



(11)

EP 3 086 377 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

14.08.2019 Bulletin 2019/33

(51) Int Cl.:

H05B 33/08 (2006.01)

(86) International application number:

PCT/JP2013/083706

(21) Application number: **13899599.8**

(22) Date of filing: **17.12.2013**

(87) International publication number:

WO 2015/092864 (25.06.2015 Gazette 2015/25)

(54) LED DRIVER CIRCUIT AND METHOD OF CONTROLLING LED DRIVER CIRCUIT

LED-TREIBERSCHALTUNG UND VERFAHREN ZUR STEUERUNG DER
LED-TREIBERSCHALTUNG

CIRCUIT DE PILOTAGE DE LED ET MÉTHODE DE COMMANDE DE CIRCUIT DE PILOTAGE DE LED

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

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(43) Date of publication of application:

26.10.2016 Bulletin 2016/43

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Description

[Technical Field]

[0001] The present invention relates to an LED driver circuit and a method of controlling the LED driver circuit.

[Background Art]

[0002] A conventional LED driver circuit that drives an LED circuit has a plurality of LED elements connected in series with each other (see Japanese Patent Laid-Open No. 2008-218457, for example). DE 10 2011 003 519 A1 describes a method and circuit for regulating a current flow through a series connection of electrical lighting elements. One or more values of a forward voltage is received via an interface to a tapping point of the forward voltage. One or more reference values are determined for one or more current controllers to control the current flow through the series connection based on the value of the forward voltage.

[0003] For example, a conventional LED driver circuit 100a includes a first constant-current power supply (a voltage boosting circuit or a voltage lowering circuit, for example) 1a that supplies a constant current for turning on an LED element to a first LED circuit "LC1a" via a high-side terminal "T1a", a second constant-current power supply (a voltage boosting circuit or a voltage lowering circuit, for example) "1b" that supplies a constant current for turning on an LED element to a second LED circuit "LC2a" via a low-side terminal "T1b", a controlling part "Xa" that controls the first and second constant-current power supplies "1a" and "1b", and a power supply "Sa" that supplies an electric power to the first and second constant-current power supplies "1a" and "1b" and the controlling part "Xa" (see Figure 2).

[0004] A positive electrode of a battery "Ba" is connected to the power supply "Sa" via a main switch "MSWa" and a battery terminal "TBa". A negative electrode of the battery "Ba" is connected to the controlling part "Xa" via a ground terminal "TGa".

[0005] The positive electrode of the battery "Ba" is connected to one end of a load "LOa" via a relay "REa", and the negative electrode of the battery "Ba" is connected to another end of the load "LOa".

[0006] A first LED switch "LS1a" capable of being turned on and off by a user is connected in series with the first LED circuit "LC1a" between the high-side terminal "T1a" (an output of the first constant-current power supply "1a") and the ground terminal "TGa".

[0007] Similarly, a second LED switch "LS2a" capable of being turned on and off by a user is connected in series with the second LED circuit "LC2a" between the low-side terminal "T1b" (an output of the second constant-current power supply "1b") and the ground terminal "TGa".

[0008] The first LED circuit "LC1a", the second LED circuit "LC2a", the first LED switch "LS1a" and the second LED switch "LS2a" form a head lamp unit 101a.

[0009] A switch detecting part "Da" detects states (on or off) of the first and second LED switches "LS1a" and "LS2a" switched by the user and outputs the detection result to the controlling part "Xa" via switching information terminals "TD1" and "TD2".

[0010] In the conventional LED driver circuit 100a, the controlling part "Xa" performs a control to make the first and second constant-current power supplies "1a" and "1b" supply a constant current to the LED elements, based on the detection result (an external signal) from the switch detecting part "Da" that is indicative of the states (on/off) of the first and second LED switches "LS1a" and "LS2a" switched by the user.

[0011] The controlling part "Xa" controls current supply as described above, thereby performing switching between a high beam and a low beam of the head lamp unit 101a (that is, a control to turn on and off the first and second LED circuits "LC1a" and "LC2a").

[0012] Furthermore, a conventional overheat protection circuit protects a transistor that controls an output of a constant-current power supply from overheating (see Japanese Patent Laid-Open No. 2010-277226, for example).

[Summary of the Invention]

[Problems to be resolved by the Invention]

[0013] As described above, the conventional LED driver circuit requires the first and second constant-current power supplies, such as a voltage boosting circuit or a voltage lowering circuit. In addition, the conventional LED driver circuit 100a requires the switch detecting part "Da" and requires information (an external signal) on switching (on/off) of the first and second LED switches "LS1a" and "LS2a" connected in series with the first and second LED circuits "LC1a" and "LC2a", respectively. In short, the conventional LED driver circuit 100a requires a terminal and wiring for the external signal.

[0014] As can be seen from the above description, the conventional LED driver circuit 100a has a problem that the circuit footprint is large, and the manufacturing cost is high.

[0015] Furthermore, the overheat protection circuit described above is not designed to protect the transistor in accordance with the voltage of the LED elements.

[Means of solving the problem]

[0016] An LED driver circuit according to the present invention is an LED driver circuit that drives a first LED circuit and a second LED circuit, the first LED circuit having one LED element or a plurality of LED elements connected in series with each other and being connected to a positive electrode of a battery at an anode side thereof, and the second LED circuit having one LED element or a plurality of LED elements connected in series with each other and being connected to the positive electrode of

the battery at an anode side thereof, the LED driver circuit comprising: a first LED terminal to which a cathode side of the first LED circuit is connected; a second LED terminal to which a cathode side of the second LED circuit is connected; a ground terminal connected to a negative electrode of the battery; a first switch element connected between the first LED terminal and the ground terminal; a second switch element connected between the second LED terminal and the ground terminal; a first voltage detecting circuit that detects a first terminal voltage at the first LED terminal; a second voltage detecting circuit that detects a second terminal voltage at the second LED terminal; and a controlling part that controls the first switch element and the second switch element in accordance with the first terminal voltage and the second terminal voltage, wherein a first LED switch capable of being turned on and off by a user is connected in series with the first LED circuit between the positive electrode of the battery and the first LED terminal, and the controlling part controls the first switch element with a first on-duty ratio if the first terminal voltage is lower than a preset first upper limit value, controls the first switch element with a second on-duty ratio smaller than the first on-duty ratio if the first terminal voltage reaches the first upper limit value, controls the second switch element with a third on-duty ratio if the second terminal voltage is lower than a preset second upper limit value, and controls the second switch element with a fourth on-duty ratio smaller than the third on-duty ratio if the second terminal voltage reaches the second upper limit value, wherein the LED driver circuit further comprises:

a battery voltage detecting circuit that detects a battery voltage of the battery, wherein the controlling part lowers the on-duty ratio of the first switch element if a first potential difference between the battery voltage and the first terminal voltage is equal to or lower than a first predefined value, and lowers the on-duty ratio of the second switch element if a second potential difference between the battery voltage and the second terminal voltage is equal to or lower than a second predefined value.

[0017] In the LED driver circuit, the controlling part turns off the first switch element if the first potential difference is equal to or lower than a third predefined value lower than the first predefined value, and turns off the second switch element if the second potential difference is equal to or lower than a fourth predefined value lower than the second predefined value.

[0018] In the LED driver circuit, the controlling part determines that a breakage has occurred in an LED element of the first LED circuit if the first terminal voltage is equal to or lower than a preset first determination value, and determines that a breakage has occurred in an LED element of the second LED circuit if the second terminal voltage is equal to or lower than a preset second deter-

mination value.

[0019] In the LED driver circuit, the first determination value and the second determination value are the ground voltage.

[0020] In the LED driver circuit, the first on-duty ratio and the third on-duty ratio are an on-duty ratio of 100%.

[0021] In the LED driver circuit, a second LED switch capable of being turned on and off by a user is connected in series with the second LED circuit between the positive electrode of the battery and the second LED terminal.

[0022] In the LED driver circuit, a first end of a relay is connected to the positive electrode of the battery, and a second end of the relay is connected to the anode side of the first LED circuit and the anode side of the second LED circuit, a load is connected between the second end of the relay and the negative electrode of the battery, the first LED circuit and the second LED circuit are LEDs of a headlamp of a motorcycle, and the load is an ignition device of an engine of the motorcycle.

[0023] In the LED driver circuit, the first switch element is a first MOS transistor that is connected between the first LED terminal and the ground terminal and whose gate voltage is controlled by the controlling part, the second switch element is a second MOS transistor that is connected between the second LED terminal and the ground terminal and whose gate voltage is controlled by the controlling part, the LED driver circuit further comprises:

a first reference voltage circuit that outputs a first reference voltage controlled by the controlling part; a first detecting resistor connected between the first switch element and the ground terminal; a first comparator that compares the first reference voltage with a first detection voltage between the first switch element and the first detecting resistor and outputs a first controlling signal that makes the first MOS transistor operate to make the first reference voltage and the first detection voltage equal to each other; a first controlling resistor connected between an output of the first comparator and a gate of the first MOS transistor; a second reference voltage circuit that outputs a second reference voltage controlled by the controlling part; a second detecting resistor connected between the second switch element and the ground terminal; a second comparator that compares the second reference voltage with a second detection voltage between the second switch element and the second detecting resistor and outputs a second controlling signal that makes the second MOS transistor oper-

ate to make the second reference voltage and the second detection voltage equal to each other; and a second controlling resistor connected between an output of the second comparator and a gate of the second MOS transistor, and the controlling part

controls the first reference voltage to make the first switch element operate with the first on-duty ratio with the first controlling signal if the first terminal voltage is lower than the first upper limit value, controls the first reference voltage to make the first switch element operate with the second on-duty ratio with the first controlling signal if the first terminal voltage reaches the first upper limit value, controls the second reference voltage to make the second switch element operate with the third on-duty ratio with the second controlling signal if the second terminal voltage is lower than the second upper limit value, and controls the second reference voltage to make the second switch element operate with the fourth on-duty ratio with the second controlling signal if the second terminal voltage reaches the second upper limit value.

[0024] A method of controlling an LED driver circuit according to the present invention is a method of controlling an LED driver circuit, the LED driver circuit that drives a first LED circuit and a second LED circuit, the first LED circuit having one LED element or a plurality of LED elements connected in series with each other and being connected to a positive electrode of a battery at an anode side thereof, the second LED circuit having one LED element or a plurality of LED elements connected in series with each other and being connected to the positive electrode of the battery at an anode side thereof, and the LED driver circuit comprising a first LED terminal to which a cathode side of the first LED circuit is connected, a second LED terminal to which a cathode side of the second LED circuit is connected, a ground terminal connected to a negative electrode of the battery, a first switch element connected between the first LED terminal and the ground terminal, a second switch element connected between the second LED terminal and the ground terminal, a first voltage detecting circuit that detects a first terminal voltage at the first LED terminal, a second voltage detecting circuit that detects a second terminal voltage at the second LED terminal, and a controlling part that controls the first switch element and the second switch element in accordance with the first terminal voltage and the second terminal voltage, wherein a first LED switch capable of being turned on and off by a user is connected in series with the first LED circuit between the positive electrode of the battery and the first LED terminal, and the method, via the controlling part controls the first switch element with a first on-duty ratio if the first terminal voltage is lower than a preset first

upper limit value,

controls the first switch element with a second on-duty ratio smaller than the first on-duty ratio if the first terminal voltage reaches the first upper limit value,

5 controls the second switch element with a third on-duty ratio if the second terminal voltage is lower than a preset second upper limit value, and

controls the second switch element with a fourth on-duty ratio smaller than the third on-duty ratio if the second terminal voltage reaches the second upper limit value, wherein the LED driver circuit further comprises:

a battery voltage detecting circuit that detects a battery voltage of the battery,

and wherein the method, via the the controlling part:

15 lowers the on-duty ratio of the first switch element if a first potential difference between the battery voltage and the first terminal voltage is equal to or lower than a first predefined value, and

lowers the on-duty ratio of the second switch element if a second potential difference between the battery voltage and the second terminal voltage is equal to or lower than a second predefined value.

[0025] An LED driver circuit according to an aspect of the present invention includes a first switch element connected between a first LED terminal and a ground terminal, a second switch element connected between a second LED terminal and the ground terminal, a first voltage detecting circuit that detects a first terminal voltage at the first LED terminal, a second voltage detecting circuit that detects a second terminal voltage at the second LED terminal, and a controlling part that controls the first switch element and the second switch element in accordance with the first terminal voltage and the second terminal voltage.

35 **[0026]** A first LED switch capable of being turned on and off by a user is connected in series with the first LED circuit between a positive electrode of a battery and the first LED terminal.

[0027] The controlling part controls the first switch element with a first on-duty ratio if the first terminal voltage is lower than a preset first upper limit value, controls the first switch element with a second on-duty ratio smaller than the first on-duty ratio if the first terminal voltage reaches the first upper limit value, controls the second switch element with a third on-duty ratio if the second terminal voltage is lower than a preset second upper limit value, and controls the second switch element with a fourth on-duty ratio smaller than the third on-duty ratio if the second terminal voltage reaches the second upper limit value.

[0028] With such a configuration, the LED driver circuit according to the present invention requires no information on switching of the switches and therefore requires no external signal. In addition, the LED driver circuit requires no constant-current power supply.

[0029] That is, the number of terminals, wires and the like of the LED driver circuit can be reduced.

[0030] Furthermore, when a battery abnormality or the

like occurs and an overvoltage occurs, the LED driver circuit according to the present invention can reduce heat generation of the MOS transistors and prevent the LED elements from suddenly going out, although the light intensity of the LED elements decreases.

[0031] If a first potential difference between the battery voltage and the first terminal voltage is equal to or lower than a first predefined value, the controlling part lowers the on-duty ratio of the first switch element. If a second potential difference between the battery voltage and the second terminal voltage is equal to or lower than a second predefined value, the controlling part lowers the on-duty ratio of the second switch element.

[0032] In this way, when the potential difference between the battery voltage and the voltage at an LED terminal is equal to or lower than a predefined value (specifically, when at least any of the LED elements is short-circuited), the on-duty ratio of the switch element (MOS transistor) can be lowered to reduce heat generation of the switch element (MOS transistor).

[0033] Furthermore, the controlling part determines that a breakage has occurred in an LED element of the first LED circuit if the first terminal voltage is equal to or lower than a preset first determination value, and determines that a breakage has occurred in an LED element of the second LED circuit if the second terminal voltage is equal to or lower than a preset second determination value.

[0034] In this way, if the voltage at an LED terminal for the low beam or high beam is zero (equal to or lower than the determination value), it can be determined that a breakage has occurred in the LED element for the low beam or high beam.

[0035] As described above, in a headlamp of a motorcycle, for example, a breakage of an LED element for the high beam and the low beam can be detected.

[Brief Description of the Drawings]

[0036]

Figure 1 is a diagram showing an example of a circuit configuration of a system 1000 including an LED driver circuit 100 according to a first embodiment; and

Figure 2 is a diagram showing an example of a circuit configuration of a system 1000a including a conventional LED driver circuit 100a.

[Detailed Description of the Invention]

[0037] In the following, an embodiment of the present invention will be described with reference to the drawings.

(First Embodiment)

[0038] In a system 1000 according to a first embodi-

ment, an LED driver circuit 100 is configured to drive a first LED circuit "LC1" and a second LED circuit "LC2" that have one LED element or a plurality of LED elements connected in series with each other (Figure 1).

[0039] A positive electrode "BP" of the battery "B" is connected to a controlling part "X" via a main switch "MSW" and a battery terminal "TB". A negative electrode "BN" of the battery "B" is connected to the controlling part "X" via a ground terminal "TG". That is, the controlling part "X" is connected between the battery terminal "TB" and the ground terminal "TG" and is driven by an electric power supplied from the battery "B".

[0040] The first LED circuit "LC1" has one LED element or a plurality of LED elements connected in series with each other and is connected to the positive electrode "BP" of the battery "B" at an anode side thereof.

[0041] The second LED circuit "LC2" has one LED element or a plurality of LED elements connected in series with each other and is connected to the positive electrode "BP" of the battery "B" at an anode side thereof.

[0042] The first LED circuit "LC1" and the second LED circuit "LC2" are LEDs of a headlamp of a motorcycle, for example. For example, the LED elements of the first LED circuit "LC1" are LED elements for a low beam, and the LED elements of the second LED circuit "LC2" are LED elements for a high beam.

[0043] A first LED switch "LS1" capable of being turned on and off by a user is connected in series with the first LED circuit "LC1" between the positive electrode "BP" of the battery "B" and a first LED terminal "TL1".

[0044] If the first LED switch "LS1" is turned on by the user, a current can flow to the first LED circuit "LC1". On the other hand, if the first LED switch "LS1" is turned off by the user, the current flowing to the first LED circuit "LC1" is interrupted.

[0045] A second LED switch "LS2" capable of being turned on and off by the user is connected in series with the second LED circuit "LC2" between the positive electrode "BP" of the battery "B" and a second LED terminal "TL2".

[0046] If the second LED switch "LS2" is turned on by the user, a current can flow to the second LED circuit "LC2". On the other hand, if the second LED switch "LS2" is turned off by the user, the current flowing to the second LED circuit "LC2" is interrupted.

[0047] The first LED circuit "LC1", the second LED circuit "LC2", the first LED switch "LS1" and the second LED switch "LS2" form a headlamp unit 101 for a motorcycle.

[0048] The main switch "MSW" is capable of being turned on and off by the user.

[0049] A relay "RE" is connected between the positive electrode "BP" of the battery "B" and the anode sides of the first LED circuit "LC1" and the second LED circuit "LC2". More specifically, the relay "RE" is connected to the positive electrode "BP" of the battery at one end thereof and to the anode sides of the first LED circuit "LC1" and the second LED circuit "LC2" at another end thereof.

[0050] If the main switch "MSW" is turned on, a current flows to a coil of the relay "RE" to turn on the relay "RE".

[0051] A load "LO" is connected between the relay "RE" and the negative electrode "BN" of the battery "B". The load "LO" is an ignition device of an engine of a motorcycle, for example.

[0052] As shown in Figure 1, the LED driver circuit 100 drives the first LED circuit "LC1" that has one LED element or a plurality of LED elements connected in series with each other and is connected to the positive electrode "BP" of the battery "B" at the anode side thereof, and the second LED circuit "LC2" that has one LED element or a plurality of LED elements connected in series with each other and is connected to the positive electrode "BP" of the battery "B" at the anode side thereof.

[0053] The LED driver circuit 100 includes the first LED terminal "TL1", to which a cathode side of the first LED circuit "LC1" is connected, and the second LED terminal "TL2", to which a cathode side of the second LED circuit "LC2" is connected.

[0054] The LED driver circuit 100 includes the ground terminal "TG" that is connected to the negative electrode "BN" of the battery "B", the battery terminal "TB" that is connected to the positive electrode "BP" of the battery "B" via the main switch "MSW", and a voltage detecting terminal "TD" that is connected to the positive electrode "BP" of the battery "B" via the relay "RE".

[0055] The LED driver circuit 100 includes a first switch element "SW1" that is connected between the first LED terminal "TL1" and the ground terminal "TG", and a second switch element "SW2" that is connected between the second LED terminal "TL2" and the ground terminal "TG".

[0056] The LED driver circuit 100 includes a first voltage detecting circuit "VD1" that detects a first terminal voltage at the first LED terminal "TL1", a second voltage detecting circuit "VD2" that detects a second terminal voltage at the second LED terminal "TL2", and a battery voltage detecting circuit "VDB" that detects a battery voltage of the battery "B".

[0057] The battery voltage detecting circuit "VDB" detects the battery voltage of the battery "B" by detecting the voltage at the voltage detecting terminal "TD", for example.

[0058] As described above, the voltage detecting terminal "TD" is connected to the positive electrode "BP" of the battery "B" via the relay "RE". Therefore, when the relay "RE" is turned on, the battery voltage of the battery "B" is supplied to the voltage detecting terminal "TD". Therefore, the battery voltage detecting circuit "VDB" can detect the battery voltage of the battery "B" by detecting the voltage at the voltage detecting terminal "TD".

[0059] The LED driver circuit 100 includes the controlling part "X" that controls the first switch element "SW1" and the second switch element "SW2" in accordance with the first terminal voltage and the second terminal voltage. The controlling part "X" is connected between the battery terminal "TB" and the ground terminal "TG" and operates

on the electric power that is supplied from the battery "B" when the main switch "MSW" is turned on.

[0060] As shown in Figure 1, the first switch element "SW1" is a first MOS transistor "M1" that is connected between the first LED terminal "TL1" and the ground terminal "TG" and whose gate voltage is controlled by the controlling part "X". As shown in Figure 1, the second switch element "SW2" is a second MOS transistor "M2" that is connected between the second LED terminal "TL2" and the ground terminal "TG" and whose gate voltage is controlled by the controlling part "X".

[0061] The LED driver circuit 100 includes a first reference voltage circuit "VR1" that outputs a first reference voltage controlled by the controlling part "X", and a first detecting resistor "R1" connected between the first switch element "SW1" and the ground terminal "TG". The LED driver circuit 100 includes a first comparator "CON1" that compares the first reference voltage with a first detection voltage between the first switch element "SW1" and the first detecting resistor "R1" and outputs a first controlling signal that makes the first MOS transistor "M1" operate to make the first detection voltage and the first reference voltage equal to each other, and a first controlling resistor "Ra" connected between an output of the first comparator "CON1" and a gate of the first MOS transistor "M1".

[0062] The controlling part "X" controls the first reference voltage described above based on the first terminal voltage, thereby controlling the first controlling signal output from the first comparator "CON1" and supplied to the gate of the first MOS transistor "M1". In other words, the controlling part "X" controls the gate voltage of the first MOS transistor "M1" by controlling the first reference voltage.

[0063] The LED driver circuit 100 includes a second reference voltage circuit "VR2" that outputs a second reference voltage controlled by the controlling part "X", and a second detecting resistor "R2" connected between the second switch element "SW2" and the ground terminal "TG". The LED driver circuit 100 includes a second comparator "CON2" that compares the second reference voltage with a second detection voltage between the second switch element "SW2" and the second detecting resistor "R2" and outputs a second controlling signal that makes the second MOS transistor "M2" operate to make the second detection voltage and the second reference voltage equal to each other, and a second controlling resistor "Rb" connected between an output of the second comparator "CON2" and a gate of the second MOS transistor "M2".

[0064] The controlling part "X" controls the second reference voltage described above based on the second terminal voltage, thereby controlling the second controlling signal output from the second comparator "CON2" and supplied to the gate of the second MOS transistor "M2". In other words, the controlling part "X" controls the gate voltage of the second MOS transistor "M2" by controlling the second reference voltage.

[0065] If the first terminal voltage is lower than a preset first upper limit value, the controlling part "X" controls the first reference voltage to control the first switch element "SW1" with a first on-duty ratio with the first controlling signal. The first on-duty ratio is an on-duty ratio of 100%, for example.

[0066] If the first terminal voltage reaches the first upper limit value, the controlling part "X" controls the first reference voltage to control the first switch element "SW1" with a second on-duty ratio smaller than the first on-duty ratio described above with the first controlling signal.

[0067] If the second terminal voltage is lower than a preset second upper limit value, the controlling part "X" controls the second reference voltage to control the second switch element "SW2" with a third on-duty ratio with the second controlling signal. The third on-duty ratio is an on-duty ratio of 100%, for example.

[0068] If the second terminal voltage reaches the second upper limit value, the controlling part "X" controls the second reference voltage to control the second switch element "SW2" with a fourth on-duty ratio smaller than the third on-duty ratio described above with the second controlling signal.

[0069] Thus, the LED driver circuit 100 requires no information on switching of the switches and therefore requires no external signal. In addition, the LED driver circuit 100 requires no constant-current power supply.

[0070] That is, the number of terminals, wires and the like of the LED driver circuit 100 can be reduced.

[0071] Furthermore, when a battery abnormality or the like occurs and an overvoltage occurs, for example, the LED driver circuit 100 can reduce heat generation of the MOS transistors and prevent the LED elements from suddenly going out, although the light intensity of the LED elements decreases.

[0072] If a first potential difference between the battery voltage and the first terminal voltage is equal to or lower than a first predefined value, the controlling part "X" controls the first reference voltage to lower the on-duty ratio of the first switch element "SW1".

[0073] The first predefined value is set to be the potential difference between the first LED terminal "TL1" and the voltage detecting terminal "TD" at the time when the first LED switch "LS1" is in the on state and any of the LED elements of the first LED circuit "LC1" is short-circuited, for example.

[0074] If a second potential difference between the battery voltage and the second terminal voltage is equal to or lower than a second predefined value, the controlling part "X" controls the second reference voltage to lower the on-duty ratio of the second switch element "SW2".

[0075] The second predefined value is set to be the potential difference between the second LED terminal "TL2" and the voltage detecting terminal "TD" at the time when the second LED switch "LS2" is in the on state and any of the LED elements of the second LED circuit "LC2" is short-circuited, for example.

[0076] In this way, when the potential difference between the battery voltage and the voltage at an LED terminal is equal to or lower than a predefined value (specifically, when at least any of the LED elements is short-circuited, for example), the on-duty ratio of the switch element (the MOS transistor) can be lowered to reduce heat generation of the switch element (the MOS transistor).

[0077] In particular, the controlling part "X" may turn off the first switch element "SW1" when the first potential difference described above is equal to or lower than the third predefined value lower than the first predefined value.

[0078] Similarly, the controlling part "X" may turn off the second switch element "SW2" when the second potential difference described above is equal to or lower than the fourth predefined value lower than the second predefined value.

[0079] In this way, when the potential difference between the battery voltage and the voltage at an LED terminal is equal to or lower than a predefined value (specifically, when at least any of the LED elements is short-circuited, for example), the switch element (the MOS transistor) can be turned off to reduce heat generation of the switch element (the MOS transistor) with higher reliability.

[0080] If a breakage occurs in an LED element of the first LED circuit "LC1", the connection between the positive electrode "BP" of the battery "B" and the first LED terminal "TL1" is interrupted. That is, the first terminal voltage at the first LED terminal "TL1" becomes equal to the voltage (the ground voltage) at the negative electrode "BN" of the battery "B".

[0081] The controlling part "X" determines that a breakage has occurred in an LED element of the first LED circuit "LC1" if the first terminal voltage described above is equal to or lower than a preset first determination value. The first determination value is the ground voltage (the voltage at the negative electrode "BN" of the battery "B"), for example.

[0082] Similarly, if a breakage occurs in an LED element of the second LED circuit "LC2", the connection between the positive electrode "BP" of the battery "B" and the second LED terminal "TL2" is interrupted. That is, the second terminal voltage at the second LED terminal "TL2" becomes equal to the voltage (the ground voltage) at the negative electrode "BN" of the battery "B".

[0083] The controlling part "X" determines that a breakage has occurred in an LED element of the second LED circuit "LC2" if the second terminal voltage described above is equal to or lower than a preset second determination value. The second determination value is the ground voltage (the voltage at the negative electrode "BN" of the battery "B"), for example.

[0084] In this way, the controlling part "X" can detect a breakage of the LED elements based on the first terminal voltage and the second terminal voltage. That is, the LED driver circuit 100 can detect a breakage of any

of the LED elements for the high beam and the low beam of the headlamp of the motorcycle, for example.

[0085] Next, an example of a method of controlling the LED driver circuit 100 configured as described above will be described.

[0086] First, in response to the user turning on the main switch "MSW", for example, the controlling part "X" is made to operate (that is, activated) by an electric power supplied from the battery "B".

[0087] Once the main switch "MSW" is turned on, the relay "RE" is turned on. As a result, an electric power can be supplied from the battery "B" to the headlamp unit 101. At this point in time, if the first and second LED switches "LS1", "LS2" are in the off state, no current flows to the first LED circuit "LC1" and the second LED circuit "LC2".

[0088] The first terminal voltage then becomes equal to the ground voltage or, in other words, becomes lower than the first upper limit value. In addition, the second terminal voltage becomes equal to the ground voltage or, in other words, becomes lower than the second upper limit value.

[0089] Since the first terminal voltage is lower than the preset first upper limit value, the controlling part "X" controls the first reference voltage to control the first switch element "SW1" with the first on-duty ratio (an on-duty ratio of 100%, for example) with the first controlling signal.

[0090] Furthermore, since the second terminal voltage is lower than the preset second upper limit value, the controlling part "X" controls the second reference voltage to control the second switch element "SW2" with the third on-duty ratio (an on-duty ratio of 100%, for example) with the second controlling signal.

[0091] Suppose that the user then turns on the first LED switch "LS1", for example. In that case, since the first switch element "SW1" is controlled with the first on-duty ratio, a predetermined amount of current flows to the first LED circuit "LC1", and the LED elements emit light.

[0092] On the other hand, suppose that the user turns on the second LED switch "LS2". In that case, since the second switch element "SW2" is controlled with the third on-duty ratio, a predetermined amount of current flows to the second LED circuit "LC2", and the LED elements emit light.

[0093] As can be seen from the above description, the LED driver circuit 100 requires no information on switching of the switches and therefore requires no external signal. In addition, the LED driver circuit 100 requires no constant-current power supply.

[0094] After that, if a battery abnormality or the like occurs and an overvoltage occurs, for example, the first terminal voltage reaches the first upper limit value, and the second terminal voltage reaches the second upper limit value.

[0095] Since the first terminal voltage has reached the first upper limit value, the controlling part "X" controls the first reference voltage to control the first switch element

"SW1" with the second on-duty ratio smaller than the first on-duty ratio with the first controlling signal.

[0096] As a result, the amount of current flowing to the first switch element "SW1" (the first MOS transistor "M1") is limited, and heat generation of the first switch element "SW1" is reduced.

[0097] Furthermore, since the second terminal voltage has reached the second upper limit value, the controlling part "X" controls the second reference voltage to control the second switch element "SW2" with the fourth on-duty ratio smaller than the third on-duty ratio with the second controlling signal.

[0098] As a result, the amount of current flowing to the second switch element "SW2" (the second MOS transistor "M2") is limited, and heat generation of the second switch element "SW2" is reduced.

[0099] In this way, when a battery abnormality or the like occurs and an overvoltage occurs, the LED driver circuit 100 can reduce heat generation of the switch elements (the MOS transistors) and prevent the LED elements from suddenly going out, although the light intensity of the LED elements decreases.

[0100] If any of the LED elements of the first LED circuit "LC1" is short-circuited, for example, the first potential difference between the battery voltage and the first terminal voltage becomes equal to or lower than the first predefined value. Since the first potential difference between the battery voltage and the first terminal voltage is equal to or lower than the first predefined value, the controlling part "X" controls the first reference voltage to lower the on-duty ratio of the first switch element "SW1".

[0101] If any of the LED elements of the second LED circuit "LC2" is short-circuited, for example, the second potential difference between the battery voltage and the second terminal voltage becomes equal to or lower than the second predefined value. Since the second potential difference between the battery voltage and the second terminal voltage is equal to or lower than the second predefined value, the controlling part "X" controls the second reference voltage to lower the on-duty ratio of the second switch element "SW2".

[0102] In this way, heat generation of the switch elements (the MOS transistors) can be reduced.

[0103] The same operation is then repeated.

[0104] As described above, the LED driver circuit 100 according to an aspect of the present invention includes the first switch element "SW1" that is connected between the first LED terminal "TL1" and the ground terminal "TG", the second switch element "SW2" that is connected between the second LED terminal "TL2" and the ground terminal "TG", the first voltage detecting circuit "VD1" that detects the first terminal voltage at the first LED terminal "TL1", the second voltage detecting circuit "VD2" that detects the second terminal voltage at the second LED terminal "TL2", and the controlling part "X" that controls the first switch element "SW1" and the second switch element "SW2" based on the first terminal voltage and the second terminal voltage.

[0105] The first LED switch capable of being turned on and off by the user is connected in series with the first LED circuit "LC1" between the positive electrode "BP" of the battery and the first LED terminal "TL1".

[0106] If the first terminal voltage is lower than the preset first upper limit value, the controlling part "X" controls the first switch element "SW1" with the first on-duty ratio. If the first terminal voltage reaches the first upper limit value, the controlling part "X" controls the first switch element "SW1" with the second on-duty ratio smaller than the first on-duty ratio. If the second terminal voltage is lower than the preset second upper limit value, the controlling part "X" controls the second switch element "SW2" with the third on-duty ratio. If the second terminal voltage reaches the second upper limit value, the controlling part "X" controls the second switch element "SW2" with the fourth on-duty ratio smaller than the third on-duty ratio.

[0107] Thus, the LED driver circuit 100 according to the present invention requires no information on switching of the switches and therefore requires no external signal. In addition, the LED driver circuit 100 requires no constant-current power supply.

[0108] That is, the number of terminals, wires and the like of the LED driver circuit 100 can be reduced.

[0109] Furthermore, when a battery abnormality or the like occurs and an overvoltage occurs, the LED driver circuit 100 according to the present invention can reduce heat generation of the MOS transistors and prevent the LED elements from suddenly going out, although the light intensity of the LED elements decreases.

[0110] If the first potential difference between the battery voltage and the first terminal voltage is equal to or lower than the first predefined value, the controlling part "X" lowers the on-duty ratio of the first switch element "SW1". If the second potential difference between the battery voltage and the second terminal voltage is equal to or lower than the second predefined value, the controlling part "X" lowers the on-duty ratio of the second switch element "SW2".

[0111] In this way, when the potential difference between the battery voltage and the voltage at an LED terminal is equal to or lower than a predefined value (specifically, when at least any of the LED elements is short-circuited, for example), the on-duty ratio of the switch element (the MOS transistor) can be lowered to reduce heat generation of the switch element (the MOS transistor).

[0112] Furthermore, if the first terminal voltage is equal to or lower than the preset first determination value, the controlling part "X" determines that a breakage has occurred in an LED element of the first LED circuit "LC1". If the second terminal voltage is equal to or lower than the preset second determination value, the controlling part "X" determines that a breakage has occurred in an LED element of the second LED circuit "LC2".

[0113] Thus, if the voltage at an LED terminal for the low beam or high beam is zero (equal to or lower than

the determination value), it can be determined that a breakage has occurred in the LED element for the low beam or high beam.

[0114] As described above, the LED driver circuit 100 can detect a breakage of any of the LED elements for the high beam and the low beam of a headlamp of a motorcycle, for example.

[0115] Although an embodiment of the present invention has been described, the embodiment is shown for illustrative purposes and is not intended to limit the scope of the present invention.

Claims

1. An LED driver system (1000) that drives an LED circuit, comprising:

a battery (B);
a first LED circuit (LC1) that has one LED element or a plurality of LED elements connected in series with each other and is connected to a positive electrode (BP) of the battery (B) at an anode side thereof;
a second LED circuit (LC2) that has one LED element or a plurality of LED elements connected in series with each other and is connected to the positive electrode (BP) of the battery (B) at an anode side thereof; and
an LED driver circuit (100) that drives the first LED circuit (LC1) and the second LED circuit (LC2),
wherein the LED driver circuit (100) comprises:

a first LED terminal (TL1) to which a cathode side of the first LED circuit (LC1) is connected;
a second LED terminal (TL2) to which a cathode side of the second LED circuit (LC2) is connected;
a ground terminal (TG) connected to a negative electrode (BN) of the battery (B);
a first switch element (SW1) connected between the first LED terminal (TL1) and the ground terminal (TG);
a second switch element (SW2) connected between the second LED terminal (TL2) and the ground terminal (TG);
a first voltage detecting circuit (VD1) that detects a first terminal voltage at the first LED terminal (TL1);
a second voltage detecting circuit (VD2) that detects a second terminal voltage at the second LED terminal (TL2); and
a controlling part (X) that controls the first switch element (SW1) and the second switch element (SW2) in response to the first terminal voltage and the second terminal

- nal voltage,
the LED driver system (1000) has
a first LED switch (LS1) capable of being
turned on and off by a user connected in
series with the first LED circuit (LS1) be-
tween the positive electrode (BP) of the bat-
tery (B) and the first LED terminal (TL1), and
the controlling part (X)
controls the first switch element (SW1) with
a first on-duty ratio if the first terminal volt-
age is lower than a preset first upper limit
value,
controls the first switch element (SW2) with
a second on-duty ratio smaller than the first
on-duty ratio if the first terminal voltage
reaches the first upper limit value,
controls the second switch element (SW2)
with a third on-duty ratio if the second ter-
minal voltage is lower than a preset second
upper limit value, and
controls the second switch element (SW2)
with a fourth on-duty ratio smaller than the
third on-duty ratio if the second terminal volt-
age reaches the second upper limit value,
characterised in that the LED driver circuit
(100) further comprises:
- a battery voltage detecting circuit
(VDB) that detects a battery voltage of
the battery (B), and
the controlling part (X)
lowers the on-duty ratio of the first
switch element (SW1) if a first potential
difference between the battery voltage
and the first terminal voltage is equal to
or lower than a first predefined value,
and
lowers the on-duty ratio of the second
switch element (SW2) if a second po-
tential difference between the battery
voltage and the second terminal volt-
age is equal to or lower than a second
predefined value.
2. The LED driver system according to claim 1, wherein
the controlling part (X)
turns off the first switch element (SW1) if the first
potential difference is equal to or lower than a third
predefined value lower than the first predefined val-
ue, and
turns off the second switch element (SW2) if the sec-
ond potential difference is equal to or lower than a
fourth predefined value lower than the second pre-
defined value.
 3. The LED driver system according to claim 1, wherein
the controlling part (X)
determines that a breakage has occurred in an LED
element of the first LED circuit (LC1) if the first ter-
minal voltage is equal to or lower than a preset first
determination value, and
determines that a breakage has occurred in an LED
element of the second LED circuit (LC2) if the second
terminal voltage is equal to or lower than a preset
second determination value.
 4. The LED driver system according to claim 3, wherein
the first determination value and the second deter-
mination value are the ground voltage.
 5. The LED driver system according to claim 1, wherein
the first on-duty ratio and the third on-duty ratio are
an on-duty ratio of 100%.
 6. The LED driver system according to claim 1, wherein
a second LED switch (LS2) capable of being turned
on and off by a user is connected in series with the
second LED circuit (LC2) between the positive elec-
trode (BP) of the battery (B) and the second LED
terminal (TL2).
 7. The LED driver system according to claim 1, wherein
a first end of a relay (RE) is connected to the positive
electrode (BP) of the battery (B), and a second end
of the relay (RE) is connected to the anode side of
the first LED circuit (LC1) and the anode side of the
second LED circuit (LC2),
a load (LO) is connected between the second end
of the relay (RE) and the negative electrode (BN) of
the battery (B),
the first LED circuit (LC1) and the second LED circuit
(LC2) are LEDs of a headlamp of a motorcycle, and
the load (L) is an ignition device of an engine of the
motorcycle.
 8. The LED driver system according to claim 1, wherein
the first switch element (SW1) is a first MOS transis-
tor (M1) that is connected between the first LED ter-
minal (TL1) and the ground terminal (TG) and whose
gate voltage is controlled by the controlling part,
the second switch element (SW2) is a second MOS
transistor that is connected between the second LED
terminal (TL2) and the ground terminal (TG) and
whose gate voltage is controlled by the controlling
part (X),
the LED driver circuit (100) further comprises:
a first reference voltage circuit (VR1) that out-
puts a first reference voltage controlled by the
controlling part (X);
a first detecting resistor (R1) connected be-
tween the first switch element (SW1) and the
ground terminal (TG);
a first comparator (CON1) that compares the
first reference voltage with a first detection volt-
age between the first switch element (SW1) and

the first detecting resistor (R1) and outputs a first controlling signal that makes the first MOS transistor (M1) operate to make the first reference voltage and the first detection voltage equal to each other;

a first controlling resistor (Ra) connected between an output of the first comparator (CON1) and a gate of the first MOS transistor (Mi);

a second reference voltage circuit (VR2) that outputs a second reference voltage controlled by the controlling part (X);

a second detecting resistor (R2) connected between the second switch element (SW2) and the ground terminal (TG);

a second comparator (CON2) that compares the second reference voltage with a second detection voltage between the second switch element (SW2) and the second detecting resistor (R2) and outputs a second controlling signal that makes the second MOS transistor (M2) operate to make the second reference voltage and the second detection voltage equal to each other; and

a second controlling resistor (Rb) connected between an output of the second comparator (CON2) and a gate of the second MOS transistor (M2), and

the controlling part (X)

controls the first reference voltage to make the first switch element (SW1) operate with the first on-duty ratio with the first controlling signal if the first terminal voltage is lower than the first upper limit value,

controls the first reference voltage to make the first switch element (SW1) operate with the second on-duty ratio with the first controlling signal if the first terminal voltage reaches the first upper limit value,

controls the second reference voltage to make the second switch element (SW2) operate with the third on-duty ratio with the second controlling signal if the second terminal voltage is lower than the second upper limit value, and

controls the second reference voltage to make the second switch element (SW2) operate with the fourth on-duty ratio with the second controlling signal if the second terminal voltage reaches the second upper limit value.

9. A method of controlling an LED driver system (1000), the LED driver system (1000) comprising a battery (B), a first LED circuit (LC1) that has one LED element or a plurality of LED elements connected in series with each other and is connected to a positive electrode (BP) of the battery (B) at an anode side thereof, a second LED circuit (LC2) that has one LED element or a plurality of LED elements connected in series with each other and is connected to the pos-

itive electrode (BP) of the battery (B) at an anode side thereof, and an LED driver circuit that drives the first LED circuit (LC1) and the second LED circuit (LC2), and the LED driver circuit comprising a first LED terminal (TL1) to which a cathode side of the first LED circuit (LC1) is connected, a second LED terminal (TL2) to which a cathode side of the second LED circuit (LC2) is connected, a ground terminal (TG) connected to a negative electrode (BN) of the battery (B), a first switch element (SW1) connected between the first LED terminal (TL1) and the ground terminal (TG), a second switch element (SW2) connected between the second LED terminal (TL2) and the ground terminal (TG), a first voltage detecting circuit (VD1) that detects a first terminal voltage at the first LED terminal (TL1), a second voltage detecting circuit that detects a second terminal voltage at the second LED terminal (TL2), and a controlling part (X) that controls the first switch element (SW1) and the second switch element (SW2) in response to the first terminal voltage and the second terminal voltage,

the LED driver system (1000) has a first LED switch (LS1) capable of being turned on and off by a user connected in series with the first LED circuit (LC1) between the positive electrode (BP) of the battery (B) and the first LED terminal (TL1), and

the method comprises, via the controlling part (X) : controlling the first switch element (SW1) with a first on-duty ratio if the first terminal voltage is lower than a preset first upper limit value,

controlling the first switch element (SW1) with a second on-duty ratio smaller than the first on-duty ratio if the first terminal voltage reaches the first upper limit value,

controlling the second switch element (SW2) with a third on-duty ratio if the second terminal voltage is lower than a preset second upper limit value, and controlling the second switch element (SW2) with a fourth on-duty ratio smaller than the third on-duty ratio if the second terminal voltage reaches the second upper limit value;

characterised in that the LED driver circuit (100) further comprises:

a battery voltage detecting circuit (VDB) that detects a battery voltage of the battery (B), and **in that**

the method, via the controlling part (X) :

lowers the on-duty ratio of the first switch element (SW1) if a first potential difference between the battery voltage and the first terminal voltage is equal to or lower than a first predefined value, and

lowers the on-duty ratio of the second switch element (SW2) if a second potential differ-

ence between the battery voltage and the second terminal voltage is equal to or lower than a second predefined value.

Patentansprüche

1. LED-Treibersystem (1000), das eine LED-Schaltung ansteuert, umfassend:

eine Batterie (B);
eine erste LED-Schaltung (LC1), die ein LED-Element oder mehrere LED-Elemente aufweist, die miteinander in Reihe geschaltet sind und mit einer positiven Elektrode (BP) der Batterie (B) an einer Anodenseite derselben verbunden ist; eine zweite LED-Schaltung (LC2), die ein LED-Element oder mehrere LED-Elemente aufweist, die miteinander in Reihe geschaltet sind und mit der positiven Elektrode (BP) der Batterie (B) an einer Anodenseite derselben verbunden ist; und eine LED-Treiberschaltung (100), die die erste LED-Schaltung (LC1) und die zweite LED-Schaltung (LC2) ansteuert, wobei die LED-Treiberschaltung (100) umfasst:

einen ersten LED-Anschluss (TL1), mit dem eine Kathodenseite der ersten LED-Schaltung (LC1) verbunden ist;
einen zweiten LED-Anschluss (TL2), mit dem eine Kathodenseite der zweiten LED-Schaltung (LC2) verbunden ist;
einen Masseanschluss (TG), der mit einer negativen Elektrode (BN) der Batterie (B) verbunden ist;
ein erstes Schaltelement (SW1), das zwischen dem ersten LED-Anschluss (TL1) und dem Masseanschluss (TG) verbunden ist;
ein zweites Schaltelement (SW2), das zwischen dem zweiten LED-Anschluss (TL2) und dem Masseanschluss (TG) verbunden ist;
eine erste Spannungserfassungsschaltung (VD1), die eine erste Anschlussspannung an dem ersten LED-Anschluss (TL1) erfasst;
eine zweite Spannungserfassungsschaltung (VD2), die eine zweite Anschlussspannung an dem zweiten LED-Anschluss (TL2) erfasst; und
einen Steuerteil (X), der das erste Schaltelement (SW1) und das zweite Schaltelement (SW2) als Reaktion auf die erste Anschlussspannung und die zweite Anschlussspannung steuert, wobei das LED-Treibersystem (1000) einen ersten LED-Schalter (LS1) aufweist,

der durch einen Benutzer ein- und ausgeschaltet werden kann, der mit der ersten LED-Schaltung (LS1) zwischen der positiven Elektrode (BP) der Batterie (B) und dem ersten LED-Anschluss (TL1) in Reihe geschaltet ist; und

wobei der Steuerteil (X)

das erste Schaltelement (SW1) mit einem ersten Einschaltverhältnis steuert, wenn die Anschlussspannung niedriger ist als ein voreingestellter erster oberer Grenzwert, das erste Schaltelement (SW2) mit einem zweiten Einschaltverhältnis steuert, das kleiner als das erste Einschaltverhältnis ist, wenn die erste Anschlussspannung den ersten oberen Grenzwert erreicht, das zweite Schaltelement (SW2) mit einem dritten Einschaltverhältnis steuert, wenn die zweite Anschlussspannung niedriger ist als ein voreingestellter zweiter oberer Grenzwert, und

das zweite Schaltelement (SW2) mit einem vierten Einschaltverhältnis steuert, das kleiner als das dritte Einschaltverhältnis ist, wenn die zweite Anschlussspannung den zweiten oberen Grenzwert erreicht,

dadurch gekennzeichnet, dass

die LED-Treiberschaltung (100) ferner umfasst:

eine Batteriespannungserfassungsschaltung (VDB), die eine Batteriespannung der Batterie (B) erfasst, und wobei der Steuerteil (X)

das Einschaltverhältnis des ersten Schaltelements (SW1) senkt, wenn eine erste Potentialdifferenz zwischen der Batteriespannung und der ersten Anschlussspannung gleich oder kleiner als ein erster vorgegebener Wert ist, und

das Einschaltverhältnis des zweiten Schaltelements (SW2) senkt, wenn eine zweite Potentialdifferenz zwischen der Batteriespannung und der zweiten Anschlussspannung gleich oder kleiner als ein zweiter vorgegebener Wert ist.

2. LED-Treibersystem nach Anspruch 1, wobei der Steuerteil (X)

das erste Schaltelement (SW1) ausschaltet, wenn die erste Potentialdifferenz gleich oder kleiner als ein dritter vorgegebener Wert ist, der kleiner als der erste vorgegebene Wert ist, und

das zweite Schaltelement (SW2) ausschaltet, wenn die zweite Potentialdifferenz gleich oder kleiner als ein vierter vorgegebener Wert ist, der kleiner als der

zweite vorgegebene Wert ist.

fasst:

3. LED-Treibersystem nach Anspruch 1, wobei der Steuerteil (X) bestimmt, dass in einem LED-Element der ersten LED-Schaltung (LC1) ein Bruch aufgetreten ist, wenn die erste Anschlussspannung gleich oder niedriger ist als ein voreingestellter erster Bestimmungswert, und bestimmt, dass in einem LED-Element der zweiten LED-Schaltung (LC2) ein Bruch aufgetreten ist, wenn die zweite Anschlussspannung gleich oder niedriger ist als ein voreingestellter zweiter Bestimmungswert. 5
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4. LED-Treibersystem nach Anspruch 3, wobei der erste Bestimmungswert und der zweite Bestimmungswert die Massespannung sind. 20
5. LED-Treibersystem nach Anspruch 1, wobei das erste Einschaltverhältnis und das dritte Einschaltverhältnis ein Einschaltverhältnis von 100 % sind. 25
6. LED-Treibersystem nach Anspruch 1, wobei ein zweiter LED-Schalter (LS2), der durch einen Benutzer ein- und ausgeschaltet werden kann, mit der zweiten LED-Schaltung (LC2) zwischen der positiven Elektrode (BP) der Batterie (B) und dem zweiten LED-Anschluss (TL2) in Reihe geschaltet ist. 30
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7. LED-Treibersystem nach Anspruch 1, wobei ein erstes Ende eines Relais (RE) mit der positiven Elektrode (BP) der Batterie (B) verbunden ist, und ein zweites Ende des Relais (RE) mit der Anodenseite der ersten LED-Schaltung (LC1) und der Anodenseite der zweiten LED-Schaltung (LC2) verbunden ist, eine Last (LO) zwischen dem zweiten Ende des Relais (RE) und der negativen Elektrode (BN) der Batterie (B) verbunden ist, die erste LED-Schaltung (LC1) und die zweite LED-Schaltung (LC2) LEDs eines Scheinwerfers eines Motorrads sind, und die Last (L) eine Zündvorrichtung eines Motors des Motorrads ist. 45
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8. LED-Treibersystem nach Anspruch 1, wobei das erste Schaltelement (SW1) ein erster MOS-Transistor (M1) ist, der zwischen dem ersten LED-Anschluss (TL1) und dem Masseanschluss (TG) angeschlossen ist und dessen Gate-Spannung durch den Steuerteil gesteuert wird, das zweite Schaltelement (SW2) ein zweiter MOS-Transistor ist, der zwischen dem zweiten LED-Anschluss (TL2) und dem Masseanschluss (TG) angeschlossen ist und dessen Gate-Spannung durch den Steuerteil (X) gesteuert wird, wobei die LED-Treiberschaltung (100) ferner um-

eine erste Referenzspannungsschaltung (VR1), die eine erste Referenzspannung ausgibt, die durch den Steuerteil (X) gesteuert wird; einen ersten Erfassungswiderstand (R1), der zwischen dem ersten Schaltelement (SW1) und dem Masseanschluss (TG) angeschlossen ist; einen ersten Komparator (CON1), der die erste Referenzspannung mit einer ersten Erfassungsspannung zwischen dem ersten Schaltelement (SW1) und dem ersten Erfassungswiderstand (R1) vergleicht und ein erstes Steuersignal ausgibt, das bewirkt, dass der erste MOS-Transistor (M1) arbeitet, um die erste Referenzspannung und die erste Erfassungsspannung einander anzugleichen; einen ersten Regelwiderstand (Ra), der zwischen einem Ausgang des ersten Komparators (CON1) und einem Gate des ersten MOS-Transistors (M1) verbunden ist; eine zweite Referenzspannungsschaltung (VR2), die eine zweite Referenzspannung ausgibt, die durch den Steuerteil (X) gesteuert wird; einen zweiten Erfassungswiderstand (R2), der zwischen dem zweiten Schaltelement (SW2) und dem Masseanschluss (TG) angeschlossen ist; einen zweiten Komparator (CON2), der die zweite Referenzspannung mit einer zweiten Erfassungsspannung zwischen dem zweiten Schaltelement (SW2) und dem zweiten Erfassungswiderstand (R2) vergleicht und ein zweites Steuersignal ausgibt, das bewirkt, dass der zweite MOS-Transistor (M2) arbeitet, um die zweite Referenzspannung und die zweite Erfassungsspannung einander anzugleichen; und einen zweiten Regelwiderstand (Rb), der zwischen einem Ausgang des zweiten Komparators (CON2) und einem Gate des zweiten MOS-Transistors (M2) angeschlossen ist; und wobei der Steuerteil (X) die erste Referenzspannung steuert, um zu bewirken, dass das erste Schaltelement (SW1) mit dem ersten Einschaltverhältnis mit dem ersten Steuersignal arbeitet, wenn die erste Anschlussspannung niedriger ist als der erste obere Grenzwert, die erste Referenzspannung steuert, um zu bewirken, dass das erste Schaltelement (SW1) mit dem zweiten Einschaltverhältnis mit dem ersten Steuersignal arbeitet, wenn die erste Anschlussspannung den ersten oberen Grenzwert erreicht, die zweite Referenzspannung steuert, um zu bewirken, dass das zweite Schaltelement (SW2) mit dem dritten Einschaltverhältnis mit dem zweiten Steuersignal arbeitet, wenn die

zweite Anschlussspannung niedriger ist als der zweite obere Grenzwert, und die zweite Referenzspannung steuert, um zu bewirken, dass das zweite Schaltelement (SW2) mit dem vierten Einschaltverhältnis mit dem zweiten Steuersignal arbeitet, wenn die zweite Anschlussspannung den zweiten oberen Grenzwert erreicht.

9. Verfahren zur Steuerung eines LED-Treibersystems (1000), wobei das LED-Treibersystem (1000) eine Batterie (B), eine erste LED-Schaltung (LC1), die ein LED-Element oder mehrere in Reihe geschaltete LED-Elemente aufweist, und mit einer positiven Elektrode (BP) der Batterie (B) an einer Anodenseite derselben verbunden ist, eine zweite LED-Schaltung (LC2), die ein LED-Element oder mehrere in Reihe geschaltete LED-Elemente aufweist und mit der positiven Elektrode (BP) der Batterie (B) an einer Anodenseite derselben verbunden ist, und eine LED-Treiberschaltung, die die erste LED-Schaltung (LC1) und die zweite LED-Schaltung (LC2) ansteuert, umfasst, und wobei die LED-Treiberschaltung einen ersten LED-Anschluss (TL1), mit dem eine Kathodenseite der ersten LED-Schaltung (LC1) verbunden ist, einen zweiten LED-Anschluss (TL2), mit dem eine Kathodenseite der zweiten LED-Schaltung (LC2) verbunden ist, einen Masseanschluss (TG), der mit einer negativen Elektrode (BN) der Batterie (B) verbunden ist, ein erstes Schaltelement (SW1), das zwischen dem ersten LED-Anschluss (TL1) und dem Masseanschluss (TG) angeschlossen ist, ein zweites Schaltelement (SW2), das zwischen dem zweiten LED-Anschluss (TL2) und dem Masseanschluss (TG) angeschlossen ist, eine erste Spannungserfassungsschaltung (VD1), die eine erste Anschlussspannung an dem ersten LED-Anschluss (TL1) erfasst, eine zweite Spannungserfassungsschaltung, die eine zweite Anschlussspannung an dem zweiten LED-Anschluss (TL2) erfasst, und einen Steuerteil (X), der das erste Schaltelement (SW1) und das zweite Schaltelement (SW2) als Reaktion auf die erste Anschlussspannung und die zweite Anschlussspannung steuert, umfasst, wobei das LED-Treibersystem (1000) einen ersten LED-Schalter (LS1) aufweist, der durch einen Benutzer ein- und ausgeschaltet werden kann, der mit der ersten LED-Schaltung (LC1) zwischen der positiven Elektrode (BP) der Batterie (B) und dem ersten LED-Anschluss (TL1) in Reihe geschaltet ist; und wobei das Verfahren mittels des Steuerteils (X):

das erste Schaltelement (SW1) mit einem ersten Einschaltverhältnis steuert, wenn die Anschlussspannung niedriger ist als ein voreingestellter erster oberer Grenzwert, das erste Schaltelement (SW1) mit einem zweiten Einschaltverhältnis steuert, das kleiner als

das erste Einschaltverhältnis ist, wenn die erste Anschlussspannung den ersten oberen Grenzwert erreicht, das zweite Schaltelement (SW2) mit einem dritten Einschaltverhältnis steuert, wenn die zweite Anschlussspannung niedriger ist als ein voreingestellter zweiter oberer Grenzwert, und das zweite Schaltelement (SW2) mit einem vierten Einschaltverhältnis steuert, das kleiner als das dritte Einschaltverhältnis ist, wenn die zweite Anschlussspannung den zweiten oberen Grenzwert erreicht;

dadurch gekennzeichnet, dass die LED-Treiberschaltung (100) ferner umfasst:

eine Batteriespannungserfassungsschaltung (VDB), die eine Batteriespannung der Batterie (B) erfasst, und dadurch, dass das Verfahren mittels des Steuerteils (X) Folgendes:

das Einschaltverhältnis des ersten Schaltelements (SW1) senkt, wenn eine erste Potentialdifferenz zwischen der Batteriespannung und der ersten Anschlussspannung gleich oder kleiner als ein erster vorgegebener Wert ist, und

das Einschaltverhältnis des zweiten Schaltelements (SW2) senkt, wenn eine zweite Potentialdifferenz zwischen der Batteriespannung und der zweiten Anschlussspannung gleich oder kleiner als ein zweiter vorgegebener Wert ist.

Revendications

1. Système d'attaque de diode LED (1000) qui commande un circuit de diode LED, comprenant :

une batterie (B) ;
un premier circuit de diode LED (LC1) qui présente un élément de diode LED, ou une pluralité d'éléments de diode LED connectés en série les uns aux autres, et qui est connecté à une électrode positive (BP) de la batterie (B) sur un côté anode de celle-ci ;
un second circuit de diode LED (LC2) qui présente un élément de diode LED, ou une pluralité d'éléments de diode LED connectés en série les uns aux autres, et qui est connecté à l'électrode positive (BP) de la batterie (B) sur un côté anode de celle-ci ; et
un circuit d'attaque de diode LED (100) qui commande le premier circuit de diode LED (LC1) et le second circuit de diode LED (LC2) ;

dans lequel le circuit d'attaque de diode LED (100) comprend :

une première borne de diode LED (TL1) à laquelle un côté cathode du premier circuit de diode LED (LC1) est connecté ;
 une seconde borne de diode LED (TL2) à laquelle un côté cathode du second circuit de diode LED (LC2) est connecté ;
 une borne de masse (TG) connectée à une électrode négative (BN) de la batterie (B) ;
 un premier élément de commutation (SW1) connecté entre la première borne de diode LED (TL1) et la borne de masse (TG) ;
 un second élément de commutation (SW2) connecté entre la seconde borne de diode LED (TL2) et la borne de masse (TG) ;
 un premier circuit de détection de tension (VD1) qui détecte une première tension de borne au niveau de la première borne de diode LED (TL1) ;
 un second circuit de détection de tension (VD2) qui détecte une seconde tension de borne au niveau de la seconde borne de diode LED (TL2) ; et
 une partie de commande (X) qui commande le premier élément de commutation (SW1) et le second élément de commutation (SW2) en réponse à la première tension de borne et à la seconde tension de borne ;
 le système d'attaque de diode LED (1000) présente :

un premier commutateur de diode LED (LS1) pouvant être activé et désactivé par un utilisateur, connecté en série avec le premier circuit de diode LED (LC1) entre l'électrode positive (BP) de la batterie (B) et la première borne de diode LED (TL1) ; et
 la partie de commande (X) :

commande le premier élément de commutation (SW1) avec un premier rapport de service si la première tension de borne est inférieure à une première valeur limite supérieure prédéfinie ;
 commande le premier élément de commutation (SW2) avec un deuxième rapport de service inférieur au premier rapport de service si la première tension de borne atteint la première valeur limite supérieure ;
 commande le second élément de commutation (SW2) avec un troisième rapport de service si la se-

conde tension de borne est inférieure à une seconde valeur limite supérieure prédéfinie ; et
 commande le second élément de commutation (SW2) avec un quatrième rapport de service, inférieur au troisième rapport de service, si la seconde tension de borne atteint la seconde valeur limite supérieure ;
caractérisé en ce que le circuit d'attaque de diode LED (100) comprend en outre :

un circuit de détection de tension de batterie (VDB) qui détecte une tension de batterie de la batterie (B) ; et
 la partie de commande (X) :

abaisse le rapport de service du premier élément de commutation (SW1) si une première différence de potentiel entre la tension de batterie et la première tension de borne est égale ou inférieure à une première valeur prédéfinie ; et
 abaisse le rapport de service du second élément de commutation (SW2) si une seconde différence de potentiel entre la tension de batterie et la seconde tension de borne est égale ou inférieure à une deuxième valeur prédéfinie.

2. Système d'attaque de diode LED selon la revendication 1, dans lequel la partie de commande (X) :

désactive le premier élément de commutation (SW1) si la première différence de potentiel est inférieure ou égale à une troisième valeur prédéfinie inférieure à la première valeur prédéfinie ; et
 désactive le second élément de commutation (SW2) si la seconde différence de potentiel est inférieure ou égale à une quatrième valeur prédéfinie inférieure à la deuxième valeur prédéfinie.

3. Système d'attaque de diode LED selon la revendication 1, dans lequel la partie de commande (X) :

- détermine qu'une rupture s'est produite dans un élément de diode LED du premier circuit de diode LED (LC1) si la première tension de borne est égale ou inférieure à une première valeur de détermination prédéfinie ; et
- détermine qu'une rupture s'est produite dans un élément de diode LED du second circuit de diode LED (LC2) si la seconde tension de borne est égale ou inférieure à une seconde valeur de détermination prédéfinie.
4. Système d'attaque de diode LED selon la revendication 3, dans lequel la première valeur de détermination et la seconde valeur de détermination correspondent à la tension de masse.
 5. Système d'attaque de diode LED selon la revendication 1, dans lequel le premier rapport de service et le troisième rapport de service correspondent à un rapport de service de 100 %.
 6. Système d'attaque de diode LED selon la revendication 1, dans lequel un second commutateur de diode LED (LS2) pouvant être activé et désactivé par un utilisateur est connecté en série avec le second circuit de diode LED (LC2) entre l'électrode positive (BP) de la batterie (B) et la seconde borne de diode LED (TL2).
 7. Système d'attaque de diode LED selon la revendication 1, dans lequel une première extrémité d'un relais (RE) est connectée à l'électrode positive (BP) de la batterie (B) et une seconde extrémité du relais (RE) est connectée au côté anode du premier circuit de diode LED (LC1) et au côté anode du second circuit de diode LED (LC2) ;
une charge (LO) est connectée entre la seconde extrémité du relais (RE) et l'électrode négative (BN) de la batterie (B) ;
le premier circuit de diode LED (LC1) et le second circuit de diode LED (LC2) correspondent à des diodes LED d'un phare d'une motocyclette ; et
la charge (L) correspond à un dispositif d'allumage d'un moteur de la motocyclette.
 8. Système d'attaque de diode LED selon la revendication 1, dans lequel le premier élément de commutation (SW1) est un premier transistor MOS (M1) qui est connecté entre la première borne de diode LED (TL1) et la borne de masse (TG) et dont la tension de grille est commandée par la partie de commande ;
le second élément de commutation (SW2) est un second transistor MOS qui est connecté entre la seconde borne de diode LED (TL2) et la borne de masse (TG) et dont la tension de grille est commandée par la partie de commande (X) ;
le circuit d'attaque de diode LED (100) comprend en outre :

un premier circuit de tension de référence (VR1) qui fournit en sortie une première tension de référence commandée par la partie de commande (X) ;
une première résistance de détection (R1) connectée entre le premier élément de commutation (SW1) et la borne de masse (TG) ;
un premier comparateur (CON1) qui compare la première tension de référence à une première tension de détection entre le premier élément de commutation (SW1) et la première résistance de détection (R1) et fournit en sortie un premier signal de commande qui amène le premier transistor MOS (M1) à fonctionner de manière à ce que la première tension de référence et la première tension de détection soient mutuellement égales ;
une première résistance de commande (Ra) connectée entre une sortie du premier comparateur (CON1) et une grille du premier transistor MOS (M1) ;
un second circuit de tension de référence (VR2) qui fournit en sortie une seconde tension de référence commandée par la partie de commande (X) ;
une seconde résistance de détection (R2) connectée entre le second élément de commutation (SW2) et la borne de masse (TG) ;
un second comparateur (CON2) qui compare la seconde tension de référence à une seconde tension de détection entre le second élément de commutation (SW2) et la seconde résistance de détection (R2) et fournit en sortie un second signal de commande qui amène le second transistor MOS (M2) à fonctionner de manière à ce que la seconde tension de référence et la seconde tension de détection soient mutuellement égales ; et
une seconde résistance de commande (Rb) connectée entre une sortie du second comparateur (CON2) et une grille du second transistor MOS (M2) ; et
la partie de commande (X) :

commande la première tension de référence en vue d'amener le premier élément de commutation (SW1) à fonctionner avec le premier rapport de service avec le premier signal de commande si la première tension de borne est inférieure à la première valeur limite supérieure ;
commande la première tension de référence en vue d'amener le premier élément de commutation (SW1) à fonctionner avec le deuxième rapport de service avec le premier signal de commande si la première tension de borne atteint la première valeur limite supérieure ;

commande la seconde tension de référence en vue d'amener le second élément de commutation (SW2) à fonctionner avec le troisième rapport de service avec le second signal de commande si la seconde tension de borne est inférieure à la seconde valeur limite supérieure ; et

commande la seconde tension de référence en vue d'amener le second élément de commutation (SW2) à fonctionner avec le quatrième rapport de service avec le second signal de commande si la seconde tension de borne atteint la seconde valeur limite supérieure.

9. Procédé de commande d'un système d'attaque de diode LED (1000), le système d'attaque de diode LED (1000) comprenant une batterie (B), un premier circuit de diode LED (LC1) qui présente un élément de diode LED ou une pluralité d'éléments de diode LED connectés en série les uns aux autres, et qui est connecté à une électrode positive (BP) de la batterie (B) sur un côté anode de celle-ci, un second circuit de diode LED (LC2) qui présente un élément de diode LED, ou une pluralité d'éléments de diode LED connectés en série les uns aux autres, et qui est connecté à l'électrode positive (BP) de la batterie (B) sur un côté anode de celle-ci, et un circuit d'attaque de diode LED qui commande le premier circuit de diode LED (LC1) et le second circuit de diode LED (LC2), dans lequel le circuit d'attaque de diode LED comprend une première borne de diode LED (TL1) à laquelle un côté cathode du premier circuit de diode LED (LC1) est connecté, une seconde borne de diode LED (TL2) à laquelle un côté cathode du second circuit de diode LED (LC2) est connecté, une borne de masse (TG) connectée à une électrode négative (BN) de la batterie (B), un premier élément de commutation (SW1) connecté entre la première borne de diode LED (TL1) et la borne de masse (TG), un second élément de commutation (SW2) connecté entre la seconde borne de diode LED (TL2) et la borne de masse (TG), un premier circuit de détection de tension (VD1) qui détecte une première tension de borne au niveau de la première borne de diode LED (TL1), un second circuit de détection de tension qui détecte une seconde tension de borne au niveau de la seconde borne de diode LED (TL2), et une partie de commande (X) qui commande le premier élément de commutation (SW1) et le second élément de commutation (SW2) en réponse à la première tension de borne et à la seconde tension de borne ;

dans lequel le système d'attaque de diode LED (1000) présente un premier commutateur de diode LED (LS1) pouvant être activé et désactivé par un utilisateur, connecté en série avec le premier circuit de diode LED (LC1) entre l'électrode positive (BP)

de la batterie (B) et la première borne de diode LED (TL1) ; et

dans lequel le procédé comprend les étapes ci-dessous consistant à, par le biais de la partie de commande (X) :

commander le premier élément de commutation (SW1) avec un premier rapport de service si la première tension de borne est inférieure à une première valeur limite supérieure prédéfinie ;

commander le premier élément de commutation (SW1) avec un deuxième rapport de service inférieur au premier rapport de service si la première tension de borne atteint la première valeur limite supérieure ;

commander le second élément de commutation (SW2) avec un troisième rapport de service si la seconde tension de borne est inférieure à une seconde valeur limite supérieure prédéfinie ; et

commander le second élément de commutation (SW2) avec un quatrième rapport de service, inférieur au troisième rapport de service, si la seconde tension de borne atteint la seconde valeur limite supérieure ;

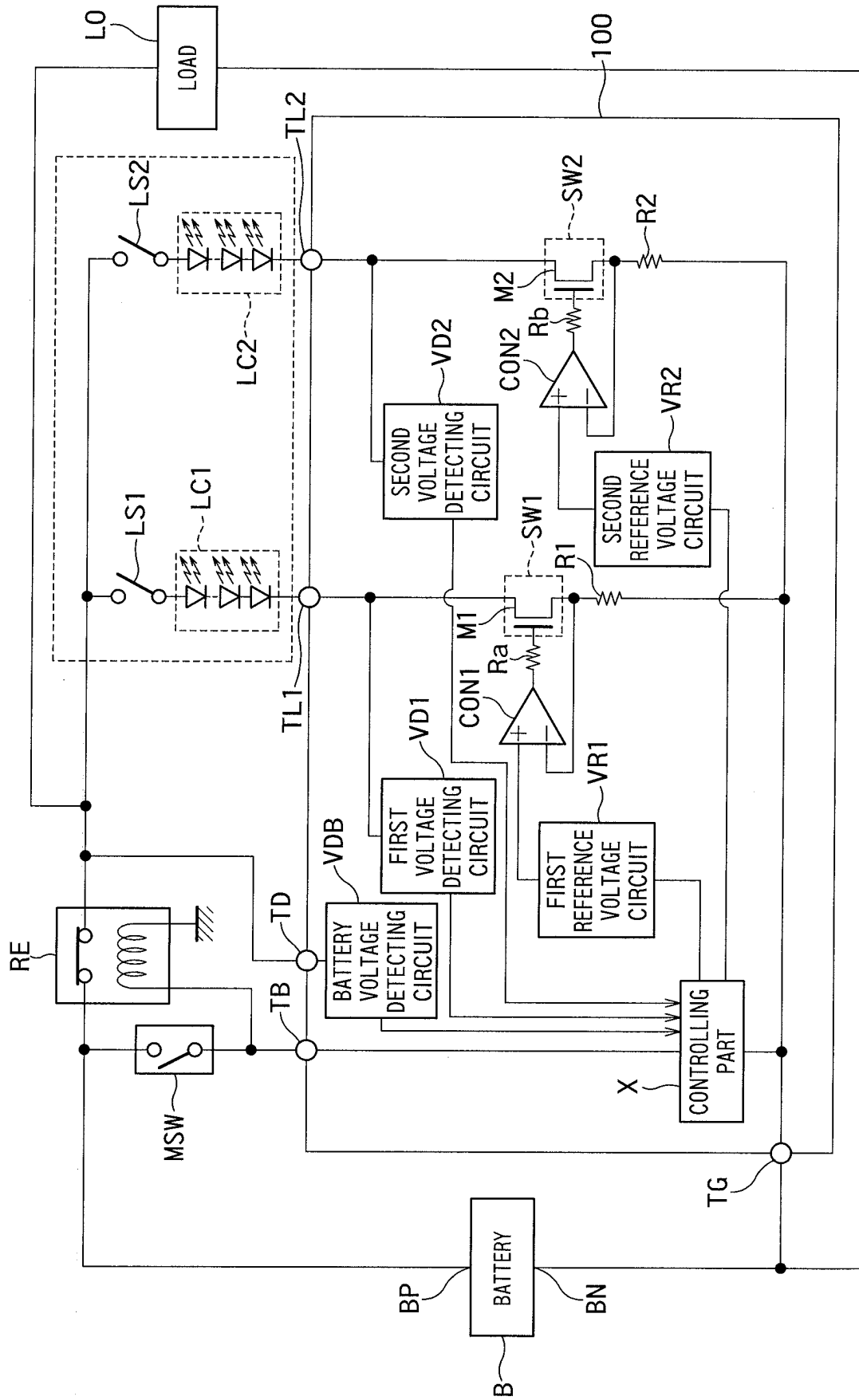
caractérisé en ce que le circuit d'attaque de diode LED (100) comprend en outre :

un circuit de détection de tension de batterie (VDB) qui détecte une tension de batterie de la batterie (B) ; et

en ce que le procédé, par l'intermédiaire de la partie de commande (X) :

abaisse le rapport de service du premier élément de commutation (SW1) si une première différence de potentiel entre la tension de batterie et la première tension de borne est égale ou inférieure à une première valeur prédéfinie ; et

abaisse le rapport de service du second élément de commutation (SW2) si une seconde différence de potentiel entre la tension de batterie et la seconde tension de borne est égale ou inférieure à une deuxième valeur prédéfinie.



1000

FIG. 1

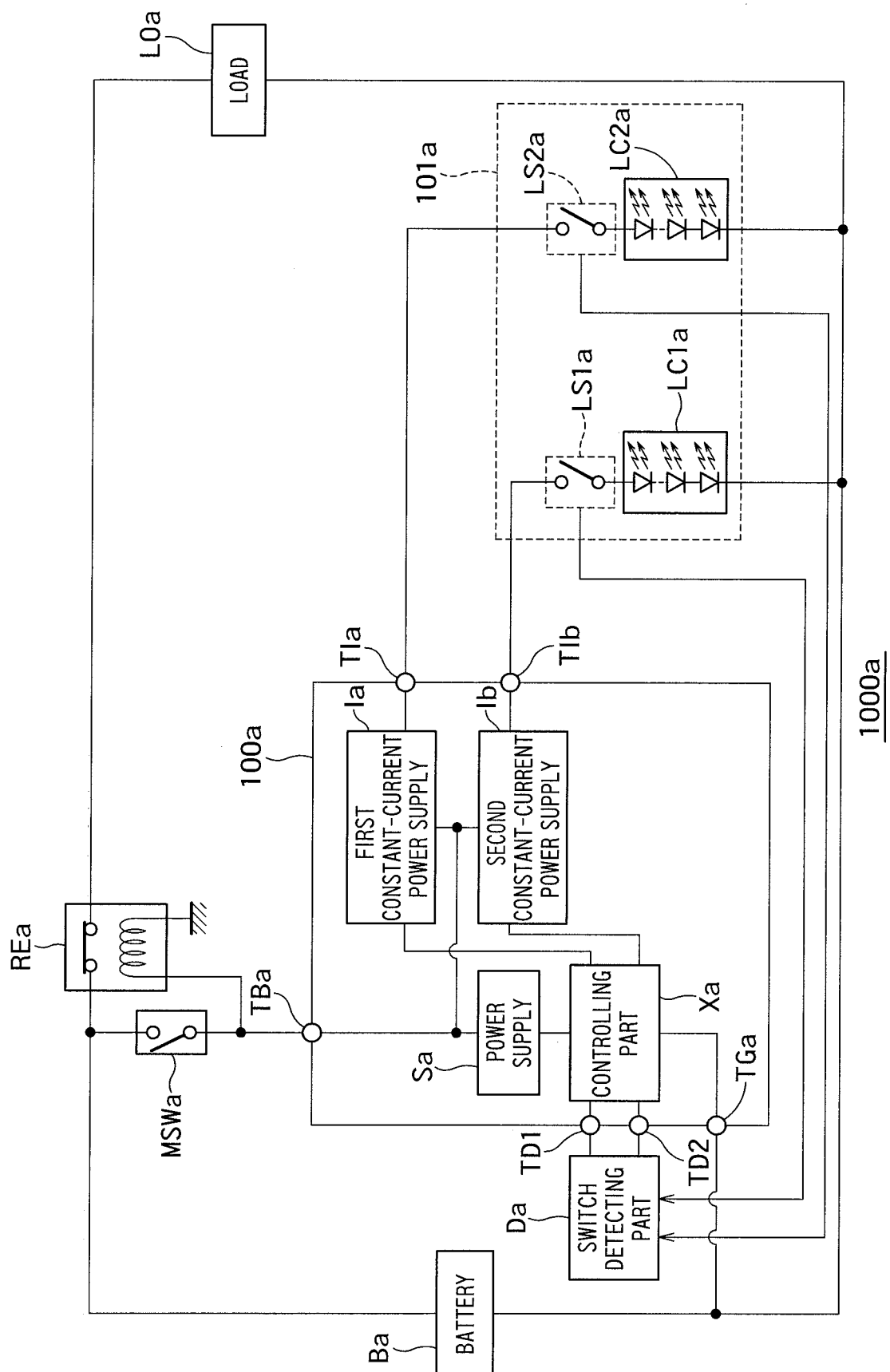


FIG. 2

REFERENCES CITED IN THE DESCRIPTION

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