

SPECIFICATION

TITLE OF INVENTION

FIRE ALARM RECEIVER

TECHNICAL FIELD

[0001] The present invention relates to a fire alarm receiver.

BACKGROUND ART

[0002] Conventionally, a gas-based fire-extinguishing system that releases a fire-extinguishing gas such as carbon dioxide to extinguish a fire has been known. For example, Patent Literature 1 discloses a gas-based fire-extinguishing system in which a fire detector for detecting a fire, a spray head for discharging a fire-extinguishing gas, and an operation box for manually discharging the fire-extinguishing gas or making an emergency stop of the discharge of the fire-extinguishing gas are included in each protected area. The gas-based fire-extinguishing system further includes a fire-extinguishing gas storage container for storing the fire-extinguishing gas and a control panel for controlling the gas-based fire-extinguishing system, outside of the protected area. When a fire is detected by the fire detector or the fire-extinguishing gas release switch of the operation box is operated in a certain protected area, this control panel starts a countdown and displays the remaining time on the panel surface and the operation box. Then, when the countdown is completed, the open valve of the fire-extinguishing gas storage container is driven to release the fire-extinguishing gas from the spray head of the target protected area.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0003] Patent Document 1: JP 2017-18337A

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] In the above-described gas-based fire-extinguishing system, even if an emergency stop operation is performed before the remaining time displayed on the operation box reaches zero, in some cases, processing for stopping the countdown on the control panel is not on time due to a signal transmission delay or a processing delay in the control panel, and the fire-extinguishing gas is released from the spray head.

[0005] The present invention has been made in view of such circumstances, and aims to reduce the delay time needed until countdown stop processing is executed in the fire alarm receiver when a user remotely instructs countdown stop processing using an emergency stop switch.

MEANS FOR SOLVING THE PROBLEM

[0006] In order to solve the above-described problem, a fire alarm receiver according to the present invention is a fire alarm receiver for receiving a signal from a terminal device installed in a protected area and executing processing according to the signal, in which the terminal device includes: a fire detector that is installed in the protected area and is configured to output a detector signal; a manual release switch for instructing release of fire-extinguishing gas from a spray head installed in the protected area, the manual release switch being configured to output a first start signal when operated by a user; and an emergency stop switch for performing an emergency stop of release of fire-extinguishing gas from the spray head, the emergency stop switch being configured to output a stop signal when operated by a user, and the fire alarm receiver starts a countdown upon receiving the detector signal or the first start signal, stops the

countdown upon receiving the stop signal before the countdown ends, releases fire-extinguishing gas from the spray head when the countdown ends, and receives the stop signal with priority over the detector signal.

[0007] In a preferred aspect, the fire alarm receiver may execute processing corresponding to the stop signal with priority over processing corresponding to the detector signal or the first start signal.

[0008] In a more preferred aspect, the fire alarm receiver may receive the first start signal and the stop signal via a first gas fire-extinguishing control device installed in the protected area, may include a storage unit configured to store an operation mode in association with the first gas fire-extinguishing control device, if the operation mode stored in the storage unit is an automatic mode, the fire alarm receiver may start the countdown upon receiving the detector signal or the first start signal, and if the operation mode stored in the storage unit is a manual mode, the fire alarm receiver may start the countdown only when the first start signal is received, and if an operation mode that is different from that of the first gas fire-extinguishing control device is stored in the storage unit in association with a second gas fire-extinguishing control device installed in the protected area, the fire alarm receiver may start the countdown only when the first start signal is received.

[0009] In a more preferred aspect, the terminal device may further include an alerting device configured to, upon receiving input of a second start signal, alert that fire-extinguishing gas is to be released from the spray head, and the first gas fire-extinguishing control device may include: an input/output control unit configured to relay the first start signal output from the manual release switch to the fire alarm receiver, relay a stop signal output from the emergency stop switch to the fire alarm receiver, and start up the alerting device in response to the second start signal output from the fire alarm receiver; and a display unit configured to

display an amount of time until fire-extinguishing gas is released from the spray head.

EFFECTS OF THE INVENTION

[0010] According to the present invention, when a user remotely instructs countdown stop processing using an emergency stop switch, the delay time required until the processing is executed in the fire alarm receiver can be shortened.

BRIEF EXPLANATION OF THE DRAWINGS

[0011] [FIG. 1] Figure 1 is a diagram showing an example of a configuration of gas-based fire-extinguishing system 1.

[FIG. 2] Figure 2 is a front view of gas fire-extinguishing control device 9.

[FIG. 3] Figure 3 is a diagram showing an internal configuration of gas fire-extinguishing control device 9.

[FIG. 4] Figure 4 is a block diagram showing an internal configuration of fire alarm receiver 10.

[FIG. 5] Figure 5 is a time chart showing an example of normal point polling.

[FIG. 6] Figure 6 is a flowchart showing an example of a reception operation.

[FIG. 7] Figure 7 is a sequence diagram showing an example of a fire-extinguishing operation for a protected area in which an operation mode is set to an automatic mode.

[FIG. 8] Figure 8 is a sequence diagram showing an example of a fire-extinguishing operation for a protected area in which the operation mode is set to the automatic mode.

[FIG. 9] Figure 9 is a sequence diagram showing an example of a fire-extinguishing operation for a protected area in which the operation mode

is set to a manual mode.

MODES FOR CARRYING OUT THE INVENTION

[0012] 1. Embodiment

Gas-based fire-extinguishing system 1 according to an embodiment of the present invention will be described with reference to the drawings.

1-1. Configuration

FIG. 1 is a diagram showing an example of a configuration of gas-based fire-extinguishing system 1. Gas-based fire-extinguishing system 1 shown in the diagram is installed in building B. This building B includes rooms R1 to R3, monitoring room R4, and cylinder room R5, which are respectively different protected areas. Among these rooms, fire detectors 2, spray heads 3, bells 4, and strobes 5 are installed inside each of rooms R1 to R3, which are protected areas. Also, manual release switches 6, emergency stop switches 7, release display lights 8, and gas fire-extinguishing control devices 9 are installed outside each of the rooms R1 to R3. Fire alarm receiver 10 is installed in monitoring room R4. Fire-extinguishing gas storage containers 11, selection valves 12, starting gas containers 13, and repeaters 14 are installed in cylinder chamber R5. Hereinafter, each constituent element of gas-based fire-extinguishing system 1 will be described.

[0013] Fire detectors 2 are installed on the ceilings of the protected areas and are connected to fire alarm receiver 10 via a signal line. When fire detector 2 detects a fire, it outputs an operation signal to fire alarm receiver 10 as a detector signal.

[0014] Spray heads 3 are installed on the ceilings of the protected areas and are connected to fire-extinguishing gas storage containers 11 via pipes. Spray head 3 discharges the fire-extinguishing gas supplied from fire-extinguishing gas storage containers 11.

- [0015] Bell 4 is an acoustic device for warning that fire-extinguishing gas is being released from spray head 3 in the protected area. Bell 4 is installed on the wall surface of the protected area and is connected to gas fire-extinguishing control device 9 via a signal line. Bell 4 rings when a start signal is input from gas fire-extinguishing control device 9.
- [0016] Strobe 5 is a lighting device for alerting that fire-extinguishing gas is being released from spray head 3 in the protected area. Strobe 5 is installed on the wall surface of the protected area and is connected to gas fire-extinguishing control device 9 via a signal line. Strobe 5 emits light when a start signal is input from gas fire-extinguishing control device 9.
- [0017] Manual release switch 6 is a switch for instructing the fire-extinguishing gas to be discharged from spray head 3 into the protected area. Manual release switch 6 is installed on the wall surface near the entrance of the protected area and is connected to gas fire-extinguishing control device 9 via a signal line. When operated by the user, manual release switch 6 outputs a start signal to gas fire-extinguishing control device 9.
- [0018] Emergency stop switch 7 is a switch for emergency stopping the release of fire-extinguishing gas from spray head 3 into the protected area. Emergency stop switch 7 is installed on the wall surface near the entrance of the protected area and is connected to gas fire-extinguishing control device 9 via a signal line. When operated by the user, emergency stop switch 7 outputs a stop signal to gas fire-extinguishing control device 9.
- [0019] Release display light 8 is a display device for warning that the fire-extinguishing gas is being released from spray head 3 in the protected area. Release display light 8 is installed on the wall surface near the entrance of the protected area, and is connected to gas fire-extinguishing control device 9 via a signal line. Release display light 8 lights up when a start signal is input from gas fire-extinguishing control device 9.

- [0020] Gas fire-extinguishing control device 9 is a relay device for relaying a signal between a terminal device installed in a protected area and fire alarm receiver 10 connected via a signal line. Here, the terminal device installed in the protected area includes bell 4, strobe 5, manual release switch 6, emergency stop switch 7, and release display light 8. Of these, bell 4 and strobe 5 are examples of warning devices. The specific configuration of gas fire-extinguishing control device 9 will be described later.
- [0021] Fire alarm receiver 10 is a device that controls the fire-extinguishing operation of gas-based fire-extinguishing system 1. The specific configuration of fire alarm receiver 10 will be described later.
- [0022] Fire-extinguishing gas storage container 11 is a container for storing fire-extinguishing gas such as carbon dioxide and halon gas. Fire-extinguishing gas storage containers 11 are each connected to a collection pipe via a container valve. This collection pipe is branched via selection valve 12 installed in each protected area. The branched pipes are connected to spray heads 3 installed in respectively different protected areas.
- [0023] Starting gas container 13 is a container for storing starting gas for opening the container valve of fire-extinguishing gas storage container 11 and selection valve 12. Starting gas container 13 is installed for each selection valve 12 (in other words, for each protected area). Starting gas containers 13 are each connected to the container valve of fire-extinguishing gas storage container 11 and corresponding selection valve 12 via a pipe. Also, the container valve solenoid of each starting gas container 13 is connected to fire alarm receiver 10 by a signal line via repeater 14. When a start signal is input from fire alarm receiver 10 to repeater 14, repeater 14 operates the container valve solenoid to release the starting gas from the starting gas container 13. The gas pressure of

the starting gas opens the container valve of fire-extinguishing gas storage container 11 and corresponding selection valve 12. As a result, the fire-extinguishing gas stored in fire-extinguishing gas storage container 11 is discharged from spray head 3 connected to the pipe through the pipe branched by selection valve 12.

[0024] Next, a specific configuration of gas fire-extinguishing control device 9 will be described.

[0025] FIG. 2 is a front view of gas fire-extinguishing control device 9. Gas fire-extinguishing control device 9 shown in the drawing includes a cuboid-shaped housing 91, and on the front surface of housing 91, includes status display light 921, countdown display 922, and mode selection switch 93.

[0026] Status display light 921 is composed of power source light 9211 that lights up when the power source of gas fire-extinguishing control device 9 is turned on, automatic mode display light 9212 that lights up while the automatic mode is selected, manual mode display light 9213 that lights up while the manual mode is selected, release warning light 9214 that lights up during the countdown until fire-extinguishing gas is released, release light 9215 that lights up while the fire-extinguishing gas is released, manual release light 9216 that lights up when manual release switch 6 is operated, and emergency stop light 9217 that lights up when emergency stop switch 7 is operated.

[0027] Countdown display 922 is a 7-segment display that displays the countdown until the fire-extinguishing gas is released.

[0028] Mode selection switch 93 is a key switch for selecting the operation mode in the protected area where gas fire-extinguishing control device 9 is installed, between the automatic mode and the manual mode. Of the operation modes selected with mode selection switch 93, the automatic mode is an operation mode in which, when fire detector 2 installed in the

protected area detects a fire, or when manual release switch 6 installed in the protected area is operated by the user, fire-extinguishing gas is released into the protected area. On the other hand, the manual mode is an operation mode in which the fire-extinguishing gas is discharged into the protected area only when manual release switch 6 installed in the protected area is operated by the user. The operation mode selected using mode selection switch 93 is stored in later-described protected area setting table TBL2 in association with the address of gas fire-extinguishing control device 9.

[0029] Next, FIG. 3 is a diagram showing an internal configuration of gas fire-extinguishing control device 9. Gas fire-extinguishing control device 9 shown in FIG. 3 accommodates display unit 92, above-mentioned mode selection switch 93, and input/output control unit 94 in housing 91.

[0030] Display unit 92 is composed of above-mentioned status display light 921 and countdown display 922.

[0031] Input/output control unit 94 includes a microcontroller. Input/output control unit 94 is connected to fire alarm receiver 10 and display unit 92 via a signal line, and receives a signal output from fire alarm receiver 10 to activate display unit 92.

[0032] Also, input/output control unit 94 is connected to mode selection switch 93 via a signal line, and relays the signal output from mode selection switch 93 to fire alarm receiver 10.

[0033] Also, input/output control unit 94 is connected to manual release switch 6 via a signal line, and relays a start signal output from manual release switch 6 to fire alarm receiver 10.

[0034] Also, input/output control unit 94 is connected to emergency stop switch 7 via a signal line, and relays a stop signal output from emergency stop switch 7 to fire alarm receiver 10.

[0035] Also, input/output control unit 94 is connected to bell 4 via a signal

line, and receives a start signal output from fire alarm receiver 10 to start bell 4.

[0036] Also, input/output control unit 94 is connected to strobe 5 via a signal line, and receives a start signal output from fire alarm receiver 10 to start strobe 5.

[0037] Also, input/output control unit 94 is connected to release display light 8 via a signal line, and receives an activation signal output from fire alarm receiver 10 to activate release display light 8.

[0038] Next, a specific configuration of fire alarm receiver 10 will be described.

[0039] FIG. 4 is a block diagram showing the internal configuration of fire alarm receiver 10. Fire alarm receiver 10 shown in FIG. 4 includes control unit 101, display unit 102, buzzer 103, and transmission unit 104.

[0040] Control unit 101 includes processor 1011 and memory 1012 for storing control program P. Processor 1011 activates control program P stored in memory 1012 to execute a reception operation and a fire-extinguishing operation, which will be described later. The details of this control unit 101 will be described later.

[0041] Display unit 102 includes fire light 1021, release warning light 1022, release light 1023, and countdown display 1024. Fire light 1021 is turned on when one fire detector 2 performs operation or manual release switch 6 is operated. When the two fire detectors 2 perform operation, release warning light 1022 lights up during the countdown until the fire-extinguishing gas is released. Release light 1023 lights up during the release of fire-extinguishing gas. Countdown display 1024 is a 7-segment display that displays a countdown until the fire-extinguishing gas is released.

[0042] Buzzer 103 is an acoustic device for alerting of the occurrence of a fire.

[0043] Transmission unit 104 is connected to fire detector 2, gas fire-

extinguishing control device 9, and repeater 14 via a signal line, and transmits and receives signals to and from these devices.

[0044] Next, the details of control unit 101 will be described.

Memory 1012 of control unit 101 stores link control table TBL1 and protected area setting table TBL2 in addition to control program P described above.

[0045] Link control table TBL1 is a table that is referred to in order to specify the processing to be executed in a linked manner when an event occurs in fire alarm receiver 10. In link control table TBL1, processing to be executed is associated with each event that occurs in fire alarm receiver 10. For example, the processing for alarm operation on the board surface and the processing for intermittent ringing of bell 4 are associated with an event of receiving the first operation signal from fire detector 2 installed in a protected area where the operation mode is the automatic mode. Also, as another example, the processing of outputting a start signal to repeater 14 is associated with the event of the end of the countdown.

[0046] Protected area setting table TBL2 is a table that is referred to in order to specify the devices that are to operate in a linked manner in each protected area. Also, this table is a table that is referred to in order to determine the operation mode of the protected area. In protected area setting table TBL2, the addresses of fire detector 2, gas fire-extinguishing control device 9, and repeater 14 that are linked to each other are associated for each protected area ID. Also, for each address of gas fire-extinguishing control device 9, the addresses of bell 4, strobe 5, manual release switch 6, emergency stop switch 7, and release display light 8, which are linked to each other, and the operation mode are associated with each other. In this table, the ID of the protected area and its operation mode are associated with each other via the address of gas fire-

extinguishing control device 9.

[0047] This protected area setting table TBL2 is edited on an information processing device such as a smart phone or a tablet terminal, which is a device that is different from fire alarm receiver 10. Then, the edited protected area setting table TBL2 is stored in memory 1012 of fire alarm receiver 10 via a storage medium such as an SD card or wired or wireless communication.

[0048] Next, the functions realized due to processor 1011 executing the above-described control program P will be described.

By executing the above-described control program P, processor 1011 realizes the functions of reception unit 105, operation mode determination unit 106, processing specification unit 107, and processing execution unit 108. Hereinafter, each function will be described.

[0049] Reception unit 105 receives signals from each of fire detector 2 and gas fire-extinguishing control device 9 by a polling/selecting method. Specifically, fire detector 2 and gas fire-extinguishing control device 9 perform normal point polling, and a signal is collected from a device that responds.

[0050] Here, normal point polling is polling in which fire detectors 2 and gas fire-extinguishing control devices 9 installed in building B are divided into a plurality of groups and polling is sequentially performed in units of groups. In each normal point polling, the normal response timing is set for each of the devices belonging to a group. A device having a signal to be output outputs the signal and the address at the response timing set in that device, in response to the polling signal output from receiving unit 105. Also, in each normal point polling, a special response timing is set for one group that includes only all gas fire-extinguishing control devices 9 installed in building B. Gas fire-extinguishing control device 9 having a signal to be output outputs only

an address at the response timing set for that group in response to the polling signal output from reception unit 105. Here, the reason why the special response timing is set separately for gas fire-extinguishing control device 9 is so that fire alarm receiver 10 quickly receives a stop signal output from gas fire-extinguishing control device 9. Since gas fire-extinguishing control device 9 has more response timings per device than fire detector 2, the stop signal output from gas fire-extinguishing control device 9 is received with priority over fire alarm receiver 10, compared to the operation signal output from fire detector 2.

[0051] FIG. 5 is a time chart showing an example of this normal system polling. FIG. 5 shows normal point polling PL1, PL2, and PL3, in which fire detector 2 and gas fire-extinguishing control device 9 installed in building B are divided into three groups and polling is performed in order in each group. In normal point polling PL1, one of normal response timings T0, T1, T2, and T3 is set for each of the devices belonging to the group. Also, special response timing Tg is set for one group including only all gas fire-extinguishing control devices 9. A device having a signal to be output responds at the response timing set for that device in response to polling signal S1 output from receiving unit 105.

[0052] In normal point polling PL2, one of normal response timings T4, T5, T6, and T7 is set for each of the devices belonging to the group. Also, special response timing Tg is set for one group including only all gas fire-extinguishing control devices 9. The device having the signal to be output responds at a response timing set for that device in response to polling signal S2 output from reception unit 105.

[0053] In normal point polling PL3, one of normal response timings T8, T9, T10, and T11 is set for each of the devices belonging to the group. Also, special response timing Tg is set for one group including only all gas fire-

extinguishing control devices 9. The device having the signal to be output responds at the response timing set for the device in response to polling signal S3 output from reception unit 105.

[0054] When a response is made at any of the special response timings of this normal point polling, reception unit 105 performs status confirmation selecting on gas fire-extinguishing control device 9 that made the response, and collects a signal from the device.

[0055] Note that the number of normal point pollings PL shown in FIG. 5 and the number of normal response timings T of each normal point polling PL are merely examples. These numbers may be appropriately changed according to the number of fire detectors 2 and gas fire-extinguishing control devices 9 installed in building B. For example, in building B, where a total of 256 fire detectors 2 and gas fire-extinguishing control devices 9 are installed, the number of normal point pollings PL may be set to “16”, and the number of normal response timings T of each normal point polling PL may be set to “16”.

The above is the description of reception unit 105.

[0056] Next, operation mode determination unit 106 determines the operation mode set for the protected area with reference to protected area setting table TBL2.

[0057] Processing specification unit 107 refers to link control table TBL1 and specifies the processing to be executed in a linked manner with the event generated in fire alarm receiver 10. Then, the information of the specified processing is stored in the buffer. There are two types of buffers, normal buffers and priority buffers. Information on the processing for stopping the countdown is stored in the priority buffer, and information on other processing is stored in the normal buffer. Here, the reason why the information of the processing for stopping the countdown is stored in the priority buffer is to give priority to the execution of the

processing.

[0058] Processing execution unit 108 reads out the processing information stored in the normal buffer and the priority buffer, and executes the processing indicated by the read-out processing information. At that time, processing execution unit 108 reads out the processing information stored in the priority buffer with priority over the processing information stored in the normal buffer. Specifically, if processing information is stored in the priority buffer, the processing information stored in the priority buffer is read out first even if processing information is stored in the normal buffer before that processing information. For this reason, processing execution unit 108 executes processing corresponding to a stop signal output from emergency stop switch 7 with priority over processing corresponding to the operation signal output from fire detector 2 or processing corresponding to the start signal output from manual release switch 6.

When processing execution unit 108 executes the processing to be controlled in a linked manner, processing execution unit 108 refers to protected area setting table TBL2 and specifies the device that is to operate in a linked manner in each protected area.

[0059] 1-2. Operation

Next, the operation of gas-based fire-extinguishing system 1 will be described. Specifically, a reception operation performed by reception unit 105 of fire alarm receiver 10 and a fire-extinguishing operation performed by gas-based fire-extinguishing system 1 will be described.

[0060] 1-2-1. Reception Operation

FIG. 6 is a flowchart showing a reception operation executed by reception unit 105 of fire alarm receiver 10.

In the reception operation shown in FIG. 6, reception unit 105 first sets variable g indicating the number of the group formed by fire detector 2

and gas fire-extinguishing control device 9 installed in building B to “0” (step Sa1). Next, normal point polling is performed on the group indicated by the set group number (step Sa2). When a response is made at the special response timing of this normal system polling (YES in step Sa3), reception unit 105 performs status confirmation selecting on gas fire-extinguishing control device 9 that made the response, and collects signals from the device (step Sa4). Then, the processing proceeds to step Sa5. On the other hand, if no response is made at the special response timing (NO in step Sa3), the processing proceeds to step Sa5 without executing step Sa4.

[0061] In step Sa5, reception unit 105 increments variable g by “1”. As a result, if variable g exceeds value G indicating the total number of groups, reception unit 105 returns to step Sa1 and sets variable g to “0” again. On the other hand, if variable g does not exceed value G indicating the total number of groups, reception unit 105 returns to step Sa2 and performs normal point polling on the group indicated by the set group number.

The above is the description of the reception operation executed by reception unit 105 of fire alarm receiver 10.

[0062] 1-2-2. Fire-Extinguishing Operation

Next, the fire-extinguishing operation performed by gas-based fire-extinguishing system 1 will be described. Specifically, the fire-extinguishing operation for a protected area in which the operation mode is set to the automatic mode will be described. Also, a fire-extinguishing operation for a protected area in which the operation mode is set to the manual mode will be described.

[0063] 1-2-2-1. Automatic Mode

FIGS. 7 and 8 are sequence diagrams showing an example of a fire-extinguishing operation for a protected area in which the operation mode

is set to the automatic mode.

If a fire breaks out in the protected area where the operation mode is set to the automatic mode (hereinafter referred to as “protected area P1” in the description of this operation), and the fire that broke out is detected by fire detector 2 installed in protected area P1, fire detector 2 outputs an operation signal to fire alarm receiver 10. Control unit 101 of fire alarm receiver 10 to which this operation signal is input (step Sb1) turns on fire light 1021 of fire alarm receiver 10 and sounds buzzer 103 (step Sb2). As a result, an observer in monitoring room R4 can know that a fire has been detected in protected area P1.

[0064] Also, control unit 101 outputs a start signal to gas fire-extinguishing control device 9 installed in protected area P1 in order to intermittently ring bell 4 installed in protected area P1 (step Sb3). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 intermittently rings bell 4 (step Sb4). As a result, a person in protected area P1 can know that a fire has been detected in protected area P1.

[0065] Thereafter, when a fire is detected by another fire detector 2 in protected area P1, other fire detector 2 outputs an operation signal to fire alarm receiver 10. Control unit 101 of fire alarm receiver 10 to which this operation signal is input (step Sb5) determines that a countdown condition is satisfied when the operation signal is input from two different fire detectors 2. Then, a countdown (e.g., 60 seconds) until the fire-extinguishing gas is released into protected area P1 is started, and the countdown is displayed on countdown display 1024 (step Sb6). Also, control unit 101 turns on release warning light 1022 of fire alarm receiver 10 (step Sb7). As a result, an observer in monitoring room R4 can know that the fire-extinguishing gas will be released into protected area P1, and can know the number of seconds until it is released.

[0066] Also, control unit 101 outputs a start signal to gas fire-extinguishing control device 9 in order to cause release warning light 9214 in gas fire-extinguishing control device 9 installed in protected area P1 to blink, and in order to display the above-described countdown on countdown display 922 (step Sb8). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 controls display unit 92. In display unit 92, countdown display 922 displays the countdown until the fire-extinguishing gas is released into protected area P1 (step Sb9), and release warning light 9214 blinks (step Sb10). As a result, a person who sees the display surface of gas fire-extinguishing control device 9 can know that the fire-extinguishing gas will be released into protected area P1, and can know the number of seconds until the fire-extinguishing gas is released.

[0067] Note that the remaining time displayed on countdown display 922 may be earlier than the remaining time displayed on countdown display 1024 of fire alarm receiver 10. As a result, a situation is reliably avoided in which the fire-extinguishing gas is released from spray heads 3 even though emergency stop switch 7 was operated before the countdown displayed on countdown display 922 was completed.

[0068] Also, control unit 101 of fire alarm receiver 10 outputs a start signal to gas fire-extinguishing control device 9 installed in protected area P1 in order to make bell 4 installed in protected area P1 ring intermittently in shorter cycles (step Sb11). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 intermittently rings bell 4 in shorter cycles (step Sb12). As a result, a person in protected area P1 can know that the fire-extinguishing gas will be released into protected area P1.

[0069] Thereafter, when the countdown performed by control unit 101 of fire alarm receiver 10 is completed (step Sb13), control unit 101 determines

that the gas release condition is satisfied. Then, in order to release the fire-extinguishing gas into protected area P1, a start signal is output to repeater 14 that controls the container valve solenoid of starting gas container 13 installed for protected area P1 (step Sb14). When this start signal is input to repeater 14, repeater 14 operates the container valve solenoid to release the starting gas from starting gas container 13. Then, the container valve of fire-extinguishing gas storage container 11 and selection valve 12 installed for protected area P1 are opened by the gas pressure of the starting gas. As a result, the fire-extinguishing gas stored in fire-extinguishing gas storage container 11 is released from spray heads 3 installed in protected area P1 through the pipe branched by selection valve 12.

[0070] When selection valve 12 is opened, a pressure switch (not shown) is operated, and an operation signal is output to fire alarm receiver 10. Control unit 101 of fire alarm receiver 10 to which this operation signal is input (step Sb15) turns off release warning light 9214 of fire alarm receiver 10 and turns on release light 1023 instead (step Sb16). As a result, an observer in monitoring room R4 can know that the fire-extinguishing gas has been released into protected area P1.

[0071] Also, control unit 101 outputs a start signal to gas fire-extinguishing control device 9 in order to light release light 9215 in gas fire-extinguishing control device 9 installed in protected area P1 (step Sb17). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 controls display unit 92. In display unit 92, release warning light 9214 is turned off, and release light 9215 is turned on instead (step Sb18). As a result, a person who sees the display surface of gas fire-extinguishing control device 9 can know that the fire-extinguishing gas is being released into protected area P1.

[0072] Also, control unit 101 of fire alarm receiver 10 outputs a start signal to

gas fire-extinguishing control device 9 installed in protected area P1 in order to continuously ring bell 4 installed in protected area P1 (step Sb19). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 continuously rings bell 4 (step Sb20). As a result, a person in protected area P1 can know that the fire-extinguishing gas is being released in protected area P1.

[0073] Also, control unit 101 of fire alarm receiver 10 outputs a start signal to gas fire-extinguishing control device 9 installed in protected area P1 in order to make strobe 5 installed in protected area P1 emit light (step Sb21). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 causes strobe 5 to emit light (step Sb22). As a result, a person in protected area P1 can visually know that the fire-extinguishing gas is being released in protected area P1.

[0074] Also, control unit 101 of fire alarm receiver 10 outputs a start signal to gas fire-extinguishing control device 9 installed in protected area P1 in order to light release display light 8 installed in protected area P1 (step Sb23). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 turns on release display light 8 (step Sb24). As a result, a person near the entrance of protected area P1 can know that the fire-extinguishing gas is being released into protected area P1.

The above is the description of the fire-extinguishing operation for the protected area where the operation mode is set to the automatic mode.

[0075] In the above fire-extinguishing operation, when a person in protected area P1 notices a fire and operates manual release switch 6 installed in protected area P1, manual release switch 6 outputs a start signal. This start signal is relayed by input/output control unit 94 of gas fire-extinguishing control device 9 installed in protected area P1 and is input to fire alarm receiver 10. Control unit 101 of fire alarm receiver 10 to

which this start signal is input executes the above steps Sb6 and onward without waiting for the output of the operation signal from another fire detector 2. Also, a start signal is output to gas fire-extinguishing control device 9 in order to turn on manual release light 9216 in gas fire-extinguishing control device 9 installed in protected area P1. In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 turns on manual release light 9216 of display unit 92.

[0076] Also, in the above fire-extinguishing operation, after the start of the countdown, when a person in protected area P1 confirms that there is no fire and operates emergency stop switch 7 installed in protected area P1, emergency stop switch 7 outputs a stop signal. This stop signal is relayed by input/output control unit 94 of gas fire-extinguishing control device 9 installed in protected area P1 and is input to fire alarm receiver 10. Control unit 101 of fire alarm receiver 10 to which this stop signal is input stops the countdown. Also, a start signal is output to the gas fire-extinguishing control device 9 in order to stop the countdown displayed on countdown display 922 in gas fire-extinguishing control device 9 installed in protected area P1 and to turn on emergency stop light 9217. In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 controls display unit 92. In display unit 92, countdown display 922 stops the countdown, and emergency stop light 9217 lights up.

[0077] 1-2-2-2. Manual Mode

FIG. 9 is a sequence diagram showing an example of a fire-extinguishing operation for a protected area in which the operation mode is set to the manual mode.

When a fire breaks out in a protected area where the operation mode is set to the manual mode (hereinafter referred to as “protected area P2” in

the description of this operation) and a person who noticed this fire operates manual release switch 6 that is installed in protected area P2, manual release switch 6 outputs a start signal (step Sc1). This start signal is relayed by input/output control unit 94 of gas fire-extinguishing control device 9 installed in protected area P2, and is input to fire alarm receiver 10 (step Sc2). Control unit 101 of fire alarm receiver 10 to which this start signal is input turns on fire light 1021 of fire alarm receiver 10 and continuously sounds buzzer 103 (step Sc3).

[0078] Also, control unit 101 determines that the countdown condition is satisfied when manual release switch 6 is operated. Then, a countdown (e.g., 25 seconds) until the fire-extinguishing gas is released into protected area P2 is started, and the countdown is displayed on countdown display 1024 (step Sc4). Also, control unit 101 turns on release warning light 1022 of fire alarm receiver 10 (step Sc5).

[0079] Also, control unit 101 outputs a start signal to gas fire-extinguishing control device 9 in order to blink release warning light 9214 and turn on manual release light 9216 in gas fire-extinguishing control device 9 installed in protected area P2, and in order to display the above-described countdown on countdown display 922 (step Sc6). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 controls display unit 92. In display unit 92, countdown display 922 displays the countdown until the fire-extinguishing gas is released into protected area P2 (step Sc7), release warning light 9214 blinks, and manual release light 9216 lights up (step Sc8).

[0080] Note that the remaining time displayed on countdown display 922 may be earlier than the remaining time displayed on countdown display 1024 of fire alarm receiver 10.

[0081] Also, control unit 101 of fire alarm receiver 10 outputs a start signal to gas fire-extinguishing control device 9 installed in protected area P2 in

order to intermittently ring bell 4 installed in protected area P2 in short cycles (step Sc9). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 intermittently rings bell 4 in short cycles (step Sc10).

[0082] Thereafter, when the countdown performed by control unit 101 of fire alarm receiver 10 is completed (step Sc11), control unit 101 determines that the gas release condition is satisfied. Then, a start signal is output to repeater 14 that controls the container valve solenoid of starting gas container 13 installed for protected area P2, in order to release fire-extinguishing gas into protected area P2 (step Sc12). When this start signal is input to repeater 14, repeater 14 operates the container valve solenoid to release the starting gas from starting gas container 13. Then, the container valve of fire-extinguishing gas storage container 11 and selection valve 12 installed for protected area P2 are opened by the gas pressure of the starting gas. As a result, the fire-extinguishing gas stored in fire-extinguishing gas storage container 11 is discharged from spray heads 3 installed in protected area P2 through the pipe branched by selection valve 12.

[0083] When selection valve 12 is opened, a pressure switch (not shown) is operated, and an operation signal is output to fire alarm receiver 10. Control unit 101 of fire alarm receiver 10 to which this operation signal is input (step Sc13) turns off release warning light 9214 of fire alarm receiver 10 and turns on release light 1023 instead (step Sc14).

[0084] Also, control unit 101 outputs a start signal to gas fire-extinguishing control device 9 in order to light release light 9215 in gas fire-extinguishing control device 9 installed in protected area P2 (step Sc15). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 controls display unit 92. In display unit 92, release warning light 9214 is turned off, and release light 9215 is

turned on instead (step Sc16).

[0085] Also, control unit 101 of fire alarm receiver 10 outputs a start signal to gas fire-extinguishing control device 9 installed in protected area P2 in order to continuously ring bell 4 installed in protected area P2 (step Sc17). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 continuously rings bell 4 (step Sc18).

[0086] Also, control unit 101 of fire alarm receiver 10 outputs a start signal to gas fire-extinguishing control device 9 installed in protected area P2 in order to make strobe 5 installed in the protected area P2 emit light (step Sc19). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 causes strobe 5 to emit light (step Sc20).

[0087] Also, control unit 101 of fire alarm receiver 10 outputs a start signal to gas fire-extinguishing control device 9 installed in protected area P2 in order to light release display light 8 installed in protected area P2 (step Sc21). In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 turns on release display light 8 (step Sc22).

The above is the description of the fire-extinguishing operation for the protected area where the operation mode is set to the manual mode.

[0088] As described above, fire alarm receiver 10 according to the above-described embodiment receives the stop signal output from emergency stop switch 7 with priority over the operation signal output from fire detector 2. Also, as described above, fire alarm receiver 10 preferentially executes processing for stopping the countdown that is to be executed, in conjunction with the reception of the stop signal. For this reason, the delay time required from the operation of emergency stop switch 7 until fire alarm receiver 10 stops the countdown is shortened. As a result, a situation is prevented in which the fire-extinguishing gas is

released from spray heads 3 even though emergency stop switch 7 was operated before the countdown displayed on gas fire-extinguishing control device 9 was completed.

[0089] Also, gas fire-extinguishing control device 9 according to the embodiment described above includes input/output control unit 94 for relaying a signal between the terminal device installed in the same protected area and fire alarm receiver 10. Also, each terminal device is connected to gas fire-extinguishing control device 9 via a signal line, and sends and receives signals to and from fire alarm receiver 10 via gas fire-extinguishing control device 9. For this reason, a wiring task becomes easier compared to the case where each terminal device is directly connected to fire alarm receiver 10.

[0090] In the gas-based fire-extinguishing system described in Patent Document 1 above, the operation box, the release display light, and the speaker installed in each of the protected areas are respectively connected to the control panel by separate signal lines. For this reason, it has been necessary to prepare at least three repeaters for each protected area and connect each of these repeaters to the control panel with signal lines, which complicates the wiring task. On the other hand, in the above-described embodiment, the wiring task between the terminal device and the fire alarm receiver of the gas-based fire-extinguishing system is made easier.

[0091] Note that gas fire-extinguishing control device 9 according to the present embodiment can also be expressed as follows.

A relay device for relaying a signal between a terminal device installed in a protected area and a fire alarm receiver,

in which the terminal device includes:

a manual release switch for instructing release of fire-extinguishing gas from a spray head installed in the protected area, the manual release

switch being configured to output a first start signal when operated by a user;

an emergency stop switch for performing an emergency stop of release of fire-extinguishing gas from the spray head, the emergency stop switch being configured to output a stop signal when operated by a user; and

an alerting device configured to, upon receiving input of a second start signal, alert that fire-extinguishing gas is to be released from the spray head, and

the relay device includes:

an input/output control unit configured to relay the first start signal output from the manual release switch to the fire alarm receiver, relay a stop signal output from the emergency stop switch to the fire alarm receiver, and start up the alerting device in response to the second start signal output from the fire alarm receiver; and a display unit configured to display an amount of time until fire-extinguishing gas is released from the spray head.

[0092] 2. Modified Examples

The above-described embodiment may be modified as follows. The modified examples described below may be combined with each other.

[0093] 2-1. Modified Example 1

A horn may be used instead of bell 4 as an audio device installed in the protected area.

[0094] 2-2. Modified Example 2

In above-described building B, one gas fire-extinguishing control device 9 is installed in one protected area. However, two gas fire-extinguishing control devices 9 may be installed in a protected area with two entrances. In this case, the addresses of two gas fire-extinguishing control devices 9 are stored in protected area setting table TBL2 of fire alarm receiver 10 in association with the ID of the protected area. Also,

the operation mode is associated with each of the addresses of two gas fire-extinguishing control devices 9. That is, two operation modes are associated with the ID of the protected area. If these two operation modes are the same, the operation mode of the protected area can be uniquely determined. However, if these two operation modes are different, it cannot be determined whether the protected area is in the automatic mode or the manual mode. As a result, the fire-extinguishing operation performed by fire alarm receiver 10 is stopped. In view of this, in order to avoid such a situation, operation mode determination unit 106 of fire alarm receiver 10 may uniformly determine that the operation mode is the manual mode if the two operation modes associated with the protected area are different.

[0095] 2-3. Modified Example 3

In the fire-extinguishing operation executed in the above-described manual mode, if a person in protected area P2 confirms that there is no fire and operates emergency stop switch 7 installed in protected area P2 after the start of the countdown, emergency stop switch 7 may output a stop signal. This stop signal is relayed by input/output control unit 94 of gas fire-extinguishing control device 9 installed in protected area P2, and is input to fire alarm receiver 10. Control unit 101 of fire alarm receiver 10, to which this stop signal is input, stops the countdown. Also, a start signal is output to gas fire-extinguishing control device 9 in order to stop the countdown displayed on countdown display 922 in gas fire-extinguishing control device 9 installed in protected area P2 and to turn on emergency stop light 9217. In response to this start signal, input/output control unit 94 of gas fire-extinguishing control device 9 controls display unit 92. In display unit 92, countdown display 922 stops the countdown, and emergency stop light 9217 lights up.

[0096] 2-4. Modified Example 4

An analog fire detector may be used instead of fire detector 2. In this case, fire alarm receiver 10 determines the occurrence of a fire instead of fire detector 2. Specifically, fire alarm receiver 10 periodically receives an analog value (e.g., a value indicating smoke concentration) as a detector signal from the analog fire detector, compares the received analog value with a predetermined threshold value, and determines that a fire has occurred when the received analog value exceeds the predetermined threshold value.

DESCRIPTION OF REFERENCE NUMERALS

- [0097] 1: Gas-based fire-extinguishing system
 2: Fire detector
 3: Spray head
 4: Bell
 5: Strobe
 6: Manual release switch
 7: Emergency stop switch
 8: Release display light
 9: Gas fire-extinguishing control device
 10: Fire alarm receiver
 11: Fire-extinguishing gas storage container
 12: Selection valve
 13: Starting gas container
 14: Repeater
 91: Housing
 92: Display unit
 93: Mode selection switch
 94: Input/output control unit
 101: Control unit

102: Display unit
103: Buzzer
104: Transmission unit
105: Reception unit
106: Operation mode determination unit
107: Processing specification unit
108: Processing execution unit
921: Status display light
922: Countdown display
1011: Processor
1012: Memory
1021: Fire light
1022: Release warning light
1023: Release light
1024: Countdown display
9211: Power source light
9212: Automatic mode display light
9213: Manual mode display light
9214: Release warning light
9215: Release light
9216: Manual release light
9217: Emergency stop light
B: Building
P: Control program
PL1, PL2, PL3: Normal point polling
R1 to R3: Room
R4: Monitoring room
R5: Cylinder room
S1, S2, S3: Polling signal

T0 to T11: Normal response timing

TBL1: Link control table

TBL1, TBL2: Protected area setting table

Tg: Special response timing

CLAIMS

[Claim 1] A fire alarm receiver for receiving a signal from a terminal device installed in a protected area and executing processing according to the signal,

wherein the terminal device includes:

a fire detector that is installed in the protected area and is configured to output a detector signal;

a manual release switch for instructing release of fire-extinguishing gas from a spray head installed in the protected area, the manual release switch being configured to output a first start signal when operated by a user; and

an emergency stop switch for performing an emergency stop of release of fire-extinguishing gas from the spray head, the emergency stop switch being configured to output a stop signal when operated by a user, and

the fire alarm receiver

performs polling on a plurality of the terminal devices to receive a signal,

starts a countdown after receiving the detector signal or the first start signal,

stops the countdown upon receiving the stop signal before the countdown ends,

releases fire-extinguishing gas from the spray head when the countdown ends, and

receives the stop signal with priority over the detector signal,

wherein in the polling, a normal response timing is set for each of the plurality of the terminal devices, and a special response timing is set for the emergency stop switch in addition to the normal response timing.

[Claim 2] The fire alarm receiver according to claim 1, wherein the fire alarm receiver executes processing corresponding to the stop signal with priority over processing corresponding to the detector signal or the first start signal.

[Claim 3] The fire alarm receiver according to claim 1 or 2, wherein the fire alarm receiver receives the first start signal and the stop signal via a first gas fire-extinguishing control device installed in the protected area, includes a storage unit configured to store an operation mode in association with the first gas fire-extinguishing control device, if the operation mode stored in the storage unit is an automatic mode, the fire alarm receiver starts the countdown upon receiving the detector signal or the first start signal, and if the operation mode stored in the storage unit is a manual mode, the fire alarm receiver starts the countdown only when the first start signal is received, and if an operation mode that is different from that of the first gas fire-extinguishing control device is stored in the storage unit in association with a second gas fire-extinguishing control device installed in the protected area, the fire alarm receiver starts the countdown only when the first start signal is received.

[Claim 4] The fire alarm receiver according to claim 3,

wherein the terminal device further includes an alerting device configured to, upon receiving input of a second start signal, alert that fire-extinguishing gas is to be released from the spray head, and

the first gas fire-extinguishing control device includes:

an input/output control unit configured to relay the first start signal output from the manual release switch to the fire alarm receiver, relay a stop signal output from the emergency stop switch to the fire alarm receiver, and start up the alerting device in response to the second start signal output from the fire alarm receiver; and

a display unit configured to display an amount of time until fire-extinguishing gas is released from the spray head.