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(54) **WIRELESS COMMUNICATION SYSTEM**

DRAHTLOSES KOMMUNIKATIONSSYSTEM

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Description

TECHNICAL FIELD

[0001] The invention relates to a wireless communication system in which multiple wireless stations transmit and receive wireless signals by use of radio waves as a medium.

BACKGROUND ART

[0002] A fire alarm system involving coordinated operation of multiple fire alarm devices through wireless signal has been proposed. In a fire alarm system of this kind, multiple fire alarm devices disposed in multiple locations each have a function for detecting the occurrence of a fire and emitting an alarm sound. When any one of the fire alarm devices detects a fire, the fire alarm device emits an alarm sound, as well as transmitting information indicating that a fire has been detected, to the other fire alarm devices by a wireless signal. Consequently, not only the fire alarm device at the origin of the fire but also other fire alarm devices in synchronization with the same emit an alarm sound in unison, thereby providing a rapid and reliable notification of the occurrence of a fire.

[0003] Furthermore, a fire alarm system is known in which a particular fire alarm device, of fire alarm devices belonging to a system, is set as a parent device, the other fire alarm devices are set as subsidiary devices, and the devices operate in coordination in relation to a fire by multi-casting of a fire alarm message and/or other messages from the parent device to the subsidiary devices. Moreover, apart from a fire alarm system in which a parent device and a subsidiary device are set up, a fire alarm system is also known, which is constituted by multiple fire alarm devices having the same functions, shape and design, and in which a parent device and subsidiary devices are not distinguishable from one another. In a fire alarm system of this kind, since there is no fire alarm device serving as a parent device, then all of the fire alarm devices each must store registration information which includes the identification codes of all of the fire alarm devices belonging to the system.

[0004] Here, in view of the fact that the time taken for the registration processing becomes longer when registration processing is individually carried out in each of the fire alarm devices, in order to store registration information respectively in all of the fire alarm devices, JP2011-65260A discloses a fire alarm system whereby the time taken for registration processing can be shortened. In the fire alarm system disclosed in this document, after completing registration processing in a fire alarm device, the fire alarm device transmits from its own wireless transmission and reception unit by multi-cast a wireless signal including registration information after the registration processing, and all of the other fire alarm devices store the registration information.

[0005] In the conventional example described above,

to carry out the registration processing, after a particular fire alarm device is switched to a registration mode for receiving a registration request message from other fire alarm devices through the operation of a registration switch in the particular fire alarm device, the registration request switches of the respective other fire alarm devices are operated. Therefore, in order to complete registration processing between the particular fire alarm device and all of the other fire alarm devices, it is necessary to operate all of the other fire alarm devices, one by one. Consequently, the work required for registration becomes more complicated, the greater the number of fire alarm devices which are the object of registration, and furthermore, there is a problem in that the time required for registration becomes long.

[0006] JP2010-049625A discloses a wireless communication system wherein the registration processing is triggered by a first station and carried out automatically by exchanging wireless messages with the other stations to be registered to the group. The registration time can thereby be shortened.

[0007] Document WO 2010/097965 A1 discloses a home security surveillance system having a plurality of terminal detectors one of which functions as a master, and the other function as a slave to constitute an in-house alarm network. The in-house network is linked to a server on the side of a service provider to transmit an aid-requesting signal through a gateway unit upon detection of a hazardous condition at each of the terminals.

[0008] Document WO 2012/013692 A1 discloses a method for transmitting sensor data by radio in an alarm system in which secondary stations, which are each coupled to a state sensor, transmit sensor data as well as addresses which identify the secondary stations to a master station. Document US 2007/093991 A1 discloses a sensor for monitoring the structural integrity of a building.

[0009] Document EP 2 199 997 A2 an alarm system and an alarm device. A fire alarm device operating as a master unit transmits a switching request signal to fire alarm devices operating as slave units at a predetermined timing, the switching request signal containing at least an own address and an address of a fire alarm device that is to operate as the master unit next.

DISCLOSURE OF THE INVENTION

[0010] The present invention has been devised in view of the foregoing circumstances, an object thereof being to provide a wireless communication system which can simplify the work required for registration and can shorten the time required for registration.

[0011] The wireless communication system of the present invention is defined in the appended claims.

[0012] The present invention can carry out registration processing, simply by operating a registration switch of any wireless station just once. Therefore, in the wireless communication system according to the present inven-

tion, it is possible to simplify the work required for registration, compared to a case where wireless stations are operated one by one, and furthermore, the time required for registration can be shortened.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is an illustrative diagram of a fire alarm device in a wireless communication system relating to an embodiment of the present invention;
 FIG. 2 is a diagram showing a flow of registration processing in the wireless communication system relating to the embodiment of the present invention;
 FIG. 3 is a time chart of registration processing in the wireless communication system relating to the embodiment of the present invention;
 FIG. 4 is a time chart diagram showing the transmission of response messages using time slots in the wireless communication system relating to the embodiment of the present invention;
 FIG. 5 is a time chart diagram showing transmission and reception of registration messages and registration response messages in the wireless communication system relating to the embodiment of the present invention; and
 FIG. 6 is a diagram showing a flow of re-registration processing in the wireless communication system relating to the embodiment of the present invention.

DESCRIPTION OF THE EMBODIMENTS

[0014] Below, a wireless communication system relating to the embodiment of the present invention (a fire alarm system to which the technical idea of the present invention is applied) is described with reference to the drawings. In the description given below, to refer to common features to individual fire alarm devices **TR1** to **TR3** (to denote not a specific device but an arbitrary device), then the terminology "fire alarm device **TR**" is used. As shown in FIG. 2, the wireless communication system according to the present embodiment includes multiple fire alarm devices **TR1** to **TR3** (in the present embodiment, three fire alarm devices), and wireless signals are transferred (transmitted and received) by radio waves as a medium between the multiple fire alarm devices **TR1** to **TR3**.

[0015] As shown in FIG. 1, the fire alarm device **TR** includes a wireless transmission and reception unit 2 configured to transmit and receive a wireless signal via an antenna 1, a fire detection unit 3 configured to detect a fire, a notification unit 4 configured to emit an alarm sound in the event of an abnormality, such as a fire, and a control unit 5 configured to implement controls of various types. Furthermore, the fire alarm device **TR** includes an operation input reception unit 6 configured to receive operation inputs of various types, and a power

source unit 7 configured to supply operating power to each unit by using a battery, such as a dry cell, as a power supply. Unique identification codes are already assigned to the respective fire alarm devices **TR** in the manufacturing stage. Therefore, each fire alarm device **TR** can specify the fire alarm device **TR** that is the addressee of the wireless signal and the fire alarm device **TR** that is the sender of the wireless signal, by the identification codes.

[0016] The wireless transmission and reception unit 2 transmits and receives wireless signals by use of radio waves as a medium in compliance with "the radio stations of a low-power security system" defined in Article 6, Section 4, Part 3 of the Ordinance for Enforcement of the Radio Law. Furthermore, the wireless transmission and reception unit 2 outputs a received signal strength indicator signal (RSSI signal) which is a DC voltage signal proportional to the intensity of the received signal. "RSSI" is an abbreviation for "Received Signal Strength Indicator". The fire detection unit 3 detects a fire by detecting smoke, heat, flames, or the like, produced by a fire, for example. The antenna 1 of the wireless transmission and reception unit 2 may be designed to project from a main body of the fire alarm device **TR**, as shown in FIG. 2, or may be designed so as to be built into the main body in such a manner that the antenna 1 is not conspicuous.

[0017] The main constituent element of the control unit 5 is a microcomputer or a rewriteable non-volatile memory (for example, an EEPROM, or the like). "EEPROM" is an abbreviation for "Electrically Erasable Programmable Read-Only Memory". The control unit 5 implements functions of various types by executing a program stored in the memory in a microcomputer. For example, when the occurrence of a fire is detected by the fire detection unit 3, the control unit 5 emits an alarm sound by a buzzer which is provided in the notification unit 4. Alternatively the control unit 5 causes a speaker provided in the notification unit 4 to emit an alarm speech message (such as "Fire! Fire!", etc.) which is previously stored in a memory. In other words, the notification unit 4 reports the occurrence of an event (here, a fire) by speech.

[0018] In this case, in order to report the fire alarm by means of the other fire alarm devices **TR**, the control unit 5 transmits a wireless signal including the fire alarm message (called simply "fire alarm message" below), from the wireless transmission and reception unit 2 to the other fire alarm devices **TR**. Furthermore, when the wireless signal transmitted by another fire alarm device **TR** is received by the wireless transmission and reception unit 2 and the fire alarm message is accepted, the control unit 5 also controls the notification unit 4 and causes an alarm sound or a speech message to be emitted.

[0019] The operation input reception unit 6 has multiple switches, such as push buttons, dip switches, or the like, for example. The operation input reception unit 6 receives the operation input corresponding to the respective switch due to operation of a switch, and outputs to the control unit 5 an operation signal corresponding to the

operation input. Furthermore, the operation input reception unit 6 is provided with a registration switch 60 which outputs an operation signal causing the control unit 5 to execute the registration processing described below, upon receiving a predetermined operation input, such as a push operation or a slide operation, or the like (here, a push operation).

[0020] In the wireless communication system according to the present embodiment, an alarm stop button 60 for stopping the emission of the alarm sound by the notification unit 4 is combined with the registration switch 60. In the stage of the registration processing, since the alarm stop button 60 is not necessary, then it is possible to reduce the number of switches in the operation input reception unit 6 by combining the alarm stop button 60 with the registration switch 60.

[0021] Below, the registration processing of the fire alarm devices **TR** in the wireless communication system according to the present embodiment will be described with reference to the drawings. Registration processing means the processing for registering the fire alarm devices **TR** to a group for reporting an alarm for coordinated operation of multiple fire alarm devices **TR**. Firstly, as shown in FIG. 2, the power supplies to the fire alarm devices **TR1** to **TR3** are switched on. Thereupon, the control units 5 of the fire alarm devices **TR1** to **TR3** activate the wireless transmission and reception units 2 and switch to a registration reception mode for continuously waiting to receive wireless signals from other fire alarm devices **TR**.

[0022] In the wireless communication system according to the present embodiment, the time period of the registration reception mode is a prescribed time period (for example, 5 minutes) starting from when the power is turned on. By limiting the time period during which registration is possible in this way, it is possible to reduce the possibility of overlapping with the time period during which another group is carrying out registration processing, and to prevent the alarm devices **TR** from being erroneously registered to be in other groups. The time period of the registration reception mode is not limited to the time period indicated above. For example, if the fire alarm device **TR** has a so-called tamper function of monitoring about whether the fire alarm device **TR** is installed on a building surface (the ceiling, or the like), then the time period during which the fire alarm device **TR** is not installed on the building surface may be set as the time period of the registration reception mode.

[0023] Next, the alarm stop button 60 on any one of the fire alarm devices **TR1** to **TR3** is pressed. In this example, the alarm stop button 60 of the fire alarm device **TR1** (first wireless station) is pressed. In this case, as shown in FIG. 3, the control unit 5 of the fire alarm device **TR1** transmits a wireless signal including a registration start message prompting a reply (hereinafter, simply called "registration start message") by broadcasting from the wireless transmission and reception unit 2, continuously for a prescribed period of time. In this case, the

control unit 5 of the fire alarm device **TR1** emits a beeping alarm sound by the buzzer of the notification unit 4. When the transmission time period of the registration start message ends, the control unit 5 of the fire alarm device **TR1** activates the wireless transmission and reception unit 2 and switches to a reply waiting mode for waiting for a reply from the other fire alarm devices **TR** for a prescribed period of time.

[0024] In this example, the fire alarm devices **TR2**, **TR3** (second wireless stations) are located inside a range reached by the wireless signal transmitted from the fire alarm device **TR1**, and therefore are able to receive the registration start message. Upon receiving the registration start message, the control unit 5 of the fire alarm device **TR2** determines a waiting time period on the basis of the identification code thereof, and then waits for the waiting time period to elapse, starting from the end time of the transmission time period of the registration start message. When the waiting time period has elapsed, the control unit 5 of the fire alarm device **TR2** transmits a wireless signal including a response message which indicates that a registration start message has been received (simply called "response message" below), from the wireless transmission and reception unit 2 to the fire alarm device **TR1**. By following a procedure similar to that of the fire alarm device **TR2**, the fire alarm device **TR3** also transmits a response message to the fire alarm device **TR1**.

[0025] When there is a fire alarm device **TR**, for which the registration processing has already been implemented, then the control unit 5 of that fire alarm device **TR** does not transmit a response message to the fire alarm device **TR1** from the wireless transmission and reception unit 2, even if that control unit 5 receives a registration start message. By this means, it is possible to prevent the fire alarm device **TR**, for which registration processing has already been implemented, from being registered erroneously in another group.

[0026] Here, the waiting time period is not limited to the time period described above. For example, if the fire alarm device **TR** has a timer for counting the elapsed time after the power supply has been switched on, then the waiting time period can be determined on the basis of the elapsed time counted by the timer.

[0027] Alternatively, a configuration may be adopted in which the control unit 5 of the fire alarm device **TR1** divides the reception time period into multiple time slots in the reply waiting mode, and the control unit 5 of each fire alarm device **TR2**, **TR3** transmits a response message to the fire alarm device **TR1** using any of the time slots. In this configuration, as shown in FIG. 4, the control unit 5 of the fire alarm device **TR1** divides the registration start message into multiple time slots and also divides the reception time period in the reply waiting mode into multiple time slots.

[0028] Upon receiving the registration start message, the control unit 5 of each fire alarm device **TR2**, **TR3** can identify the start point of the reception time period from

the number of the time slot at the timing the message was received. The control unit 5 of each fire alarm device **TR2**, **TR3** then generates a random number within the range of the number of divisions of the time slots, and transmits a response message during the reception time period, using the time slot of the number determined on the basis of this random number.

[0029] By determining the waiting time by using either of the methods described above, it is possible to reduce the probability of a conflict between response messages transmitted to the fire alarm device **TR1** from the fire alarm devices **TR2** and **TR3**.

[0030] Furthermore, when the response message is transmitted to the fire alarm device **TR1**, the control unit 5 of each fire alarm device **TR2**, **TR3** may perform a carrier sense operation, and after detecting that there are no conflicting radio waves, may transmit the response message to fire alarm device **TR1**. With this configuration, it is possible to further reduce the probability of conflict between response messages transmitted to the fire alarm device **TR1** from the fire alarm devices **TR2** and **TR3**.

[0031] When the reply waiting mode ends, the control unit 5 of the fire alarm device **TR1** stores registration information including the respective identification codes of the fire alarm devices **TR** which have transmitted the response messages and the identification code of the fire alarm device **TR1**, in the memory, and individually assigns device numbers to the fire alarm devices **TR** including the fire alarm device **TR1** itself. In this example, since the response messages from the fire alarm devices **TR2**, **TR3** are received, then the control unit 5 of the fire alarm device **TR1** assigns, for example, the device number "0" to the fire alarm device **TR1** itself, assigns the device number "1" to the fire alarm device **TR2**, and assigns the device number "2" to the fire alarm device **TR3**. Since the device numbers are well-known, they are not described here.

[0032] Thereupon, as shown in FIG. 5, the control unit 5 of the fire alarm device **TR1** transmits in order from the wireless transmission and reception unit 2 wireless signals each including a registration message (simply called "registration messages" below) to the fire alarm devices **TR** to which the device numbers have been assigned. When the registration message is transmitted, the control unit 5 of the fire alarm device **TR1** activates the wireless transmission and reception unit 2 and waits for a prescribed time period for a reply from the fire alarm device **TR** to which the registration message has been transmitted.

[0033] Here, the control unit 5 of the fire alarm device **TR1** transmits registration messages from the wireless transmission and reception unit 2, in order from the fire alarm device having the smallest device number. Consequently, the control unit 5 of the fire alarm device **TR1** firstly transmits a registration message to the fire alarm device **TR2**, from the wireless transmission and reception unit 2. The registration message includes the registration

information and the device numbers of all of the fire alarm devices **TR** that have been registered.

[0034] When the registration message is received, the control unit 5 of the fire alarm device **TR2** stores the registration information and the device numbers included in the registration message, in the memory. The control unit 5 of the fire alarm device **TR2** transmits a wireless signal including a registration response message which indicates that registration has been completed (simply called "registration response message" below), from the wireless transmission and reception unit 2 to the fire alarm device **TR1**. Thereupon, the control unit 5 of the fire alarm device **TR2** transfers to an asynchronous intermittent reception mode in which the wireless transmission and reception unit 2 is activated periodically. Since the intermittent reception mode is well-known, this mode is not described here.

[0035] Upon receiving the registration response message, the control unit 5 of the fire alarm device **TR1** subsequently transmits a registration message to the fire alarm device **TR3** from the wireless transmission and reception unit 2. When the registration message is received, the control unit 5 of the fire alarm device **TR3** stores the registration information and the device numbers included in the registration message, in the memory. The control unit 5 of the fire alarm device **TR3** transmits a registration response message to the fire alarm device **TR1** from the wireless transmission and reception unit 2. Subsequently, the control unit 5 of the fire alarm device **TR3** transfers to an asynchronous intermittent reception mode.

[0036] When registration response messages have been received from all of the fire alarm devices **TR**, the control unit 5 of the fire alarm device **TR1** terminates the registration processing, and then transfers to an asynchronous intermittent reception mode after a lapse of a prescribed time period. In this case, the control unit 5 of the fire alarm device **TR1** causes the speaker of the notification unit 4 to emit a speech message stating "Device registered. There are three registered devices(, including this one)." Accordingly, the installer and/or user can confirm the number of fire alarm devices **TR** that have been registered. The time taken for the registration processing depends on the number of fire alarm devices **TR** that are to be registered, but is from 5 to 20 seconds.

[0037] In the registration processing, a registration error may occur due to conflict between the response messages from the fire alarm devices **TR** which are to be registered. Therefore, the control unit 5 of the fire alarm device **TR1** may be configured to repeat a series of operations involving: re-transmission of the registration start message, by broadcasting from the wireless transmission and reception unit 2 after the end of the reply waiting mode; and subsequently switching again to the reply waiting mode, multiple times (for example, three times). By re-transmitting the registration start message in this way, it is possible to raise the probability of receiving response messages from the fire alarm devices **TR**

which are to be registered.

[0038] It is also possible to adopt a configuration in which the control unit 5 of the fire alarm device **TR1** measures the RSSI value of the wireless signal received in the reply waiting mode, and if the RSSI value is lower than a previously established threshold value, then re-transmission of the registration start message is stopped. With this configuration, it is possible to determine whether or not registration has been completed for all of the fire alarm devices **TR** that are to be registered. In other words, if the RSSI value is lower than the threshold value, then it is considered that a wireless signal corresponding to a response message has not been transmitted by any of the fire alarm devices **TR** that are to be registered. Consequently, with this configuration, it is possible to prevent the time taken for the registration processing from becoming unnecessarily long, since the registration start message is never re-transmitted unnecessarily.

[0039] Thereafter, for confirming whether or not the registration processing has been completed normally, what is needed is to press the alarm stop button 60 of any of fire alarm devices **TR**, as shown in FIG. 2. For example, when the alarm stop button 60 of the fire alarm device **TR1** is pressed, then the control unit 5 of the fire alarm device **TR1** transmits a wireless signal including a test message prompting a reply (simply called "test message" below), by multicast from the wireless transmission and reception unit 2.

[0040] Upon receiving the test message, the control unit 5 of each of the fire alarm devices **TR2**, **TR3** which belong to the same group transmits a response message to the fire alarm device **TR1** from the wireless transmission and reception unit 2. In this case, the control unit 5 of each fire alarm device **TR2**, **TR3** emits a speech message stating "normal" by the speaker of the notification unit 4.

[0041] When response messages from the fire alarm devices **TR2**, **TR3** are received, the control unit 5 of the fire alarm device **TR1** compares the identification codes of the fire alarm devices **TR** included in the response messages from the fire alarm devices **TR2**, **TR3**, with the identification codes of all of the fire alarm devices **TR** which are stored in the fire alarm device **TR1**. As a result of this comparison, the control unit 5 of the fire alarm device **TR1** confirms that there has been a reply from all of the fire alarm devices **TR**, and then terminates the test operation. In this case, the control unit 5 of the fire alarm device **TR1** emits a speech message stating "normal" by the speaker of the notification unit 4. This test operation can be carried out also after the fire alarm devices **TR** have been installed on the building surface. In this case also, the alarm stop button 60 of any of the fire alarm devices **TR** should be pressed in a similar fashion to that described above (see FIG. 2).

[0042] As described above, in the wireless communication system according to the present embodiment, it is possible to implement registration processing for registering respective fire alarm devices **TR** in a group in

which the multiple fire alarm devices **TR** report an alarm in a coordinated fashion, just by operating the alarm stop button 60 (registration switch) on any one of the fire alarm devices **TR**, one time. Therefore, in the wireless communication system according to the present embodiment, it is possible to simplify the work required for registration, compared to a case where the fire alarm devices **TR** are operated one by one, and furthermore, the time required for registration can be shortened.

[0043] In cases where the installation location of the fire alarm device **TR** is changed or where a new fire alarm device **TR** is added to the alarm system, for example, it is necessary to erase registration information of the fire alarm devices **TR** and implement registration anew. Below, the re-registration processing of the fire alarm devices **TR** in the wireless communication system according to the present embodiment will be described with reference to FIG. 6.

[0044] Firstly, the power supplies to the fire alarm devices **TR1** to **TR3** are switched off. Thereupon, the power supply to the fire alarm device **TR1** is switched on, while depressing and holding the alarm stop button 60 of the fire alarm device **TR1**. Accordingly, the control unit 5 of the fire alarm device **TR1** switches to an erasure mode for erasing the registration information. In this case, the control unit 5 of the fire alarm device **TR1** emits a "beep" alarm sound by the buzzer of the notification unit 4. By following a similar procedure in respect of the fire alarm devices **TR2** and **TR3** as well, the control units 5 of the fire alarm devices **TR2**, **TR3** are switched to an erasure mode.

[0045] Next, the alarm stop button 60 of the fire alarm device **TR1** is depressed and held within a prescribed time period (for example, several seconds) after switching on the power supply. Accordingly, the control unit 5 of the fire alarm device **TR1** erases the registration information which is stored in the memory. In this case, the control unit 5 of the fire alarm device **TR1** causes the buzzer of the notification unit 4 to issue a "beep" alarm sound, and also causes the speaker of the notification unit 4 to emit a speech message stating "erased". By following a similar procedure in respect of the fire alarm devices **TR2** and **TR3** as well, the registration information is erased by the control units 5 of each fire alarm device **TR2**, **TR3**.

[0046] After switching off the power supply, by again executing the registration processing that has already been described above, it is possible to register the fire alarm devices **TR1** to **TR3** again. Furthermore, if a new fire alarm device **TR** is added, for example, then by carrying out the registration processing that has already been described, including the new fire alarm device **TR**, it is possible to register the fire alarm devices including the new fire alarm device **TR**.

[0047] In the re-registration processing described above, when a new fire alarm device **TR** is added, it is necessary to operate each of the fire alarm devices **TR** individually, in order to erase the registration information

of all of the fire alarm devices **TR**, and there is a concern that this will be burdensome. Therefore, one-to-one registration processing may be carried out between any of the fire alarm devices **TR**, for which registration has already been implemented, and a newly added fire alarm device **TR**, and then additional registration processing may be carried out to transmit updated registration information to all of the fire alarm devices **TR** belonging to the same group after the registration processing. In this case, since there is no need to erase the registration information of all of the fire alarm devices **TR**, then it is possible to omit the tasks required for additional registration.

[0048] However, it is necessary to additionally store a program for carrying out the abovementioned additional registration processing in the memory of each of the fire alarm devices **TR**, which requires a large-capacity memory, and thus there is a concern that it will be impossible to make the fire alarm devices **TR** compact in size and low in cost. Therefore, it should be decided whether or not to use a program for carrying out the additional registration processing, as appropriate, by taking account of the convenience for the operator and/or the user.

[0049] The wireless stations of the wireless communication system according to the present embodiment are not limited to the fire alarm devices **TR** described above. For example, the wireless communication system of the present embodiment may be constructed by using wireless stations other than the fire alarm devices **TR**.

[0050] For example, it is also possible to construct the wireless communication system according to the present embodiment by using a wireless station having an air quality sensor configured to measure the so-called air quality, such as the humidity in the air. A gas sensor is one example of the air quality sensor. A gas sensor measures the gas content of fuel gas, such as town gas, LP gas, or the like, or the COx gas content which is an environmental indicator, such as carbon dioxide and/or carbon monoxide, or dirt, such as dust, which is floating in the air, etc. A gas alarm configured to report the occurrence of a gas leak and/or incomplete combustion, by an alarm sound, is an example of a wireless station which includes this gas sensor.

[0051] Furthermore, the wireless communication system according to the present embodiment may also be constructed by using a wireless station which has a human sensor configured to detect the presence of a human. The human sensor may employ a system which detects the presence of a human by detecting infrared radiation emitted from a human or a system which detects the presence of a human by image processing analysis of an image captured of a target region. Alternatively, both of the abovementioned systems may be used in combination in a human sensor.

[0052] Furthermore, a wireless station having this air quality sensor and/or a wireless station having a human sensor may be combined with a wireless fire alarm device **TR** described above to construct a wireless communica-

tion system. In this case, it is possible to construct a wireless communication system which combines the objects of detecting people and/or issuing ventilation warnings, in addition to detecting fires.

Claims

1. A wireless communication system, comprising:

multiple wireless stations (TR1, TR2, TR3) configured to transmit and receive wireless signals by use of radio waves as a medium, each of the multiple wireless stations having a mutually different unique identification code, each of the multiple wireless stations (TR1, TR2, TR3) comprising:

a wireless transmission and reception unit (2) configured to transmit and receive the wireless signals;

a control unit (5) configured to carry out registration processing for registering the wireless station comprising this control unit (5) to a group for performing wireless communications for coordinated operation of the multiple wireless stations (TR1, TR2, TR3); and

a registration switch (60) configured to, in response to reception of an operation input, cause the control unit (5) to carry out the registration processing,

the control unit (5) of a first wireless station (TR1), which carries out the registration processing, of the multiple wireless stations (TR1, TR2, TR3), being configured to, in the registration processing, transmit a registration start message prompting registration to multiple second wireless stations (TR2, TR3) which are the others of the multiple wireless stations, through the wireless transmission and reception unit (2) of the first wireless station (TR1),

the control unit (5) of each of the multiple second wireless stations (TR2, TR3) being configured to, upon receiving the registration start message, transmit a response message including the identification code of a second wireless station comprising this control unit (5) to the first wireless station (TR1), through the wireless transmission and reception unit (2) of the second wireless station,

the control unit (5) of the first wireless station being configured to, upon receiving the response messages, store registration information including the respective identification codes of all of second wireless stations

- (TR2, TR3), which have transmitted the response messages, of the multiple second wireless stations (TR2, TR3) and the identification code of the first wireless station (TR1) comprising this control unit (5), and transmit a registration message including the registration information to all of the second wireless stations (TR2, TR3) which have transmitted the response messages, through the wireless transmission and reception unit (2) of the first wireless station (TR1),
- characterized in that** the control unit (5) of a second wireless station which has already completed the registration processing is configured not to transmit the response message through the wireless transmission and reception unit of the second wireless station, even when the control unit (5) receives the registration start message.
2. The wireless communication system according to claim 1, wherein each of the multiple wireless stations (TR1, TR2, TR3) is configured to wait for a wireless signal from another wireless station, until a prescribed time period has elapsed since switching on of a power supply to the wireless station.
 3. The wireless communication system according to claim 1, wherein:

each of the multiple wireless stations (TR1, TR2, TR3) has a function configured to detect whether the wireless station is installed on a building surface; and

each of the multiple wireless stations (TR1, TR2, TR3) is configured to wait for a wireless signal from another wireless station, while the wireless station is not installed on a building surface.
 4. The wireless communication system according to claim 1, wherein the control unit (5) of each of the multiple second wireless stations (TR2, TR3) is configured to, upon receiving the registration start message, transmit the response message to the first wireless station (TR1) after a lapse of a waiting time which is determined based on the identification code of the second wireless station comprising this control unit (5), through the wireless transmission and reception unit (2) of the second wireless station.
 5. The wireless communication system according to claim 1, wherein:

each of the multiple wireless stations (TR1, TR2, TR3) has a timer configured to count an elapsed time since switching on of a power supply to the wireless station; and
- the control unit (5) of each of the multiple second wireless stations (TR2, TR3) is configured to, upon receiving the registration start message, transmit the response message to the first wireless station (TR1) after a lapse of a waiting time which is determined based on the elapsed time counted by the timer of the second wireless station, through the wireless transmission and reception unit (2) of the second wireless station.
6. The wireless communication system according to claim 4 or 5, wherein the control unit of each of the multiple second wireless stations (TR2, TR3) is configured to transmit the response message to the first wireless station (TR1) through the wireless transmission and reception unit (2) of the second wireless station, after detecting that there are no conflicting radio waves by a carrier sense function.
 7. The wireless communication system according to claim 1, wherein:

the control unit (5) of the first wireless station (TR1) is configured to divide a time period of waiting for transmission of the response messages into multiple time slots; and

the control unit (5) of each of the multiple second wireless stations (TR2, TR3) is configured to transmit the response message to the first wireless station (TR1) by using any of the multiple time slots, through the wireless transmission and reception unit of the second wireless station.
 8. The wireless communication system according to claim 1, wherein the control unit (5) of the first wireless station (TR1) is configured to re-transmit the registration start message through the wireless transmission and reception unit (2) of the first wireless station (TR1), after a prescribed interval.
 9. The wireless communication system according to claim 8, wherein the control unit (5) of the first wireless station (TR1) is configured to measure received signal strength of the wireless signals during a time period of waiting for transmission of the response messages, and stop the re-transmission of the registration start message if the received signal strength is lower than a pre-established threshold value.
 10. The wireless communication system according to claim 1, wherein:

each of the multiple wireless stations (TR1, TR2, TR3) has a notification unit configured to report occurrence of an event by speech; and

the control unit (5) of the first wireless station (TR1) is configured to, upon completing the registration processing, cause the notification unit

to report the number of wireless stations that have been registered, by speech.

11. The wireless communication system according to claim 1, wherein each of the multiple wireless stations (TR1, TR2, TR3) is at least one of: a fire alarm device configured to detect occurrence of a fire; a wireless station having an air quality sensor configured to measure air quality; and a wireless station having a human sensor configured to detect presence of a human.

Patentansprüche

1. Drahtloses Kommunikationssystem, umfassend:

mehrere drahtlose Stationen (TR1, TR2, TR3), die konfiguriert sind, um drahtlose Signale unter Verwendung von Funkwellen als Medium zu senden und zu empfangen, wobei jede der mehreren drahtlosen Stationen einen gegenseitig unterschiedlichen eindeutigen Identifikationscode aufweist, wobei jede der mehreren drahtlosen Stationen (TR1, TR2, TR3) umfasst:

eine drahtlose Sende- und Empfangseinheit (2), die konfiguriert ist, um die drahtlosen Signale zu senden und zu empfangen; eine Steuereinheit (5), die konfiguriert ist, um eine Registrierungsverarbeitung zum Registrieren der drahtlosen Station durchzuführen, die diese Steuereinheit (5) umfasst, an eine Gruppe zum Ausführen drahtloser Kommunikationen für einen koordinierten Betrieb der mehreren drahtlosen Stationen (TR1, TR2, TR3); und einen Registrierungsschalter (60), der konfiguriert ist, um als Reaktion auf den Empfang einer Betriebseingabe die Steuereinheit (5) zu veranlassen, die Registrierungsverarbeitung durchzuführen, wobei die Steuereinheit (5) einer ersten drahtlosen Station (TR1), die die Registrierungsverarbeitung durchführt, der mehreren drahtlosen Stationen (TR1, TR2, TR3) konfiguriert ist, um in der Registrierungsverarbeitung eine Registrierungsstartnachricht, die eine Registrierung an mehrere zweite drahtlose Stationen (TR2, TR3) anfordert, die die übrigen der mehreren drahtlosen Stationen sind, über die drahtlose Sende- und Empfangseinheit (2) der ersten drahtlosen Station (TR1) zu senden, wobei die Steuereinheit (5) jeder der mehreren zweiten drahtlosen Stationen (TR2, TR3) konfiguriert ist, um beim Empfangen

der Registrierungsstartnachricht eine Antwortnachricht, die den Identifikationscode einer zweiten drahtlosen Station enthält, die diese Steuereinheit (5) umfasst, über die drahtlose Sende- und Empfangseinheit (2) der zweiten drahtlosen Station an die erste drahtlose Station (TR1) zu senden, wobei die Steuereinheit (5) der ersten drahtlosen Station konfiguriert ist, um beim Empfangen der Antwortnachrichten Registrierungsinformationen, die die jeweiligen Identifikationscodes aller zweiten drahtlosen Stationen (TR2, TR3), die die Antwortnachrichten gesendet haben, der mehreren zweiten drahtlosen Stationen (TR2, TR3) und den Identifikationscode der ersten drahtlosen Station (TR1), die diese Steuereinheit (5) umfasst, zu speichern und eine Registrierungsstartnachricht, die die Registrierungsinformationen enthält, über die drahtlose Sende- und Empfangseinheit (2) der ersten drahtlosen Station (TR1) an sämtliche zweiten drahtlosen Stationen (TR2, TR3), die die Antwortnachrichten gesendet haben, zu senden,

dadurch gekennzeichnet, dass

die Steuereinheit (5) einer zweiten drahtlosen Station, die bereits die Registrierungsverarbeitung vollendet hat, konfiguriert ist, um die Antwortnachricht nicht über die drahtlose Sende- und Empfangseinheit der zweiten drahtlosen Station zu senden, selbst wenn die Steuereinheit (5) die Registrierungsstartnachricht empfängt.

2. Drahtloses Kommunikationssystem nach Anspruch 1, wobei jede der mehreren drahtlosen Stationen (TR1, TR2, TR3) konfiguriert ist, um auf ein drahtloses Signal von einer anderen drahtlosen Station zu warten, bis eine vorgegebene Zeitspanne seit dem Einschalten einer Stromversorgung für die drahtlose Station verstrichen ist.

3. Drahtloses Kommunikationssystem nach Anspruch 1, wobei:

jede der mehreren drahtlosen Stationen (TR1, TR2, TR3) eine Funktion aufweist, die konfiguriert ist, um zu erfassen, ob die drahtlose Station auf einer Gebäudeoberfläche installiert ist; und jede der mehreren drahtlosen Stationen (TR1, TR2, TR3) konfiguriert ist, um auf ein drahtloses Signal von einer anderen drahtlosen Station zu warten, während die drahtlose Station nicht auf einer Gebäudeoberfläche installiert ist.

4. Drahtloses Kommunikationssystem nach Anspruch 1, wobei die Steuereinheit (5) jeder der mehreren

zweiten drahtlosen Stationen (TR2, TR3) konfiguriert ist, um beim Empfangen der Registrierungsstartnachricht die Antwortnachricht nach Ablauf einer Wartezeit, die auf der Grundlage des Identifikationscodes der zweiten drahtlosen Station, die diese Steuereinheit (5) umfasst, bestimmt wird, durch die drahtlose Sende- und Empfangseinheit (2) der zweiten drahtlosen Station an die erste drahtlose Station (TR1) zu senden.

5. Drahtloses Kommunikationssystem nach Anspruch 1, wobei:

jede der mehreren drahtlosen Stationen (TR1, TR2, TR3) einen Zeitgeber aufweist, der konfiguriert ist, um eine verstrichene Zeit seit dem Einschalten einer Stromversorgung für die drahtlose Station zu messen; und die Steuereinheit (5) jeder der mehreren zweiten drahtlosen Stationen (TR2, TR3) konfiguriert ist, um beim Empfangen der Registrierungsstartnachricht die Antwortnachricht nach Ablauf einer Wartezeit, die auf der Grundlage der verstrichenen Zeit bestimmt wird, die von dem Zeitgeber der zweiten drahtlosen Station gemessen wird, durch die drahtlose Sende- und Empfangseinheit (2) der zweiten drahtlosen Station an die erste drahtlose Station (TR1) zu senden.

6. Drahtloses Kommunikationssystem nach Anspruch 4 oder 5, wobei die Steuereinheit jeder der mehreren zweiten drahtlosen Stationen (TR2, TR3) konfiguriert ist, um die Antwortnachricht über die drahtlose Sende- und Empfangseinheit (2) der zweiten drahtlosen Station an die erste drahtlose Station (TR1) zu senden, nachdem durch eine Trägersensorfunktion erfasst ist, dass keine kollidierenden Funkwellen vorhanden sind.

7. Drahtloses Kommunikationssystem nach Anspruch 1, wobei:

die Steuereinheit (5) der ersten drahtlosen Station (TR1) konfiguriert ist, um eine Zeitspanne des Wartens auf die Sendung der Antwortnachrichten in mehrere Zeitschlitze aufzuteilen; und die Steuereinheit (5) jeder der mehreren zweiten drahtlosen Stationen (TR2, TR3) konfiguriert ist, um die Antwortnachricht unter Verwendung eines der mehreren Zeitschlitze über die drahtlose Sende- und Empfangseinheit der zweiten drahtlosen Station an die erste drahtlose Station (TR1) zu senden.

8. Drahtloses Kommunikationssystem nach Anspruch 1, wobei die Steuereinheit (5) der ersten drahtlosen Station (TR1) konfiguriert ist, um die Registrierungsstartnachricht nach einem vorgegebenen Intervall

erneut über die drahtlose Sende- und Empfangseinheit (2) der ersten drahtlosen Station (TR1) zu senden.

9. Drahtloses Kommunikationssystem nach Anspruch 8, wobei die Steuereinheit (5) der ersten drahtlosen Station (TR1) konfiguriert ist, um die empfangene Signalstärke der drahtlosen Signale während einer Zeitspanne des Wartens auf das Senden der Antwortnachrichten zu messen und die erneute Sendung der Registrierungsstartnachricht anzuhalten, wenn die empfangene Signalstärke niedriger als ein vorgegebener Schwellenwert ist.

10. Drahtloses Kommunikationssystem nach Anspruch 1, wobei:

jede der mehreren drahtlosen Stationen (TR1, TR2, TR3) eine Benachrichtigungseinheit aufweist, die konfiguriert ist, um ein Auftreten eines Ereignisses durch Sprache zu melden; und die Steuereinheit (5) der ersten drahtlosen Station (TR1) konfiguriert ist, um bei Vollendung der Registrierungsverarbeitung zu veranlassen, dass die Benachrichtigungseinheit die Anzahl der drahtlosen Stationen, die registriert wurde, durch Sprache meldet.

11. Drahtloses Kommunikationssystem nach Anspruch 1, wobei jede der mehreren drahtlosen Stationen (TR1, TR2, TR3) mindestens eines von Folgendem ist: eine Feueralarmvorrichtung, die konfiguriert ist, um das Auftreten eines Brandes zu erfassen; eine drahtlose Station mit einem Luftqualitätssensor, der konfiguriert ist, um die Luftqualität zu messen; und eine drahtlose Station mit einem Personensensor, der konfiguriert ist, um die Anwesenheit einer Person zu erfassen.

Revendications

1. Système de communication sans fil, comprenant :

de multiples stations sans fil (TR1, TR2, TR3) configurées de manière à transmettre et à recevoir des signaux sans fil en utilisant des ondes radio en qualité de support, chacune des multiples stations sans fil ayant un code d'identification unique mutuellement différent ;
chacune des multiples stations sans fil (TR1, TR2, TR3) comprenant :

une unité d'émission et de réception sans fil (2) configurée de manière à émettre et recevoir les signaux sans fil ;
une unité de commande (5) configurée de manière à mettre en oeuvre un traitement

d'enregistrement pour enregistrer la station sans fil comprenant cette unité de commande (5) auprès d'un groupe en vue de mettre en oeuvre des communications sans fil pour un fonctionnement coordonné des multiples stations sans fil (TR1, TR2, TR3) ; et un commutateur d'enregistrement (60) configuré de manière à, en réponse à la réception d'une entrée d'opération, amener l'unité de commande (5) à mettre en oeuvre le traitement d'enregistrement,

l'unité de commande (5) d'une première station sans fil (TR1), qui met en oeuvre le traitement d'enregistrement, des multiples stations sans fil (TR1, TR2, TR3), étant configurée de manière à, dans le cadre du traitement d'enregistrement, transmettre un message de début d'enregistrement demandant un enregistrement à de multiples secondes stations sans fil (TR2, TR3) qui correspondent aux autres des multiples stations sans fil, à travers l'unité d'émission et de réception sans fil (2) de la première station sans fil (TR1) ;

l'unité de commande (5) de chacune des multiples secondes stations sans fil (TR2, TR3) étant configurée de manière à, suite à la réception du message de début d'enregistrement, transmettre un message de réponse incluant le code d'identification d'une seconde station sans fil comprenant cette unité de commande (5), à la première station sans fil (TR1), à travers l'unité d'émission et de réception sans fil (2) de la seconde station sans fil ;

l'unité de commande (5) de la première station sans fil étant configurée de manière à, suite à la réception des messages de réponse, stocker des informations d'enregistrement incluant les codes d'identification respectifs de la totalité des secondes stations sans fil (TR2, TR3), qui ont transmis les messages de réponse, des multiples secondes stations sans fil (TR2, TR3), et le code d'identification de la première station sans fil (TR1) comprenant cette unité de commande (5), et à transmettre un message d'enregistrement incluant les informations d'enregistrement à la totalité des secondes stations sans fil (TR2, TR3) qui ont transmis les messages de réponse, à travers l'unité d'émission et de réception sans fil (2) de la première station sans fil (TR1),

caractérisé en ce que :

l'unité de commande (5) d'une seconde station sans fil qui a déjà terminé le traitement d'enregistrement est configurée de manière à ne pas transmettre le message de réponse, à travers l'unité d'émission et de réception sans fil de la seconde station sans fil, y compris lorsque l'unité de commande (5) reçoit le

message de début d'enregistrement.

2. Système de communication sans fil selon la revendication 1, dans lequel chacune des multiples stations sans fil (TR1, TR2, TR3) est configurée de manière à attendre un signal sans fil en provenance d'une autre station sans fil, jusqu'à ce qu'une période de temps prescrite se soit écoulée depuis la mise sous tension d'une alimentation électrique au niveau de la station sans fil.

3. Système de communication sans fil selon la revendication 1, dans lequel :

chacune des multiples stations sans fil (TR1, TR2, TR3) présente une fonction configurée de manière à détecter si la station sans fil est installée sur une surface de bâtiment ; et chacune des multiples stations sans fil (TR1, TR2, TR3) est configurée de manière à attendre un signal sans fil en provenance d'une autre station sans fil, tandis que la station sans fil n'est pas installée sur une surface de bâtiment.

4. Système de communication sans fil selon la revendication 1, dans lequel l'unité de commande (5) de chacune des multiples secondes stations sans fil (TR2, TR3) est configurée de manière à, suite à la réception du message de début d'enregistrement, transmettre le message de réponse à la première station sans fil (TR1), après un laps de temps d'attente qui est déterminé sur la base du code d'identification de la seconde station sans fil comprenant cette unité de commande (5), à travers l'unité d'émission et de réception sans fil (2) de la seconde station sans fil.

5. Système de communication sans fil selon la revendication 1, dans lequel :

chacune des multiples stations sans fil (TR1, TR2, TR3) présente un temporisateur configuré de manière à compter un temps écoulé depuis la mise sous tension d'une alimentation électrique au niveau de la station sans fil ; et l'unité de commande (5) de chacune des multiples secondes stations sans fil (TR2, TR3) est configurée de manière à, suite à la réception du message de début d'enregistrement, transmettre le message de réponse à la première station sans fil (TR1) après un laps de temps d'attente qui est déterminé sur la base du temps écoulé compté par le temporisateur de la seconde station sans fil, à travers l'unité d'émission et de réception sans fil (2) de la seconde station sans fil.

6. Système de communication sans fil selon la reven-

dication 4 ou 5, dans lequel l'unité de commande de chacune des multiples secondes stations sans fil (TR2, TR3) est configurée de manière à transmettre le message de réponse à la première station sans fil (TR1) à travers l'unité d'émission et de réception sans fil (2) de la seconde station sans fil, dès lors qu'il a été détecté, par une fonction de détection de porteuse, qu'il n'existe aucune onde radio conflictuelle.

7. Système de communication sans fil selon la revendication 1, dans lequel :

l'unité de commande (5) de la première station sans fil (TR1) est configurée de manière à diviser une période de temps d'attente pour la transmission des messages de réponse en de multiples tranches de temps ; et
l'unité de commande (5) de chacune des multiples secondes stations sans fil (TR2, TR3) est configurée de manière à transmettre le message de réponse à la première station sans fil (TR1) en utilisant l'une quelconque des multiples tranches de temps, à travers l'unité d'émission et de réception sans fil de la seconde station sans fil.

8. Système de communication sans fil selon la revendication 1, dans lequel l'unité de commande (5) de la première station sans fil (TR1) est configurée de manière à retransmettre le message de début d'enregistrement à travers l'unité d'émission et de réception sans fil (2) de la première station sans fil (TR1), après un intervalle prescrit.

9. Système de communication sans fil selon la revendication 8, dans lequel l'unité de commande (5) de la première station sans fil (TR1) est configurée de manière à mesurer une intensité de signal reçu des signaux sans fil pendant une période de temps d'attente pour la transmission des messages de réponse, et à mettre fin à la retransmission du message de début d'enregistrement si l'intensité de signal reçu est inférieure à une valeur de seuil prédéterminée.

10. Système de communication sans fil selon la revendication 1, dans lequel :

chacune des multiples stations sans fil (TR1, TR2, TR3) présente une unité de notification configurée de manière à signaler vocalement l'occurrence d'un événement ; et
l'unité de commande (5) de la première station sans fil (TR1) est configurée de manière à, une fois le traitement d'enregistrement terminé, amener l'unité de notification à signaler vocalement le nombre de stations sans fil qui ont été enregistrées.

11. Système de communication sans fil selon la revendication 1, dans lequel chacune des multiples stations sans fil (TR1, TR2, TR3) correspond à au moins l'un des éléments parmi : un dispositif d'alarme d'incendie configuré de manière à détecter la survenue d'un incendie ; une station sans fil présentant un capteur de qualité d'air configuré de manière à mesurer une qualité d'air ; et une station sans fil présentant un capteur de présence humaine configuré de manière à détecter la présence d'un humain.

FIG. 1

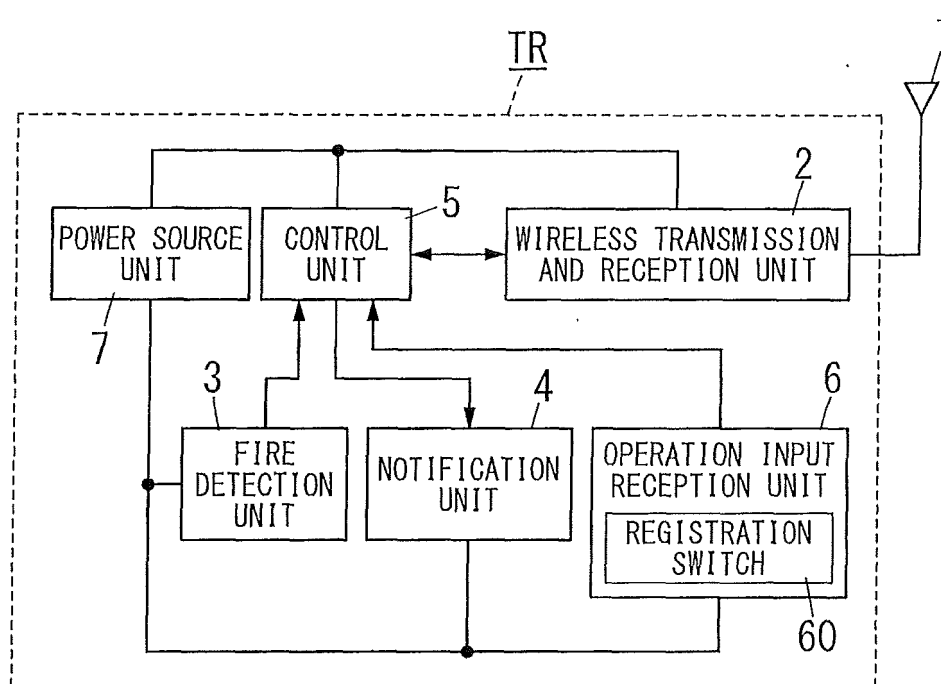


FIG. 2

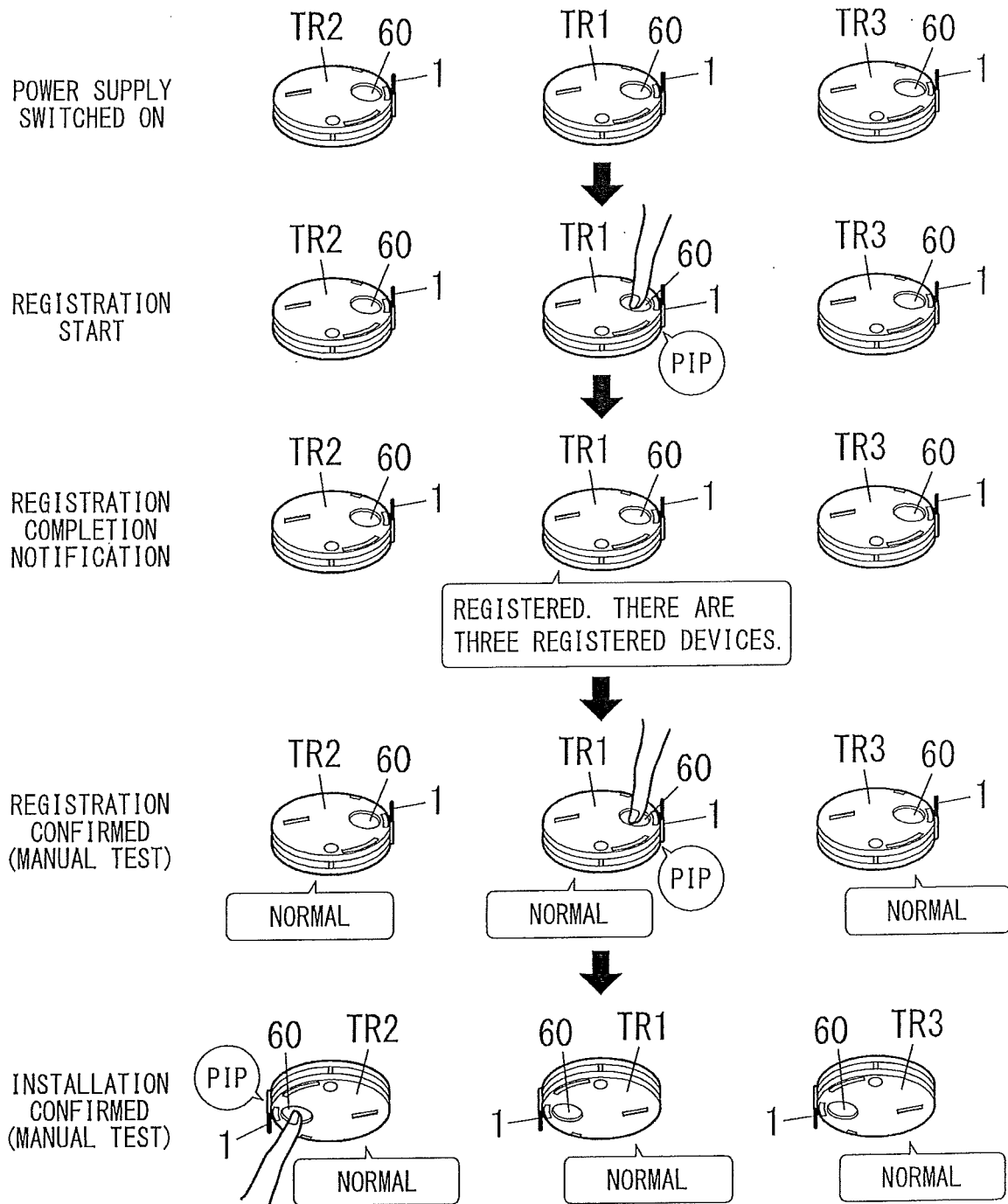


FIG. 3

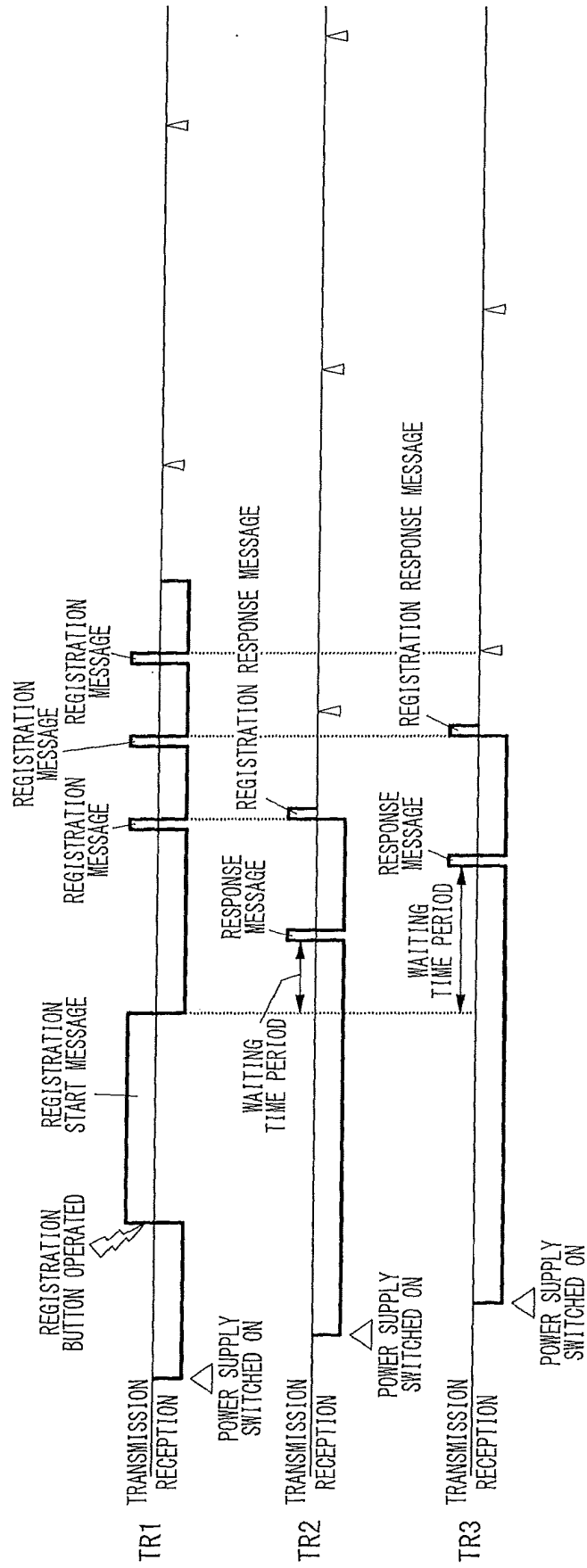


FIG. 4

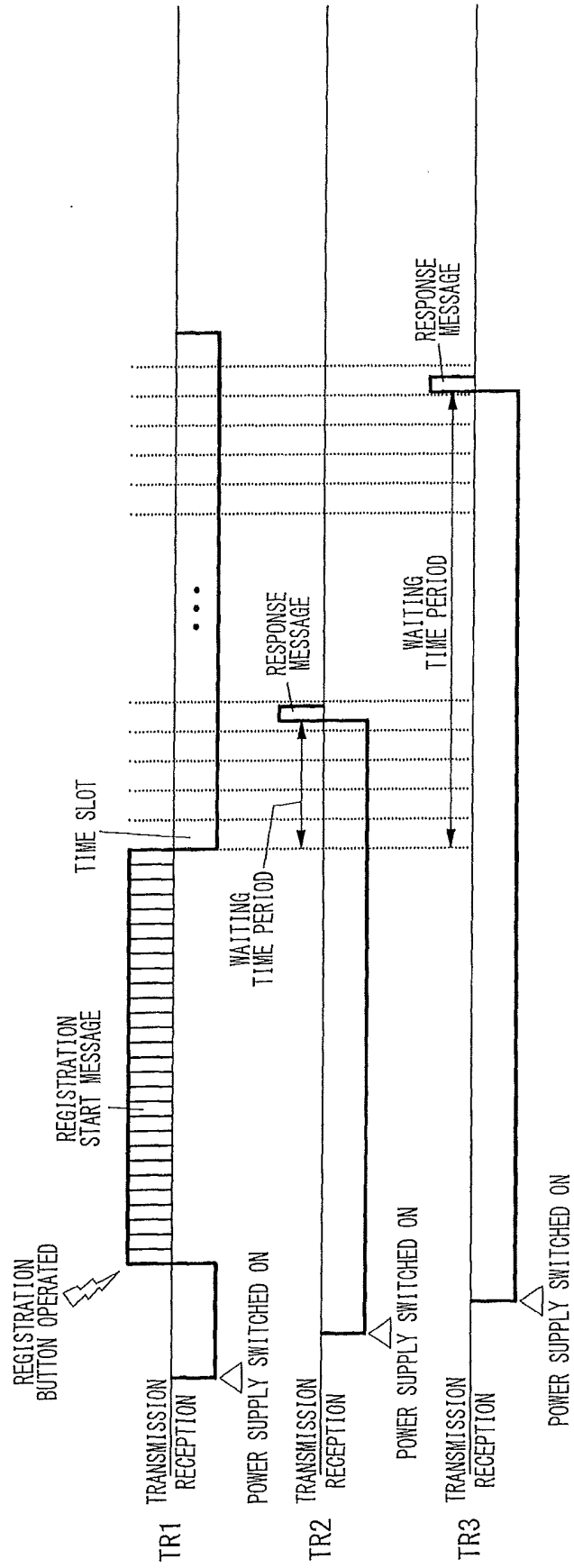


FIG. 5

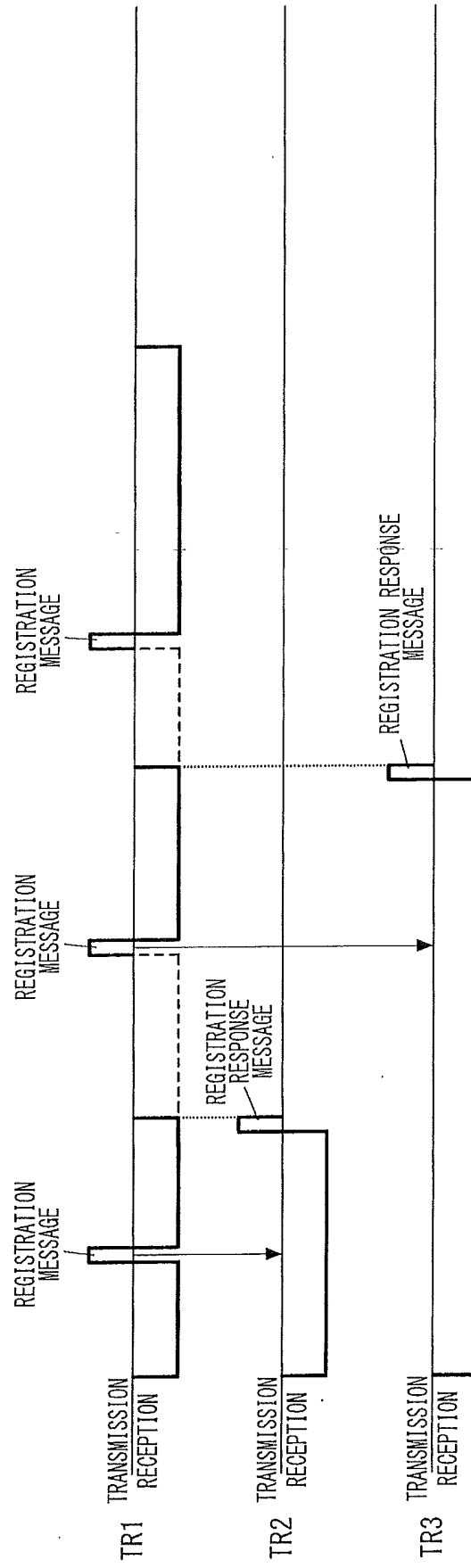
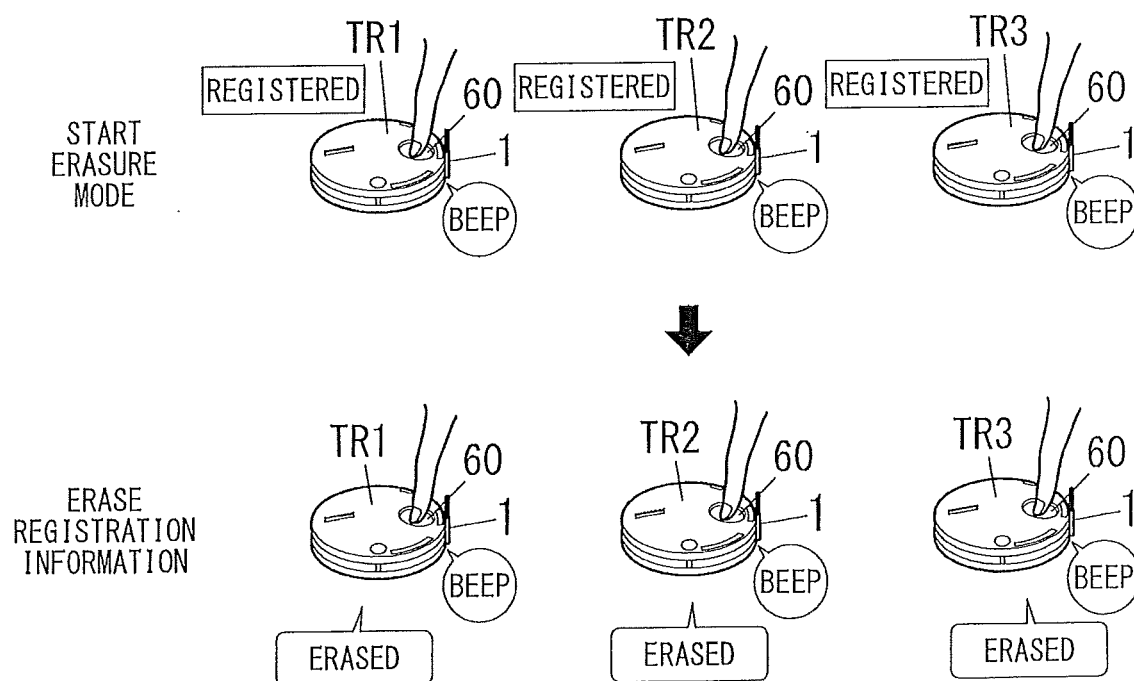


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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