24. The sound collector 22 is configured to collect an ambient sound to generate a sound signal in form of an electric signal. The determination processor 24 is configured to detect an impulse sound (target sound) as a detection target based on the sound signal to determine whether or not an event associated with generation of the impulse sound occurs. The plug connector is provided with, as the impulse sound, a plurality of types of impulse sounds. The determination processor 24 has an absence mode (first mode) and a home mode (second mode) as operation modes. The determi-

nation processor 24 is configured to detect a first target sound of the plurality of types of impulse sounds in the first mode and detect a second target sound of the plurality of types of impulse sounds in the second mode. The type of the first target sound and the type of the second target sound are different from each other. In other words, in the determination processor 24, the types of impulse sounds (target sounds) as the detection targets are different between the first mode and the second mode.

[0054] This configuration enables the types of impulse sounds (target sounds) as detection targets to be easily changed depending on, for example, situations around the plug connector 1. For example, the types of the impulse sounds as detection targets are easily switchable depending on the presence or absence of a user in the dwelling house. Therefore, for example, a case where a type of impulse sound is to be included in the detection targets in one situation but is to be excluded from the detection targets in the other situation can be easily handled by switching the determination processor 24 between the operation modes. For example, when the operation mode of the determination processor 24 is the absence mode, a setting of excluding, for example, a sound (impulse sound) of clapping hands from the detection target is possible, whereas when the operation mode of the determination processor 24 is the home mode, a setting of excluding a sound (impulse sound) of hitting a pane of glass from the detection target is possible. That is, the plug connector 1 is capable of easily switch the types of impulse sounds as detection targets depending on situations around the plug connector 1, and thus, the convenience can be improved.

[0055] A plug connector 1 according to a second aspect referring to the first aspect preferably includes a communicator 25, a switch 21, and a controller 26. The communicator 25 is preferably configured to transmit a determination result by the determination processor 24 to a server 5 (external apparatus). The switch 21 is preferably configured to make and break electrical connection between the attachment plug 11 and the plug receptacle 12. The controller 26 is preferably configured to control the communicator 25 and the switch 21. Moreover, the controller 26 is preferably configured to control at least one of the communicator 25 and the switch 21 in accordance with the operation mode when the determination processor 24 determines the occurrence of the event.

[0056] With this configuration, operation performed in response to determining that an event associated with generation of an impulse sound as a detection target occurs can be different depending on, for example, situations around the plug connector 1. For example, when the operation mode of the determination processor 24 is the absence mode, it is possible to set such that the switch 21 is not controlled when a sound (impulse sound) of clapping hands is generated. Moreover, when the operation mode of the determination processor 24 is the home mode, it is possible to set such that the server 5 is not informed of an abnormality when a sound (impulse sound) of hitting a pane of glass is generated. Thus, the plug connector 1 can further improve the convenience.

[0057] In a plug connector 1 according to a third aspect referring to the second aspect, the controller 26 is preferably configured to cause the communicator 25 to transmit the determination result by the determination processor 24 to the server 5 (an external apparatus) when the determination processor 24 determines the occurrence of the event with the operation mode being the absence mode (first mode).

[0058] With this configuration, it becomes possible to cause the plug connector 1 to serve as a security sensor configured to notify the server 5 (external apparatus) of an abnormality when it is determined that an event associated with generation of the impulse sound occurs around the plug connector 1.

[0059] In a plug connector 1 according to a fourth aspect referring to the second or third aspect, the controller 26 is preferably configured to control the switch 21 when the determination processor 24 determines the occurrence of the event with the operation mode being the home mode (second mode).

[0060] With this configuration, it becomes possible to cause the plug connector 1 to serve as a remote controller configured to control the electrical device 4 connected to the plug receptacle 12 when it is determined that an event involving generation of the impulse sound occurs around the plug connector 1. Moreover, when the plug connector 1 serves as the remote controller, the plug connector 1 does not communicate with the server 5 even when it is determined that an event associated with generation of the impulse sound occurs. Thus, communication traffic between the plug connector 1 and the server 5 can be reduced.

[0061] In a plug connector 1 according to a fifth aspect referring to any one of the first to fourth aspects, the determination processor 24 is preferably configured to determine the occurrence of the event when the determination processor 24 detects the impulse sound (second target sound) twice or more within a specified time T2 with the operation mode being the home mode (second mode).

[0062] This configuration suppresses an impulse sound unintentionally generated once from being erroneously determined as occurrence of an event associated with generation of the impulse sound when the operation mode of the determination processor 24 is the home mode. Thus, the plug connector 1 can improve determination accuracy of whether or not an event associated with generation of the impulse sound as a detection target occurs.

[0063] In a plug connector 1 according to a sixth aspect referring to the fifth aspect, the determination processor 24 is preferably configured to determine that the event does not occur when the number of times the impulse sound (second target sound) is detected within the spec-

ified time T2 exceeds a maximum number of times.

[0064] This configuration suppresses an impulse sound sequentially and continuously generated by, for example, operation of a machine from being erroneously determined as the occurrence of the event when the operation mode of the determination processor 24 is the home mode. Thus, the plug connector 1 can improve determination accuracy of whether or not an event involving generation of the impulse sound as a detection target occurs.

[0065] In a plug connector 1 according to a seventh aspect referring to any one of the first to sixth aspects, the sound collector 22 is preferably configured to generate the sound signal whose amplitude increases as a sound pressure level of the sound collected increases. The determination processor 24 is preferably configured to determine the occurrence of the event when the amplitude of the sound signal reaches or exceeds a threshold Th1 within a determination time T1 from detection of the impulse sound (first target sound) with the operation mode being the absence mode (first mode).

[0066] This configuration suppresses an impulse sound generated once from being erroneously determined as occurrence of an event associated with generation of the impulse sound when the operation mode of the determination processor 24 is the absence mode. Thus, the plug connector 1 can improve determination accuracy of whether or not an event involving generation of the impulse sound as a detection target occurs. Moreover, it is possible to reduce that the server 5 is erroneously notified of an abnormality due to erroneous determination of whether or not the event occurs.

[0067] A plug connector 1 according to an eighth aspect referring to any one of the first to seventh aspects preferably includes a filter 28 configured to remove a low-frequency component from the sound signal generated by the sound collector 22 to output a resultant signal to the determination processor 24.

[0068] As described above, an auditory signal and the like of an electrical device, in many cases, include a frequency component which peaks at a frequency (e.g., 2 kHz) regarded to be sensitively audible by the human ear. The filter 28 removes a low-frequency component (e.g., 2 kHz) from the sound signal generated by the sound collector 22, and thus, the determination processor 24 is suppressed from erroneously detecting the auditory signal and the like of the electrical device as the impulse sound. Thus, the plug connector 1 can improve determination accuracy of whether or not an event involving generation of the impulse sound as a detection target occurs.

[0069] Moreover, the frequency characteristics of a sound of clapping hands are different depending on a way of clapping the hands, the size of the hands (a volume of air between the hands), and the like. The difference between the frequency characteristics leads to a large difference in, in particular, a low-frequency range. Thus, removing a low-frequency component by the filter 28 from the sound signal generated by the sound collector 22 reduces influence of the difference between the frequency characteristics of the sound of clapping hands, the influence caused due to the difference in the way of clapping the hands, the size of the hands. Thus, it becomes possible to improve the accuracy of detecting a sound of clapping hands (impulse sound) by the determination processor 24.

<Variations>

[0070] Variations of the plug connector 1 will be described below.

[0071] The plug connector 1 may have a configuration in which a sound pressure level determination processor is disposed between the filter 28 and the sound collector 22. The sound pressure level determination processor is configured to determine, based on a sound signal generated by the sound collector 22, whether or not the sound pressure level of the sound collected by the sound collector 22 is higher than or equal to a threshold. The filter 28 removes, based on a determination result by the sound pressure level determination processor, a low-frequency component from only a sound signal obtained by converting a sound having sound pressure level higher than or equal to the threshold. Moreover, the determination processor 24 determines, based on only a sound signal, whether or not an event involving generation of an impulse sound as a detection target occurs, wherein the sound signal is obtained by converting a sound, the sound pressure level of the sound is higher than or equal to the threshold based on the determination result of the sound pressure level determination processor. Thus, only when a loud sound is generated, the filter 28 and the determination processor 24 operate, which can reduce processes by the filter 28 and the determination processor 24.

[0072] Moreover, the sound collector 22 is configured to collect a sound around the plug connector 1 through the sound collector pore 13 formed in the front surface of the housing 10. In front of the housing 10 of the plug connector 1, a space is provided for connection of the attachment plug 41 to the plug receptacle 12, which improves the sound collector 22 efficiently collect a sound around the plug connector 1. Moreover, the sound collector pore 13 is formed above the plug receptacle 12, and therefore, even when the attachment plug 41 is connected to the plug receptacle 12, the sound collector pore 13 is not closed with the attachment plug 41. Thus, the sound collector 22 can efficiently collect a sound around the plug connector 1 because sound insulation by the attachment plug 41 is suppressed.

[0073] Moreover, the plug connector 1 can easily realize the function as a security sensor by only connecting the attachment plug 11 to the plug receptacle 31 of the socket 3. Moreover, the difference between the appearance of the plug connector 1 and the appearance of a plug connector having only a function as wiring acces-

sories is small. Therefore, an invader is less likely to notice that the plug connector 1 also serves as a security sensor, which suppresses detachment of the plug connector 1 by the invader.

[0074] Moreover, the plug connector 1 is capable of serving as a security sensor or a remote controller without being manually operated by a user. Therefore, it is possible to suppress a reduction in convenience due to installation at a location where an operation is hardly performed. Moreover, installing the plug connector 1 at a location where the plug connector 1 is hardly noticed by an invader reduces the probability that the invader notices and detaches the plug connector 1.

[0075] Moreover, in the above-described examples, a case where the target sound as the detection target of the determination processor 24 is the impulse sound has been described, but the target sound is not limited the impulse sound but may be a sound other than the impulse sound.

[0076] Note that the above-described embodiment is a mere example of the present invention. Therefore, the present invention is not limited to the above-described embodiment. Even in configurations other than that illustrated in this embodiment, various modifications may be made depending on design and the like without departing from the technical idea of the present invention.

Reference Signs List

[0077]

1	Plug Connector
11	Attachment Plug
12	Plug Receptacle
21	Switch
22	Sound Collector
24	Determination Processor
25	Communicator
26	Controller
28	Filter
5	Server (External Apparatus)
T1	Determination Time
T2	Specified Time
Th1	Threshold

Claims

1. A plug connector for wiring, including an attachment plug and a plug receptacle, the plug connector comprising:

a sound collector configured to collect an ambient sound to generate a sound signal in form of an electric signal; and
a determination processor configured to detect a target sound as a detection target based on the sound signal to determine whether or not an event associated with generation of the target sound occurs, wherein
the plug connector is provided with, as the target sound, a plurality of types of target sounds,
the determination processor has a first mode and a second mode as operation modes,
the determination processor is configured to

detect a first target sound of the plurality of types of target sounds in the first mode and detect a second target sound of the plurality of types of target sounds in the second mode, the type of the first target sound and the type of the second target sound being different from each other.

2. The plug connector according to claim 1, comprising:

a communicator configured to transmit a determination result by the determination processor to an external apparatus;
a switch configured to make and break electrical connection between the attachment plug and the plug receptacle; and
a controller configured to control the communicator and the switch, wherein

the controller is configured to control at least one of the communicator and the switch in accordance with the operation mode when the determination processor determines the occurrence of the event.

3. The plug connector according to claim 2, wherein
the controller is configured to cause the communicator to transmit the determination result by the determination processor to the external apparatus when the determination processor determines the occurrence of the event with the operation mode being the first mode.

4. The plug connector according to claims 2 or 3, wherein
the controller is configured to control the switch when the determination processor determines the occurrence of the event with the operation mode being the second mode.

5. The plug connector according to any one of claims 1 to 4, wherein
the determination processor is configured to determine the occurrence of the event when the determination processor detects the second target sound twice or more within a specified time with the operation mode being the second mode.

6. The plug connector according to claim 5, wherein
the determination processor is configured to determine that the event does not occur when the number

of times the second target sound is detected within the specified time exceeds a maximum number of times.

7. The plug connector according to any one of claims 1 to 6, wherein
the sound collector is configured to generate the sound signal whose amplitude increases as a sound pressure level of the sound collected increases, and the determination processor is configured to determine the occurrence of the event when the amplitude of the sound signal reaches or exceeds a threshold within a determination time from detection of the first target sound with the operation mode being the first mode.

8. The plug connector according to any one of claims 1 to 7, further comprising a filter configured to remove a low-frequency component from the sound signal generated by the sound collector to output a resultant signal to the determination processor.

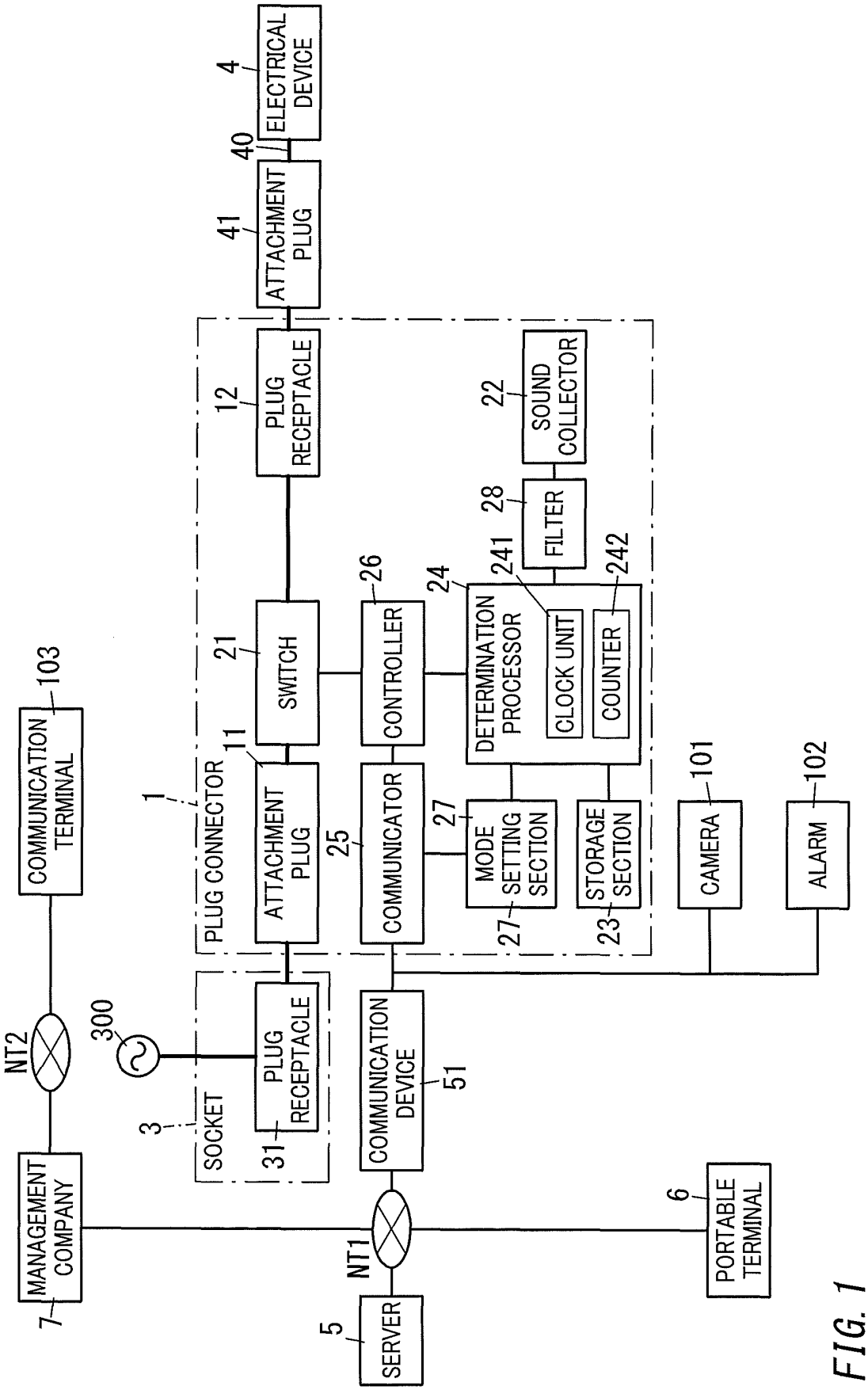

4
ELECTRICAL DEVICE
40
41
ATTACHMENT PLUG
12
PLUG RECEPTACLE
22
SOUND COLLECTOR
28
FILTER
241
242
24
DETERMINATION PROCESSOR
CLOCK UNIT
COUNTER
26
CONTROLLER
21
SWITCH
11
ATTACHMENT PLUG
1
PLUG CONNECTOR
25
COMMUNICATOR
27
MODE SETTING SECTION
27
23
STORAGE SECTION
101
CAMERA
102
ALARM
103
COMMUNICATION TERMINAL
NT2
300
3
SOCKET
31
PLUG RECEPTACLE
COMMUNICATION DEVICE
51
MANAGEMENT COMPANY
7
NT1
5
SERVER
6
PORTABLE TERMINAL

FIG. 1

FIG. 2A

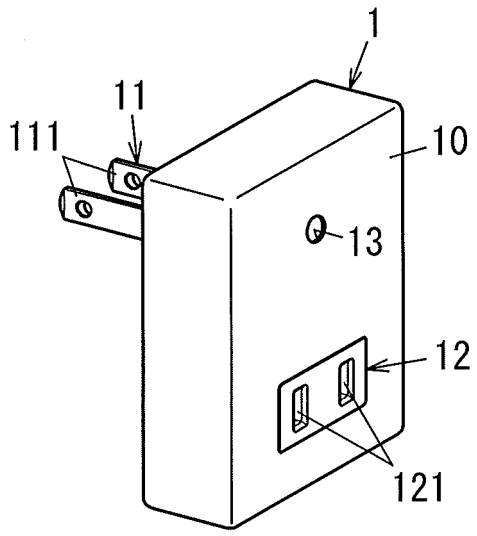


FIG. 2B

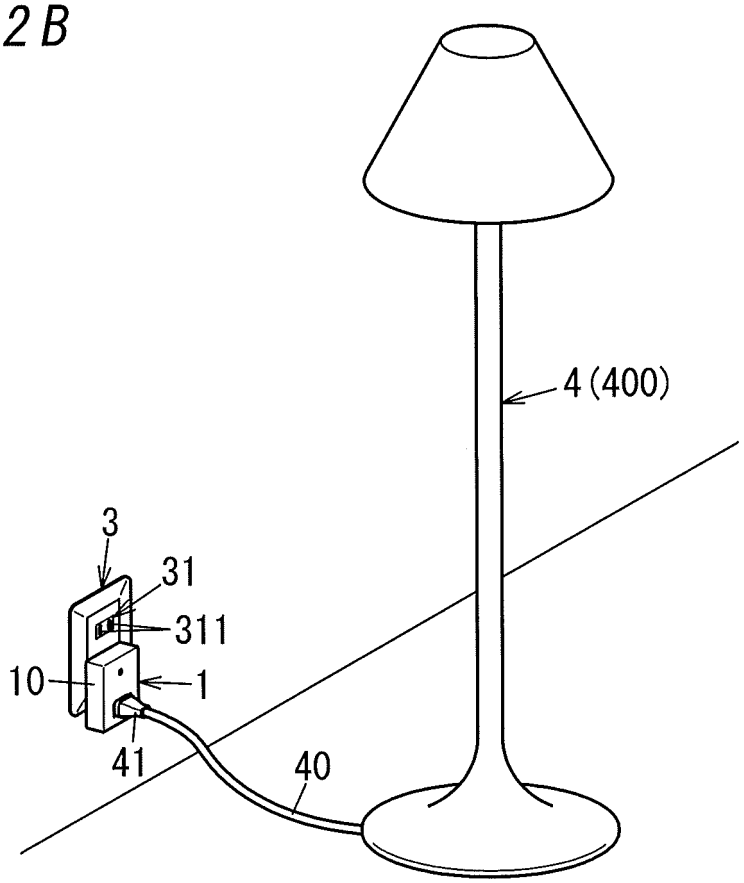


FIG. 3

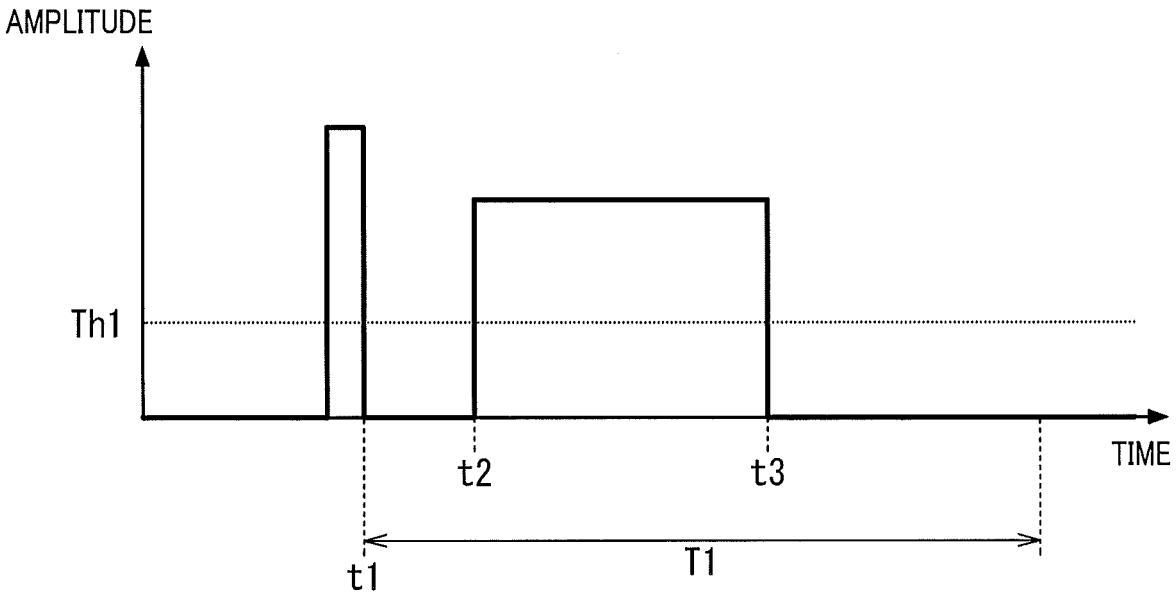
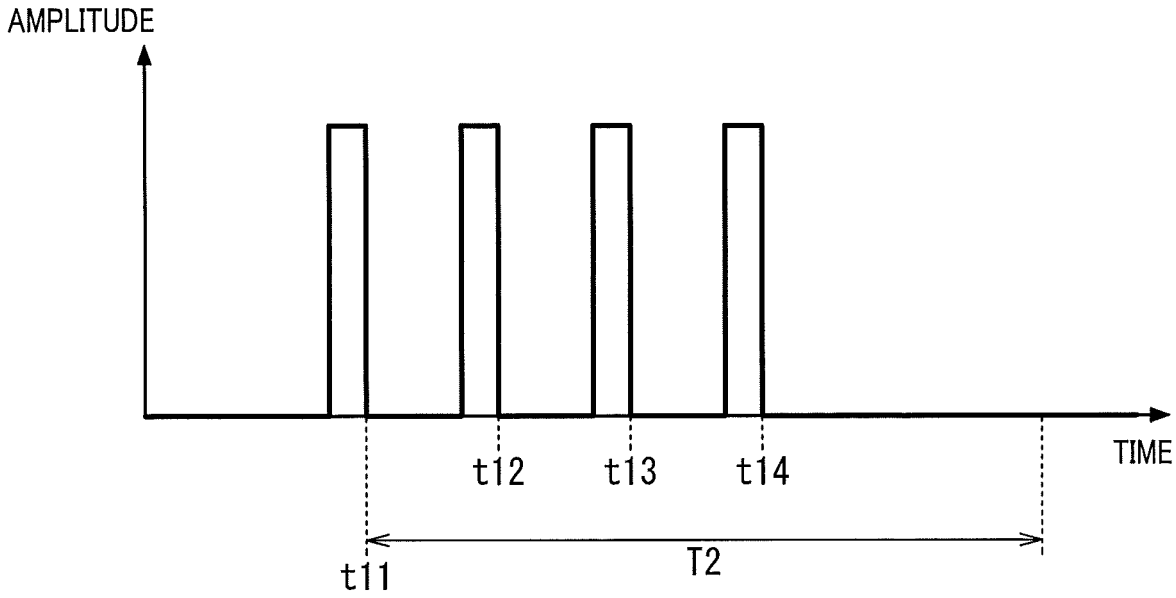

AMPLITUDE
Th1
TIME
t1
t2
t3
T1

FIG. 4


AMPLITUDE
TIME
t11
t12
t13
t14
T2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/009431

A. CLASSIFICATION OF SUBJECT MATTER
H01R31/06(2006.01)i, *G08B13/04*(2006.01)i, *G08B25/00*(2006.01)i, *G08B25/04*(2006.01)i, *G08B25/08*(2006.01)i, *H01R13/66*(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)
H01R31/06, G08B13/04, G08B25/00, G08B25/04, G08B25/08, H01R13/66

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017
Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

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.
A	JP 54-82678 A (Matsushita Electric Works, Ltd.), 02 July 1979 (02.07.1979), entire text; all drawings (Family: none)	1-8
A	JP 48-38099 A (Matsushita Electric Works, Ltd.), 05 June 1973 (05.06.1973), entire text; all drawings (Family: none)	1-8
A	JP 11-102788 A (Optex Co., Ltd.), 13 April 1999 (13.04.1999), paragraphs [0008] to [0019]; fig. 2 to 3 (Family: none)	1-8

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 May 2017 (25.05.17)	06 June 2017 (06.06.17)
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/JP2017/009431

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 2012-190161 A (Panasonic Corp.), 04 October 2012 (04.10.2012), entire text; all drawings (Family: none)	1-8
P,X	WO 2016/208135 A1 (Panasonic Intellectual Property Management Co., Ltd.), 29 December 2016 (29.12.2016), paragraphs [0010] to [0042]; fig. 1 to 3 & JP 2017-10762 A	1-3

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2014185965 A **[0004]**