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(54) **AUTOMATIC FIRE ALARM SYSTEM AND BASE DEVICE FOR AUTOMATIC FIRE ALARM SYSTEM**

**AUTOMATISCHES FEUERALARMSYSTEM UND BASISVORRICHTUNG FÜR AUTOMATISCHES  
FEUERALARMSYSTEM**

**SYSTÈME D'ALARME INCENDIE AUTOMATIQUE ET DISPOSITIF DE BASE POUR SYSTÈME  
D'ALARME INCENDIE AUTOMATIQUE**

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## Description

[Technical Field]

**[0001]** The present invention generally relates to an automatic fire alarm system and more particularly relates to an automatic fire alarm system in which a master unit and a slave unit are electrically connected to each other through a pair of electrical wires.

[Background Art]

**[0002]** There have been two types of such automatic fire alarm systems, namely, P-type (proprietary-type) and R-type (record-type) systems. Both the P-type automatic fire alarm system and the R-type automatic fire alarm system are configured to detect the occurrence of a fire by a slave unit including a heat sensor, a smoke sensor, and a flame sensor, and report the occurrence of the fire from the slave unit to a master unit including a receiver.

**[0003]** In the P-type automatic fire alarm system, the slave unit reports the occurrence of a fire to the master unit including the receiver by electrically short-circuiting a pair of electrical wires. In the R-type automatic fire alarm system, the slave unit reports the occurrence of a fire to the master unit via communication using a transmission signal that is transmitted through a transmission line. Generally, the R-type automatic fire alarm system is often used in a large building, and the P-type automatic fire alarm system is often used in a middle-sized or smaller building for reasons of easy installation and the like.

**[0004]** For example, document JP 2002-008154 A discloses a P-type automatic fire alarm system in which a plurality of fire sensors which are slave units are connected to a plurality of sensor lines led from a fire receiver which is a master unit. The automatic fire alarm system disclosed in document JP 2002-008154 A is configured such that when a slave unit detects an abnormality of the slave unit itself, the slave unit outputs an abnormality detection signal having the same signal format as a fire signal which is to be output to the master unit when a fire is detected, for a predetermined period of time different from output time of the fire signal. When the master unit receives the abnormality detection signal, the master unit distinguishes this input from input of the fire signal by a difference between input time of this abnormality detection signal and that of the fire signal, and performs a predetermined alarm operation.

**[0005]** Document JP 2011-243106 A discloses a P-type fire alarm system connecting a plurality of fire sensors to a sensor line led out of a receiver. The fire sensor comprises an alarm activation control part sequentially outputting a fire alarm activation signal and an address code signal when detecting a fire and activating an alarm, a first switching circuit transmitting a common fire signal by applying a first voltage change when the fire alarm activation signal is output, and a second switching circuit transmitting an address signal by applying a second volt-

age change when the address code signal is output.

**[0006]** Document JP 2002-109649 A discloses a fire alarm system comprising a fire receiver for alarming, while monitoring a fire per each sensor circuit connected to a fire sensor, is provided with a test alarm generation confirming unit for confirming a result of receiving, when generating the alarm for the test of the fire sensor by sending the result of the fire back to the fire sensor.

10 [Summary of Invention]

[Technical Problem]

**[0007]** In the automatic fire alarm system disclosed in document JP 2002-008154 A, however, the master unit can merely distinguish between the fire signal and the abnormality detection signal received from the slave unit, and the slave unit is not capable of transmitting various data to the master unit via communication using a transmission signal unlike in the R-type system. This means that the automatic fire alarm system disclosed in document JP 2002-008154 A is not capable of additionally including a function installed in the R-type system, such as the function of identifying a slave unit that issues a notification or the function of automatic testing.

**[0008]** The present invention has been made in light of the issues described above and is intended to provide an automatic fire alarm system with the simplest possible configuration that is capable of additionally including a function of the R-type system even through this automatic fire alarm system is of the P type.

[Solution to Problem]

**[0009]** An automatic fire alarm system according to an aspect of the present invention includes: a master unit including a voltage applicator that applies a voltage to a pair of electrical wires; at least one first slave unit that is electrically connected to the pair of electrical wires and switches between a state of short-circuiting the pair of electrical wires and a state of not short-circuiting the pair of electrical wires; and at least one second slave unit that is electrically connected to the pair of electrical wires and transmits a downlink current signal which includes an electric current signal and is generated in the pair of electrical wires by changing an electric current flowing in from the pair of electrical wires, wherein the master unit includes: a resistor that is provided between the voltage applicator and at least one of the pair of electrical wires and limits an electric current that flows through the pair of electrical wires when the pair of electrical wires is short-circuited by the at least one first slave unit; and a receiver that receives a downlink voltage signal resulting from conversion of the downlink current signal into a change in voltage in the pair of electrical wires by a voltage drop at the resistor.

**[0010]** A master unit for an automatic fire alarm system according to an aspect of the present invention is a mas-

ter unit for an automatic fire alarm including: at least one first slave unit that is electrically connected to a pair of electrical wires and switches between a state of short-circuiting the pair of electrical wires and a state of not short-circuiting the pair of electrical wires; and at least one second slave unit that is electrically connected to the pair of electrical wires and transmits a downlink current signal which includes an electric current signal and is generated in the pair of electrical wires by changing an electric current flowing in from the pair of electrical wires, and the master unit includes: a voltage applicator that applies a voltage between the pair of electrical wires; a resistor that is provided between the voltage applicator and at least one of the pair of electrical wires and limits an electric current that flows through the pair of electrical wires when the pair of electrical wires is short-circuited by the at least one first slave unit; and a receiver that receives a downlink voltage signal resulting from conversion of the downlink current signal into a change in voltage in the pair of electrical wires by a voltage drop at the resistor.

#### [Advantageous Effects of Invention]

**[0011]** According to an aspect of the present invention, at least one second slave unit that transmits a downlink current signal by changing an electric current flowing in from a pair of electrical wires is provided, and therefore it is possible to transmit various data from the second slave unit to the master unit. In addition, in the automatic fire alarm system according to an aspect of the present invention, a resistor for limiting an electric current that flows through a pair of electrical wires when the pair of electrical wires is short-circuited by the first slave unit is also used to convert, into a voltage signal, an electric current signal transmitted from the second slave unit. There is therefore the advantage of allowing even the P-type system to have the simplest possible configuration and additionally include a function of the R-type system.

#### [Brief Description of Drawings]

#### **[0012]**

[FIG. 1] FIG. 1 illustrates a schematic configuration of an automatic fire alarm system according to an embodiment.

[FIG. 2] FIG. 2 illustrates an overall configuration of an automatic fire alarm system according to an embodiment.

[FIG. 3] FIG. 3 illustrates an automatic testing operation of an automatic fire alarm system according to an embodiment.

[FIG. 4] FIG. 4 illustrates an operation performed by an automatic fire alarm system according to an embodiment upon issuance of a notification.

#### [Description of Embodiment]

**[0013]** Automatic fire alarm system 1 according to the present embodiment includes master unit 2, at least one first slave unit 3, and at least one second slave unit 4, as illustrated in FIG. 1.

**[0014]** Master unit 2 includes voltage applicator 21 that applies a voltage between a pair of electrical wires 51 and 52.

**[0015]** First slave unit 3 is electrically connected to a pair of electrical wires 51 and 52 and switches between the state of short-circuiting the pair of electrical wires 51 and 52 and the state of not short-circuiting the pair of electrical wires 51 and 52.

**[0016]** Second slave unit 4 is electrically connected to a pair of electrical wires 51 and 52 and transmits a downlink current signal which includes an electric current signal and is generated in the pair of electrical wires 51 and 52 by changing an electric current flowing in from the pair of electrical wires 51 and 52.

**[0017]** Master unit 2 includes resistor 22 and receiver 23. Resistor 22 is provided between voltage applicator 21 and at least one of a pair of electrical wires 51 and 52 and limits an electric current that flows through the pair of electrical wires 51 and 52 when the pair of electrical wires 51 and 52 is short-circuited by first slave unit 3. Receiver 23 receives a downlink voltage signal resulting from conversion of the downlink current signal into a change in voltage in the pair of electrical wires 51 and 52 by a voltage drop at resistor 22.

**[0018]** Thus, automatic fire alarm system 1 according to the present embodiment is a system in which two different slave units, first slave unit 3 and second slave unit 4, co-exist. First slave unit 3 is a slave unit of a type that reports the occurrence of a fire to master unit 2 by short-circuiting a pair of electrical wires 51 and 52. Second slave unit 4 is a slave unit of a type that reports the occurrence of a fire to master unit 2 via communication using a transmission signal that is transmitted through a pair of electrical wires 51 and 52.

**[0019]** In automatic fire alarm system 1 according to the present embodiment, resistor 22 in master unit 2 is shared by first slave unit 3 and second slave unit 4. To put it another way, in this automatic fire alarm system 1, resistor 22 for limiting an electric current that flows through a pair of electrical wires 51 and 52 when the pair of electrical wires 51 and 52 is short-circuited by first slave unit 3 is also used to convert, into a voltage signal, an electric current signal transmitted from second slave unit 4.

**[0020]** Automatic fire alarm system 1 according to the present embodiment is described in detail below. The configurations described below are a mere example of the present invention, meaning that the present invention is not limited to the embodiment described below; various modifications can be made in the present invention according to the design and the like within the scope of the technical idea of the present invention to provide other

embodiments.

#### Overall Configuration

**[0021]** In the present embodiment, automatic fire alarm system 1 used in a housing complex (condominium apartments) is described as an example; however, automatic fire alarm system 1 is applicable not only to a housing complex, but also to various buildings such as commercial facilities, hospitals, hotels, and multi-tenant buildings.

**[0022]** In automatic fire alarm system 1 according to the present embodiment, one master unit 2, a plurality of first slave units 301, 302, 303, ... and a plurality of second slave units 401, 402, 403, ... are provided in one housing complex 6, as illustrated in FIG. 2. The plurality of first slave units 301, 302, 303, ... are herein referred to simply as "first slave unit 3" when these first slave units are not particularly distinguished from one another, and the plurality of second slave units 401, 402, 403, ... are herein referred to simply as "second slave unit 4" when these second slave units are not particularly distinguished from one another.

**[0023]** Furthermore, in this automatic fire alarm system 1, a pair of electrical wires 51 and 52 is provided on each of the first to the fourth floors. In other words, housing complex 6 includes four sets, in total, of paired electrical wires 51 and 52, which are two electrical wires forming one set (a two-wire system).

**[0024]** Although first slave unit 3 and second slave unit 4 co-exist even on the same floor in the example illustrated in FIG. 2, first slave unit 3 and second slave unit 4 need not co-exist on the same floor. As a specific example, there may be only first slave units 3 on the first floor and on the second floor while there are only second slave units 4 on the third floor and on the fourth floor; first slave unit 3 and second slave unit 4 may be present on different floors. In this case, only the same type of slave unit (first slave unit 3 or second slave unit 4) is electrically connected to a pair of electrical wires 51 and 52 in the same set. Even in this case, first slave unit 3 and second slave unit 4 are electrically connected through (a plurality of sets of) paired electrical wires 51 and 52 when viewed from master unit 2, meaning that two types of slave units, namely, first slave unit 3 and second slave unit 4, co-exist in automatic fire alarm system 1.

**[0025]** In this example, up to 30 slave units (first slave units 3 or second slave units 4) can be connected to each set of electrical wires 51 and 52, and up to 50 to 200 lines (50 to 200 sets) of paired electrical wires 51 and 52 can be connected to one master unit 2. Thus, when up to 130 lines of paired electrical wires 51 and 52 can be connected to one master unit 2, for example, up to 3,900 ( $= 30 \times 130$ ) slave units (first slave units 3 or second slave units 4) can be connected to one master unit 2. Note that these numerical values are one example; it is not intended that the present invention be limited to these numerical values.

**[0026]** Paired electrical wires 51 and 52 are electrically connected to each other via terminating resistor 7 at a terminating end of paired electrical wires 51 and 52 (which is an end opposite master unit 2). Master unit 2 is therefore capable of detecting disconnection of paired electrical wires 51 and 52 by monitoring an electric current flowing through paired electrical wires 51 and 52.

**[0027]** When only second slave units 4 are connected to each set of electrical wires 51 and 52, up to 40 to 80 slave units (second slave units 4) can be connected. Thus, when up to 40 second slave units 4 can be connected to each set of electrical wires 51 and 52 and up to 50 lines of paired electrical wires 51 and 52 can be connected to one master unit 2, for example, up to 2,000 ( $= 40 \times 50$ ) second slave units 4 can be connected to one master unit 2. Note that these numerical values are one example; it is not intended that the present invention be limited to these numerical values. In this case, terminating resistors 7 are omitted.

**[0028]** Automatic fire alarm system 1 is basically configured to detect the occurrence of a fire by slave units (first slave unit 3 and second slave unit 4) including a heat sensor, a smoke sensor, and a flame sensor, and report the occurrence of a fire from the slave unit to master unit 2 which is a receiver. The slave units (first slave unit 3 and second slave unit 4) may include not only a sensor that detects the occurrence of a fire, but also a beacon or the like. The beacon is a device having a push-button switch (not illustrated in the drawings) and that when a person who discovers a fire manually operates the push-button switch, reports the occurrence of a fire to master unit 2.

**[0029]** There are two types of general automatic fire alarm systems, P-type (proprietary-type) and R-type (record-type) systems. In the P-type automatic fire alarm system, a slave unit reports the occurrence of a fire to a master unit by electrically short-circuiting a pair of electrical wires. In the R-type automatic fire alarm system, a slave unit reports the occurrence of a fire to a master unit via communication using a transmission signal that is transmitted through a transmission line.

**[0030]** Automatic fire alarm system 1 according to the present embodiment is basically of the P type. More specifically, in the case assumed in the present embodiment, in the housing complex in which the P-type automatic fire alarm system is provided, existing wiring (electrical wires 51 and 52) is used with a receiver replaced (by master unit 2) and slave units replaced (by first slave unit 3 and second slave unit 4). The slave units may include an existing slave unit. Note that automatic fire alarm system 1 according to the present embodiment can be applied as a newly introduced automatic fire alarm system.

**[0031]** In other words, by using second slave unit 4 capable of communication using a transmission signal, automatic fire alarm system 1 according to the present embodiment additionally includes a function of the R-type system even through this automatic fire alarm system is of the P type. Specifically, in automatic fire alarm system

1, when a notification is issued, second slave unit 4 transmits a preassigned identifier (address) to master unit 2, and thus master unit 2 is capable of identifying not a set of paired electrical wires 51 and 52, but a slave unit (second slave unit 4), as the source that issues the notification. Furthermore, in automatic fire alarm system 1, while no notification is issued (in the normal situation), communication can be performed between master unit 2 and second slave unit 4 to conduct automatic testing on the condition of communication between master unit 2 and second slave unit 4, an operation of second slave unit 4, and the like.

**[0032]** Automatic fire alarm system 1, in which the use of communication allows master unit 2 and second slave unit 4 to exchange various information with each other, can additionally include not only the function of identifying a slave unit as the source that issues a notification and the function of conducting the automatic testing as described above, but also various other functions.

**[0033]** Hereinafter, in the communication between master unit 2 and second slave unit 4, the flow of a transmission signal from second slave unit 4 to master unit 2 is referred to as "downlink", and the flow of a transmission from master unit 2 to second slave unit 4 is referred to as "uplink".

#### Configuration of Master Unit

**[0034]** In the present embodiment, master unit 2 is a P-type receiver which receives a report of the occurrence of a fire from a slave unit (first slave unit 3 or second slave unit 4). Master unit 2 is provided in a management room of a building (housing complex 6).

**[0035]** As illustrated in FIG. 1, master unit 2 includes not only voltage applicator 21, resistor 22, and receiver 23, but also transmitter 24 that transmits a transmission signal to second slave unit 4, display 25 that displays various data, input unit 26 that receives input from a user, and controller 27 that controls each element. When master unit 2 receives a report of the occurrence of a fire from a slave unit (first slave unit 3 or second slave unit 4), master unit 2 displays, on display 25, the location where the fire occurred and other information.

**[0036]** Controller 27 includes a microcomputer as a main element and provides a desired function by executing a program stored in a memory (not illustrated in the drawings). Note that the program may either be written into the memory in advance or be stored in a recording medium such as a memory card and provided in this state.

**[0037]** Furthermore, master unit 2 includes a function of coordination with other facilities such as a smoke blocker or ejector (not illustrated in the drawings) and an emergency broadcasting system (not illustrated in the drawings). With these, when master unit 2 receives a report of the occurrence of a fire, master unit 2 can, for example, control a fire door of the smoke blocker or ejector and output sound or voice from the emergency broad-

casting system to inform a user of the occurrence of the fire. Moreover, master unit 2 is electrically connected to an external notification transfer device (not illustrated in the drawings) and thus configured to, when master unit 2 receives a report of the occurrence of a fire from a slave unit, cause the external notification transfer device to report the fire to an external related person, fire authority, security company, and the like.

**[0038]** Master unit 2, which includes voltage applicator 21 that applies a voltage to a pair of electrical wires 51 and 52 as described above, functions as a power supply for operations of entire automatic fire alarm system 1 including the slave units (first slave unit 3 and second slave unit 4) connected to the pair of electrical wires 51 and 52. One example of the voltage which voltage applicator 21 applies between a pair of electrical wires 51 and 52 is direct-current 24 V; it is not intended that the voltage be limited to this value.

**[0039]** Master unit 2 further includes preliminary power supply 28 that uses a storage battery so that power supply for operations of automatic fire alarm system 1 can be secured even in the event of a power outage. The main power supply of master unit 2 is a commercial power supply, a private electric generator, or the like (not illustrated in the drawings). Voltage applicator 21 automatically switches the power supply source from the main power supply to preliminary power supply 28 in the event of a power outage of the main power supply and automatically switches the power supply source from preliminary power supply 28 to the main power supply after restoration of the main power supply. The specifications, such as electricity capacity, of preliminary power supply 28 are determined to meet a standard stipulated in a ministerial ordinance.

**[0040]** Resistor 22 is provided between voltage applicator 21 and at least one of a pair of electrical wires 51 and 52 as described above. In the example illustrated in FIG. 1, resistor 22 is inserted between voltage applicator 21 and one (a high potential one) of a pair of electrical wires 51 and 52, that is, electrical wire 51. Note that this example is non-limiting; resistor 22 may be inserted between voltage applicator 21 and the other (low potential) electrical wire 52 or may be inserted between voltage applicator 21 and each of a pair of electrical wires 51 and 52. Furthermore, resistor 22 is not limited to a single resistor and may be a resistor group including a plurality of resistors connected in series or in parallel.

**[0041]** Resistor 22 has the following two functions: the first function of limiting an electric current that flows through a pair of electrical wires 51 and 52 when the pair of electrical wires 51 and 52 is short-circuited by first slave unit 3; and the second function of converting, into a voltage signal, an electric current signal transmitted from second slave unit 4, as described above. In short, resistor 22 has both the first function as a current limiting element and the second function as a current-to-voltage converting element. One example of the resistance value of resistor 22 is 400  $\Omega$  or 600  $\Omega$ ; it is not intended that the

resistance value be limited to this value.

**[0042]** Receiver 23 and transmitter 24 are electrically connected between resistor 22 and a pair of electrical wires 51 and 52. Note that receiver 23 is not limited to being connected between resistor 22 and a pair of electrical wires 51 and 52 and may, for example, be electrically connected between voltage applicator 21 and resistor 22. Since receiver 23 receives a transmission signal from second slave unit 4 and transmitter 24 transmits a transmission signal to second slave unit 4, master unit 2 is capable of bidirectional communication with second slave unit 4.

**[0043]** Receiver 23 receives a transmission signal from second slave unit 4 as a voltage signal (a change in voltage) in a pair of electrical wires 51 and 52. Specifically, the downlink current signal which second slave unit 4 transmits (generates) into a pair of electrical wires 51 and 52 is converted into a downlink voltage signal by a voltage drop at resistor 22, and thus receiver 23 receives the downlink voltage signal as the transmission signal from second slave unit 4. In other words, receiver 23 receives, as the downlink voltage signal, a change in voltage (a voltage signal) that occurs in a pair of electrical wires 51 and 52 when second slave unit 4 changes an electric current flowing in from the pair of electrical wires 51 and 52.

**[0044]** Transmitter 24 transmits, to second slave unit 4, a transmission signal that is an electric current signal generated in a pair of electrical wires 51 and 52 by changing an electric current flowing in from the pair of electrical wires 51 and 52. The uplink current signal which transmitter 24 transmits (generates) into a pair of electrical wires 51 and 52 is converted into an uplink voltage signal by a voltage drop at resistor 22, and second slave unit 4 receives the uplink voltage signal as a transmission signal from master unit 2. In other words, second slave unit 4 receives, as the uplink voltage signal, a change in voltage (a voltage signal) that occurs in a pair of electrical wires 51 and 52 when transmitter 24 changes an electric current flowing in from the pair of electrical wires 51 and 52.

**[0045]** Master unit 2 further includes identifying unit 29 that identifies the state in which a pair of electrical wires 51 and 52 is short-circuited by first slave unit 3 (hereinafter referred to as a "short-circuited state") and the state in which a pair of electrical wires 51 and 52 is not short-circuited by first slave unit 3 (hereinafter referred to as a "non-short-circuited state"). Identifying unit 29 monitors the value of an electric current flowing between a pair of electrical wires 51 and 52 and distinguishes between the short-circuited state and the non-short-circuited state according to whether or not the value of this electric current exceeds a predetermined threshold value. Specifically, identifying unit 29 determines the current state as the non-short-circuited state when the value of the electric current flowing between a pair of electrical wires 51 and 52 is less than or equal to the threshold value, whereas identifying unit 29 determines the current state as the

short-circuited state when the value of the electric current flowing between a pair of electrical wires 51 and 52 exceeds the threshold value.

## 5 Configuration of Slave Unit

**[0046]** Next, the configurations of the slave units (first slave unit 3 and second slave unit 4) are described with reference to FIG. 1. In FIG. 1, one first slave unit 3 and one second slave unit 4 connected to a pair of electrical wires 51 and 52 and including sensors are illustrated, and the illustration of other slave units is omitted.

**[0047]** First slave unit 3 includes (first) diode bridge 31, (first) power supply circuit 32, (first) sensor 33, thyristor 34, and drive circuit 35.

**[0048]** Diode bridge 31 has input terminals electrically connected with a pair of electrical wires 51 and 52 and output terminals electrically connected with power supply circuit 32 and thyristor 34. Power supply circuit 32 generates power for operations of first slave unit 3 from power in a pair of electrical wires 51 and 52. Sensor 33 detects the occurrence of a fire. Drive circuit 35 switches the current state from the non-short-circuited state to the short-circuited state by turning ON thyristor 34 according to the output of sensor 33.

**[0049]** With this configuration, when first slave unit 3 detects the occurrence of a fire, first slave unit 3 reports the occurrence of a fire to master unit 2 by turning ON thyristor 34, placing a pair of electrical wires 51 and 52 in the short-circuited state in which a pair of electrical wires 51 and 52 is electrically short-circuited.

**[0050]** Second slave unit 4 includes (second) diode bridge 41, (second) power supply circuit 42, (second) sensor 43, transmitting circuit 44, receiving circuit 45, control circuit 46, and storage 47.

**[0051]** Diode bridge 41 has input terminals electrically connected with a pair of electrical wires 51 and 52 and output terminals electrically connected with power supply circuit 42, transmitting circuit 44, and receiving circuit 45. Power supply circuit 42 generates power for operations of second slave unit 4 from power in a pair of electrical wires 51 and 52. Sensor 43 detects the occurrence of a fire. Control circuit 46 controls transmitting circuit 44 and receiving circuit 45 to cause transmitting circuit 44 to transmit a transmission signal to master unit 2 according to the output of sensor 43 and to cause receiving circuit 45 to receive a transmission signal from master unit 2, for example.

**[0052]** Transmitting circuit 44 transmits, to master unit 2, a transmission signal that is an electric current signal generated in a pair of electrical wires 51 and 52 by changing an electric current flowing in from the pair of electrical wires 51 and 52. The downlink current signal which transmitting circuit 44 transmits (generates) into a pair of electrical wires 51 and 52 is converted into a downlink voltage signal by a voltage drop at resistor 22, and master unit 2 receives the downlink voltage signal as a transmission signal from second slave unit 4. In other words, master

unit 2 receives, as the downlink voltage signal, a change in voltage (a voltage signal) that occurs in a pair of electrical wires 51 and 52 when transmitting circuit 44 changes an electric current flowing in from the pair of electrical wires 51 and 52.

**[0053]** Receiving circuit 45 receives a transmission signal from master unit 2 as a voltage signal (a change in voltage) in a pair of electrical wires 51 and 52. Specifically, the uplink current signal which master unit 2 transmits (generates) into a pair of electrical wires 51 and 52 is converted into an uplink voltage signal by a voltage drop at resistor 22, and thus receiving circuit 45 receives the uplink voltage signal as the transmission signal from master unit 2. In other words, receiving circuit 45 receives, as the uplink voltage signal, a change in voltage (a voltage signal) that occurs in a pair of electrical wires 51 and 52 when master unit 2 changes an electric current flowing in from the pair of electrical wires 51 and 52.

**[0054]** Storage 47 stores at least an identifier (address) preassigned to second slave unit 4. Specifically, the plurality of second slave units 401, 402, 403, ... are assigned with unique identifiers in one-to-one correspondence. Each of the identifiers is registered in master unit 2 in association with an installation location (such as a room number) of a corresponding one of the plurality of second slave units 401, 402, 403, ....

**[0055]** With this configuration, when second slave unit 4 detects the occurrence of a fire, second slave unit 4 reports the occurrence of a fire to master unit 2 by transmitting, to master unit 2, data including at least the identifier stored in storage 47 via communication using a transmission signal that is transmitted through a pair of electrical wires 51 and 52. At this time, when master unit 2 receives the report of the occurrence of the fire from second slave unit 4, master unit 2 can identify, by the identifier included in the received data, second slave unit 4 that is the source that issues the notification.

**[0056]** Note that in the event of a power outage, the slave units (first slave unit 3 and second slave unit 4) operate with power supplied from preliminary power supply 28 of master unit 2. Since there are cases where multiple slave units are connected to one master unit 2, per-unit power consumption of the slave units (first slave unit 3 and second slave unit 4) need to be relatively small in order to allow automatic fire alarm system 1 to operate with power from preliminary power supply 28 for at least a predetermined length of time.

## Operations

**[0057]** Operations of automatic fire alarm system 1 according to the present embodiment are described below. In order to describe an operation involving communication between master unit 2 and second slave unit 4, the operation performed in automatic testing and the operation performed in issuing a notification are described as an example.

**[0058]** First, the operation performed by automatic fire

alarm system 1 in automatic testing is described with reference to FIG. 3. FIG. 3 illustrates a voltage waveform of a pair of electrical wires 51 and 52 with the horizontal axis being a time axis and the vertical axis representing voltage values.

**[0059]** At the time of conducting the automatic testing, master unit 2 switches the operating mode from a normal mode to an automatic testing mode. In the automatic testing mode, master unit 2 repeatedly transmits time-division test signals to a pair of electrical wires 51 and 52. The test signal is in the form of a voltage waveform including a plurality of sections along the time axis for each frame, as illustrated in FIG. 3. In other words, the test signal is a time-division signal including three sections (periods): synchronization zone 101; transmission zone 102; and reply zone 103. In FIG. 3, only one-frame part of the test signal is illustrated.

**[0060]** Master unit 2 periodically generates a synchronization signal in synchronization zone 101 by periodically changing the voltage which voltage applicator 21 applies to a pair of electrical wires 51 and 52. In transmission zone 102, master unit 2 transmits requested data from transmitter 24 to second slave unit 4. Reply zone 103 is a period in which master unit 2 receives reply data from second slave unit 4. Reply zone 103 is divided into a plurality of time slots T1, T2, T3, ..., so that time slots T1, T2, T3, ..., are assigned to second slave units 401, 402, 403, ..., respectively. In the example of FIG. 3, assuming the case where up to 64 second slave units 4 can be connected to one set of electrical wires 51 and 52, reply zone 103 is divided into 64 time slots T1 to T64.

**[0061]** In other words, master unit 2 periodically outputs a synchronization signal and sets, in the interval between two consecutive synchronization signals, transmission zone 102 and the plurality of time slots T1 to T64 that are assigned to second slave units 401, 402, 403, ... in one-to-one correspondence. In transmission zone 2, master unit 2 transmits requested data that is an instruction indicating automatic testing items to be conducted from transmitter 24 to second slave unit 4. The automatic testing items include, for example, a link check (keep-alive) and a self-check of second slave unit 4.

**[0062]** When second slave unit 4 receives a synchronization signal, second slave unit 4 switches the operating mode from a standby mode to a receiving mode and receives, at receiving circuit 45, the requested data from master unit 2 in transmission zone 102. Second slave unit 4 subsequently transmits reply data from transmitting circuit 44 to master unit 2 in the time slot assigned to second slave unit 4 itself among the plurality of time slots T1 to T64 of reply zone 103. The reply data include at least the identifier of second slave unit 4 that is a source that transmits the data and further include the result of the test indicating a normal or abnormal (or malfunction) condition. Thereafter, second slave unit 4 repeats the process of receiving requested data in transmission zone 102 and the process of transmitting reply data in reply zone 103 by performing the synchronization every time

second slave unit 4 receives a synchronization signal.

**[0063]** Next, the operation performed by automatic fire alarm system 1 in issuing a notification is described with reference to FIG. 4. FIG. 4 illustrates a voltage waveform of a pair of electrical wires 51 and 52 with the horizontal axis being a time axis and the vertical axis representing voltage values.

**[0064]** In this case, master unit 2 is operating in the normal mode and second slave unit 4 is operating in the standby mode. When no notification is issued (in the normal situation), master unit 2 applies, from voltage applicator 21, a constant voltage (for example, direct-current 24 V) between a pair of electrical wires 51 and 52. In this example, second slave unit 4 is configured to be able to reduce the voltage between a pair of electrical wires 51 and 52 step by step, by up to two steps, specifically, from "V3" to "V2" and "V1" ( $V3 > V2 > V1$ ), by adjusting the amount of an electric current which transmitting circuit 44 draws in.

**[0065]** When second slave unit 4 detects the occurrence of a fire, second slave unit 4 reports the occurrence of the fire to master unit 2 by reducing the voltage between a pair of electrical wires 51 and 52 by one step from "V3" to "V2" by drawing an electric current in at transmitting circuit 44. After standby time has elapsed since the reduction of the voltage to "V2", second slave unit 4 transmits the identifier of second slave unit 4 itself as notification data from transmitting circuit 44 to master unit 2 (S1 in FIG. 4). At this time, second slave unit 4 transmits the notification data by further reducing the voltage between a pair of electrical wires 51 and 52 by one step by drawing a further electrical current in at transmitting circuit 44, and switching alternately between "V2" and "V1". The standby time is set on the basis of the identifier (address) that is unique to second slave unit 4, and thus it is possible to avoid collision between the notification data from second slave units 4, which have different identifiers.

**[0066]** After the transmission of the notification data, second slave unit 4 ends the drawing in of an electric current performed at transmitting circuit 44 and sets the voltage between a pair of electrical wires 51 and 52 back to "V3". If second slave unit 4 continuously detects the occurrence of a fire, second slave unit 4 reports the occurrence of the fire to master unit 2 by reducing the voltage between one electrical wires 51 and 52 from "V3" to "V2" again and transmits notification data after a lapse of the standby time (S2).

**[0067]** Furthermore, in the case where second slave unit 4 is a sensor (coordination sensor) that generates coordination data for causing another facility to operate in coordination, when second slave unit 4 detects the occurrence of a fire, second slave unit 4 transmits, to master unit 2, coordination data instead of the notification data (S3). The coordination data includes the identifier of second slave unit 4 as does the notification data, and further includes coordination information necessary for causing another facility to operate in coordination. Even

in this case, second slave unit 4 reports the occurrence of the fire to master unit 2 by reducing the voltage between a pair of electrical wires 51 and 52 from "V3" to "V2" by drawing an electric current in at transmitting circuit 44, and transmits the coordination data after a lapse of the standby time. At the time of transmitting the coordination data, second slave unit 4 transmits the coordination data by further reducing the voltage between a pair of electrical wires 51 and 52 by one step by drawing a further electrical current in at transmitting circuit 44, and switching alternately between "V2" and "V1".

**[0068]** After the transmission of the coordination data, second slave unit 4, which is the coordination sensor, ends the drawing in of an electric current performed at transmitting circuit 44 and sets the voltage between a pair of electrical wires 51 and 52 back to "V3". If second slave unit 4, which is the coordination sensor, continuously detects the occurrence of a fire, second slave unit 4 reports the occurrence of the fire to master unit 2 by reducing the voltage between one electrical wires 51 and 52 from "V3" to "V2" again and transmits coordination data after a lapse of the standby time (S4).

**[0069]** In this way, at the occurrence of a fire, by drawing in an electric current in two steps, second slave unit 4 can transmit the notification data or the coordination data as triggered not by the synchronization signal, but by the voltage between a pair of electrical wires 51 and 52 being reduced from "V3" to "V2". In this case, second slave unit 4 can transmit the notification data or the coordination data while second slave unit 4 reports the occurrence of a fire to master unit 2 by reducing the voltage between a pair of electrical wires 51 and 52 from "V3" to "V2".

**[0070]** When receiver 23 receives the notification data from second slave unit 4, master unit 2 identifies, by the identifier included in the notification data, second slave unit 4 that issues the notification. Master unit 2 that identified the source that issues the notification displays, on display 25, the installation location (such as the room number) of second slave unit 4 that issues the notification, to inform a user of a fire in such a way that it is possible to identify not only the occurrence of the fire, but also the location of the fire. In addition to informing a user of a fire, when receiver 23 receives the coordination data from second slave unit 4, master unit 2 transmits a coordination signal to another facility to cause the facility to operate in coordination.

**[0071]** The timing for second slave unit 4 to transmit the notification data or the coordination data is not limited to a point in time during the period in which the occurrence of a fire is reported to master unit 2 by reducing the voltage between a pair of electrical wires 51 and 52 from "V3" to "V2" as described above. Specifically, second slave unit 4 may be configured, for example, to transmit the notification data or the coordination data before or after the occurrence of a fire is reported to master unit 2 by reducing the voltage between a pair of electrical wires 51 and 52 from "V3" to "V2". In this case, the configuration

in which second slave unit 4 reduces the voltage between a pair of electrical wires 51 and 52 step by step is not indispensable.

**[0072]** The communication between master unit 2 and second slave unit 4 performed in the automatic testing and in issuing a notification is premised on the non-short-circuited state in which a pair of electrical wires 51 and 52 to which this second slave unit 4 is connected is not short-circuited by first slave unit 3 as described above. In other words, in the short-circuited state in which a pair of electrical wires 51 and 52 is electrically short-circuited by first slave unit 3 turning ON thyristor 34, the communication such as that described above is not performed between master unit 2 and second slave unit 4 to which this pair of electrical wires 51 and 52 is connected. This means that at the occurrence of a fire, in the case where first slave unit 3 detects the occurrence of the fire earlier than second slave unit 4, first slave unit 3 rather than second slave unit 4 reports the occurrence of the fire to master unit 2.

#### Advantageous Effects

**[0073]** With automatic fire alarm system 1 according to the present embodiment described above, which includes at least one second slave unit 4 that transmits a downlink current signal by changing an electric current flowing in from a pair of electrical wires 51 and 52, it is possible to transmit various data from the slave unit (second slave unit 4) to master unit 2. Thus, automatic fire alarm system 1 is capable of conducting the automatic testing and identifying the source that issues a notification as described above, for example. If the automatic testing is possible, the burden of performing a test required to be performed on a regular basis can be removed, meaning that, for example, a reduction in labor cost can be expected. Furthermore, if it is possible to identify the source that issues a notification, it is advantageous that firefighting, evacuation guidance, and the like be efficient.

**[0074]** Moreover, in automatic fire alarm system 1 according to the present embodiment, resistor 22 for limiting an electric current that flows through a pair of electrical wires 51 and 52 when the pair of electrical wires 51 and 52 is short-circuited by first slave unit 3 is also used to convert, into a voltage signal, an electric current signal transmitted from second slave unit 4. Therefore, it is not necessary to provide current-voltage converters for paired electrical wires 51 and 52 separately from master unit 2; the structure of automatic fire alarm system 1 in which first slave unit 3 and second slave unit 4 co-exist is simple. As a result, automatic fire alarm system 1 according to the present embodiment has the advantage that with the simplest possible configuration, this automatic fire alarm system is capable of additionally including a function of the R-type system even through this automatic fire alarm system is of the P type.

**[0075]** In automatic fire alarm system 1, it is preferred

that master unit 2 include transmitter 24 and second slave unit 4 include receiving circuit 45 as in the present embodiment. Transmitter 24 generates an uplink current signal including an electric current signal in the pair of electrical wires 51 and 52 by changing an electric current flowing in between resistor 22 and a pair of electrical wires 51 and 52 from the pair of electrical wires 51 and 52. Receiving circuit 45 receives an uplink voltage signal resulting from conversion of the uplink current signal into a change in voltage in a pair of electrical wires 51 and 52 by a voltage drop at resistor 22. With this configuration, master unit 2 is capable of bidirectional communication with second slave unit 4.

**[0076]** In automatic fire alarm system 1, at least one second slave unit 4 may be a plurality of second slave units 4 as in the present embodiment. In this case, it is preferred that master unit 2 periodically output a synchronization signal and set, in the interval between two consecutive synchronization signals, a plurality of time slots that are assigned to second slave units 4 in one-to-one correspondence. In this case, it is preferred that each of the plurality of second slave units 4 be configured to transmit the downlink current signal in a corresponding time slot among the plurality of time slots. With this configuration, since master unit 2 and the plurality of second slave units 4 perform time-division communication, it is advantageous that communication interference between different second slave units 4 be avoided.

#### [Reference Signs List]

#### [0077]

|        |                             |
|--------|-----------------------------|
| 1      | automatic fire alarm system |
| 2      | master unit                 |
| 3      | first slave unit            |
| 4      | second slave unit           |
| 21     | voltage applicator          |
| 22     | resistor                    |
| 23     | receiver                    |
| 24     | transmitter                 |
| 45     | receiving circuit           |
| 51, 52 | a pair of electrical wires  |

#### Claims

1. An automatic fire alarm system (1), comprising:

a master unit (2) including a voltage applicator (21) configured to apply a voltage to a pair of electrical wires (51, 52) ;  
at least one first slave unit (3) that is electrically connected to the pair of electrical wires and configured to switch between a state of short-circuiting the pair of electrical wires and a state of not short-circuiting the pair of electrical wires; and

at least one second slave unit (4) that is electrically connected to the pair of electrical wires and configured to transmit a downlink current signal which includes an electric current signal and is generated in the pair of electrical wires by changing an electric current flowing in from the pair of electrical wires,

wherein the master unit (2) includes: a resistor (22) that is provided between the voltage applicator (21) and at least one of the pair of electrical wires and configured to limit an electric current that flows through the pair of electrical wires when the pair of electrical wires is short-circuited by the at least one first slave unit (3); and a receiver (23) configured to receive a downlink voltage signal resulting from conversion of the downlink current signal into a change in voltage in the pair of electrical wires by a voltage drop at the resistor (22).

2. The automatic fire alarm system (1) according to claim 1,

wherein the master unit (2) further includes a transmitter (24) configured to generate an uplink current signal including an electric current signal in the pair of electrical wires by changing the electric current flowing in between the resistor (22) and the pair of electrical wires from the pair of electrical wires, and the at least one second slave unit (4) includes a receiving circuit (45) configured to receive an uplink voltage signal resulting from conversion of the uplink current signal into a change in voltage in the pair of electrical wires by a voltage drop at the resistor (22).

3. The automatic fire alarm system (1) according to claim 1 or 2,

wherein the at least one second slave unit (4) is a plurality of second slave units (4), the master unit (2) is configured to periodically output a synchronization signal and is configured to set, in the interval between two consecutive signals, each of which is the synchronization signal, a plurality of time slots that are assigned to the plurality of second slave units (4) in one-to-one correspondence, and each of the plurality of second slave units (4) is configured to transmit the downlink current signal in a corresponding time slot among the plurality of time slots.

4. A master unit (2) for an automatic fire alarm system (1) including: at least one first slave unit (3) that is electrically connected to a pair of electrical wires (51, 52) and configured to switch between a state of short-circuiting the pair of electrical wires and a state of not short-circuiting the pair of electrical wires; and at least one second slave unit (4) that is electrically connected to the pair of electrical wires and configured to transmit a downlink current signal which in-

cludes an electric current signal and is generated in the pair of electrical wires by changing an electric current flowing in from the pair of electrical wires, the master unit (2) comprising:

a voltage applicator (21) configured to apply a voltage between the pair of electrical wires;

a resistor (22) that is provided between the voltage applicator (21) and at least one of the pair of electrical wires and configured to limit an electric current that flows through the pair of electrical wires when the pair of electrical wires is short-circuited by the at least one first slave unit (3); and

a receiver (23) configured to receive a downlink voltage signal resulting from conversion of the downlink current signal into a change in voltage in the pair of electrical wires by a voltage drop at the resistor (22).

## Patentansprüche

1. Automatisches Feueralarmsystem (1), umfassend:

eine Master-Einheit (2) mit einem Spannungsapplikator (21), der konfiguriert ist, um eine Spannung an ein Paar elektrischer Drähte (51, 52) anzulegen;

mindestens eine erste Slave-Einheit (3), die elektrisch mit dem Paar elektrischer Drähte verbunden ist und konfiguriert ist, um zwischen einem Zustand des Kurzschließens des Paares elektrischer Drähte und einem Zustand des Nicht-Kurzschließens des Paares elektrischer Drähte umzuschalten; und

mindestens eine zweite Slave-Einheit (4), die elektrisch mit dem Paar elektrischer Drähte verbunden ist und konfiguriert ist, um ein Downlink-Stromsignal zu übertragen, das ein elektrisches Stromsignal enthält und in dem Paar elektrischer Drähte erzeugt wird, indem ein elektrischer Strom, der von dem Paar elektrischer Drähte einfließt, geändert wird,

wobei die Master-Einheit (2) aufweist: einen Widerstand (22), der zwischen dem Spannungsapplikator (21) und mindestens einem aus dem Paar elektrischer Drähte vorgesehen ist und konfiguriert ist, um einen elektrischen Strom zu begrenzen, der durch das Paar elektrischer Drähte fließt, wenn das Paar elektrischer Drähte durch die mindestens eine erste Slave-Einheit (3) kurzgeschlossen wird; und einen Empfänger (23), der konfiguriert ist, um ein Downlink-Spannungssignal zu empfangen, das aus einer Umwandlung des Downlink-Stromsignals in eine Spannungsänderung in dem Paar elektrischer Drähte durch einen Spannungsabfall an dem

Widerstand (22) resultiert.

2. Automatisches Feueralarmsystem (1) nach Anspruch 1, wobei die Master-Einheit (2) ferner einen Sender (24) aufweist, der konfiguriert ist, um ein Uplink-Stromsignal, das ein elektrisches Stromsignal enthält, in dem Paar elektrischer Drähte zu erzeugen, indem der elektrische Strom, der von dem Paar elektrischer Drähte zwischen dem Widerstand (22) und dem Paar elektrischer Drähte einfließt, geändert wird, und die mindestens eine zweite Slave-Einheit (4) eine Empfangsschaltung (45) aufweist, die konfiguriert ist, um ein Uplink-Spannungssignal zu empfangen, das aus einer Umwandlung des Uplink-Stromsignals in eine Spannungsänderung in dem Paar elektrischer Drähte durch einen Spannungsabfall an dem Widerstand (22) resultiert.
3. Automatisches Feueralarmsystem (1) nach Anspruch 1 oder 2, wobei die mindestens eine zweite Slave-Einheit (4) mehrere zweite Slave-Einheiten (4) beinhaltet, die Master-Einheit (2) konfiguriert ist, um periodisch ein Synchronisationssignal auszugeben, und konfiguriert ist, um in dem Intervall zwischen zwei aufeinanderfolgenden Signalen, von denen jedes das Synchronisationssignal ist, mehrere Zeitschlitze einzustellen, die den mehreren zweiten Slave-Einheiten (4) in Eins-zu-Eins-Entsprechung zugeordnet sind, und jede der mehreren zweiten Slave-Einheiten (4) konfiguriert ist, um das Downlink-Stromsignal in einem entsprechenden Zeitschlitz unter den mehreren Zeitschlitzen zu übertragen.
4. Master-Einheit (2) für ein automatisches Feueralarmsystem (1), aufweisend: mindestens eine erste Slave-Einheit (3), die elektrisch mit einem Paar elektrischer Drähte (51, 52) verbunden ist und konfiguriert ist, um zwischen einem Zustand des Kurzschließens des Paares elektrischer Drähte und einem Zustand des Nicht-Kurzschließens des Paares elektrischer Drähte umzuschalten; und mindestens eine zweite Slave-Einheit (4), die elektrisch mit dem Paar elektrischer Drähte verbunden ist und konfiguriert ist, um ein Downlink-Stromsignal zu übertragen, das ein elektrisches Stromsignal enthält und in dem Paar elektrischer Drähte erzeugt wird, indem ein elektrischer Strom, der von dem Paar elektrischer Drähten einfließt, geändert wird, wobei die Master-Einheit (2) aufweist:

einen Spannungsapplikator (21), der konfiguriert ist, um eine Spannung zwischen dem Paar elektrischer Drähte anzulegen;  
einen Widerstand (22), der zwischen dem Span-

nungsapplikator (21) und mindestens einem aus dem Paar elektrischer Drähte vorgesehen ist und konfiguriert ist, um einen elektrischen Strom zu begrenzen, der durch das Paar elektrischer Drähte fließt, wenn das Paar elektrischer Drähte durch die mindestens eine erste Slave-Einheit (3) kurzgeschlossen wird; und einen Empfänger (23), der konfiguriert ist, um ein Downlink-Spannungssignal zu empfangen, das aus einer Umwandlung des Downlink-Stromsignals in eine Spannungsänderung in dem Paar elektrischer Drähte durch einen Spannungsabfall an dem Widerstand (22) resultiert.

## Revendications

1. Système d'alarme incendie automatique (1), comprenant :

une unité maîtresse (2) incluant un module d'application de tension (21) configuré de manière à appliquer une tension à une paire de fils électriques (51, 52) ;

au moins une première unité esclave (3) qui est électriquement connectée à la paire de fils électriques et configurée de manière à commuter entre un état de court-circuit de la paire de fils électriques et un état de non-court-circuit de la paire de fils électriques ; et

au moins une seconde unité esclave (4) qui est électriquement connectée à la paire de fils électriques et configurée de manière à transmettre un signal de courant de liaison descendante qui inclut un signal de courant électrique et qui est généré dans la paire de fils électriques en modifiant un courant électrique circulant à partir de la paire de fils électriques ;

dans lequel l'unité maîtresse (2) inclut : une résistance (22) qui est fournie entre le module d'application de tension (21) et au moins un fil de la paire de fils électriques, et configurée de manière à limiter un courant électrique qui circule à travers la paire de fils électriques, lorsque la paire de fils électriques est court-circuitée par ladite au moins une première unité esclave (3) ; et un récepteur (23) configuré de manière à recevoir un signal de tension de liaison descendante résultant d'une conversion du signal de courant de liaison descendante en une modification de tension dans la paire de fils électriques sous l'effet d'une chute de tension au niveau de la résistance (22).

2. Système d'alarme incendie automatique (1) selon la revendication 1, dans lequel l'unité maîtresse (2) inclut en outre un émetteur (24) configuré de manière à générer un

signal de courant de liaison montante incluant un signal de courant électrique dans la paire de fils électriques, en modifiant le courant électrique circulant entre la résistance (22) et la paire de fils électriques, à partir de la paire de fils électriques ; et 5  
 dans lequel ladite au moins une seconde unité esclave (4) inclut un circuit de réception (45) configuré de manière à recevoir un signal de tension de liaison montante résultant d'une conversion du signal de courant de liaison montante en une modification de tension dans la paire de fils électriques, sous l'effet d'une chute de tension au niveau de la résistance (22). 10

3. Système d'alarme incendie automatique (1) selon la revendication 1 ou 2, 15  
 dans lequel ladite au moins une seconde unité esclave (4) correspond à une pluralité de secondes unités esclaves (4) ;  
 dans lequel l'unité maîtresse (2) est configurée de manière à fournir périodiquement en sortie un signal de synchronisation et est configurée de manière à définir, dans l'intervalle entre deux signaux consécutifs, dont chacun correspond au signal de synchronisation, une pluralité de tranches de temps qui sont affectées à la pluralité de secondes unités esclaves (4) dans une correspondance biunivoque ; et 20  
 dans lequel chaque unité de la pluralité de secondes unités esclaves (4) est configurée de manière à transmettre le signal de courant de liaison descendante dans une tranche de temps correspondante parmi la pluralité de tranches de temps. 25 30

4. Unité maîtresse (2) pour un système d'alarme incendie automatique (1) incluant : au moins une première unité esclave (3) qui est connectée électriquement à une paire de fils électriques (51, 52) et qui est configurée de manière à commuter entre un état de court-circuit de la paire de fils électriques et un état de non-court-circuit de la paire de fils électriques ; 35 40  
 et au moins une seconde unité esclave (4) qui est connectée électriquement à la paire de fils électriques et qui est configurée de manière à transmettre un signal de courant de liaison descendante qui inclut un signal de courant électrique et qui est généré dans la paire de fils électriques, en modifiant un courant électrique circulant à partir de la paire de fils électriques, l'unité maîtresse (2) comprenant : 45

un module d'application de tension (21) configuré de manière à appliquer une tension entre les fils de la paire de fils électriques ; 50  
 une résistance (22) qui est fournie entre le module d'application de tension (21) et au moins un fil de la paire de fils électriques, et configurée de manière à limiter un courant électrique qui circule à travers la paire de fils électriques, lorsque la paire de fils électriques est court-circuitée 55

par ladite au moins une première unité esclave (3) ; et  
 un récepteur (23) configuré de manière à recevoir un signal de tension de liaison descendante résultant d'une conversion du signal de courant de liaison descendante en une modification de tension dans la paire de fils électriques sous l'effet d'une chute de tension au niveau de la résistance (22).

FIG. 1

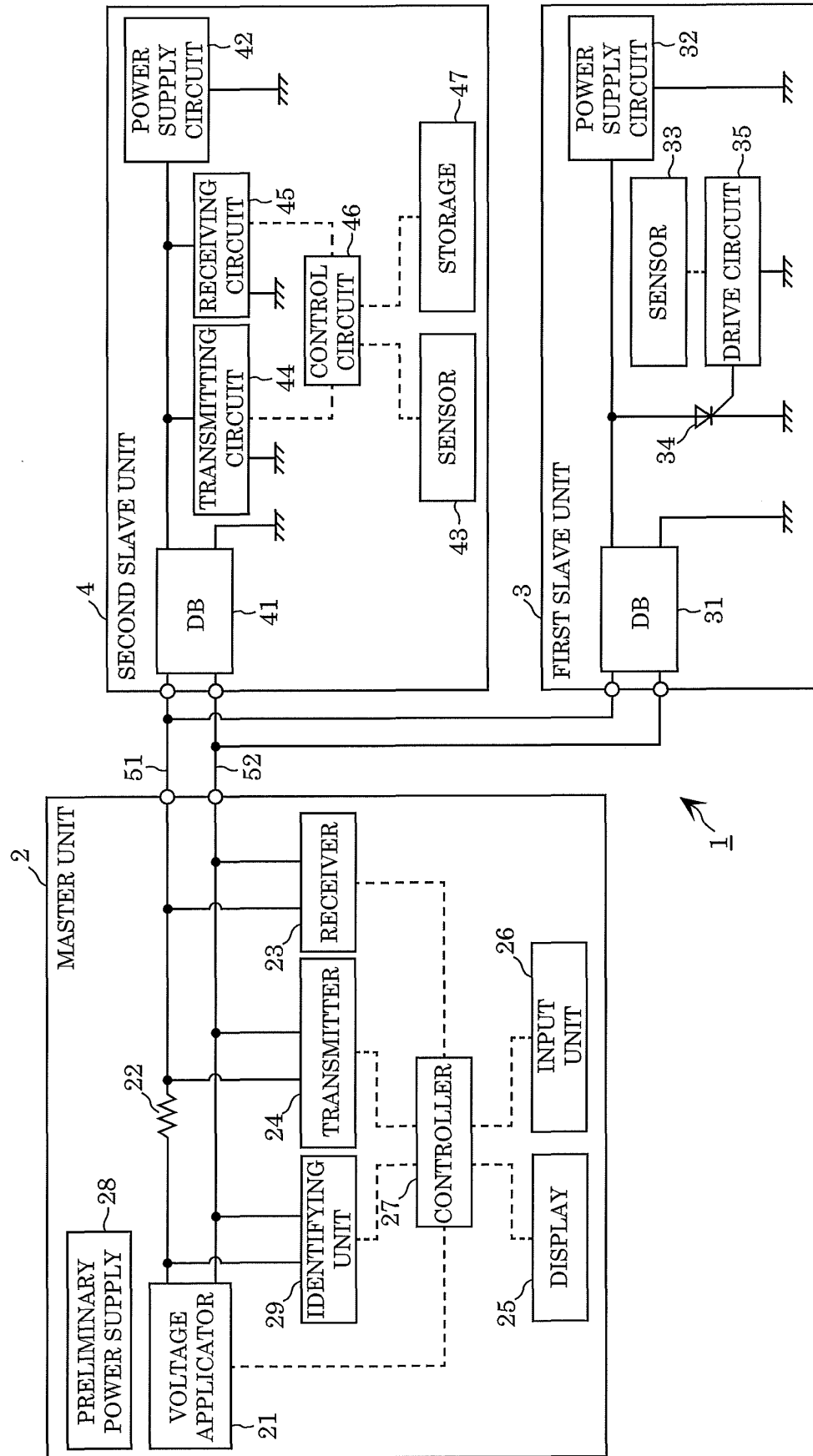


FIG. 2

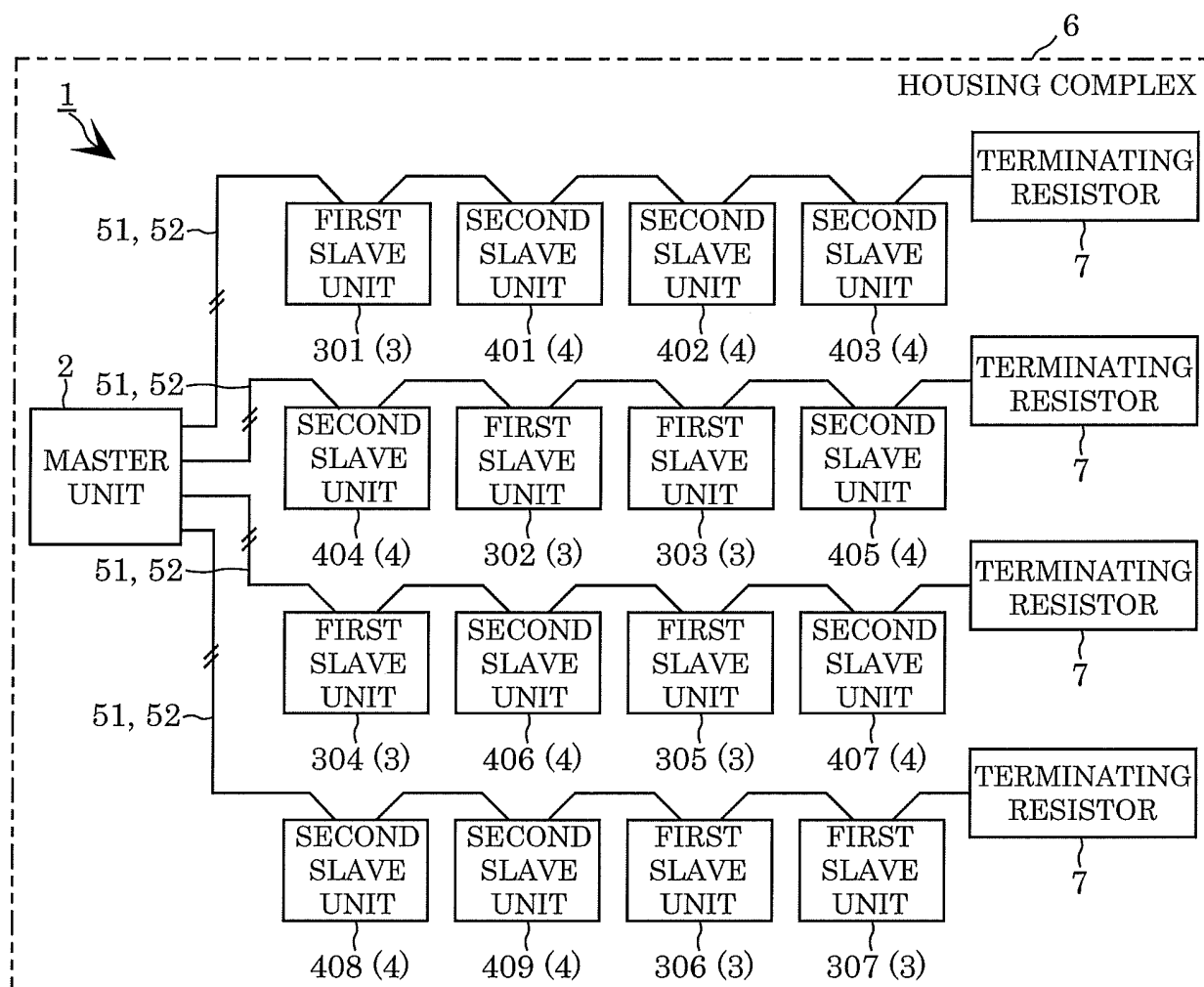
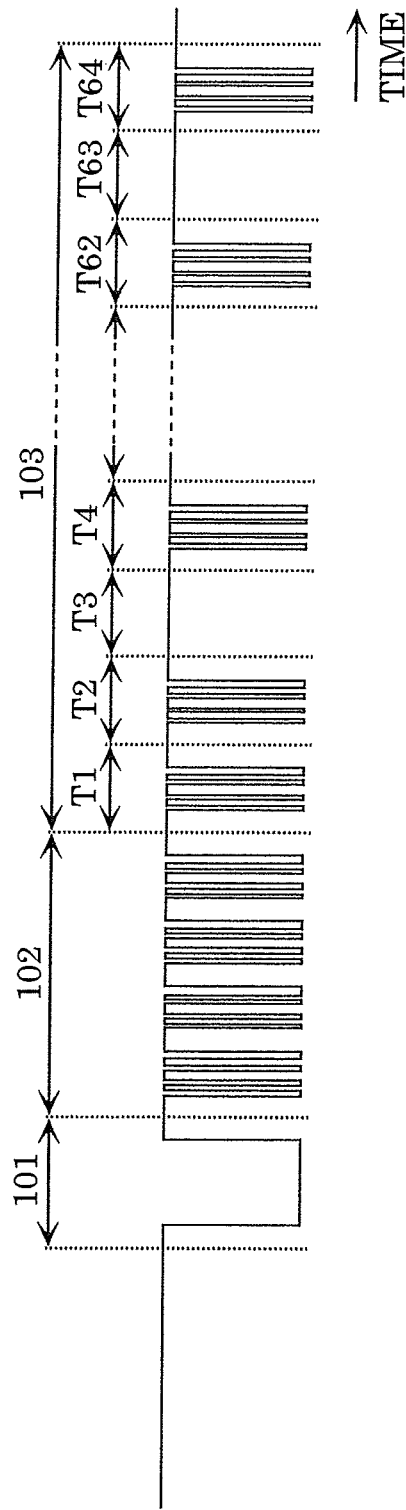


FIG. 3





**REFERENCES CITED IN THE DESCRIPTION**

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