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(54) Title: SELF-DIAGNOSTIC FAULT IDENTIFICATION SYSTEM FOR EMERGENCY LIGHTING UNIT

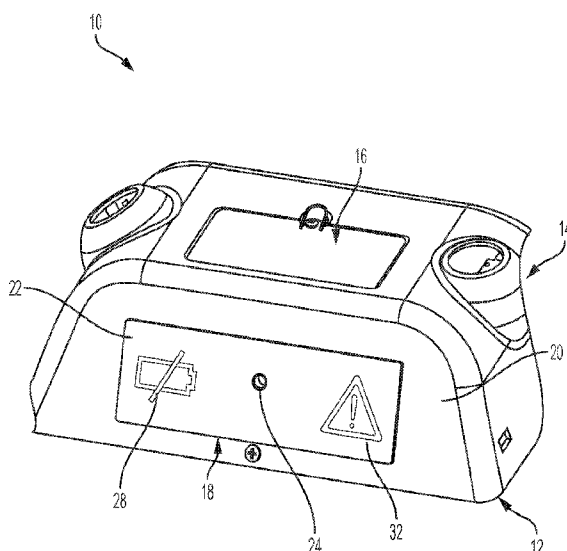


FIG. 1

(57) Abstract: An emergency lighting device includes a housing, a light emitter positioned in the housing, a control circuit positioned in the housing and operatively connected to the light emitter, an indicator light positioned in the housing, and a fault indicator circuit positioned in the housing and operatively connected to the indicator light. The fault indicator circuit is configured to monitor the light emitter, analyze activation of the light emitter, and activate the indicator light based on the analysis of the activation of the light emitter.

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

SELF-DIAGNOSTIC FAULT IDENTIFICATION SYSTEM FOR EMERGENCY LIGHTING UNIT

RELATED APPLICATIONS

[0001] The present application claims priority to U.S. Provisional Patent Application No. 62/368,286, filed on July 29, 2016, the entire contents of which are hereby incorporated by reference.

FIELD

[0002] Embodiments relate to emergency lighting units, for example indoor emergency lighting units that can be mounted on a wall or ceiling.

BACKGROUND

[0003] Emergency units, such as exit signs and light fixtures, are commonly used in public buildings to indicate and illuminate areas such as stairs and exits in the event of a power failure. These fixtures typically have an emergency backup power system such as a battery that automatically turns on the emergency light when the primary power source is interrupted.

[0004] Once an emergency unit is installed, it must be serviced periodically to make sure it is functioning properly. Service issues can range, for example, from a simple battery replacement to the replacement of a complex, high-voltage circuit board. While some units have the ability to alert the user of an error or malfunction in the unit, determining the exact cause can be time consuming and expensive.

SUMMARY

[0005] According to an exemplary embodiment, an emergency lighting device including a housing, a light emitter positioned in the housing, a control

circuit positioned in the housing and operatively connected to the light emitter, and a fault indicator circuit positioned in the housing and operatively connected to the control circuit. The device further includes a first indicator light connected to the fault indicator circuit, a second indicator light connected to the fault indicator circuit, and a third indicator light connected to the fault indicator circuit. Wherein the fault indicator circuit is configured to activate the first indicator light to indicate a plurality of faults, to activate the second indicator light to indicate a first fault, and to activate the third indicator light to indicate a second fault.

[0006] Another embodiment provides an emergency lighting device including a housing and a light emitter positioned in the housing. The device further includes a fault indication system positioned in the housing having a first indicator light, a second indicator light, a third indicator light, and a diffuser positioned over the first, second, and third indicator lights. The diffuser has a first symbol indicating a first fault and a second symbol indicating a second fault.

[0007] Another embodiment provides an emergency lighting device including a housing, a light emitter positioned in the housing, a control circuit positioned in the housing and operatively connected to the light emitter, an indicator light positioned in the housing, and a fault indicator circuit positioned in the housing and operatively connected to the indicator light. The fault indicator circuit is configured to monitor the light emitter, analyze activation of the light emitter, and activate the indicator light based on the analysis of the activation of the light emitter.

[0008] Another embodiment provides a method of controlling an emergency lighting device. The method includes monitoring, via a controller, one or more characteristics of the emergency lighting device, and activating a first indicator based on the one or more characteristics. The method further includes monitoring activation of the first indicator, analyzing the activation

of the first indicator, and activating, based on the analysis of the activation of the first indicator, a second indicator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The aspects and features of various exemplary embodiments will be more apparent from the description of those exemplary embodiments taken with reference to the accompanying drawings, in which:

[0010] FIG. 1 is a bottom perspective view of an exemplary lighting unit and fault indication system;

[0011] FIG. 2 is a bottom view of FIG. 1 showing the first indicator light activated;

[0012] FIG. 3 is a bottom perspective view of the light unit showing the second indicator light activated;

[0013] FIG. 4 is a bottom perspective view of the light unit showing the third indicator light activated;

[0014] FIG. 5 is a bottom perspective view of the light unit with the diffuser plate removed;

[0015] FIG. 6 is a rear perspective view showing the interior of the light unit;

[0016] FIG. 7 is an exemplary circuit diagram of the light unit and fault indication system; and

[0017] FIG. 8 is a flow chart illustrating an exemplary method of the lighting unit and fault indication system.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0018] Emergency signaling devices, such as emergency exit lights, can include a housing containing one or more light emitters, a backup battery, a charging and control assembly, and other electrical components. The charging and control assembly can include a control circuit configured to charge the backup battery and discharge the battery to power the lights when

a main power supply is unavailable. The control circuit can also be configured to run a self-diagnostic or otherwise detect faults in one or more of the electrical components, for example the battery, driver, charger, etc.

[0019] A fault can be triggered from a low-voltage condition. For example, a battery voltage level can be compared to a one-minute test, a 30 minute test, a 60 minute test, and a 90 minute test. If the battery voltage is insufficient to pass the one-minute test, the battery voltage is sufficiently low that the battery could not power the emergency lighting unit 100 for one minute during the emergency mode. Similar comparisons are performed for the 30, 60, and 90 minute tests to assess how long the battery would be able to power the emergency lighting unit 100.

[0020] The self-test diagnostic fault conditions also include a battery disconnect fault (e.g., battery disconnected from emergency lighting unit), a battery fault (e.g., battery capacity or battery voltage too low), a charger fault (e.g., bulk charge voltage exceeds +/- 10% of desired voltage for too great of a period [e.g., 15+ hours]), an LED driver fault (e.g., LED string voltage at or near zero volts), a lamp fault, and a load learn fault. Identifying the lamp fault includes enabling the driver module and monitoring an LED string voltage when operating normally. The LED string voltage is continuously monitored and, if the LED string voltage is outside of a desired voltage range (e.g., +/- one volt), the lamp fault is triggered. The load learn fault is related to the emergency lighting unit being unable to determine or learn a proper or normal load for the emergency lighting unit (e.g., LED string voltage).

[0021] When a self-test diagnostic fault condition is identified, a specific LED blinking pattern can be used to indicate the fault to a user. The fault light can be a bi-color LED light that blinks to signal a fault. The length and number of blinks are a code that can signal specific faults to a user. This system can have drawbacks. The codes can be confusing to determine and require a reference card that may not always be accessible. People who are color blind may also not be able to tell the difference in the LED colors.

[0022] Further details regarding emergency exit lighting devices are included in US Patent Application Serial Nos. 14/955,497 and 15/130,415 the disclosures of which are hereby incorporated by reference in their entirety.

[0023] According to various exemplary embodiments, an emergency signaling device includes an alternative fault signaling system having a simplified fault indication. In an exemplary embodiment, the fault signaling system has a first signal that indicates that a battery needs to be replaced and a second signal that indicates that the entire unit should be replaced.

[0024] FIGS. 1-4 show an exemplary embodiment of an emergency exit light device 10 that includes a housing 12 having a pair of light emitters 14, a battery compartment 16, and a fault indication system 18. The fault indication system 18 can be positioned on a bottom wall 20 of the housing, allowing a fault indication to be easily seen when the unit is placed on a wall or other support.

[0025] The fault indication system 18 includes a diffuser 22 and one or more (for example, three) indicator lights (i.e. LEDs) positioned behind the diffuser 22. The diffuser 22 may be a substantially flat plate having one or more transparent or semi-opaque sections with identifying symbols. The first indicator light 24 may be a bi-color LED that is capable of signaling to a user a wide range of default codes through a series of blinking lights (for example, red or green blinking lights). The second indicator light 26 may be a replace battery indicator that is positioned behind a replace battery symbol 28 of the diffuser 22. The third indicator light 30 may be a replace unit indicator positioned behind a replace unit symbol 32 of the diffuser 22.

[0026] FIG. 5, shows the diffuser 22 removed to expose the indicator LEDs 24, 26, 30. The LEDs may be white to eliminate any issues with color blindness, although different colors may also be used. The symbols may also be colored to impart color to the light through the diffuser 22. The housing 12 includes one or more tapered openings 34 around the second and third indicator LEDs 26, 30 to help direct the emitted light.

[0027] By utilizing the indicators, fault status is easily visible and understood by a user on the floor and users are not required to cross reference blink codes from a bi-color LED to a blink code description chart to determine the fault present on a unit after self-testing has occurred.

[0028] FIG. 6 shows an interior of the housing 12. The indicator lights 24, 26, 30 may be connected to a fault indicator circuit board 40. The fault indicator circuit board 40 may be connected to a control circuit board (not shown). In an exemplary embodiment, the fault indicator circuit board 40 is capable of translating or interpreting faults from the control circuit board. The fault indicator circuit board 40 determines if the fault requires the replacement of the battery or replacing of the entire unit and activates the appropriate indicator. In addition, or separately for other faults, the first indicator 24 can transmit the appropriate code to indicate a more specific problem with the unit.

[0029] FIG. 7 show an exemplary circuit schematic for the fault indicator circuit board. The emergency exit light device 10 includes, among other things, a voltage input 50, a first controller 55, a second controller 60, a charger LED 65, the first indicator light 24, the second indicator light 26, and the third indicator light 30. A nominal voltage may be received at the voltage input 50 and supplied to various components of the emergency exit light device 10.

[0030] The first controller 55 is electrically and/or communicatively connected to a variety of modules or components of the emergency exit light device 10. For example, the first controller 55 is connected to the second controller 60, the charger LED 65, the first indicator light 24, and antenna 85. The first controller 55 includes combinations of hardware and software that are operable to, among other things, monitor and/or control the operation of the emergency exit light device 10.

[0031] In some embodiments, the controller 55 is electrically and/or communication connected to one or more sensors sensing one or more

characteristics of the device. In one embodiment, the sensors are temperature sensors configured to sense one or more temperatures of the device (for example, a temperature within housing 12, an ambient temperature external housing 12, a battery temperature, etc.). In other embodiments, the sensor may be electrical sensors configured to monitor one or more electrical characteristics. For example, the sensor may monitor an electrical characteristic (for example, voltage, current, power, etc.) of one or more components of the device 10 (for example, the battery, the indicators, the light emitters, the mains voltage input to device 10, etc.).

[0032] In some embodiments, the first controller 55 includes a plurality of electrical and electronic components that provide power, operation control, and protection to the components and modules within the first controller 55 and the emergency exit light device 10. For example, the first controller 55 includes, among other things, a processing unit and a memory. In some embodiments, the first controller 55 is implemented partially or entirely on a semiconductor (e.g., a field-programmable gate array ["FPGA"] semiconductor) chip, such as a chip developed through a register transfer level ("RTL") design process.

[0033] The memory includes, for example, a program storage area and a data storage area. The program storage area and the data storage area can include combinations of different types of memory, such as read-only memory ("ROM"), random access memory ("RAM") (e.g., dynamic RAM ["DRAM"], synchronous DRAM ["SDRAM"], etc.), electrically erasable programmable read-only memory ("EEPROM"), flash memory, a hard disk, an SD card, or other suitable magnetic, optical, physical, or electronic memory devices. The processing unit is connected to the memory and executes software instructions that are capable of being stored in a RAM of the memory (e.g., during execution), a ROM of the memory (e.g., on a generally permanent basis), or another non-transitory computer readable medium such as another memory or a disc. Software included in the implementation of the emergency

exit light device 10 can be stored in the memory of the first controller 55. The software includes, for example, firmware, one or more applications, program data, filters, rules, one or more program modules, and other executable instructions. The first controller 55 is configured to retrieve from memory and execute, among other things, instructions related to the control processes and methods described herein. In other constructions, the first controller 55 includes additional, fewer, or different components.

[0034] In operation, the first controller 55 monitors one or more characteristics of the emergency exit light device 10 and controls operation of the charger LED 65 and the first indicator light 24, based on the monitored characteristics. For example, when a fault is detected by the first controller 55, the first controller 55 activates the first indicator light 24 accordingly. In some embodiments, the first indicator light 24 is activated corresponding to a fault code. In such an embodiment, a flash rate (for example, one flash per predetermined time period, two flashes per predetermined time period, etc.) may be used to indicate the type of fault (for example, unit has failed, battery has failed, etc.).

[0035] In some embodiments, the second controller 60 is substantially similar to the first controller 55. In some embodiments, the second controller 60 is a PIC16 microcontroller. The second controller 60 is also electrically and/or communicatively connected to a variety of modules or components of the emergency exit light device 10. For example, the second controller 60 is connected to the third indicator light 30, the second indicator light 26, and a self-diagnostic input 90.

[0036] The self-diagnostic input 90 receives a self-diagnostic signal corresponding to activation of the first indicator light 24. In operation, when the self-diagnostic signal is received, the second controller 60 interprets the self-diagnostic signal. In some embodiments, interpreting the self-diagnostic signal may include counting the amount of flashes of the first indicator light 24 that occur within the predetermined time period. The second controller 60

activates the third indicator light 30 and/or the battery fault LED 70 according to the interpreted self-diagnostic signal.

[0037] Fig. 8 is a flow chart illustrating a process, or operation, 100 according to some embodiments. It should be understood that the order of the steps disclosed in process 500 could vary. Furthermore, additional steps may be added to the process and not all of the steps may be required. Process 100 begins by monitoring one or more characteristics of device 10 (block 105). A determination is made whether there is a fault based on the monitored characteristics (block 110). If a fault is not determined, process 100 cycles back to block 105.

[0038] If a fault is determined, charger LED 65 and/or first indicator light 24 are controlled based on the determined fault (block 115). For example, fault indicator light 24 may be activated (for example, activated according to a flash rate) corresponding to a fault code.

[0039] The activation (for example, flash rate) of charger LED 65 and/or first indicator light 24 is monitored (block 120). The activation is analyzed (block 125). The third indicator light 30 and/or battery fault LED 70 is activated based on the analysis of block 125 (block 130).

[0040] The foregoing detailed description of the certain exemplary embodiments has been provided for the purpose of explaining the principles of the invention and its practical application, thereby enabling others skilled in the art to understand the invention for various embodiments and with various modifications as are suited to the particular use contemplated. This description is not necessarily intended to be exhaustive or to limit the invention to the exemplary embodiments disclosed. Any of the embodiments and/or elements disclosed herein may be combined with one another to form various additional embodiments not specifically disclosed. Accordingly, additional embodiments are possible and are intended to be encompassed within this specification and the scope of the appended claims. The

specification describes specific examples to accomplish a more general goal that may be accomplished in another way.

[0041] As used in this application, the terms “front,” “rear,” “upper,” “lower,” “upwardly,” “downwardly,” and other orientational descriptors are intended to facilitate the description of the exemplary embodiments of the present invention, and are not intended to limit the structure of the exemplary embodiments of the present invention to any particular position or orientation. Terms of degree, such as “substantially” or “approximately” are understood by those of ordinary skill to refer to reasonable ranges outside of the given value, for example, general tolerances associated with manufacturing, assembly, and use of the described embodiments.

CLAIMS:

1. An emergency lighting device comprising:
 - a housing;
 - a light emitter positioned in the housing;
 - a control circuit positioned in the housing and operatively connected to the light emitter;
 - a fault indicator circuit positioned in the housing and operatively connected to the control circuit;
 - a first indicator light connected to the fault indicator circuit;
 - a second indicator light connected to the fault indicator circuit; and
 - a third indicator light connected to the fault indicator circuit,wherein the fault indicator circuit is configured to activate the first indicator light to indicate a plurality of faults, to activate the second indicator light to indicate a first fault, and to activate the third indicator light to indicate a second fault.
2. The emergency lighting device of claim 1, wherein the first fault is a replace battery fault.
3. The emergency lighting device of claim 1, wherein the second fault is a replace unit fault.
4. The emergency lighting device of claim 1, further comprising a diffuser positioned over the first, second, and third indicator lights.
5. The emergency lighting device of claim 4, wherein the diffuser includes a first symbol indicating the first fault and a second symbol indicating the second fault.

6. The emergency lighting device of claim 1, wherein the first indicator is a bi-color LED.
7. The emergency lighting device of claim 1, wherein the fault indicator circuit includes a first controller and a second controller.
8. An emergency lighting device comprising:
 - a housing;
 - a light emitter positioned in the housing;
 - a control circuit positioned in the housing and operatively connected to the light emitter;
 - an indicator light positioned in the housing;
 - a fault indicator circuit positioned in the housing and operatively connected to the indicator light, the fault indicator circuit configured to
 - monitor the light emitter,
 - analyze activation of the light emitter, and
 - activate the indicator light based on the analysis of the activation of the light emitter.
9. The emergency lighting device of claim 8, wherein activation of the light emitter includes a flash rate.
10. The emergency lighting device of claim 9, wherein the flash rate includes one or more flashes per predetermined time period.
11. The emergency lighting device of claim 8, wherein the light emitter is activated based on a characteristic monitored by the control circuit.
12. The emergency lighting device of claim 11, wherein the control circuit determines a fault based on the characteristic monitored by the control circuit.

13. The emergency lighting device of claim 12, wherein the fault is a battery fault.
14. The emergency lighting device of claim 12, wherein the fault is a unit fault.
15. A method of controlling an emergency lighting device, the method comprising:
 - monitoring, via a controller, one or more characteristics of the emergency lighting device;
 - activating a first indicator based on the one or more characteristics;
 - monitoring activation of the first indicator;
 - analyzing the activation of the first indicator; and
 - activating, based on the analysis of the activation of the first indicator, a second indicator.
16. The method of claim 15, wherein activation of the first indicator includes a flash rate.
17. The method of claim 15, wherein the flash rate includes one or more flashes per predetermined time period.
18. The method of claim 15, further comprising determining a fault based on the one or more monitored characteristics.
19. The method of claim 18, wherein the fault is a battery fault.
20. The method of claim 18, wherein the fault is a unit fault.

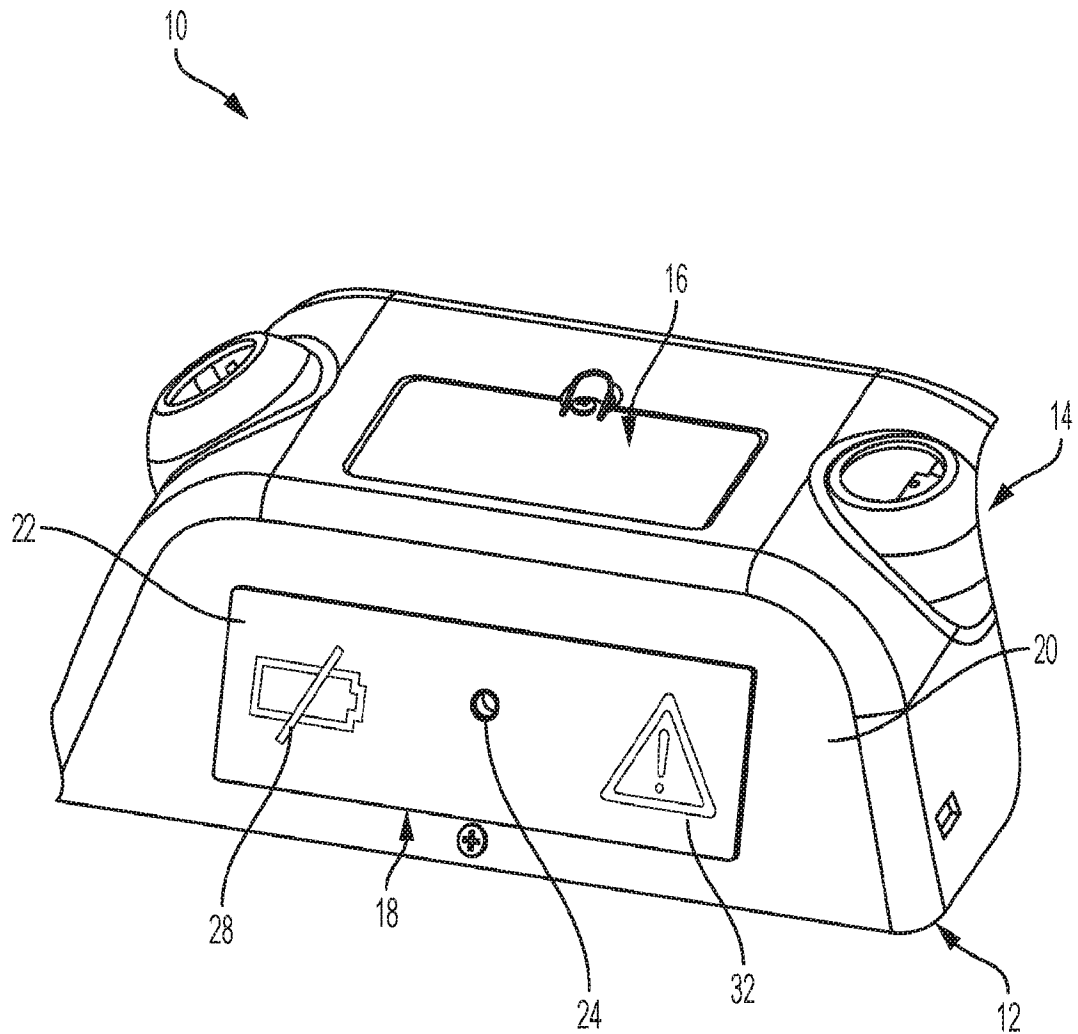


FIG. 1

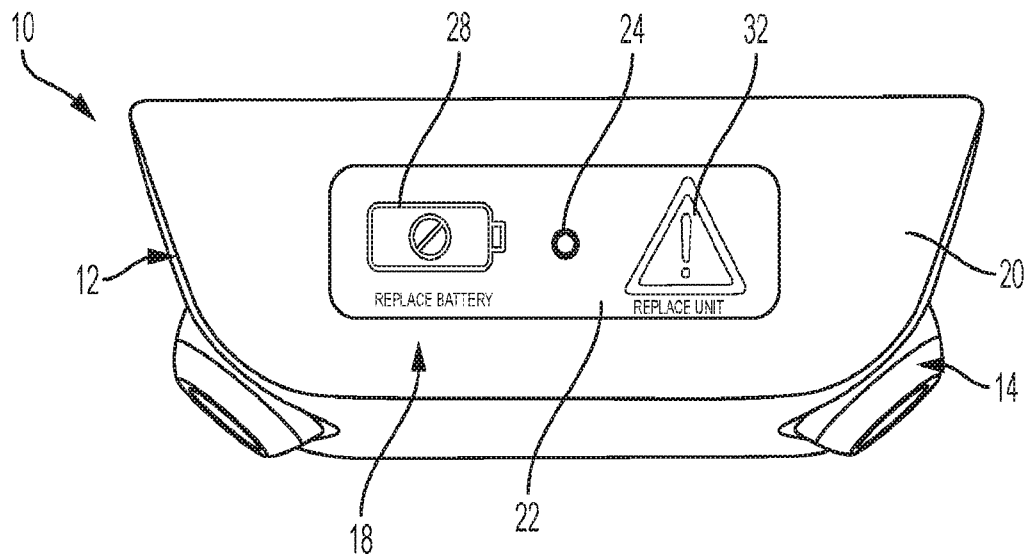


FIG. 2

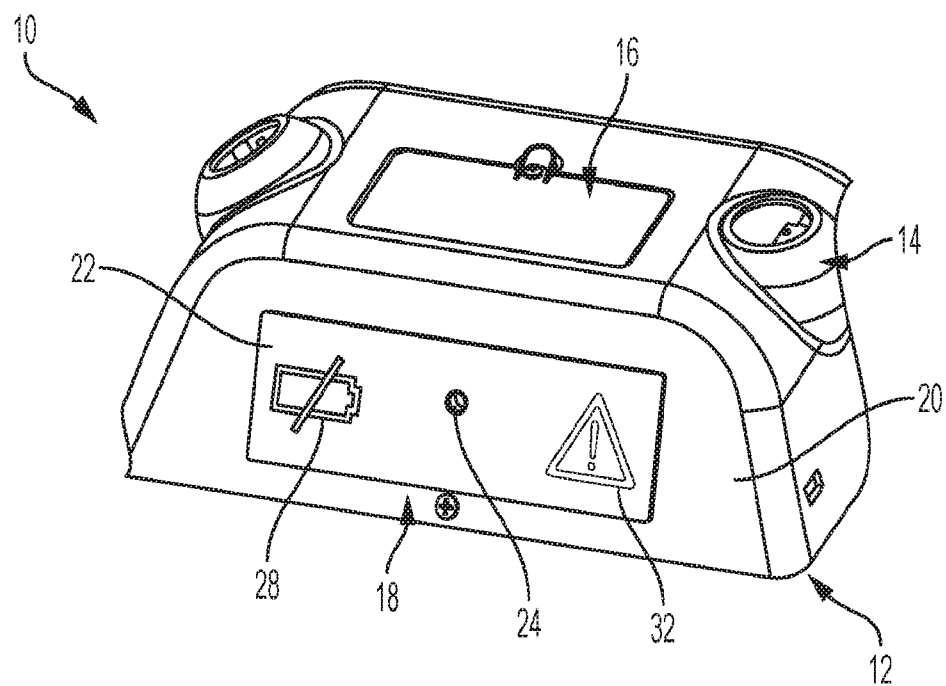


FIG. 3

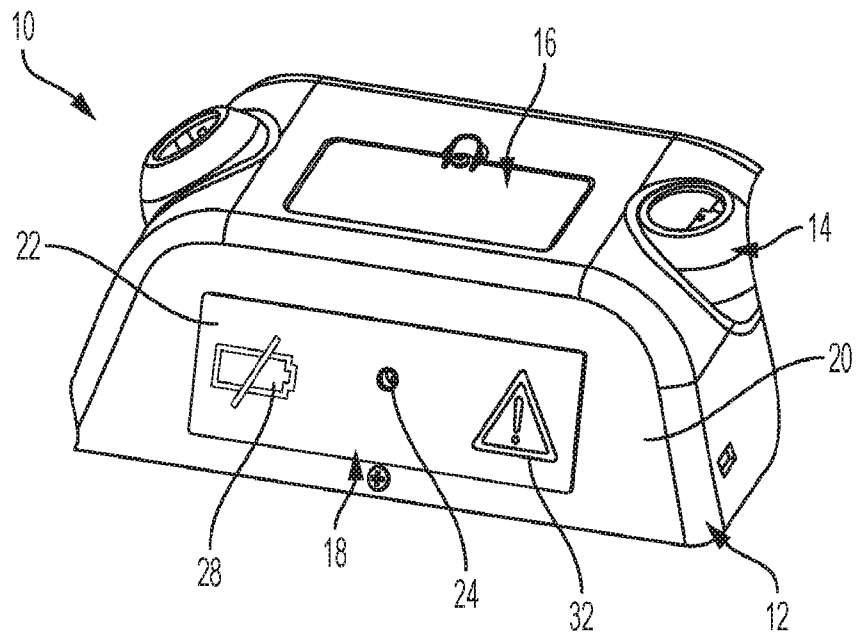


FIG. 4

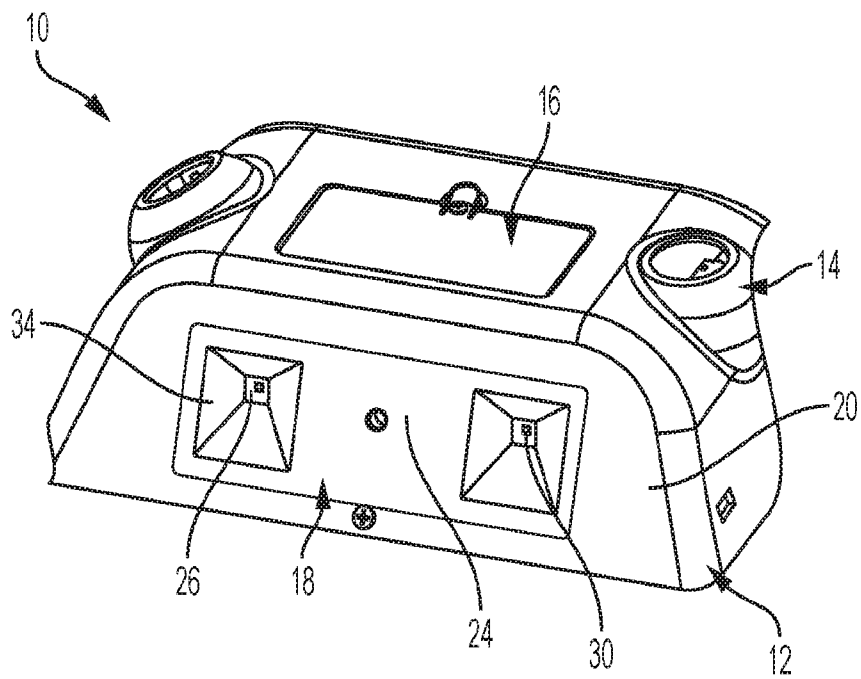


FIG. 5

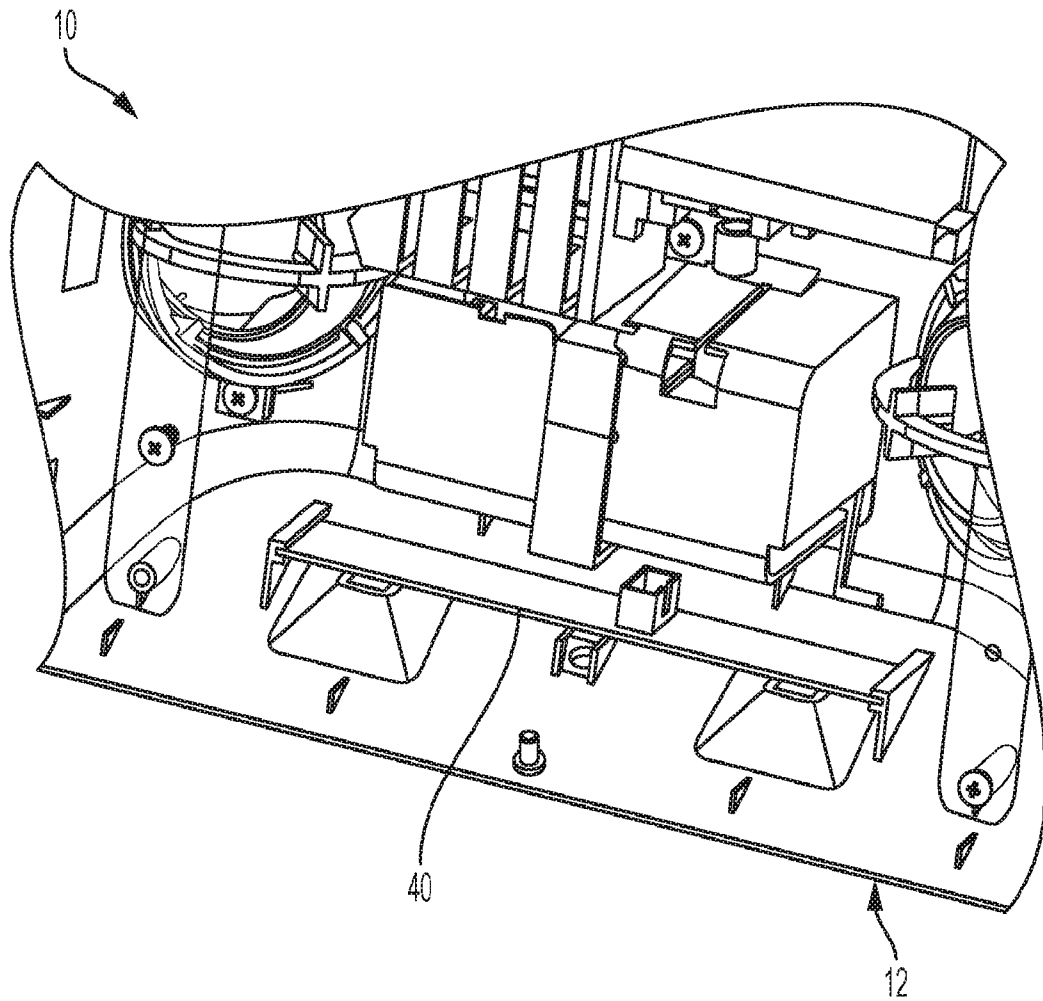


FIG. 6

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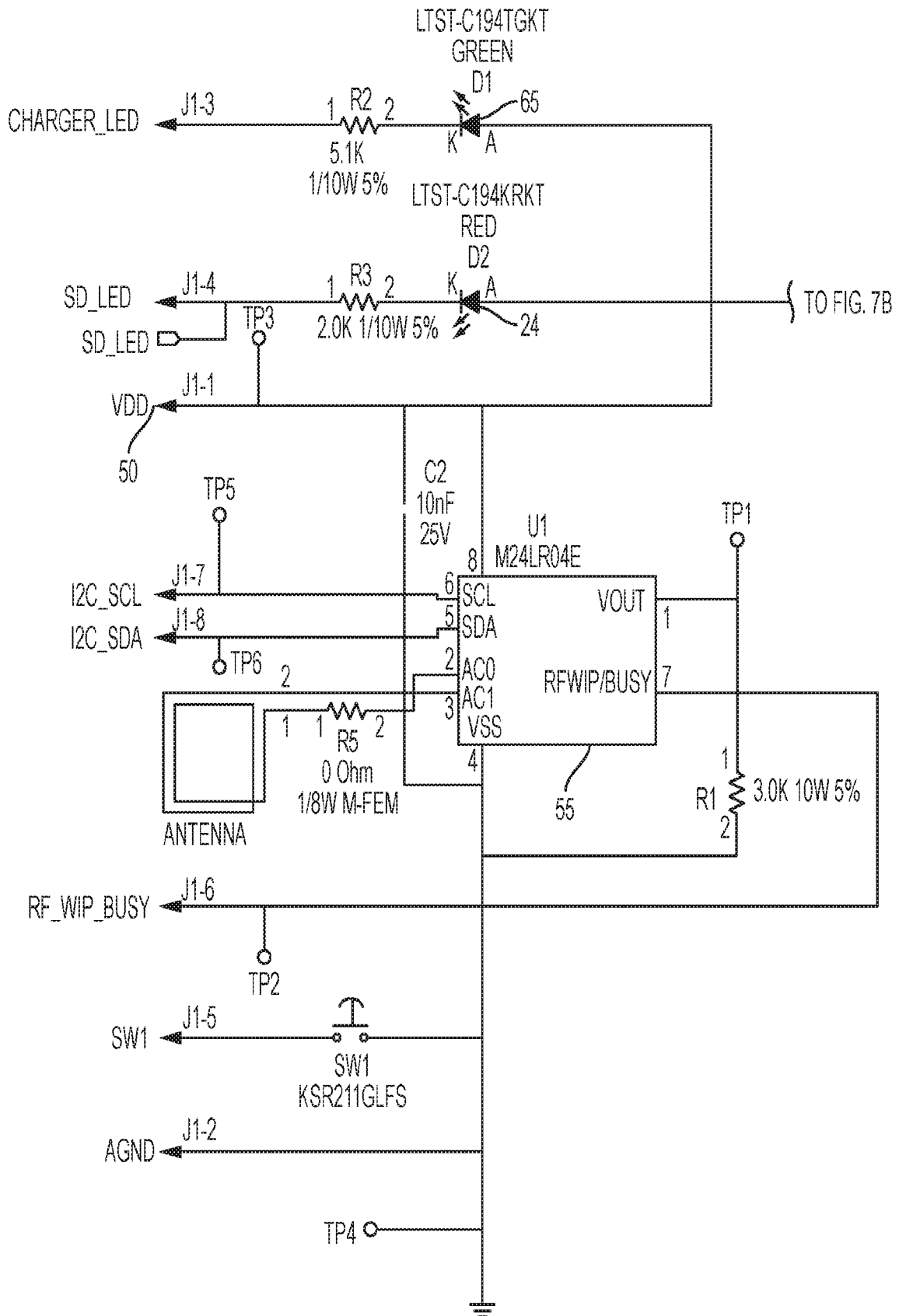


FIG. 7A

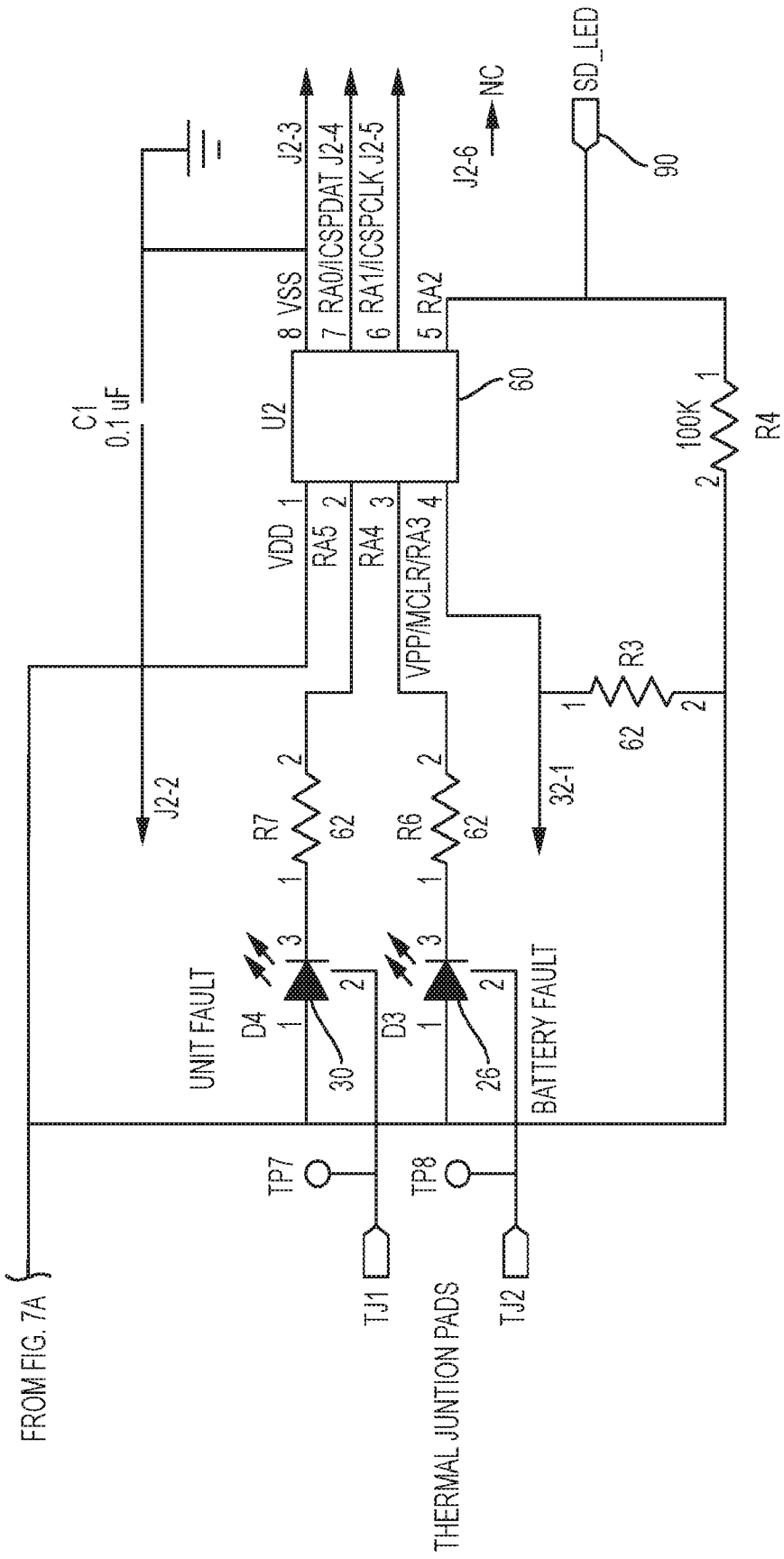


FIG. 7B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/44641

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Group I: Claims 1-7; Group II: Claims 8-14; Group III: Claims 15-20

-Continued within extra sheet-

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-7

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/44641

A. CLASSIFICATION OF SUBJECT MATTER

IPC - H02J 9/02; H05B 37/02, 37/03 (2017.01)

CPC - H02J 9/065; H05B 37/03, 37/034, 37/0236, 37/0218, 33/0851, 33/0884

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,396,216 B1 (NOONE, S et al.) May 28, 2002; figure 1, column 1, lines 4-7, column 3, lines 60-66, column 4, lines 6-18, column 5, lines 11-15, lines 44-52, lines 60-64, column 6, lines 15-27	1-7
Y	US 2011/0260624 A1 (BIGGE, W et al.) October 27, 2011; figure 1, paragraphs [0026], [0029], [0055], claims 19, 29	1-7
Y	US 7,573,396 B2 (STOKES, P) August 11, 2009; claim 16	2
Y	US 6,870,655 B1 (NORTHMAN, B et al.) March 22, 2005; abstract, column 7, lines 31-50, column 8, lines 61-64, claim 10	4, 5
Y	US 2016/0216704 A1 (KOH, K) July 28, 2016; abstract	7

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

21 September 2017 (21.09.2017)

Date of mailing of the international search report

22 NOV 2017

Name and mailing address of the ISA/

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P.O. Box 1450, Alexandria, Virginia 22313-1450

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Authorized officer

Shane Thomas

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/44641

-Continued from Box No. III - Observations where unity of invention is lacking-

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-7 are directed towards an emergency lighting device including a fault indicator circuit and three fault indicators.

Group II: Claims 8-14 are directed towards an emergency lighting device comprising monitoring a light emitter.

Group III: Claims 15-20 are directed towards a method of controlling an emergency lighting device comprising monitoring activation of a first indicator.

The inventions listed as Groups I-III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical features of Group I include at least a third indicator light connected to the fault indicator circuit, wherein the fault indicator circuit is configured to activate the first indicator light to indicate a plurality of faults, to activate the second indicator light to indicate a first fault, and to activate the third indicator light to indicate a second fault, which are not present in Groups II-III.

The special technical features of Group II include monitor the light emitter, analyze activation of the light emitter, and activate the indicator light based on the analysis of the activation of the light emitter, which are not present in Groups I and III.

The special technical features of Group III include monitoring, via a controller, one or more characteristics of the emergency lighting device; monitoring activation of the first indicator; analyzing the activation of the first indicator; and activating, based on the analysis of the activation of the first indicator, a second indicator, which are not present in Groups I-II.

The common technical features shared by Groups I-II are an emergency lighting device comprising: a housing; a light emitter positioned in the housing; a control circuit positioned in the housing and operatively connected to the light emitter; a fault indicator circuit positioned in the housing; a first indicator light; and a second indicator light.

However, these common features are previously disclosed by US 2011/0260624 A1 to BIGGE et al. (hereinafter "Bigge"). Bigge discloses an emergency lighting device comprising: a housing (light fixture housing; para [0026]); a light emitter positioned in the housing (GU24 CFL; para [0026]); a control circuit positioned in the housing and operatively connected to the light emitter (photocontrol circuit is coupled to photosensors; para [0026]); a fault indicator circuit positioned in the housing (lighting system also includes a fault monitoring circuit for detecting faults or malfunctions in the photocontrol circuit; para [0022]); a first indicator light (LED fault indicator; para [0031]); and a second indicator light (two fault indicating LEDs; para [0061]).

Since the common technical features are previously disclosed by the Bigge reference, these common features are not special and so Groups I-II lack unity.