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

(11) **EP 3 866 133 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.08.2021 Bulletin 2021/33

(51) Int Cl.:
G08B 29/18 *(2006.01)* ***G08B 17/00*** *(2006.01)*

(21) Application number: **20382112.9**

(22) Date of filing: **17.02.2020**

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

(71) Applicant: **Carrier Corporation**
Palm Beach Gardens, FL 33418 (US)

(72) Inventors:
- **CORDOBA GALERA, Andrés**
  08940 Cornellà de Llobregat, Barcelona (ES)
- **RIBALDA GÀLVEZ, Miquel**
  08980 Sant Feliu de Llobregat, Barcelona (ES)

(74) Representative: **Dehns**
St. Bride's House
10 Salisbury Square
London EC4Y 8JD (GB)

(54) OUTPUT MODULE FOR A FIRE ALARM SYSTEM

(57) An output module (1) for a fire alarm system is provided. The output module (1) comprises an indicator device (3) for indicating the presence of a possible emergency and an output driver (2) for controlling operation of the indicator device (3). The output driver (2) includes sensing apparatus (6) for measuring electrical properties of the output module (1). A method of installing the output module (1) in a fire alarm system and a method of using the output module (1) when installed in a fire alarm system are also provided.

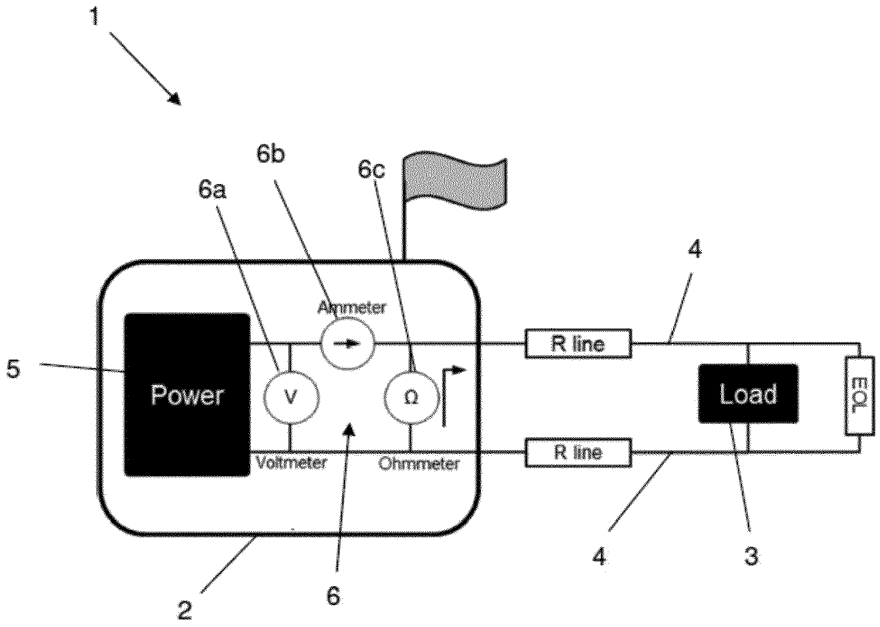

Fig. 1

EP 3 866 133 A1

Description

[0001] The present invention relates to an output module for a fire alarm system, and a fire alarm system comprising such an output module. The invention also relates to methods of installing and using such an output module.

[0002] Fire alarm systems are used in buildings to identify the existence of fires (and also in some cases other emergencies) and to alert occupants and/or authorities to their existence. In many cases there is a regulatory requirement for a fire alarm system to be in place, as well as further requirements on the nature of the system. Typical fire alarm systems include a fire detection system and a fire alert system that are arranged in communication via a fire alarm control panel.

[0003] Fire detection systems typically include a number of indicating devices (e.g. smoke alarms, manual call points) for detecting the presence of a fire. These indicating devices may be connected to the fire alarm control panel and arranged to communicate with the fire alarm control panel to inform whether or not a fire is present. Fire alert systems may include a number and indicator devices (e.g. sirens, bells, lights, voice messages and so on) for raising an alarm and alerting occupants to the presence of a fire. The indicator devices may be connected to the fire alarm control panel and be configured to be automatically activated by the fire alarm control panel when a fire is detected, for example by the indicating devices. The fire alarm system can also include fire extinguishing devices that can be automatically triggered via the fire alarm control panel. There are hence a number of remote units distributed across the building and connected to a fire alarm control panel.

[0004] The remote units are typically also connected to a central power supply to provide electric power to the remote units. Each indicator device is commonly connected to the power source via driver circuit, such as a relay, which can control the activation of the indicator device by controlling the provision of power from the power supply to the indicator device. Hence, the driver circuits function as switches that are arranged to activate the indicator devices, for example in response to a fire being detected by the indicating devices to alert occupants to the presence of the fire.

[0005] It is important to ensure that the power received by the indicator devices, as well as the voltage and current that the indicator devices are subjected to, falls within an operational range that is appropriate for the particular indicator device. If the power received is too low, the indicator device may not function properly and/or fail to successfully alert occupants to the alarm. Conversely, if the power received is too great, the indicator device may become damaged and require replacing. Similarly, if the voltage or current that the indicator device is subjected to is outside of an operational range the indicator device may become overloaded and damaged. To this end, it is common to connect the output module to the power source via a variable power controller, such as a variable transformer, to provide control over the voltage and current (and therefore power) supplied to the indicator devices.

[0006] It is therefore necessary, for example when designing fire alarm systems and installing indicator devices within fire alarm systems, to take into account of the electrical properties of the system in order to be able to set the parameters of the variable power controllers to ensure that the power received by the indicator devices falls within the required operational range. This typically involves the taking of measurements to evaluate the electrical properties of the system, for example using voltmeters, ammeters and/or ohmmeters, and then performing manual calculations to determine the operational parameters of the variable power controllers. The variable power controllers can then be set appropriately to ensure that the power received by the indicator devices falls within the operational range.

[0007] Viewed from a first aspect, the present invention provides an output module for a fire alarm system, the output module comprising: an indicator device for indicating the presence of a possible emergency; and an output driver for controlling operation of the indicator device, wherein the output driver includes sensing apparatus for measuring electrical properties of the output module.

[0008] By providing the output driver with sensing apparatus, the output module may be used to measure its own electrical properties. These measurements may be used by the user of the output module, for example during installation of the output module in a fire alarm system to set certain parameters of a fire alarm system to ensure that power, voltage and/or current that the indicator device is subjected to falls within an operational range of the indicator device. The sensing apparatus can also be used to take measurements of the electrical properties of the output module after initial installation of the output module in a fire alarm system to allow a user to periodically review the properties of the output module. The user may use these measurements to infer the health of the output module, for example to see if the output module has become damaged or degraded.

[0009] In prior art systems without dedicated sensing apparatus, it is necessary to connect external apparatus to the output module and/or fire alarm system in order to measure the electrical properties of the output module. The invention therefore avoids the need for such additional apparatus, which can make installing the output module in a fire alarm system and monitoring the health of the output module simpler for the user, and more time efficient.

[0010] The measured electrical properties may be such that they can be used to determine electrical parameters for the indicator device and to ensure that these remain within operational ranges of the indicator device. For example the measured electrical properties may relate to determination of a voltage, a current and/or an electric power received by the indicator device.

[0011] The sensing apparatus can include any instrumentation capable of measuring an electrical property of the output module. The sensing apparatus may include a voltmeter for measuring a potential difference (i.e. voltage) across the indicator device. The voltmeter may be arranged in parallel with the indicator device. The sensing apparatus may include an ohmmeter for measuring resistance within the output module. The ohmmeter may be arranged in parallel with the indicator device. The sensing apparatus may include an ammeter for measuring electric current within the output module. The ammeter may be arranged in series with the indicator device. The sensing apparatus may include at least one of, or at least two of, a voltmeter, an ohmmeter, and an ammeter. In some example implementations, the sensing apparatus is provided by a so called "smart" power switch, with the sensing capabilities of the smart power switch hence being used as explained herein in order to measure electrical properties that can be used to determine an electric power to be received by the indicator device.

[0012] In order to control operation of the indicator device, the output driver may include a switch. The switch may be a relay switch. When the switch is open, electric current will be prevented from flowing through the output module, thereby preventing activation of the indicator device. Conversely, when the switch is closed, electric current will be able to flow through the output module, thereby allowing activation of the indicator device.

[0013] The output driver may include a processor. The processor may be arranged to control operation of the sensing apparatus and/or the switch. The processor may also be in communication with the sensing apparatus and arranged to perform calculations using data measured by the sensing apparatus. These calculations may include calculations to determine the electric power, voltage and/or current that the indicator device is subjected to.

[0014] It is known that the electrical energy received by an indicator device must fall within an operational range to ensure correct activation of the indicator device. The minimum and maximum values of this operational range may be set by regulatory standards and/or may be inherent to the indicator device. For example, the maximum power value within the operational range for an indicator device may be the maximum power that can be received by the indicator device without damaging the indicator device. The processor may be arranged to calculate a maximum and/or minimum allowable power that can be input into the output module whilst ensuring that the power received by the indicator device is within the operational range. This maximum and minimum power may be known respectively as the upper and lower threshold power of the output module. This calculated data may be used for instance during installation of the output module in a fire alarm system and/or for checking the health of the output module without the need to perform manual calculations.

[0015] The processor may similarly be arranged to determine maximum values for the supply voltage and/or current to ensure that the voltage and/or current that the indicator device is subjected to is within the operational range.

[0016] The processor may be arranged to cause the sensing apparatus to automatically measure electrical properties of the output module when power is initially supplied to the output module. The processor may be arranged to calculate the upper and lower threshold power of the output module using these initial measurements when power is initially supplied to the output module. In this context, the initial supply of power to the output module may be the very first time power has been supplied to the output module (e.g. after a first installation of the output module) or the first time power has been supplied to the output module after an absence of power (e.g. after re-installation, or a power outage).

[0017] In this way, the output module can be used to provide an automatic determination of the maximum and/minimum input power, voltage and/or current upon installation of the output module within a fire alarm system. The user can use this automatically calculated data to set certain parameters of a fire alarm system to ensure that power, voltage and/or current that the indicator device is subjected to falls within the operational range of the indicator device. This avoids the need for manual calculations, thereby simplifying installation of the output device and making the installation more efficient.

[0018] The processor may be arranged to periodically instruct the sensing apparatus to measure electrical properties of the output module and perform calculations using this measured data. These calculations may include calculations to determine the power received by the indicator device, and/or the upper and/or lower threshold power of the output module. The processor may perform these periodic measurements and calculations at intervals within the range of 1 to 10 seconds. For example, the processor may perform the measurements and calculations every 2 seconds, every 5 seconds or every 7 seconds. The processor may be arranged in accordance with applicable standards and/or regulations, such as EU regulations and the like, which may set requirements on the nature and timing of this type of check.

[0019] The data provided by these periodic calculations can be used to infer the health of the output module. For instance, an increase in the upper threshold power may indicate an increase in the losses in the output module. This could indicate that that output module has become damaged or degraded. Hence, the output module provides data that allows the user to periodically monitor the health of the output device. The measurements and calculations may be performed during activation of the indicator device so that a user can monitor the health of the output device during an emergency scenario. The user may use this information to ensure that the indicator device remains able to alert users to the presence of an emergency during an on-going emergency scenario.

[0020] The processor may be capable of communica-

tion with an external device, such as communication with a computer device, including a fire alarm control panel of a fire alarm system. This may allow for automatic adjustment of parameters of a fire alarm system to ensure that power received by the indicator device from the fire alarm system falls within an operational range of the indicator device. The processor may be capable of wired and/or wireless communication with an external device. For this purpose, the output driver may include a transceiver in communication with the processor to enable wireless communication with an external device.

[0021] The output driver may include a memory. The memory may be arranged to store data measured by the sensing apparatus and/or data calculated by the processor.

[0022] The processor may be arranged to compare data stored on the memory with data calculated using measurements taken using the sensing apparatus. For instance, the processor may be arranged to calculate a value for the upper threshold power using measured data and compare this with a value for the upper threshold power stored in the memory. As discussed above, an increase in the upper threshold power may indicate that the output module has become damaged or degraded. Hence, if the comparison shows that the upper threshold value has increased, the processor may be arranged to raise an alarm to alert a user. This provides the output module with the ability to automatically alert a user to possible damage and/or degradation to the output module. Thus, this negates the need to manually check the output module periodically for faults, damage and or degradation.

[0023] In some arrangements, the functions of the processor and the memory may be combined in a single processing component.

[0024] The indicator device can be any device capable of indicating an alarm condition. For example, the indicator device may include an audible or visible alert device. The indicator device may include a siren, a bell, a speech sounder, a speaker, lights, a beacon or a remote indicator. The indicator device may also include one or more transmitter devices for sending alarm notifications to users. Alarm notifications may be sent to local users, for example via wireless transmission of notifications to a mobile device, and/or may be sent to remote users such as building management authorities and/or emergency services.

[0025] The possible emergency may be related to a fire, for example, but it will be appreciated that the output module may also be used for also other emergencies, such as non-fire emergencies requiring activation of an evacuation procedure.

[0026] The invention extends to a fire alarm system incorporating the output module. Thus, viewed from a second aspect, the invention provides a fire alarm system for a building, the fire alarm system comprising: an output module as in the first aspect; and a central power source electrically connected to the output module for providing electric power to the output module.

[0027] The fire alarm system may have any of the features discussed above.

[0028] The fire alarm system may include a variable power controller to enable control over the voltage and current (and hence the electric power) supplied to the output module. The variable power controller may be a variable transformer. The parameters of the variable power controller may be set to ensure that the maximum power, voltage and/or current that the indicator device is subjected to does not exceed the operational range of the indicator device. The parameters of the variable power controller may be informed by the data measured and/or calculated by the output module.

[0029] The fire alarm system may include a fire alarm control panel in communication with the output module. The fire alarm control panel may be in communication with the processor of the output driver such that the processor can receive commands from the fire alarm control panel. The fire alarm control panel may be arranged to monitor the building and cause the indicator device of the output module to be activated if a possible emergency is detected. That is to say, the processor may be arranged to close the switch, thereby allowing current to flow to the indicating device, in response to an instruction from the fire alarm control panel.

[0030] The fire alarm system may include indicating devices for determining conditions that are indicative of a possible emergency. The indicating devices may be in communication with the fire alarm control panel such that the fire alarm control panel can receive data from the indicating devices. The indicating devices may provide inputs for triggering an alarm condition of the fire alarm system. The indicating devices may include a smoke and/or fire alarm.

[0031] The possible emergency may be related to a fire, for example, but it will be appreciated that the fire alarm system may also be used for also other emergencies, such as non-fire emergencies requiring activation of an evacuation procedure.

[0032] Viewed from a third aspect, the invention provides a method of installing an output module as in the first aspect in a fire alarm system having a central power source, wherein the method comprises: electrically connecting the output module to the central power source; using the sensing apparatus to measure electrical properties of the output module; and using the measured data to determine one or more maximum input parameters for electrical energy that can be supplied to the output module whilst ensuring that the electrical energy that the indicator device is subjected to falls within an operational range for the indicator device.

[0033] The maximum input parameters may include a maximum input power that can be supplied to the output module whilst ensuring that the power received by the indicator device does not exceed a maximum threshold power, a maximum supply voltage that can be supplied to the output module whilst ensuring that the voltage that

the indicator device is subjected to does not exceed a maximum threshold voltage, and/or a maximum input current that can be supplied to the output module whilst ensuring that the current received by the indicator device does not exceed a maximum threshold current.

[0034] The output module may have any of the other features discussed above.

[0035] This method utilises the measurements of the electrical properties taken by the sensing apparatus to determine the maximum input power, supply voltage and/or input current that can be supplied to the output module. In this way, these maximum values can be determined easily without the need for any external equipment or devices.

[0036] The maximum input parameters may be the maximum parameters of the electrical energy that can be supplied to the output module without causing damage to the indicator device. For instance, the indicator device may only be able to receive a maximum power without damage being caused to the indicator device. Hence, the method can be used upon installation of the output module to set parameters of the fire alarm system to ensure that the indicator device is not damaged by the electrical energy supplied by the fire alarm system.

[0037] The maximum power, voltage and/or current that the indicator device can be subjected to depends on the particular indicator device utilised within the output module. The maximum power that the indicator device can be subjected to, i.e. the maximum power threshold, may be a power in the range between 1 mW to 6 W. For example, the maximum power threshold value may be 5 mW, 10mW, 100 mW, 500 mW, 1 W or 5W.

[0038] The method may include a step of using the measured data to determine one or more minimum input parameters for electrical energy that can be input into the output module whilst ensuring that the indicator device receives electrical energy falling within an operational range for the indicator device. The minimum input parameters may include a minimum input power that can be supplied to the output module whilst ensuring that the power received by the indicator device is sufficient to enable the indicator device to alert users to the presence of an emergency, a minimum supply voltage that can be supplied to the output module whilst ensuring that the voltage that the indicator device is subjected to is sufficient to enable the indicator device to alert users to the presence of an emergency, and/or a minimum input current that can be supplied to the output module whilst ensuring that the current that the indicator device is subjected to is sufficient to enable the indicator device to alert users to the presence of an emergency. These minimum parameters may be set by regulatory standards. Hence, the method can be used upon installation of the output module to set parameters of the fire alarm system to ensure that the indicator device is capable of alerting users to the presence of an emergency.

[0039] The minimum power, voltage and/or current that the indicator device can be subjected to whilst ensuring activation of the indicator device depends on the particular indicator device utilised within the output module. The minimum power that the indicator device can be subjected to, i.e. the minimum power threshold, may be a power in the range between 1 mW to 6 W. For example, the minimum threshold value may be 5 mW, 10mW, 100 mW, 500 mW, 1 W or 5W.

[0040] The step of using the sensing apparatus to measure the electrical properties of the output module may be performed automatically. For instance, the processor of the output driver may cause the sensing apparatus to measure the properties of the output module automatically upon receipt of power, i.e. upon connection to the central power source.

[0041] The step of determining the maximum input parameters may be performed automatically by the output module and/or the fire alarm system. For instance, the processor of the output driver may automatically calculate the maximum input parameters using the measurements of the electrical properties taken by the sensing apparatus.

[0042] The fire alarm system may include a variable power controller to enable control over the voltage and current (and hence the electric power) supplied to the output module. The variable power controller may have any of the features of the variable power controller discussed above in respect of the second aspect. The method may comprise setting parameters of the variable power controller to ensure that parameters of the electrical energy supplied to the output module do not exceed the determined maximum input parameters and/or fall below the determined minimum input parameters.

[0043] The step of setting the parameters of the variable power controller may be performed automatically by the fire alarm control system and/or the output module. For instance, when the maximum input power has been determined, the processor may communicate the determined value to the fire alarm system, which may adjust the parameters of the variable power controller appropriately.

[0044] By performing one or more of the above method steps automatically, the output module makes installing and/or setting the initial parameters of the fire alarm system and output module simpler and more efficient. For instance, there is no need for a user installing the output module in a fire alarm system to perform manual calculations and/or manually set the parameters of the variable power controller.

[0045] Viewed from a fourth aspect, the invention provides a method of using an output module as in the first aspect when installed in a fire alarm system having a central power source, the method comprising: using the sensing apparatus to periodically measure electrical properties of the output module; and using the measured data to determine one or more maximum input parameters for electrical energy that can be supplied to the output module whilst ensuring that the electrical energy that the indicator device is subjected to falls within an operational

range for the indicator device.

[0046] The output module may have any of the other features discussed above.

[0047] By periodically measuring the electrical properties of the output module and determining the maximum input parameters it is possible to ensure that the electrical energy received by the indicator device falls within the operational range of the indicator device throughout the operational lifetime of the output module. Also, a change in the maximum input parameters may indicate that the output module has become damaged and/or degraded. For instance, if wiring within the output module has become damaged, the fraction of the input power that is received by the indicator device may fall. Thus, the maximum input power may increase. Hence, periodic determination of the maximum input parameters allows the health of the output module to be monitored throughout its operational life.

[0048] The maximum input parameters may include a maximum input power that can be supplied to the output module whilst ensuring that the power received by the indicator device does not exceed a maximum threshold power, a maximum supply voltage that can be supplied to the output module whilst ensuring that the voltage received by the indicator device does not exceed a maximum threshold voltage, and/or a maximum input current that can be supplied to the output module whilst ensuring that the current received by the indicator device does not exceed a maximum threshold current.

[0049] The method may include a step of using the measured data to determine one or more minimum input parameters for electrical energy that can be supplied to the output module whilst ensuring that the indicator device receives electrical energy falling within an operational range for the indicator device. The minimum input parameters may include a minimum input power, a minimum supply voltage, and/or a minimum input current. The minimum input power, the minimum supply voltage and the minimum input current may be the same as those discussed above.

[0050] The measurements may be taken every at intervals within the range of 1 to 10 seconds. For example, the measurements may be taken every 2 seconds, every 5 seconds or every 7 seconds. The frequency of these measurements may set in accordance with applicable standards and/or regulations, such as EU regulations and the like, which may set requirements on the nature and timing of this type of check.

[0051] The method may comprise a step of storing the periodically determined values of the maximum input parameters. These stored values may be compared to check whether one or more of the maximum input parameters have changed over time.

[0052] The method may comprise a step of raising an alarm if one or more of the determined maximum input parameters has changed, for example risen, compared to the previously determined maximum input parameters. For example, an alarm may be raised if the determined maximum input power has risen compared to the previously determined maximum input power. The alarm may only be raised if a newly determined maximum input parameter has risen by 5% or 10% compared to a previously determined maximum input parameter. This alerts a user to possible damage and/or degradation of the output module.

[0053] Certain embodiments of the invention will now be described by way of example only and with reference to the sole accompanying drawing, Figure 1, which is a diagram of an output module for use in a fire alarm system.

[0054] As seen in Figure 1, the output module 1 includes an output driver 2 and a siren 3. Circuitry, in the form of electrically conductive wires 4, connects the output driver 2 to the siren 3.

[0055] The siren 3 is a form of indicator device for alerting users to the presence of a fire. In this case, the siren 3 alerts users to the presence of a fire by emitting a noise. Whilst in this example the indicator device is a siren, it will be appreciated that it could alternatively be any device capable of raising awareness to the presence of a fire. For example, the indicator device may be a bell, a speech sounder, a speaker, lights, a beacon or a transmitter device for sending alarm notifications to users via wireless transmission to a mobile device.

[0056] The output driver 2 includes an electrical connector 5 for enabling electrical connection of the output module 1 to a power source, a switch (not shown), and sensing apparatus 6 for measuring electrical properties of the output module 1.

[0057] The switch provides the output driver 2 with the ability to selectively connect and disconnect the siren 3 from a power source. When the switch is closed, the output driver 2 is operated in an "on" state in which current is allowed to flow through the output driver 2, and to the siren 3. Conversely, when the switch is open, the output driver 2 is operated in an "off" state in which current is prevented from flowing through the output driver 2. Hence, the output driver 2 can be used to control activation of the siren 3.

[0058] In the present example, the sensing apparatus 6 includes a voltmeter 6a, an ammeter 6b and an ohmmeter 6c. The voltmeter 6a is arranged in parallel with the siren 3 to measure the electrical potential difference across the electrical connector 5. The ammeter 6b is arranged in series with the siren 3 to measure the current flowing through the output module 1. The ohmmeter 6c is arranged in parallel with the siren 3 to measure the electrical resistance within the output module 1.

[0059] The output driver 2 therefore includes all the necessary sensing apparatus to measure the electrical properties of the output module 1. In this way, the output driver 2 can be used to measure the voltage and current that the siren 3 is subjected to, the impedance of the conductive wires 4 connecting the output driver 2 to the siren 3, and the electric power being sent to the siren 3.

[0060] The output driver 2 also includes a processor

and a memory (not shown). The processor is arranged to control operation of the output driver 2 between the on and off states and to control operation of the sensing apparatus 6. The processor is also arranged to receive data measured by the sensing apparatus 6 and to perform calculations using the measured data to determine the electric power input into the output module 1 via the electrical connector 5, and the electric power being received by the siren 3. The processor can also determine the voltage and current that the siren 3 is subject to based on the data measured by the sensing apparatus 6. The memory is arranged to store data measured by the sensing apparatus 6 and/or calculated by the processor.

[0061] The processor therefore provides the output driver 2 with the ability to monitor the power input into the output module 1 and the power received by the siren 3 when the output module 1 is connected to a power source.

[0062] As discussed above, the siren 3 will only activate properly if the electric power, voltage and current it receives falls within a particular operational range. In this case, proper activation of the siren 3 means that it functions sufficiently to alert users to the presence of a fire. This may be set by a regulatory standard. For instance, the siren 3 may be required by regulation to emit an audible sound within a specified decibel range when alerting users to the presence of a fire.

[0063] The upper limit to this operational range is specific to the particular component, and is an inherent property of the component. If the power received by the siren 3 exceeds this upper limit, the siren 3 may become damaged, for example by overheating, which could render the siren 3 inoperable. If this were to happen, the siren 3 may no longer be able to alert users to the presence of a fire and may require the siren 3 to be replaced. The upper limit to the operational range may be known as the maximum operational power of the siren 3.

[0064] Conversely, if the power received by the siren 3 falls below the lower limit of the operational range then the power will be insufficient to properly activate the siren 3. In this case, the siren 3 may emit a noise that is below the required decibel range set by the regulatory standards, or may even emit no audible noise at all. Hence, the power provided to the siren 3 will not be enough to alert users to the presence of a fire. The lower limit of the operational range may be known as the minimum operational power of the siren 3.

[0065] The amount of power received by the siren 3 is a function of the power input into the output module 1 and the losses within the output module 1, for example caused by the impedance of the conductive wires 4 that connect the siren 3 to the output driver 2.

[0066] Provided that the minimum and maximum operational powers of the siren 3 are known to the processor, the processor can be used to calculate the maximum and minimum powers that may be input into the output module 1. The minimum and maximum operational powers of the siren 3 may be stored in the memory and used by the processor in these calculations.

[0067] By using measurements taken by the sensing apparatus 6 and the maximum operational power of the siren 3, the processor is able to calculate the maximum amount of power that can be input into the output module 1 whilst ensuring that the power received by the siren 3 does not exceed the maximum operable power of the siren 3. This maximum power may be known as the upper threshold power of the output module 1.

[0068] Similarly, the processor can also calculate the minimum amount of power that can be input into the output module 1 whilst ensuring that the power received by the siren 3 does not fall below the minimum operable power of the siren 3. This minimum power may be known as the lower threshold power of the output module 1.

[0069] These threshold values define the upper and lower boundaries of an allowable power range that can be received by the output module 1 to ensure proper activation of the siren 3. The threshold values calculated by the processor may be stored in the memory.

[0070] The values of the upper and lower threshold powers will vary between different output modules, and are dependent on, amongst other things, the particular indicator device used and the impedance of the wiring connecting the output driver 2 to the indicator device. Since the impedance of a wire is proportional to its length, the threshold values are also dependent on the length of the conductive wires 4.

[0071] The processor can also use the data measured by the sensing apparatus 6 to determine minimum and maximum values for the input voltage and current to ensure that the voltage and the current that the siren 3 is subject to falls within the operational range of the siren 3.

[0072] When the output module 1 is installed in a fire alarm system, for example a fire alarm system of a building, the electrical connector 5 is connected to an output of a variable transformer, which in turn is connected to a central power supply of the fire alarm system. The variable transformer provides the ability to manipulate and control the voltage and current (and hence the electric power) supplied to the output module 1.

[0073] The output module 1 may also be in communication with a fire alarm control panel of the fire alarm system. The fire alarm control panel may provide control over the fire alarm system, for instance by causing activation of one or more indicator devices when a fire has been detected. To this end, the fire alarm control panel may communicate with the output driver 2 to control the state of the output module 1, by initiating switching of the output module 1 between the on and off states (and vice versa) by the processor at appropriate times, for instance when a fire has been detected. In this way, the fire alarm control panel provides a means of initiating activation of the siren 3.

[0074] Communication between the output module 1 and the fire alarm control panel may be achieved via a communications network. This may include wired links between the fire alarm control panel and the output mod-

ule 1, which may be formed when the output module 1 is connected to the power source via the electrical connector 5. That is to say, the wired connection may provide a supply of electric power to the output module 1 as well as a communication link between the output module 1 and the fire alarm control panel.

[0075] Alternatively, the communications network may include wireless communication between the fire alarm control panel and the output module 1. In such a case, the output driver 2 may comprise a transceiver for providing wireless communication with the fire alarm control panel.

[0076] The fire alarm system may include one or more indicating devices, such as smoke and/or fire detectors, for detecting a property indicative of the presence of a fire. The indicating devices may be in communication with the fire alarm control panel and the fire alarm control panel may use information received from the indicating devices to control activation of the siren 3. For instance, if one or more of the indicating devices detects the presence of a fire, the fire alarm control panel may send a signal to the output driver 2 which causes the processor to switch the output driver 2 to the on state to activate the siren 3.

[0077] The fire alarm control panel may include an output device, such as a screen, for communicating information to a user, and an input device, such as a keypad or touchscreen, to allow the user to interact with the fire alarm system via the fire alarm control panel.

[0078] The output driver 2 can be used during installation of the output module 1 in a fire alarm system to calculate the upper and lower threshold powers of the output module 1. The processor may be arranged to automatically collect data using the sensing apparatus 6 and perform the relevant calculations upon initial installation, for example upon receipt of power via the electrical connector 5.

[0079] The calculated values of the upper and lower threshold powers may be stored in the memory. Alternatively, or in addition, the processor may communicate the value of the threshold powers to the fire alarm control panel. In this way, the threshold values can be communicated to a user, enabling the user to use this information to adjust parameters of the variable transformer to ensure that the power output by the variable transformer (and input into the output module 1) falls within the allowable power range of the output module 1.

[0080] In an alternative arrangement, the fire alarm control panel may be in communication with the variable transformer and may be arranged to automatically control the parameters of the variable transformer in response to receipt of power threshold data from the processor.

[0081] The output module 1 therefore avoids the need for the user to manually calculate the allowable power range during installation and/or during a planning phase prior to installation of the output module 1. Instead, the output module 1 is able to automatically determine the allowable power range and communicate this value to the user. This reduces the time required to install the output module 1, and can reduce installation costs.

[0082] The output driver 2 can also be used to periodically monitor electrical properties of the output module 1 after initial installation within a fire alarm system. The processor may be arranged to collect data using the sensing apparatus 6 and perform the relevant calculations periodically to determine the allowable power range. The measured and/or calculated values may be stored in the memory. In this way, the output driver 2 can be used to monitor whether the power input into the output module 1 remains within the allowable power range during the lifetime of the output module 1.

[0083] The output module 1 may be arranged to take measurements and perform calculations every 10 seconds, for example. The periodicity of the measurements and calculations may be altered via the fire alarm control panel.

[0084] A change in the upper and/or lower threshold powers may be indicate that the output module 1 has malfunctioned or become damaged. For example, an increase in the value of the upper threshold power of the output module 1 calculated by the processor is indicative of additional losses in the output module 1. This may be caused, for example, if the wires 4 connecting the output driver 2 to the siren 3 were to become degraded. Hence, an increase in the upper threshold value is an indication that the output module 1 has become damaged and/or degraded.

[0085] A reduction in the value of the upper threshold power may also result in the power output by the variable transformer exceeding the (new, lower) upper threshold power. This could cause damage to the siren 3. Hence, the processor is arranged to raise an alarm if it detects that the power being supplied to the output module 1 exceeds the upper threshold value. For example, the processor may send a signal to the fire alarm control panel to alert a user.

[0086] In respect of the lower threshold value, if the power received by the output module 1 were to fall below this threshold value then the siren 3 may not activate properly and may not be able to successfully alert a user to the presence of a fire. Hence, the processor is arranged to raise an alarm if it detects that the power being supplied to the output module 1 is less than the lower threshold value of the output module 1. As above, the processor may send a signal to the fire alarm control panel to alert a user.

[0087] The processor may also be arranged to communicate the value of the periodically re-calculated threshold powers to the fire alarm control panel so that they can be communicated to a user. The user can use this information to adjust parameters of the variable transformer. In an alternative arrangement, the fire alarm control panel may be arranged to automatically control the parameters of the variable transformer in response to receipt of the re-calculated power threshold data from the processor.

[0088] Whilst in the description above use of the output module to determine the input power thresholds is discussed, it will be appreciated that the output module may also be used to determine thresholds for the supply voltage and/or supply current to ensure that the voltage and the current that the siren 3 is subjected to falls within the operational range of the siren 3. Thus, electrical parameters such as power, voltage and current may be used either alone or in combinations as appropriate for a given system.

[0089] Thus, the output driver 2 provides the output module 1 with the ability to automatically monitor its electrical properties periodically throughout its operational lifetime and alert a user if it becomes broken, damaged or otherwise inoperable. This is of particular importance in the field of fire alarm systems since it is vital that the output module 1 is able to alert a user in response to the detection of a fire. The output module 1 avoids the need for manual periodic checking of the operability of the output module 1.

Claims

1. An output module for a fire alarm system, the output module comprising:

   an indicator device for indicating the presence of a possible emergency; and
   an output driver for controlling operation of the indicator device, wherein the output driver includes sensing apparatus for measuring electrical properties of the output module.

2. An output module as claimed in claim 1, wherein the sensing apparatus includes one or more of:

   a voltmeter for measuring a potential difference across the indicator device;
   an ohmmeter for measuring a resistance within the output module; and
   an ammeter for measuring electric current within the output module.

3. An output module as claimed in claim 1 or 2, wherein the output driver includes a switch for controlling operation of the indicator device.

4. An output module as claimed in any of claims 1, 2 or 3, wherein the output driver includes a processor arranged to control operation of the sensing apparatus and/or the switch.

5. An output module as claimed in claim 4, wherein the processor is arranged to perform calculations using data measured by the sensing apparatus to determine an electric power received by the indicator device.

6. An output module as claimed in claim 4 or 5, wherein the processor is arranged to periodically instruct the sensing apparatus to measure electrical properties of the output module and perform calculations using this measured data to determine the electric power received by the indicator device.

7. An output module as claimed in any of claims 4 to 6, wherein the output driver includes a memory arranged to store data measured by the sensing apparatus and/or calculated by the processor, optionally wherein the processor is arranged to compare data stored in the memory with data calculated using measurements taken using the sensing apparatus.

8. An output module as claimed in any preceding claim wherein the indicator device includes an audible or visible alert device, or a transmitter device for sending alarm notifications to users.

9. A fire alarm system for a building, the fire alarm system comprising:

   an output module as claimed in any preceding claim; and
   a central power source electrically connected to the output module for providing electric power to the output module.

10. A fire alarm system as claimed in claim 9, comprising a variable power controller arranged to allow control over the voltage and/or current supplied to the output module from the central power source.

11. A method of installing an output module as in any of claims 1 to 8 in a fire alarm system having a central power source, wherein the method comprises:

    electrically connecting the output module to the central power source;
    using the sensing apparatus to measure electrical properties of the output module;
    and
    using the measured data to determine one or more maximum input parameters for electrical energy that can be supplied to the output module whilst ensuring that the electrical energy that the indicator device is subjected to falls within an operational range for the indicator device.

12. A method as claimed in claim 11, wherein the step(s) of using the sensing apparatus to measure electrical properties of the output module and/or using the measured data to determine one or more maximum input parameters are performed automatically by the output module.

13. A method of using an output module as in any of

claims 1 to 8 when installed in a fire alarm system having a central power source, the method comprising:

using the sensing apparatus to periodically measure electrical properties of the output module; and
using the measured data to determine one or more maximum input parameters for electrical energy that can be supplied to the output module whilst ensuring that the electrical energy that the indicator device is subjected to falls within an operational range for the indicator device.

14. A method as claimed in claim 13, wherein the measurements are taken at intervals within the range of 1 to 10 seconds.

15. A method as claimed in claim 13 or 14, comprising raising an alarm if one or more of the determined maximum input parameters has risen compared to a previously determined maximum input parameter.

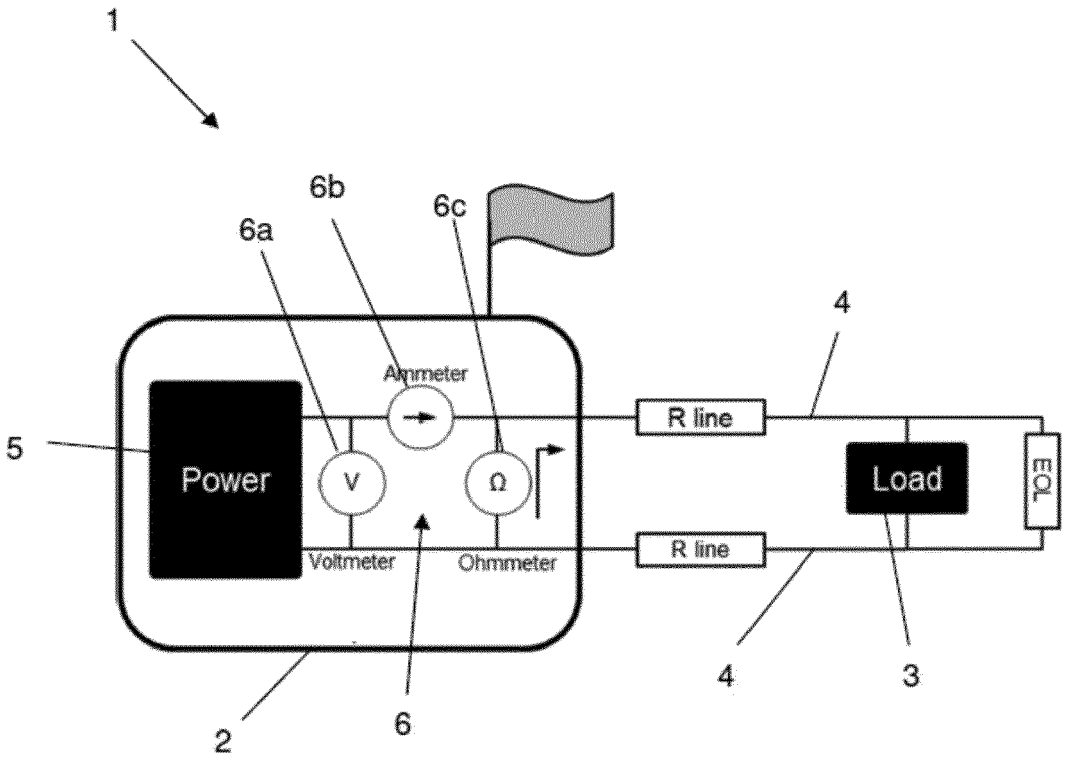
1
6b
6c
6a
4
Ammeter
5
Power
V
Ω
R line
Load
EOL
R line
Voltmeter
Ohmmeter
4
3
2
6

Fig. 1

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 38 2112

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	CN 203 102 512 U (SICHUAN HUAXING TEST TECHNOLOGY INST) 31 July 2013 (2013-07-31) * figure 1 * * paragraph sumary of invention - page 1 *	1,2,4 3,5-15	INV. G08B29/18 G08B17/00
Y	CN 206 003 261 U (SIQI TECH CO LTD) 8 March 2017 (2017-03-08) * figure 1 *	3,5,14	
Y	US 2009/212937 A1 (STAMER ARNE [DE] ET AL) 27 August 2009 (2009-08-27) * paragraph [0006] *	6	
Y	KR 2019 0081712 A (HNS SOLUTION CO LTD [KR] ET AL.) 9 July 2019 (2019-07-09) * paragraphs [0006], [0050]; figure 1 *	7,9-13, 15	
Y	CN 204 423 574 U (ZHEJIANG QIJUN ELECTRONIC TECHNOLOGY CO LTD) 24 June 2015 (2015-06-24) * claim 4 *	8	

TECHNICAL FIELDS SEARCHED (IPC)

G08B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 August 2020	Coffa, Andrew

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 38 2112

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-08-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 203102512 U	31-07-2013	NONE	
CN 206003261 U	08-03-2017	NONE	
US 2009212937 A1	27-08-2009	CN 101515403 A	26-08-2009
		EP 2093737 A1	26-08-2009
		ES 2442520 T3	12-02-2014
		PL 2093737 T3	31-03-2014
		PT 2093737 E	05-12-2013
		RU 2009106144 A	27-08-2010
		US 2009212937 A1	27-08-2009
KR 20190081712 A	09-07-2019	NONE	
CN 204423574 U	24-06-2015	NONE	

EPO FORM P0459

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