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(54) Title: LED TUBE FOR RETROFITTING IN A FLUORESCENT TUBE LIGHTING FIXTURE

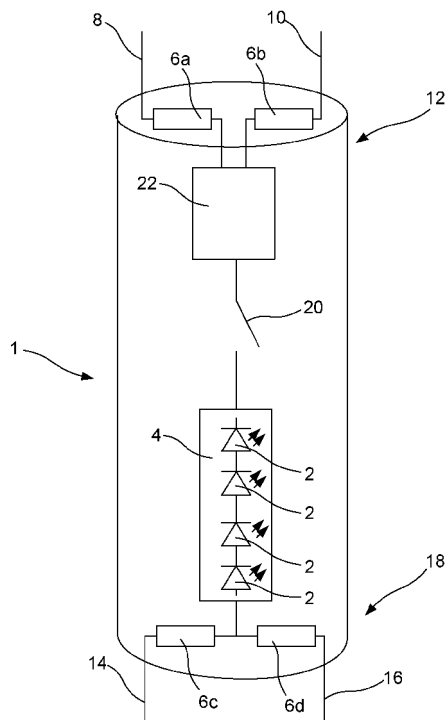


FIG. 1

(57) Abstract: The present invention relates to a LED tube(1)for retrofitting in a fluorescent tube lighting fixture having a preheat phase and a normal operation phase. Said LED tube(1) comprising: an array LEDs(2), a LED driver(4), a first pair of contact pins(8, 10) and a second pair of contact pins(14, 16)for connecting said LED tube(1) electronically and mechanically to said fluorescent tube lighting fixture, said first pair of contact pins(8, 10) being connected forming a first circuitry, said second pair of contact pins(14, 16) being connected forming a second circuitry, one or more resistive elements(6a, 6b) connected between said first pair of contact pins(8, 10) and arranged to mimic a filament of a fluorescent tube, a voltage controlled switch(20) arranged to open and close a current path between said first circuitry and said second circuitry, and control circuitry(22) for controlling said voltage controlled switch(20), said control circuitry(22) being arranged to close said voltage controlled switch(20) during said preheat phase by powering said voltage controlled switch(20) using a preheat current, and to keep said voltage controlled switch(20) closed by powering said voltage controlled switch(20) using an operation current flowing through said current path between said first pair of contact pins(8, 10) and said second pair of contact pins(14, 16) during said normal operation phase.



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GW, KM, ML, MR, NE, SN, TD, TG).

LED tube for retrofitting in a fluorescent tube lighting fixture

FIELD OF THE INVENTION

The present invention is related to a LED tube for retrofitting in a fluorescent tube lighting fixture. Moreover, the present invention is also related to a method for preventing a shock hazard during retrofitting of a LED tube in a fluorescent tube lighting
5 fixture.

BACKGROUND OF THE INVENTION

In a traditional fluorescent tube lamp, the body is a straight tube with a length of 15 to 60 times the diameter of the tube. Fluorescent tubes are low-pressure mercury
10 discharge lamps in which the inner surface of the tube is coated with fluorescent material. The fluorescent tube lamp consists of an air-tight glass tube containing a small amount of mercury, an inert gas, a fluorescent coating, such as phosphor, and electrodes. At each end of the fluorescent tube, there is a lid with two symmetrically positioned contact pins, to which the electrodes are connected. Power supply to the fluorescent tube is provided via these
15 contact pins. When the lamp is in operation, the temperature of the electrodes must be sufficiently high, so that electrons release from them. A fluorescent lamp does not ignite at a normal operation voltage without preheating. It is typical of fluorescent tubes that their cathodes are heated with separate preheat circuits or arrangements. On the other hand, after the lamp has gone on, the discharging current through the tube must be restricted, so that the
20 tube will not be damaged. Therefore, all fluorescent tubes require some kind of ballast.

Conventionally, the ballast has been a ballast-starter combination, a so called passive electro-magnetic, or short EM, ballast. However, nowadays electronic ballasts (e.g. active high frequency, or short HF, ballasts) are also used. Common to both these types of ballasts are that the fluorescent tube lighting fixture is arranged to heat the electrodes of the
25 fluorescent tube with separate preheat circuits or arrangements during a preheat phase. During the preheat phase the electrodes of the fluorescent tube are heated so that electrons are emitted. The emitted electrons ionize the gas inside the fluorescent tube. The ionized gas forms a current path through the tube. A voltage difference between the electrodes of the fluorescent tube ignites the ionized gas and starts the fluorescent tube lamp. During a normal

operation phase of the fluorescent tube lighting fixture a current is running through the fluorescent tube that is limited by the EM or HF lamp ballast.

Retrofitting a fluorescent tube with a LED tube is nowadays becoming common. Retrofitting means replacing a fluorescent tube by a LED tube without altering the fluorescent tube lighting fixture except for removing or replacing the starter (if the passive - magnetic ballast is used) by a similar shaped device with a different function (this is optional). Usually, the LED tube has internal electronics for compatibility with the existing ballast in the fluorescent tube lighting fixture. When retrofitting a fluorescent tube with a LED tube both fluorescent tube lighting fixtures having a passive EM-ballast and fluorescent tube lighting fixtures having an active (HF) ballast must be taken into consideration. The goal is to be able to replace a fluorescent tube with a LED tube without changing the fluorescent tube lighting fixture structures. Then, the LED tube can be replaced easily and without assistance from a professional.

When retrofitting a fluorescent tube with a LED tube a problem related to the risk of an electric shock during the mounting step of the LED tube occurs. According to the safety regulations in the field of electricity, fluorescent tube lighting fixtures are to be constructed in such a way that, when a fluorescent tube is replaced, it is not possible for a user to touch any parts at the mains voltage even if the fluorescent tube lighting fixture were carrying voltage. This requirement is met even if the fluorescent tube were replaced in such a way that only one end of the tube were in contact with the contacts of a tube holder of the fluorescent tube lighting fixture and the person replacing the tube can touch the other end of the tube. This requirement is met because no current goes through the gas-filled fluorescent tube before the gas in the tube is ionized with a starting pulse. In other words, the gas in the fluorescent tube serves as an insulator in itself. The electric structure of the lighting fixture, in turn, is such that generation of a starting pulse requires that both ends of the tube be connected to the contacts of the tube holders. This way the fluorescent tube prevents the risk of an electric shock during replacement.

With LED tubes, this electric safety requirement is not necessarily met. Inside LED tubes, there is a printed board or a corresponding structure, on which LEDs and electronic current supply components that they require are mounted. The purpose of these components is to convert the alternating voltage of the mains into direct voltage and to regulate the direct current required by the LEDs. In practice, current flows through these components once voltage is applied to them, in other words, the LED tube is in a conductive state without a separate starting pulse. Therefore, in a practical situation, when the LED tube

is being mounted on a fluorescent tube lighting fixture, the contact pins at one end of the LED tube may hit the contacts of the tube holder of the fluorescent tube lighting fixture, and the other end of the tube may remain outside the fluorescent tube lighting fixture, so that the person mounting or replacing the tube may touch it, whereby he is prone to the risk of an electric shock.

US2011/0260614 discloses an LED tube for retrofitting in a fluorescent tube lighting fixture. The LED tube comprises a safety unit arranged to prevent a voltage from transferring through the tube lamp from its one end to the other until a voltage supplied from a corresponding tube holder of the fluorescent tube lighting fixture to the pair of contact pins has been separately detected at each end of the LED tube. Inside the LED tube, there is at least one optical line that is arranged to transfer a control or measurement signal associated with the safety unit from one end of the LED tube to the other without capacitive leakage currents. Although US2011/0260614 presents a solution to the above mentioned problem of the risk of an electric shock when retrofitting an LED tube in a fluorescent tube lighting fixture, the solution according to US2011/0260614 is complex and expensive due to the use of the optical line arranged to transfer a control or measurement signal associated with the safety unit from one end of the LED tube to the other.

SUMMARY OF THE INVENTION

It is an objective of the present invention to present a simple and unexpressive solution to the risk of an electric shock when retrofitting an LED tube in a fluorescent tube lighting fixture.

According to a first aspect of the invention, this and other objectives are achieved by a LED tube for retrofitting in a fluorescent tube lighting fixture having a preheat phase during which said fluorescent tube lighting fixture is arranged to preheat filaments of a fluorescent tube and a normal operation phase during which said fluorescent tube lighting fixture is arranged to supply said fluorescent tube with an operation current. Said LED tube comprises an array of LEDs, a LED driver for driving said array of LEDs, a first pair of contact pins at a first end of said LED tube and a second pair of contact pins at a second end of said LED tube for connecting said LED tube electronically and mechanically to said fluorescent tube lighting fixture, said first pair of contact pins being connected forming a first circuitry, said second pair of contact pins being connected forming a second circuitry, said LED driver being connected between said first circuitry and said second circuitry, one or more impedance resistive elements (e.g. resistors, capacitors, inductors, or a combination of

those, or an electronic circuit mimicking this) connected between said first pair of contact pins and arranged to mimic a filament of a fluorescent tube, a voltage controlled switch arranged to open and close a current path between said first circuitry and said second circuitry, and control circuitry for controlling said voltage controlled switch, said control circuitry being connected between said first circuitry and said second circuitry and being arranged to close said voltage controlled switch during said preheat phase of said fluorescent tube lighting fixture by powering said voltage controlled switch using a preheat current passing between said first pair of contact pins and through said one or more e.g. resistive elements, and to keep said voltage controlled switch closed by powering said voltage controlled switch using an operation current flowing through said current path between said first pair of contact pins and said second pair of contact pins during said normal operation phase of said fluorescent tube lighting fixture.

The above LED tube is suitable for retrofitting in a fluorescent tube lighting fixture without the need to modify the fixture. Said voltage controlled switch being arranged to be closed by the preheat current and to be kept closed by the normal operation current prevents a shock hazard from occurring during retrofitting by the LED tube in the fluorescent tube lighting fixture. This since the voltage controlled switch will be open as long as the LED tube is not properly fitted into the fluorescent tube lighting fixture. It is only after proper mounting in the fixture the preheat phase starts. Compared to the LED tube disclosed in US2011/0260614 the LED tube according to the present invention is simple to manufacture and is less expensive since no optical line arranged to transfer a control or measurement signal associated with the safety unit from one end of the LED tube to the other is needed.

According to a second aspect of the invention, this and other objectives are achieved by a method for preventing a shock hazard during retrofitting of a LED tube in a fluorescent tube lighting fixture having a preheat phase during which said fluorescent tube lighting fixture is arranged to preheat filaments of a fluorescent tube and a normal operation phase during which said fluorescent tube lighting fixture is arranged to supply said fluorescent tube with an operation current. Said method comprises mimicking filaments of a fluorescent tube by one or more e.g. resistive elements connected between a first pair of contact pins at a first end of said LED tube and a second pair of contact pins at a second end of said LED tube, respectively, said first pair of contact pins being connected forming a first circuitry, said second pair of contact pins being connected forming a second circuitry providing a voltage controlled switch arranged to open and close a current path between said first circuitry and said second circuitry, blocking current through said current path by means

of said voltage controlled switch, starting said preheat phase of said fluorescent tube lighting fixture, closing said voltage controlled switch during said preheat phase using current passing between said first pair of contact pins and through said one or more resistive elements connected between said first pair of contact pins, keeping said voltage controlled switch closed using said operation current flowing through said LED tube during said normal operation phase of said fluorescent tube lighting fixture.

It is noted that the invention relates to all possible combinations of features recited in the claims.

10 BRIEF DESCRIPTION OF THE DRAWINGS

This and other aspects of the present invention will now be described in more detail, with reference to the appended drawings showing embodiments of the invention.

Fig. 1 is a schematic view of a LED tube according to an embodiment of the present invention for retrofitting in a fluorescent tube lighting fixture.

15 Fig. 2 is a schematic view of a preferred embodiment of the LED tube.

As illustrated in the Figures, the sizes of layers and regions are exaggerated for illustrative purposes and, thus, are provided to illustrate the general structures of embodiments of the present invention. Like reference numerals refer to like elements throughout.

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DETAILED DESCRIPTION

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which currently preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these
25 embodiments are provided for thoroughness and completeness, and fully convey the scope of the invention to the skilled person.

This invention is compatible with all fluorescent tube lighting fixture having a preheat phase. During the preheat phase the fluorescent tube lighting fixture is arranged to, at
30 each of the two ends of a fluorescent tube, apply a current between a first pair of contact pins at a first end of the fluorescent tube and between a second pair of contact pins at a second end of the fluorescent tube. The current is applied in order to heat a corresponding filament connected between said first and second pair of contact pins, respectively, so that electrons are emitted.

In Fig. 1 an embodiment of a LED tube 1 for retrofitting in a fluorescent tube lighting fixture is schematically illustrated. The LED tube 1 comprises an array of LEDs 2, a LED driver 4, one or more impedance resistive elements 6a, 6b, 6c, 6d, a first pair of contact pins 8, 10 at a first end 12 of said LED tube 1, and a second pair of contact pins 14, 16 at a second end 18 of said LED tube 1, a voltage controlled switch 20, and control circuitry 22 for controlling said voltage controlled switch 20.

The one or more impedance resistive elements 6a, 6b, 6c, 6d are arranged to mimic filaments of a fluorescent tube. The one or more impedance resistive elements 6a, 6b, 6c, 6d are connected between said first pair of contact pins 8, 10 and the second pair of contact pins 14, 16, respectively. The one or more impedance resistive elements 6a, 6b, 6c, 6d may e.g. be resistors, capacitors, inductors, or a combination of those, or an electronic circuit mimicking this. A typical resistance, but not mentioned as a limiting example, of the one or more impedance resistive elements 6a, 6b, 6c, 6d arranged to mimic a filament of a fluorescent tube is in the range of 5Ω to 12Ω , preferably 5Ω to 8Ω , more preferably 5Ω to 6Ω .

The first pair of contact pins 8, 10 and said second pair of contact pins 14, 16 are arranged for connecting said LED tube 1 electronically and mechanically to said fluorescent tube lighting fixture. The first pair of contact pins (8, 10) being connected forming a first circuitry. The second pair of contact pins (14, 16) being connected forming a second circuitry.

The LED driver 4 is connected between the first circuitry and the second circuitry. The LED driver 4 is arranged to drive the array of LEDs 2. The LED driver 4 is arranged in series with the first circuitry and the second circuitry.

The voltage controlled switch 20 is arranged to open and close a current path between said first circuitry and said second circuitry. Thus, the voltage controlled switch 20 is arranged to open and close a current path going through the LED tube 1. The control circuitry 22 is arranged to close the voltage controlled switch 20 during the preheat phase of said fluorescent tube lighting fixture using a preheat current passing between said first pair of contact pins 8, 10 and through said one or more impedance resistive elements 6a, 6b, thus, the preheat current is going through said first circuitry. Moreover, said control circuitry 22 is also arranged to keep said voltage controlled switch 20 closed using an operation current flowing through said current path between said circuitry and said second circuitry during said normal operation phase of said fluorescent tube lighting fixture.

The principle of operation of said LED tube 1 will now be discussed in more detail. The filaments of a fluorescent tube are mimicked electronically by one or more impedance resistive elements 6a, 6b, 6c, 6d. When the ballast of the fluorescent tube lighting fixture is off, current flow through the LED tube 1 is blocked by said voltage controlled switch 20, comprising e.g. a relay or a semiconductor. When the ballast of the fluorescent tube lighting fixture is turned on, the preheat phase will start. Note, that in the case of a fluorescent tube fixture having a preheat phase, this preheat phase is only started when the LED tube is connected with both ends 12, 18 to the fixture. During the preheat phase the preheat current is used to close said voltage controlled switch 20. This will allow current to flow through the LED tube 1 between the outputs of the ballast of the fluorescent tube lighting fixture. The current flowing through the LED tube 1 in a normal operation phase is used to keep said voltage controlled switch 20 closed. Thus, said voltage controlled switch 20 is powered by both the preheat current flowing between said first pair of contact pins 8, 10 and the operation current flowing through the LED tube 1 in the current path between said first circuitry and said second circuitry.

In connection with Fig. 2 a detailed possible implementation of the present invention is explained. Note that currents are alternating, having both positive and negative direction. The current flow during only one half of a sinus-cycle is shown. According to this embodiment said voltage controlled switch 20 comprises a relay 24 having a coil. Moreover, according to this embodiment said control circuitry 22 comprises a chargeable voltage supplier 26 and a voltage regulator element 28. Said chargeable voltage supplier 26 is arranged to power said voltage controlled switch 20 and to be charged both by said preheat current passing between said first pair of contact pins 8, 10 during said preheat phase and by said operation current flowing through said current path between said first circuitry and said second circuitry during said normal operation phase. According to the embodiment of Fig. 2 said voltage supplier 26 is a capacitor. Said voltage regulator element 28 is having a first threshold voltage. When the voltage across said chargeable voltage supplier 26 reaches said first threshold voltage said voltage regulator element 28 is being arranged to conduct preventing the voltage across said chargeable voltage supplier 26 from rising any further. According to the embodiment of Fig. 2 said voltage regulator element 28 is a Zener diode.

Assume that the currents generated by the ballast of the fluorescent tube lighting fixture are higher than the current required to power the coil of the relay 24. At the starting point all currents and voltages are set to zero and there is no charge in said chargeable voltage supplier 26. When power is applied to the driver of the fluorescent tube

lighting fixture, it starts generating two separate preheat current loops (indicated by dashed lines): one current loop starting at impedance resistive element 6a and returning through impedance resistive element 6b and one current loop starting at impedance resistive element 6c and returning through impedance resistive element 6d. The current through impedance resistive elements 6a and 6b charges said chargeable voltage supplier 26, resulting in an increasing voltage across the coil of the relay 24. The preheat current is much larger than the current drawn by the coil of the relay 24. Therefore said chargeable voltage supplier 26 is almost immediately charged to said first threshold voltage of the voltage regulator element 28 which starts to conduct. When the voltage across the coil of the relay 24 reaches a threshold voltage of the relay 24, the contacts of the relay 24 will close. The LED driver 4 will activate and start to draw a normal operation current (indicated by a solid line). Depending on the type of ballast of the fluorescent tube lighting fixture, the preheat current may remain unchanged, reduce or stop completely. The normal operation current is enough to keep the relay 24 activated. When the voltage across said chargeable voltage supplier 26 and the relay 24 reaches the threshold voltage of the voltage regulator element 28, the voltage regulator element 28 will start to conduct and prevent the voltage from rising any further. Said first threshold voltage of the voltage regulator element 28 is set higher than the threshold voltage of the coil of the relay 24. The threshold voltage of the voltage regulator element 28 shall fit the threshold voltage of the relay 24. As a non limiting example, the threshold voltage of the voltage regulator element 28 is 4,7 V and the threshold voltage of the relay 24 is 4,5V.

In case of the fluorescent tube lighting fixture comprising a passive electromagnetic ballast said chargeable voltage supplier 26 functions as a buffer. Thus, the low frequency of the passive EM ballast determines the value of capacitor of said chargeable voltage supplier 26 (electronic HF ballasts operate at much higher frequencies). Typical characteristics for the capacitor of the chargeable voltage supplier 26 are voltage rating according the relay voltage, sufficient lifetime, tolerant for ripple currents in the used frequency domain.

The person skilled in the art realizes that the present invention by no means is limited to the preferred embodiments described above. On the contrary, many modifications and variations are possible within the scope of the appended claims.

Additionally, variations to the disclosed embodiments can be understood and effected by the skilled person in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does

not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

CLAIMS:

1. A LED tube (1) for retrofitting in a fluorescent tube lighting fixture having a preheat phase during which said fluorescent tube lighting fixture is arranged to preheat filaments of a fluorescent tube and a normal operation phase during which said fluorescent tube lighting fixture is arranged to supply said fluorescent tube with an operation current,

5 said LED tube (1) comprising:

an array LEDs (2),

a LED driver (4) for driving said array of LEDs (2),

a first pair of contact pins (8, 10) at a first end (12) of said LED tube (1) and a second pair of contact pins (14, 16) at a second end (18) of said LED tube (1) for connecting
10 said LED tube (1) electronically and mechanically to said fluorescent tube lighting fixture, said first pair of contact pins (8, 10) being connected forming a first circuitry, said second pair of contact pins (14, 16) being connected forming a second circuitry, said LED driver (4) being connected between said first circuitry and said second circuitry,

one or more impedance resistive elements (6a, 6b) connected between said
15 first pair of contact pins (8, 10) and arranged to mimic a filament of a fluorescent tube,

a voltage controlled switch (20) arranged to open and close a current path between said first circuitry and said second circuitry, and

control circuitry (22) for controlling said voltage controlled switch (20), said control circuitry (22) being connected between said first circuitry and said second circuitry
20 and being arranged to close said voltage controlled switch (20) during said preheat phase of said fluorescent tube lighting fixture by powering said voltage controlled switch (20) using a preheat current passing between said first pair of contact pins (8, 10) and through said one or more resistive elements (6a, 6b), and to keep said voltage controlled switch (20) closed by powering said voltage controlled switch (20) using an operation current flowing through said
25 current path between said first pair of contact pins (8, 10) and said second pair of contact pins (14, 16) during said normal operation phase of said fluorescent tube lighting fixture.

2. The LED tube (1) according to claim 1, wherein said control circuitry (22) comprises:

a chargeable voltage supplier (26) arranged to power said voltage controlled switch (20) and to be charged both by said preheat current passing between said first pair of contact pins (8, 10) and through said one or more resistive elements (6a, 6b) during said preheat phase and by said operation current flowing through said current path between said first pair of contact pins (8, 10) and said second pair of contact pins (14, 16) during said normal operation phase, and

a voltage regulator element (28) having a first threshold voltage, said voltage regulator element (28) being arranged to conduct, when the voltage across said chargeable voltage supplier (26) reaches said first threshold voltage, preventing the voltage across said chargeable voltage supplier (26) from rising any further.

3. The LED tube (1) according to claim 2, wherein said voltage controlled switch (20) is having a second threshold voltage for closing the switch and wherein said second threshold voltage is lower than said first threshold voltage.

4. The LED tube (1) according to claim 2 or 3, wherein said chargeable voltage supplier (26) comprises a capacitor.

5. The LED tube (1) according to any one of claims 2-4, wherein said voltage regulator element (28) comprises a Zener diode.

6. The LED tube (1) according to any one of claims 1-5, wherein said voltage controlled switch (20) comprises a relay (24) comprising a coil.

7. A method for preventing a shock hazard during retrofitting of a LED tube (1) in a fluorescent tube lighting fixture having a preheat phase during which said fluorescent tube lighting fixture is arranged to preheat filaments of a fluorescent tube and a normal operation phase during which said fluorescent tube lighting fixture is arranged to supply said fluorescent tube with an operation current, said method comprising:

mimicking filaments of a fluorescent tube by one or more resistive elements (6a, 6b, 6c, 6d) connected between a first pair of contact pins (8, 10) at a first end (12) of said LED tube (1) and a second pair of contact pins (14, 16) at a second end (18) of said LED tube (1), respectively, said first pair of contact pins (8, 10) being connected forming a first circuitry, said second pair of contact pins (14, 16) being connected forming a

second circuitry

providing a voltage controlled switch (20) arranged to open and close a current path between said first circuitry and said second circuitry,

blocking current through said current path by means of said voltage controlled

5 switch (20),

starting said preheat phase of said fluorescent tube lighting fixture,

closing said voltage controlled switch (20) during said preheat phase using current passing between said first pair of contact pins (8, 10) and through said one or more resistive elements (6a, 6b) connected between said first pair of contact pins (8, 10),

10 keeping said voltage controlled switch (20) closed using said operation current flowing through said LED tube (1) during said normal operation phase of said fluorescent tube lighting fixture.

8. The method according to claim 7, further comprising connecting said LED

15 tube (1) electronically and mechanically to said fluorescent tube lighting fixture by means of said first and second pairs of contact pins (8, 10, 14, 16).

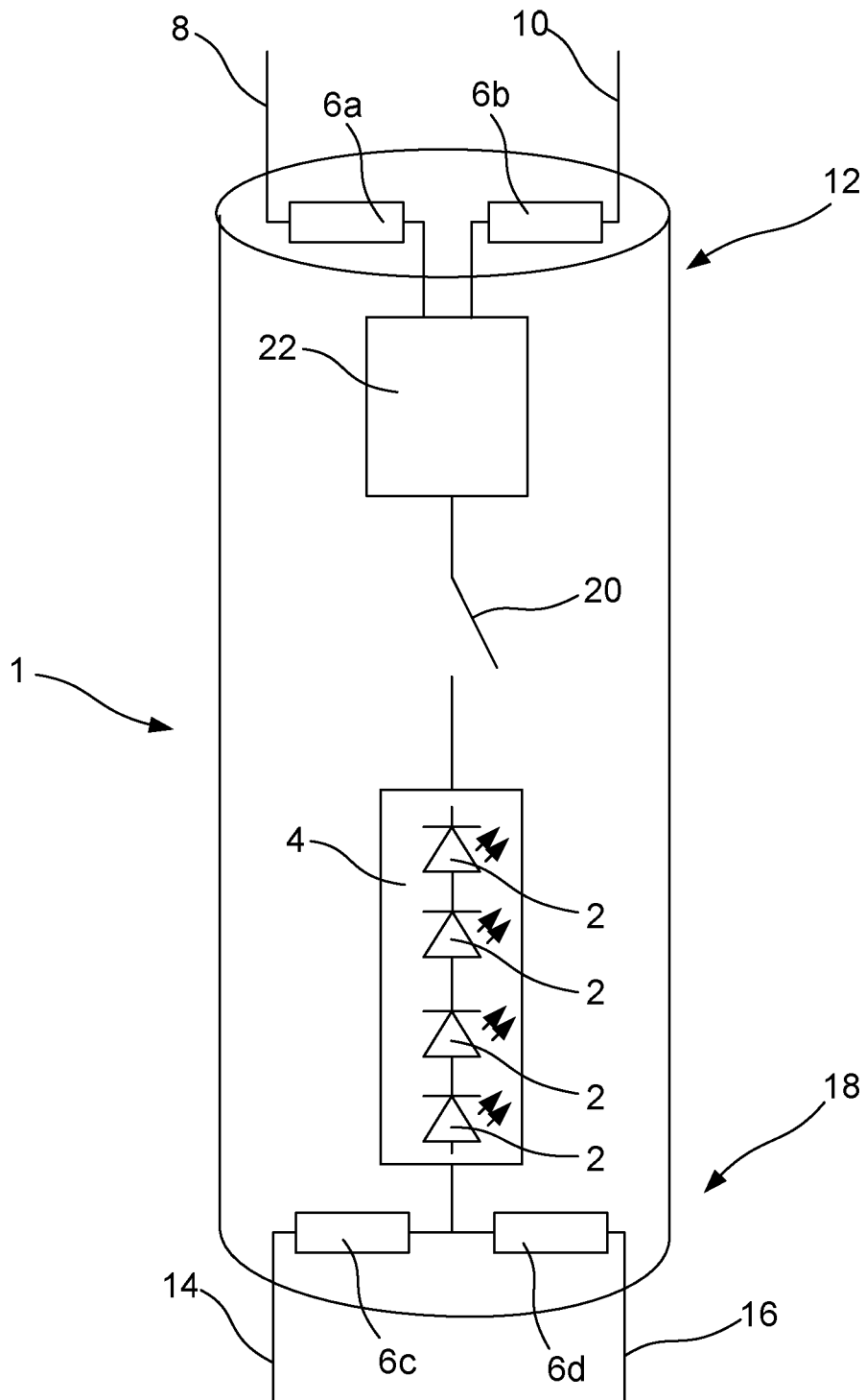
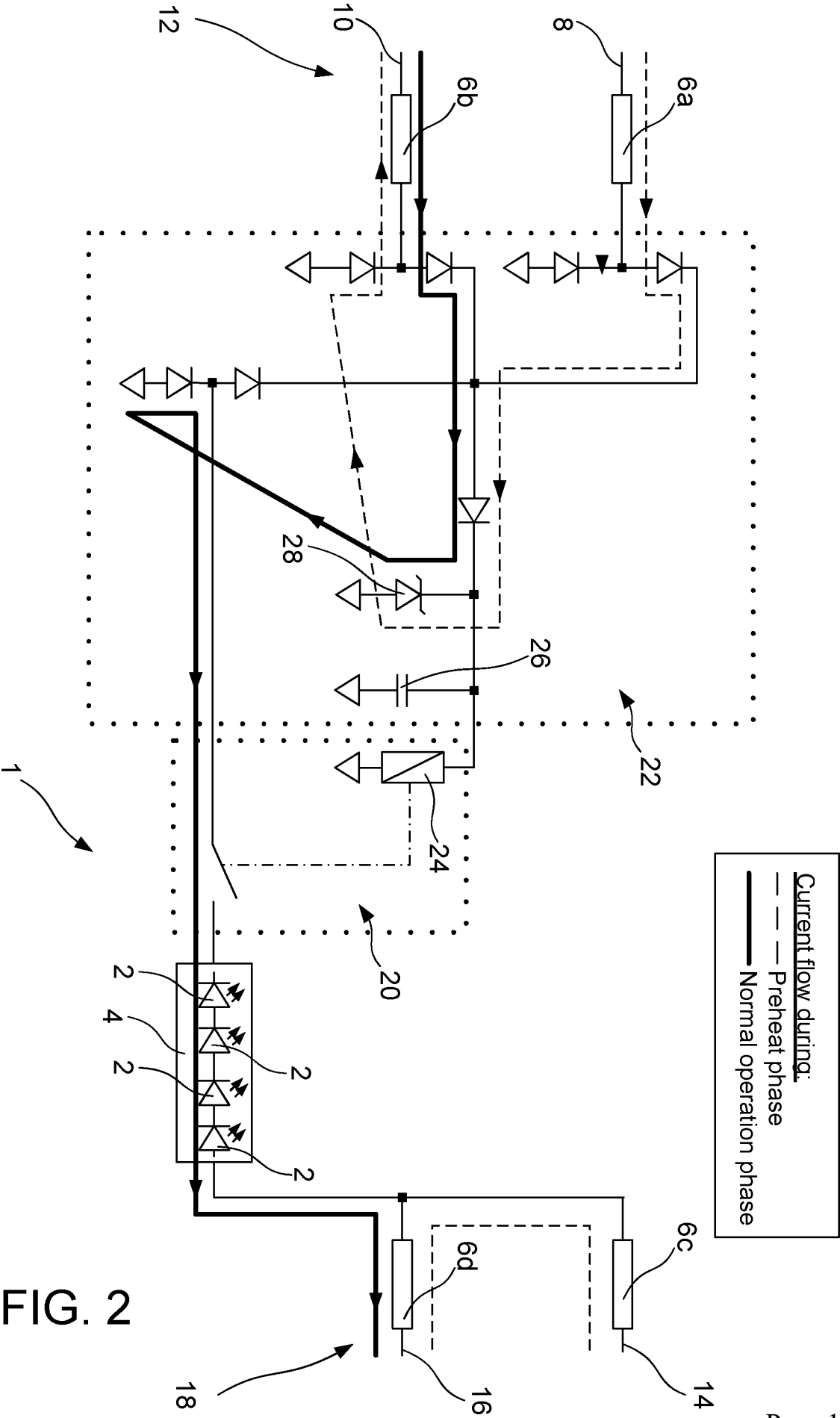


FIG. 1



INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2013/061444

A. CLASSIFICATION OF SUBJECT MATTER
 INV. H05B33/08
 ADD.

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)
 H05B

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	EP 2 503 848 A1 (OSRAM AG [DE]) 26 September 2012 (2012-09-26) the whole document -----	1-8
A	EP 2 477 456 A1 (ONTOPX LED GMBH [DE]) 18 July 2012 (2012-07-18) abstract paragraphs [0068] - [0143]; figures 2-9 ----- -/-	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"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

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Date of the actual completion of the international search

8 April 2014

Date of mailing of the international search report

16/04/2014

Name and mailing address of the ISA/

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João Carlos Silva

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2013/061444

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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