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(54) **POWER-LINE COMMUNICATION EMERGENCY LIGHTING FIXTURE**

(57) A lighting fixture 100 is configured to receive power-line communication command (PLCC) data through at least one electrical input. One example PLCC will set the lighting fixture to an inhibition mode, that prevents the transition from a normal mode to an emergency mode. The PLCC may be sent by a controller 201 installed between a main switchboard 200 and the at least one lighting fixture 100. The lighting fixture 100 comprises a driver that is configured to parse the PLCC data and drive the lighting fixture 100 to the rest mode instead to the emergency mode, when the main switchboard 200 is unable to deliver power to the system (i.e., a wanted maintenance break) . When the controller 201 is installed in series as in the example embodiment, the need for extra cable installation for the rest mode and the inhibition mode is no longer needed.

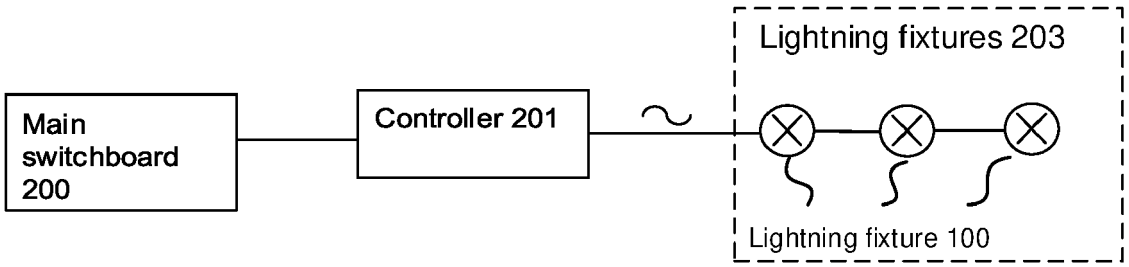

FIG. 4

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Description

TECHNICAL FIELD

[0001] The present disclosure generally relates to the field of emergency lighting. In particular, the present disclosure relates to a lighting fixture for emergency lighting and a related system for operating the lighting fixture.

BACKGROUND

[0002] Emergency lighting systems generally have four main operation modes: A normal mode, a rest mode, an emergency mode, and an inhibition mode. The normal mode is generally a state of light-source operation, where the power is received from a normal power supply, such as a main switchboard etc. The rest mode is generally the "off mode", where the lighting is intentionally extinguished. The emergency mode is the state of light-source operation, when the power from the normal power supply is not available for various reasons, such as power failure or maintenance break. In the emergency mode, the power to the lighting fixture(s) is received from another power supply, such as a conventional battery. The battery may be inside the fixture itself or lie outside the fixture(s) and controlled by an external controller device. The inhibition mode is a state, where the light-source of the lighting fixture inhibits the transition between normal mode and emergency mode, and instead transitions to the rest mode, when the normal supply is turned off.

[0003] Generally, inhibition mode and rest mode controls are achieved by adding additional cabling to the emergency lighting system, which adds additional work for installing a system with inhibition mode and rest mode.

SUMMARY

[0004] The scope of protection sought for various example embodiments of the disclosure is set out by the independent claims. The example embodiments and features, if any, described in this specification that do not fall under the scope of the independent claims are to be interpreted as examples useful for understanding various example embodiments of the disclosure.

[0005] The disclosure herein provides a lighting fixture and a system for emergency lighting. The lighting fixture is configured to parse data from the powerline. The system comprises a controller that is serially coupled to the normal supply and the lighting fixture, therefore eliminating any unnecessary cabling.

[0006] An example embodiment of lighting fixture for emergency lighting systems comprises: at least one electrical input; at least one light source; and a driver. The driver is configured for operation in at least the following four operation modes: *a normal mode* (a state of readiness to operate in an emergency mode, while receiving normal power at the electrical input); *an emergency mode* (a state of lighting applied when normal power is not received at the electrical input); *a rest mode* (a state of intentionally extinguished lighting when normal power is not received at the electrical input); and *an inhibition mode* (a mode that inhibits transition from the normal mode to the emergency mode even if normal power is not received at the electrical input). Furthermore, the driver is configured to regulate power delivered to the light source, detect and receive power-line communication (PLC) data at the electrical input, and - based on the received PLC data - start operating in the inhibition mode. This example embodiment eliminates any unnecessary extra cable installation that is commonly required in prior art for controlling operation in the rest mode and inhibition mode.

[0007] In an example embodiment, alternatively or in addition to the above-described example, the driver is further configured to selectively start operating in any of said four modes based on the received PLC data. In this example embodiment, the user of the lighting fixture may, by demand, set the lighting fixture to any of the modes for example for the purpose of a maintenance break.

[0008] In an example embodiment, alternatively or in addition to the above-described examples, the driver is configured to indicate the start of operating in the inhibition mode by making the light source emit an indicator signal. This example embodiment provides the user of the lighting fixture visual feedback of the successful starting of the inhibition mode. Any number of flicks may be utilized.

[0009] In an example embodiment, alternatively or in addition to the above-described examples, the driver is configured to revert from the inhibition mode to the normal mode as a response to any of: a predefined time elapsing after the start of operating in the inhibition mode without losing normal power at the electrical input; receiving normal power again at the electrical input after first having lost normal power at the electrical input. This example embodiment provides for practical and easy-to-use return to the normal mode without requiring extra operations from the user.

[0010] In an example embodiment, alternatively or in addition to the above-described examples, the electrical power at the electrical input is AC. The driver may be configured to execute AC-DC conversion and DC-DC regulation for the light source, and parse any received PLC data encoded in the AC waveform arriving at the electrical input. In case a system controller is set to deliver AC power to the lighting fixture, this example embodiment may be utilized.

[0011] In an example embodiment, alternatively or in addition to the above-described first, second, third or fourth example, the electrical power at the electrical input is DC, and wherein the driver is further configured to: execute DC-DC conversion and regulation for the light source, and parse any received PLC data encoded in the DC power arriving at the electrical input. In case a system controller is set to deliver DC power to the lighting fixture, this example embodiment may be utilized.

[0012] In an example embodiment, alternatively or in addition to the above described examples, the driver further comprises a microprocessor unit and a regulator unit that executes power regulation for the at least one light source and for the microprocessor unit. The microprocessor unit may then be configured to parse the received PLC data arriving at the electrical input; and based on the parsed PLC data, make the driver start operating in the inhibition mode. This example embodiment allows the manufacturer to use any available electrical component that can be configured to execute the necessary functions (i.e., a third-party microcontroller unit and a specialized regulator unit), possibly saving manufacturing costs.

[0013] In an example embodiment, alternatively or in addition to the above-described examples, the lighting fixture further comprises a battery. The driver may then be configured to power the light source with the battery when no power at the electrical input is available. In case a system, wherein the example embodiment is utilized does not comprise a separate battery for the emergency lighting, this example embodiment may be utilized in the system.

[0014] An example embodiment of a system for emergency lighting comprises a main switchboard, at least one lighting fixture according to any of above described examples, and a controller, electrically coupled between the main switchboard and the at least one lighting fixture. The controller may then be configured to receive electrical power from the main switchboard, deliver electrical power from the main switchboard to the at least one lighting fixture, and selectively send a power-line communication command (PLCC) to the at least one lighting fixture for making the at least one lighting fixture start operating in the inhibition mode. This example embodiment describes the system, wherein unnecessary cable installation for the rest mode and the inhibition mode is no longer required.

[0015] An example embodiment of a system, alternatively or in addition to the above-described example of a system, further comprises a battery, that is configured to supply power to the controller and the at least one lighting fixture, when the main switchboard is unable to deliver power to the rest of the system. In this example embodiment, a battery is configured for the controller, and the controller may provide power for the at least one lighting fixture as well.

[0016] An example embodiment of a system, alternatively or in addition to the first described example of a system, further comprises a battery, wherein the battery is configured to deliver electrical power to the at least one lighting fixture, when the power from the main switchboard is not available. In this example embodiment, the controller is configured to only send a PLCC command for the at least one lighting fixture to be set in the inhibition mode. The lighting fixture may receive its power from the example battery, or it may use a battery configured within the lighting fixture itself.

DESCRIPTION OF THE DRAWINGS

[0017] The accompanying drawings, which are included to provide a further understanding of the example embodiments and constitute a part of this specification, illustrate example embodiments and together with the description help to explain the principles of the example embodiments. In the drawings:

Fig. 1 is a block diagram illustrating an example embodiment of a lighting fixture (100) for emergency lighting systems.

Fig. 2 is a block diagram illustrating an example embodiment of a lighting fixture (100), wherein the driver (102) comprises a regulation unit (301) and a microcontroller unit (302).

Fig. 3 is a block diagram illustrating an example embodiment of a lighting fixture (100), further comprising a battery (300).

Fig. 4 illustrates an example embodiment of a system, wherein the example embodiment of lighting fixture (100) may be used, and a controller (201) is installed in series between a main switchboard (200) and the lighting fixture.

Fig. 5 illustrates an example embodiment of a system, wherein a battery (500) is utilized for both the controller (201) and the lighting fixture (100) in case the main switchboard (200) is unable to deliver power to the rest of the system.

Fig. 6 illustrates an example embodiment of a system, wherein a battery (500) is utilized only for the lighting fixture (100) in case the main switchboard (200) is unable to deliver power to the rest of the system.

DETAILED DESCRIPTION

[0018] Reference will now be made in detail to example embodiments, examples of which are illustrated in the accompanying drawings. The detailed description provided below in connection with the appended drawings is intended as a description of the present examples and is not intended to represent the only forms in which the present disclosure may be constructed or utilized. The description sets forth the functions of the example and the sequence of steps for constructing and operating the example. However, the same or equivalent functions and sequences may be accomplished by different example embodiments.

[0019] Fig. 1 is a block diagram of an example embodiment of a lighting fixture 100. The lighting fixture 100 may comprise at least one electrical input 101, at least one light source 103 and a driver 102. The driver comprises four operation modes for controlling the at least one light source.

[0020] First operation mode is a normal mode, wherein the normal mode is a state of lighting, that is ready to operate in an emergency mode, while the power at the

electrical input is received from a normal supply. The normal supply power may be delivered by a main switchboard 200, that is installed on a building that requires an emergency lighting system.

[0021] The second operation mode is an emergency mode, wherein the emergency mode is state of lighting, when the power is not received from the normal supply. I.e., the power to the at least one light source 103 may be delivered from a battery, that is installed in the lighting fixture 100, or it may lie outside the lighting fixture 100 as a separate power source for a plurality of lighting fixtures 100 installed in a full emergency lighting system.

[0022] The third mode is a rest mode, wherein the rest mode is a state of intentionally extinguished lighting, when the power is not received from a normal supply. Generally, when the normal power supply for the lighting fixture 100 is not available, the light source 103 is automatically driven to the emergency mode however, in some cases the light source 103 is intentionally extinguished. The rest mode also comprises the functionality to revert back to normal mode, when the normal supply is available again.

[0023] The fourth mode is an inhibition mode, wherein the inhibition mode is a transition state, which inhibits the transition from the normal mode to the emergency mode, when the power is not received from the normal supply.

[0024] Furthermore, in the example embodiment, the driver 102 is further configured to regulate the power to the light source, detect and receive a power-line communication (PLC) data at the electrical input, and based on the received PLC data, set the light source to the inhibition mode. The data may be received from a controller (201), that is electrically coupled in series between the normal supply and the lighting fixture 100. When the data is sent through the powerline, no additional cabling installation is required. The PLC data may be referred to as a power-line communication command (PLCC).

[0025] The driver 102 may be further configured to receive additional data, such as a straight command to set the light source 103 to normal mode, emergency mode or rest mode.

[0026] For the purposes of clarification, Fig. 1 illustrates the electrical input 101 having two wires. In the case of DC power input, the lower wire may be the ground wire and the upper wire the signal wire. In case of an AC power input, the upper wire and the lower wire may comprise the full AC signal, and the ground wire is not illustrated, however it may be understood as also the upper wire comprising the full AC signal and the lower wire may be the AC ground. Whatever the configuration, the two-signal illustration illustrates any embodiment in this description properly.

[0027] In an example embodiment of a lighting fixture 100, the driver 102 is further configured, based on the received PCC, to set the light source in any of the four modes previously described: The normal mode, the rest mode, the emergency mode, and the inhibition mode.

[0028] In an example embodiment of a lighting fixture 100, the driver is further configured to flick (switch off-on) the light source at least one time, when an inhibition mode is set. This will notify the user that instead of going to emergency mode, when the normal supply will be turned off, the lighting fixture 100 will enter the rest mode.

[0029] In an example embodiment of a lighting fixture 100, the rest mode further comprises functionality to revert to the normal mode, after the normal supply power at the electrical input 101 is available again.

[0030] In an example embodiment of a lighting fixture 100, the electrical power at the electrical input 101 is AC and the driver 102 is further configured to execute AC-DC conversion and DC-DC regulation for the light source 103. Furthermore, the driver 102 is also configured to parse any received PLC data encoded in the AC waveform arriving at the electrical input. It is not uncommon to have AC-DC conversion available in modern lighting fixtures, therefore a proper implementation for parsing the data from the powerline should be designed. In this example embodiment, the AC data transfer technique may be any data transfer technique, such as AM, FM or half-wave rectified AC signal without load capacitance at the transmitter side to hold the output (input of the lighting fixture 100).

[0031] In an example embodiment of a lighting fixture 100, the electrical power at the electrical input 101 is DC, and the driver 102 is further configured to execute DC-DC conversion and DC-DC regulation for the light source 103. Furthermore, the driver 102 is also configured to parse any received PLC data encoded in the DC waveform arriving at the electrical input. In this example embodiment, the driver is not configured to receive AC power, therefore the driver 102 comprises the configuration to parse the PLCC encoded in the DC waveform. One example DC data transfer technique may be a half-wave rectified signal, where the DC power is temporarily reduced, when a full-wave rectifier is switched to a half-wave rectifier, when a logical 1 or 0 is transmitted.

[0032] Fig. 2 illustrates an example embodiment of a lighting fixture 100, where the driver 102 further comprises: a microprocessor unit 302; and a regulator unit 301, that executes the conversion (either AC-DC or DC-DC) and regulation for the light source, and wherein the microprocessor unit is configured to parse the received PLC data arriving at the electrical input 101. Based on the received PLC data, the driver 102 is then configured to drive the light source to the inhibition mode. In this example embodiment, any available electrical components that are designed for the implementation of the example embodiment may be used, possibly saving costs for large manufacturing cycles.

[0033] In an example embodiment, Fig. 2 also illustrates a DC block 303, that is required, should the microcontroller 302 receive its power from the regulation unit 301 (PWR bus 304). A data transfer bus 305 is also illustrated between the regulation unit 301 and the microcontroller unit 302.

[0034] In an example embodiment, the microcontroller

unit 302 may comprise memory that stores the commands that are available to switch between different modes.

[0035] In an example embodiment, the microcontroller unit 302 may comprise a simple multiplexer which accepts the input data in the control input and directs a proper command from the input of the multiplexer to the regulation unit, which then sets the light source 103 to the desired operation mode. For example, the microcontroller unit 302 may also comprise a Digital-to-Analog converter (DAC) that converts the multiplexer output to a reference voltage for the regulation unit 301. In another example embodiment, the regulation unit 301 may comprise the DAC to set the proper reference voltage, and the microcontroller unit has a pure digital output.

[0036] In an example embodiment of a lighting fixture 100, lighting fixture 100 further comprises a battery 400 that may be used in the emergency mode and wherein the driver 102 is further configured to power the light source 103 with the battery, when no power at the electrical input 101 is available. It is not uncommon to feature a battery in the lighting fixture 100, therefore an embodiment is described.

[0037] Fig. 4 is a block diagram of an example embodiment of a system, wherein the lighting fixture 100 may be installed in. The system comprises at least one lighting fixture 100 embodied as any of the example embodiments described herein, however it may also comprise a plurality of lighting fixtures 203 as illustrated. The system may also comprise a main switchboard 200, which is configured to distribute electricity to any device installed in the system, or to any device that may lie outside the system. The system further comprises a controller 201, that is electrically coupled in series between the main switchboard 200 and the at least one lighting fixture 100. The controller 201 is configured to receive power from the main switchboard 200, and to deliver power to the at least one lighting fixture 100. Furthermore, the controller 201 is configured to send a PLCC to the at least one lighting fixture 100 that sets the at least one lighting fixture to inhibition mode.

[0038] Fig. 5 illustrates another example embodiment of a system, where the system comprises a battery 500, that is configured to power both the controller 201 and the at least one lighting fixture 100, should the power from the main switchboard 200 close.

[0039] Fig. 6 illustrates another example embodiment of a system, where the system comprises a battery 500, which is installed only to power the lighting fixtures in case the power from the main switchboard 200 is closed off. In this example embodiment of a system, the controller 201 comprises functionality to at least send the PLCC to the lighting fixture to be set into emergency mode, before the controller 201 loses its power. The battery 500 is illustrated as being configured outside the lighting fixture, however the battery may be configured in the at least one lighting fixture 100 itself, as was described in an earlier example embodiment.

[0040] Although the subject matter has been described in language specific to structural features and/or acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as examples of implementing the claims and other equivalent features and acts are intended to be within the scope of the claims.

[0041] It will be understood that the benefits and advantages described above may relate to one example embodiment or may relate to several example embodiments. The example embodiments are not limited to those that solve any or all of the stated problems or those that have any or all of the stated benefits and advantages.

[0042] The term 'comprising' is used herein to mean including the method, blocks or elements identified, but that such blocks or elements do not comprise an exclusive list and a method or apparatus may contain additional blocks or elements.

[0043] It will be understood that the above description is given by way of example only and that various modifications may be made by those skilled in the art. The above specification, examples and data provide a complete description of the structure and use of exemplary embodiments. Although various example embodiments have been described above with a certain degree of particularity, or with reference to one or more individual example embodiments, those skilled in the art could make numerous alterations to the disclosed example embodiments without departing from the spirit or scope of this specification.

Claims

1. A lighting fixture (100) for emergency lighting systems, comprising:

    - at least one electrical input (101),
    - at least one light source (103), and
    - a driver (102) configured for operation in at least the following four operation modes:

        -- a normal mode, wherein the normal mode is a state of readiness to operate in an emergency mode, while receiving normal power at the electrical input,
        -- an emergency mode, wherein the emergency mode is a state of lighting applied when normal power is not received at the electrical input,
        -- a rest mode, wherein the rest mode is a state of intentionally extinguished lighting when normal power is not received at the electrical input, and
        -- an inhibition mode, wherein the inhibition mode inhibits transition from the normal

mode to the emergency mode even if normal power is not received at the electrical input;

and wherein the driver is configured to:

- regulate power delivered to the light source,
- detect and receive power-line communication (PLC) data at the electrical input, and
- based on received PLC data, start operating in the inhibition mode.

2. A lighting fixture (100) according to claim 1, wherein the driver (102) is further configured to selectively start operating in any of said four modes based on the received PLC data.

3. A lighting fixture (100) according to any of the preceding claims, wherein the driver is configured to indicate the start of operating in the inhibition mode by making the light source emit an indicator signal.

4. A lighting fixture (100) according to any of the preceding claims, wherein the driver is configured to revert from the inhibition mode to the normal mode as a response to any of:

- a predefined time elapsing after the start of operating in the inhibition mode without losing normal power at the electrical input,
- receiving normal power again at the electrical input after first having lost normal power at the electrical input.

5. A lighting fixture (100) according to any of the preceding claims, wherein said normal power at the electrical input (101) is AC, and wherein the driver (102) is configured to:

- execute AC-DC conversion and subsequent DC-DC regulation for the light source (103), and
- parse any received PLC data encoded in the AC waveform arriving at the electrical input.

6. A lighting fixture (100) according to any of claims 1-4, wherein the electrical power at the electrical input (101) is DC, and wherein the driver (102) is further configured to:

- execute DC-DC conversion and regulation for the light source (103), and
- parse any received PLC data encoded in the DC power arriving at the electrical input.

7. A lighting fixture (100) according to any of the preceding claims, wherein the driver (102) further comprises:

- a microprocessor unit (302), and
- a regulator unit (301) that executes power regulation for the at least one light source (103) and for the microprocessor unit;

and wherein the microprocessor unit is configured to:

- parse the received PLC data arriving at the electrical input (101), and
- based on parsed PLC data, make the driver start operating in the inhibition mode.

8. The lighting fixture (100) according to any of the preceding claims, wherein the lighting fixture further comprises a battery (400), wherein the driver (102) is further configured to power the light source (103) with the battery when no normal power at the electrical input (101) is available.

9. An emergency light operation system, comprising:

- a main switchboard (200),
- at least one lighting fixture (100) according to any of claims 1-8, and
- a controller (201) that is electrically coupled between the main switchboard and the at least one lighting fixture and configured to:

-- receive electrical power from the main switchboard,
-- deliver electrical power from the main switchboard to the at least one lighting fixture, and
-- selectively send a power-line communication command (PLCC) to the at least one lighting fixture for making the at least one lighting fixture start operating in the inhibition mode.

10. An emergency light operation system according to claim 9, further comprising a battery (500), that is configured to supply power to the controller (201) and the at least one lighting fixture (100), when the main switchboard (200) is unable to deliver power to the rest of the system.

11. An emergency light operation system of claim 9, further comprising a battery (500), wherein the battery is configured to deliver electrical power to the at least one lighting fixture (100), when the power from the main switchboard (200) is not available.

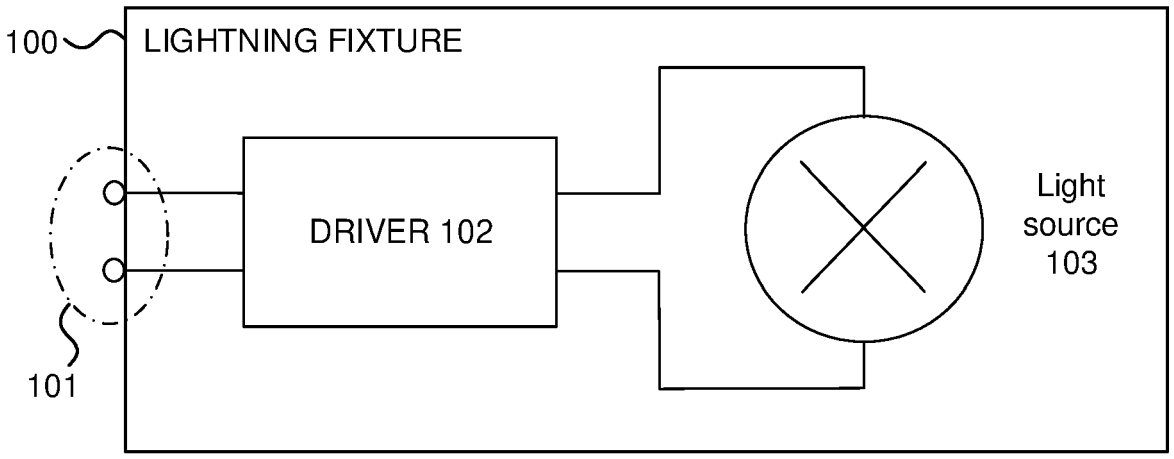

FIG. 1

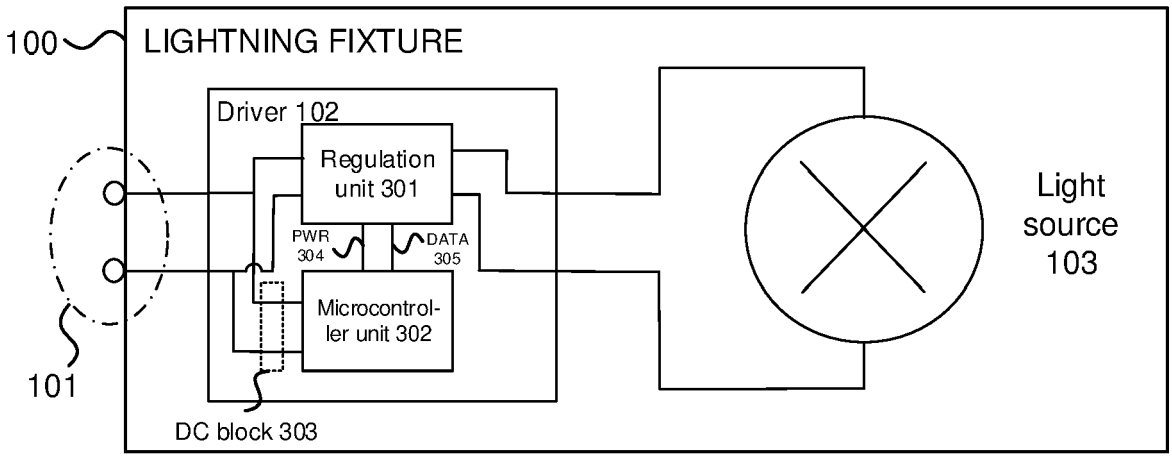
100
LIGHTNING FIXTURE
Driver 102
Regulation unit 301
PWR 304
DATA 305
Microcontrol-ler unit 302
101
DC block 303
Light source 103

FIG. 2

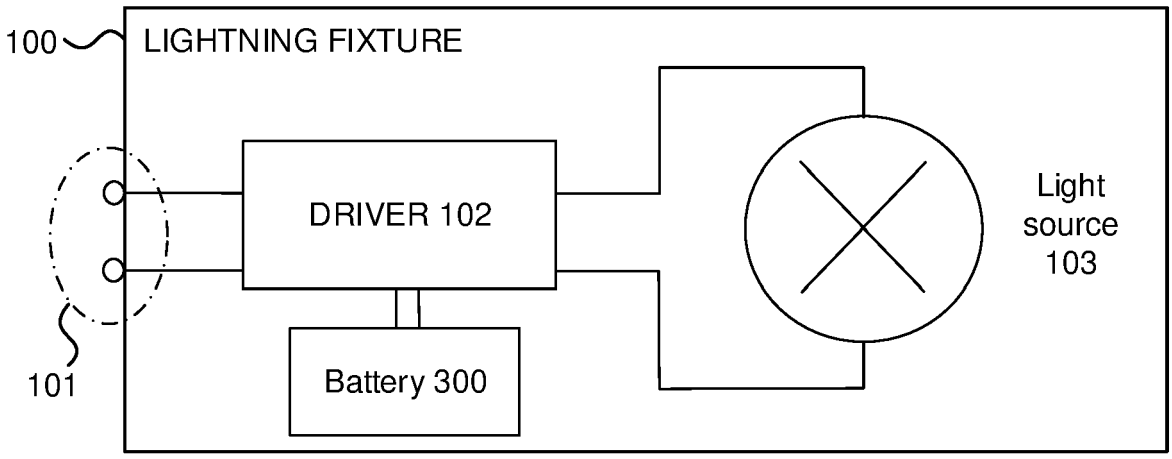
100
LIGHTNING FIXTURE
DRIVER 102
Battery 300
Light source 103
101

FIG. 3

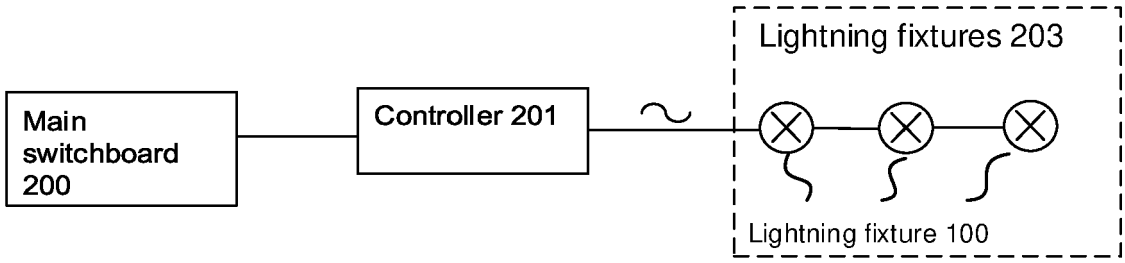
Lightning fixtures 203
Main switchboard 200
Controller 201
Lightning fixture 100

FIG. 4

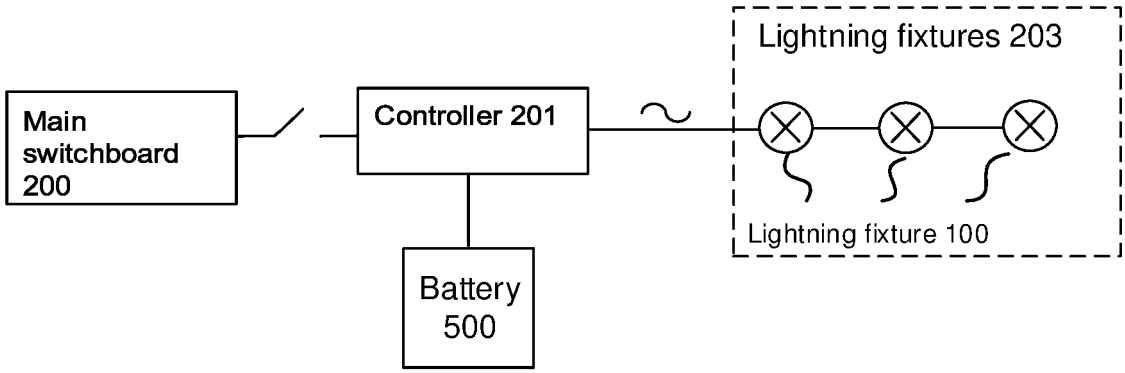
Lightning fixtures 203
Main switchboard 200
Controller 201
Lightning fixture 100
Battery 500

FIG. 5

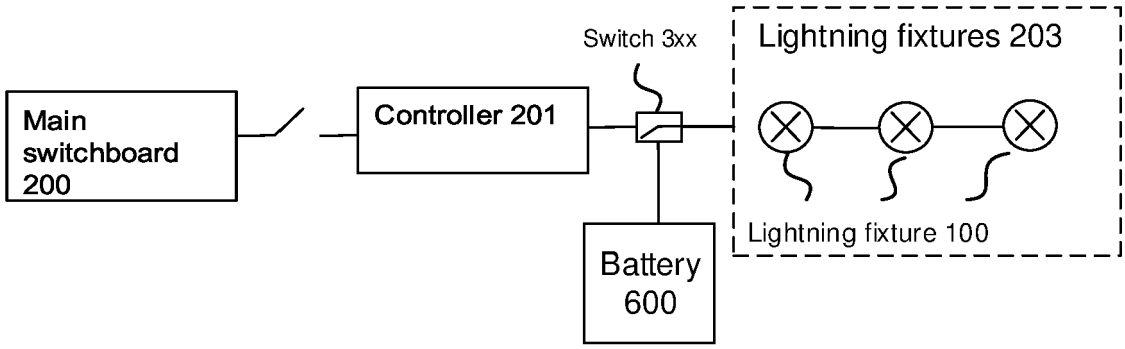
Main switchboard 200
Controller 201
Switch 3xx
Lightning fixtures 203
Lightning fixture 100
Battery 600

FIG. 6

Europäisches Patentamt
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Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 16 2204

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	US 2016/005294 A1 (BROWN PHILIP GREGORY [AU] ET AL) 7 January 2016 (2016-01-07) * paragraphs [0010] - [0012] * * paragraphs [0055] - [0058]; figures 6,6a,7 * * paragraphs [0037], [0075] - [0077]; claim 26; figure 15 * -----	1,2,5-11	INV. H05B47/17 ADD. H05B47/185
A	"Luminaires - Part 2-22: Particular requirements - Luminaires for emergency lighting", IEC 60598-2-22:2021 RLV, IEC, 3, RUE DE VAREMBÉ, PO BOX 131, CH-1211 GENEVA 20, SWITZERLAND , 6 December 2021 (2021-12-06), pages 1-119, XP082031029, Retrieved from the Internet: URL:https://api.iec.ch/harmonized/publications/download/1147921 [retrieved on 2021-12-06] * page 34 - page 35 * * Annex D * -----	1-11	

TECHNICAL FIELDS SEARCHED (IPC)
H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 June 2023	Maicas, Jesús

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 16 2204

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		US 2016005294 A1	07-01-2016
		WO 2016004331 A1	07-01-2016

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