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(54) **POWER SUPPLY SYSTEM OF ONE OR MORE LIGHTING MODULES WITH LIGHT-EMITTING DIODES, ASSOCIATED LIGHTING SYSTEM AND ASSOCIATED POWER SUPPLY METHOD**

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(58) **Field of Classification Search**
USPC 315/291, 308
See application file for complete search history.

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(57) **ABSTRACT**

The power supply system for one or more lighting modules with light-emitting diodes comprises an electrical power source able to be connected to each lighting module via an electrical connection and a detection device to detect a connection direction of each lighting module. The detection device comprises an injection circuit to inject a setpoint current, a first comparison circuit to compute a voltage measured on the corresponding electrical connection following the injection of the setpoint with a first voltage threshold, and an inversion circuit to invert the polarity of the lighting module when the voltage measured on the corresponding electrical connection is greater than or equal to the first voltage threshold.

13 Claims, 5 Drawing Sheets

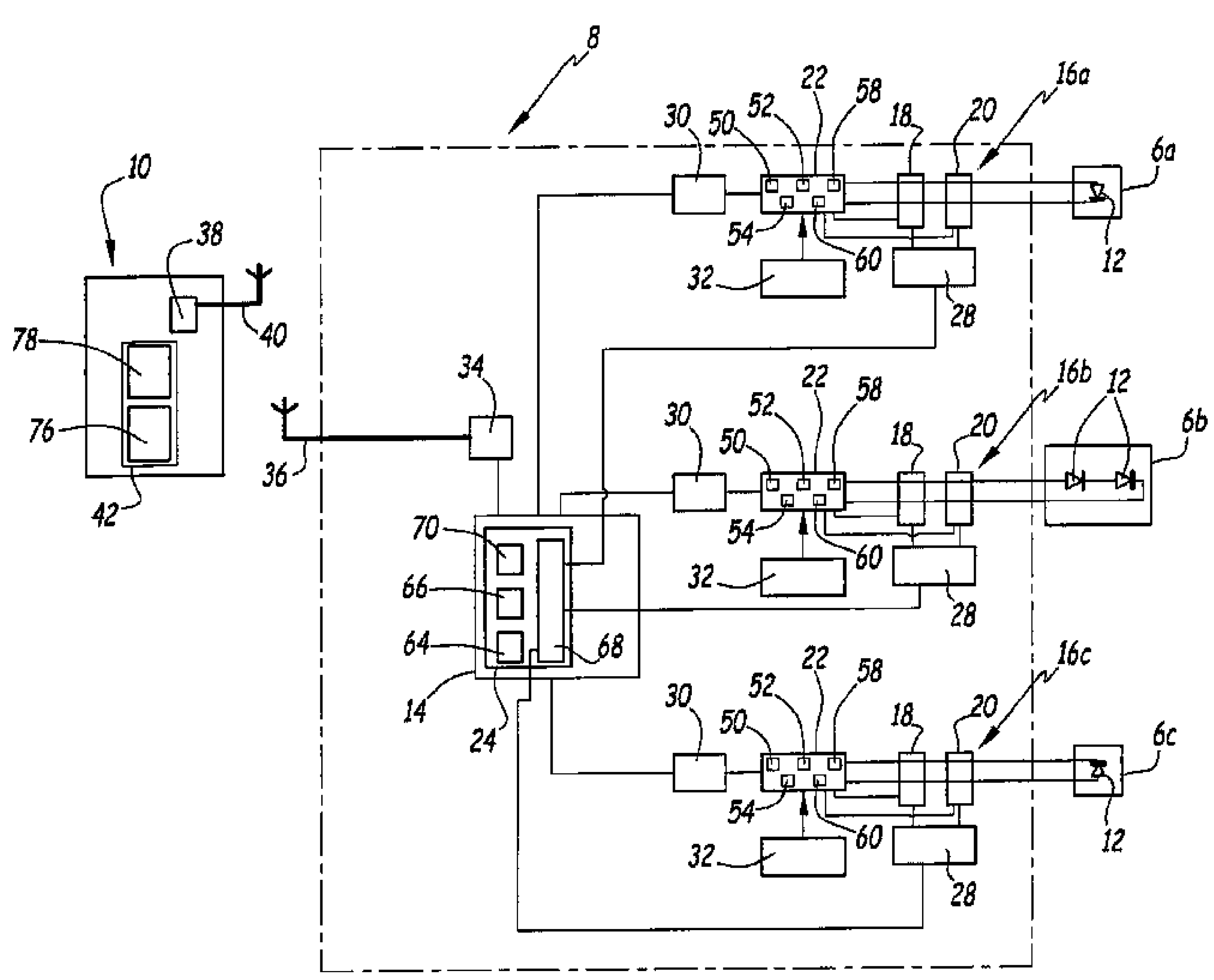
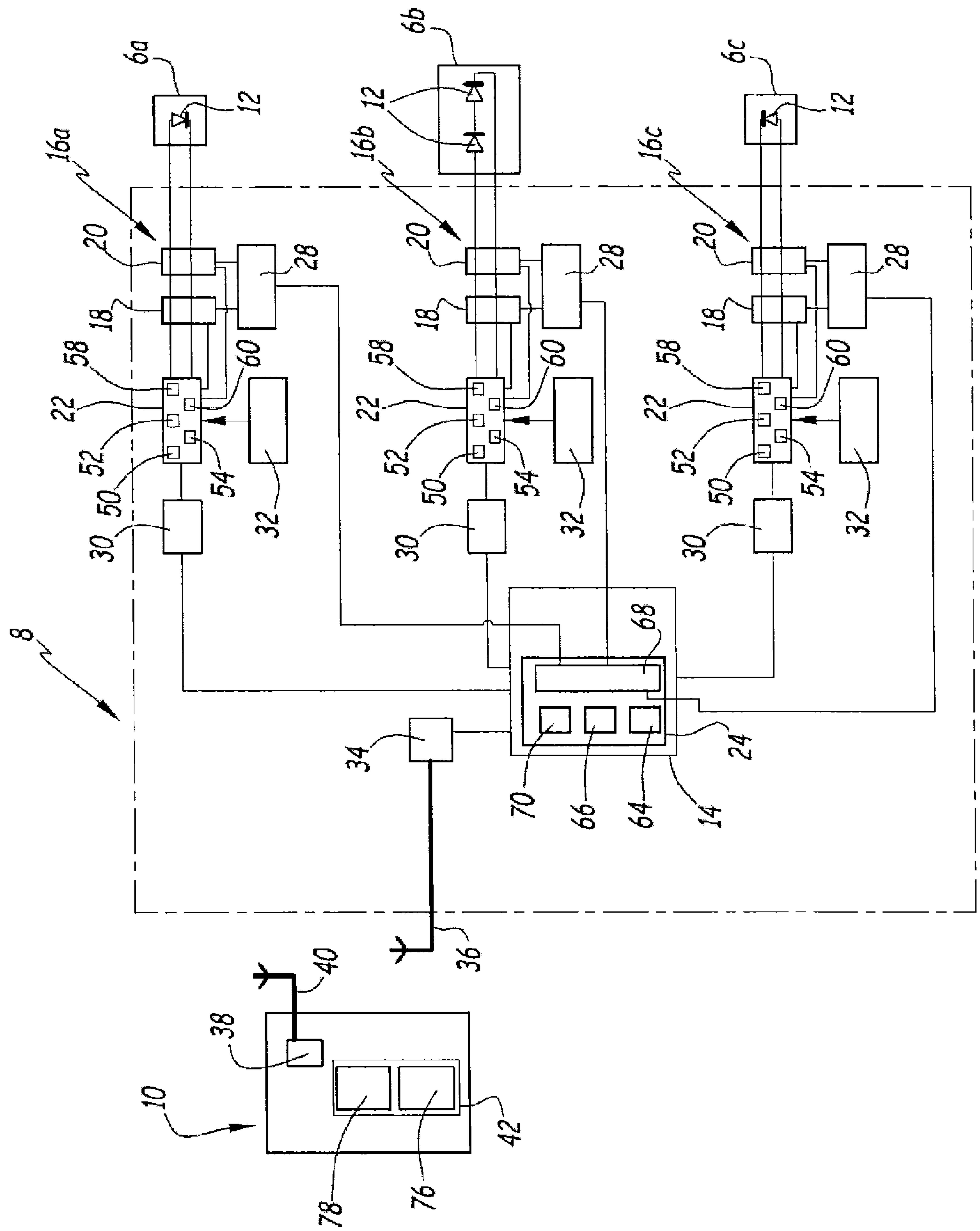


Fig.1


6a
6b
6c
12
16a
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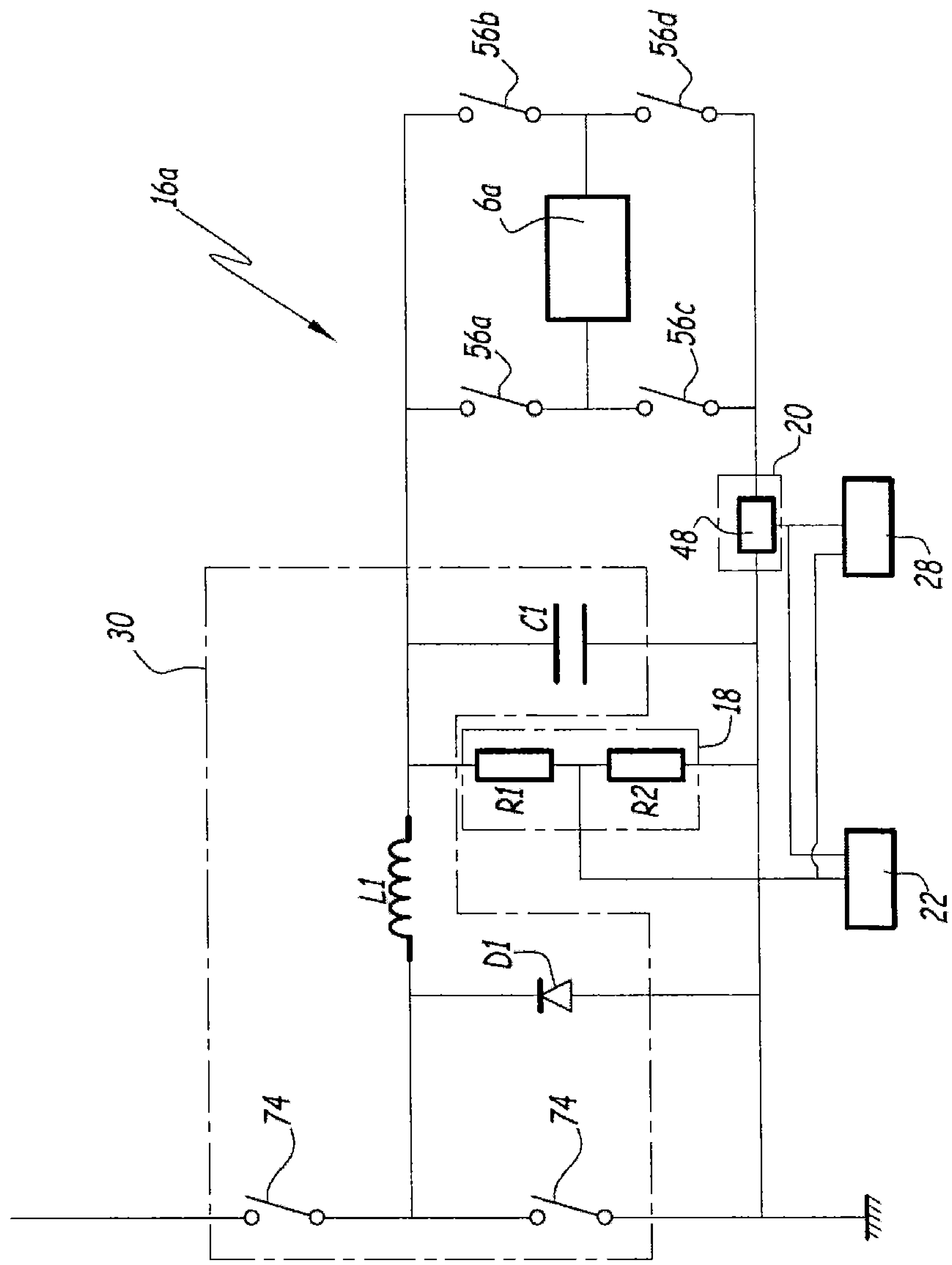

Fig.2

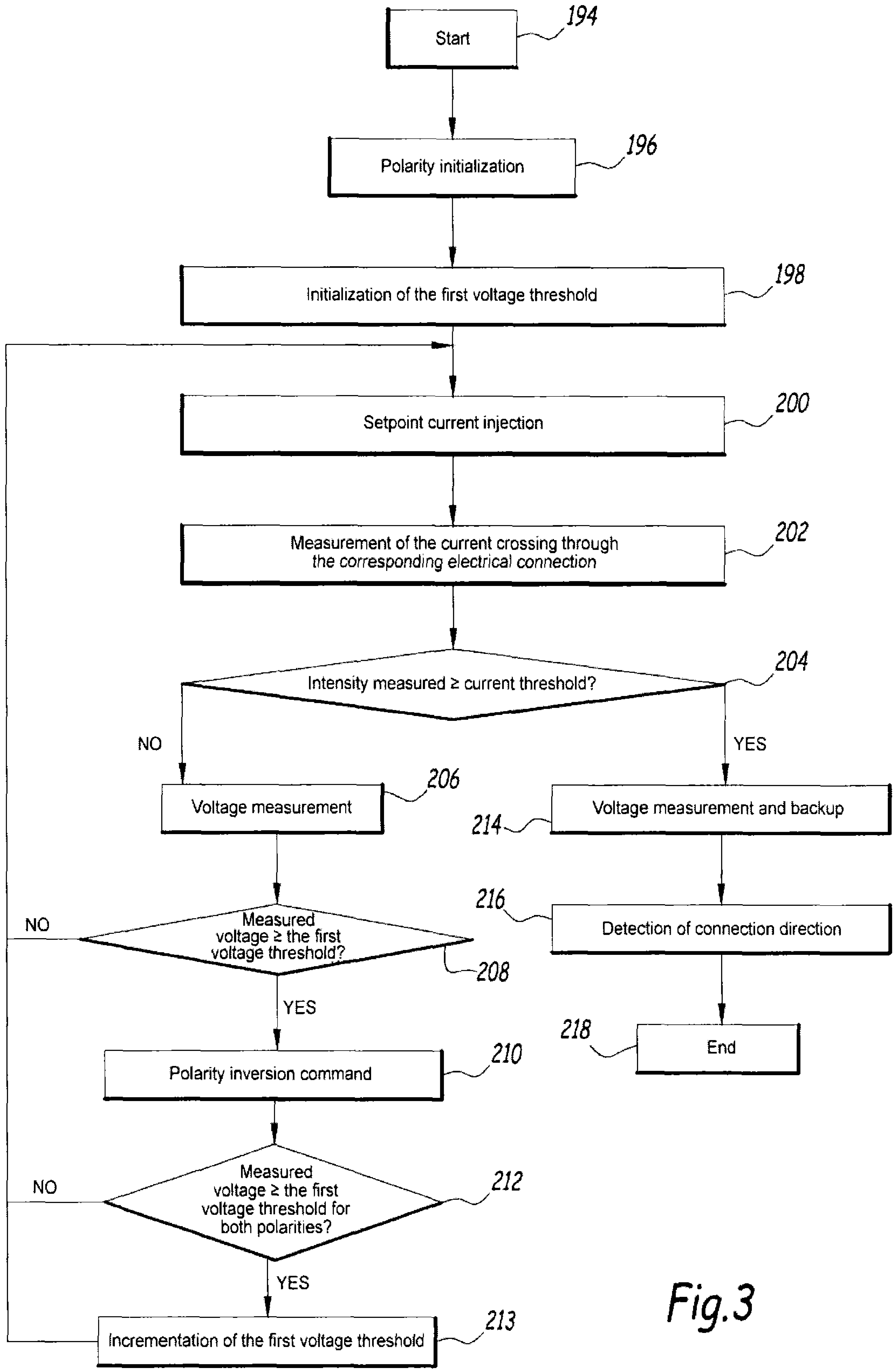
Start
194
Polarity initialization
196
Initialization of the first voltage threshold
198
Setpoint current injection
200
Measurement of the current crossing through the corresponding electrical connection
202
Intensity measured ≥ current threshold?
204
NO
YES
Voltage measurement
206
Voltage measurement and backup
214
Measured voltage ≥ the first voltage threshold?
208
NO
YES
Detection of connection direction
216
Polarity inversion command
210
End
218
Measured voltage ≥ the first voltage threshold for both polarities?
212
NO
YES
Incrementation of the first voltage threshold
213

Fig.3

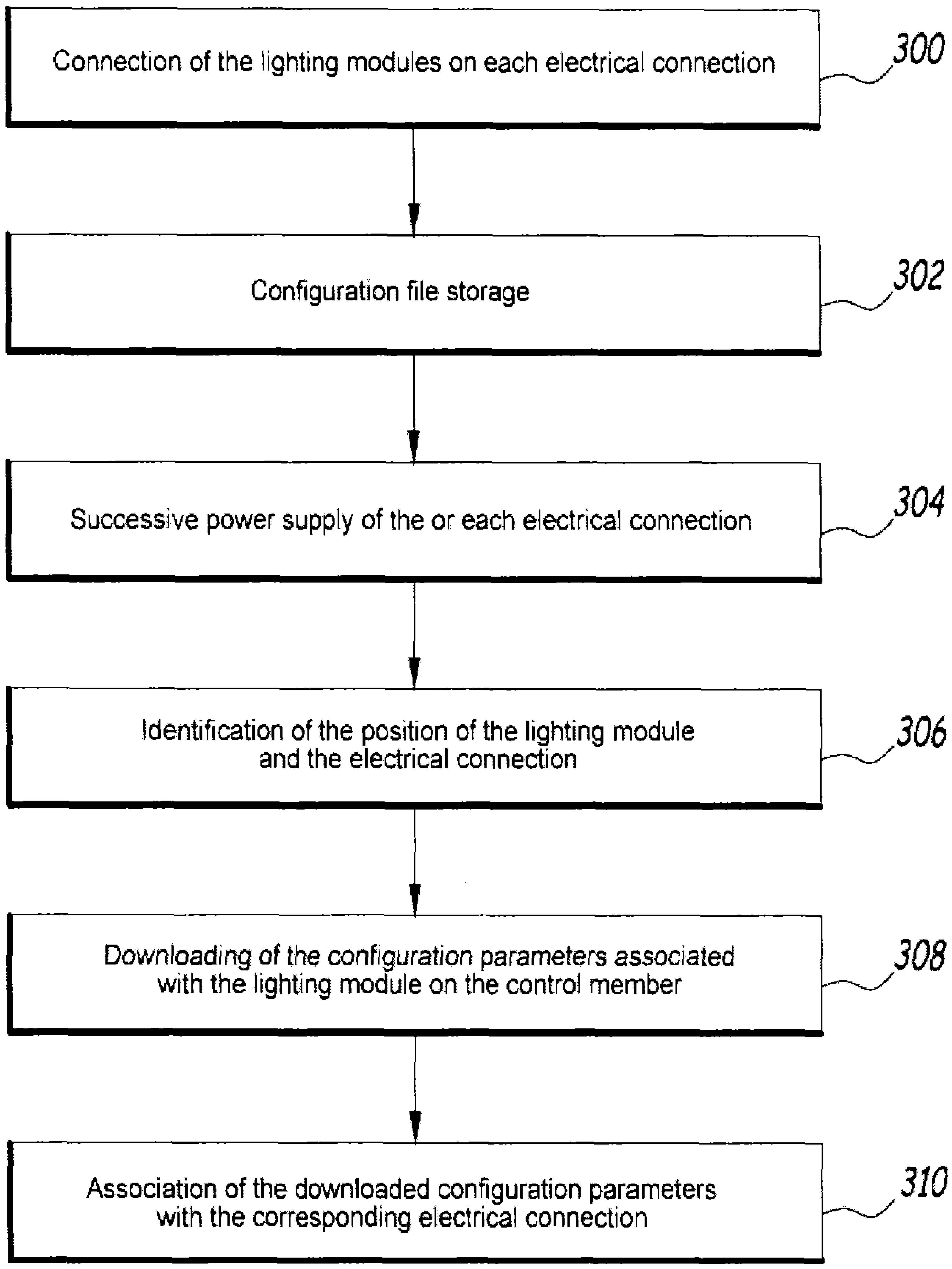
Connection of the lighting modules on each electrical connection
300
Configuration file storage
302
Successive power supply of the or each electrical connection
304
Identification of the position of the lighting module and the electrical connection
306
Downloading of the configuration parameters associated with the lighting module on the control member
308
Association of the downloaded configuration parameters with the corresponding electrical connection
310

Fig.4

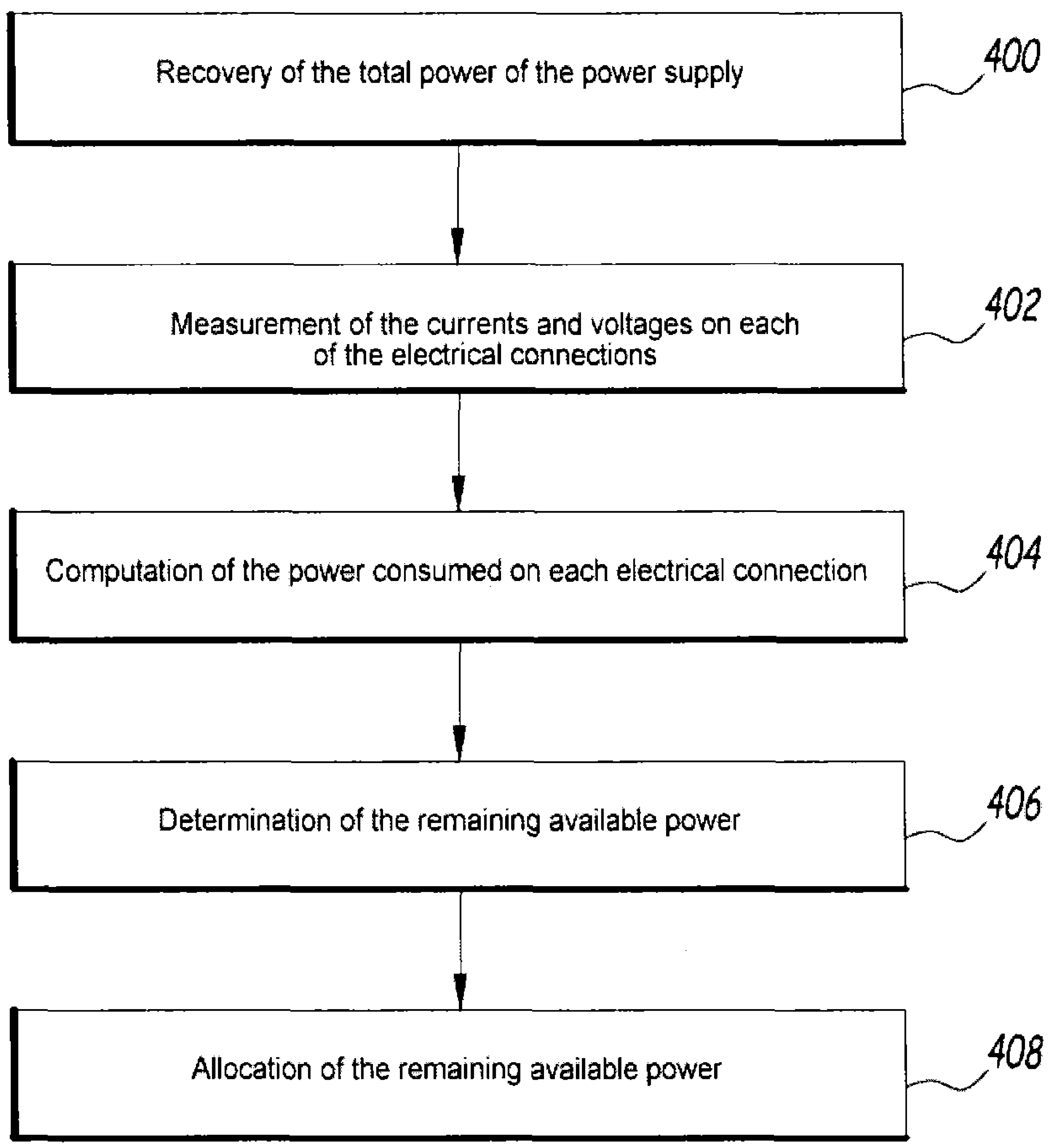
Recovery of the total power of the power supply
400
Measurement of the currents and voltages on each of the electrical connections
402
Computation of the power consumed on each electrical connection
404
Determination of the remaining available power
406
Allocation of the remaining available power
408

Fig.5

POWER SUPPLY SYSTEM OF ONE OR MORE LIGHTING MODULES WITH LIGHT-EMITTING DIODES, ASSOCIATED LIGHTING SYSTEM AND ASSOCIATED POWER SUPPLY METHOD

The present invention relates to a power supply system for one or more lighting modules with light-emitting diodes, a set of light-emitting diodes including one or more such lighting modules and a power supply system, as well as a method for powering the lighting module(s) using such a power supply system.

The or each lighting module comprises at least one light-emitting diode and can be polarized using a direct polarity or an inverse polarity depending on the direction in which it is connected to the power supply system. The light-emitting diode(s) are polarized in direct mode for the direct polarity of the lighting module, and in the inverse mode, respectively, for the inverse polarity of the lighting module.

In the field of the power supply for lighting modules with light-emitting diodes, it is known to use power supply systems that make it possible to group several electrical connections together in the same housing for powering a plurality of lighting modules. The power supply of the lighting modules is thus centralized and the connection of the lighting modules to the power supply system is simplified. However, during the installation of such power supply systems, it is generally necessary for an operator to know and respect the polarity of the light-emitting diode(s) of the lighting modules in order to connect them to the power supply system. Furthermore, each lighting module must be connected to a predetermined electrical power supply connection. Moreover, the power necessary to power the lighting modules must be known and allocated to the corresponding electrical power supply connections. It therefore appears that such power supply systems for lighting modules with light-emitting diodes are complex to implement, in particular when there is a large number of lighting modules.

Furthermore, known from document EP-A1-2,464,198 is a power supply system for one or more lighting modules with light-emitting diodes making it possible to connect the lighting module(s) to the power supply system, without taking the polarity of the light-emitting diode(s) into account. In fact, this power supply system comprises means for detecting the connection direction of the lighting module(s), making it possible to determine the direction of the current to be delivered to the or each lighting module, in order to polarize its light-emitting diode(s) in the direct direction. In such a system, in order to detect the connection direction, a current pulse is transmitted to the corresponding lighting module so as to flow in a first direction, then in a second direction through that module. However, such a system may create a risk of destruction of said light-emitting diode(s) and therefore of the corresponding lighting module. This risk is even higher with organic light-emitting diodes (OLED), which are particularly fragile and sensitive to excesses of their rated current and voltage values.

The aim of the invention is therefore to propose a power supply system for one or more lighting modules, which are easy to install and make it possible to simplify the connection of the lighting module(s) to the power supply system, without any risk of destruction of the lighting module(s).

To that end, the invention relates to a power supply system for one or more lighting modules with light-emitting diodes, the or each lighting module comprising at least one light-emitting diode and being able to be polarized depending on its connection direction according to a direct polarity or an inverse polarity, the light-emitting diode(s) being polarized in direct mode for the direct polarity of the lighting module and in inverse mode, respectively, for the inverse polarity of the lighting module,

the system including:

- an electrical power source able to be connected to the or each lighting module via an electrical connection for the or each lighting module,
- a first measuring device for measuring, on the or each electrical connection, a voltage delivered to the corresponding lighting module and a second measuring device for measuring, on the or each electrical connection, a current delivered to the corresponding lighting module,
- a detection device for detecting a connection direction of the or each lighting module comprising, for the or each lighting module, injection means for injecting a setpoint current on the corresponding electrical connection, first comparison means for comparing with a first voltage threshold, the voltage measured on the corresponding electrical connection following the injection of the setpoint current and inversion means for inverting the polarity of the lighting module when the voltage measured on the corresponding electrical connection is greater than or equal to the first voltage threshold.

According to the invention, the voltage measured on the corresponding electrical connection is greater than or equal to the first voltage threshold for the direct and inverse polarities of the lighting module, and the first comparison means are capable of incrementing the first voltage threshold by a reference value for one or more future comparisons of said voltage with the first voltage threshold.

Owing to the invention, when the connection direction of the or each lighting module is detected, the voltage delivered on the corresponding electrical connection is measured, and the direction of the current flowing through the lighting module is inverted when the measured voltage exceeds the first voltage threshold. The power supply system thus makes it possible to limit the voltage across the terminals of the or each lighting module when the connection direction of the or each lighting module is detected, and thus to protect the or each lighting module from any destruction due to the application of an excessively high voltage across its terminals, in particular when the light-emitting diodes are polarized in the inverse mode.

According to other aspects of the invention, the power supply system comprises one or more of the following features, considered alone or according to all technically possible combinations:

- the detection device comprises, for the or each lighting module, second comparison means for comparing the intensity of the current measured on the corresponding electrical connection with a current threshold, the second comparison means being able to detect the direct polarity of the lighting module when the measured intensity is above the current threshold;
- for the or each lighting module, the injection means are able, upon each change in polarity of the lighting module, to inject the setpoint current in order to increasingly vary the voltage delivered to the lighting module, between a second voltage threshold and a maximum voltage, the value of the first voltage threshold being comprised between that of the second voltage threshold and that of the maximum voltage;
- the detection device comprises storage means for the or each lighting module, for the value of the voltage measured by the first measuring device, when the intensity of

the current measured by the second measuring device is greater than the current threshold, the stored value corresponding to a minimum operating voltage of the corresponding lighting module.

The invention also relates to a lighting assembly with light-emitting diodes including one or more lighting modules with light-emitting diodes and a power supply system as defined above.

According to other advantageous aspects of the invention, the assembly further comprises one or more of the following features, considered alone or according to any technically admissible combinations:

the assembly comprises several lighting modules, while the power supply system comprises a control member for the electrical power supply capable of successively powering each electrical connection, the control member comprising identification means for the electrical connection associated with each lighting module;

the assembly further comprises a configuration module for the power supply system, the configuration module comprising means for backing up a configuration file, the configuration file including configuration parameters for each lighting module, whereas following the identification of each electrical connection, the configuration module is able to download the configuration parameters into the control member and associate them with the corresponding electrical connection;

for each lighting module, the power supply system comprises first computation means for computing an instantaneous consumed power, while the first computation means are able to send the control member the instantaneous powers computed for each electrical connection, and whereas the control member comprises a second computation means for computing a remaining available power based on the instantaneous consumed powers, and allocation means for allocating power to the various electrical connections.

The invention also relates to a power supply method for one or more lighting modules with light-emitting diodes using a power supply system, the or each lighting module comprising at least one light-emitting diode and being able to be polarized using a direct polarity or an inverse polarity depending on its connection direction, the light-emitting diodes(s) being polarized in direct mode for the direct polarity of the lighting module, and in inverse mode, respectively, for the inverse polarity of the lighting module, the system including an electrical power supply able to be connected to the or each lighting module via an electrical connection for the or each lighting module, a first measuring device for measuring a voltage delivered to the corresponding lighting module on the or each electrical connection, a second measuring device for measuring a current delivered to the corresponding lighting module on the or each electrical connection, and a detection device for detecting a connection direction of the or each lighting module,

the method comprising, for the or each lighting module, the following steps:

a) using the detection device to inject a setpoint current on the corresponding electrical connection,

b) measuring the voltage delivered to the lighting module,

c) comparing the measured voltage with a first voltage threshold, during the measuring step,

d) inverting the polarity of the corresponding lighting module, when the voltage measured on the corresponding electrical connection is greater than or equal to the first threshold voltage, and returning to the injection step.

According to the invention, the method further comprises, for the or each lighting module, the following step:

e) when said voltage is greater than or equal to the first voltage threshold for the direct and inverse polarities of the lighting module, incrementing the first voltage threshold by a reference value, for one or more future comparisons of the voltage measured on the corresponding electrical connection with the first voltage threshold.

According to other advantageous aspects of the invention, the method further comprises one or more of the following features, considered alone or according to all technically acceptable combinations:

for the or each lighting module, the method comprises the following steps before the step for measuring the voltage:

a1) measuring the current circulating in the corresponding electrical connection,

a2) comparing the intensity measured in the corresponding electrical connection with a current threshold,

and whereas after the intensity comparison step, if the measured intensity is greater than or equal to the current threshold, the method further comprises the following step:

a3) detecting the direct polarity of the lighting module;

during the injection step, the setpoint current is injected to cause the voltage delivered to the lighting module to vary increasingly, between a second voltage threshold and a maximum voltage, the value of the first voltage threshold being comprised between that of the second voltage threshold and that of the maximum voltage.

The invention will be better understood and other advantages thereof will appear more clearly in light of the following description, provided solely as a non-limiting example, and done in reference to the drawings, in which:

FIG. **1** is a diagrammatic illustration of a lighting assembly with light-emitting diodes according to the invention, the assembly including first, second and third lighting modules with light-emitting diodes, and a power supply system for powering the lighting modules via three electrical connections;

FIG. **2** is a very diagrammatic illustration of an electrical connection of the power supply system of FIG. **1**, to which the first lighting module with light-emitting diodes is connected;

FIG. **3** is a flowchart of a power supply method for the lighting modules of FIG. **1** according to a first embodiment of the invention; and

FIGS. **4** and **5** are views similar to that of FIG. **3** according to a second and third embodiment of the invention, respectively.

In FIG. **1**, a lighting assembly **4** with light-emitting diodes comprises first **6***a*, second **6***b* and third **6***c* lighting modules with light-emitting diodes, a power supply system **8** for the lighting modules **6***a*, **6***b*, **6***c*, and a configuration module **10** for the power supply system **8**.

The lighting modules **6***a*, **6***b*, **6***c* each comprise one or more light-emitting diodes **12** able to be polarized in a direct polarity or an inverse polarity depending on their connection direction. More specifically, in FIG. **1**, the first lighting module **6***a* comprises a light-emitting diode **12** connected in a first direction, the second lighting module **6***b* comprises two light-emitting diodes **12** connected in series and connected in the first direction, and the third lighting module **6***c* comprises a light-emitting diode **12** connected in a second direction, opposite the first direction. Each lighting module **6***a*, **6***b*, **6***c* is in a direct polarity when the corresponding light-emitting diode(s) **12** are directly polarized, respectively in an inverse polarity when the corresponding light-emitting diode(s) **12** are polarized in the inverse mode.

The power supply system **8** comprises an electrical power supply source **14** able to be connected to each lighting module **6***a*, **6***b*, **6***c* via a respective electrical connection **16***a*, **16***b*, **16***c*. The power supply system **8** also comprises, for each lighting module **6***a*, **6***b*, **6***c*, a first measuring device **18** for measuring a voltage on the corresponding electrical connection **16***a*, **16***b*, **16***c*, a second measuring device **20** for measuring the intensity of the current delivered to the lighting module **6***a*, **6***b*, **6***c* on the corresponding electrical connection **16***a*, **16***b*, **16***c*, and a detection device **22** for detecting a connection direction of the lighting module **6***a*, **6***b*, **6***c*.

The power supply system **8** comprises a control member **24** for the electrical power supply source **14** and, for each electrical connection **16***a*, **16***b*, **16***c*, a first software application **28** for computing an instantaneous power consumed by each lighting module **6***a*, **6***b*, **6***c*. The power supply system **8** comprises, for each electrical connection **16***a*, **16***b*, **16***c*, a module **30** for steering the electrical power delivered on each electrical connection **16***a*, **16***b*, **16***c* and an allocation device **32** for allocating polarity to the corresponding lighting module **6***a*, **6***b*, **6***c*.

The power supply system **8** also comprises a first wireless transceiver **34** and a first wireless antenna **36**.

The configuration module **10** includes a second wireless transceiver **38**, a second wireless antenna **40** and a processing unit **42**.

Each wireless connection **16***a*, **16***b*, **16***c* is able to deliver, owing to the electric power supply source **14**, a current and a voltage to the corresponding lighting module **6***a*, **6***b*, **6***c*.

Each first measuring device **18** is able to measure the voltage delivered to the corresponding lighting module **6***a*, **6***b*, **6***c* on the corresponding electrical connection **16***a*, **16***b*, **16***c*. Each first measuring device **18** for example comprises, as shown in FIG. **2**, two resistances R1, R2 connected in parallel with the corresponding lighting module **6***a*, **6***b*, **6***c*, the measured voltage being recovered between the two resistances R1, R2 and sent to the detection device **22** in the first computation software **28**.

Each second measuring device **20** is able to measure the current delivered to the corresponding lighting module **6***a*, **6***b*, **6***c* on the corresponding electrical connection **16***a*, **16***b*, **16***c*. Each second measuring device **20** for example comprises a shunt **48** able to measure the intensity of the current crossing through it and send the measured intensity to the first computation software **28** and the detection device **22**.

Each detection device **22** comprises injection means **50** for injecting a setpoint current on the corresponding electrical connection **16***a*, **16***b*, **16***c*. Each detection device **22** comprises first comparison software **52**, for comparing the voltage measured by the first measuring device **18** on the corresponding electrical connection **16***a*, **16***b*, **16***c*, following the injection of the setpoint by the injection means **50**, to a first voltage threshold S1. The detection device **22** comprises inversion means **54** for inverting the polarity of the corresponding lighting module **6***a*, **6***b*, **6***c*, when the voltage measured on the corresponding electrical connection **16***a*, **16***b*, **16***c* is greater than or equal to the first voltage threshold S1. The first voltage threshold S1 is for example comprised between 3 Volts (V) and 50 V.

Each detection device **22** also comprises, for the corresponding lighting module **6***a*, **6***b*, **6***c*, second software **58** for comparing the intensity measured on the corresponding electrical connection **16***a*, **16***b*, **16***c* with a current threshold A1. The current threshold A1 is for example comprised between 20 mA and 50 mA. More specifically, the current threshold A1 is for example equal to the current reference value.

Each detection device **22** includes, for the corresponding lighting module **6***a*, **6***b*, **6***c*, software **60** for storing a value of the voltage measured by the corresponding first measuring device **18**, when the intensity measured by the corresponding second measuring device **20** is above the current threshold A1. The stored value corresponds to a minimum operating voltage of the corresponding lighting module **6***a*, **6***b*, **6***c*.

The control member **24** is able to control the power supply of each electrical connection **16***a*, **16***b*, **16***c* successively. The control member **24** comprises software **64** for identifying the electrical connection **16***a*, **16***b*, **16***c* associated with each lighting module **6***a*, **6***b*, **6***c* and first software **66** for downloading configuration parameters on the corresponding steering module **30**. The configuration parameters for example correspond to the rated voltage and the rated operating voltage of each lighting module **6***a*, **6***b*, **6***c*, i.e., a current and a voltage corresponding to an optimal operation of said lighting module **6***a*, **6***b*, **6***c*.

The control member **24** also comprises second software **68** for computing the remaining available power based on the instantaneous powers consumed by each lighting module **6***a*, **6***b*, **6***c* and computed by each first computation software **28**. The second computation software **68** is also suitable for computing a maximum power that can be delivered by the electrical power supply **14**. The control member **24** includes software **70** for allocating power to the different electrical connections **16***a*, **16***b*, **16***c*, i.e., to the different lighting modules **6***a*, **6***b*, **6***c*.

Each steering module **30** can distribute the power allocated by the allocation software **70** to the corresponding electrical connection **16***a*, **16***b*, **16***c*. Each control module **30** can also be controlled via the injection means **50** of the setpoint current, in order to deliver said setpoint current to the corresponding lighting module **6***a*, **6***b*, **6***c*.

Each steering module **30** comprises, as shown in FIG. **2**, two control switches **74** for controlling the current and voltage delivered by the electrical power supply **14** on the corresponding electrical connection **16***a*, a diode D**1** for protecting against overvoltages, a coil L1 capable of supplying current to the corresponding lighting module **6***a* and a capacitor C1 connected in parallel with the lighting module **6***a*.

The allocation device **32** is able, depending on the connection direction detected by the detection device **22**, to set the polarity of the corresponding lighting module **6***a*, **6***b*, **6***c*, so that the latter is always in a direct polarity and its light-emitting diode(s) **12** light around them.

The first transceiver **34** and the first antenna **36** can exchange data with the second wireless transceiver **38** and the second wireless antenna **40**. More specifically, the configuration module **10** and the power supply system **8** are able to communicate via the first **36** and second **40** wireless antennas and the first **34** and second **38** wireless transceivers.

The processing unit **42** comprises software **76** for backing up a configuration file including the configuration parameters for each lighting module **6***a*, **6***b*, **6***c*. The processing unit **42** also comprises second downloading software **78** capable of downloading the configuration parameters corresponding to the lighting module **6***a*, **6***b*, **6***c* whereof the light-emitting diode(s) **12** are powered into the control member **24**, when the control member **24** controls the power supply for each electrical connection **16***a*, **16***b*, **16***c* successively.

The injection means **50** are able, upon each change in polarity of the corresponding lighting module **6***a*, **6***b*, **6***c*, to inject the setpoint current, in order to increase the voltage delivered to the corresponding lighting module **6***a*, **6***b*, **6***c*.

More specifically, the voltage varies between a second voltage threshold S2 and a maximum voltage Umax. The value of the first voltage threshold S1 is comprised between that of the second voltage threshold S2 and that of the maximum voltage Umax. The second voltage threshold S2 is for example equal to 0.3 V, and the maximum voltage Umax is for example equal to 50 V. More specifically, as shown in FIG. **2**, the injection means **50** are able to vary the voltage across the terminals of the capacitor C1, and thus to increase the voltage delivered to the corresponding lighting module **6***a*, until that voltage is sufficient to power the corresponding light-emitting diode **12** or the first voltage threshold S1 is reached.

Each first comparison software application **52** is able, when the voltage measured on the corresponding electrical connection **16***a*, **16***b*, **16***c* is greater than or equal to the first voltage threshold S1 for the direct and inverse polarities of the corresponding lighting module **6***a*, **6***b*, **6***c*, to increase the first voltage threshold S1 by a reference value for the next comparison(s) of the measured voltage to the first voltage threshold S1.

The inversion means **54** for example include four controllable switches **56***a*, **56***b*, **56***c*, **56***d* that can, depending on their position, modify the direction of a current passing through the corresponding lighting module **6***a*, **6***b*, **6***c*, as shown in FIG. **2**. More generally, the inversion means **54** are as shown in FIG. 3 and paragraph [0025] patent application EP-A1-2,464,198.

The identification software **64** is able to identify the electrical connection **16***a*, **16***b*, **16***c* associated with each lighting module **6***a*, **6***b*, **6***c*. More specifically, during the successive control of the power supply of each electrical connection **16***a*, **16***b*, **16***c*, the identification software **64** can identify the electrical connections **16***a*, **16***b*, **16***c* supplied with electricity.

The downloading software **66** is able to download, onto the control module **30** corresponding to the electrical connection **16***a*, **16***b*, **16***c* identified by the identification software, the configuration parameters downloaded on the control member **24** via the second downloading software **78**.

The second computation software **68** computes the remaining available power based on the instantaneous powers consumed, computed by the first computation software **28**, and the maximum power that the electrical power supply **14** can provide.

The allocation software **70** is able to allocate electrical power to each lighting module **6***a*, **6***b*, **6***c*. The allocation software **70** is for example able to carry out an allocation and distribution strategy for the electrical power delivered by the electricity supply means **14** between the lighting modules **6***a*, **6***b*, **6***c*. Said allocation and distribution strategy is, for example, stored by the control member **24**.

Additionally, in the context of an installation and successive connection of the lighting modules **6***a*, **6***b*, **6***c* to the power supply system **8**, i.e., the electrical connections **16***a*, **16***b*, **16***c*, the second computation software **68** is able to compute the remaining available power following connection of one of the lighting modules **6***a*, **6***b*, **6***c* to the power supply system **8**. Thus, the control member **24** is able to send the configuration module **10** the available remaining power, and the display member, not shown, allows an operator, following each connection of one of the lighting modules **6***a*, **6***b*, **6***c* to the corresponding electrical connection **16***a*, **16***b*, **16***c*, to determine the remaining available power and to define the power to be allocated to the next lighting module(s) **6***a*, **6***b*, **6***c* to be connected to the electrical connections **16***a*, **16***b*, **16***c*.

When the control member **24** commands the power supply of each electrical connection **16***a*, **16***b*, **16***c*, successively, the operator is able to identify the lighting module **6***a*, **6***b*, **6***c* for which the light-emitting diodes are powered on and light around them. The second downloading means **78** are then able to send the first downloading software **66** the configuration parameters corresponding to the lighting module **6***a*, **6***b*, **6***c* identified by the operator.

Three embodiments of a method for powering on the lighting modules **6***a*, **6***b*, **6***c* using the power supply system **8** will be described below.

The power supply method shown in FIG. **3** is according to a first embodiment and is applicable to each lighting module **6***a*, **6***b*, **6***c*. The power supply method according to the first embodiment comprises a first starting step **194**, i.e., for launching an algorithm corresponding to the method and applying the algorithm to the corresponding lighting module **6***a*, **6***b*, **6***c*.

Then, during the step **196** for initializing polarity, the polarity of the corresponding lighting module **6***a*, **6***b*, **6***c* is set, and the corresponding lighting module **6***a*, **6***b*, **6***c* has a first polarity, called default polarity. The default polarity corresponds to a predetermined state of the switches **56***a*, **56***b*, **56***c*, **56***d*. More specifically, the default polarity corresponds either to a closed position of switches **56***a* and **56***d* and an open position of the switches **56***b* and **56***c*, or a closed position of the switches **56***b* and **56***c* and an open position of the switches **56***a* and **56***d*.

Next, during step **198**, the value of the first voltage threshold S1 is initialized. More specifically, the value of the first threshold voltage S1 is for example set at 5 V.

Then, the method comprises a step **200** consisting of the injection, by the detection device **22**, and more specifically by the injection means **50**, of the setpoint current on the corresponding electrical connection **16***a*, **16***b*, **16***c*. The setpoint current is injected in order to increasingly vary the voltage delivered to the corresponding lighting module **6***a*, **6***b*, **6***c*, between the second voltage threshold S2 and the maximum voltage Umax.

Following the injection step **200**, the intensity of the current crossing through the corresponding second measuring device **20** is measured during a step **202**.

During a following step **204**, the intensity measured on the corresponding electrical connection is compared with the current threshold A1.

Next, if the intensity measured during step **204** is below the current threshold A1, the first measuring device **18** then measures the voltage delivered to the corresponding lighting module **6***a*, **6***b*, **6***c* during a step **206**. Following step **206**, the measured voltage is compared to the first voltage threshold S1 during a step **208**.

If the voltage measured during step **208** is below the first voltage threshold S1, the injection step **200** is repeated.

If, during step **208**, the measured voltage is greater than or equal to the first voltage threshold S1, then, during step **210**, the inversion means **54** command the inversion of the polarity of the corresponding lighting module **6***a*, **6***b*, **6***c*.

Furthermore, following step **210**, the detection device **22** verifies, during a step **212**, whether the voltage measured by the first corresponding measuring device **18** is greater than or equal to the first voltage threshold S1 for the direct and inverse polarities of the lighting module **6***a*, **6***b*, **6***c*.

If the voltage measured by the first corresponding measuring device **18** is below the first voltage threshold S1 for one of the direct and inverse polarities of the lighting module **6***a*, **6***b*, **6***c*, then the injection step **200** is repeated.

If the voltage measured by the first corresponding measuring device **18** is greater than or equal to the first voltage threshold S1 both for the direct polarity and the inverse polarity of the lighting module **6***a*, **6***b*, **6***c*, then, during a step **213**, the first comparison software **52** increments the first voltage threshold S1 by the reference value, for the next comparison(s) done in step **208** for the corresponding lighting module **6***a*, **6***b*, **6***c*.

If, during step **204**, the measured intensity is greater than or equal to the current threshold A1, during the step **214**, the first measuring device **18** measures the voltage delivered to the corresponding lighting module **6***a*, **6***b*, **6***c* and that value is stored by the storage software **60**. Next, during step **216**, the connection direction, i.e., the direct polarity of the corresponding lighting module **6***a*, **6***b*, **6***c*, is detected. In fact, a non-zero current greater than the current threshold A1 crosses through the corresponding lighting module **6***a*, **6***b*, **6***c* and its light-emitting diode(s) **12** are powered on and then light around them.

Lastly, following step **216**, an ending step **218**, i.e., stopping the algorithm for the corresponding lighting module **6***a*, **6***b*, **6***c*, is carried out.

Thus, the connection direction of each lighting module **6***a*, **6***b*, **6***c* is determined for the direct and inverse polarities while limiting the voltage applied across the terminals of the lighting modules **6***a*, **6***b*, **6***c* to the first voltage threshold S1. This makes it possible to avoid the destruction of the light-emitting diode(s) **12** of each lighting module **6***a*, **6***b*, **6***c*, when looking for the connection direction of each lighting module **6***a*, **6***b*, **6***c*. The power supply system **8** in particular makes it possible to avoid applying a voltage to each lighting module that could lead to the destruction of its light-emitting diode(s) **12**. Incrementing the first voltage threshold S1 with a pitch corresponding to the reference value makes it possible to increase the voltage applied to the corresponding lighting module **6***a*, **6***b*, **6***c* little by little, without any risk of destroying the lighting module **6***a*, **6***b*, **6***c*.

Additionally, when, following the incrementation step **213**, the first incremented voltage threshold has a value greater than or equal to the maximum voltage, the search for the polarity is stopped, and the detection device **22** detects an open circuit. More specifically, the detection device **22** detects that no lighting module **6***a*, **6***b*, **6***c* is connected on the corresponding electrical connection **16***a*, **16***b*, **16***c*.

Also additionally, during step **213**, the value of the second voltage threshold S2 is also incremented by the reference value.

Also additionally, following the measuring steps **206**, **214**, the detection device **22** performs a step, not shown, for comparing the measured voltage with a third voltage threshold S3. The third voltage threshold S3 is for example comprised between 0.3 V and 2.5 V. Following this step for comparison with the third voltage threshold S3, if the measured voltage is below the third voltage threshold S3, then the detection device **22** detects an error and tells the operator, via the control member **24** and the configuration module **10**, that he must change the corresponding lighting module **6***a*, **6***b*, **6***c*.

Also additionally, if, following the comparison step with the third voltage threshold, the measured voltage is below the third voltage threshold S3 both for the direct polarity and the inverse polarity, a short-circuit is detected.

Also additionally, following the comparison step with the third voltage threshold, the detection device **22** performs a step for comparing the measured voltage with a fourth voltage threshold S4, for example, comprised between 2.5 V and 3 V. If, during the comparison step with the fourth voltage threshold S4, the measured voltage is comprised between the third voltage threshold S3 and the fourth voltage threshold S4, then the presence of a protection diode in the corresponding lighting module **6***a*, **6***b*, **6***c* to protect the light-emitting diodes **12** from overvoltages is detected. Furthermore, if the measured voltage is comprised between the third voltage threshold S3 and the fourth voltage threshold S4 for the direct and inverse polarities, then an error is detected and the detection device **22** indicates to the operator, via the control member and the configuration module **10**, that the corresponding lighting module **6***a*, **6***b*, **6***c* must be changed.

According to the second embodiment of the power supply method, shown in FIG. **4**, the method comprises a first step **300** consisting of connecting the lighting modules **6***a*, **6***b*, **6***c* to each corresponding electrical connection **16***a*, **16***b*, **16***c*. Next, during a step **302**, the configuration file is stored in the configuration module **10**.

Then, during a step **304**, the control member **24** commands the electrical power supply **14**, in order to deliver electricity successively on each electrical connection **16***a*, **16***b*, **16***c*. Additionally, each electrical connection **16***a*, **16***b*, **16***c* is supplied with the setpoint current and the minimum operating voltage is recorded during step **214**.

Next, during step **306**, the position and the electrical connection **16***a*, **16***b*, **16***c* associated with the corresponding lighting module **6***a*, **6***b*, **6***c* are identified after the operator identifies the lighting module **6***a*, **6***b*, **6***c* whereof the light-emitting diodes are powered on and that are then lighting around themselves. During step **306**, the identification means **66** identify the electrical connection that was powered on during step **304**.

Next, during step **308**, the configuration parameters corresponding to the lighting module **6***a*, **6***b*, **6***c* identified by the operator are downloaded onto the control member **24** from the second downloading software **78**.

Then, during a step **310**, the first downloading software **66** downloads the configuration parameters downloaded during step **308** onto the electrical connection **16***a*, **16***b*, **16***c* identified in step **306**, and more specifically onto the corresponding steering module **30**.

The second embodiment makes it possible to connect each lighting module **6***a*, **6***b*, **6***c* randomly to one of the electrical connections **16***a*, **16***b*, **16***c*. In fact, owing to the successive power supply of the various lighting modules, the identification software **64** and the first **66** and second **78** downloading software applications make it possible to determine which lighting module **6***a*, **6***b*, **6***c* is associated with which electrical connection **16***a*, **16***b*, **16***c*, and to download the configuration parameters associated with the corresponding lighting module **6***a*, **6***b*, **6***c* onto the steering module **30** of the corresponding electrical connection **16***a*, **16***b*, **16***c*.

Furthermore, the second embodiment allows the operator to verify the position of each lighting module **6***a*, **6***b*, **6***c* in a room.

A third embodiment of the power supply method is shown in FIG. **5**. In the third embodiment, a first step **400** consists of using a control member **24** to record the maximum power delivered by the power supply **14**.

Then, during a following step **402**, the first **18** and second **20** measuring devices measure the voltage and the current on each electrical connection **16***a*, **16***b*, **16***c*.

During a step **404**, each first computation software **28** computes the power consumed by each electrical connection **16***a*, **16***b*, **16***c*. Next, during a step **406**, the second computation software **68** determines the remaining available power based on the maximum power of the power supply **14** and the power supplies computed in step **404**.

Lastly, during a step **408**, the allocation software **70** allocates the available remaining power computed in step **406** to each electrical connection **16***a*, **16***b*, **16***c*.

Thus, in the context of the installation and successive connection of the lighting modules **6***a*, **6***b*, **6***c* to the various electrical connections **16***a*, **16***b*, **16***c*, the control member **24** indicates to the operator, via the configuration module **10**, the remaining available power to be allocated to the electrical connections **16***a*, **16***b*, **16***c* not yet connected to a lighting module **6***a*, **6***b*, **6***c*.

Also alternatively, the control member **24** backs up allocation strategies comprising information relative to the power to be allocated to each electrical connection **16***a*, **16***b*, **16***c* and applies said strategies via the allocation software **70**.

Also additionally, the operator sends, via the configuration module **10**, a load shedding order associated with a lighting module **6***a*, **6***b*, **6***c* and an electrical connection **16***a*, **16***b*, **16***c* and the allocation software **70** reduces the power allocated to said electrical connection **16***a*, **16***b*, **16***c* and allocates the remaining electrical power to the other electrical connections **16***a*, **16***b*, **16***c*.

One skilled in the art will understand that the technical features of the embodiments described above can be combined with each other.

Additionally, the electrical power supply system **8** comprises a single detection device **22** and a single first computation software application **28** able to respectively carry out the detection and the computation of the instantaneous power consumed for each electrical connection **16***a*, **16***b*, **16***c*.

The third embodiment allows a dynamic allocation of the power to the different electrical connections **16***a*, **16***b*, **16***c* and the determination, during the successive connection of the lighting modules **6***a*, **6***b*, **6***c* on the electrical connections **16***a*, **16***b*, **16***c*, of the available remaining power and therefore of the type and rated power of the lighting modules that can be subsequently connected.

Furthermore, having a centralized allocation software **70** for all of the electrical connections **16***a*, **16***b*, **16***c* makes it possible to calibrate each steering module **30** and each electrical connection **16***a*, **16***b*, **16***c*, based on the maximum electrical power intended to be associated therewith.

Lastly, the third embodiment allows the management of a load shedding order for en electrical power, i.e., the management of a decrease in the power allocated to one of the electrical connections **16***a*, **16***b*, **16***c*.

In the first embodiment described above, the reference value is for example equal to 5 V and the maximum voltage Umax is for example 10 times greater than the reference value.

The invention claimed is:

1. A power supply system for one or more lighting modules with light-emitting diodes, each lighting module comprising at least one light-emitting diode and being able to be polarized depending on its connection direction according to a direct polarity or an inverse polarity, the light-emitting diode(s) being polarized in direct mode for the direct polarity of the lighting module and in inverse mode, respectively, for the inverse polarity of the lighting module,

the system comprising:

an electrical power source that is connectable to each lighting module via an electrical connection for the lighting module,

a first measuring device to measure, on each electrical connection, a voltage delivered to the corresponding lighting module, and a second measuring device to measure, on each electrical connection, a current delivered to the corresponding lighting module, and

a detection device to detect a connection direction of each lighting module comprising an injection circuit to inject a setpoint current on the corresponding electrical connection, a first comparison circuit to compare with a first voltage threshold, the voltage measured on the corresponding electrical connection following an injection of the setpoint current, and an inversion circuit to invert the polarity of the lighting module when the voltage measured on the corresponding electrical connection is greater than or equal to the first voltage threshold,

wherein when the voltage measured on the corresponding electrical connection is greater than or equal to the first voltage threshold for the direct and inverse polarities of the lighting module, the first comparison circuit increments the first voltage threshold by a reference value for one or more future comparisons of said voltage with the first voltage threshold.

2. The system according to claim **1**, wherein the detection device comprises a second comparison circuit to compare an intensity of the current measured on the corresponding electrical connection with a current threshold, and the second comparison circuit detects the direct polarity of the lighting module when the measured intensity is above the current threshold.

3. The system according to claim **1**, wherein the injection circuit, upon each change in polarity of the lighting module, injects the setpoint current in order to increasingly vary the voltage delivered to the lighting module, between a second voltage threshold and a maximum voltage, a value of the first voltage threshold being comprised between that of the second voltage threshold and that of the maximum voltage.

4. The system according to claim **1**, wherein the detection device comprises a storage medium to store a value of the voltage measured by the first measuring device, when an intensity of the current measured by the second measuring device is greater than a current threshold, the stored value corresponding to a minimum operating voltage of the corresponding lighting module.

5. A lighting assembly with light-emitting diodes comprising:

one or more lighting modules with light-emitting diodes; and

the power supply system according to claim **1**, wherein the power supply system is provided for the lighting modules.

6. The assembly according to claim **5**, wherein the assembly comprises several lighting modules, and wherein the power supply system comprises a control member to successively power each electrical connection, the control member comprising an identification circuit for the electrical connection associated with each lighting module.

7. The assembly according to claim **6**, wherein the assembly further comprises a configuration module for the power supply system, the configuration module comprising a circuit to back up a configuration file, the configuration file including configuration parameters for each lighting module, and wherein following an identification of each electrical connection, the configuration module is configured to download the configuration parameters into the control member and associate them with the corresponding electrical connection.

8. The assembly according to claim **7**, wherein the power supply system comprises a first computation circuit to compute an instantaneous consumed power, wherein the first computation circuit sends the control member the instantaneous power computed for each electrical connection, and wherein the control member comprises a second computation circuit to compute a remaining available power based on the instantaneous consumed power, and an allocation circuit to allocate power to various electrical connections.

9. The assembly according to claim **6**, wherein the power supply system comprises a first computation circuit to compute an instantaneous consumed power, wherein the first computation circuit sends the control member the instantaneous power computed for each electrical connection, and wherein the control member comprises a second computation circuit to compute a remaining available power based on the instantaneous consumed power, and an allocation circuit to allocate power to various electrical connections.

10. A power supply method for one or more lighting modules with light-emitting diodes using a power supply system, each lighting module comprising at least one light-emitting diode and being able to be polarized using a direct polarity or an inverse polarity depending on its connection direction, the light-emitting diodes(s) being polarized in direct mode for the direct polarity of the lighting module, and in inverse mode, respectively, for the inverse polarity of the lighting module, the system including an electrical power supply that is connectable to the lighting module via an electrical connection for the lighting module, a first measuring device to measure a voltage delivered to the corresponding lighting module on the electrical connection, a second measuring device to measure a current delivered to the corresponding lighting module on the electrical connection, and a detection device to detect a connection direction of the lighting module,

the method comprising:

injecting a setpoint current on the corresponding electrical connection using the detection device,

measuring the voltage delivered to the corresponding lighting module,

comparing the measured voltage with a first voltage threshold, during the measuring,

inverting the polarity of the corresponding lighting module, when the voltage measured on the corresponding electrical connection is greater than or equal to the first threshold voltage, and returning to the injecting,

wherein the method further comprises, for each lighting module:

when said measured voltage is greater than or equal to the first voltage threshold for the direct and inverse polarities of the lighting module, incrementing the first voltage threshold by a reference value, for one or more future comparisons of the voltage measured on the corresponding electrical connection with the first voltage threshold.

11. The method according to claim **10**, wherein before the measuring of the voltage, the method comprises:

measuring the current circulating in the corresponding electrical connection,

comparing an intensity of the current measured in the corresponding electrical connection with a current threshold,

and wherein after the comparing of the intensity, when the measured intensity is greater than or equal to the current threshold, the method further comprises:

detecting the direct polarity of the lighting module.

12. The method according to claim **11**, wherein, during the injecting, the setpoint current is injected to cause the voltage delivered to the lighting module to vary increasingly, between a second voltage threshold and a maximum voltage, the value of the first voltage threshold being comprised between that of the second voltage threshold and that of the maximum voltage.

13. The method according to claim **10**, wherein, during the injecting, the setpoint current is injected to cause the voltage delivered to the lighting module to vary increasingly, between a second voltage threshold and a maximum voltage, the value of the first voltage threshold being comprised between that of the second voltage threshold and that of the maximum voltage.

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