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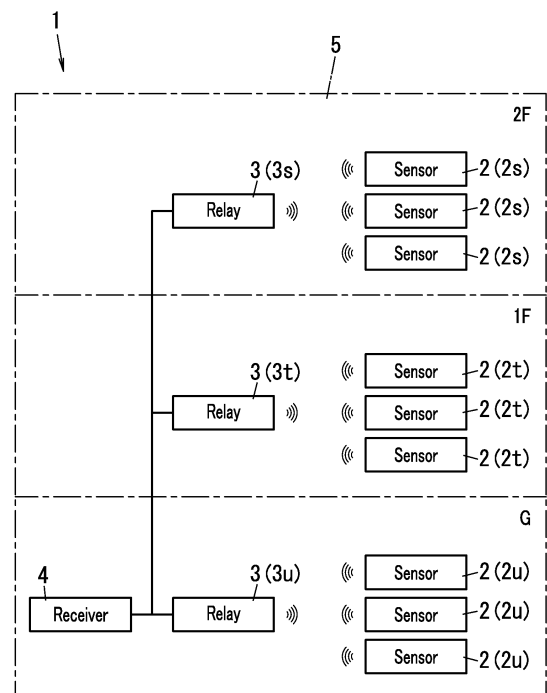
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ALARM SYSTEM, RELAY, CONTROL METHOD, AND PROGRAM

(57) Provided is an alarm system that allows the worker to have sensor registration work done more efficiently. An alarm system (1) includes: a plurality of sensors (2), each of which detects an event; and a relay (3). The relay (3) relays a communication between the plurality of sensors (2) and a receiver (4) that communicates with the plurality of sensors (2) to receive a result of detection from each of the plurality of sensors (2). The relay (3) includes a registration processing unit (362) that determines, in response to a registration request from at least one sensor (2) belonging to the plurality of sensors (2), whether a registered number of a first group of sensors (2) belonging to the plurality of sensors (2) which have already been registered with the relay (3) has reached a predetermined number. The registration processing unit (362) cancels, when making a decision that the registered number has reached the predetermined number, registration processing of registering the at least one sensor (2) with the relay (3).

FIG. 1



Description

Technical Field

[0001] The present disclosure generally relates to an alarm system, a relay, a control method, and a program. More particularly, the present disclosure relates to an alarm system including a relay for relaying a communication between a sensor and a receiver, the relay, a method for controlling the relay, and a program.

Background Art

[0002] JP 2010-41545 A discloses a wireless disaster prevention system (alarm system) including: a wireless sensor (sensor); and a wireless reception relay (relay) for relaying a communication between the wireless sensor and a proprietary-type (P-type) receiver (receiver). A plurality of wireless sensors are installed on each floor of a building. When finding the smoke concentration or temperature involved with a fire greater a threshold value, the wireless sensor detects the presence of the fire and transmits a fire event signal as a wireless accident warning signal. A single wireless reception relay is installed on each floor of the building. On receiving the fire event signal, the wireless reception relay transmits a fire warning signal to the P-type receiver.

[0003] A wireless disaster prevention system such as the one disclosed in JP 2010-41545 A requires the worker to register at least one sensor with a relay. In this case, the worker needs to register the sensors with the relay such that the number of sensors registered with the relay (hereinafter referred to as a "registered number") does not exceed the maximum allowable number of sensors that can be registered with the relay or the number of sensors still registerable with the receiver (hereinafter referred to as a "registerable number"). Therefore, before registering the sensors with the relay, the worker needs to check, in advance, the maximum allowable number and the registerable number. Such need for checking these numbers often prevents the worker from having the sensor registration work done efficiently.

Summary of Invention

[0004] In view of the foregoing background, it is therefore an object of the present disclosure to provide an alarm system, a relay, a control method, and a program, all of which allow the worker to have the sensor registration work done more efficiently.

[0005] An alarm system according to an aspect of the present disclosure includes a plurality of sensors, each of which detects an event, and a relay. The relay relays a communication between the plurality of sensors and a receiver that communicates with the plurality of sensors to receive a result of detection from each of the plurality of sensors. The relay includes a registration processing unit that determines, in response to a registration request

from at least one sensor belonging to the plurality of sensors, whether a registered number of a first group of sensors belonging to the plurality of sensors which have already been registered with the relay has reached a predetermined number. The registration processing unit cancels, when making a decision that the registered number have reached the predetermined number, registration processing of registering the at least one sensor with the relay.

[0006] A relay according to another aspect of the present disclosure relays a communication between a plurality of sensors and a receiver. Each of the plurality of sensors detects an event. The receiver communicates with the plurality of sensors to receive a result of detection from each of the plurality of sensors. The relay includes a registration processing unit that determine, in response to a registration request from at least one sensor belonging to the plurality of sensors, whether a registered number of a first group of sensors belonging to the plurality of sensors which have already been registered with the relay has reached a predetermined number. The registration processing unit cancels, when making a decision that the registered number have reached the predetermined number, registration processing of registering the at least one sensor with the relay.

[0007] A control method according to still another aspect of the present disclosure is a method for controlling a relay. The relay relays a communication between a plurality of sensors and a receiver. Each of the plurality of sensors detects an event. The receiver communicates with the plurality of sensors to receive a result of detection from each of the plurality of sensors. The control method includes processing of determining, in response to a registration request from at least one sensor belonging to the plurality of sensors, whether a registered number of a first group of sensors belonging to the plurality of sensors which have already been registered with the relay has reached a predetermined number. The processing includes cancelling, when making a decision that the registered number have reached the predetermined number, registration processing of registering the at least one sensor with the relay.

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

Brief Description of Drawings

[0009]

FIG. 1 illustrates a configuration for an alarm system according to an exemplary embodiment;
FIG. 2 illustrates a configuration for a sensor included in the alarm system;
FIG. 3 illustrates a configuration for a relay included in the alarm system;
FIG. 4 illustrates a configuration for a receiver included in the alarm system;

FIG. 5 is Part 1 of a sequence chart illustrating how the alarm system performs first registration processing;

FIG. 6 is Part 2 of the sequence chart illustrating how the alarm system performs the first registration processing;

FIG. 7 is Part 3 of the sequence chart illustrating how the alarm system performs the first registration processing; and

FIG. 8 is a sequence chart illustrating how the alarm system performs second registration processing.

Description of Embodiments

[0010] A alarm system 1 according to an exemplary embodiment will be described with reference to the accompanying drawings.

(1) Overview

[0011] The alarm system 1 according to this embodiment is a system installed in a building 5 (such as a single-family dwelling house) to detect the outbreak of any disaster (such as a fire) in the building 5. A fire is an exemplary event that may break out in the building 5.

[0012] The "building" is supposed to be a single-family dwelling house in this embodiment, but this should not be construed as limiting. Alternatively, the building may also be a multi-family dwelling house (i.e., a so-called "mansion" in Japan) or even a non-dwelling house such as an office, a store, a school, or a nursing care facility. Although the "disaster" is supposed to be a fire in this embodiment, this should not be construed as limiting. Alternatively, the disaster may also be an earthquake or intrusion of a suspicious person, for example.

[0013] As shown in FIG. 1, an alarm system 1 according to this embodiment includes a plurality of sensors 2 and a relay 3. Each of the plurality of sensors 2 detects an event (such as the outbreak of a disaster). The relay 3 relays a communication between the plurality of sensors 2 and a receiver 4 that communicates with the plurality of sensors 2 to receive a result of detection from each of the plurality of sensors 2. The relay 3 includes a registration processing unit 362 that determines, in response to a registration request from at least one of the plurality of sensors 2, whether a registered number of a first group of sensors 2 belonging to the plurality of sensors 2 which have already been registered with the relay 3 has reached a predetermined number. The registration processing unit 362 cancels, when making a decision that the registered number have reached the predetermined number, registration processing of registering the at least one sensor 2 with the relay 3.

[0014] According to this configuration, when a decision is made that the registered number of sensors 2 already registered with the relay 3 have reached the predetermined number, the registration processing is cancelled, thus cancelling the registration of the at least one sensor

2 that has transmitted the registration request with the relay 3. This cancellation allows the worker who is registering the sensors 2 to learn that the registered number of sensors 2 already registered with the relay 3 has reached the predetermined number. This reduces the chances of the worker registering more than the predetermined number of sensors 2 with the relay 3 even if he or she does not know the specific value of the predetermined number. Consequently, the worker may have the registration work done more efficiently.

(2) Details

[0015] Next, the alarm system 1 according to this embodiment will be described in further detail.

(2.1) Overall configuration

[0016] As shown in FIG. 1, the alarm system 1 according to this embodiment includes a plurality of sensors 2, one or more (e.g., three in the example illustrated in FIG. 1) relays 3, and a receiver 4.

[0017] The plurality of sensors 2 are installed at mutually different locations inside the building 5 to detect the outbreak of an event (such as a disaster) inside the building 5. Each of the plurality of sensors 2 is associated with any one of the three relays 3 and wirelessly communicates with the associated relay 3. Alternatively, the communication between the sensors 2 and the relay 3 may also be wired communication. On detecting the disaster, the plurality of sensors 2 transmits the result of detection to the receiver 4 via their associated relays 3.

[0018] In this embodiment, the plurality of sensors 2 are classified into multiple groups (e.g., three groups in the example illustrated in FIG. 1) of sensors 2. The sensors 2 belonging to the same group are installed on the same floor of the building 5. The sensors 2 belonging to different groups are installed on mutually different floors of the building 5. In the example shown in FIG. 1, the plurality of sensors 2 are classified into three groups (e.g., a group consisting of three sensors 2s, a group consisting of three sensors 2t, and a group consisting of three sensors 2u). The three sensors 2s are installed at mutually different locations on the second floor of the building 5, for example, and associated with the relay 3s. The three sensors 2t are installed at mutually different locations on the first floor of the building 5, for example, and associated with the relay 3t. The three sensors 2u are installed at mutually different locations on the ground floor of the building 5, for example, and associated with the relay 3u.

[0019] The frequency of communication between the relay 3s and its associated sensors 2s, the frequency of communication between the relay 3t and its associated sensors 2t, and the frequency of communication between the relay 3u and its associated sensors 2u are different from each other. Thus, each group of the sensors 2s, 2t, 2u are configured to communicate with only their associated relay 3s, 3t, 3u. Alternatively, the frequency of

communication between the relay 3s and its associated sensors 2s, the frequency of communication between the relay 3t and its associated sensors 2t, and the frequency of communication between the relay 3u and its associated sensors 2u may be the same.

[0020] Each of the three relays 3 relays a communication between its associated sensors 2 and the receiver 4. More specifically, each of the three relays 3 wirelessly communicates with its associated sensors 2 as described above. The three relays 3 may establish wired communication with the receiver 4. Alternatively, wireless communication may also be established between the relays 3 and the receiver 4.

[0021] In relaying a communication between any of the sensors 2 and the receiver 4, each of the relays 3 changes the communication method for relaying the communication from one of the wireless method and the wired method to the other. For example, when receiving information that has been transmitted wirelessly from any one of the sensors 2, the relay 3 changes the communication method from the wireless method to the wired method to transmit the information thus received to the receiver 4 by the wired method.

[0022] In this embodiment, the three relays 3 are associated with the three groups of sensors 2, respectively, and each of the three relays 3 communicates with the associated group of sensors 2, as described above. Each of the three relays 3 is installed on the same floor of the building 5 as the floor on which the associated group of sensors 2 are installed. For example, the relay 3s is installed on the second floor of the building 5, the relay 3t is installed on the first floor of the building 5, and the relay 3u is installed on the ground floor of the building 5.

[0023] The receiver 4 receives the results of detection from the plurality of sensors 2 via the relay 3 to control, based on the results of detection thus received, either sounding an alarm from the receiver 4 to the presence of the disaster or sounding an alarm from the plurality of sensors 2 to the presence of the disaster. The receiver 4 may be installed in either a caretaker's room of the building 5 or an emergency control center located at a different site from the building 5, whichever is appropriate.

[0024] In the alarm system 1 with such a configuration, the plurality of sensors 2 for use in the alarm system 1 are registered in advance by the worker with their associated relay 3 before the alarm system 1 starts to be operated. In addition, even while the alarm system 1 is being operated, the worker may further register additional sensors 2 with the relay 3 or cancel registration of any of the sensors 2 already registered with the relay 3. In the following description, the sensors 2, the relays 3, and the receiver 4 will be described in further detail from this point of view.

(2.2) Configuration for sensors

[0025] As shown in FIG. 2, each of the plurality of sen-

sors 2 includes a communications unit 21, a sensing unit 22, an operating unit 23, a storage unit 24, an alert unit 25, and a control unit 26.

[0026] The communications unit 21 may, for example communicate wirelessly with its associated relay 3. The communications unit 21 communicates with the receiver 4 via the associated relay 3.

[0027] The sensing unit 22 detects the outbreak of a disaster inside the building 5. On detecting the presence of the disaster, the sensing unit 22 associates, under the control of the control unit 26, the result of detection with the identification information of the sensor 2 and makes the communications unit 21 transmit the result of detection to the receiver 4 via the associated relay 3. The sensing unit 22 detects, as the disaster, at least one of the outbreak of a fire, the occurrence of an earthquake, and the intrusion of a suspicious person (such as a prowler). That is to say, the sensor 2 includes at least one of a fire detection sensor for detecting the outbreak of a fire, a seismic sensor for detecting the occurrence of an earthquake, or a security sensor for detecting the intrusion of any suspicious person.

[0028] Alternatively, the sensor 2 may also detect the occurrence of an earthquake by receiving an earthquake early warning issued by an external earthquake early warning issuer at the occurrence of an earthquake, instead of including the seismic sensor. Examples of the security sensor include a human detection sensor for detecting the presence of a (suspicious) person by his or her movement or body temperature, an opening/closing sensor for detecting opening and closing of a door or a window by a (suspicious) person, and a vibration sensor for detecting the vibration produced when a (suspicious) person breaks the glass window.

[0029] The operating unit 23 may be implemented as, for example, a touchscreen panel or a physical switch and accepts an operating command (such as a command of registration operation or deregistration operation) entered into the sensor 2. As used herein, the "registration operation" refers to the operation performed by the worker to register the sensor 2 with its associated relay 3. On the other hand, the "deregistration operation" as used herein refers to the operation performed by the worker to cancel the registration of any of the sensors 2 currently registered with the relay 3.

[0030] The storage unit 24 stores various types of information required for the sensor 2 to perform processing. The storage unit 24 may be, for example, an electrically programmable nonvolatile storage device (such as a flash memory). Note that the "various types of information" may include, for example, the identification information of the sensor 2 itself.

[0031] Examples of the alert unit 25 include a loud-speaker. The alert unit 25 provides, under the control of the control unit 26, various types of information as an alert. The alert unit 25 may emit, under the control of the control unit 26, a sound (e.g., a voice or an electronic sound such as an alarm sound) as an alert to the outbreak

of a disaster.

[0032] The control unit 26 includes a computer system including a processor and a memory, for example. The computer system performs the functions of the control unit 26 by making the processor execute a program stored in the memory. In this embodiment, the program to be executed by the processor is stored in advance in the memory of the computer system. Alternatively, the program may also be distributed after having been stored in a non-transitory storage medium such as a memory card or downloaded via a telecommunications line such as the Internet.

[0033] The control unit 26 controls every constituent element (including, for example, the communications unit 21, the sensing unit 22, the operating unit 23, the storage unit 24, and the alert unit 25) of the sensor 2 but the control unit 26 itself.

[0034] In response to a registration operating command entered into the operating unit 23, the control unit 26 associates a registration request with the identification information stored in the storage unit 24 and makes the communications unit 21 transmit the registration request to the relay 3. As used herein, the "registration request" refers to a control signal requesting that the sensor 2 be registered with the associated relay 3. On the other hand, in accordance with a deregistration operating command entered into the operating unit 23, the control unit 26 associates a deregistration request with the identification information stored in the storage unit 24 and makes the communications unit 21 transmit the deregistration request to the relay 3. As used herein, the "deregistration request" refers to a control signal requesting that any desired one of the sensors 2 currently registered with the relay 3 be deregistered.

[0035] On receiving the registration request, the relay 3 registers, with the relay 3 itself, the sensor 2 that has transmitted the registration request as will be described later. On the other hand, on receiving the deregistration request, the relay 3 cancels the registration of the sensor 2 that has transmitted the deregistration request with the relay 3 itself.

[0036] On receiving a control signal, instructing that an alert to the outbreak of a disaster be sounded, from the receiver 4 via the communications unit 21, the control unit 26 makes the alert unit 25 emit an alarm sound that alerts to the outbreak of the disaster. As a result, at the outbreak of the disaster, an alarm sound alerting people to the presence of the disaster is emitted from the alert unit 25.

(2.3) Configuration for relay

[0037] As shown in FIG. 3, the relay 3 includes a communications unit 31, another communications unit 32, an operating unit 33, a storage unit 34, an alert unit 35, and a control unit 36.

[0038] The communications unit 31 may establish, for example, wireless communication with the associated

sensors 2 via, for example, a local area network (LAN) or compliant with the Wi-Fi(R) standard.

[0039] The communications unit 32 may establish, for example, wired communication with the receiver 4 via, for example, a local area network (LAN) or a wide area network (WAN).

[0040] The operating unit 33 may be implemented as, for example, a touchscreen panel or a physical switch, and accepts an operating command (such as a command of mode switch operation) entered into the relay 3. As used herein, the "mode switch operation" refers to the operation performed by the worker to selectively enable or disable a registration mode of the relay 3. As used herein, the "registration mode" refers to an operation mode in which the sensor 2 is registered with the relay 3.

[0041] The storage unit 34 may be, for example, an electrically programmable nonvolatile storage device (such as a flash memory). The storage unit 34 stores various types of information required for the relay 3 to perform processing. Examples of the "various types of information" include the identification information of the relay 3 itself, the identification information of each sensor 2 that has been received from the sensor 2 via the communications unit 31, and communications address assigned to the sensor 2.

[0042] The alert unit 35 includes at least one alert means selected from the group consisting of, for example, a loudspeaker, a light emitter such as a light-emitting diode (LED), and a display unit such as a liquid crystal display. The alert unit 35 provides, as an alert, various types of information by emitting a sound (such as a voice or an electronic sound) from the loudspeaker, emitting light from the light emitter, and/or displaying an alert message on the display unit.

[0043] The control unit 36 includes a computer system including a processor and a memory, for example. The computer system performs the functions of the control unit 36 by making the processor execute a program stored in the memory. In this embodiment, the program to be executed by the processor is stored in advance in the memory of the computer system. Alternatively, the program may also be distributed after having been stored in a non-transitory storage medium such as a memory card or downloaded via a telecommunications line such as the Internet.

[0044] The control unit 36 controls every constituent element of the relay 3 (such as the communications unit 31, the communications unit 32, the operating unit 33, and the storage unit 34) but the control unit 36 itself.

[0045] The control unit 36 includes a mode switching unit 361, a registration processing unit 362, an alert control unit 363, a preliminary alert control unit 364, an address acquisition unit 365, and an assignment processing unit 366.

[0046] The mode switching unit 361 selectively enables or disables the registration mode of the relay 3 in accordance with an operating command (i.e., a command of mode switch operation) entered into the oper-

ating unit 33. As used herein, the "registration mode" refers to an operation mode in which the sensor 2 is registered with the relay 3. Enabling the registration mode of the relay 3 allows the worker to register the sensor 2 with the relay 3.

[0047] The registration processing unit 362 performs registration processing of registering the sensor 2 with the relay 3 (hereinafter simply referred to as "registration processing"). More specifically, in response to a registration request received from the sensor 2 via the communications unit 31, the registration processing unit 362 registers the sensor 2 with the relay 3. Depending on whether communication is ready to be established between the relay 3 and the receiver 4 when the registration mode of the relay 3 is enabled, the registration processing unit 362 changes the mode of the processing of registering the sensor 2 with the relay 3 into either first registration processing or second registration processing.

[0048] More specifically, if communication is not ready to be established yet between the relay 3 and the receiver 4 when the registration mode of the relay 3 is enabled, the registration processing unit 362 registers the sensor 2 with the relay 3 by performing the first registration processing. In that case, on receiving the registration request from the sensor 2 via the communications unit 31, the registration processing unit 362 determines (i.e., makes a first decision) whether the number of the sensors 2 already registered with the relay 3 (hereinafter referred to as a "registered number") has reached a predetermined number.

[0049] When this first decision is made, the "registered number of the sensors 2 already registered with the relay 3" refers to the number of sensors 2 that have been already registered, not including the sensor 2 that has transmitted the registration request. Also, in the first registration processing, the "predetermined number" herein refers to a maximum allowable number of sensors 2 that can be registered with the relay 3. Information about this maximum allowable number (second information) is stored in the storage unit 34. That is to say, in the first registration processing, in response to the registration request from the sensor 2, the registration processing unit 362 reads out the second information from the storage unit 34 and sets the predetermined number at the maximum allowable number thus read out. Then, the registration processing unit 362 determines (i.e., makes a first decision) whether the registered number of the sensors 2 already registered with the relay 3 has reached the maximum allowable number (i.e., the predetermined number in this case).

[0050] Note that the state where "communication is not ready to be established yet between the relay 3 and the receiver 4" herein refers to, for example, a situation where a communications cable for use to establish communication between the relay 3 and the receiver 4 is not connected between the relay 3 and the receiver 4.

[0051] When deciding that the registered number of the sensors 2 already registered with the relay 3 have

not reached the maximum allowable number yet, the registration processing unit 362 registers, with the relay 3, the sensor 2 that has transmitted the registration request. On the other hand, when deciding that the registered number of the sensors 2 already registered with the relay 3 have reached the maximum allowable number, the registration processing unit 362 cancels the registration processing. As a result, the registration processing unit 362 keeps the sensors 2 that have already been registered before the registration processing is cancelled still registered and cancels the registration of the sensor 2 that has transmitted the registration request with the relay 3. When the relay 3 is in the registration mode, any desired number of sensors 2 may be registered with the relay 3 as long as the number is equal to or less than the maximum allowable number.

[0052] As used herein, to "cancel the registration processing" refers to cancelling the registration processing being currently performed by the registration processing unit 362. For example, if the registration processing unit 362 cancels the registration processing as a result of the first decision, then the registration processing unit 362 cancels the registration processing that the registration processing unit 362 is currently performing (e.g., registration, with the relay 3, of the sensor 2 that has transmitted the registration request). That is to say, the registration processing unit 362 no longer accepts the worker's request for registering the sensor 2. This allows the worker to learn that the registered number of the sensors 2 already registered with the relay 3 has reached the maximum allowable number.

[0053] If communication is ready to be established between the relay 3 and the receiver 4 after the desired number of sensors 2 have been registered with the relay 3 as described above (i.e., after the first decision has been made), the registration processing unit 362 acquires, from the receiver 4 via the communications unit 32, information about the number of sensors 2 still registerable with the receiver 4 (hereinafter referred to as a "registerable number of sensors") (i.e., acquires the first information). As used herein, the "registerable number of sensors 2 still registerable with the receiver 4" is the number calculated by subtracting the number of the sensors 2 already registered with the receiver 4 from the maximum registerable number of the sensors 2 that can be registered with the receiver 4.

[0054] Then, the registration processing unit 362 determines whether the registered number of the sensors 2 already registered with the relay 3 is greater than the registerable number derived from the first information (i.e., makes a second decision). When deciding that the registered number of the sensors 2 already registered with the relay 3 not be greater than the registerable number, the registration processing unit 362 finally authorizes the registration of the sensors 2 already provisionally registered with the relay 3. On the other hand, when deciding that the registered number of the sensors 2 already registered with the relay 3 be greater than the

registerable number, the registration processing unit 362 cancels the registration processing. As a result, the registration processing unit 362 cancels the registration processing that the registration processing unit 362 is currently performing. The current registration processing may be, for example, switching the mode of the processing into that of the next processing (i.e., processing of making the receiver 4 issue addresses to be described later) when the worker performs the operation of disabling the registration mode. That is to say, the registration processing unit 362 enters a standby mode. This allows the worker to learn that the registered number of the sensors 2 already registered with the relay 3 has reached the registerable number.

[0055] Note that if the registration processing is cancelled after the second decision has been made as described above, then the worker performs the deregistration operation on one or more sensors 2 out of all the sensors 2 already registered with the relay 3, thereby cancelling the registration of the one or more sensors 2. In this manner, the worker reduces the registered number of the sensors 2 registered with the relay 3. Then, the worker reestablishes communication between the relay 3 and the receiver 4. When deciding that the registered number of the sensors 2 currently registered with the relay 3 not be greater than the registerable number as a result, the registration processing unit 362 finally authorizes the registration of all the sensors 2 already provisionally registered with the relay 3. Thereafter, when the registration of the sensors 2 currently registered with the relay 3 is finally authorized, the worker operates the operating unit 33 of the relay 3 to disable the registration mode of the relay 3 and thereby finish the registration work.

[0056] As can be seen from the foregoing description, in the first registration processing, communication is not ready to be established yet between the relay 3 and the receiver 4 when the operation mode is the registration mode, and therefore, the relay 3 cannot acquire the first information (i.e., information about the registerable number of the sensors 2 still registerable with the receiver 4) from the receiver 4. Thus, the relay 3 performs registration processing with the maximum allowable number of the sensors 2 that can be registered with the relay 3 regarded as a provisional reference number. Thereafter, when communication is ready to be established between the relay 3 and the receiver 4, the relay 3 acquires the first information from the receiver 4. Then, the relay 3 determines (i.e., makes a second decision) whether every sensor 2 already provisionally registered with the relay 3 may be finally registered with the relay 3 with the registerable number derived from the first information thus acquired used as a reference number.

[0057] Note that in this alarm system 1, the sensors 2 are registered with the receiver 4 via the relays 3. In this case, the receiver 4 has the registerable number of sensors 2 still registerable with the receiver 4 and each relay 3 has the maximum allowable number of sensors 2 that

can be registered with the relay 3. Thus, the sensors 2 are allowed to be registered as long as the number of the sensors registered is equal to or less than both the registerable number of sensors 2 still registerable with the receiver 4 and the maximum allowable number of sensors 2 that can be registered with the relay 3. The first registration processing includes, first, determining (i.e., making a first decision) whether the number of the sensors 2 to be registered with the relay 3 is equal to or less than the maximum allowable number of sensors 2 that can be registered with the relay 3 and provisionally registering a desired number of sensors 2 with the relay 3. Thereafter, the first registration processing includes determining (i.e., making a second decision) whether the registered number of the sensors 2 provisionally registered with the relay 3 is equal to or less than the registerable number of sensors 2 still registerable with the receiver 4.

[0058] On the other hand, if communication is ready to be established between the relay 3 and the receiver 4 when the registration mode of the relay 3 is enabled, then the registration processing unit 362 performs second registration processing as the registration processing. In that case, on receiving the registration request from the sensor 2 via the communications unit 31, the registration processing unit 362 determines (i.e., makes a third decision) whether the registered number of the sensors 2 already registered with the relay 3 has reached the predetermined number.

[0059] In that case, in the second registration processing, if communication is ready to be established between the relay 3 and the receiver 4 when the registration mode of the relay 3 is enabled, the registration processing unit 362 acquires the first information (i.e., information about the registerable number of sensors 2 still registerable with the receiver 4) from the receiver 4 via the communications unit 32. Then, when finding the registerable number derived from the first information greater than the maximum allowable number of sensors 2 that can be registered with the relay 3, the registration processing unit 362 makes the third decision with the predetermined number set at the maximum allowable number. On the other hand, when finding the registerable number derived from the first information equal to or less than the maximum allowable number of sensors 2 that can be registered with the relay 3, the registration processing unit 362 makes the third decision with the predetermined number set at the registerable number.

[0060] When deciding, as a result of the third decision, that the registered number of the sensors 2 already registered with the relay 3 be short of the predetermined number (which may be either the maximum allowable number or the registerable number), the registration processing unit 362 registers, with the relay 3, the sensor 2 that has transmitted the registration request. On the other hand, when deciding, as a result of the third decision, that the registered number of the sensors 2 already registered with the relay 3 have reached the predeter-

mined number (which may be either the maximum allowable number or the registerable number), the registration processing unit 362 cancels the registration processing. As a result, the registration processing unit 362 keeps the sensors 2 that have already been registered before the registration processing is cancelled still registered and cancels the registration, with the relay 3, of the sensor 2 that has transmitted the registration request. In addition, the registration processing unit 362 does not register, with the relay 3, the sensor 2 that has transmitted the registration request after the registration processing has been cancelled, either.

[0061] Thereafter, on registering a desired number of sensors 2 with the relay 3, the worker operates the operating unit 33 of the relay 3 to disable the registration mode of the relay 3 and thereby finish the registration work.

[0062] Note that the state where "communication is ready to be established between the relay 3 and the receiver 4" herein refers to, for example, a situation where the communications cable for use to establish communication between the relay 3 and the receiver 4 is connected between the relay 3 and the receiver 4.

[0063] As can be seen from the foregoing description, in the second registration processing, communication is ready to be established between the relay 3 and the receiver 4 when the operation mode is the registration mode, the relay 3 may acquire the first information (i.e., information about the registerable number of sensors 2 still registerable with the receiver 4) from the receiver 4. This allows the relay 3 to set the predetermined number at a number with both the maximum allowable number of sensors 2 that can be registered with the relay 3 and the registerable number of sensors 2 still registerable with the receiver 4 taken into account as described above. This allows, by making the third decision, the sensors 2 to be registered with the relay 3 so that the number of sensors 2 registered is equal to or less than both the maximum allowable number and the registerable number.

[0064] If the registration processing unit 362 has decided, as a result of the first and third decisions, that the registered number of the sensors 2 already registered with the relay 3 have reached the predetermined number (i.e., if the registration processing has been cancelled), then the alert control unit 363 makes the alert unit 35 provide alert information indicating the result of the decisions. As used herein, the "alert information" may be a piece of information indicating that the registration processing to register the sensor 2 with the relay 3 has been cancelled. Alternatively, the alert information may also be a message that says, "no sensors are registerable any longer."

[0065] If the registration processing unit 362 has decided, as a result of the second decision, that the registered number of the sensors 2 already registered with the relay 3 be greater than the registerable number (i.e., if the registration processing has been cancelled), then

the alert control unit 363 makes the alert unit 35 provide alert information indicating the result of the decision. As used herein, the "alert information" may be, for example, a piece of information indicating that the registration processing has been cancelled. Alternatively, the alert information may be, for example, a message that says, "the sensor cannot be registered" or "the number of sensors registered is greater by N than registerable number."

[0066] The alert control unit 363 provides alert information if the registration mode of the relay 3 is enabled, for example. On the other hand, if the registration mode of the relay 3 is disabled, the alert control unit 363 provides no alert information.

[0067] As can be seen, if the registration processing unit 362 has decided that the registered number of the sensors 2 already registered with the relay 3 either have reached the predetermined number or be greater than the registerable number, then the alert control unit 363 lets the worker learn the result of the decision, thus allowing the worker to have the registration work done more efficiently.

[0068] If the registration processing unit 362 has decided, as a result of the first and third decisions, that the registered number of the sensors 2 already registered with the relay 3 be short of the predetermined number, then the preliminary alert control unit 364 may make, for example, the alert unit 35 provide, as preliminary alert information, information indicating the result of the decisions. The preliminary alert information may be, for example, information about the registered number of the sensors 2 already registered with the relay 3 (e.g., a message saying "Nth sensor has now been registered"). Alternatively, the preliminary alert information may also be information about the registerable number of sensors 2 still registerable with the relay 3 (e.g., a message saying "N more sensors are still registerable").

[0069] If the registration processing unit 362 has decided, as a result of the second decision, that the registered number of the sensors 2 already registered with the relay 3 not be greater than the registerable number, then the preliminary alert control unit 364 may make, for example, the alert unit 35 provide, as preliminary alert information, information indicating the result of the decision. The preliminary alert information may be information about the registerable number of sensors 2 still registerable with the relay 3 (e.g., a message saying "N more sensors are still registerable").

[0070] The preliminary alert control unit 364 provides the preliminary alert information if the registration mode of the relay 3 is enabled, for example. On the other hand, if the registration mode of the relay 3 is disabled, the preliminary alert control unit 364 provides no preliminary alert information.

[0071] As can be seen, if the registration processing unit 362 has decided that the registered number of the sensors 2 already registered with the relay 3 be short of the predetermined number or not be greater than the registerable number, then the preliminary alert control

unit 364 lets the worker learn the result of the decision. In addition, the preliminary alert control unit 364 also provides the worker with, for example, information about the registerable number of sensors 2 that are still registerable with the relay 3, thus allowing the worker to have the registration work done more efficiently.

[0072] The address acquisition unit 365 receives, from the receiver 4, the communication addresses to be assigned to the respective sensors 2 that have been registered with the relay 3. More specifically, when the registration mode of the relay 3 that has been enabled is disabled via the operating unit 33 of the relay 3, the address acquisition unit 365 makes the communications unit 32 transmit the registration information of the sensors 2 (i.e., identification information of all sensors 2 registered with the relay 3) to the receiver 4. On receiving the registration information from the relay 3, the receiver 4 issues as many communication addresses as pieces of the identification information of the sensors 2 included in the registration information and transmits the communication addresses thus issued to the relay 3 that has transmitted the registration information.

[0073] When the address acquisition unit 365 receives the communication addresses from the receiver 4, the assignment processing unit 366 assigns the communication addresses thus received to all the sensors 2 registered with the relay 3. Then, the assignment processing unit 366 stores the result of this assignment processing (i.e., correspondence between the identification information of the respective sensors 2 and their communication addresses) in the storage unit 34. In addition, the assignment processing unit 366 also makes the communications unit 32 transmit the result of the assignment processing to the receiver 4.

(2.4) Configuration for receiver

[0074] As shown in FIG. 4, the receiver 4 includes a communications unit 41, a storage unit 42, an alert unit 43, and a control unit 44.

[0075] The communications unit 41 may establish, for example, wired communication with the communications unit 32 of each relay 3 as described above.

[0076] The storage unit 42 may be, for example, an electrically programmable nonvolatile storage device (such as a flash memory). The storage unit 42 stores various types of information required for the receiver 4 to perform processing. Examples of the "various types of information" include correspondence between the identification information of the sensors 2 registered with the respective relays 3 and their communication addresses and the first information (i.e., information about the registerable number of sensors 2 still registerable with the receiver 4).

[0077] The alert unit 43 includes at least one alert means selected from the group consisting of, for example, a loudspeaker, a light emitter such as an LED, and a display unit such as a liquid crystal display. The alert

unit 43 provides, as an alert, various types of information by emitting a sound (such as a voice or an electronic sound) from the loudspeaker, emitting light from the light emitter, and/or displaying an alert message on the display unit.

[0078] The control unit 44 includes a computer system including a processor and a memory, for example. The computer system performs the functions of the control unit 44 by making the processor execute a program stored in the memory. In this embodiment, the program to be executed by the processor is stored in advance in the memory of the computer system. Alternatively, the program may also be distributed after having been stored in a non-transitory storage medium such as a memory card or downloaded via a telecommunications line such as the Internet.

[0079] The control unit 44 controls every constituent element (e.g., the communications unit 41, the storage unit 42, and the alert unit 43) of the receiver 4 but the control unit 44 itself.

[0080] The control unit 44 includes an address issuing unit 441, an update unit 442, and an alert control unit 443.

[0081] On receiving the registration information from each of the relays 3 via the communications unit 41, the address issuing unit 441 issues as many communication addresses as pieces of identification information of the sensors 2 included in the registration information thus received and transmits the respective communication addresses thus issued to the relay 3 that has transmitted the registration information. Also, on receiving the result of the assignment processing from the relay 3 in response to the transmission of the communication addresses, the address issuing unit 441 stores the result of the reception in the storage unit 42.

[0082] On receiving the registration information from each of the relays 3 via the communications unit 41, the update unit 442 updates, based on the registration information thus received, the first information stored in the storage unit 42 (i.e., information about the registerable number of sensors 2 still registerable with the receiver 4). In response to a transmission request for transmitting the first information from each of the relays 3 via the communications unit 41, the update unit 442 makes the communications unit 41 transmit the first information stored in the storage unit 42 to the relay 3 that has transmitted the transmission request.

[0083] On receiving the results of detection by the respective sensors 2 from the respective relays 3 via the communications unit 41, the alert control unit 443 designates, based on the results of detection thus received, one of the plurality of sensors 2 registered with each of the relays 3 to be a sensor 2 that should sound an alarm to the outbreak of a disaster. Then, the alert control unit 443 controls the sensor 2 that has been designated via the communications unit 41 and the relay 3 to make the alert unit 25 of the sensor 2 thus designated sound the alarm.

[0084] In addition, the alert control unit 443 also des-

ignates one of the plurality of relays 3 connected to the receiver 4 as a relay 3 that should sound the alarm (e.g., a relay 3 with which the sensor 2 that has detected the disaster is registered) and makes the alert unit 35 of the relay 3 thus designated sound the alarm.

(2.5) Operation of alarm system

[0085] Next, it will be described how the alarm system 1 operates (more specifically, how the alarm system 1 operates when the worker registers the sensors 2 with the receiver 4 via the relays 3).

[0086] First, it will be described with reference to FIGS. 5-7 how the alarm system 1 operates in a situation where the relay 3 registers sensors 2 (e.g., sensors 2a, 2b) by performing the first registration processing (i.e., in a situation where communication is not ready to be established yet between the relay 3 and the receiver 4 when the registration mode of the relay 3 is enabled).

[0087] The worker operates the operating unit 33 of the relay 3 (i.e., performs a mode switch operation) to enable the registration mode of the relay 3 (in Step S1). When the registration mode is enabled, the registration processing unit 362 of the relay 3 determines whether communication is ready to be established between the communications unit 32 of the relay 3 and the communications unit 41 of the receiver 4. In this exemplary operation, the registration processing unit 362 decides that communication not be ready to be established yet between the communications unit 32 of the relay 3 and the communications unit 41 of the receiver 4 (in Step S2). In this exemplary operation, when the registration mode of the relay 3 is enabled, communication is supposed to be not ready to be established yet between the relay 3 and the receiver 4 as described above. Thus, in Step S2, a decision is made that communication not be ready to be established yet between the relay 3 and the receiver 4 as described above. If such a decision is made, the registration processing unit 362 starts performing the first registration processing (in Step S3). Also, if such a decision is made, the registration processing unit 362 sets the predetermined number for use to make the first decision (to be described later) at the maximum allowable number of sensors 2 that can be registered with the relay 3 (in Step S3A).

[0088] After the relay 3 has started performing the first registration processing, the worker operates the operating unit 23 of a first one 2a of the sensors 2 to be registered (i.e., performs registration operation) to make the communications unit 21 of the sensor 2a transmit a registration request D1, requesting that the sensor 2a be registered with the relay 3, to the communications unit 32 of the relay 3 (in Step S4).

[0089] On receiving the registration request D1 from the sensor 2a via the communications unit 31, the registration processing unit 362 of the relay 3 determines (i.e., makes a first decision) whether the registered number of the sensors 2 already registered with the relay 3 has

reached the maximum allowable number of sensors 2 that can be registered with the relay 3 (predetermined number) (in Step S5). In this exemplary operation, the registration processing unit 362 decides, as a result of the first decision, that the registered number be still short of the maximum allowable number. When making such a decision, the registration processing unit 362 registers, with the relay 3, the sensor 2a that has transmitted the registration request D1 (in Step S6). Then, the preliminary alert control unit 364 of the relay 3 makes the alert unit 35 of the relay 3 provide preliminary alert information such as a message saying, "Nth sensor has now been registered" or a message saying, "N more sensors are still registerable" (in Step S7). This allows the worker to determine, based on this preliminary alert information, how many sensors are still registerable with the relay 3.

[0090] In this exemplary operation, the worker registers the second sensor 2 with the relay 3 with the preliminary alert information provided in Step S7 taken into account. In this exemplary operation, the worker is supposed to have registered M more sensors 2 with the relay 3 by repeatedly performing the same series of processing steps S4-S7 M times, although description thereof will be omitted herein. Then, the worker registers an (M + 1)th sensor 2b. More specifically, the worker operates the operating unit 23 of the (M + 1)th sensors 2b (i.e., performs registration operation) to make the communications unit 21 of the sensor 2b transmit a registration request D2, requesting that the sensor 2b be registered with the relay 3, to the communications unit 32 of the relay 3 (in Step S8).

[0091] On receiving the registration request D2 from the sensor 2b via the communications unit 31, the registration processing unit 362 of the relay 3 determines (i.e., makes a first decision) whether the registered number of the sensors 2 already registered with the relay 3 has reached the maximum allowable number of sensors 2 that can be registered with the relay 3 (predetermined number) (in Step S9). In this exemplary operation, the registration processing unit 362 decides, as a result of the first decision, that the registered number have reached the maximum allowable number. When making such a decision, the registration processing unit 362 cancels the registration processing (in Step S10). This cancellation causes the registration processing unit 362 to keep the sensors 2 that have already been registered before the cancellation of the registration processing still registered and prevents the registration processing unit 362 from registering, with the relay 3, the sensor 2b that has transmitted the registration request D2. In addition, the registration processing unit 362 does not register, with the relay 3, any sensor 2 that has transmitted the registration request after the cancellation of the registration processing, either. That is to say, the relay 3 no longer accepts the worker's request for registering any sensors 2. This allows the worker to learn that no sensors 2 are registerable with the relay 3 any longer (i.e., that the registered number of the sensors 2 already registered with

the relay 3 has reached the maximum allowable number).

[0092] Then, the alert control unit 363 of the relay 3 makes the alert unit 35 of the relay 3 provide, as the alert information, the result of the first decision (e.g., information in the form of a message saying "registered number of sensors registered with relay has reached maximum allowable number") (in Step S11). This alert information also tells the worker that no sensors 2 are registerable with the relay 3 any longer. As a result, the worker stops registering the sensors 2 with the relay 3 to establish communication between the communications unit 32 of the relay 3 and the communications unit 41 of the receiver 4 (in Step S12). For example, the worker may connect the communications units 32, 41 to each other via a communication cable.

[0093] The registration processing unit 362 of the relay 3 determines whether communication is ready to be established between the communications unit 32 of the relay 3 and the communications unit 41 of the receiver 4. In this case, since the worker has established the communication in Step S12, the registration processing unit 362 decides that communication be ready to be established between the communications unit 32 of the relay 3 and the communications unit 41 of the receiver 4. When making such a decision, the registration processing unit 362 makes the communications unit 32 transmit a transmission request D3, requesting the transmission of the first information D11 (i.e., information about the registerable number of sensors 2 still registerable with the receiver 4), to the receiver 4 (in Step S13).

[0094] In response to the transmission request D3 from the relay 3, the receiver 4 transmits the first information D11 to the relay 3 (in Step S14).

[0095] Then, on receiving the first information D11 from the receiver 4, the registration processing unit 362 of the relay 3 makes the second decision (i.e., determine whether the registered number of the sensors 2 already registered with the relay 3 is greater than the registerable number derived from the first information D11) (in Step S15). If the result of this second decision indicates that the registered number is greater than the registerable number (if the answer is YES in Step S16), the registration processing unit 362 cancels the registration processing (in Step S17). This cancellation causes the registration processing unit 362 to cancel the registration processing (e.g., switching the mode of the processing to that of the next processing when the worker performs the operation of disabling the registration mode) that the registration processing unit 362 is currently performing and enter the standby mode. In this standby mode, even if the worker performs the operation of disabling the registration mode in Step S25, for example, the registration processing unit 362 does not change the registration processing into the next processing (i.e., the processing step S26 of transmitting the registration information). Entering the standby mode in this manner allows the worker to learn that the registered number of the sensors 2 already registered with the relay 3 is greater than the reg-

isterable number. Then, the alert control unit 363 of the relay 3 makes the alert unit 35 provide information as, for example, a message saying, "the number of sensors registered is greater by N than registerable number" or "no sensors are registerable any longer" (in Step S18).

[0096] Providing the alert information in Step S18 also tells the worker that the registered number of the sensors 2 already registered with the relay 3 is greater than the registerable number of sensors 2 still registerable with the receiver 4. Taking this alert information into consideration, the worker reduces the registered number of the sensors 2 currently registered with the relay 3. More specifically, the worker operates the operating unit 23 of the sensor 2 (such as the sensor 2a) registered with the relay 3 (i.e., performs a deregistration operation) to have a deregistration request D4, requesting that the sensor 2a be deregistered transmitted, from the sensor 2a to the relay 3 (in Step S19).

[0097] In response to the deregistration request D4 from the sensor 2a, the registration processing unit 362 of the relay 3 cancels the registration of the sensor 2a with the relay 3 (in Step S20). Then, the worker reestablishes communication between the communications unit 32 of the relay 3 and the communications unit 41 of the receiver 4 (in Step S21). More specifically, the worker once disconnects the communication between the communications unit 32 of the relay 3 and the communications unit 41 of the receiver 4 and then reestablishes the communication between them. Reestablishing the communication in this manner causes the registration processing unit 362 to transmit a first information transmission request to the receiver 4, acquire the first information from the receiver 4, and makes the second decision all over again based on the first information thus acquired (in Step S22). As a result of this second decision, the registration processing unit 362 may decide, for example, that the registered number not be greater than the registerable number to authorize the registration of all sensors 2 provisionally registered with the relay 3 (in Step S23). Then, the preliminary alert control unit 364 provides, as preliminary alert information, information such as a message saying, "N more sensors are still registerable" (in Step S24). The worker may determine, in accordance with this preliminary alert information, whether any additional sensors 2 should be registered with the relay 3. In this exemplary operation, the worker does not register any additional sensors 2 with the relay 3 to finish registering the sensors 2 with the relay 3. More specifically, the worker operates the operating unit 33 of the relay 3 (i.e., performs a mode switch operation) to disable the registration mode of the relay 3 (in Step S25). This operation causes the relay 3 to disable the registration mode of the relay 3 itself. Disabling the registration mode of the relay 3 allows the worker to finish registering the sensors 2 with the relay 3.

[0098] On the other hand, if the registration processing unit 362 of the relay 3 decides, in Step S16 as a result of the second decision, that the registered number not

be greater than the registerable number (if the answer is NO in Step S16), then the process proceeds to Steps S23, S24, and S25 in this order. As a result, the registration of all sensors 2 provisionally registered with the relay 3 is authorized in the same way as described above (in Step S23). Then, the alert information is provided (in Step S24). Thereafter, the registration mode of the relay 3 is disabled by the worker, thus finishing registering the sensors 2 with the relay 3 (in Step S25).

[0099] Then, when the registration mode of the relay 3 is disabled in Step S25, the address acquisition unit 365 of the relay 3 makes the communications unit 32 transmit the registration information D5 (such as the identification information of the sensors 2) about the sensors 2 registered with the relay 3 to the receiver 4 (in Step S26).

[0100] On receiving the registration information D5 from the relay 3 via the communications unit 41, the address issuing unit 441 of the receiver 4 issues as many communication addresses as the pieces of identification information of the sensors 2 included in the registration information D5 (in Step S27). Then, the address issuing unit 441 transmits information about the communication addresses thus issued (hereinafter referred to as "address information D6") to the relay 3 that has transmitted the registration information D5 (in Step S28).

[0101] On receiving the address information D6 from the receiver 4 via the communications unit 32, the assignment processing unit 366 of the relay 3 performs the assignment processing of assigning the communication addresses included in the address information D6 to the sensors 2 registered with the relay 3 (in Step S29). Then, the assignment processing unit 366 stores the result of the assignment processing (i.e., correspondence between the identification information of the respective sensors 2 and the communication addresses) in the storage unit 34 (in Step S30). In addition, the assignment processing unit 366 also makes the communications unit 32 transmit the result D12 of the assignment processing to the receiver 4 (in Step S31). On receiving the result of the assignment processing from the relay 3 via the communications unit 41, the address issuing unit 441 of the receiver 4 stores the result of the assignment processing thus received in the storage unit 42 (in Step S32). Then, the process ends.

[0102] Next, it will be described with reference to FIG. 8 how this alarm system 1 operates in a situation where the relay 3 registers the sensors 2 by performing the second registration processing (i.e., in a situation where communication is ready to be established between the relay 3 and the receiver 4 when the registration mode of the relay 3 is enabled).

[0103] The worker operates the operating unit 33 of the relay 3 (i.e., performs a mode switch operation) to enable the registration mode of the relay 3 (in Step S50). Then, the registration processing unit 362 of the relay 3 determines whether communication is ready to be established between the communications unit 32 of the relay

3 and the communications unit 41 of the receiver 4. In this exemplary operation, the registration processing unit 362 decides that communication be ready to be established between the communications unit 32 of the relay 3 and the communications unit 41 of the receiver 4 (in Step S51). In this exemplary operation, when the registration mode of the relay 3 is enabled, communication is supposed to be ready to be established between the relay 3 and the receiver 4 as described above. Thus, in Step S51, a decision is made that communication be ready to be established between the communications unit 32 of the relay 3 and the communications unit 41 of the receiver 4. If such a decision is made, the registration processing unit 362 starts performing the second registration processing (in Step S52).

[0104] On starting to perform the second registration processing, the registration processing unit 362 makes the communications unit 32 transmit a transmission request D7, requesting that the first information D8 (i.e., information about the registerable number of sensors 2 still registerable with the receiver 4) be transmitted, to the receiver 4 (in Step S53).

[0105] In response to the transmission request D7 from the relay 3, the receiver 4 transmits the first information D8 to the relay 3 (in Step S54).

[0106] On receiving the first information D8 from the receiver 4, the registration processing unit 362 of the relay 3 sets, based on the first information D8, a predetermined number for use to make the third decision (to be described later) (in Step S55). More specifically, when finding the registerable number derived from the first information D8 thus acquired (i.e., the registerable number of sensors 2 still registerable with the receiver 4) greater than the maximum allowable number of sensors 2 that can be registered with the relay 3, the registration processing unit 362 sets the predetermined number at the maximum allowable number. On the other hand, when finding the registerable number derived from the first information D8 thus acquired equal to or less than the maximum allowable number, the registration processing unit 362 sets the predetermined number at the registerable number.

[0107] Then, the worker operates the operating unit 23 of the first sensor 2a requesting to be registered (i.e., performs a registration operation) to make the communications unit 21 of the sensor 2a transmit a registration request D9, requesting that the sensor 2a be registered with the relay 3, to the communications unit 32 of the relay 3 (in Step S56).

[0108] On receiving the registration request D9 from the sensor 2a via the communications unit 31, the registration processing unit 362 of the relay 3 determines (i.e., makes a third decision) whether the registered number of the sensors 2 already registered with the relay 3 has reached the predetermined number (i.e., the predetermined number that has been set in Step S56) (in Step S57). In this exemplary operation, the registration processing unit 362 decides, as a result of the third de-

cision, that the registered number is still short of the predetermined number. When making such a decision, the registration processing unit 362 registers, with the relay 3, the sensor 2a that has transmitted the registration request D9 (in Step S58). Then, the preliminary alert control unit 364 of the relay 3 makes the alert unit 35 of the relay 3 provide preliminary alert information such as a message saying, "Nth sensor has now been registered" or a message saying, "N more sensors are still registerable" (in Step S59). This allows the worker to determine, based on this preliminary alert information, whether the second sensor 2 should be registered with the relay 3. In this exemplary operation, the worker registers the second sensor 2 with the relay 3. In this exemplary operation, the worker is supposed to have registered M more sensors 2 with the relay 3 by repeatedly performing the same series of processing steps S56-S59 M times, although description thereof will be omitted herein. Then, the worker registers an (M + 1)th sensor 2b. More specifically, the worker operates the operating unit 23 of the (M + 1)th sensors 2b (i.e., performs registration operation) to make the communications unit 21 of the sensor 2b transmit a registration request D10, requesting that the sensor 2b be registered with the relay 3, to the communications unit 32 of the relay 3 (in Step S60).

[0109] On receiving the registration request D10 from the sensor 2b via the communications unit 31, the registration processing unit 362 of the relay 3 makes the third decision (in Step S61). In this exemplary operation, the registration processing unit 362 decides, as a result of the third decision, that the registered number have reached the predetermined number. When making such a decision, the registration processing unit 362 cancels the registration processing (in Step S62). This cancellation causes the registration processing unit 362 to keep the sensors 2 that have already been registered before the cancellation of the registration processing still registered and prevents the registration processing unit 362 from registering, with the relay 3, the sensor 2b that has transmitted the registration request D10. In addition, the registration processing unit 362 does not register, with the relay 3, any sensor 2 that has transmitted the registration request after the cancellation of the registration processing, either. That is to say, the relay 3 no longer accepts the worker's request for registering any sensors 2. This allows the worker to learn that no sensors 2 are registerable with the relay 3 any longer (i.e., that the registered number of the sensors 2 already registered with the relay 3 has reached the predetermined number).

[0110] Then, the alert control unit 363 of the relay 3 makes the alert unit 35 of the relay 3 provide, as the alert information, information in the form of a message saying "registered number of sensors registered with relay has reached predetermined number" or "no sensors are registerable with relay any longer" (in Step S63). This alert information also tells the worker that no sensors 2 are registerable with the relay 3 any longer. Then, the worker operates the operating unit 33 of the relay 3 (i.e., performs

a deregistration operation) to make the relay 3 disable the registration mode (in Step S64). This operation causes the relay 3 to disable the registration mode of the relay 3. When the registration mode of the relay 3 is disabled, the worker finishes registering the sensors 2 with the relay 3.

[0111] After the registration mode of the relay 3 has been disabled in Step S64, the same series of processing steps as S26-S32 shown in FIGS. 6 and 7 will be performed once again to end the processing.

(2.6) Advantages

[0112] An alarm system 1 according to this embodiment includes a plurality of sensors 2, each of which detects an event (such as a disaster), and a relay 3. The relay 3 relays a communication between the plurality of sensors 2 and a receiver 4 that communicates with the plurality of sensors 2 to receive a result of detection from each of the plurality of sensors 2. The relay 3 includes a registration processing unit 362 that determines (i.e., makes a first decision), in response to a registration request from at least one sensor 2 belonging to the plurality of sensors 2, whether a registered number of a first group of sensors 2 belonging to the plurality of sensors 2 which have already been registered with the relay 3 has reached a predetermined number. The registration processing unit 362 cancels, when making a decision that the registered number have reached the predetermined number, registration processing of registering the at least one sensor 2 with the relay 3.

[0113] According to this configuration, when a decision is made that the registered number of sensors 2 already registered with the relay 3 have reached the predetermined number, the registration processing is cancelled, thus cancelling the registration, with the relay 3, of the at least one sensor 2 that has transmitted the registration request. This cancellation allows the worker who is registering the sensors 2 to learn that the registered number of sensors 2 already registered with the relay 3 has reached the predetermined number. This reduces the chances of the worker registering more than the predetermined number of sensors 2 with the relay 3 even if he or she does not know the specific value of the predetermined number. Consequently, the worker may have the registration work done more efficiently.

(3) Implementations other than the exemplary embodiment

[0114] The functions of the alarm system 1 according to the exemplary embodiment may also be implemented as, for example, a relay, a control method, a computer program, or a non-transitory storage medium that stores the computer program thereon.

[0115] A relay according to an implementation relays a communication between a plurality of sensors, each of which detects an event, and a receiver that communi-

cates with the plurality of sensors to receive a result of detection from each of the plurality of sensors. The relay includes a registration processing unit that determines, in response to a registration request from at least one sensor belonging to the plurality of sensors, whether a registered number of a first group of sensors belonging to the plurality of sensors which have already been registered with the relay has reached a predetermined number. The registration processing unit cancels, when making a decision that the registered number have reached the predetermined number, registration processing of registering the at least one sensor with the relay.

[0116] A control method according to another implementation is a method for controlling a relay. The relay relays a communication between a plurality of sensors, each of which detects an event, and a receiver that communicates with the plurality of sensors to receive a result of detection from each of the plurality of sensors. The control method includes processing of determining, in response to a registration request from at least one sensor belonging to the plurality of sensors, whether a registered number of a first group of sensors belonging to the plurality of sensors which have already been registered with the relay has reached a predetermined number. The processing includes cancelling, when making a decision that the registered number have reached the predetermined number, registration processing of registering the at least one sensor with the relay.

[0117] A program according to still another implementation is designed to cause a computer system to perform the control method according to the above-described implementation.

[0118] A non-transitory storage medium according to yet another implementation stores thereon a program that causes a computer system to perform the control method according to the above-described implementation.

(4) Variations

[0119] Next, variations of the exemplary embodiment will be enumerated one after another. Note that the variations to be described below may be adopted in combination as appropriate.

(4.1) First variation

[0120] In the exemplary embodiment described above, the alert information and the preliminary alert information are provided by the alert unit 35 of the relay 3. However, this is only an example and should not be construed as limiting. Rather, the alert information and the preliminary alert information may be provided by the alert unit 35 of the relay 3, the alert unit 25 of the sensor 2, or the alert unit 43 of the receiver 4, whichever is appropriate.

[0121] In the exemplary embodiment described above, the alert unit 35 of the relay 3 provides the alert informa-

tion in the following manner, for example. Specifically, the relay 3 acquires the first information from the receiver 4, makes the third decision based on the first information thus acquired, and then makes the alert unit 35 of the relay 3 provide the alert information (such as a message saying "no sensors are registerable with relay any longer") depending on the result of the third decision. However, this is only an example and should not be construed as limiting. Alternatively, the alert information may also be provided according to the first variation in the following manner.

[0122] For example, the alert unit 25 of the sensor 2 may provide the alert information (such as a message saying "no sensors are registerable with relay any longer") when the sensor 2 receives a registration unacceptable notification as a response to the registration request. In this example, if a registration request from any sensor 2 is unacceptable for the relay 3, the relay 3 is supposed to transmit the registration unacceptable notification to the sensor 2. Note that if the registration request from a sensor 2 is unacceptable for the relay 3 but the registration unacceptable notification is not transmitted to the sensor 2, then the sensor 2 decides, based on no reception of the registration unacceptable notification, that the request have been declined and makes the alert unit 25 thereof provide the alert information.

[0123] Alternatively, the alert unit 43 of the receiver 4 may also provide, when the receiver 4 receives the result of the assignment processing from the relay 3, the preliminary alert information such as a message saying, "N more sensors are still registerable."

[0124] Still alternatively, the alert unit 25 of the sensor 2 may also provide the preliminary alert information in the following manner. For example, if a decision is made, as a result of the third decision, that the registered number be still short of the predetermined number but have reached a certain number smaller than the predetermined number, the alert unit 25 of the sensor 2 that has transmitted a registration request may provide the preliminary alert information such as a message saying "the registered number of sensors already registered with relay has reached certain number." In this example, the determination whether the registered number has reached the certain number (a fourth decision) is made by, for example, the registration processing unit 362 of the relay 3, not the sensor 2. The sensor 2 receives the result of the fourth decision from the relay 3 and provides the preliminary alert information.

[0125] According to this first variation, the alert information and the preliminary alert information may be provided in any of various forms of notification (e.g., as a sound such as a voice emitted from a loudspeaker, a message displayed on a monitor, or light emitted from an LED). In addition, the alert information and the preliminary alert information may be provided by any of the constituent elements of the alarm system 1 (namely, by any of the receiver 4, the sensors 2, or the relays 3).

(4.2) Second variation

[0126] In the exemplary embodiment described above, a threshold value may be set for the radio field strength of the communication established between the sensor 2 and the relay 3 for use in the registration mode of the relay 3. More specifically, the threshold value (first threshold value) of the radio field strength of the communication for use in the registration mode may be set at a higher value than the threshold value (second threshold value) of the radio field strength of the communication (established between the sensor 2 and the relay 3) for use in an operating mode. As used herein, the "operating mode" refers to a mode in which the alarm system 1 is operated.

[0127] In the registration mode, the worker performs the registration work of registering the sensors 2 with the relay 3 with the sensors 2 disposed close to the relay 3. Thus, in the registration mode, the distance between the sensors 2 and the relay 3 is shorter than in the operating mode. This makes the radio field strength of the communication established between the sensor 2 and the relay 3 in the registration mode higher than the radio field strength of the communication established between the sensor 2 and the relay 3 in the operating mode. This allows the first threshold value to be set at a higher value than the second threshold value.

[0128] Note that setting the first threshold value for the radio field strength of the communication for use in the registration mode makes communication established at a radio field strength equal to or greater than the first threshold value enabled and makes communication established at a radio field strength less than the first threshold value disabled in the registration mode. Thus, in the registration mode, communication can be established only at a radio field strength equal to or greater than the first threshold value. In the same way, setting the second threshold value for the radio field strength of the communication for use in the operating mode makes communication established at a radio field strength equal to or greater than the second threshold value enabled and makes communication established at a radio field strength less than the second threshold value disabled in the operating mode. Thus, in the operating mode, communication can be established only at a radio field strength equal to or greater than the second threshold value.

[0129] Setting the first threshold value at a higher value than the second threshold value in this manner enables reducing not only the effect of external noise when the sensor 2 is registered with the relay 3 in the registration mode but also the electromagnetic effect to be caused by other radio devices operating at frequencies close to the frequency of the communication between the sensor 2 and the relay 3.

(4.3) Third variation

[0130] In the exemplary embodiment described above, the communication between the relay 3 and the sensors 2 is supposed to be established by star connection. However, this is only an example and should not be construed as limiting. Alternatively, the communication between the relay 3 and the sensors 2 may also be established by, for example, multi-hop connection in which each of multiple sensors 2 relays a communication between the relay 3 and other sensors 2.

(5) Aspects

[0131] The exemplary embodiment and its variations described above are specific implementations of the following aspects of the present disclosure.

[0132] An alarm system (1) according to a first aspect includes: a plurality of sensors (2), each of which detects an event; and a relay (3). The relay (3) relays a communication between the plurality of sensors (2) and a receiver (4) that communicates with the plurality of sensors (2) to receive a result of detection from each of the plurality of sensors (2). The relay (3) includes a registration processing unit (362) that determines (i.e., makes a first decision and a second decision), in response to a registration request from at least one sensor (2) belonging to the plurality of sensors (2), whether a registered number of a first group of sensors (2) belonging to the plurality of sensors (2) which have already been registered with the relay (3) has reached a predetermined number. The registration processing unit (362) cancels, when making a decision that the registered number have reached the predetermined number, registration processing of registering the at least one sensor (2) with the relay (3).

[0133] According to this configuration, when a decision is made that the registered number of sensors (2) already registered with the relay (3) have reached the predetermined number, the registration processing is cancelled, thus cancelling the registration, with the relay (3), of the at least one sensor (2) that has transmitted the registration request. This cancellation allows the worker who is registering the sensors (2) to learn that the registered number of sensors (2) already registered with the relay (2) has reached the predetermined number. This reduces the chances of the worker registering more than the predetermined number of sensors (2) with the relay (3) even if he or she does not know the specific value of the predetermined number. Consequently, the worker may have the registration work done more efficiently.

[0134] In an alarm system (1) according to a second aspect, which may be implemented in conjunction with the first aspect, the predetermined number is a maximum allowable number of a second group of sensors (2) belonging to the plurality of sensors (2) which can be registered with the relay (3).

[0135] This configuration allows, if the registered number has reached the maximum allowable number,

the registration of the at least one sensor (2) with the relay (3) to be cancelled. This reduces the chances of the worker registering more than the maximum allowable number of sensors (2) with the relay (3) even if he or she does not know the specific value of the maximum allowable number.

[0136] In an alarm system (1) according to a third aspect, which may be implemented in conjunction with the second aspect, when communication is ready to be established between the relay (3) and the receiver (4) after the decision has been made, the registration processing unit (362) acquires, from the receiver (4), first information about a registerable number of a third group of sensors (2) belonging to the plurality of sensors (2) which are still registerable with the receiver (4). The registration processing unit (362) cancels the registration processing when finding the registered number greater than the registerable number derived from the first information.

[0137] According to this configuration, cancelling the registration processing when communication is ready to be established between the relay (3) and the receiver (4) after the decision (i.e., the first decision) has been made allows the worker to learn that the registered number is greater than the registerable number even if he or she does not know the registerable number of sensors (2) still registerable with the receiver (4).

[0138] In an alarm system (1) according to a fourth aspect, which may be implemented in conjunction with the first aspect, when a registerable number of a third group of sensors (2) belonging to the plurality of sensors (2) which are still registerable with the receiver (4) is greater than a maximum allowable number of a second group of sensors (2) belonging to the plurality of sensors (2) which are possibly registered with the relay (3), the predetermined number is the maximum allowable number. When the registerable number is equal to or less than the maximum allowable number, the predetermined number is the registerable number.

[0139] This configuration allows the predetermined number to be set at an appropriate value depending on which one of the registerable number or the maximum allowable number is larger than the other.

[0140] In an alarm system (1) according to a fifth aspect, which may be implemented in conjunction with the fourth aspect, the relay (3) has a registration mode in which the plurality of sensors (2) are registered with the relay (3). In a situation where communication is ready to be established between the relay (3) and the receiver (4) when the registration mode is enabled, the registration processing unit (362) acquires, from the receiver (4), first information about the registerable number of the third group of sensors (2) belonging to the plurality of sensors (2) which are still registerable with the receiver (4).

[0141] According to this configuration, if communication is ready to be established between the relay (3) and the receiver (4) when the registration mode is enabled, the relay (3) may automatically acquire the first information from the receiver (4). This allows, if communication

is ready to be established between the relay (3) and the receiver (4) when the registration mode is enabled, the predetermined number to be set at an appropriate number with both the maximum allowable number and the registerable number taken into account as in the fourth aspect. This allows, by registering the sensors (2) with the relay (3) in the registration mode such that the registered number is not greater than the predetermined number, the worker to register the sensors (2) with the relay (3) so that the registered number is not greater than the maximum allowable number or the registerable number.

[0142] An alarm system (1) according to a sixth aspect, which may be implemented in conjunction with any one of the first to fifth aspects, further includes an alert control unit (363) that issues, when the registration processing unit (362) has decided that registered number have reached the predetermined number, an alert indicating that registered number has reached the predetermined number.

[0143] According to this configuration, the alert control unit (363) may more reliably alert the worker to the fact that the registered number has reached the predetermined number.

[0144] An alarm system (1) according to a seventh aspect, which may be implemented in conjunction with any one of the first to sixth aspects, further includes a preliminary alert control unit (364) that issues, before the registered number reaches the predetermined number, a preliminary alert about either the registered number or a registerable number of a fourth group of sensors (2) belonging to the plurality of sensors (2) which are still registerable with the relay (3). The fourth group is included in the second group.

[0145] This configuration allows the worker to learn, before the registered number reaches the predetermined number, the registered number of sensors (2) already registered with the relay (3) or the registerable number of sensors (2) still registerable with the relay (3), thus allowing the worker to have the registration work done more efficiently.

[0146] A relay (3) according to an eighth aspect relays a communication between a plurality of sensors (2) and a receiver (4). Each of the plurality of sensors (2) detects an event. The receiver (4) communicates with the plurality of sensors (2) to receive a result of detection from each of the plurality of sensors (2). The relay (3) includes a registration processing unit (362) that determines, in response to a registration request from at least one sensor (2) belonging to the plurality of sensors (2), whether a registered number of a first group of sensors (2) belonging to the plurality of sensors (2) which have already been registered with the relay (3) has reached a predetermined number. The registration processing unit (362) cancels, when making a decision that the registered number have reached the predetermined number, registration processing of registering the at least one sensor (2) with the relay (3).

[0147] According to this configuration, when a decision is made that the registered number of sensors (2) already registered with the relay (3) have reached the predetermined number, the registration processing is cancelled, thus cancelling the registration, with the relay (3), of the at least one sensor (2) that has transmitted the registration request. This cancellation allows the worker who is registering the sensors (2) to learn that the registered number of sensors (2) already registered with the relay (2) has reached the predetermined number. This reduces the chances of the worker registering more than the predetermined number of sensors (2) with the relay (3) even if he or she does not know the specific value of the predetermined number. Consequently, the worker may have the registration work done more efficiently.

[0148] A control method according to a ninth aspect is a method for controlling a relay (3). The relay (3) relays a communication between a plurality of sensors (2) and a receiver (4). Each of the plurality of sensors (2) detects an event. The receiver (4) communicates with the plurality of sensors (2) to receive a result of detection from each of the plurality of sensors (2). The control method includes processing of determining, in response to a registration request from at least one sensor (2) belonging to the plurality of sensors (2), whether a registered number of a first group of sensors (2) belonging to the plurality of sensors (2) which have already been registered with the relay (3) has reached a predetermined number. The processing includes cancelling, when making a decision that the registered number have reached the predetermined number, registration processing of registering the at least one sensor (2) with the relay (3).

[0149] According to this method, when a decision is made that the registered number of sensors (2) already registered with the relay (3) have reached the predetermined number, the registration processing is cancelled, thus cancelling the registration, with the relay (3), of the at least one sensor (2) that has transmitted the registration request. This cancellation allows the worker who is registering the sensors (2) to learn that the registered number of sensors (2) already registered with the relay (2) has reached the predetermined number. This reduces the chances of the worker registering more than the predetermined number of sensors (2) with the relay (3) even if he or she does not know the specific value of the predetermined number. Consequently, the worker may have the registration work done more efficiently.

[0150] A program according to a tenth aspect is designed to cause a computer system to perform the control method according to the ninth aspect.

[0151] This aspect provides a program designed to cause a computer system to perform the control method according to the ninth aspect.

Reference Signs List

[0152]

- 1 Alarm System
- 2 Sensor
- 3 Relay
- 4 Receiver
- 5 362 Registration Processing Unit
- 363 Alert Control Unit
- 364 Preliminary Alert Control Unit

10 Claims

1. An alarm system (1) comprising:

- 15 a plurality of sensors (2), each of the plurality of sensors (2) being configured to detect an event; and
a relay (3) configured to relay a communication between the plurality of sensors (2) and a receiver (4), the receiver (4) being configured to communicate with the plurality of sensors (2) to receive a result of detection from each of the plurality of sensors (2),
the relay (3) including a registration processing unit (362) configured to determine, in response to a registration request from at least one sensor (2) belonging to the plurality of sensors (2), whether a registered number of a first group of sensors (2) belonging to the plurality of sensors (2) which have already been registered with the relay (3) has reached a predetermined number, the registration processing unit (362) being configured to, when making a decision that the registered number have reached the predetermined number, cancel registration processing of registering the at least one sensor (2) with the relay (3).
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2. The alarm system (1) of claim 1, wherein the predetermined number is a maximum allowable number of a second group of sensors (2) belonging to the plurality of sensors (2) which are possibly registered with the relay (3).
3. The alarm system (1) of claim 2, wherein the registration processing unit (362) is configured to, when communication is ready to be established between the relay (3) and the receiver (4) after the decision has been made, acquire, from the receiver (4), first information about a registerable number of a third group of sensors (2) belonging to the plurality of sensors (2) which are still registerable with the receiver (4), and the registration processing unit (362) is configured to, when finding the registered number greater than the registerable number derived from the first information, cancel the registration processing.

4. The alarm system (1) of claim 1, wherein

when a registerable number of a third group of sensors (2) belonging to the plurality of sensors (2) which are still registerable with the receiver (4) is greater than a maximum allowable number of a second group of sensors (2) belonging to the plurality of sensors (2) which are possibly registered with the relay (3), the predetermined number is the maximum allowable number, and when the registerable number is equal to or less than the maximum allowable number, the predetermined number is the registerable number.

5. The alarm system (1) of claim 4, wherein

the relay (3) has a registration mode in which the plurality of sensors (2) are registered with the relay (3), and the registration processing unit (362) is configured to, in a situation where communication is ready to be established between the relay (3) and the receiver (4) when the registration mode is enabled, acquire, from the receiver (4), first information about the registerable number of the third group of sensors (2) belonging to the plurality of sensors (2) which are still registerable with the receiver (4).

6. The alarm system (1) of any one of claims 1 to 5, further comprising an alert control unit (363) configured to, when the registration processing unit (362) has decided that the registered number have reached the predetermined number, issue an alert indicating that registered number has reached the predetermined number.

7. The alarm system (1) of any one of claims 1 to 5, further comprising a preliminary alert control unit (364) configured to, before the registered number reaches the predetermined number, issue a preliminary alert about either the registered number or a registerable number of a fourth group of sensors (2) belonging to the plurality of sensors (2) which are still registerable with the relay (3), the fourth group being included in the second group.

8. A relay (3) configured to relay a communication between a plurality of sensors (2) and a receiver (4), each of the plurality of sensors (2) being configured to detect an event, the receiver (4) being configured to communicate with the plurality of sensors (2) to receive a result of detection from each of the plurality of sensors (2),

the relay (3) comprising a registration processing unit (362) configured to determine, in response to a registration request from at least

one sensor (2) belonging to the plurality of sensors (2), whether a registered number of a first group of sensors (2) belonging to the plurality of sensors (2) which have already been registered with the relay (3) has reached a predetermined number, the registration processing unit (362) being configured to, when making a decision that the registered number have reached the predetermined number, cancel registration processing of registering the at least one sensor (2) with the relay (3).

9. A control method for controlling a relay (3), the relay (3) being configured to relay a communication between a plurality of sensors (2) and a receiver (4), each of the plurality of sensors (2) being configured to detect an event, the receiver (4) being configured to communicate with the plurality of sensors (2) to receive a result of detection from each of the plurality of sensors (2),

the control method comprising processing of determining, in response to a registration request from at least one sensor (2) belonging to the plurality of sensors (2), whether a registered number of a first group of sensors (2) belonging to the plurality of sensors (2) which have already been registered with the relay (3) has reached a predetermined number, the processing including cancelling, when making a decision that the registered number have reached the predetermined number, registration processing of registering the at least one sensor (2) with the relay (3).

10. A program designed to cause a computer system to perform the control method of claim 9.

FIG. 1

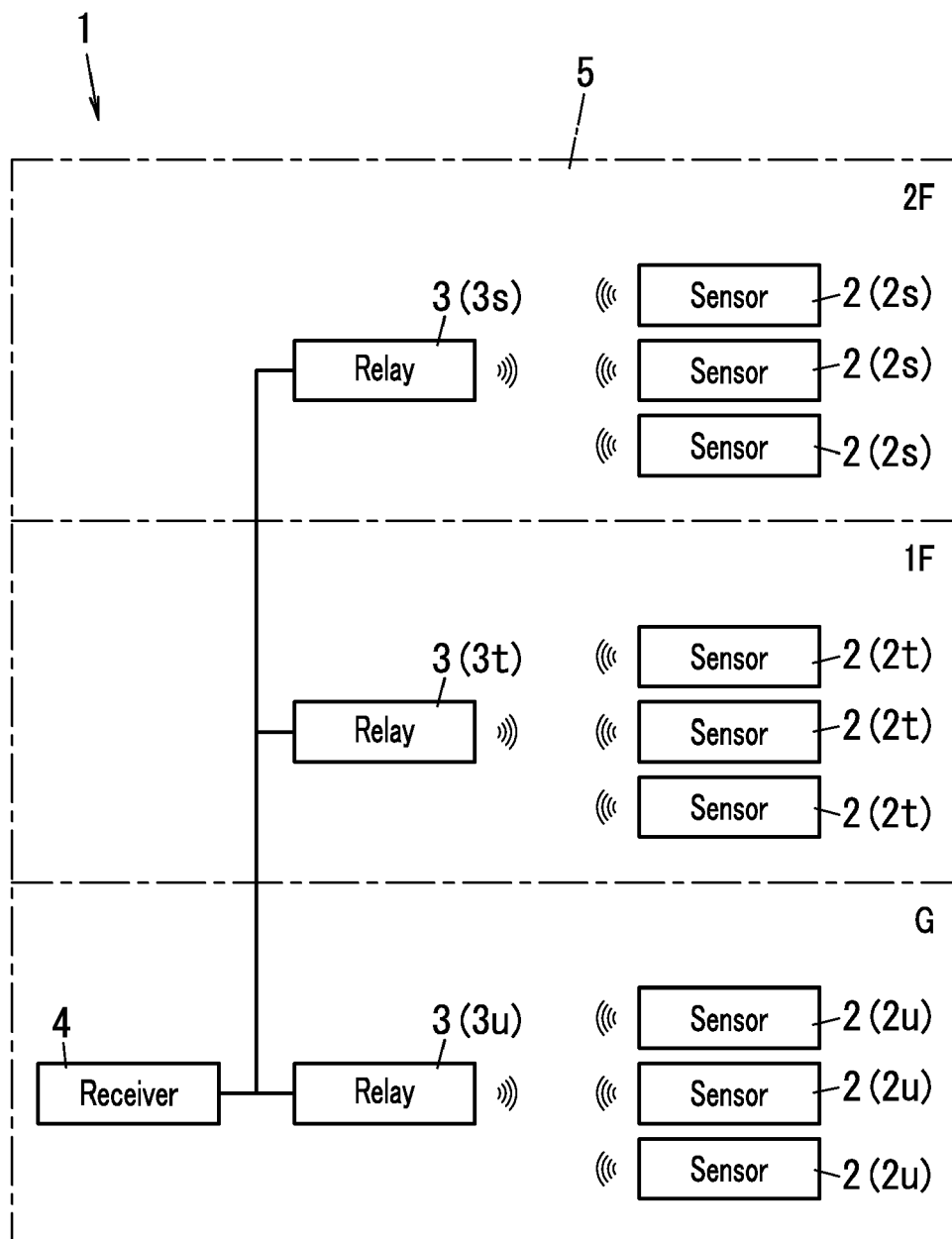


FIG. 2

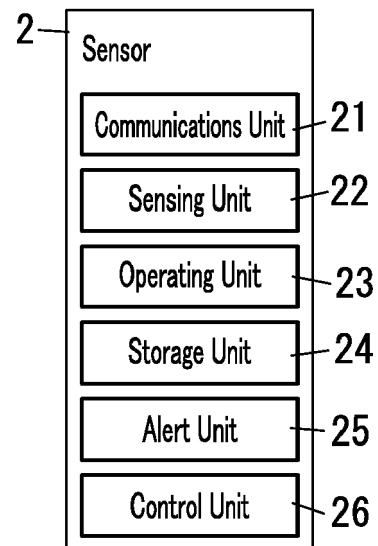


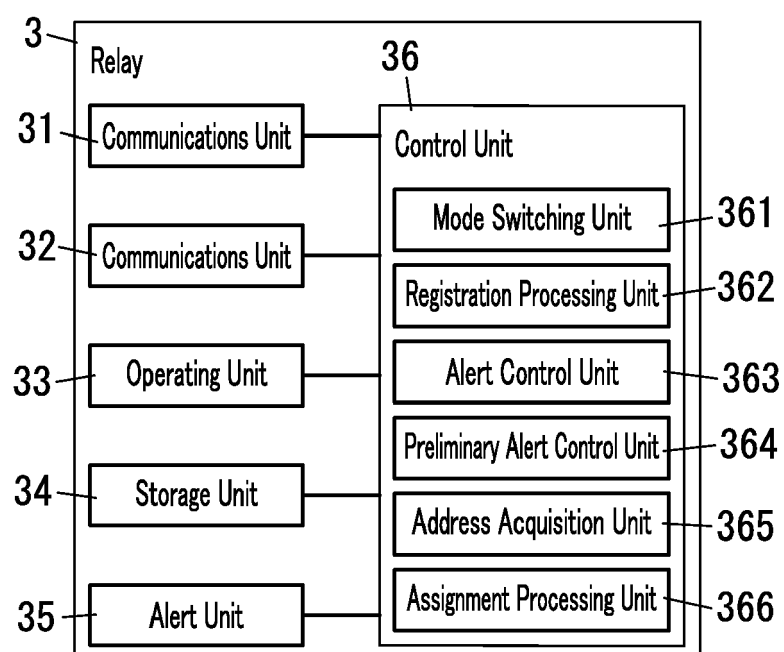
FIG. 3

FIG. 4

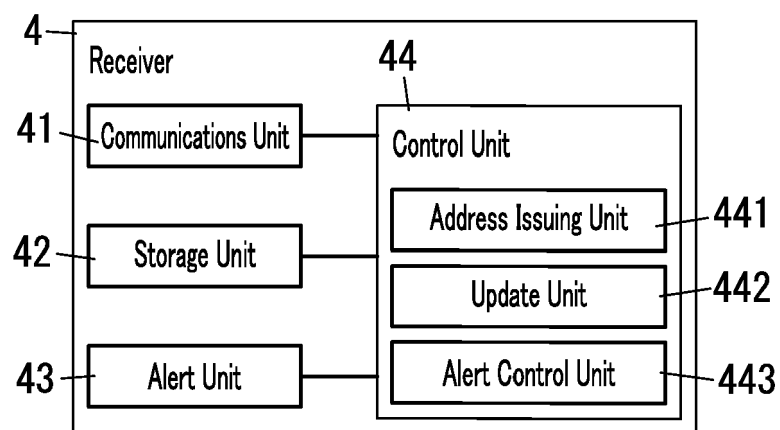


FIG. 5

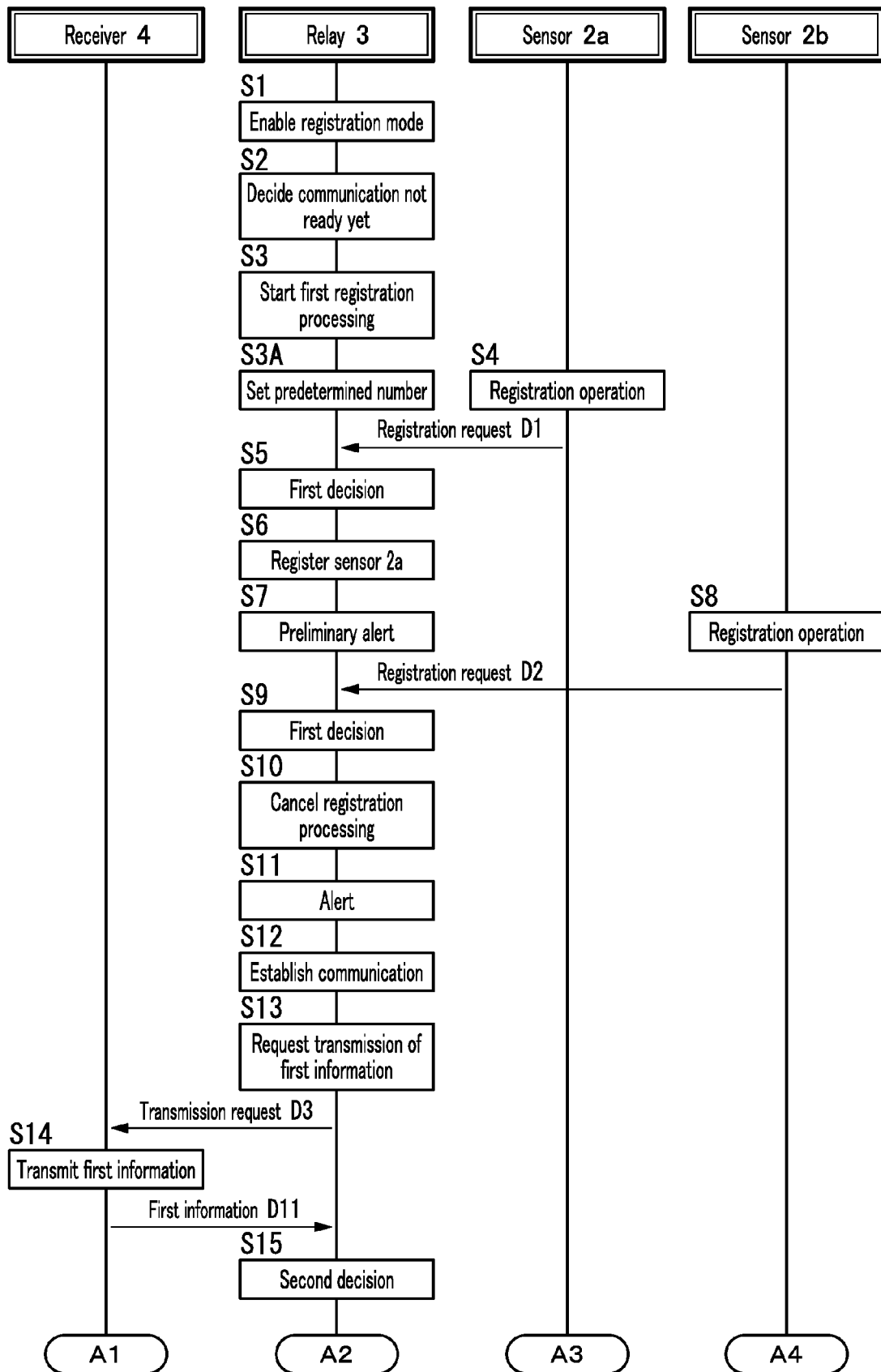


FIG. 6

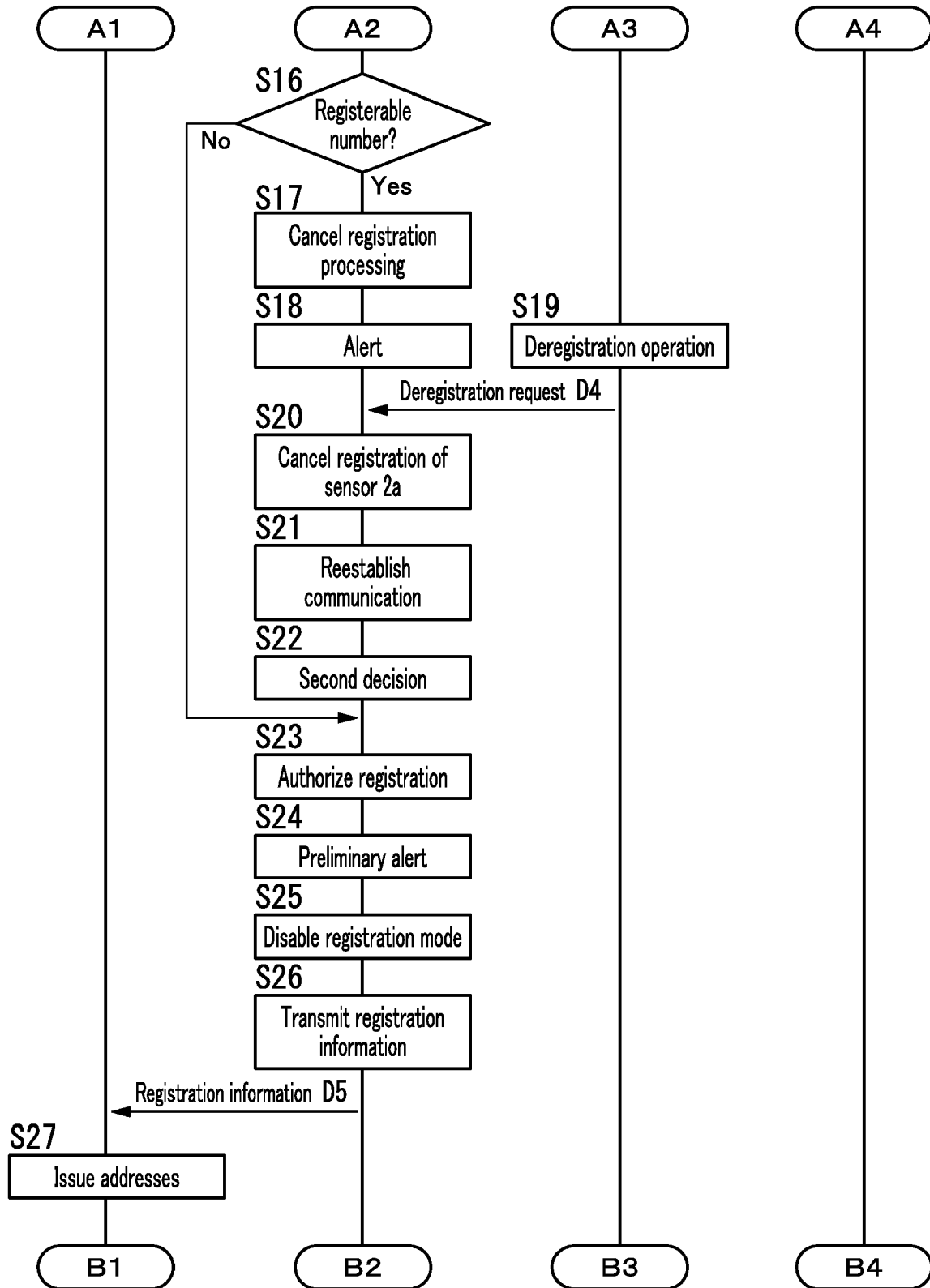


FIG. 7

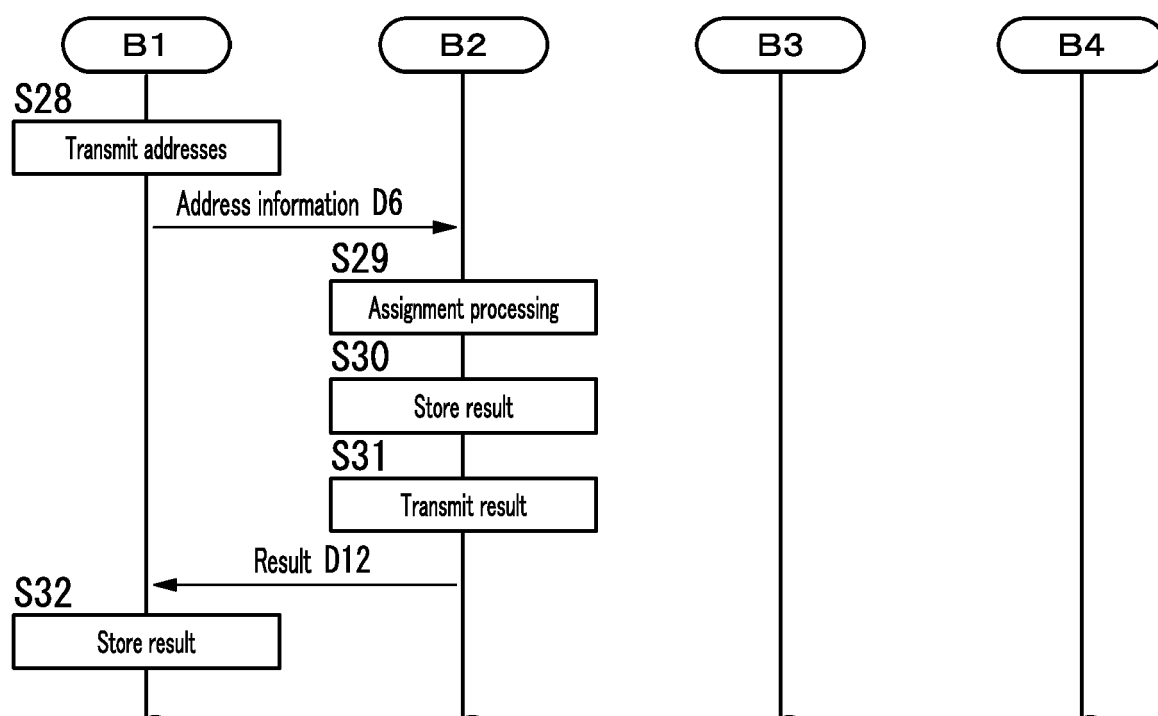
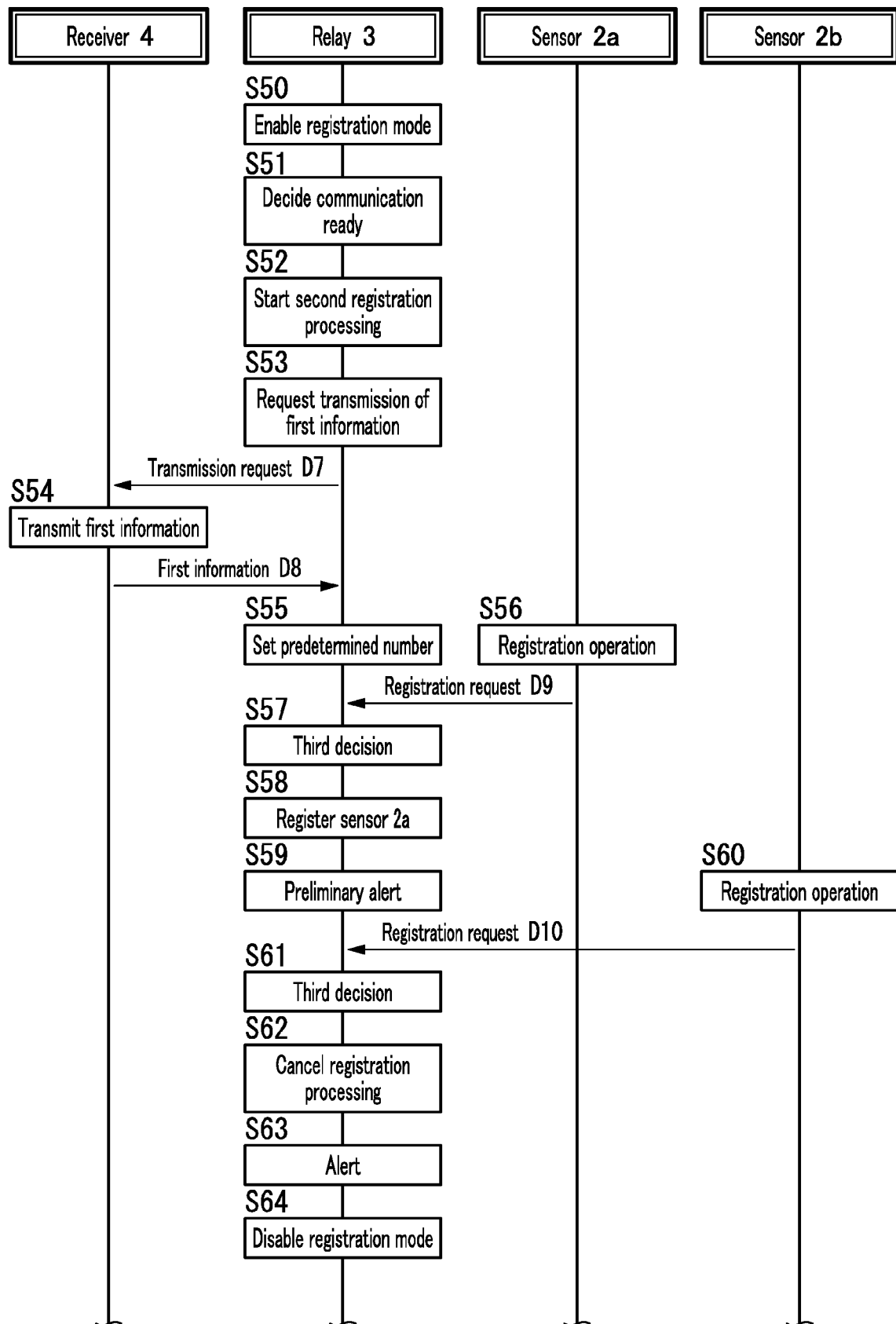


FIG. 8





EUROPEAN SEARCH REPORT

Application Number

EP 24 15 8045

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 6 028073 B2 (NOHMI BOSAI LTD) 16 November 2016 (2016-11-16)	1,2,8-10	INV. G08B25/00
A	* paragraph [0013] - paragraph [0015]; figures 1-3 * * paragraph [0034] - paragraph [0039] * -----	3-7	
A	JP 2016 062371 A (HOCHIKI CO) 25 April 2016 (2016-04-25) * paragraph [0041] - paragraph [0046]; figures 1-4 * -----	1-10	
			TECHNICAL FIELDS SEARCHED (IPC)
			G08B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		3 July 2024	Kurzbauer, Werner
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 24 15 8045

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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03 - 07 - 2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 6028073 B2	16-11-2016	JP 6028073 B2	16-11-2016
		JP 2015228232 A	17-12-2015
JP 2016062371 A	25-04-2016	JP 6544903 B2	17-07-2019
		JP 2016062371 A	25-04-2016

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- JP 2010041545 A [0002] [0003]