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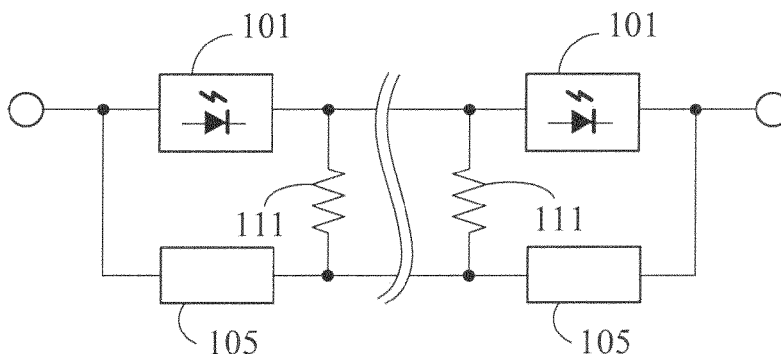
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(54) **LED device with voltage-limiting unit and shunt current-limiting resistance**

(57) The present invention provides a LED device with the voltage-limiting unit and the shunt current-limiting resistance wherein a voltage-limiting unit is connected in series with a current-limiting resistance then connected in parallel with two ends of a LED, so that to con-

stitute the light-emitting unit, thereby when plural of the light-emitting units are connected in series (including connected in series and parallel), the current of LED loaded with higher end voltage passing through the voltage-limiting unit is prevented to be overly high when subject to abnormal high voltage.

FIG. 3



Description

BACKGROUND OF THE INVENTION

(a) Field of the invention

[0001] According to the present invention, hereinafter the term "LED" is the abbreviation of the light-emitting diode.

[0002] The present invention relates to a LED device with voltage-limiting unit and shunt current-limiting resistance in which a voltage-limiting unit is connected in series with a current-limiting resistance then connected in parallel with two ends of a LED for limiting the shunt current passing through the voltage-limiting unit.

(b) Description of the Prior Art

[0003] Conventional LEDs usually parallel connect with the voltage-limiting units at two ends of each LED, such as the zener diode, to constitute the light-emitting unit, thereby when the end voltage of LED is abnormally increased, the abnormal voltage is absorbed by the zener diode; however, when the light-emitting units being parallel connected by the above mentioned LED and the zener diode are series connected (including series-parallel connected) in plural sets to constitute the light-emitting unit, the voltage is not able to be evenly distributed due to the different properties of the LED and the zener diode, so that when subject to abnormal high voltage, the LED loaded with higher end voltage is passed by the higher current therefore the LED is often damaged.

SUMMARY OF THE INVENTION

[0004] The present invention provides a LED device with the voltage-limiting unit and the shunt current-limiting resistance wherein a voltage-limiting unit is connected in series with a current-limiting resistance then connected in parallel with two ends of a LED, so that to constitute the light-emitting unit, thereby when plural of the light-emitting units are connected in series (including connected in series and parallel), the current of LED loaded with higher end voltage passing through the voltage-limiting unit is prevented to be overly high when subject to abnormal high voltage.

[0005] According to one aspect of the present invention, a light emitting unit comprises:

an LED (101);
a voltage limiting unit (105) and
a current limiting resistance (111) connected in parallel with the LED (101);

wherein the voltage limiting unit (105) is a semi-conductor unit with a property of resistance which rapidly reduces when subject to overvoltage,

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The present invention will be apparent to those skilled in the art by reading the following detailed description of a preferred embodiment thereof, with reference to the attached drawings, in which:

FIG. 1 is a circuit schematic diagram showing that a conventional light-emitting unit is constituted by a LED connected in parallel with a voltage-limiting unit. FIG. 2 is a circuit schematic diagram showing that a light-emitting unit is constituted by a voltage-limiting unit being connected in series with a current-limiting resistance then connected in parallel with two ends of a LED, according to the present invention.

FIG. 3 is a circuit schematic diagram showing that two or more than two of the light-emitting units as shown in FIG. 2 are series-connected or series-parallel connected in the same polarity to constitute the light-emitting unit set.

FIG. 4 is an applied circuit schematic diagram showing that two or more than two of the light-emitting unit sets as shown in FIG. 3 are connected in series in the reverse polarity.

FIG. 5 is an applied circuit schematic diagram showing that two ends of the light-emitting unit set as shown in FIG. 3 are connected in parallel in the reverse polarity with a diode.

FIG. 6 is an applied circuit schematic diagram showing that two ends of the reverse-polarity series light-emitting unit sets as shown in FIG. 4 are respectively connected in parallel in the reverse polarity with a diode.

FIG. 7 is a circuit schematic diagram showing that plural sets of the light-emitting units, which are constituted by the LED connected in parallel with a voltage-equalizing resistance, and a voltage-limiting unit being connected in series with a current-limiting resistance then connected in parallel with the LED, are connected in series or in series-parallel in the same polarity to constitute the light-emitting unit set.

FIG. 8 is an applied circuit schematic diagram showing that two of the light-emitting unit sets as shown in FIG. 7 are in reverse-polarity series connection.

DESCRIPTION OF MAIN COMPONENT SYMBOLS

[0007]

101: LED Light-emitting diode
105: Voltage-limiting unit
106: Diode
107: Voltage-equalizing resistance
111: Current-limiting resistance

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0008] Conventional LEDs usually parallel connect with the voltage-limiting units at two ends of each LED, such as the zener diode, to constitute the light-emitting unit, thereby when the end voltage of LED is abnormally increased, the abnormal voltage is absorbed by the zener diode; however, when the light-emitting units being parallel connected by the above mentioned LED and the zener diode are series connected (including series-parallel connected) in plural sets to constitute the light-emitting unit, the voltage is not able to be evenly distributed due to the different properties of the LED and the zener diode, so that when subject to abnormal high voltage, the LED loaded with higher end voltage is passed by the higher current therefore the LED is often damaged.

[0009] The present invention provides a LED device with voltage-limiting unit and shunt current-limiting resistance in which a LED is connected in parallel with a voltage-limiting unit, and a current-limiting resistance is connected in series between the LED and the voltage-limiting unit for limiting the shunt current passing through the voltage-limiting unit.

[0010] Referring to FIG. 1, which is a circuit schematic diagram showing that a conventional light-emitting unit is constituted by a LED being connected in parallel with a voltage-limiting unit;

[0011] As shown in FIG. 1, a light-emitting unit is constituted by a LED being connected in parallel with a zener diode.

[0012] Referring to FIG. 2, which is a circuit schematic diagram showing that a light-emitting unit is constituted by a voltage-limiting unit being connected in series with a current-limiting resistance then connected in parallel with two ends of a LED, according to the present invention;

[0013] As shown in FIG. 2, it mainly consists of:

- LED (101): constituted by the light emitting diode;
- Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;
- Current-limiting resistance (111): constituted by a resistive unit and served to be installed between the LED (101) and the voltage-limiting unit (105);

Wherein a light-emitting unit is structured through series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with two ends of the LED (101).

[0014] Referring to FIG. 3, which is a circuit schematic diagram showing that two or more than two of the light-emitting units as shown in FIG. 2 are series-connected or series-parallel connected in the same polarity to constitute the light-emitting unit set;

[0015] As shown in FIG. 3, it mainly consisted of:

- LED (101): constituted by the light emitting diode;
- Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;
- Current-limiting resistance (111): constituted by a resistive unit and served to be installed between the LED (101) and the voltage-limiting unit (105);

10 Wherein a light-emitting unit is structured through series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with two ends of the LED (101);

15 **[0016]** A light-emitting unit set is structured through series-connecting or series-parallel connecting two or more than two of the mentioned light-emitting units in the same polarity.

20 **[0017]** Referring to FIG. 4, which is an applied circuit schematic diagram showing that two or more than two of the light-emitting unit sets as shown in FIG. 3 are connected in series in the reverse polarity;

[0018] As shown in FIG. 4, it mainly consists of:

- LED (101): constituted by the light emitting diode;
 - Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;
 - Current-limiting resistance (111): constituted by a resistive unit and served to be installed between the LED (101) and the voltage-limiting unit (105);
- 35 Wherein a light-emitting unit is structured through series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with two ends of the LED (101);
- A light-emitting unit set is structured through series-connecting or series-parallel connecting two or more than two of the mentioned light-emitting units in the same polarity;

40 **[0019]** The LED device is structured through series-connecting two or more than two sets of mentioned light-emitting unit sets in the reverse polarity.

45 **[0020]** Referring to FIG. 5, which is an applied circuit schematic diagram showing that two ends of the light-emitting unit set as shown in FIG. 3 are connected in parallel in the reverse polarity with a diode;

[0021] As shown in FIG. 5, it mainly consisted of:

- LED (101): constituted by the light emitting diode;
- Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;
- Current-limiting resistance (111): constituted by a resistive unit and served to be installed between the LED (101) and the voltage-limiting unit (105);

Wherein a light-emitting unit is structured through series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with two ends of the LED (101);

[0022] A light-emitting unit set is structured through series-connecting or series-parallel connecting two or more than two of the mentioned light-emitting units in the same polarity;

[0023] Two ends of the mentioned light-emitting unit sets, which are series connected in the same polarity, are connected in parallel in the reverse polarity with a diode (106).

[0024] Referring to FIG. 6, which is an applied circuit schematic diagram showing that two ends of the reverse-polarity series light-emitting unit sets as shown in FIG. 4 are respectively connected in parallel in the reverse polarity with a diode;

[0025] As shown in FIG. 6, it mainly consists of:

- LED (101): constituted by the light emitting diode;
- Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;
- Current-limiting resistance (111): constituted by a resistive unit and served to be installed between the LED (101) and the voltage-limiting unit (105);

Wherein a light-emitting unit is structured through series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with two ends of the LED (101);

[0026] A light-emitting unit set is structured through series-connecting or series-parallel connecting two or more than two of the mentioned light-emitting units in the same polarity;

[0027] Two or more than two of the mentioned light-emitting unit sets are further connected in series in the reverse polarity;

[0028] FIG. 7 is a circuit schematic diagram showing that plural sets of the light-emitting units, which are constituted by the LED connected in parallel with a voltage-equalizing resistance, and a voltage-limiting unit being connected in series with a current-limiting resistance then connected in parallel with the LED, are connected in series or in series-parallel in the same polarity to constitute the light-emitting unit set.

[0029] As shown in FIG. 7, it mainly consists of:

- LED (101): constituted by the light emitting diode;
- Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;
- Voltage-equalizing resistance (107): constituted by the resistive unit and served to be parallel connected at two ends of each LED;
- Current-limiting resistance (111): constituted by

the resistive unit and served to be installed between the LED (101) and the voltage-limiting unit (105);

wherein a light-emitting unit is structure through parallel-connecting the LED (101) with the voltage-equalizing resistance (107), and series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with the LED (101);

[0030] A light-emitting unit set is structured through series-connecting or series-parallel connecting two or more than two of the mentioned light-emitting units in the same polarity.

[0031] Referring to FIG. 8, which is an applied circuit schematic diagram showing that two of the light-emitting unit sets as shown in FIG. 7 are in reverse-polarity series connection.

[0032] As shown in FIG. 8, it mainly consists of:

- LED (101): constituted by the light emitting diode;
- Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;
- Voltage-equalizing resistance (107): constituted by the resistive unit and served to be parallel connected at two ends of each LED;
- Current-limiting resistance (111): constituted by the resistive unit and served to be installed between the LED (101) and the voltage-limiting unit (105);

wherein a light-emitting unit is structure through parallel-connecting the LED (101) with the voltage-equalizing resistance (107), and series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with the LED (101);

[0033] A light-emitting unit set is structured through series-connecting or series-parallel connecting two or more than two of the mentioned light emitting units in the same polarity;

[0034] Two or more than two of the mentioned light-emitting unit sets are connected in series in the reverse polarity.

[0035] In the mentioned light-emitting unit sets of different polarity sides, which are connected in series in the reverse polarity, two of the plural series-connected or series-parallel connected light-emitting unit sets in the same polarity are respectively connected in parallel in the reverse polarity with a diode (106).

[0036] According to the LED device with voltage-limiting unit and shunt current-limiting resistance of the present invention, the mentioned LED (101) can not only be structured with a single LED (101), but two or more than two LEDs (101) can be provided for structuring a LED unit through connecting the LEDs in series, in parallel or in series and parallel to replace the single LED (101.).

[0037] According to the LED device with voltage-limiting unit and shunt current-limiting resistance of the

present invention, the voltage-limiting protective unit consists one or more than more of the following units, wherein one or more than one units being in same-polarity series, parallel or series and parallel connection, which include:

- zener diode;
- varistor;
- diode with property of forward voltage drop;
- zener diode with property of reverse-polarity forward voltage drop.

[0038] According to the present invention, the power source for the provided LED device can be a constant-current power source or constant-voltage power source, or a current-limiting power source or voltage-limiting power source, or a power source wherein voltage and current not being particularly controlled; for cooperating the operation of the voltage-limiting unit of the present invention, an internal impedance at an output end of the power source or an impedance unit between the output end of the power source and the loading can be further provided, so when the voltage of the power source is altered, the current passing through the voltage-limiting unit generates a voltage drop at the two ends of the impedance unit, and a voltage regulation effect is provided to the voltage at the two ends of the LED device of the present invention.

[0039] Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific examples of the embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

Claims

1. A LED device with voltage-limiting unit and shunt current-limiting resistance, wherein a light-emitting unit is structured through a voltage-limiting unit being connected in series with a current-limiting resistance then connected in parallel with two ends of a LED, and it mainly consists of:

- LED (101): constituted by the light emitting diode;
- Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;
- Current-limiting resistance (111): constituted

by a resistive unit and being installed between the LED (101) and the voltage-limiting unit (105);

Wherein a light-emitting unit is structured through series connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel connecting with two ends of the LED (101).

2. The LED device with voltage-limiting unit and shunt current-limiting resistance as claimed in claim 1, wherein it includes the constitution that two or more than two of the mentioned light-emitting units are series-connected or series-parallel connected in the same polarity to constitute the light-emitting unit sets, and it mainly consists of:

- LED (101): constituted by the light emitting diode;
- Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;
- Current-limiting resistance (111): constituted by a resistive unit and being installed between the LED (101) and the voltage-limiting unit (105);

Wherein a light-emitting unit is structured through series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with two ends of the LED (101);

A light-emitting unit set is structured through series-connecting or series-parallel connecting two or more than two of the mentioned light-emitting units in the same polarity.

3. The LED device with voltage-limiting unit and shunt current-limiting resistance as claimed in claim 2, wherein the constitution includes that two or more than two of the mentioned light-emitting unit sets are connected in series in the reverse polarity, and it mainly consists of:

- LED (101): constituted by the light emitting diode;
- Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;
- Current-limiting resistance (111): constituted by a resistive unit and being installed between the LED (101) and the voltage-limiting unit (105);

Wherein a light-emitting unit is structured through series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with two ends of the LED (101);

A light-emitting unit set is structured through series-connecting or series-parallel connecting two or more

than two of the mentioned light-emitting units in the polarity;

The LED device is structured through series-connecting two or more than two sets of mentioned light-emitting unit sets in the reverse polarity.

4. The LED device with voltage-limiting unit and shunt current-limiting resistance as claimed in claim 2, wherein the constitution includes that two ends of the light-emitting unit set are connected in parallel in the reverse polarity with a diode;

--LED (101): by the light

--LED (101): constituted by the light emitting diode; unit,

--Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;

--Current-limiting resistance (111): constituted by a resistive unit and being between the LED (101) and the voltage-limiting unit (105);

Wherein a light-emitting unit is structured through series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with two ends of the LED (101);

A light-emitting unit set is structured through series-connecting or series-parallel connecting two or more than two of the mentioned light-emitting units in the same polarity,

Two ends of the mentioned light-emitting unit sets, which are series connected in the same polarity, are connected in parallel in the reverse polarity with a diode (106).

5. The LED device with voltage-limiting unit and shunt current-limiting resistance as claimed in claim 3, wherein the constitution includes that two ends of the two reverse-polarity series light-emitting unit sets are respectively connected in parallel in the reverse polarity with a diode, and it mainly consists of:

--LED (101): constituted by the light emitting diode,

--Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;

--Current-limiting resistance (111): constituted by a resistive unit and being installed between the LED (101) and the voltage-limiting unit (105);

Wherein a light-emitting unit is structured through series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with two ends of the LED (101);

A light-emitting unit set is structured through series-

connecting or series-parallel connecting two or more than two of the mentioned light-emitting units in the same polarity;

Two or more than two of the mentioned light-emitting unit sets are further connected in series in the reverse polarity;

In the mentioned light-emitting unit sets of different polarity sides, which are connected in series in the reverse polarity, two ends of the plural series-connected or series-parallel connected light-emitting unit sets in the same polarity are respectively connected in parallel in the reverse polarity with a diode (106).

6. The LED device with voltage-limiting unit and shunt current-limiting resistance as claimed in claim 1, wherein its constitution includes that plural sets of the light-emitting units, which are constituted by the LED connected in parallel with a voltage-equalizing resistance, and a voltage-limiting unit being connected in series with a current-limiting resistance then connected in parallel with the LED, are connected in series or in series-parallel in the same polarity to constitute the light-emitting unit set, and it mainly consists of:

--LED (101): constituted by the light emitting diode;

--Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage;

--Voltage-equalizing resistance (107): constituted by the resistive unit and served to be parallel connected at two ends of each LED;

--Current-limiting resistance (111): constituted by the resistive unit and served to be installed between the LED (101) and the voltage-limiting unit (105);

wherein a light-emitting unit is structure through parallel-connecting the LED (101) with the voltage-equalizing resistance (107), and series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel -connecting with the LED (101);

A light-emitting unit set is structured through series-connecting or series-parallel connecting two or more than two of the mentioned light-emitting units in the same polarity.

7. The LED device with voltage-limiting unit and shunt current-limiting resistance as claimed in claim 6, wherein its constitution includes that two of the light-emitting unit sets are in reverse-polarity series connection, and it mainly consists of:

--LED (101): constituted by the light emitting di-

ode;

--Voltage-limiting unit (105): constituted by a semiconductor unit, e.g. a zener diode or a varistor, with a property of the resistance thereof being rapidly dropped when subject to overvoltage; 5

--Voltage-equalizing resistance (107): constituted by the resistive unit and served to be parallel connected at two ends of each LED;

--Current-limiting resistance (111): constituted by the resistive unit and served to be installed between the LED (101) and the voltage-limiting unit (105); 10

wherein a light-emitting unit is structure through parallel-connecting the LED (101) with the voltage-equalizing resistance (107), series-connecting the voltage-limiting unit (105) with the current-limiting resistance (111) then parallel-connecting with the LED (101); 15

A light-emitting unit set is structured through series-connecting or series-parallel connecting two or more than two of the mentioned light emitting units in the same polarity; 20

Two or more than two of the mentioned light-emitting unit sets are connected in series in the reverse polarity. 25

8. The LED device with voltage-limiting unit and shunt current-limiting resistance as claimed in claim 1, 2, 3, 4, 5, 6 or 7, wherein the mentioned LED (101) is not only structured with a single LED (101), but two or more than two LEDs (101) are able to be provided for structuring a LED unit through connecting the LEDs in series, in parallel or in series and parallel to replace the single LED (101). 30 35

9. The LED device with voltage-limiting unit and shunt current-limiting resistance as claimed in claims 1, 2, 3, 4, 5, 6 or 7, wherein the voltage-limiting protective unit consists one or more than more of the following units, wherein one or more than one units being in same-polarity series, parallel or series and parallel connection, which include: 40

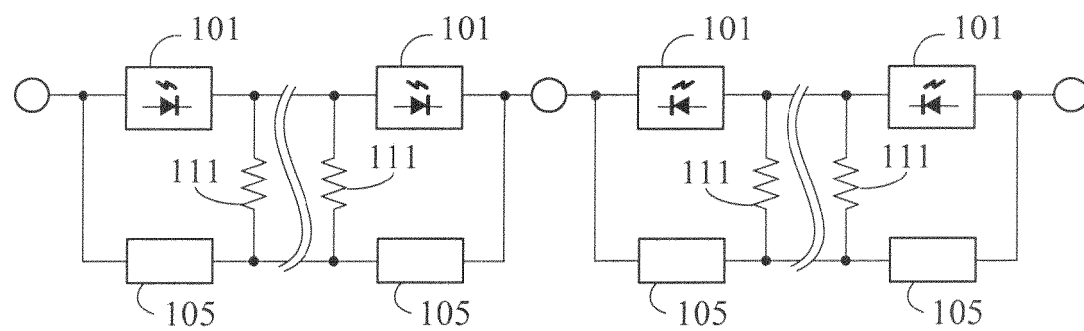
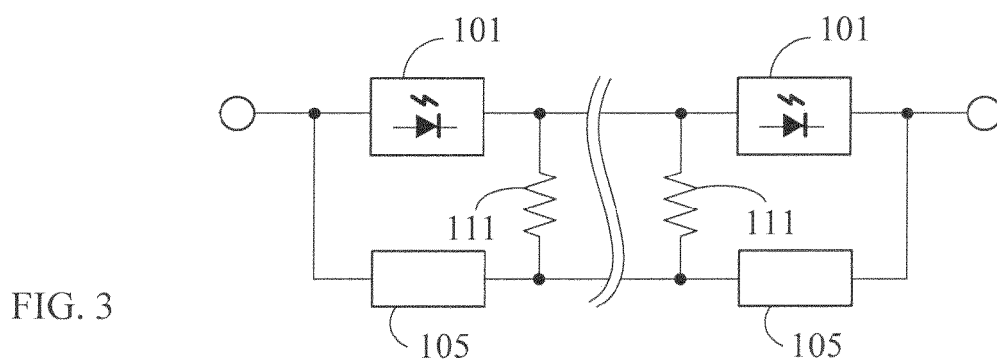
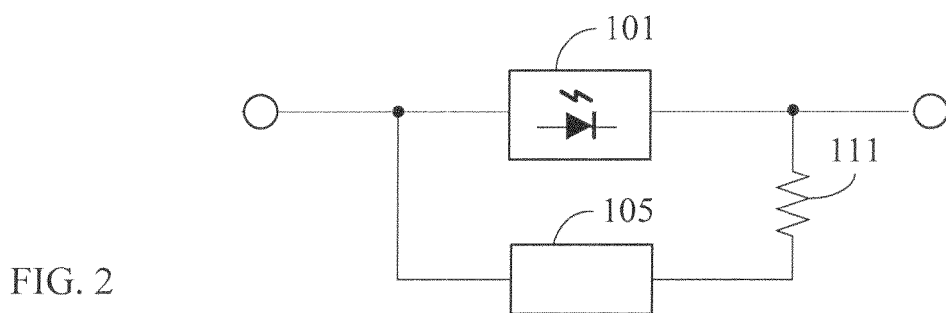
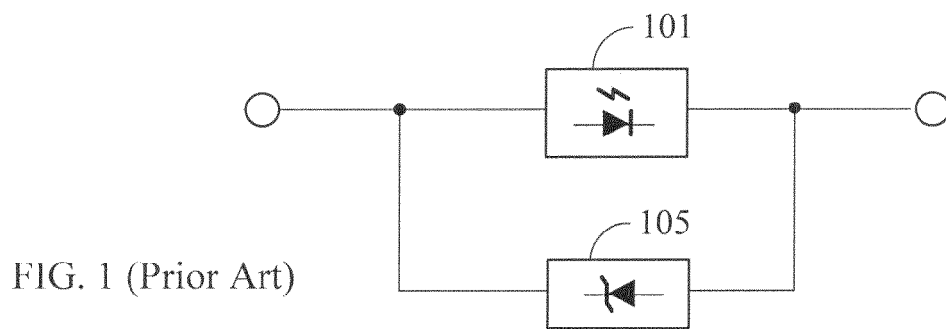
--zener diode, 45

--varistor;

--diode with property of forward voltage drop; and

--zener diode with property of reverse-polarity forward voltage drop. 50

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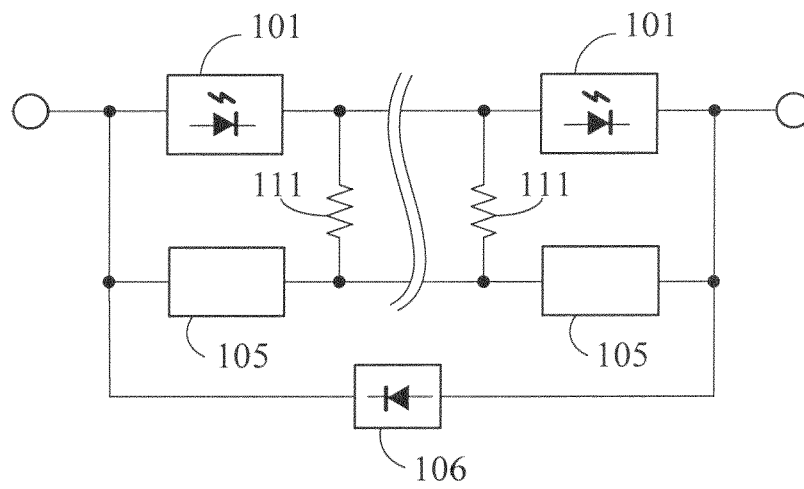


FIG. 5

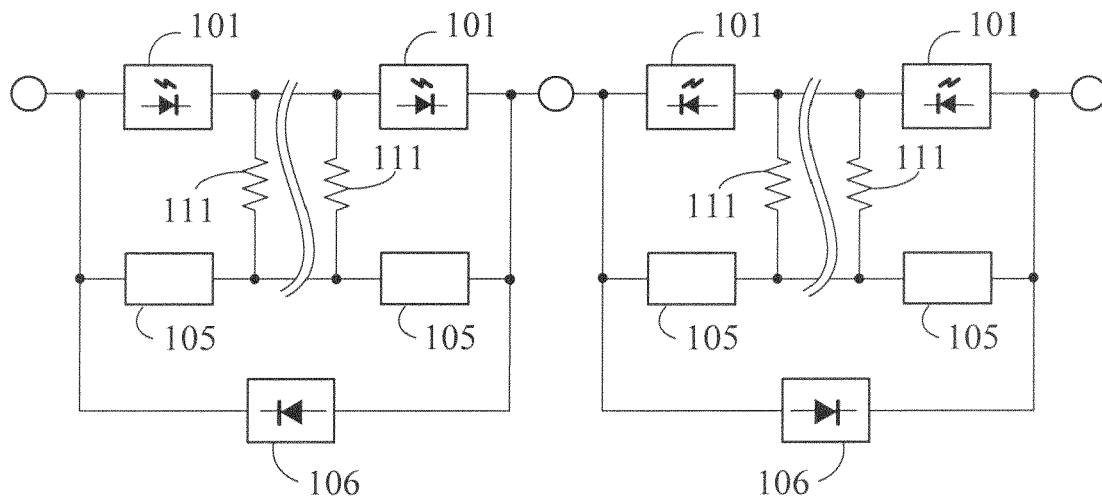


FIG. 6

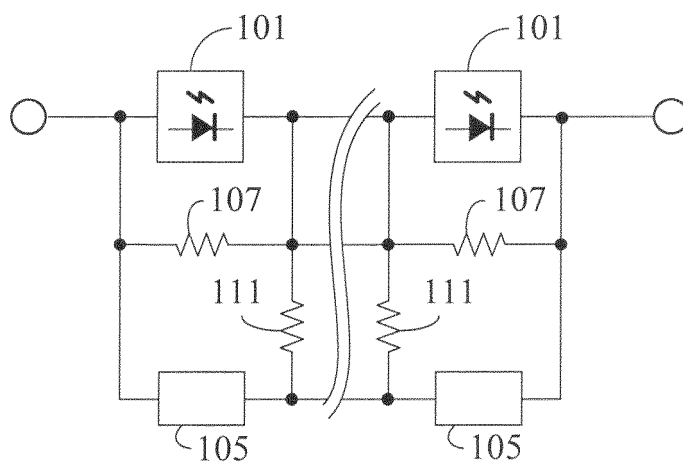


FIG. 7

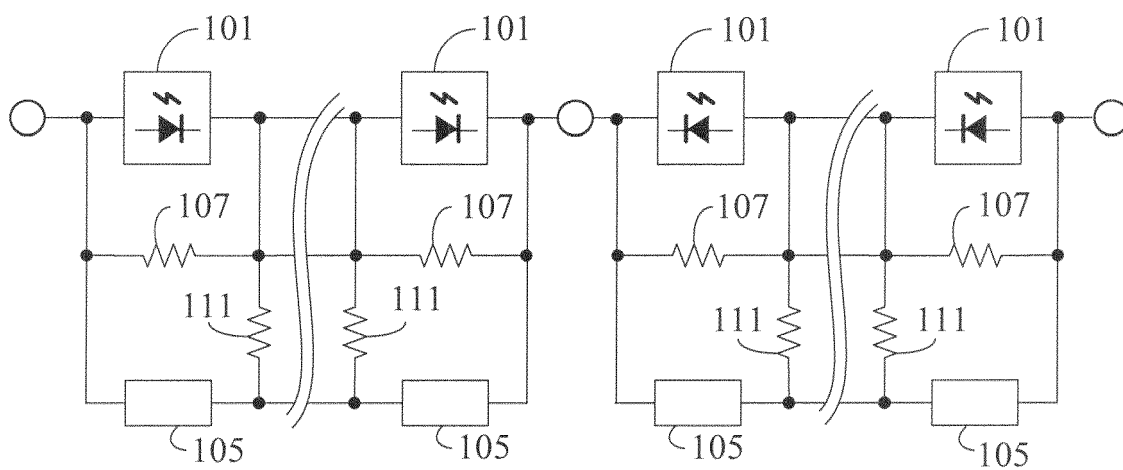


FIG. 8