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(54) **Illuminating apparatus and method thereof**

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an illuminating apparatus and method thereof; in particular, to a light emitting diode (LED)-based illuminating apparatus and method thereof.

2. Description of Related Art

[0002] EP 2 288 234 A1 discloses an LED driver comprising multiple LED arrays, at least one dividing diode, a power module, a driving module, at least one switch pair and a voltage sensing module. Each LED array comprises multiple LEDs connected in series. The dividing diode is mounted between adjacent LED arrays. The power module is connected to an external power source and forms a pulsating direct current (DC) voltage. The driving module receives the pulsating DC voltage outputs a constant current to the LED arrays. The voltage sensing module closes and opens the switch pairs that changes electrical configuration of the LED arrays. Thanks for characteristics of low power consumption, high brightness, and long duration associated with LEDs, the LEDs are gradually applicable to various lighting means. Please refer to FIG. 1, which is a schematic diagram of a conventional illuminating means. The conventional illuminating means includes a rectifying circuit 90, a lighting set 92 and a current source 94. The illuminating means further includes a plurality of LEDs in serial connection. In one implementation, the rectifying circuit 90 is a full-wave rectifying circuit for converting an alternating current (AC) current into a direct current (DC), which serves as an input power for the LEDs. When the serial-connected LEDs are turned on, the current source 94 provides a steady current for each of the LEDs in the lighting set 92.

[0003] For improving brightness of the lighting means, conventionally, a plurality of LEDs are serial-connected, however, correspondingly increasing a turn-on voltage of the lighting set 92. With the increased turn-on voltage of the lighting set 92, such lighting set 92 is conducted only when a voltage level of the input power is larger than the turn-on voltage. Therefore, a flashing effect associated with the lighting set 92 would be more significant.

SUMMARY OF THE INVENTION

[0004] The object of the present invention is for providing an illuminating apparatus and method thereof to address the issue of the foregoing drawbacks. The object of the invention is achieved by the subject-matter of the independent claims. Advantageous embodiments are disclosed by the dependent claims.

[0005] According to one example, an illuminating apparatus is provided to receive a pulse DC as an input power being comprises a lighting unit, a detecting unit and a controlling unit. The lighting unit comprises a plurality of lighting sets and a switching unit, the switching unit is adapted to cause the lighting sets to be connected with each other serially or in parallel. The detecting unit is adapted to detect state of the input power. And the controlling unit is coupled to the detecting unit and switching unit, and bases upon the detecting unit detecting the state of the input power controls the switching unit.

[0006] Another example is for providing an illuminating apparatus having a lighting unit, a detecting unit and a controlling unit. The lighting unit comprises a plurality of inter-coupled LED modules, and each of the LED modules includes a first lighting set, a second lighting set and a switching circuit. The first lighting set is composed of a plurality of first LEDs in a serial connection. The second lighting set is composed of a plurality of second LEDs in a serial connection. The switching circuit coupled between the first lighting sets and the second lighting set is for causing changes to connection relationship between the first lighting set and the second lighting set. The detecting unit is adapted for detecting the state of the input power. The controlling unit is coupled to the detecting unit and the switching circuit, and base upon the detecting unit detecting the state of the input power controls the switching circuit to cause the changes to the connection relationship between the first lighting sets and the second lighting sets.

[0007] Still another example is for providing an illuminating method including detecting the state of the input power and controlling the switching unit according to detecting the state of the input power.

[0008] Hence, according to the disclosures of the claims, improvements can be made as such: For the illuminating apparatus, its turn-on voltage can be adjusted so as to extend turn-on time of the lighting unit within a period time of the input power, and thus reducing the flashing of the lighting unit during the lighting.

[0009] In order to further the understanding regarding the present invention, the following embodiments are provided along with illustrations to facilitate the disclosure of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 shows a schematic diagram of a conventional illuminating means;

FIG. 2 shows a simplified block diagram of the illuminating apparatus according to an embodiment of the present invention;

FIG. 3 shows a flow chart of the illuminating method according to an embodiment of the present invention;

FIG. 4 shows a simplified block diagram of the illuminating apparatus according to one embodiment of the present invention integrating with a power supply;

FIG. 5 shows a flow chart of an illuminating method according to one embodiment of the present invention;

FIG. 6 shows a schematic diagram showing the input power waveform plot for the input power and the turn-on voltage of the illuminating apparatus according to the present invention;

FIG. 7 shows a schematic diagram illustrating a comparison of periods during which the illuminating apparatus according to the present invention and the conventional illuminating apparatus are turned on, respectively;

FIG. 8 shows a simplified block diagram of the illuminating apparatus according to another embodiment of the present invention;

FIG. 9 shows a block diagram of an illuminating apparatus according to another embodiment of the present invention; and

FIG. 10 shows a flow chart of an illustrating method according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] The present invention relates to an illuminating apparatus and method thereof. The illuminating apparatus refers to a lighting array having a plurality of lighting LEDs, and by means of serial/parallel connections between the LEDs, the turn-on voltage for the lighting array may be adjustable. For example, when the input power fails to turn on all of the serially connected LEDs, some or all of the LEDs may be adapted to be in a parallel connection to reduce the turn-on voltage of the lighting array, so as to extend a time period during which the illuminating apparatus is turned on.

[0012] Please refer to FIG. 2, which is a simplified block diagram for the illuminating apparatus according to an embodiment of the present invention. An illuminating apparatus 1 includes a detecting unit 11, a lighting unit 13 and a controlling unit 15 coupled between the detecting unit 11 and the lighting unit 13.

[0013] The detecting unit 11 is adapted for detecting a state of an input power Vin applied to the lighting unit 13. For example, the detecting unit 11 may sense a phase variation or a voltage variation of the input power Vin. As such, the detecting unit 11 may be a phase detecting circuit or a voltage detecting circuit but not limited thereto. The input power may be a pulse DC, for example, which is a product of a rectified AC power. Furthermore, the pulse DC may be a full-waved or half-waved pulse DC. And the following description adopts full-waved pulse DC as the input power for the illustration purposes.

[0014] The lighting unit 13 includes a plurality of lighting sets 131 and a switching unit 133. The lighting sets 131 may include a plurality of LEDs with connections between the lighting sets 131 adjustable according to the state of the input power. The switching unit 133, meanwhile, includes a plurality of switching devices and/or related circuit device (such as a unilateral-conducting device).

[0015] The switching unit 133 may be adapted to cause a serial connection or a parallel connection between the lighting sets 131. For example, under the control of the switching unit 133, one of the lighting units 131 may be connected in the serial connection or alternatively in the parallel connection with another one or other lighting sets 131. In another implementation, the lighting sets 131 may be divided into a plurality of groups and each of the groups may include a plurality of lighting sets 131 inter-connected with each other serially or in parallel, and the groups themselves may be further interconnected with each other serially or in parallel.

[0016] The controlling unit 15 controls the switching unit 133 according to the detecting unit 11 detecting the state of the input power to adjust the connection between the lighting sets 131 of the lighting unit 13. For example, when the detecting unit 11 detects a voltage of the input power Vin is larger than the turn-on voltage of one set of the lighting sets 131 or the turn-on voltages of a plurality of lighting sets 131 in the serial connection, the controlling unit 15 may thus operate to control the switching unit 133 to cause the lighting sets 131 to be connected serially or in parallel. In one implementation, the detecting unit 11 may be configured to detect the state of the input power at predetermined points within a time period of the input power waveform (e.g., the time period of the pulse DC). In another implementation, the detecting unit 11 may be configured to detect the voltage of the input power before determining whether the voltage of the input power has reached predetermined voltage levels.

[0017] The illuminating apparatus 1 may further include a current source 17 coupled to the lighting unit 13 and capable of providing a steady current when the lighting sets 131 in the lighting unit 13 are turned on. The current source 17 may also provide an adjustable current under the control of the controlling unit 15. More specifically, when the turn-on voltage of the lighting sets 131 is smaller, indicative of the lighting sets 131 may be connected with each other in parallel, a larger turn-on current may become necessary, prompting the adjustable current source 17 to offer a corresponding larger current to the lighting sets 131. On the other hand, when the turn-in voltage of the lighting sets 131 is larger, which indicates the lighting sets 131 may be in the serial connection among themselves and thus necessities a corresponding smaller turn-in current for the lighting sets 131, the current source 17 may be adjusted to provide the current of the smaller value with the lighting sets 131.

[0018] In conjunction with FIG. 2, please refer to FIG. 3, which relates to a flow chart for the illuminating method according to an embodiment of the present invention.

[0019] The controlling unit 15 detects the state of the input power via the detecting unit 11 (step S301) so as to determine the state of the input power. In one implementation, the state of the input power may be a phase a waveform of the input power. In another implementation, the state of the input power may be in terms of predetermined time values counting from the zero phase of the input power waveform. According to the detecting unit 11 detecting the state of the input power, the controlling unit 15 may determine whether the predetermined time values have been reached (step S303). When the predetermined time values have been reached, the controlling unit 15 bases upon the predetermined time values, all of which may correspond to their respective turn-on voltages of the lighting unit 13, may control the switching unit 133 to manipulate connection relationships between each lighting unit 13 (step S305), so that each of the lighting sets 131 may be turned on uninterruptedly with this particular turn-on voltage. It is worth noting that the aforementioned steps may be performed repeatedly.

[0020] Please refer to FIG. 4, which relates to a simplified block diagram of the illuminating apparatus according to another embodiment of the present invention integrating with a power supply. An illuminating apparatus 2 includes a rectifying unit 10, a detecting unit 11, a voltage stabilizing unit 12, a lighting unit 14, a controlling unit 15 and a current source 17. The rectifying unit 10 is coupled to the detecting unit 11, the voltage stabilizing unit 12, and the lighting unit 14. The controlling unit 15 is coupled to the detecting unit 11, the voltage stabilizing unit 12 and the lighting unit 14.

[0021] In one implementation, the rectifying unit 10 may be a full-wave rectifying circuit, for rectifying an AC power waveform into an input power source adapted for the lighting unit 14, which may require a full-wave pulse DC as its input power. What is noteworthy is the rectifying unit 10 is not limited thereto, which may be implemented by a half-wave rectifying circuit.

[0022] The detecting unit 11 is adapted to detect the state of the input power. As previously mentioned, the detecting unit 11 may be also a phase detection circuit or a voltage detection circuit.

[0023] The voltage stabilizing unit 12 is adapted to stabilize the input power in order to output a DC current source with a steady voltage value to serve the controlling unit 15.

[0024] The lighting unit 14, meanwhile, includes a plurality of LED modules which are connected serially with each other, and each of the LED modules 141 further includes a plurality of lighting sets and a switching circuit 1412. In one implementation, the LED module 141 may include two lighting sets having a first lighting set 1411 and a second lighting set 1413. The first lighting set 1411 and the second lighting set 1413 each includes LEDs which are inter-connected in serial and equal in the number. And each of the lighting sets is adapted to receive the input power and is turned on when the voltage of the input power exceeds the turn-on voltage of the lighting set.

[0025] The switching circuit 1412 further includes a first switching device S1, the second switching device S2 and a unilateral-conducting device D1. The first switching device S1 may be coupled to one side of the first lighting set 1411, the second switching device S2 may be coupled to one side of the second lighting set 1413, and the unilateral-conducting device may be coupled between the first lighting set 1411 and the second lighting set 1413. The first switching device S1 and the second switching device S2 may be a machinery switch or an electronic switch. When the first switching device S1 and the second switching device S2 are the electronic switches, they may be implemented in terms of a Darlington circuit. The unilateral-conducting device D1 may be a diode.

[0026] When both the first switching device S1 and the second switching device S2 are both non-conducted, the first lighting set 1411, the unilateral-conducting device D1 and the second lighting set 1413 are serially connected. And when both the first switching device S1 and the second switching device S2 are conducted, the first lighting set 1411 and the second lighting set 1413 are connected in parallel with the unilateral-conducting device D1 non-conducted.

[0027] More specifically, the first lighting set 1411 and the second lighting set 1413 may be connected in the serial manner or in the parallel manner and the connection relationship between the first lighting set 1411 and the second lighting set 1413 may be determined by the switching circuit 1412. In other words, the switching circuit 1412 that is controlled by the controlling unit 15 may be configured to switch the first lighting set 1411 and the second lighting set 1413 so that the turn-on voltage of the lighting unit 14 may range between a lowest turn-on voltage when the first lighting set 1411 and the second lighting set 1413 are connected in parallel and a highest turn-on voltage when the first lighting set 1411 and the second lighting set 1413 are serially connected. For example, in view of the lighting unit 14 illustrated in FIG. 4, when the first lighting set 1411 and the second lighting set 1413 of each of the LED modules 141 are connected in parallel, the lowest turn-on voltage of the lighting unit 14 is "n" times the turn-on voltage for the single lighting set, where "n" refers to the amount of the LED module 141 in the lighting unit 14. The highest turn-on voltage of the lighting unit 14 is "2n" times the turn-on voltage drop of the lighting set with n referring to the amount of the LED module 141 in the lighting unit 14.

[0028] The state of the input power may dictate the connection relationship between the first lighting set 1411 and the second lighting set 1413. For example, at least one voltage level may be set and when the input power has reached any particular voltage level the switching circuit 1412 may switch on the first switching device S1 and the second switching device S2 in all of the LED modules 141. In another implementation, when the input power reaches another predetermined voltage level the switching circuit 1412 may switch on the first switching device S1 and the second switching device S2 in some of the LED modules 141. In doing so, the controlling unit 15 may ensure the input power regardless of the state thereof may be sufficient to turn on all the lighting sets that are switched on by the switching circuit 1412.

[0029] In another aspect, when the controlling unit 15 adjusts the turn-on voltage of the lighting unit 14 via the switching circuit 1412, a current volume for the current source 17 of the lighting unit 14 may be simultaneously adjusted.

[0030] Please refer to FIG. 5, which relates to a flow chart of an illuminating method according to one embodiment of the present invention. Please also refer to FIG. 4 and FIG. 6 in conjunction with FIG. 5. For the illustration purpose, in FIG. 4 the LED modules 141 each includes two lighting sets and the detecting unit 11 is implemented by the phase detecting circuit.

[0031] FIG. 6 is a schematic diagram showing the input power waveform and turn-on voltages of the illuminating apparatus according to the present invention. The illuminating apparatus 2 is adapted to detect via the phase detecting circuit or bases upon specifications of the input power (such as voltage or frequency) to determine the input power is a periodical signal and thus set up predetermined time values within a time period of the periodical input power. The predetermined time values may be determined based on the turn-on voltages of the lighting unit 14 (such as VI, V2), each of which may correspond to the time values of the input power waveform (such as T1, T2, T3, T4). Therefore, when the time values are reached the switching circuit 1412 in the lighting unit 14 may in turn adjust the serial/ parallel connection of the first lighting set 1411 and the second lighting set 1413 to ensure that the corresponding turn-on voltages associated with the time values are sufficient enough to turn on the lighting sets connected with each other in corresponding ways.

[0032] For the illustration purposes, the initial connection relationship between the first lighting set and the second lighting set in each of the LED module 141 is in parallel.

[0033] Via the phase detecting circuit, the controlling unit 15 detects the phase of the input power (step S501). According to detection result in S501, the controlling unit determines whether to trigger the determination of the predetermined time values are reached (step S503). In one implementation, to trigger such determination is when the input power waveform is at the zero phase thereof such as T0.

[0034] When step S503 determines that the input power waveform is at its zero phase, the controlling unit 15 starts counting from T0 before determining whether T1 has been reached (step S505). When T1 is reached, the controlling unit 15 causes the first lighting set 1411 and the second lighting set 1413 of the first LED module 141 to be in the serial connection by switching off the first switching device S1 and the second switching device S2 (step S507). And then the turn-on voltage of the lighting unit 14 having the first lighting set 1411 and the second lighting set 1413 of the first Led module serially connected may be V1.

[0035] The controlling unit 15 further determines whether another predetermined time value T2 has been reached (step S509). If so, the controlling unit 15 may further cause the first lighting set 1411 and the second lighting set 1413 of another LED module 141 (e.g., a second LED module) to be in the serial connection (step S511) by switching off the first and second switching devices S1 and S2. And then the turn-on voltage of the lighting unit 14 having the first lighting set 1411 and the second lighting set 1413 of the second LED module in the serial connection may be at V2.

[0036] The controlling unit 15 may be configured to further determine whether another predetermined time value T3 has been reached (step S513). If so, the controlling unit 15 may be configured to cause the first lighting set 1411 and the second lighting set 1413 in the first LED module 141 to be in the parallel connection by switching on the first and second switching devices S1 and S2 in the first LED module 141 (step S515). And the turn-on voltage of the lighting unit 14 having the first lighting set 1411 and the second lighting set 1413 of the first LED module 141 that is in the parallel connection may be at V2.

[0037] Additionally, the controlling unit 15 determines whether another predetermined time value T4 has been reached (step S517). If so, the controlling unit 15 may be configured to cause the first lighting set 1411 and the second lighting set 1413 of the second LED module 141 to be in the parallel connection by switching on the first and second switching devices S1 and S2 in the second LED module 141 (step S519). And the turn-on voltage of the lighting unit 14 having the first lighting set 1411 and the second lighting set 1413 of the second LED module 141 may be at V1.

[0038] The foregoing S501 ~ S519 illustrate operations of the controlling unit 15 in a single time period of the input power waveform and may be repeatedly performed in the subsequent time periods of the input power waveform.

[0039] Plus, when S507 and S511 are executed, the controlling unit 15 may simultaneously control the current source 17 to reduce the current that is provided with the lighting unit 14 so that the minimum requirement sufficient to cause the lighting unit 14 to illuminate may be met. And while S515 and S519 are executed, the controlling unit 15 may simultaneously control the current source 17 to provide another current of an increased value that is at the minimum requirement for the lighting unit 14 to illuminate.

[0040] Hence, according to FIG. 5, before the input power waveform reaches a peak V3 thereof the number of the first lighting set 1411 and the second lighting set 1413 that are in the serial connection increases, resulting in the increased turn-on voltage for the lighting unit 14. On the other hand, after the input power reaches the peak of V3 the number of the first lighting set 1411 and the second lighting set 1413 in the lighting unit 14 that are connected in parallel may increase as well, decreasing the required turn-on voltage of the lighting unit 14.

[0041] Additionally, in the foregoing description for FIG. 5, whether to cause the serial /parallel connections between the first lighting set 1411 and the second lighting set 1413 in each of the LED module 141 is determined on basis of whether the predetermined time values relative to the zero phase of the input power waveform has been reached. In another implementation, the controlling unit 15 may be configured to cause the changes to the connection relationship between the first lighting set 1411 and the second lighting set 1413 in all lighting units 141. When the controlling unit 15 detects the voltages of the input power waveform reach the predetermined voltage levels associated with the predetermined time values T1-T4, the connection relationship between the first lighting set 1141 and the second lighting set 1143 may be altered.

[0042] Please refer to FIG. 7, which relates to a comparison of periods during which the illuminating apparatus according to the present invention and the conventional illuminating apparatus are turned on, respectively. Assume the present invention illuminating apparatus and the conventional illuminating apparatus include LEDs of the same number with the LEDs in the conventional apparatus connected with each other serially. The waveform P1 stands for the waveform of the input power in a single time period T11, the waveform P2 is associated with the illuminating apparatus according to the present invention while the waveform P3 corresponds to the conventional illuminating apparatus. More specifically, the waveforms P2 and P3 indicate that the period during which the illuminating apparatus could be turned on (T12) within the time period of the input power waveform (i.e., T11) is larger and earlier than the period during which the conventional illuminating apparatus could be turned on (T13) within the same time period of the input power.

[0043] Please refer to FIG. 8, which relates to a simplified block diagram for the illuminating apparatus 3 according to another embodiment of the present invention. The difference between the illuminating apparatus 3 illustrated in FIG. 8 and the illuminating apparatus illustrated in FIG. 4 is the switching circuit 143 may be coupled between the LED modules 141 when the LED modules 141 are in the serial or parallel connection.

[0044] Please refer to FIG. 9 which is a block diagram of the illuminating apparatus according to the embodiment of the present invention. The illuminating apparatus 4 of the embodiment in FIG. 9 is similar to the illuminating apparatus 1 of the embodiment in FIG. 2. For example, the illuminating apparatus 4 may also control the switching unit 133 by using the controlling unit 15, which makes the lighting sets 131 be connected with one another in parallel or serial connections via the switching unit 133.

[0045] However, there are differences between the illuminating apparatuses 1 and 4, which are that the illuminating apparatus 4 further includes a switching switch SW1, a rectifying unit 10, a dimming unit 19, and a power conversion unit 21. The controlling unit 15 further includes a counting circuit 151 and a switch circuit 153.

[0046] The switching switch SW1 is coupled between the AC power and the rectifying unit 10, and may serve as the switch for turning on or off the AC power. Thus, the user may operate the switching switch SW1 according to the indoor illuminating needs. For example, the user may operate the switching switch SW1 and let the switching switch be set to ON status, and the illuminating apparatus 4 may output illuminating brightness accordingly. Of course, if the switching switch SW1 is set to OFF status, the illuminating apparatus 4 may be turned off. Therefore, the user may let the illuminating apparatus 4 output different illuminating brightness or several levels of brightness by operating the switching switch SW1.

[0047] In addition, in other embodiments, the switching switch SW1 may be coupled between the rectifying unit 10 and the lighting unit 13. Of course, the user may also make the illuminating apparatus 4 output brightness by using the switching switch SW1. Thus, the switching switch SW1 may serve as the switch for changing the ON status and OFF status of the AC power or the input power. For explanation convenience, the switching switch SW1 in this embodiment is coupled between the AC power and the rectifying unit 10, and the arrangement, location, and operation modes of the switching switch SW1 are just an example which does not limit the scope of the present invention.

[0048] The rectifying unit 10 may be AC/DC power rectifying circuit or a full-wave rectifying circuit, for rectifying the waveform of the AC power and converting it into the input power which may be used by the lighting unit 13. The input power may be full-wave pulse direct current. It's worth noting that the rectifying unit 10 may also be a half-wave rectifying circuit and is not limited thereby.

[0049] The detecting unit 11 is used for detecting the status of the input power used by the lighting unit 13, for example, detecting the phase changes or voltage changes of the input power. Specifically, the detecting unit 11 may be a phase detecting circuit or a voltage detecting circuit, but the scope of the present invention is not restrict thereby.

[0050] Practically, the detecting unit 11 may detect the ON or OFF statuses of the switching switch SW1. For example, the detecting unit 11 may be a phase detecting circuit. When the switching switch SW1 is set to OFF status, the detecting unit 11 may detect a power with zero-phase, and when the switching switch SW1 is set to ON status, the detecting unit 11 may detect the phase of the power. For more examples, the detecting unit 11 may be a voltage detecting circuit, when the switching switch is set to OFF status, the detecting unit 11 may detect the power with zero voltage level, and when the switching switch SW1 is set to ON status, the detecting unit 11 may detect the voltage level of the power.

[0051] The lighting unit 13 may include several lighting sets 131 and a switching unit 133. The lighting set 131 may be a lamp series comprises a plurality of light emitting diodes, and may be able to receive the input power and may show the forward conducting property. The switching unit 133 may be used for changing the circuit connecting relations between the lighting sets 131. The switching unit 133 may include several switching devices and/or relative circuit devices (such as unilateral-conducting devices).

[0052] The controlling unit 15 may be a MCU chip. The controlling unit 15 controls the switching unit 133 according to the detecting result of the detecting unit 11, for connecting the circuits between each of the lighting sets 131 of the lighting unit 13, and for adjusting and conducting the lighting unit 13 according to the status of the input power (such as voltages or phases). In addition, the controlling unit 15 controls the changes of the duty cycle of the pulse width modulation signal according to a brightness adjusting signal. Specifically, the controlling unit 15 generates the brightness adjusting signal when the detecting unit 11 detects that the time of the input power stopping inputting into the lighting unit 13 by the controlling of the switching switch SW1 is kept within a predetermined time range. Thus, the brightness adjusting signal changes according to the ON-OFF operations of the switching switch SW1. For example, the brightness adjusting signal is set as the Nth signals according to the ON-OFF operations of the switching switch SW1, and the N is a positive integer. And the controlling unit 15 correspondingly generates the Nth pulse width modulation signals according to the changes of the duty cycles of the pulse width modulation signals controlled by the Nth signals.

[0053] Practically, the switching switch SW1 executes the ON-OFF operations. If the time when the switching switch SW1 is set at OFF status within the predetermined time range such as the time range between a first predetermined time and a second predetermined time, the controlling unit 15 generates the brightness adjusting signal according to the ON-OFF operation of the switching switch SW1. Then the controlling unit 15 controls the changes of the duty cycles of the pulse width modulation signals according to the brightness adjusting signal, and transmits the pulse width modulation signals to the dimming unit 19, which allows the dimming unit 19 to change the currents making the lighting unit 13 emit light along with the duty cycles of the pulse width modulation signals according to the pulse width modulation signals.

[0054] It is worth noting that the controlling of the controlling unit 15 controls the changes of the duty cycles of the pulse modulation signals is by selecting one from several different predetermined duty cycles. Specifically, the controlling unit 15 may have N numbers of different predetermined duty cycles. Of course, the controlling unit 15 may also have the pulse width modulation signals with N numbers of predetermined duty cycles. Moreover, the controlling unit 15 controls the changes of the duty cycles of the pulse width modulation signals according to the brightness adjusting signal. Therefore, the pulse width modulation signals of N numbers of different predetermined duty cycles are corresponding to N numbers of different brightness adjusting signals, and N is a positive integer.

[0055] For example, the controlling unit 15 has three pulse width modulation signals with different predetermined duty cycles, so N equals to 3. The three pulse width modulation signals with different duty cycles are corresponding to three different brightness adjusting signals. The brightness adjusting signals may be the first signals, the second signals, or the third signals. The brightness adjusting signals are one selected from the group of the first signals, the second signals, and the third signals. Thus, the changes of the duty cycles of the pulse width modulation signals are selected from one of the three different predetermined duty cycles. For example, the changes of the duty cycles of the pulse width modulation signals may be distinguished as the first pulse width modulation signals, the second pulse width modulation signals, or the third pulse width modulation signals.

[0056] Specifically, the controlling unit 15 has a counting circuit 151 and a switch circuit 153. The counting circuit 151 counts the time that the input power stops inputting into the lighting unit 13 according to the detecting result of the detecting unit 11. When the time that the input power stops inputting into the lighting unit 13 is within the predetermined time range, the counting circuit 151 may generate the brightness adjusting signals. The switch circuit 153 may be a pulse width modulation circuit, for adjusting the duty cycles of the pulse width modulation signals according to the brightness adjusting signals.

[0057] For example, if the time that the pulse voltage of the input power is at zero voltage level is located within the time range between the first predetermined time and the second predetermined time, the counting circuit 151 may increase the counting value for generating brightness adjusting signals. When the counting value of the counting circuit 151 is one, the brightness adjusting signals are the first signals. When the counting value of the counting circuit 151 is two, the brightness adjusting signals are the second signals. And when the counting value of the counting circuit 151 is N, the brightness adjusting signals are the Nth signals. In addition, the counting circuit 151 may provide the brightness adjusting signals to the switch circuit 153, and the switch circuit 153 may adjust the duty cycle of the pulse width modulation signals according to the brightness adjusting signals. For example, the switch circuit 153 may adjust the duty cycle of the pulse width modulation signals according to the third signals, and generates the third pulse width modulation signals accordingly.

[0058] In addition, the controlling unit 15 transmits the pulse width modulation signals to the dimming unit 19 through the switch circuit 153. The dimming unit 19 controls the current source 17 according to the pulse width modulation signals, which allows the current source 17 provides the current to the lighting unit 13 for light emitting. Thus, the lighting unit 13 outputs illuminating brightness according to the magnitude of the current. For example, the controlling unit 15 adjusts the duty cycles of the pulse width modulation signals according to the brightness adjusting signals. The brightness adjusting signals may be the Nth signals. The controlling unit 15 transmits the pulse width modulation signals to the dimming unit 19, and the dimming unit 19 controls the lighting unit 13 for outputting the Nth illuminating brightness according to the magnitude of the current.

[0059] It is worth noting that the controlling unit 15 may include a predetermined mode and a power saving mode, and the present embodiment makes the controlling unit 15 enter and set the power saving mode by using the ON-OFF operations of the switching switch SW1. The power saving mode controls the changes of the duty cycles of the pulse width modulation signals according to the brightness adjusting signals. Practically, the predetermined mode of the controlling unit 15 set the first signals as the brightness adjusting signals. The brightness adjusting signals are serially switched to the Nth signals, and when the number N exceeds a upper limit value, it is restored to 1.

[0060] For example, the switch circuit 153 may generate 5 kinds of pulse width modulation signals with different duty cycles, and the corresponding brightness adjusting signals may be respectively set as the first signals, the second signals, the third signals, the fourth signals, and the fifth signals. Thus, the fifth signals are the upper limit signals of the switch circuit 153, and the upper limit value is 5. When the Nth signals exceed the fifth signals, they may be restored to the predetermined first signals. Therefore, the first signals to the fifth signals may form a loop.

[0061] The brightness adjusting signals of the predetermined mode in this embodiment may set from the first signals serially switched to the Nth signals. For example, if the number N is 3, the first signals may be changed to the second signals, the second signals may be changed to the third signals, and the third signals may be changed to the first signals. It is worth noting that, in other embodiments, the brightness adjusting signals of the predetermined mode may be set as the Nth signals, or, the first signals of the power saving mode may not need to be switched serially to the Nth signals. The brightness adjusting signals of the power saving mode may be set according to the requirements of the users. The programming of the power saving mode or the predetermined mode is not limited in the present invention, and the one skilled in the art may design it freely according to the actually needs.

[0062] It is worth noting that, in other embodiments, the brightness adjusting signals is inputted by a button circuit connecting with the controlling unit 15, or is received wirelessly from a wireless transmitter to the controlling unit 15. For example, the user may use infrared remote control device, wireless radio frequency device, or Bluetooth radio frequency device for controlling the switching switch SW1, and making the switching switch SW1 execute ON-OFF operations. Alternatively, the user may provide a signal to the controlling unit 15 through the button circuit, infrared remote control device, wireless radio frequency device, or Bluetooth radio frequency device connecting with the controlling unit 15, which makes the controlling unit 15 enter and set the power saving mode. Using the switching switch SW1 for setting the power saving mode of the controlling unit 15 are only for explanation, and the scope of the present invention is not limited by FIG. 9.

[0063] The current source 17 is coupled between the lighting unit 13 and the dimming unit 19, for providing steady power when the lighting sets 131 of the lighting unit 13 are conducting. Practically, the current source 17 makes the magnitudes of the currents flowing through each of the LEDs of the lighting unit 13 equal to one another, and effectively avoids over-magnitude currents from flowing through each of the LEDs.

[0064] The dimming unit 19 is coupled between the current source 17 and the controlling unit 15, for controlling the current source 17, and for making the current source 17 provide the current to the lighting unit 13. Practically, the dimming unit 19 receives the pulse width modulation signals transmitted by the switch circuit 153, and controls the current source 17 according to the pulse width modulation signals, which makes the current source 17 correspondingly provide different conducting currents according to the pulse width modulation signals and the conducting voltage of the serial and/or parallel connections between the lighting sets 131.

[0065] For example, the dimming unit 19 may be a dimming switching switch SW1, for turning on or off the current paths between the current source 17 and the lighting unit 13 according to the pulse width modulation signals generated by the switch circuit 153 of the controlling unit 15, and for controlling the average current flowing through each of the LEDs of the lighting unit 13, in order to implement the dimming processes. Therefore, the dimming unit 19 controls the current source 17 according to the pulse width modulation signals of the switch circuit 153. The current source 17 may also provide adjustable current source according to the controlling of the dimming unit 19. Moreover, the current source 17 correspondingly provides different conducting currents according to the differences between the serial and/or parallel connected lighting sets 131 and the pulse width modulation signals.

[0066] The power conversion unit 21 is coupled between the rectifying unit 10 and the controlling unit 15, for power converting the input power and for outputting steady voltage direct current (DC) power to the controlling unit 15. For example, the 110 volts DC power is converted into 5 volts DC power by the power conversion unit 21, and is provided to the controlling unit 15.

[0067] In addition, the power conversion unit 21 may include a capacity. When the switching switch SW1 is executing ON-OFF operations, the power conversion unit 21 provides a maintaining power to the controlling unit 15, which makes the controlling unit 15 work within the predetermined time range. It is worth nothing that, in other embodiment, the power conversion unit 21 may be a battery, rechargeable battery, or other power provider.

The implementation of the power conversion unit 21 is not limited in the present invention, and the one skilled in the art may freely design it according to the actual needs.

[0068] Please refer to FIG. 10 which is a flow chart of an illuminating method according to an embodiment of the present invention. Please also refer to the illuminating apparatus 4 in FIG. 9 along with FIG. 10, and for the convenience of explanation, the switching switch SW1 may be coupled to the AC power. The procedure in FIG. 10 includes the following steps. The controlling unit 15 is initially set to the predetermined mode (as step S701), in which the brightness adjusting signals of the predetermined mode is pre-set as the first signals. Then the controlling unit 15 may determine whether to set the power saving mode or not (as step S703). If the determination result is positive, the controlling unit 15 may change the duty cycle of the pulse width modulation signals according to the brightness adjusting signals (as step S705), for example, sets the brightness adjusting signals as the Nth signals.

[0069] Practically, after the controlling unit 15 sets the power saving mode, it may enter the power saving mode. If the controlling unit 15 wants to set the power saving mode, it may change the first signals to the third signals, then the third pulse width modulation signals may be transmitted to the lighting unit 13 through the switch circuit 153, which makes the lighting unit 13 output the third level of illuminating brightness. In other embodiments, the user may use the infrared remote control device, the wireless radio frequency device, or the Bluetooth radio frequency device to control the switching switch SW1 for allowing the switching switch SW1 to execute the ON-OFF operations. Alternatively, the user may use the button circuit connecting with the controlling unit 15, infrared remote control device, wireless radio frequency device, or Bluetooth radio frequency device to provide the signals to the controlling unit 15, for allowing the controlling unit 15 to enter and set the power saving mode. Although the present embodiment uses the switching switch SW1 for setting the power saving mode of the controlling unit 15, the scope of the present invention is not limited thereby.

[0070] In addition, the controlling unit 15 may change the duty cycles of the pulse width modulation signals according to the brightness adjusting signals (as step S705). Specifically, the brightness adjusting signals may be the Nth signals. The controlling unit 15 changes the duty cycles of the pulse width modulation signals according to the Nth signals, and generates corresponding Nth pulse width modulation signals. The duty cycle is the occupied time percentage which allows the lighting unit 13 to emit light during a time unit. For example, if the brightness adjusting signals are set as the first signals, the duty cycle of the first pulse width modulation signals has relatively longer light emitting time. Or, the brightness adjusting signals are set as the Nth signals, the duty cycle of the Nth pulse width modulation signals has relatively shorter light emitting time. Thus, the lighting unit 13 may have longer light emitting time according to the duty cycle of the first pulse width modulation signals than the duty cycle of the Nth pulse width modulation signals, therefore, the first level of the illuminating brightness is lighter than the Nth level of the illuminating brightness of the lighting unit 13.

[0071] In addition, the predetermined first signals may be serially switched to the Nth signals, and if the number exceeds N, the brightness adjusting signals may be set back to the first signals. Alternatively, the brightness adjusting signals may be directly set from the first signals to the Nth signals according to the requirements of the user. Therefore, the switching method may be freely designed by the one skilled in the art.

[0072] Practically, through the steps S705, S707, and S709, the controlling unit 15 forms a loop for setting the brightness adjusting signals. Moreover, if the AC power is at ON status in the step S707, determining that the time of the AC power in the OFF status is within a predetermined time range (as S709). If the determination result is positive, the controlling unit 15 may enter the step S705 for setting the duty cycle of the pulse width modulation signals according to the brightness adjusting signals. The predetermined time range is the time range between a first predetermined time and a second predetermined time.

[0073] For example, the illuminating apparatus 4 includes a switching switch SW1. The switching switch SW1 electrically connects with the current AC power for switching the ON-OFF operations. In addition, for the convenience of explanation, the present embodiment uses the first signals which are serially switched to the Nth signals. When the switching switch SW1 executes three times of ON status and two OFF status, and when the switching switch SW1 is at the OFF status for the first time, the controlling unit 15 determines that the time of the AC power with OFF status is between the first predetermined time and the second predetermined time (as step S709). If yes, the controlling unit 15 may adjust the first signals to the second signals.

[0074] Of course, when the switching switch SW1 is at the OFF status for the second time, the controlling unit 15 may determine that the time of the AC power which is at the OFF status is between the first predetermined time and the second predetermined time (as step S709). If the determination result is positive, the controlling unit 15 then adjusts the second signals into the third signals. After that, if the AC power is at ON status in step S707, the controlling unit 15 may control the duty cycle of the pulse width modulation signals according to the brightness adjusting signals. In this case, the brightness adjusting signals are adjusted to the third signals, thus the controlling unit 15 generates the third pulse width modulation signals corresponding to the third signals. Then the controlling unit 15 may transmit the third pulse width modulation signals to the dimming unit 19. The dimming unit 19 controls the current source 17 according to the third pulse width modulation signals, for allowing the current source 17 to provide the current making the lighting unit 13 emit light. Therefore, the lighting unit 13 is adjust to output the third level of illuminating brightness.

[0075] Practically, the first predetermined time is the upper limit time of the AC power in the OFF status. For example, the user presses the switching switch SW1 for ON-OFF operations. If the time that the switching switch SW1 is set to OFF status exceeds the first predetermined time, the controlling unit 15 may determine not to set the power saving mode.

[0076] On the other hand, the second predetermined time is the lower limit time of the AC power in the OFF status. For example, the user presses the switching switch SW1 for ON-OFF operations. If the time that the switching switch is set to OFF status exceeds the second predetermined time and is smaller than the first predetermined time, the controlling unit 15 may determine to set the power saving mode. Thus, the controlling unit 15 enters and sets the power saving mode. In addition, the second predetermined time may avoid the wrong determination caused by the unsteady power supply, and the controlling unit 15 may enters the power saving mode correctly by precisely determining the time when the user presses the switching switch SW1.

[0077] The first predetermined time and the second predetermined time are the upper limit and the lower limit respectively of the OFF status of the AC power. Thus, the first predetermined time is larger than the second predetermined time, for example, the first predetermined time may be 10 seconds and the second predetermined time may be 1 second.

[0078] For example, if the time of the user closing the power of the illuminating apparatus 4 exceeds the first predetermined time, the illuminating apparatus 4 may not enter the power saving mode when the user turns it on. In addition, if the power system provides unstable power to the illuminating apparatus 4 and the time of the OFF status of the AC power does not exceed the second predetermined time, the illuminating apparatus 4 may still remain the original illuminating brightness and may not enter the power saving mode. Thus, the values and manners of setting up the first predetermined time and the second predetermined time may be freely designed by the one skilled in the art according to the actual needs.

[0079] If the user presses the switching switch SW1 and makes the time of the ON-OFF operations lie between the first predetermined time and the second predetermined time, the first signals are serially converted to the second signals, the second signals are serially converted to the third signals, the third signals are serially converted to the Nth signals, and the Nth signals are serially converted to the first signals. Thus, the conversions from the first signals to the Nth signals form a loop, and the loop may change the brightness adjusting signals according to the ON-OFF operations of the switching switch SW1, for letting the controlling unit 15 to control the duty cycles of the pulse width modulation signals according to the brightness adjusting signals.

[0080] Therefore, the controlling unit 15 may form a loop for setting the brightness adjusting signals through the steps S705, S707, and S709. The operation times of the ON-OFF operations executed by the switching switch SW1 make the controlling unit 15 enter the power saving mode for changing the brightness adjusting signals, and the different brightness adjusting signals are corresponding to the different pulse width modulation signals with different duty cycles. For example, if the brightness adjusting signals is set as the Nth signals, the controlling unit 15 may generate the Nth pulse width modulation signals according to the Nth signals. Then if the determination result in step S707 is positive, the controlling unit 15 transmits the pulse width modulation signals to the dimming unit 19, thus the dimming unit 19 may adjust the current making the lighting unit 13 emit light to change along with the duty cycles of the pulse width modulation signals. The controlling unit 15 controls the switching unit 133 according to the detecting result of the detecting unit 11, for allowing the conducting voltage of the lighting unit 13 to change along with the input power (as S711).

[0081] Practically, the controlling unit 15 controls the changes of the duty cycle of the pulse width modulation signals according to the Nth signals , and transmits the Nth pulse width modulation signals to the dimming unit 19. The dimming unit 19 controls the current source 17 according to the Nth pulse width modulation signals, for allowing the current source 17 to provide the current to the lighting unit 13. Thus, the lighting unit 13 may be adjusted and output the Nth level of illuminating brightness. The first level of illuminating brightness may be 100% brightness, the second level of illuminating brightness may be 90% brightness, and the Nth level of illuminating brightness may be N% brightness. It is worth noting that the first to Nth level of illuminating brightness indicate that every LEDs of the lighting unit 13 are wholly changing lighter or darker.

[0082] It is worth noting that, in other embodiments, the switching switch SW1 is coupled between the rectifying circuit 10 and the lighting unit 13, and in step S707, it determines that the input power is at ON status or not; and in step S709, it determines the time of the input power in OFF status lies within the predetermined time range or not. Thus, the controlling unit 15 may determine the ON or OFF statuses of the input power along with the coupling of the switching switch SW1, for making the controlling unit 15 adjust the duty cycle of the pulse width modulation signals according to the brightness adjusting signals.

[0083] In addition, in other embodiments, the user may use the infrared remote control device, wireless radio frequency device, or Bluetooth radio frequency device for controlling the switching switch SW1, in order to allow the switching switch SW1 to execute ON-OFF operations. Alternatively, the user may use the button circuit connecting with the controlling unit 15, the infrared remote control device, wireless radio frequency device, or Bluetooth radio frequency device for providing signals to the controlling unit 15. Thus, the controlling unit 15 may omit the step S709 in FIG. 10. The controlling unit 15 determines whether to set the power saving mode or not in step S703. If the determination result is positive, the step S705 may be executed for changing the duty cycle of the pulse width modulation signals.

[0084] After that, in step S707, if the AC power or the input power is at ON status, the step S711 is executed. If the AC power or the input power is not at ON status, the illuminating apparatus 4 is turned off and does not output illuminating brightness. Thus, the user may use the button circuit connecting with the controlling unit 15, the infrared remote control device, the wireless radio frequency device, or the Bluetooth radio frequency device for freely setting the brightness of the illuminating apparatus 4. The steps using the switching switch SW1 for setting the power saving mode is just an example, and the scope of the present invention is not limited thereby.

[0085] To sum up, by adjusting the connection relationship between the lighting sets of the lighting unit at different stages of the input power the turn-on voltage of the lighting unit may be adjusted and the period during which the lighting unit is turned on may extend, effectively minimizing the flash phenomenon associated with the conventional illuminating apparatus.

Claims

1. An illuminating apparatus (1), adapted to receive an input power which is a pulse DC, comprising:

a lighting unit (14), having a plurality of intercoupled LED modules, and each of the LED modules comprising:

a first lighting set (1411) having a plurality of first LEDs serially interconnected;
a second lighting set (1413) having a plurality of second LEDs serially interconnected; and
a switching circuit (1412), coupled between the first lighting set (1411) and the second lighting set (1413), for causing the first lighting set (1411) and the second lighting set (1413) to be interconnected in a serial manner or in a parallel manner, wherein the switching circuit (1412) includes:

a first switching device (S1), coupled to the first lighting set (1411);
a second switching device (S2), coupled to the second lighting set (1413); and
a unilateral-conducting device (D1), coupled between the first switching device (S1) and the second switching device (S2);
wherein when the first switching device (S1) and the second switching device (S2) are turned on, the first lighting set (1411) and the second lighting set (1413) are in parallel connection;
wherein when the first switching device (S1) and the second switching device (S2) are not turned on, the first lighting set (1411) and the second lighting set (1413) are in serial connection, and the unilateral-conducting device (D1) is turned on;

a detecting unit (11), for detecting a state of the input power inputted to the lighting unit (14); and
a controlling unit (15), coupled between the detecting unit (11) and the switching circuit (1412), for controlling the switching circuit (1412) based upon the detecting unit (11) detecting the state of the input power so as to adjust a turn-on voltage of the lighting unit (14) according to a variation in the input power, wherein the turn-on voltage of the lighting unit (14) ranges between a lowest turn-on voltage when the first lighting set (1411) and the second lighting set (1413) are connected in parallel and a highest turn-on voltage when the first lighting set (1411) and the second lighting set (1413) are connected in serial; the illuminating apparatus being **characterised in that** it further comprises:

a dimming unit (19), coupled between the lighting unit (13, 14) and the controlling unit (15), for controlling a current of the lighting unit (13, 14);
wherein the controlling unit (15) is configured to receive a time period information indicating a time period of the input power via the detecting unit (11), and is configured to set up a plurality of predetermined time values within the time period, and the controlling unit (15) is configured to control the switching circuit (1412) to operate when the time values have been reached;
wherein the controlling unit (15) has a counting circuit (151) which is configured to count the time that the input power stopped inputting into the lighting unit (14) according to the detecting result of the detecting unit (11); when the counted time that the input power stopped inputting into the lighting unit (14) is within a predetermined time range, the counting circuit (151) is configured to generate a brightness adjusting signal;
wherein the controlling unit (15) is configured to control a duty cycle of a pulse width modulation signal, and transmit the pulse width modulation signal to the dimming unit (19), for allowing the dimming unit (19) to adjust the current which makes the lighting unit (13, 14) emit light to change along with the duty cycle of the pulse width modulation signal according to the pulse width modu-

lation signal;
wherein the controlling unit (15) is configured to control changes of the duty cycle of the pulse width modulation signal according to the brightness adjusting signal, and the controlling unit (15) is configured to generate the brightness adjusting signal when the detecting unit (11) detects that a time of the input power being controlled by a switching switch and stopping inputting to the lighting unit (13, 14) is kept within the predetermined time range, and the controlling of the changes of the duty cycle of the pulse width modulation signal is operated by selecting one of a plurality of different predetermined duty cycles

2. The illuminating apparatus (1) according to claim 1, wherein the detecting unit (11) is a phase detecting circuit.

3. An illuminating method for controlling an illuminating apparatus (1) as claimed in claim 1, the illuminating apparatus (1) including a lighting unit (13, 14) having a plurality of LED lighting sets (1411, 1413) and a switching circuit (1412) for causing the LED lighting sets (1411, 1413) to be connected in a serial manner or in a parallel manner according to the voltage levels of the pulsed DC voltage, comprising:

detecting a state of an input power of the lighting unit (13, 14), wherein the input power is in a form of a pulse DC; and
controlling by a controlling unit (15) the switching circuit (1412) according to detecting the state of the input power to adjust a turn-on voltage of the lighting unit (13, 14), the method being **characterised in that**:

the controlling unit (15) receives a time period information indicating a time period of the input power via the detecting unit (11), and sets up a plurality of predetermined time values within the time period, the controlling unit (15) determines whether to trigger the determination of the predetermined time values are reached and controls the switching circuit (1412) to operate when the predetermined time values have been reached;
wherein the controlling unit (15) has a counting circuit (151) that counts the time that the input power stopped inputting into the lighting unit (14) according to the detecting result of the detecting unit (11); when the counted time that the input power stopped inputting into the lighting unit (14) is within a predetermined time range, the counting circuit (151) is configured to generate a brightness adjusting signal;
wherein the controlling unit (15) provides a pulse width modulation signal to a dimming unit (19), and controls a duty cycle of the pulse width modulation signal, for allowing the dimming unit (19) to adjust a current which makes the lighting unit (13, 14) emit light to change along with the duty cycle of the pulse width modulation signal according to the pulse width modulation signal;
wherein the controlling unit (15) controls changes of the duty cycle of the pulse width modulation signal according to the brightness adjusting signal, and the controlling unit (15) generates the brightness adjusting signal when the detecting unit (11) detects that a time of the input power being controlled by a switching switch and stopping inputting to the lighting unit (13, 14) is kept within the predetermined time range, and the controlling of the changes of the duty cycle of the pulse width modulation signal is operated by selecting one of a plurality of different predetermined duty cycles.

4. The illuminating method according to claim 3, wherein the detecting unit (11) is a phase detecting circuit.

5. The illuminating method according to claim 3, wherein when the input power waveform is at the zero phase the controlling unit (15) triggers the determination of whether the predetermined time values are reached.

Patentansprüche

1. Eine Beleuchtungsvorrichtung (1), die zum Empfangen einer Eingangsleistung angepasst ist, die ein gepulster Gleichstrom ist, umfassend:

eine Leuchteinheit (14), die eine Mehrzahl von miteinander gekoppelten LED-Modulen umfasst, und wobei jedes der LED-Module umfasst:

einen ersten Leuchtsatz (1411), der eine Mehrzahl von ersten LEDs umfasst, die miteinander in Reihe geschaltet sind,
einen zweiten Leuchtsatz (1413), der eine Mehrzahl von zweiten LEDs umfasst, die miteinander in Reihe geschaltet sind, und
einen Schaltkreis (1412), der zwischen dem ersten Leuchtsatz (1411) und dem zweiten Leuchtsatz (1413) gekoppelt ist, zum Bewirken dessen, dass der erste Leuchtsatz (1411) und der zweite Leuchtsatz (1412) in Reihe oder parallel miteinander verbunden

werden, wobei der Schaltkreis (1412) umfasst:

eine erste Schaltvorrichtung (S1), die mit dem ersten Leuchtsatz (1411) gekoppelt ist,
eine zweite Schaltvorrichtung (S2), die mit dem zweiten Leuchtsatz (1413) gekoppelt ist, und
eine einseitig leitende Vorrichtung (D1), die zwischen der ersten Schaltvorrichtung (S1) und der zweiten Schaltvorrichtung (S2) gekoppelt ist,
wobei, wenn die erste Schaltvorrichtung (S1) und die zweite Schaltvorrichtung (S2) eingeschaltet sind, der erste Leuchtsatz (1411) und der zweite Leuchtsatz (1413) parallel geschaltet sind,
wobei, wenn die erste Schaltvorrichtung (S1) und die zweite Schaltvorrichtung (S2) nicht eingeschaltet sind, der erste Leuchtsatz (1411) und der zweite Leuchtsatz (1413) in Reihe geschaltet sind und die einseitig leitende Vorrichtung (D1) eingeschaltet ist,
eine Detektionseinheit (11) zum Detektieren eines Zustands der in die Leuchteinheit (14) eingegebenen Eingangsleistung und
eine Steuereinheit (15), die zwischen der Detektionseinheit (11) und dem Schaltkreis (1412) gekoppelt ist, zum Steuern des Schaltkreises (1412) basierend auf dem Detektieren des Zustands der Eingangsleistung durch die Detektionseinheit (11), um eine Einschaltspannung der Leuchteinheit (14) gemäß einer Variation der Eingangsleistung anzupassen, wobei die Einschaltspannung der Leuchteinheit (14) zwischen einer niedrigsten Einschaltspannung, wenn der erste Leuchtsatz (1411) und der zweite Leuchtsatz (1413) parallel geschaltet sind, und einer höchsten Einschaltspannung liegt, wenn der erste Leuchtsatz (1411) und der zweite Leuchtsatz (1413) in Reihe geschaltet sind, wobei die Beleuchtungsvorrichtung **dadurch gekennzeichnet ist, dass** sie ferner umfasst:

eine Dimm-Einheit (19), die zwischen der Leuchteinheit (13, 14) und der Steuereinheit (15) gekoppelt ist, zum Steuern eines Stromes der Leuchteinheit (13, 14),
wobei die Steuereinheit (15) konfiguriert ist, um über die Detektionseinheit (11) eine Zeitdauerinformation zu empfangen, die eine Zeitdauer der Eingangsleistung angibt, und konfiguriert ist, um eine Mehrzahl von vorbestimmten Zeitwerten innerhalb der Zeitdauer einzurichten, und die Steuereinheit (15) konfiguriert ist, um den Schaltkreis (1412) zu steuern, um zu funktionieren, wenn die Zeitwerte erreicht worden sind,
wobei die Steuereinheit (15) eine Zählschaltung (151) umfasst, die konfiguriert ist, um gemäß dem Detektionsergebnis der Detektionseinheit (11) die Zeit zu zählen, während der das Eingeben der Eingangsleistung in die Leuchteinheit (14) angehalten wurde, wobei, wenn die gezählte Zeit, während der das Eingeben der Eingangsleistung in die Leuchteinheit (14) angehalten wurde, innerhalb einer vorbestimmten Zeitspanne liegt, die Zählschaltung (151) konfiguriert ist, um ein Helligkeitsanpassungssignal zu erzeugen,
wobei die Steuereinheit (15) konfiguriert ist, um einen Arbeitszyklus eines Pulsbreitenmodulationssignals zu steuern und das Pulsbreitenmodulationssignal an die Dimm-Einheit (19) zu übertragen, zum Ermöglichen dessen, dass die Dimm-Einheit (19) den Strom, der bewirkt, dass die Leuchteinheit (13, 14) Licht emittiert, anpasst, um sich zusammen mit dem Arbeitszyklus des Pulsbreitenmodulationssignals gemäß dem Pulsbreitenmodulationssignal zu ändern,
wobei die Steuereinheit (15) konfiguriert ist, um Änderungen des Arbeitszyklus des Pulsbreitenmodulationssignals gemäß dem Helligkeitsanpassungssignal zu steuern, und die Steuereinheit (15) konfiguriert ist, um das Helligkeitsanpassungssignal zu erzeugen, wenn die Detektionseinheit (11) detektiert, dass eine Zeit, während der die Eingangsleistung durch einen Schaltungsschalter gesteuert wird und das Eingeben in die Leuchteinheit (13, 14) angehalten wird, innerhalb des vorbestimmten Zeitbereichs gehalten wird, und das Steuern der Änderungen des Arbeitszyklus des Pulsbreitenmodulationssignals durchgeführt wird durch Auswählen von einem von einer Mehrzahl von verschiedenen vorbestimmten Arbeitszyklen.

2. Die Beleuchtungsvorrichtung (1) nach Anspruch 1, wobei die Detektionseinheit (11) eine Phasendetektionseinheit ist.

3. Ein Beleuchtungsverfahren zum Steuern einer Beleuchtungsvorrichtung (1) nach Anspruch 1, wobei die Beleuchtungsvorrichtung umfasst eine Leuchteinheit (13, 14), umfassend eine Mehrzahl von LED-Leuchtsätzen (1411, 1413) und einen Schaltkreis (1412) zum Bewirken dessen, dass die LED-Leuchtsätze (1411, 1413) in Reihe oder parallel geschaltet werden, gemäß den Spannungspegeln der gepulsten Gleichspannung, umfassend:

Detektieren eines Zustands einer Eingangsleistung der Leuchteinheit (13, 14), wobei die Ein-

gangsleistung in einer Form eines gepulsten Gleichstroms ist, und
Steuern des Schaltkreises (1412) mittels einer Steuereinheit (15) gemäß dem Detektieren des Zustandes der Eingangsleistung, um eine Einschaltspannung der Leuchteinheit (13, 14) anzupassen,
wobei das Verfahren **dadurch gekennzeichnet ist, dass**:

die Steuereinheit (15) über die Detektionseinheit (11) eine Zeitdauerinformation empfängt, die eine Zeitdauer der Eingangsleistung angibt, und eine Mehrzahl von vorbestimmten Zeitwerten innerhalb der Zeitdauer einrichtet, die Steuereinheit (15) ermittelt, ob das Ermitteln dessen, ob die vorbestimmten Zeitwerte erreicht sind, auszulösen ist, und den Schaltkreis (1412) steuert, um zu funktionieren, wenn die vorbestimmten Zeitwerte erreicht worden sind;
wobei die Steuereinheit (15) eine Zählschaltung (151) umfasst, die gemäß dem Detektionsergebnis der Detektionseinheit (11) die Zeit zählt, für die das Eingaben der Eingangsleistung in die Leuchteinheit (14) angehalten wurde, wobei, wenn die gezählte Zeit, für die das Eingeben der Eingangsleistung in die Leuchteinheit (14) angehalten wurde, innerhalb einer vorbestimmten Zeitspanne liegt, die Zählschaltung (151) konfiguriert ist, um ein Helligkeitsanpassungssignal zu erzeugen,
wobei die Steuereinheit (15) ein Pulsbreitenmodulationssignal an eine Dimm-Einheit (19) bereitstellt und einen Arbeitszyklus des Pulsbreitenmodulationssignals steuert, zum Ermöglichen dessen, dass die Dimm-Einheit (19) einen Strom, der bewirkt, dass die Leuchteinheit (13, 14) Licht emittiert, zum Ändern zusammen mit dem Arbeitszyklus des Pulsbreitenmodulationssignals gemäß dem Pulsbreitenmodulationssignal anpasst,
wobei die Steuereinheit (15) Änderungen des Arbeitszyklus des Pulsbreitenmodulationssignals gemäß dem Helligkeitsanpassungssignal steuert, und die Steuereinheit (15) das Helligkeitsanpassungssignal erzeugt, wenn die Detektionseinheit (11) detektiert, dass eine Zeit, während der die Eingangsleistung durch einen Schaltungsschalter gesteuert wird und das Eingeben in die Leuchteinheit (13, 14) angehalten wurde, innerhalb der vorbestimmten Zeitspanne gehalten wird, und das Steuern der Änderungen des Arbeitszyklus des Pulsbreitenmodulationssignals durch Auswählen von einem aus einer Mehrzahl von verschiedenen vorbestimmten Arbeitszyklen erfolgt.

4. Das Beleuchtungsverfahren nach Anspruch 3, wobei die Detektionseinheit (11) eine Phasendetektionseinheit ist.

5. Das Beleuchtungsverfahren nach Anspruch 3, wobei, wenn die Eingangsleistungswellenform in der Null-Phase ist, die Steuereinheit (15) das Ermitteln dessen auslöst, ob die vorbestimmten Zeitwerte erreicht sind.

Revendications

1. Appareil d'éclairage (1), adapté pour recevoir une puissance d'entrée qui est un courant continu (DC) impulsionnel, comprenant :
une unité d'éclairage (14), présentant une pluralité de modules à LED couplés entre eux, et chacun des modules à LED comprenant :

un premier ensemble d'éclairage (1411) présentant une pluralité de premières LED interconnectées en série ;
un second ensemble d'éclairage (1413) présentant une pluralité de secondes LED interconnectées en série ; et
un circuit de commutation (1412), couplé entre le premier ensemble d'éclairage (1411) et le second ensemble d'éclairage (1413), destiné à provoquer l'interconnexion du premier ensemble d'éclairage (1411) et du second ensemble d'éclairage (1413), d'une façon en série ou d'une façon en parallèle, où le circuit de commutation (1412) comprend :

un premier dispositif de commutation (S1), couplé au premier ensemble d'éclairage (1411) ;
un second dispositif de commutation (S2), couplé au second ensemble d'éclairage (1413) ; et
un dispositif à conduction unidirectionnelle (D1), couplé entre le premier dispositif de commutation (S1) et le second dispositif de commutation (S2) ;
où, lorsque le premier dispositif de commutation (S1) et le second dispositif de commutation (S2) sont mis en service, le premier ensemble d'éclairage (1411) et le second ensemble d'éclairage (1413) sont connectés en parallèle ;
où, lorsque le premier dispositif de commutation (S1) et le second dispositif de commutation (S2) ne sont pas mis en service,

le premier ensemble d'éclairage (1411) et le second ensemble d'éclairage (1413) sont connectés en série, et le dispositif à conduction unidirectionnelle (D1) est mis en service ;
une unité de détection (11), destinée à détecter l'état de la puissance d'entrée entrée dans l'unité d'éclairage (14) ; et
une unité de commande (15), couplée entre l'unité de détection (11) et le circuit de commutation (1412), destinée à commander le circuit de commutation (1412) sur la base du fait que l'unité de détection (11) détecte l'état de la puissance d'entrée afin de régler la tension de mise en service de l'unité d'éclairage (14) selon une variation de la puissance d'entrée, où la tension de mise en service de l'unité d'éclairage (14) s'étend entre la tension de mise en service la plus basse lorsque le premier ensemble d'éclairages (1411) et le second ensemble d'éclairage (1413) sont connectés en parallèle, et la tension de mise en service la plus élevée lorsque le premier ensemble d'éclairages (1411) et le second ensemble d'éclairage (1413) sont connectés en série ;
l'appareil d'éclairage étant **caractérisé en ce qu'**il comprend en outre :

une unité de gradation (19), couplée entre l'unité d'éclairage (13, 14) et l'unité de commande (15), destinée à commander le courant de l'unité d'éclairage (13, 14) ;
où l'unité de commande (15) est configurée pour recevoir une information de période de temps indiquant une période de temps de la puissance d'entrée par l'intermédiaire de l'unité de détection (11), et est configurée pour fixer une pluralité de valeurs temps prédéterminées au cours de la période de temps, et l'unité de commande (15) est configurée pour commander le circuit de commutation (1412) afin de fonctionner lorsque les valeurs temps ont été atteintes ;
où l'unité de commande (15) présente un circuit de comptage (151) qui est configuré pour compter le temps pendant lequel la puissance d'entrée a cessé d'entrer dans l'unité d'éclairage (14) selon le résultat de la détection de l'unité de détection (11) ; lorsque le temps compté pendant lequel la puissance d'entrée a cessé d'entrer dans l'unité d'éclairage (14) se situe dans une plage de temps prédéterminée, le circuit de comptage (151) est configuré pour générer un signal de réglage de la luminosité ;
où l'unité de commande (15) est configurée pour commander le rapport cyclique d'un signal de modulation de largeur d'impulsion, et pour transmettre le signal de modulation de largeur d'impulsion à l'unité de gradation (19), pour permettre à l'unité de gradation (19) de régler le courant qui fait que l'unité d'éclairage (13, 14) modifie l'émission de lumière avec le rapport cyclique du signal de modulation de largeur d'impulsion selon le signal de modulation de largeur d'impulsion ;
où l'unité de commande (15) est configurée pour commander les modifications du rapport cyclique du signal de modulation de largeur d'impulsion selon le signal de réglage de la luminosité, et l'unité de commande (15) est configurée pour générer le signal de réglage de la luminosité lorsque l'unité de détection (11) détecte que la durée de la puissance d'entrée que commande un commutateur de commutation et arrêtant l'entrée dans l'unité d'éclairage (13, 14), est maintenu dans la plage de temps prédéterminée, et la commande des modifications du rapport cyclique du signal de modulation de largeur d'impulsion, est actionnée en sélectionnant l'un d'une pluralité de rapport cyclique prédéterminés différents.

2. Appareil d'éclairage (1) selon la revendication 1, où l'unité de détection (11) est un circuit de détection de phase.

3. Procédé d'éclairage destiné à commander un appareil d'éclairage (1) selon la revendication 1, l'appareil d'éclairage (1) comprenant une unité d'éclairage (13, 14) présentant une pluralité d'ensembles d'éclairage à LED (1411, 1413), et un circuit de commutation (1412) destiné à provoquer la connexion des ensembles d'éclairage à LED (1411, 1413), d'une façon en série ou d'une façon en parallèle selon les niveaux de tension de la tension DC impulsionnelle, comprenant les étapes suivantes :

détecter l'état d'une puissance d'entrée de l'unité d'éclairage (13, 14), où la puissance d'entrée se présente sous la forme d'un courant continu (DC) impulsionnel ; et
commander avec une unité de commande (15), la circuit de commutation (1412) selon la détection de l'état de la puissance d'entrée afin de

régler la tension de mise en service de l'unité d'éclairage (13, 14),
le procédé étant **caractérisé en ce que** :

l'unité de commande (15) reçoit une information de période de temps indiquant une période de temps de la puissance d'entrée par l'intermédiaire de l'unité de détection (11), et fixe une pluralité de valeurs de temps prédéterminées au cours de la période de temps, l'unité de commande (15) détermine s'il convient de déclencher la détermination selon laquelle les valeurs de temps prédéterminées sont atteintes, et commande le circuit de commutation (1412) afin qu'il fonctionne lorsque les valeurs de temps prédéterminées ont été atteintes ;
où l'unité de commande (15) présente un circuit de comptage (151) qui compte le temps pendant lequel la puissance d'entrée a cessé d'entrer dans l'unité d'éclairage (14) selon le résultat de la détection de l'unité de détection (11); lorsque le temps compté pendant lequel la puissance d'entrée a cessé d'entrer dans l'unité d'éclairage (14) se situe dans une plage de temps prédéterminée, le circuit de comptage (151) est configuré pour générer un signal de réglage de la luminosité ;
où l'unité de commande (15) fournit un signal de modulation de largeur d'impulsion à une unité de gradation (19), et commande le rapport cyclique du signal de modulation de largeur d'impulsion, pour permettre à l'unité de gradation (19) de régler le courant qui fait que l'unité d'éclairage (13, 14) modifie l'émission de lumière avec le rapport cyclique du signal de modulation de largeur d'impulsion selon le signal de modulation de largeur d'impulsion ;
où l'unité de commande (15) commande les modifications du rapport cyclique du signal de modulation de largeur d'impulsion selon le signal de réglage de la luminosité, et l'unité de commande (15) génère le signal de réglage de la luminosité lorsque l'unité de détection (11) détecte que la durée de la puissance d'entrée que commande un commutateur de commutation et arrêtant l'entrée dans l'unité d'éclairage (13, 14), est maintenu dans la plage de temps prédéterminée, et la commande des modifications du rapport cyclique du signal de modulation de largeur d'impulsion, est actionnée en sélectionnant l'un d'une pluralité de rapport cyclique prédéterminés différents.

4. Procédé d'éclairage selon la revendication 3, où l'unité de détection (11) est un circuit de détection de phase.

5. Procédé d'éclairage selon la revendication 3, où, lorsque la forme d'onde de la puissance d'entrée est à la phase zéro, l'unité de commande (15) déclenche la détermination permettant de savoir si les valeurs de temps prédéterminées sont atteintes.

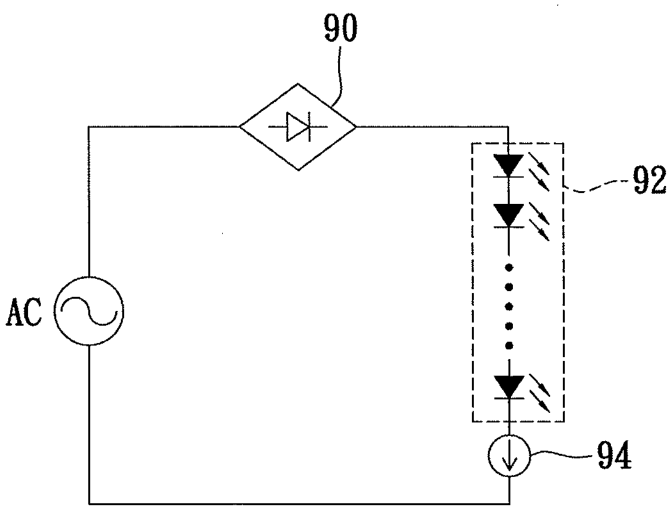

FIG. 1
PRIOR ART

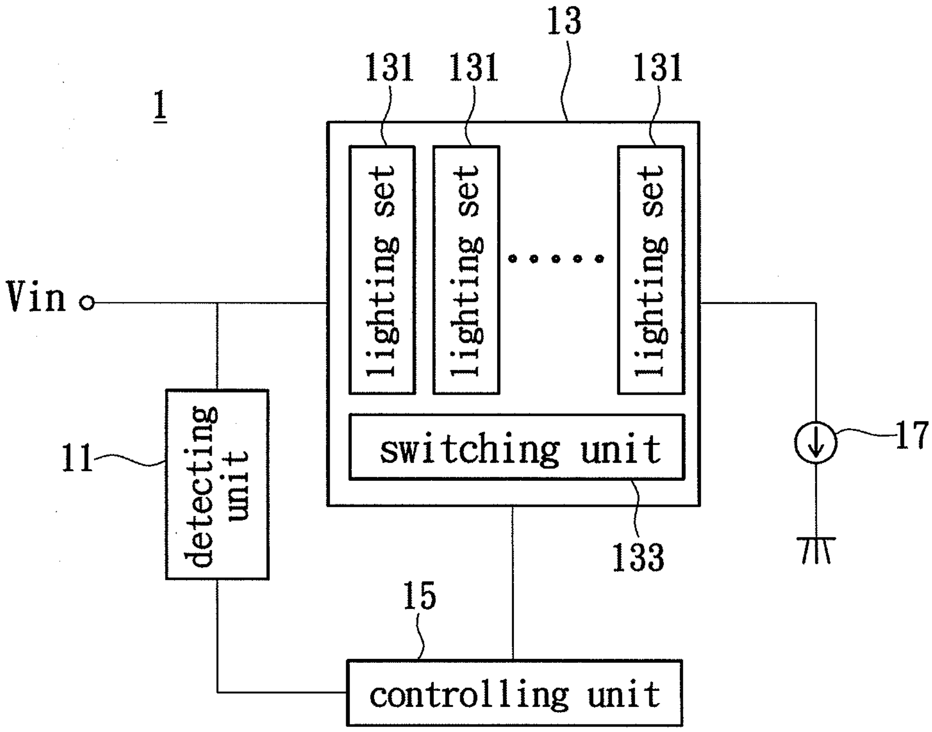
1
13
131
131
131
lighting set
lighting set
lighting set
Vin
switching unit
17
11
detecting unit
133
15
controlling unit

FIG. 2

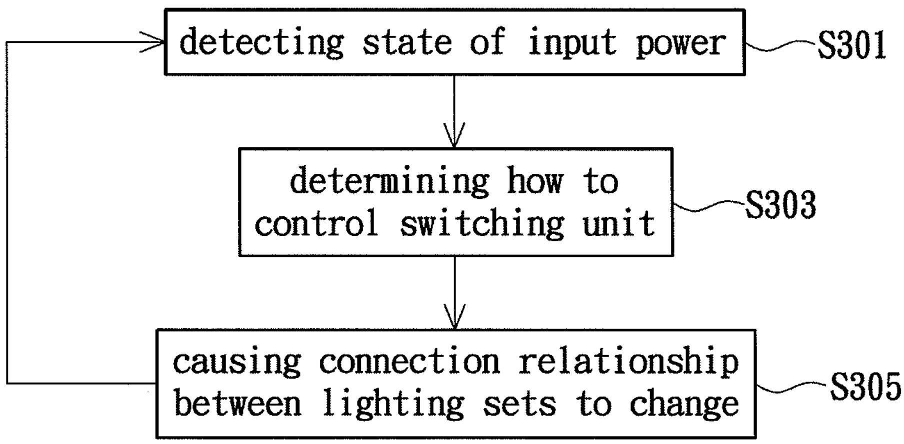
detecting state of input power
S301
determining how to control switching unit
S303
causing connection relationship between lighting sets to change
S305

FIG. 3

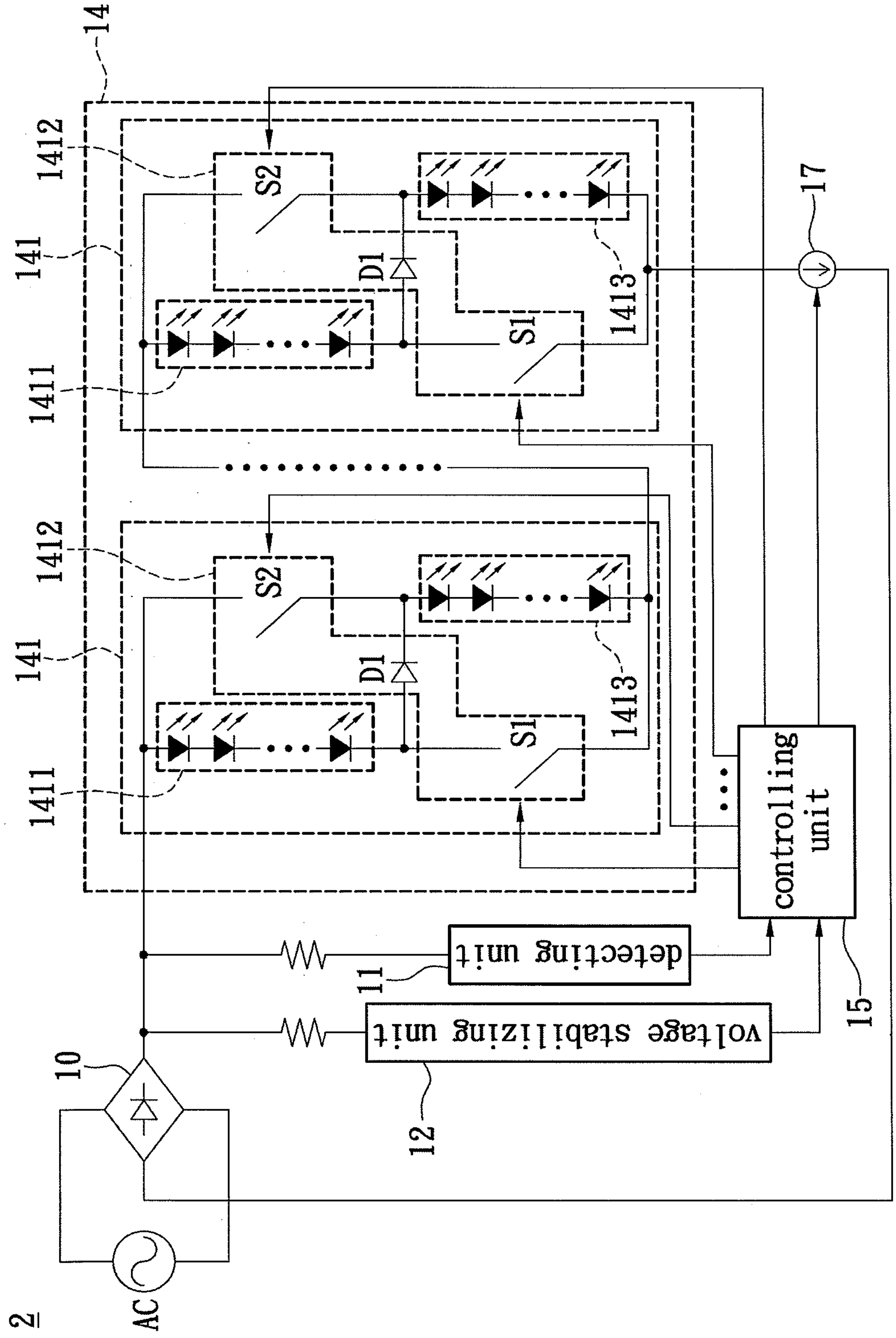
2
AC
10
11
12
14
141
1411
1412
1413
15
17
S1
S2
D1
detecting unit
voltage stabilizing unit
controlling unit

FIG. 4

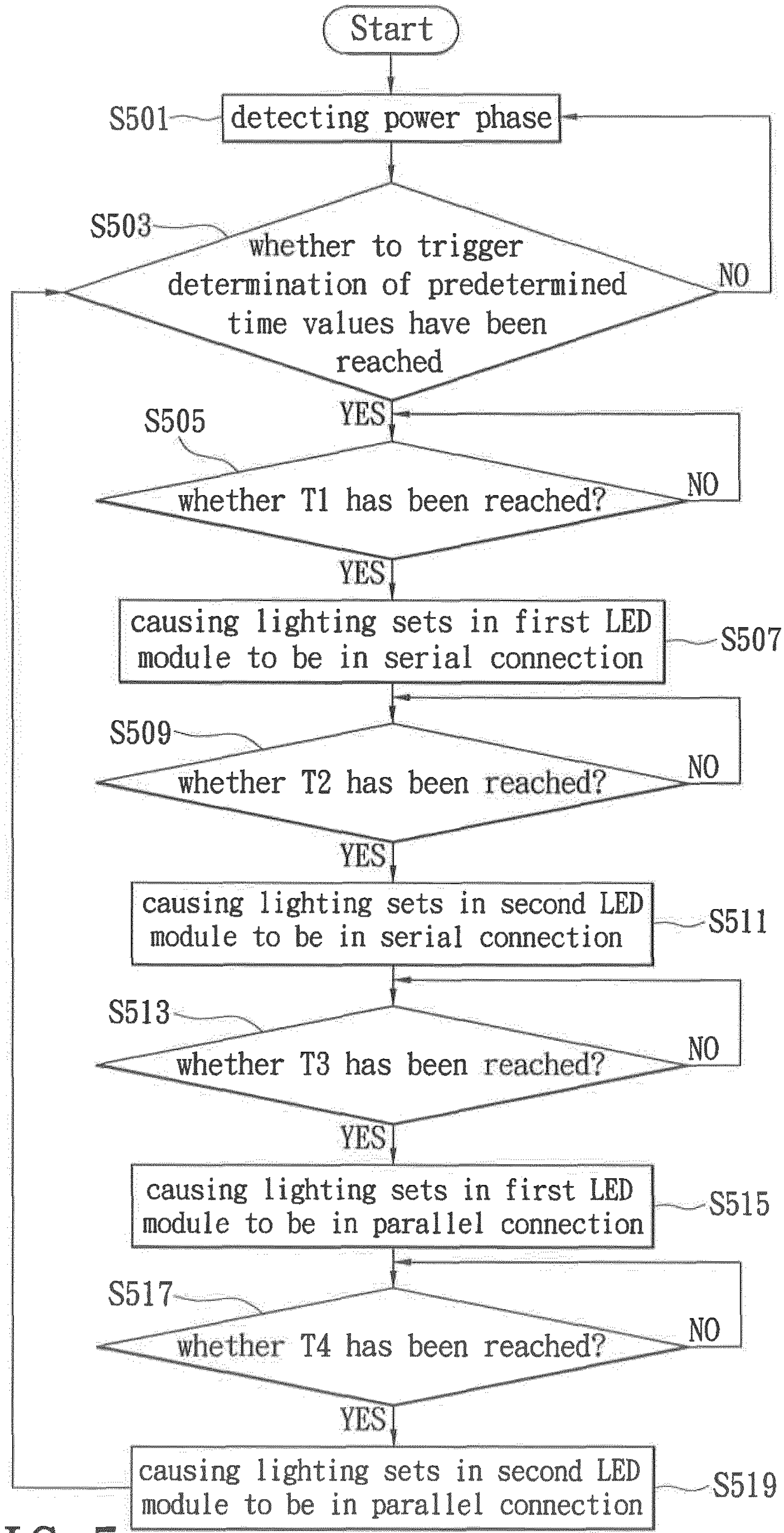
Start
S501
detecting power phase
S503
whether to trigger determination of predetermined time values have been reached
NO
YES
S505
whether T1 has been reached?
NO
YES
causing lighting sets in first LED module to be in serial connection
S507
S509
whether T2 has been reached?
NO
YES
causing lighting sets in second LED module to be in serial connection
S511
S513
whether T3 has been reached?
NO
YES
causing lighting sets in first LED module to be in parallel connection
S515
S517
whether T4 has been reached?
NO
YES
causing lighting sets in second LED module to be in parallel connection
S519

FIG. 5

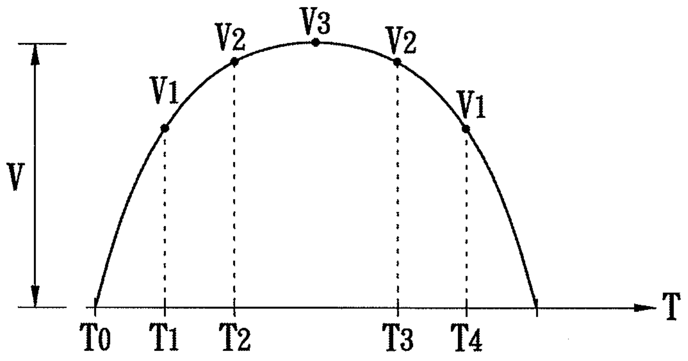

FIG. 6

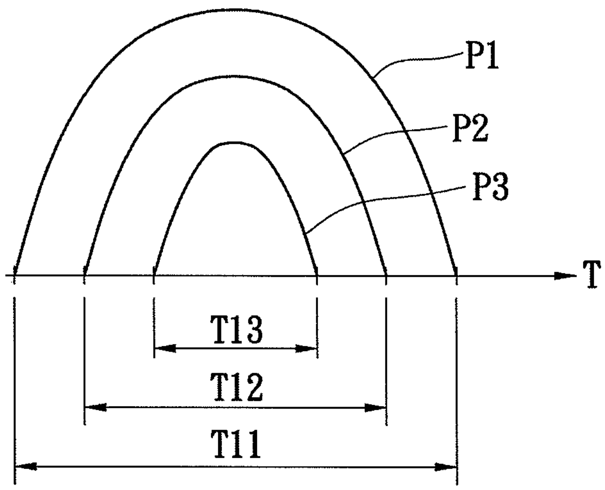

FIG. 7

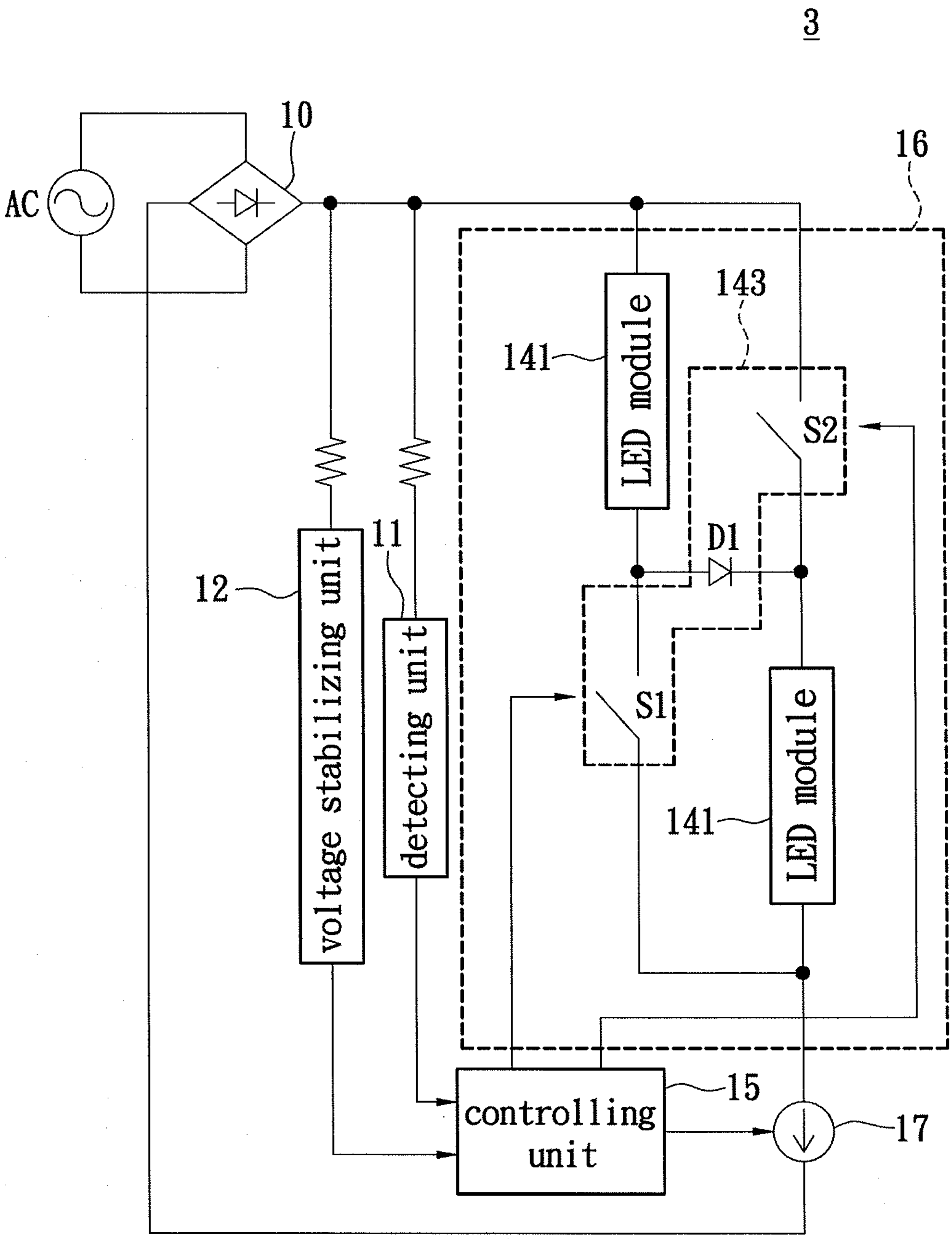
3
AC
10
16
143
141
LED module
S2
D1
11
12
voltage stabilizing unit
detecting unit
S1
141
LED module
controlling unit
15
17

FIG. 8

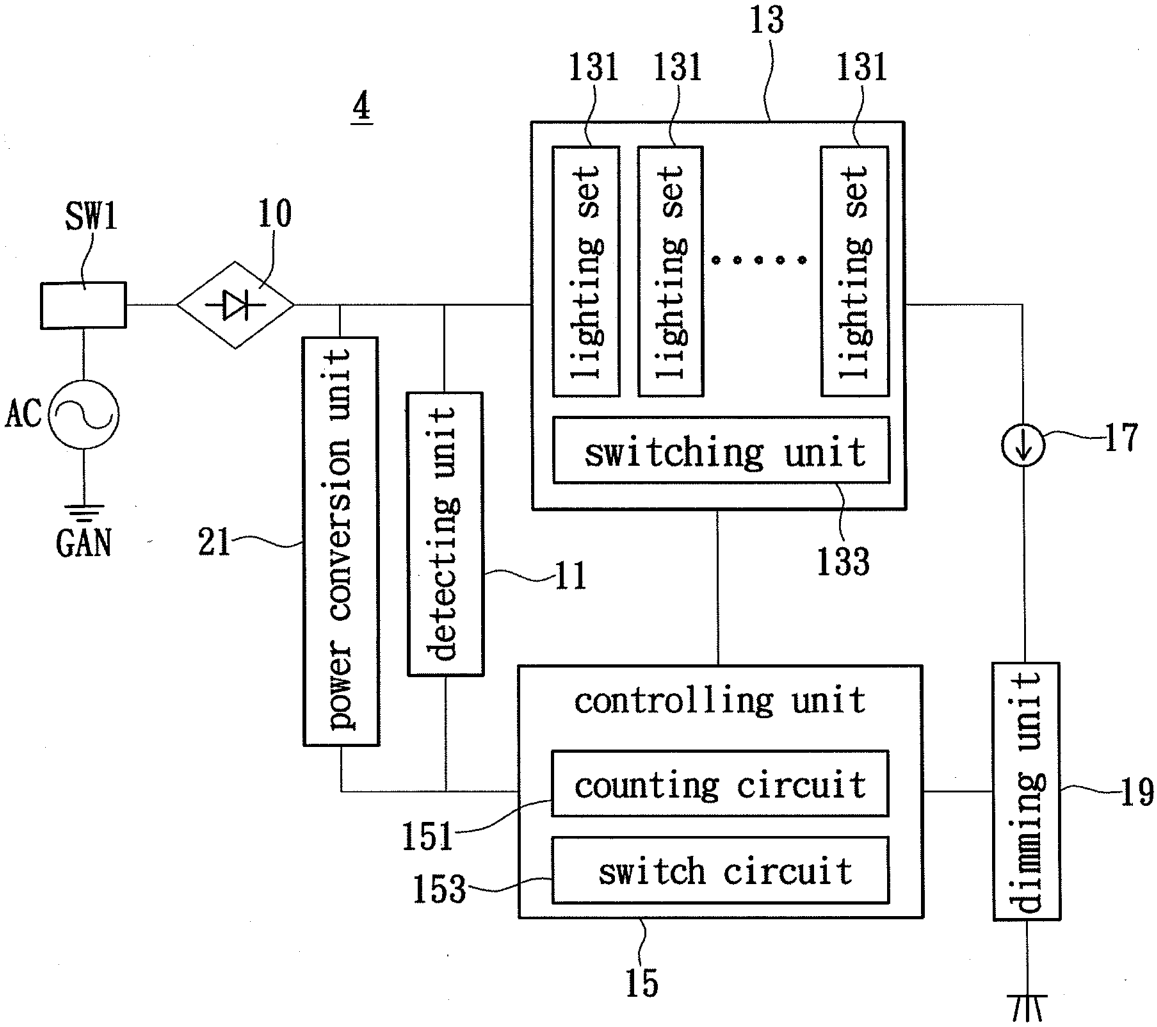
4
SW1
10
AC
GAN
13
131
131
131
lighting set
lighting set
lighting set
switching unit
133
17
21
power conversion unit
detecting unit
11
controlling unit
counting circuit
switch circuit
151
153
15
dimming unit
19

FIG. 9

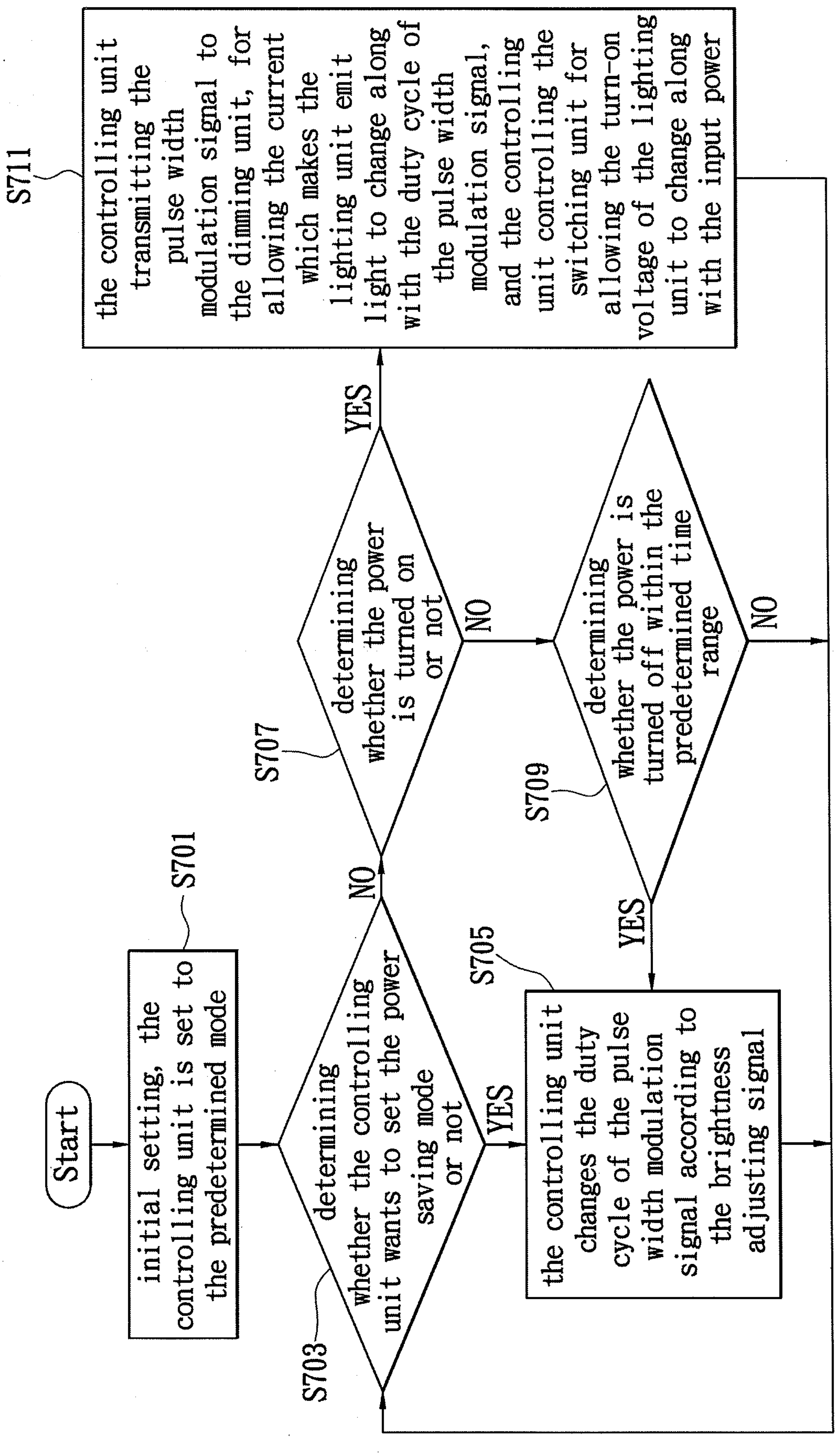
Start
S701
initial setting, the controlling unit is set to the predetermined mode
S703
determining whether the controlling unit wants to set the power saving mode or not
YES
NO
S705
the controlling unit changes the duty cycle of the pulse width modulation signal according to the brightness adjusting signal
S707
determining whether the power is turned on or not
YES
NO
S709
determining whether the power is turned off within the predetermined time range
YES
NO
S711
the controlling unit transmitting the pulse width modulation signal to the dimming unit, for allowing the current which makes the lighting unit emit light to change along with the duty cycle of the pulse width modulation signal, and the controlling unit controlling the switching unit for allowing the turn-on voltage of the lighting unit to change along with the input power

FIG. 10

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2288234 A1 **[0002]**