(19) Europäisches Patentamt
European Patent Office
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(11) **EP 1 843 640 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.10.2007 Bulletin 2007/41

(51) Int Cl.:
H05B 33/08 *(2006.01)*

(21) Application number: **06112272.7**

(22) Date of filing: **05.04.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(71) Applicant: **SEMAI LIGHTING, S. L.**
08027 Barcelona (ES)

(72) Inventors:
- **Sanchez Navarro, Juan**
  08027, Barcelona (ES)
- **Navarro Gea, Víctor**
  08027, BARCELONA (ES)

(74) Representative: **Barlocci, Anna**
ZBM Patents
Zea, Barlocci & Markvardsen
C/ Balmes, 114 - 4°
08008 Barcelona (ES)

(54) **LED module and LED-based lighting system**

(57) A Led module (1) comprises at least one Led (4) and a current controller (5) which regulates the current delivered to the Led (4), so that said controller (5) sets the intervals of time in which the Led (4) is conducting current. A Led-based lightning system comprises at least a first controller (3) and at least one of said Led modules (1), whose controller (5) is then a second controller, and a data connection between the first controller (3) and the Led module (1), through which a modulation signal generated by said first controller (3) is transmitted to the associated second controller (5).

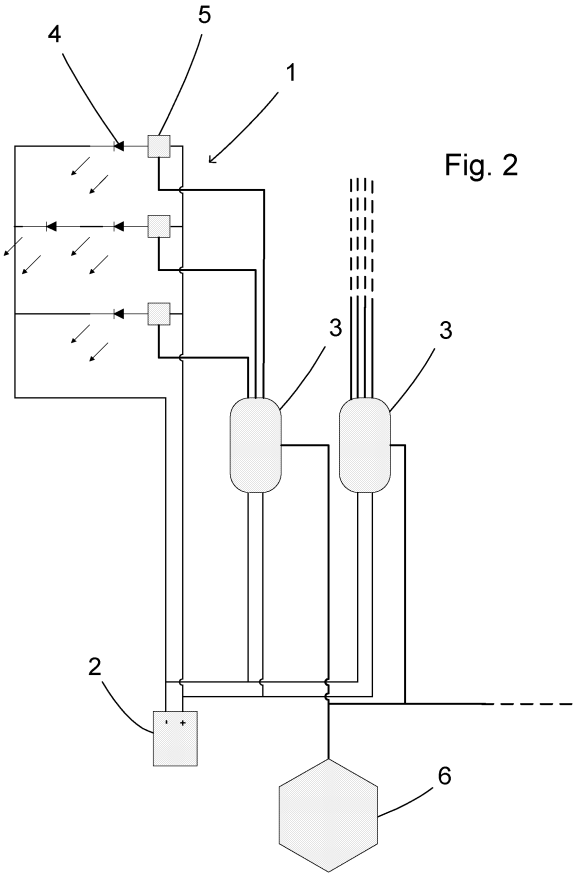

Fig. 2

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Description

[0001] This invention relates to a Led module which comprises at least one Led, and it also relates to a Led based lightning system which may comprise a first controller external to the Led module. The Led module may comprise a plurality of Leds.

[0002] Each first controller is part of a control system and contributes to regulate the current delivered to the Leds, with the aim of controlling the luminosity of the Leds as a function of time.

BACKGROUND ART

[0003] The lighting industry has experienced a gradual change in recent years due to the emergence of LED technology as a substitute for conventional lighting technology, heretofore based mainly on incandescent bulbs and fluorescents. Led average life span is longer and Leds are less energy-consuming and more impervious to environmental extremes.

[0004] A Led (Light Emitting Diode) is essentially a PN junction semiconductor diode that emits a monochromatic light when operated in a forward biased direction.

[0005] The firsts Leds could only achieve a very limited number of light wavelengths (colors) but, as Led technology evolved through the 1970's, additional colors became available. This helped to extend their use to a wider range of devices, but they were still used mainly as indicators and not for general lighting purposes.

[0006] As research on Led-based lighting systems has progressed, Led bulbs or Led fixtures (formed by several grouped Leds) have come to be used more widely in more situations, often replacing conventional bulbs in space-illumination applications, and not just in low-power instrumentation or indication appliances. This circumstance has brought the need of developing control systems for groups of Leds which are arranged separately from each other.

[0007] The input (current), and hence the output (light), of a Led-based lighting system admit much more possibilities of electronic control than the same in a conventional lighting system, because of the rapid response of Leds to current supply variation. This allows energy-saving and color and luminosity variation.

[0008] Leds are available in a variety of colors, mainly red, green, blue, amber and white. A plurality of diversely coloured Leds may be combined in a lighting fixture and the intensity of the Leds of each color may be independently varied to produce different hues.

[0009] In recent years there have been developed methods for controlling the current supply to Led-based lighting systems that are largely based on computer programming. This control is necessary because Leds properly work at a fixed nominal current.

[0010] In the known lightning systems, the control means are suitable to control only a limited number of Leds.

[0011] A comercially available known Led-based lightning control system integrates in the same apparatus (fig. 1) a DMX protocol controller provided with an input data line, a power supply source and three current supply sources designed to support at most 10 Leds connected to each of them. Said connections are arranged in a way such that the Leds are connected in a serial mode and the ground cable returns to the correspondent current supply source. Instructions related to the luminosity of the Leds are transmitted to the controller through its input data line.

[0012] Thus, this apparatus allows the control of a definite number of Leds; if, for example, there is one more Led in the lightning system, then another of said apparatuses has to be added and the new Led has to be connected to it. This is cumbersome as well as expensive.

SUMMARY OF THE INVENTION

[0013] It is an object of the present invention to provide a current supply control for a Led-based lighting system which allows to control a large number of Leds in a versatile way.

[0014] Thus, according to one aspect, one Led module comprises an internal current controller which regulates the current supplied to the Led, so that said controller sets the intervals of time in which the Led is conducting current. Consequently, the Leds of a Led module have an autonomous current control, though perhaps linked to an external control.

[0015] Here internal and external means belonging or not belonging to the Led module, respectively, though said internal controller may be physically placed somewhat far from the Leds.

[0016] The internal controller comprises a data input pin through which it can receive a modulation signal, in order to modulate the current delivered to the Led. The modulation signal may advantageously be a Pulse Width Modulation carrier, the amplitude of which may determine whether the controller allows the passage of current through the Led.

[0017] According to another aspect of the invention, one Led-based lighting system comprises at least one Led module having the above features. It may also comprise a first controller and a data connection between the first controller and the Led module. In this case, the Led module controller is called a second controller.

[0018] Thus, one first controller can cooperate with several second controllers to jointly set the luminosity of the Leds. In order to do so, said data connection reaches the Led module through its second controller.

[0019] Preferably, there is a distinct connection between the first controller and each Led module associated to it. In this way each Led module can receive a specific set of instructions.

[0020] The lightning system comprises a control device prepared to send to each first controller instructions related to the desired amount of brightness of each Led

as a function of time. Then, the first controller, in response to the instructions received from the control device, generates and transmits a modulation signal, e.g. a PWM carrier, to the second controllers.

[0021] The lightning system also comprises a power supply source, to the terminals of which each Led module is connected in parallel. As a consequence, there is no need to provide, after the last Led module of a string, for a return cable to the power supply source.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] A particular embodiment of the present invention will be described in the following, only by way of non-limiting example, with reference to the appended drawings, in which:

figure 1 is a schematic view of a control system for Leds known in the art;
figure 2 is a schematic view of a lighting system according to the invention ; and
figure 3 is a graph of a modulation signal.

DESCRIPTION OF PARTICULAR EMBODIMENTS

[0023] A particular embodiment of a Led-based lightning system according to the invention comprises (fig. 2) a control device 6, a power supply source 2, several (although it might be one) first controllers 3 and several (although it might be one) Led modules 1 connected to each first controller 3.

[0024] The control device 6 may be any device capable of sending instructions to lightning luminaires, such as a switch or group of switches, a mix board, a computer, etc.

[0025] The first controller 3 has a current connection to the power supply source 2, a data connection to the control device 6, and a data connection to each Led module associated with it.

[0026] Each Led module 1 comprises at least one Led 4 and one second cotroller 5, which acts essentially as a current supply source and is connected to one corresponding first controller 3, so that the second controllers 5 and their corresponding first controller 3 cooperate to, according to the instructions received from the control device 6, control the luminosity produced by the Leds 4. Said luminosity depends on the amount of current that go through each Led 4 in a certain period of time. Since in order to work properly the Leds must conduct a current of a fixed nominal intensity, it follows that for varying its luminosity it is convenient for them to stop conducting current during an interval of said period.

[0027] Each Led module 1 is connected in parallel to the terminals of the power supply source 2. Both this current connection and the data connection of each module 1 with its corresponding first controller 3 go through the second controller 5. Each second controller 5 comprises an electronic device for regulating the amount of current delivered to the Leds 4 of its module 1.

[0028] The connection between one first controller 3 and the Led modules 1 may comprise several lines, one for each group of Leds 4 related by a certain feature that may be desired to control independently (for example Leds of the same color, the same temperature of white, the same position, etc).

[0029] In this embodiment, the control device 6 employs a DMX protocol for addressing each first controller 3 connected to it, but it might employ any other suitable standard data transmission protocol.

[0030] The control device 6 issues a set of instructions for controlling the Leds 4 and for controlling, when appropiate, each group of Leds independently. Said instructions specify which Leds have to emit light, when and with which luminosity. Furthermore, it packages said set of instructions with said data transmission protocol, with the aim of adressing a specific first controller 3 and correctly transmitting the data to its correponding second controllers 5.

[0031] When the control device 6 is sending instructions to the first controllers 3, each first controller accepts only the instructions addressed to it. Upon receiving an instruction correctly assigned, a specific first controller interprets and retransmits it to each second controller 5 associated, in the form of a modulation signal with a variable pulse length which sets the time during which the corresponding Leds 4 are active.

[0032] The division of the current control system between a first (or several) controller 3 and a plurality of second controllers 5 associated to it, one for each corresponding Led module 1, allows the addition of new Led modules without having to add new controllers 3, because any new Led module 1 carries its own second controller 5, which is a lot cheaper than the first controller 3.

[0033] A preferred modulation signal is a PWM (Pulse Width Modulation) carrier which in this case is an ON/OFF signal that allows the free passage of current during a portion of its period and stops it during the rest of the period. This proportion of ON/OFF determines the level of luminosity produced by the Leds (figure 3). In other words, the supplied voltage and current intensity are fixed but, by virtue of the PWM carrier, the power delivered to the Leds is a portion of the maximum power.

[0034] The pulse width, and hence the power delivered to the Leds, of the PWM carrier is determined by the instructions sent by the control device 6. Said PWM carrier is generated by the first controller 3.

[0035] Although only particular embodiments of the invention have been shown and described in the present specification, the skilled man will be able to introduce modifications and substitute any technical features thereof with others that are technically equivalent, depending on the particular requirements of each case, without departing from the scope of protection defined by the appended claims.

Claims

1. Led module (1) which comprises at least one Led (4), **characterized in that** it also comprises a current controller (5) which regulates the current delivered to the Led (4), so that said controller (5) sets the intervals of time in which the Led (4) is conducting current.

2. Led module (1) according to claim 1, wherein the controller (5) comprises a data input pin for receiving a modulation signal.

3. Led module (1) according to claim 2, wherein the modulation signal is a PWM carrier.

4. Led module (1) according to claim 2 or 3, wherein the amplitude of the modulation signal determines whether the controller (5) allows the passage of current through the Led (4).

5. Led-based lightning system **characterized in that** it comprises at least one Led module (1) according to any of claims 1 to 4.

6. Lighting system according to claim 5, which comprises a first controller (3) and a data connection between said first controller (3) and the Led module (1).

7. Lightning system according to claim 6, wherein said data connection reaches the Led module (1) through its controller (5), which is a second controller.

8. Lightning system according to claim 6 or 7, wherein there is a distinct connection between the first controller (3) and each Led module (1) associated to it.

9. Lightning system according to any of claims 6 to 8, which comprises a control device (6) prepared to send to each first controller (3) instructions related to the desired amount of luminosity of each Led as a function of time.

10. Lightning system according to any of claims 6 to 9, wherein the first controller (3),generates and transmits a PWM modulation signal to the second controllers (5).

11. Lightning system according to any of claims 5 to 10, which comprises a power supply source (2) to the terminals of which each Led module (1) is connected in parallel.

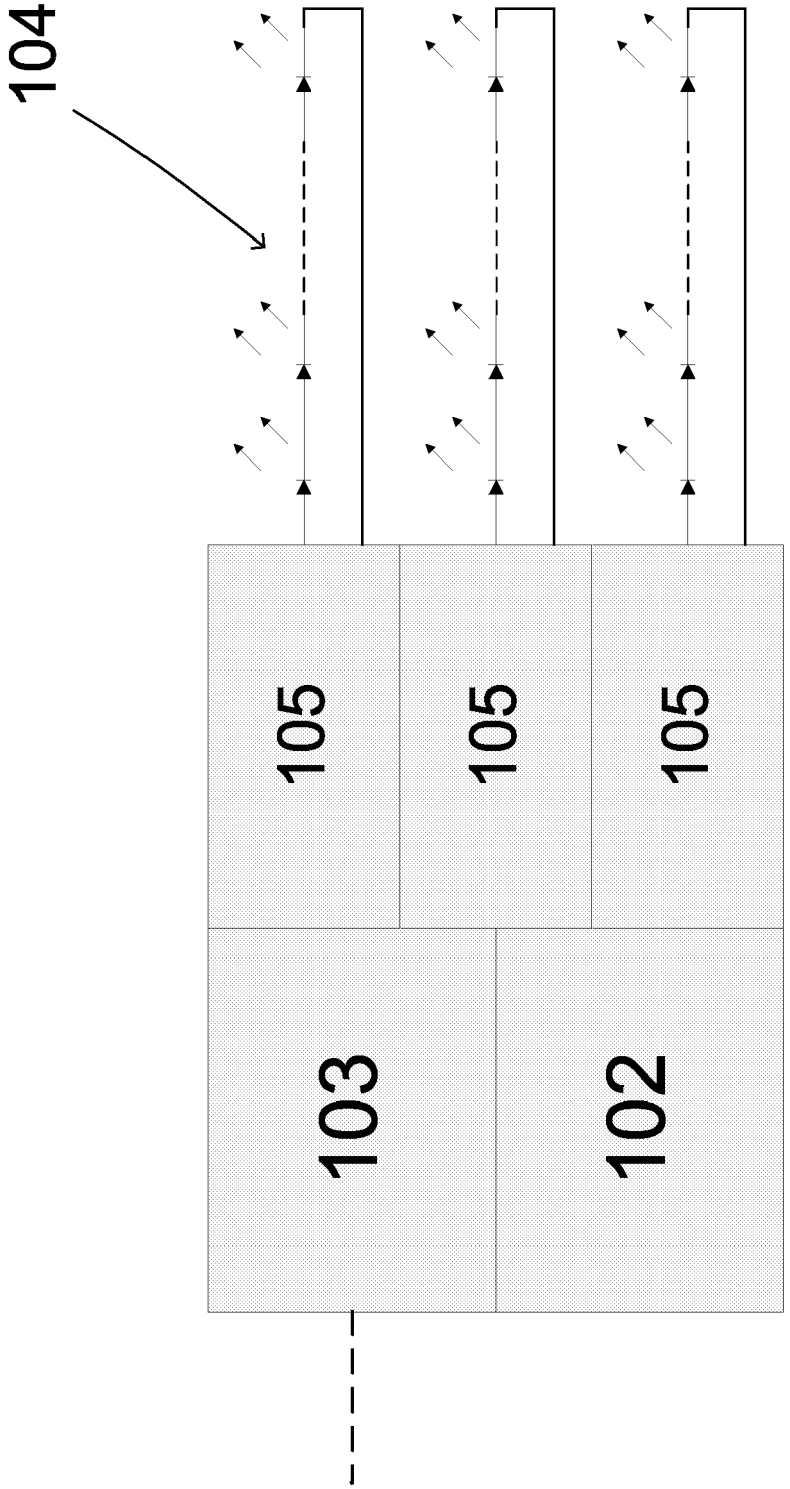

Fig. 1

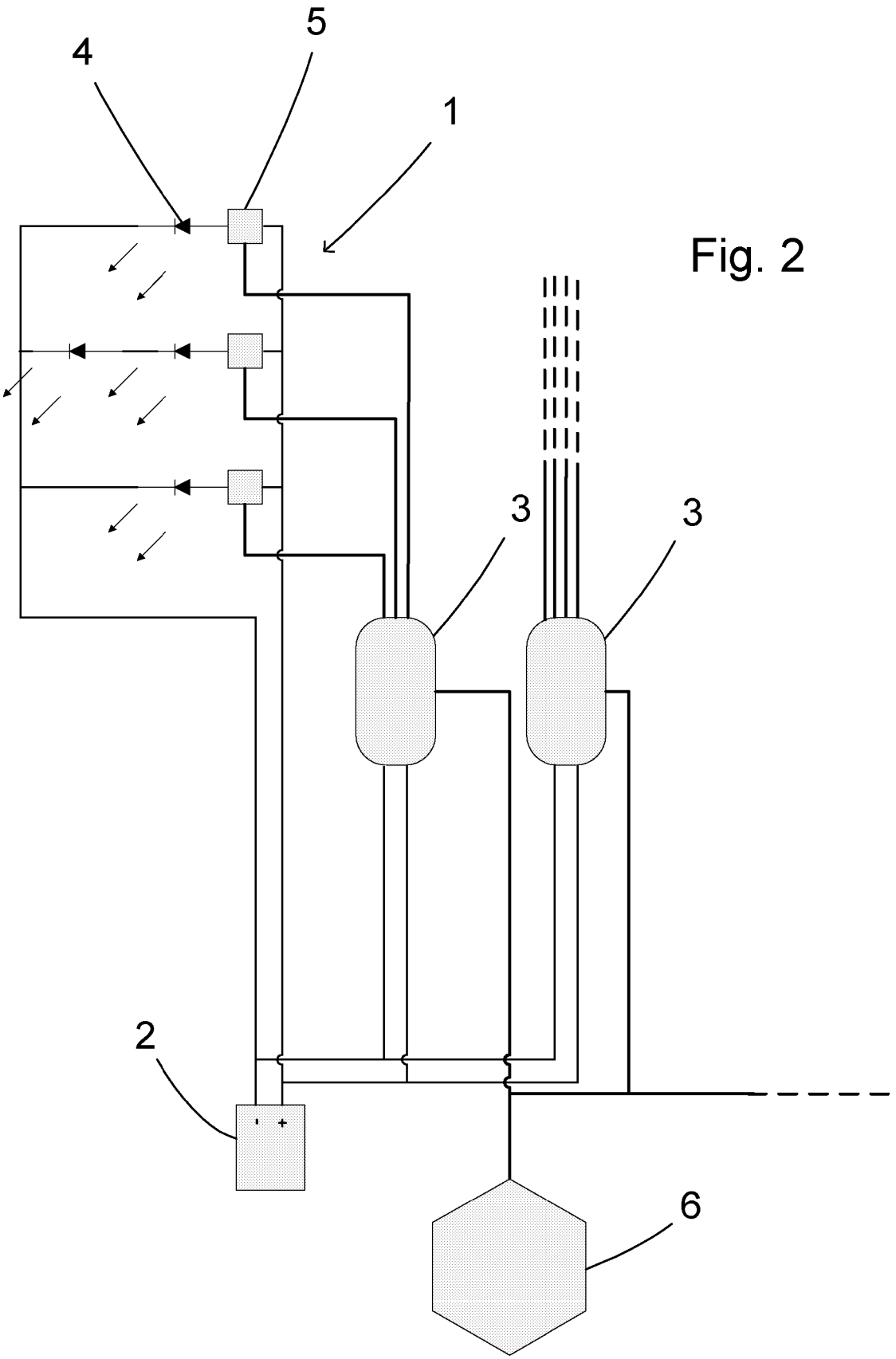

Fig. 2

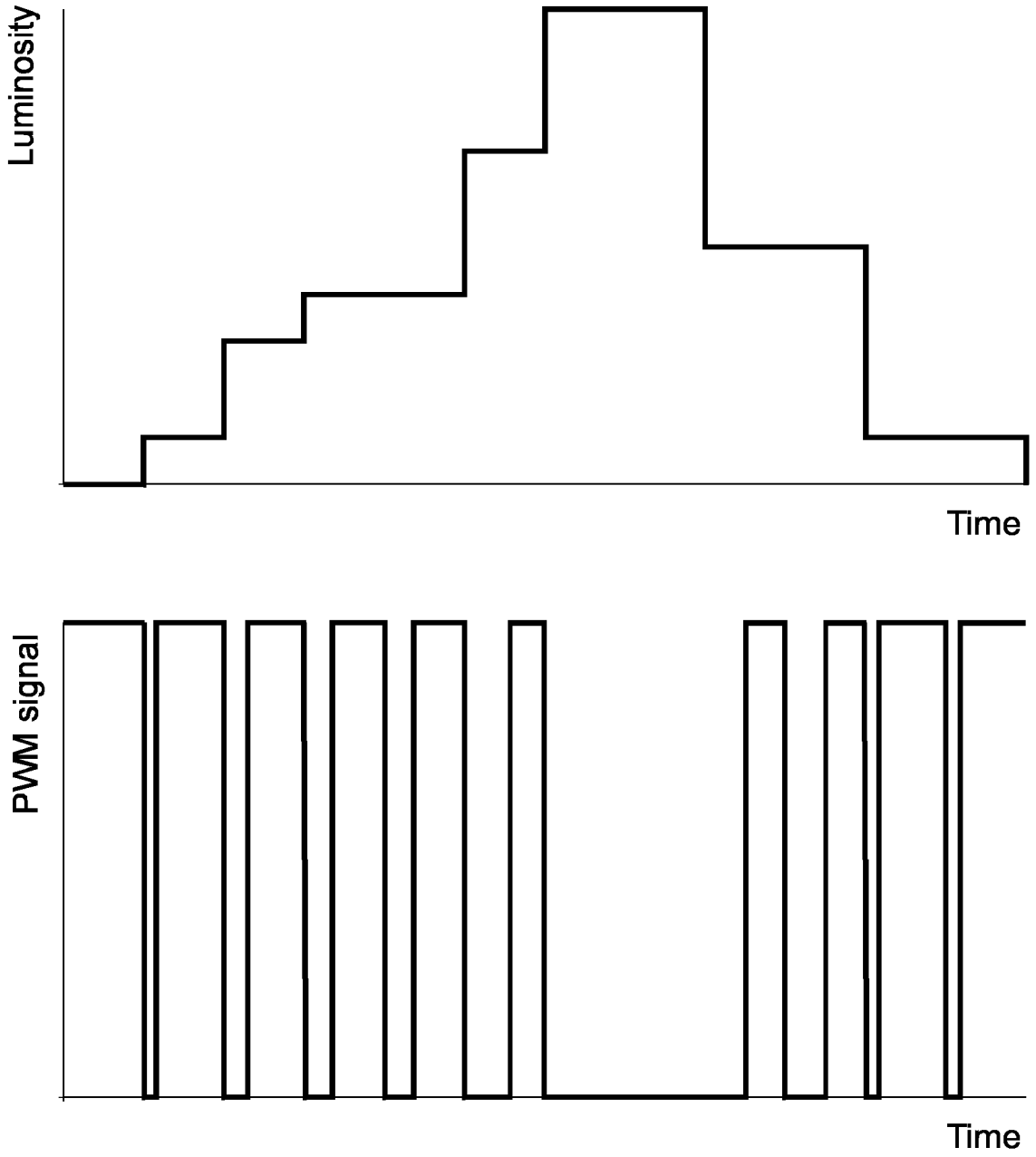

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 06 11 2272

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 August 2006	Hagan, C

CATEGORY OF CITED DOCUMENTS

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