

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 1 147 687 B1

(12)

EUROPEAN PATENT SPECIFICATION

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

26.01.2005 Bulletin 2005/04

(21) Application number: **00979299.5**

(22) Date of filing: **17.11.2000**

(51) Int Cl.7: **H05B 33/08**, G08G 1/097

(86) International application number:
PCT/CA2000/001380

(87) International publication number:
WO 2001/039553 (31.05.2001 Gazette 2001/22)

(54) **Device for remote monitoring of Led lamps**

Anordnung zur Fernüberwachung von Led Leuchten

Dispositif de surveillance à distance de lampes à Leds

(84) Designated Contracting States:
DE FR GB NL SE

(30) Priority: **19.11.1999 CA 2290203**
05.04.2000 US 543240

(43) Date of publication of application:
24.10.2001 Bulletin 2001/43

(60) Divisional application:
02022506.6 / 1 280 383
02022507.4 / 1 274 285

(73) Proprietor: **Gelcore Company**
Lachine, Quebec H8T 3M6 (CA)

(72) Inventor: **ST-GERMAIN, Nicholas**
St-Bruno, Quebec J3V 6G8 (CA)

(74) Representative: **Texier, Christian et al**
Cabinet Régimbeau
20, rue de Chazelles
75847 Paris cedex 17 (FR)

(56) References cited:
WO-A-99/07186 **WO-A-99/56504**
CA-A- 2 225 005 **FR-A- 2 724 749**
US-A- 6 150 771

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 1 147 687 B1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to the electric supply of light-emitting loads, in particular light-emitting diode (LED) lamps. More specifically, the present invention is concerned with electric circuits required for remote monitoring of LED lamps.

BACKGROUND OF THE INVENTION

[0002] Light-emitting diode (LED) lamps are becoming more and more popular in automotive traffic lights, railway signal lights and other applications. Their lower power consumption is an attractive feature, but the main reason for their popularity is their long life (100 000 hours) compared to standard incandescent lamps (5 000 hours). Manifestly, these features allow important reduction in maintenance costs.

[0003] In certain applications, such as railway signal lights, these lamps may be used, as those skilled in the art would know, for main line signalling and/or grade crossing signalling. Grade crossing signals are usually situated in populated areas such as road intersections. Remote monitoring of the LED lamps in grade crossing signals is therefore not necessary. Main line signals, on the other hand, can be installed in remote areas, which are not easily accessible. Remote monitoring for checking the integrity of the lamps signals is therefore common practice.

[0004] For lamps equipped with standard incandescent bulb, electrical integrity can be easily verified. If the filament of the incandescent bulb is in normal condition, current flows through the bulb according to Ohm's law ($I = V/R$). Otherwise, if the filament is open, no current flows through the bulb and it should be replaced.

[0005] For LED lamps, however, LED current is controlled by a power supply. Current characteristics are therefore not identical in a LED lamp and in an incandescent lamp. In a LED lamp, alternative current (ac) line voltage is rectified and then converted to a suitable level by a dc-dc (direct current) converter, which also regulates LED current. In case of LED failure, or failure of any other electrical component in the LED lamp, it is possible for the power supply to continue drawing current at or near the nominal current value, even if the LED's are not emitting any light. Remote monitoring systems could therefore see the LED lamp as functioning correctly when in reality it is not. This situation is not acceptable since it can lead to very hazardous train operations and cause major accidents.

[0006] Another problem, related to LED lamps and their power supplies and controllers, is caused by electric components which retain residual voltage differentials after power is removed from the LED lamp. The resulting characteristic is that a LED lamp will effectively light up when the power applied to it reaches a first high

level while it will be turned off only when the power reaches a second lower level. The resulting problem is that if a certain power is induced by, for example, other nearby cables, the LED lamp could remain on while in fact it should be off. This could also lead to dangerous situations.

[0007] These particularities of LED lamps limit their widespread use in situations where they need to be remotely monitored such as in railway main line signalling applications.

[0008] Known in the prior art is Patent Application No. WO 99/07186 disclosing a fuse blow-out circuit intended for traffic light monitoring device. This device establishes a short-circuit between the supply lines when the output voltage at the LED load terminals exceeds a certain threshold corresponding to a defect in the LED load. The short-circuit between the supply lines blows a fuse in order to emulate an open filament condition (field incandescent bulb).

[0009] However, in order for the fuse blow-out circuitry to be activated, the converter has to be functional so that the output voltage rises above the threshold level. The invention thus depends on the converter integrity to activate the fuse blow-out.

[0010] Also known in the art is French Patent Application No. 2 724 749 disclosing a traffic light monitoring device. This device has current switch-off means for switching off the LED load when current detecting means detect that the current through the LED load drops below a certain level, in order to emulate an open filament condition. Again, in order for the fuse blow-out circuitry to be activated, the converter must be functional since the blow-out circuitry is activated when the current flowing through the LED load is lower than a certain threshold for a minimum time period.

[0011] In both previously described patent applications, if the converter is damaged and cannot generate the supply voltage (V_{cc}), the fuse blow-out circuitry may not be activated.

OBJECT OF THE INVENTION

[0012] An object of the present invention is therefore to allow LED lamps to become compatible with remote detection systems designed for monitoring of incandescent lamps.

[0013] Another object of the invention is to provide LED lamp circuitry which will emulate an incandescent lamp's behaviour upon remote monitoring of the LED lamp.

SUMMARY OF THE INVENTION

[0014] More specifically, in accordance with the present invention, there is provided a fuse blow-out circuit for establishing a short circuit between first and second voltage and current supply lines to blow out a protection fuse through which a current supplied to a light-

emitting diode (LED) by the first and second lines flows, said fuse blow-out circuit being placed on an input side of a converter supplying the LED from the first and second lines, characterized in that said fuse blow-out circuit comprises:

- a) a timer means responsive to the voltage across said first and second lines for producing a time-representative signal after a certain period of time;
- b) means connected to the timer means for preventing production of the time representative signal in response to the current supplied to the LED; and
- c) means for establishing a current path between the first and second lines in response to the time-representative signal;

whereby when no current is supplied to the LED, said current path is established and provides the short circuit between the first and second lines that will blow out the protection fuse and emulate an open circuit of a defective incandescent lamp.

[0015] Further in accordance with the present invention, there is provided a power supply unit responsive to a voltage and current from a source for supplying a dc voltage and current to a LED comprising:

- a) a rectifier unit rectifying the voltage and current from the source and supplying the rectified voltage and current to first and second voltage and current supply lines;
- b) a protection fuse through which the current from the source is supplied to the rectifier unit;
- c) a converter of the rectified voltage and current into the dc voltage and current supplied to the LED;
- d) a fuse blow-out circuit as recited in claim 2 for establishing a short circuit between the first and second voltage and current supply lines to blow out the protection fuse; and
- e) a controller of the converter in response to the rectified voltage on the first and second lines.

[0016] The embodiments described herein present the advantage that they permit the use of LED lamps in applications, such as railway signal light applications, where there is a need for remote monitoring of the lamps, while keeping the advantageous features of lower power consumption and longer life.

[0017] Other objects, advantages and features of the present invention will become more apparent upon reading of the following non-restrictive description of preferred embodiments thereof, given by way of example only with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] In the appended drawings:

Figure 1 is a schematic block diagram showing a

LED lamp assembly including a fuse blow-out circuit, a cold filament detection circuit, and a turn-off voltage circuit;

Figure 2A is a schematic electrical circuit diagram of a first embodiment of a fuse blow-out circuit according to the invention;

Figure 2B is a schematic electrical circuit diagram of a second embodiment of the fuse blow-out circuit according to the invention;

Figure 3 is a schematic electrical circuit diagram of a cold filament detection circuit which can be used in combination with a fuse blow-out circuit in accordance with the present invention; and

Figure 4 is a schematic electrical circuit diagram of a turn-off voltage circuit which can be used in combination with a fuse blow-out circuit according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Referring to Figure 1, an ac (alternating current) line voltage is supplied to a LED lamp 8 by a voltage and current supply source 10 through a line 11. The AC line voltage is EMI (Electromagnetic Interference) filtered and surge suppressed by means of functional block 12 including an EMI filter, a surge suppressor and an input fuse. Then, the line voltage is rectified through a rectifier 14 and subsequently converted to a DC voltage through a DC-DC converter 20. The DC voltage from the converter 20 is supplied on line 21 to light up a series/parallel LED (light-emitting diodes) array 22. LEDs are also more generally referred to in the present specification as light-emitting loads.

[0020] The current flowing through the series/parallel LED array 22 is sensed by a current sensor 100. This current sensor 100 produces a LED current sense signal 23 supplied to a power factor controller 28. The function of the power factor controller 28 is to control the DC-DC converter 20 through a line 27, which in turn controls the DC current and voltage on line 21.

[0021] In the illustrated example, the series/parallel LED array 22 is formed of a plurality of subsets 26 of five (5) serially interconnected light-emitting diodes 24. Each subset 26 of serially interconnected light-emitting diodes 24 are connected in parallel to form the series/parallel LED array 22. A particularity is that the anodes of the first light-emitting diodes of the subsets 26 are interconnected, the cathodes the first light-emitting diodes of the subsets 26 and the anodes of the second light-emitting diodes of the subsets 26 are interconnected, the cathodes of the second light-emitting diodes of the subsets 26 and the anodes of the third light-emitting diodes of the subsets 26 are interconnected, the cath-

odes of the third light-emitting diodes of the subsets 26 and the anodes of fourth light-emitting diodes of the subsets 26 are interconnected, the cathodes of the fourth light-emitting diodes of the subsets 26 and the anodes of the fifth light-emitting diodes of the subsets 26 are interconnected, and the cathodes of the fifth light-emitting diodes of the subsets 26 are interconnected. Of course, other types of arrangements comprising various numbers of LEDs are possible within the scope of the present invention.

[0022] Various embodiments of EMI filter (block 12), surge suppressor (block 12), input fuse (block 12), rectifier 14 and DC-DC converter 20 can be used. These embodiments are well known to those of ordinary skill in the art and, accordingly, will not be further described in the present specification. Also, in a preferred embodiment of the invention, a Motorola® MC33262P integrated circuit (IC) chip is used as power factor controller 28. However, it is within the scope of the present invention to use other IC chips commercially available on the market, or that will become available on the market in the future.

[0023] Figure 1 shows a fuse blow-out circuit 16, a cold filament detection circuit 18 and a turn-off voltage circuit 30. These circuits will be described in greater detail hereinafter.

FUSE BLOW-OUT CIRCUIT

[0024] Referring to Figure 2A, a first embodiment of the fuse blow-out circuit is shown and generally designated by the reference 16. The fuse blow-out circuit 16 receives the rectified voltage from output terminal 15 of the rectifier 14 on an input 48. The fuse blow-out circuit 16 also comprises a second input 49 to receive the LED current sense signal 23 from the current sensor 100. As long as no LED current sense signal 23 appears on the input 49, a FET (Field-Effect Transistor) transistor 42 is turned off. While transistor 42 is turned off, capacitor 34 is being charged through resistor 31 and diode 32 from the voltage supplied on the input 48. Concurrently, capacitor 41 is being charged through resistor 31, diode 32 and resistor 37. When the voltage across capacitor 41 reaches the breakdown voltage of Zener diode 40 having its anode grounded through resistor 47 (while transistor 42 is still turned off), silicon bilateral switch (or triac) 38 turns on to supply a current to a trigger electrode 103 of a thyristor 39 to thereby trigger this thyristor 39. Triggering of the thyristor 39 into conduction creates a short-circuit between output terminal 15 of rectifier 14 (see Figures 1 and 2A) and a ground output terminal 101 of the same rectifier 14.

[0025] This short-circuit will effectively blow out the input fuse of functional block 12, thereby opening the circuit. Detection of that open circuit will indicate that the lamp is defective thereby emulating the open circuit of a defective incandescent lamp.

[0026] It is to be noted that the sequence of events

described above will only take place after a given period of time (fuse blow-out time) has lapsed during which no current is sensed by current sensor 100. This given period of time is constant and is dependent on the values of resistor 31, resistor 33, resistor 35 and capacitor 34.

[0027] If, on the other hand, a LED current sense signal 23 is supplied to the input 49 prior to the end of the above mentioned given period of time, this LED current sense signal 23 is applied to the gate electrode 102 of FET transistor 42 through resistor 43 to turn this transistor 42 on. Capacitor 41 then discharges to the ground 101 through resistor 36 and the source/drain junction of transistor 42. Accordingly, capacitor 41 will never become fully charged, the breakdown voltage of Zener diode 40 will never be reached, and no short circuit will be created between the terminals 15 and 101 of rectifier 14. Then, the input fuse of functional block 12 will remain intact.

[0028] Referring to Figure 2B, a second embodiment of the fuse blow-out circuit is shown and still designated by the reference 16. Again, the fuse blow-out circuit 16 comprises the input 48 to receive the rectified voltage from terminal 15 of the rectifier 14. The fuse blow-out circuit 16 also comprises the second input 49 receiving the LED current sense signal 23 from the current sensor 100 (Figure 1). As long as no LED current sense signal 23 appears on the input 49, FET transistor 42 is turned off. When transistor 42 is turned off, capacitor 34 is being charged through resistor 31 and diode 32 from the voltage supplied on the input 48. When the voltage across the capacitor 34 reaches the breakdown voltage of the Zener diode 44, (while transistor 42 is still turned off) Zener diode 44 starts conducting current. A current is then supplied to the base of a PNP transistor 45 through resistor 31, diode 32 and Zener diode 44 to turn this transistor 45 on. When turned on, the collector/emitter junction of the transistor 45 becomes conductive to supply a current to the gate electrode of a FET transistor 46. This turns the FET transistor 46 on to establish a short circuit between output terminals 15 and 101 of the rectifier 14 through the source/drain junction of the FET transistor 46. As illustrated, the emitter of the transistor 45 and the gate electrode of the transistor 46 are both connected to the ground through a resistor 47.

[0029] This short circuit will effectively blow out the input fuse of block 12, thereby opening the circuit. Detection of that open circuit will indicate that the LED lamp 8 is defective thereby emulating the open circuit of a defective incandescent lamp.

[0030] It should be noted that the sequence of events described above will only take place after a given period of time (fuse blow-out time) has lapsed during which no LED current sense signal 23 appears on the input 49. This given period of time is constant and depends on the values of resistor 31, resistor 33, resistor 35 and capacitor 34.

[0031] If, on the other hand, the LED current sense signal 23 appears on the input 49 prior to lapsing of the

above mentioned given period of time, this signal 23 is supplied to the gate electrode 102 of FET transistor 42 to thereby turn transistor 42 on. This connects the positive terminal of capacitor 34 to ground 101 through resistor 36 to thereby discharge capacitor 34. In this case, the breakdown voltage of Zener diode 44 will never be reached, transistor 45 will remain turned off, and no short circuit will be created between output terminals 15 and 101 of rectifier 14. The input fuse of block 12 will, in this case, remain intact.

[0032] It should be noted that the "fuse blow-out time" must be longer than the "LED current set up time". For example, in an embodiment, the LED current set up time is approximately 100 msec. Just a word to specify that the "LED current set up time" is the period of time between switching the LED lamp on and appearance of the LED current sense signal 23 at input 49.

COLD FILAMENT DETECTION CIRCUIT

[0033] The cold filament detection circuit 18 of Figure 3 is used to simulate an incandescent lamp as seen by a lamp proving system. Lamp proving is usually performed by sending a voltage pulse on the voltage supply line 11, and verifying that current rises to a certain level, within a certain period of time. This represents the behaviour of an incandescent lamp, which is equivalent to a simple resistor.

[0034] A LED lamp uses a power supply which has a current set up time. Therefore, when sending a pulse on line 11, the current will not rise immediately, but only after the power factor controller 28 is turned on (for example after about 100 msec in an embodiment). The cold filament detection circuit 18 of Figure 3 solves this problem.

[0035] As soon as power is supplied on line 11, the voltage drop across resistor 51, connected between the output terminal 15 (input 56 of the cold filament detection circuit 18) and a gate electrode 104 of a FET transistor, will turn on this transistor 53. This will connect resistor 52 between the output terminals 15 and 101 of the rectifier 14.

[0036] When power is applied on line 11 for a period of time which is longer than the LED current set up time, the LED current sense signal 23 will be supplied on an input 57 of the cold filament detection circuit 18. This signal 23 is applied to the base 105 of a PNP transistor 54 to turn on this transistor 54 thereby turning transistor 53 off by forcing its gate electrode 104 to the ground 101. The cold filament detection circuit 18 is thereby disabled to enable the LED lamp 8 to operate normally. Biasing resistor 50 and Zener diode 55 are connected in series between the input 56 and the base electrode 105. Biasing resistor 50 is also used for overvoltage protection.

[0037] The cold filament detection circuit 18 also serves as a back up for the fuse blow-out circuit 16. If fuse blow-out circuit 16 was to fail (that is, it does not

cause a short circuit to blow out the input fuse of block 12 when in fact it should), transistor 53 would remain turned on since no LED current sense signal 23 would appear on input 57. The current draw through resistor 52 is sufficiently high to blow out the input fuse of block 12 after a certain period of time. For example, in an embodiment of the invention, this time period is of a few minutes.

TURN-OFF VOLTAGE CIRCUIT

[0038] The turn-off voltage circuit 30 of Figure 4 simply inhibits the power factor controller 28 (see Figure 1) when the input voltage on line 11 of the circuit 30 is below a first predetermined trigger voltage.

[0039] The turn-off voltage circuit 30 comprises an input 70 supplied with the voltage on the output terminal 15 of the rectifier 14. The first predetermined trigger voltage 72 is determined by a voltage divider comprising resistors 60 and 69 serially connected between the input 70 of the turn-off voltage circuit 30 and the ground 101. The first predetermined trigger voltage is established after a capacitor 68 has been charged through the resistor 60 and the diode 61, i.e. after a given period of time following application of the voltage on the input 70. This period of time is determined by the values of the resistors 60, 69 and 107 and of the capacitor 68.

[0040] The first predetermined trigger voltage 72 is applied to a gate electrode 106 of a FET transistor 65 through the diode 61. When the first trigger voltage 72 reaches the breakdown voltage of the gate electrode 106 of the FET transistor 65, transistor 65 is turned on.

[0041] The turn-off voltage circuit 30 comprises a terminal 71 connected to a control terminal 29 of the power factor controller 28. Before the transistor 65 is turned on, the power factor controller 28 produces a voltage drop across high impedance resistor 62, to thereby produce a second trigger voltage 73, which in turn turns on a FET transistor 63. This in turn creates a low impedance path comprising resistor 67 between terminal 29 of the power factor controller 28 and the ground 101. As long as transistor 63 is turned on, the voltage on terminal 29 of power factor controller 28 will be lower than the voltage level required to turn on the power factor controller 28.

[0042] When transistor 65 is turned on, this will modify the second trigger voltage 73 thereby turning off transistor 63. The voltage on terminal 29 will then reach the level required to turn on the power factor controller 28, due to the high impedance value of the resistor 62.

[0043] Note that the LED lamp 8 will not be turned on until the first trigger voltage 72 is reached and once the lamp 8 is lit, it will stay on until the voltage on input 70 produces a first trigger voltage 72 which is below the transistor 65 trigger voltage (breakdown voltage of the gate electrode 106).

[0044] Although the present disclosure describes particular types of transistors in the different circuits of Fig-

ures 2A, 28, 3 and 3, it should be kept in mind that these different types of transistors can be substituted or replaced by other available types of transistors.

Claims

1. A fuse blow-out circuit (16) for establishing a short circuit between first (15) and second (101) voltage and current supply lines to blow out a protection fuse (12) through which a current supplied to a light-emitting diode (LED) (22) by the first (15) and second (101) lines flows, said fuse blow-out circuit being placed on the input side of a converter (20) supplying the LED (22) from the first and second lines, **characterized in that** said fuse blow-out circuit (16) comprises:

- a) a timer means responsive to the voltage across said first (15) and second (101) lines for producing a time-representative signal after a certain period of time;
- b) means connected to the timer means for preventing production of the time representative signal in response to the current supplied to the LED (22); and
- c) means for establishing a current path between the first (15) and second (101) lines in response to the time-representative signal;

whereby when no current is supplied to the LED (22), said current path is established and provides the short circuit between the first (15) and second (101) lines that will blow out the protection fuse (12) and emulate an open circuit of a defective incandescent lamp.

2. A fuse blow-out circuit as in claim 1, wherein said timer means comprises a resistor (31) and a capacitor (34) connected in series between the first (15) and second (101) lines, said resistor (31) having a given resistance value, and said capacitor (34) having a given capacitance value and a capacitor charge period dependent on said given resistance value and said given capacitance value; said means connected to the timer means comprises a trigger circuit connected in parallel with the capacitor (41), and comprising a first controllable switch member closed in response to the current supplied to the light-emitting load (22) to discharge said capacitor (41); and said means for establishing a current path comprises a second controllable switch member defining a current path between said first (15) and second (101) lines and closed in response to a given voltage amplitude across the capacitor (41); whereby, in the absence of current supplied to the LED (22) for a duration equivalent to said ca-

pacitor (41) charge period, said given voltage amplitude across said capacitor (41) is reached to thereby close said second switch member, establish said current path and provide the short circuit between the first (15) and second (101) lines that will blow out the protection fuse (12) and emulate an open circuit of a defective incandescent lamp.

3. A fuse blow-out circuit as in claim 1, wherein said first controllable switch member comprises a first transistor (42).
4. A fuse blow-out circuit as in claim 3, wherein said resistor (31) is a first resistor, said capacitor (34) is a first capacitor, and said second controllable switch member comprises:

- a) a second resistor (37) connected in series with a second capacitor (41), said serially interconnected second resistor (37) and second capacitor (41) being connected in parallel with said first capacitor (34);
- b) a semiconductor switch selected from the group consisting of a triac and a silicon bilateral switch (38), said semiconductor switch connected in parallel with said second capacitor (41), said semiconductor switch having first and second semiconductor switch electrodes, and a trigger electrode;
- c) a Zener diode (40) connected between the trigger electrode and one of the first and second semiconductor switch electrodes, said Zener diode (40) having a breakdown voltage value and being responsive to a voltage across said second capacitor (41); and
- d) a thyristor (39) connected between said first (15) and second (101) lines and having a trigger electrode connected to one of said first and second semiconductor switch electrodes;

whereby, in the absence of current supplied to the LED (22) for a duration equivalent to said capacitor (34) charge period, said given voltage amplitude across said first capacitor (34) is reached to thereby charge said second capacitor (41) through said second resistor (37) until said breakdown voltage value of the Zener diode (40) is reached and said semiconductor switch is triggered to thereby trigger said thyristor (39), establish through said thyristor (39) said current path, and provide the short circuit between the first (15) and second (101) lines that will blow the protection fuse (12) and emulate an open circuit of a defective incandescent lamp.

5. A fuse blow-out circuit as in claim 4, further comprising a third resistor (47) connected in series with the first resistor (31) between said first (15) and second (101) lines, wherein said first capacitor (34) is

connected in parallel with the third resistor (47).

6. A fuse blow-out circuit as in claim 3, wherein said second controllable switch member comprises:

- a) a second transistor (45) connected in parallel with said capacitor (34) and having a control electrode;
- b) a Zener diode (44) connected between the control electrode of the second transistor (45) and said capacitor (34), having a breakdown voltage, and being responsive to the voltage across the capacitor (34); and
- c) a third transistor (46) connected between said first (15) and second (101) lines and having a control electrode activated by the second transistor (45);

whereby, in the absence of current supplied to the LED (22) for a duration equivalent to said capacitor (34) charge period, said given voltage amplitude across said capacitor (34) is reached to successively apply said breakdown voltage to the Zener diode (44), turn on said second transistor (45), and turn on said third transistor (46) to establish said current path and provide the short circuit between the first (15) and second (101) lines that will blow out the protection fuse (12) and emulate an open circuit of a defective incandescent lamp.

7. A fuse blow-out circuit as in claim 6, wherein said resistor (31) is a first resistor, and said fuse blow-out circuit (16) further comprises a second resistor (33) connected in series with said first resistor (31), said capacitor (34) being connected in parallel with said second resistor (33).

8. A power supply unit responsive to a voltage and current from a source (10) for supplying a dc voltage and current to a LED (22), comprising:

- a) a rectifier unit (14) rectifying the voltage and current from the source (10) and supplying the rectified voltage and current to first (15) and second (101) voltage and current supply lines;
- b) a protection fuse (12) through which the current from the source is supplied to the rectifier unit (14);
- c) a converter (20) of the rectified voltage and current into the dc voltage and current supplied to the LED (22);
- d) a fuse blow-out circuit (16) as recited in claim 2 for establishing a short circuit between the first (15) and second (101) voltage and current supply lines to blow out the protection fuse (12); and
- e) a controller (28) of the converter in response to the rectified voltage on the first (15) and sec-

ond (101) lines.

9. A power supply unit as in claim 8, wherein said first controllable switch member comprises a first transistor (42).

10. A power supply unit as in claim 9, wherein said resistor (31) is a first resistor, said capacitor (34) is a first capacitor, and said second controllable switch member comprises:

- a) a second resistor (37) connected in series with a second capacitor (41), said serially interconnected second resistor (37) and second capacitor (41) being connected in parallel with said first capacitor (34);
- b) a semiconductor switch selected from the group consisting of a triac (38) and a silicon bilateral switch (38), said semiconductor switch connected in parallel with said second capacitor (41), said semiconductor switch having first and second semiconductor switch electrodes, and a trigger electrode;
- c) a Zener diode (40) connected between the trigger electrode and one of the first and second semiconductor switch electrodes, said Zener diode (40) having a breakdown voltage value and being responsive to a voltage across said second capacitor (41); and
- d) a thyristor (39) connected between said first (15) and second (101) lines and having a trigger electrode (103) connected to one of said first and second semiconductor switch electrodes;

whereby, in the absence of current supplied to the LED (22) for a duration equivalent to said capacitor (34) charge period, said given voltage amplitude across said first capacitor (34) is reached to thereby charge said second capacitor (41) through said second resistor (37) until said breakdown voltage value of the Zener diode (40) is reached and said semiconductor switch is triggered to thereby trigger said thyristor (39), establish through said thyristor (39) said current path and provide the short circuit between the first (15) and second (101) lines that will blow the protection fuse (12) and emulate an open circuit of a defective incandescent lamp.

11. A power supply unit as in claim 10, further comprising a third resistor (33) connected in series with the first resistor (31) between said first (15) and second lines (101), wherein said first capacitor (34) is connected in parallel with the third resistor (33).

12. A power supply unit as in claim 9, wherein said second controllable switch member comprises:

- a) a second transistor (45) connected in parallel

with said capacitor and having a control electrode;

b) a Zener diode (44) connected between the control electrode of the second transistor (45) and said capacitor (34), having a breakdown voltage, and being responsive to the voltage across the capacitor (34), and
c) a third transistor (46) connected between said first (15) and second (101) lines and having a control electrode activated by the second transistor (45);

whereby, in the absence of current supplied to the LED (22) for a duration equivalent to said capacitor (34) charge period, said given voltage amplitude across said capacitor (34) is reached to successively apply said breakdown voltage to the Zener diode (44), turn on said second transistor (45), and turn on said third transistor (46) to establish said current path and provide the short circuit between the first (15) and second (101) lines that will blow out the protection fuse (12) and emulate an open circuit of a defective incandescent lamp.

13. A power supply unit as in claim 12, wherein said resistor (31) is a first resistor, and said fuse blow-out circuit (16) further comprises a second resistor (33) connected in series with said first resistor (31), said capacitor (34) being connected in parallel with said second resistor (33).

Patentansprüche

1. Sicherungsdurchschlagsschaltkreis (16) zum Herstellen eines Kurzschlusses zwischen ersten (15) und zweiten (101) Spannungs- und Stromversorgungsleitungen, um eine Schutzsicherung (12) zum Durchschlag zu bringen, durch die ein einer Leuchtdiode (LED) (22) mittels der ersten (15) und zweiten (101) Leitungen zugeführter Strom fließt, wobei der Sicherungsdurchschlagsschaltkreis an der Eingangsseite eines Wandlers (20) angeordnet ist, der die LED (22) ausgehend von den ersten und zweiten Leitungen versorgt, **dadurch gekennzeichnet, dass** der Sicherungsdurchschlagsschaltkreis (16) umfasst:

a) eine Zeitgebereinrichtung, die auf die Spannung zwischen den ersten (15) und zweiten (101) Leitungen anspricht, um nach einer bestimmten Zeitperiode ein zeitrepräsentatives Signal zu erzeugen,
b) eine Einrichtung, die mit der Zeitgebereinrichtung verbunden ist, um eine Erzeugung des zeitrepräsentativen Signals in Antwort auf den der LED (22) zugeführten Strom zu verhindern, und

c) eine Einrichtung, um einen Stromweg zwischen den ersten (15) und zweiten (101) Leitungen in Antwort auf das zeitrepräsentative Signal herzustellen,

wodurch, wenn kein Strom der LED (22) zugeführt wird, der Stromweg aufgebaut wird und für den Kurzschluss zwischen den ersten (15) und zweiten (101) Leitungen gesorgt wird, der die Schutzsicherung (12) zum Durchschlag bringt und einen offenen Schaltkreis einer fehlerhaften Glühlampe emuliert.

2. Sicherungsdurchschlagsschaltkreis nach Anspruch 1, bei dem

die Zeitgebereinrichtung einen Widerstand (31) und einen Kondensator (34) umfasst, die in Reihe zwischen den ersten (15) und zweiten (101) Leitungen angeschlossen sind, wobei der Widerstand (31) einen vorgegebenen Widerstandswert aufweist und der Kondensator (34) einen vorgegebenen Kapazitätswert und eine Kapazitätsladeperiode aufweist, die von dem vorgegebenen Widerstandswert und dem vorgegebenen Kapazitätswert abhängt,

die mit der Zeitgebereinrichtung verbundene Einrichtung einen Auslöseschaltkreis umfasst, der parallel zu dem Kondensator (41) angeschlossen und ein erstes steuerbares Schaltbauteil umfasst, das in Antwort auf den der LED (22) zugeführten Strom geschlossen wird, um den Kondensator (41) zu laden, und

die Einrichtung zum Herstellen eines Stromwegs ein zweites steuerbares Schalterbauteil umfasst, das einen Stromweg zwischen den ersten (15) und zweiten (101) Leitungen definiert und in Antwort auf eine vorgegebene Spannungsamplitude über der Kapazität (41) geschlossen wird,

wodurch, beim Fehlen von der LED (22) zugeführten Stroms für eine Dauer, die der Ladeperiode des Kondensators (41) entspricht, die vorgegebene Spannungsamplitude über dem Kondensator (41) erreicht wird, um dadurch das zweite Schalterbauteil zu schließen, den Stromweg herzustellen und für den Kurzschluss zwischen den ersten (15) und zweiten (101) Leitungen zu sorgen, der die Schutzsicherung (12) zum Durchschlag bringt und einen offenen Schaltkreis einer fehlerhaften Glühlampe emuliert.

3. Sicherungsdurchschlagsschaltkreis nach Anspruch 1, bei dem das erste steuerbare Schalterbauteil einen ersten Transistor (42) umfasst.

4. Sicherungsdurchschlagsschaltkreis nach Anspruch 3, bei dem der Widerstand (31) ein erster Widerstand ist, der Kondensator (34) ein erster Kondensator ist und das zweite steuerbare Schalterbauteil einen zweiten Widerstand (33) umfasst, der parallel zu dem ersten Widerstand (31) angeschlossen ist, und ein zweites steuerbares Schalterbauteil, das einen zweiten Stromweg zwischen den ersten (15) und zweiten (101) Leitungen definiert, umfasst.

terbauteil umfasst:

- a) einen zweiten Widerstand (37), der in Reihe mit einem zweiten Kondensator (41) angeschlossen ist, wobei der zweite Widerstand (37) und der zweite Kondensator (41), die in Reihe miteinander verbunden sind, parallel zu dem ersten Kondensator (34) angeschlossen sind, 5
- b) einen Halbleiterschalter, der aus der Gruppe ausgewählt ist, die aus einem Triac- und einem bilateralen Siliziumschalter (38) besteht, wobei der Halbleiterschalter parallel zu dem zweiten Kondensator (41) angeschlossen ist, wobei der Halbleiterschalter erste und zweite Halbleiterschalterelektroden und eine Triggerelektrode aufweist, 10
- c) eine Zenerdiode (40), die zwischen der Triggerelektrode und einer der ersten und zweiten Halbleiterschalterelektroden angeschlossen ist, wobei die Zenerdiode (40) einen Durchbruchspannungswert aufweist und auf eine Spannung über dem zweiten Kondensator (41) anspricht, und 15
- d) einen Thyristor (39), der zwischen den ersten (15) und zweiten (101) Leitungen angeschlossen ist und eine Triggerelektrode aufweist, die mit einer der ersten und zweiten Halbleiterschalterelektroden verbunden ist, 20

wodurch, beim Fehlen von der LED (22) zugeführten Stroms für eine Dauer, die der Ladeperiode des Kondensators (34) entspricht, die vorgegebene Spannungsamplitude über dem ersten Kondensator (34) erreicht wird, um dadurch dem zweiten Kondensator (41) über den zweiten Widerstand (37) zu laden, bis der Durchbruchspannungswert der Zenerdiode (40) erreicht wird und der Halbleiterschalter ausgelöst wird, um dadurch den Thyristor (39) auszulösen, über den Thyristor (39) den Stromweg herzustellen und für den Kurzschluss zwischen den ersten (15) und zweiten (101) Leitungen zu sorgen, der die Schutzsicherung (12) zum Durchschlag bringt und einen offenen Schaltkreis einer fehlerhaften Glühlampe emuliert. 25

- 5. Sicherungsdurchschlagsschaltkreis nach Anspruch 4, ferner mit einem dritten Widerstand (47), der zwischen den ersten (15) und zweiten (101) Leitungen in Reihe mit dem ersten Widerstand (31) angeschlossen ist, wobei der erste Kondensator (34) parallel zu dem dritten Widerstand (47) angeschlossen ist. 30
- 6. Sicherungsdurchschlagsschaltkreis nach Anspruch 3, bei dem das zweite steuerbare Schalterbauteil umfasst: 35

- a) einen zweiten Transistor (45), der parallel zu dem ersten Kondensator (34) angeschlossen ist und eine Steuerelektrode aufweist,
- b) einer Zenerdiode (44), die zwischen der Steuerelektrode des zweiten Transistors (45) und dem Kondensator (34) angeschlossen ist, eine Durchbruchspannung aufweist und auf die Spannung über dem Kondensator (34) anspricht, und
- c) einen dritten Transistor (46), der zwischen den ersten (15) und zweiten (101) Leitungen angeschlossen ist und eine von dem zweiten Transistor (45) aktivierte Steuerelektrode aufweist, 40

wodurch, beim Fehlen von der LED (22) zugeführten Stroms für eine Dauer, die der Ladeperiode des Kondensators (34) entspricht, die vorgegebene Spannungsamplitude über dem Kondensator (34) erreicht wird, um nachfolgend die Durchbruchspannung an die Zenerdiode (44) anzulegen, den zweiten Transistor (45) einzuschalten und den dritten Transistor (46) einzuschalten, um den Stromweg herzustellen und für den Kurzschluss zwischen den ersten (15) und zweiten (101) Leitungen zu sorgen, der die Schutzsicherung (12) zum Durchschlag bringt und einen offenen Schaltkreis einer fehlerhaften Glühlampe emuliert. 45

- 7. Sicherungsdurchschlagsschaltkreis nach Anspruch 6, bei dem der Widerstand (31) ein erster Widerstand ist und der Sicherungsdurchschlagsschaltkreis (16) ferner einen zweiten Widerstand (33) umfasst, der in Reihe mit dem ersten Widerstand (31) angeschlossen ist, wobei der Kondensator (34) parallel mit dem zweiten Widerstand (33) angeschlossen ist. 50
- 8. Leistungszufuhreinheit, die auf eine Spannung und einen Strom von einer Quelle (10) anspricht, um eine Gleichspannung und -strom einer LED (22) zuzuführen, mit: 55

- a) einer Gleichrichtereinheit (14), die die Spannung und den Strom von der Quelle (10) gleichrichtet und die gleichgerichtete Spannung und Strom ersten (15) und zweiten (101) Spannungs- und Stromzufuhrleitungen zuführt,
- b) einer Schutzsicherung (12), durch die der Strom von der Quelle der Gleichrichtereinheit (14) zugeführt wird,
- c) einem Wandler (20) der gleichgerichteten Spannung und Strom in die Gleichspannung und -strom, die der LED (22) zugeführt werden,
- d) einem Sicherungsdurchschlagsschaltkreis (16) nach Anspruch 2 zum Herstellen eines Kurzschlusses zwischen den ersten (15) und zweiten (101) Spannungs- und Stromzufuhrlei-

tungen, um die Schutzsicherung (12) zum Durchschlag zu bringen, und
e) einer Steuerungseinrichtung (28) des Wandlers in Antwort auf die gleichgerichtete Spannung an den ersten (15) und zweiten (101) Leitungen.

9. Leistungszufuhreinheit nach Anspruch 8, bei dem das erste steuerbare Schalterbauteil einen ersten Transistor (42) umfasst.

10. Leistungszufuhreinheit nach Anspruch 9, bei dem der Widerstand (31) ein erster Widerstand ist, der Kondensator (34) ein erster Kondensator ist und das zweite steuerbare Schalterbauteil umfasst:

a) einen zweiten Widerstand (37), der in Reihe mit einem zweiten Kondensator (41) angeschlossen ist, wobei der zweite Widerstand (37) und der zweite Kondensator (41), die in Reihe miteinander verbunden sind, parallel zu dem ersten Kondensator (34) angeschlossen sind,

b) einen Halbleiterschalter, der aus der Gruppe ausgewählt ist, die aus einem Triac- und einem bilateralen Siliziumschalter (38) besteht, wobei der Halbleiterschalter parallel zu dem zweiten Kondensator (41) angeschlossen ist, wobei der Halbleiterschalter erste und zweite Halbleiterschalterelektroden und eine Triggerelektrode aufweist,

c) eine Zenerdiode (40), die zwischen der Triggerelektrode und einer der ersten und zweiten Halbleiterschalterelektroden angeschlossen ist, wobei die Zenerdiode (40) einen Durchbruchspannungswert aufweist und auf eine Spannung über dem zweiten Kondensator (41) anspricht, und

d) einen Thyristor (39), der zwischen den ersten (15) und zweiten (101) Leitungen angeschlossen ist und eine Triggerelektrode aufweist, die mit einer der ersten und zweiten Halbleiterschalterelektroden verbunden ist,

wodurch, beim Fehlen von der LED (22) zugeführten Stroms für eine Dauer, die der Ladeperiode des Kondensators (34) entspricht, die vorgegebene Spannungsamplitude über dem ersten Kondensator (34) erreicht wird, um dadurch den zweiten Kondensator (41) über den zweiten Widerstand (37) zu laden, bis der Durchbruchspannungswert der Zenerdiode (40) erreicht wird und der Halbleiterschalter ausgelöst wird, um dadurch den Thyristor (39) auszulösen, über den Thyristor (39) den Stromweg herzustellen und für den Kurzschluss zwischen den ersten (15) und zweiten (101) Leitungen zu sorgen, der die Schutzsicherung (12) zum Durchschlag bringt und einen offenen Schaltkreis einer fehler-

haften Glühlampe emuliert.

11. Leistungszufuhreinheit nach Anspruch 10, ferner mit einem dritten Widerstand (47), der zwischen den ersten (15) und zweiten (101) Leitungen in Reihe mit dem ersten Widerstand (31) angeschlossen ist, wobei der erste Kondensator (34) parallel zu dem dritten Widerstand (47) angeschlossen ist.

12. Leistungszufuhreinheit nach Anspruch 9, bei dem das zweite steuerbare Schalterbauteil umfasst:

a) einen zweiten Transistor (45), der parallel zu dem Kondensator (34) angeschlossen ist und eine Steuerelektrode aufweist,

b) einer Zenerdiode (44), die zwischen der Steuerelektrode des zweiten Transistors (45) und dem Kondensator (34) angeschlossen ist, eine Durchbruchspannung aufweist und auf die Spannung über dem Kondensator (34) anspricht, und

c) einen dritten Transistor (46), der zwischen den ersten (15) und zweiten (101) Leitungen angeschlossen ist und eine von dem zweiten Transistor (45) aktivierte Steuerelektrode aufweist,

wodurch, beim Fehlen von der LED (22) zugeführten Stroms für eine Dauer, die der Ladeperiode des Kondensators (34) entspricht, die vorgegebene Spannungsamplitude über dem Kondensator (34) erreicht wird, um nachfolgend die Durchbruchspannung an die Zenerdiode (44) anzulegen, den zweiten Transistor (45) einzuschalten und den dritten Transistor (46) einzuschalten, um den Stromweg herzustellen und für den Kurzschluss zwischen den ersten (15) und zweiten (101) Leitungen zu sorgen, der die Schutzsicherung (12) zum Durchschlag bringt und einen offenen Schaltkreis einer fehlerhaften Glühlampe emuliert.

13. Leistungszufuhreinheit nach Anspruch 12, bei dem der Widerstand (31) ein erster Widerstand ist und der Sicherungsdurchschlagsschaltkreis (16) ferner einen zweiten Widerstand (33) umfasst, der in Reihe mit dem ersten Widerstand (31) angeschlossen ist, wobei der Kondensator (34) parallel zu dem zweiten Widerstand (33) angeschlossen ist.

Revendications

1. Circuit de claquage de fusible (16) pour établir un court-circuit entre des première (15) et seconde (101) lignes d'alimentation en tension et en courant pour faire sauter un fusible de protection (12) à travers lequel passe un courant fourni à une diode électroluminescente (DEL) (22) par les première

(15) et seconde (101) lignes, ledit circuit de claquage de fusible étant placé sur le côté d'entrée d'un convertisseur (20) alimentant la DEL (22) à partir des première et seconde lignes, **caractérisé en ce que** ledit circuit de claquage de fusible (16) comprend :

a) un moyen de compteur de temps recevant la tension sur lesdites première (15) et seconde (101) lignes pour produire un signal représentatif du temps après une certaine période de temps ;

b) un moyen connecté au moyen de compteur de temps pour empêcher la production du signal représentatif de temps en réponse au courant fourni à la DEL (22) ; et

c) un moyen pour établir un circuit de courant entre les première (15) et seconde (101) lignes en réponse au signal représentatif de temps ;

lorsqu'aucun courant n'est fourni à la DEL (22), ledit circuit de courant est établi et constitue le court-circuit entre les première (15) et seconde (101) lignes qui fera sauter le fusible de protection (12) et émulerà le circuit ouvert d'une lampe à incandescence défectueuse.

2. Circuit de claquage de fusible selon la revendication 1, dans lequel :

- ledit moyen de compteur de temps comprend une résistance (31) et un condensateur (34) connectés en série entre les première (15) et seconde (101) lignes, ladite résistance (31) présentant une valeur de résistance donnée et ledit condensateur (34) possédant une valeur donnée de capacitance et une période de charge de condensateur dépendant de ladite valeur de résistance donnée et de ladite valeur donnée de capacitance ;

- ledit moyen connecté au moyen de compteur de temps comprend un circuit de déclenchement connecté en parallèle avec le condensateur (41) et comprenant un premier commutateur à commande fermé en réponse au courant fourni à la charge électroluminescente (22) pour décharger ledit condensateur (41) ; et

- ledit moyen d'établissement d'un circuit de courant comprend un second commutateur à commande définissant un circuit de courant entre lesdites première (15) et seconde (101) lignes et fermé en réponse à une amplitude donnée de tension aux bornes du condensateur (41) ;

en l'absence d'un courant fourni à la DEL (22) pendant une durée équivalente à la période de charge dudit condensateur (41), ladite amplitude donnée de tension aux bornes dudit condensateur (41) est atteinte, fermant ainsi ledit second commutateur, établissant ledit circuit de courant et constituant le court-circuit entre les première (15) et seconde (101) lignes qui fera sauter le fusible de protection (12) et émulerà le circuit ouvert d'une lampe à incandescence défectueuse.

3. Circuit de claquage de fusible selon la revendication 1, dans lequel ledit premier commutateur à commande comprend un premier transistor (42).

4. Circuit de claquage de fusible selon la revendication 3, dans lequel ladite résistance (31) est une première résistance, ledit condensateur (34) est un premier condensateur et ledit second commutateur à commande comprend :

a) une seconde résistance (37) connectée en série avec un second condensateur (41), lesdits seconde résistance (37) et second condensateur (41) connectés en série étant en parallèle avec ledit premier condensateur (34) ;

b) un commutateur à semi-conducteur choisi dans le groupe comprenant un triac et un commutateur bilatéral au silicium (38), ledit commutateur à semi-conducteur étant connecté en parallèle avec ledit second condensateur (41), ledit commutateur à semi-conducteur possédant des première et seconde électrodes de commutateur à semi-conducteur et une électrode de déclenchement ;

c) une diode Zener (40) connectée entre l'électrode de déclenchement et une des première et seconde électrodes de commutateur à semi-conducteur, ladite diode Zener (40) présentant une certaine valeur de tension de claquage et recevant une tension aux bornes dudit second condensateur (41) ; et

d) un thyristor (39) connecté entre lesdites première (15) et seconde (101) lignes et possédant une électrode de déclenchement connectée à une desdites première et seconde électrodes de commutateur à semi-conducteur ;

en l'absence d'un courant fourni à la DEL (22) pendant une durée équivalente à la période de charge dudit condensateur (34), ladite amplitude donnée de tension aux bornes dudit premier condensateur (34) est atteinte, chargeant ainsi ledit second condensateur (41) par l'intermédiaire de ladite seconde résistance (37) jusqu'à l'atteinte de ladite

valeur de tension de claquage de la diode Zener (40) et ledit commutateur à semi-conducteur étant déclenché pour déclencher ainsi ledit thyristor (39), établissant ledit circuit de courant par l'intermédiaire dudit thyristor (39) et constituant le court-circuit entre les première (15) et seconde (101) lignes qui fera sauter le fusible de protection (12) et émulerà le circuit ouvert d'une lampe à incandescence défectueuse.

5. Circuit de claquage de fusible selon la revendication 4, comprenant, de plus, une troisième résistance (47) connectée en série avec la première résistance (31) entre lesdites première (15) et seconde (101) lignes, dans lequel ledit premier condensateur (34) est connecté en parallèle avec la troisième résistance (47).

6. Circuit de claquage de fusible selon la revendication 3, dans lequel ledit second commutateur à commande comprend :

a) un second transistor (45) connecté en parallèle avec ledit condensateur (34) et possédant une électrode de commande ;

b) une diode Zener (44) connectée entre l'électrode de commande du second transistor (45) et ledit condensateur (34), possédant une certaine tension de claquage et recevant la tension aux bornes du condensateur (34) ; et

c) un troisième transistor (46) connecté entre lesdites première (15) et seconde (101) lignes et possédant une électrode de commande activée par le second transistor (45) ;

en l'absence du courant fourni à la DEL (22) pendant une durée équivalente à la période de charge dudit condensateur (34), ladite amplitude donnée de tension aux bornes dudit condensateur (34) est atteinte pour appliquer successivement ladite tension de claquage à la diode Zener (44), rendre passant ledit second transistor (45) et rendre passant ledit troisième transistor (46) afin d'établir ledit circuit de courant et constituer le court-circuit entre les première (15) et seconde (101) lignes qui fera sauter le fusible de protection (12) et émulerà le circuit ouvert d'une lampe à incandescence défectueuse.

7. Circuit de claquage de fusible selon la revendication 6, dans lequel ladite résistance (31) est une première résistance et ledit circuit de claquage de fusible (16) comprend de plus une seconde résistance (33) connectée en série avec ladite première résistance (31), ledit condensateur (34) étant connecté en parallèle avec ladite seconde résistance

(33).

8. Unité d'alimentation en énergie recevant une tension et un courant d'une source (10) pour fournir une tension et un courant D.C. à une DEL (22), comprenant :

a) une unité de redresseur (14) redressant la tension et le courant à partir de la source (10) et fournissant la tension et le courant redressés aux première (15) et seconde (101) lignes d'alimentation en tension et en courant ;

b) un fusible de protection (12) à travers lequel le courant de la source est fourni à l'unité de redresseur (14) ;

c) un convertisseur (20) de la tension et du courant redressés en la tension et le courant D.C. fournis à la DEL (22) ;

d) un circuit de claquage de fusible (16) selon la revendication 2 pour établir un court-circuit entre les première (15) et seconde (101) lignes d'alimentation en tension et en courant afin de faire sauter le fusible de protection (12) ; et

e) un contrôleur (28) du convertisseur en réponse à la tension redressée sur les première (15) et seconde (101) lignes.

9. Unité d'alimentation en énergie selon la revendication 8, dans laquelle le premier commutateur à commande comprend un premier transistor (42).

10. Unité d'alimentation en énergie selon la revendication 9, dans laquelle ladite résistance (31) est une première résistance, ledit condensateur (34) est un premier condensateur et ledit second commutateur à commande comprend :

a) une seconde résistance (37) connectée en série avec un second condensateur (41), lesdits seconde résistance (37) et second condensateur (41) connectés en série étant en parallèle avec ledit premier condensateur (34) ;

b) un commutateur à semi-conducteur choisi dans le groupe comprenant un triac (38) et un commutateur bilatéral au silicium (38), ledit commutateur à semi-conducteur étant connecté en parallèle avec ledit second condensateur (41), ledit commutateur à semi-conducteur possédant des première et seconde électrodes de commutateur à semi-conducteur et une électrode de déclenchement ;

c) une diode Zener (40) connectée entre l'élec-

trode de déclenchement et une des première et seconde électrodes de commutateur à semi-conducteur, ladite diode Zener (40) présentant une certaine valeur de tension de claquage et recevant une tension aux bornes dudit second condensateur (41) ; et

d) un thyristor (39) connecté entre lesdites première (15) et seconde (101) lignes et possédant une électrode de déclenchement (103) connectée à une desdites première et seconde électrodes de commutateur à semi-conducteur ;

en l'absence d'un courant fourni à la DEL (22) pendant une durée équivalente à la période de charge dudit condensateur (34), ladite amplitude donnée de tension aux bornes dudit premier condensateur (34) est atteinte, chargeant ainsi ledit second condensateur (41) par l'intermédiaire de ladite seconde résistance (37) jusqu'à l'atteinte de ladite valeur de tension de claquage de la diode Zener (40) et ledit commutateur à semi-conducteur étant déclenché pour déclencher ainsi ledit thyristor (39), établissant ledit circuit de courant par l'intermédiaire dudit thyristor (39) et constituant le court-circuit entre les première (15) et seconde (101) lignes qui fera sauter le fusible de protection (12) et émulerà le circuit ouvert d'une lampe à incandescence défectueuse.

11. Unité d'alimentation en énergie selon la revendication 10, comprenant, de plus, une troisième résistance (33) connectée en série avec la première résistance (31) entre lesdites première (15) et seconde (101) lignes, dans lequel ledit premier condensateur (34) est connecté en parallèle avec la troisième résistance (33).

12. Unité d'alimentation en énergie selon la revendication 9, dans lequel ledit second commutateur à commande comprend :

a) un second transistor (45) connecté en parallèle avec ledit condensateur et possédant une électrode de commande ;

b) une diode Zener (44) connectée entre l'électrode de commande du second transistor (45) et ledit condensateur (34), possédant une certaine tension de claquage et recevant la tension aux bornes du condensateur (34) ; et

c) un troisième transistor (46) connecté entre lesdites première (15) et seconde (101) lignes et possédant une électrode de commande activée par le second transistor (45) ;

en l'absence du courant fourni à la DEL (22) pendant une durée équivalente à la période de charge dudit condensateur (34), ladite amplitude donnée de tension aux bornes dudit condensateur (34) est atteinte pour appliquer successivement ladite tension de claquage à la diode Zener (44), rendre passant ledit second transistor (45) et rendre passant ledit troisième transistor (46) afin d'établir ledit circuit de courant et constituer le court-circuit entre les première (15) et seconde (101) lignes qui fera sauter le fusible de protection (12) et émulerà le circuit ouvert d'une lampe à incandescence défectueuse.

13. Unité d'alimentation en énergie selon la revendication 12, dans lequel ladite résistance (31) est une première résistance et ledit circuit de claquage de fusible (16) comprend, de plus, une seconde résistance (33) connectée en série avec ladite première résistance (31), ledit condensateur (34) étant connecté en parallèle avec ladite seconde résistance (33).

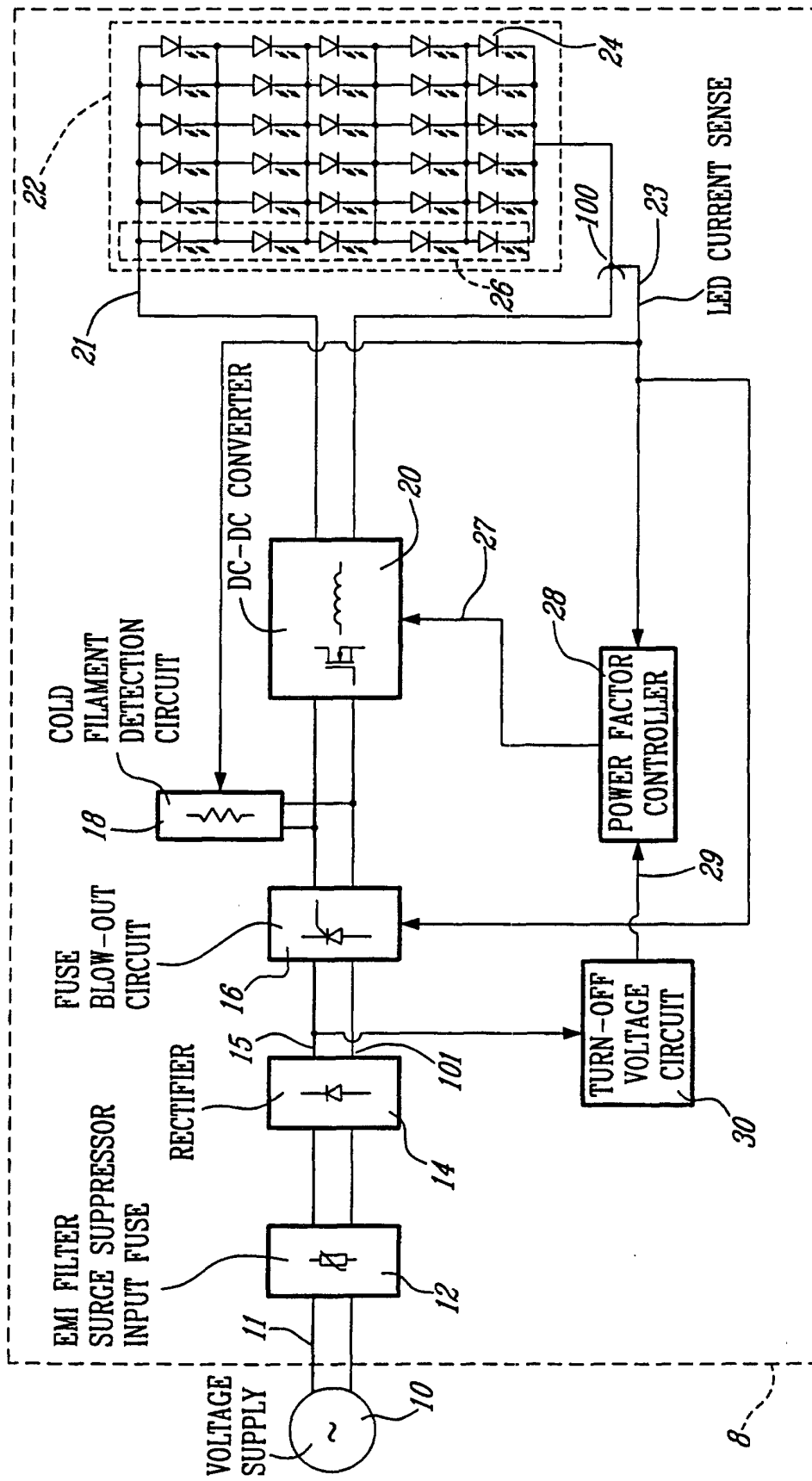
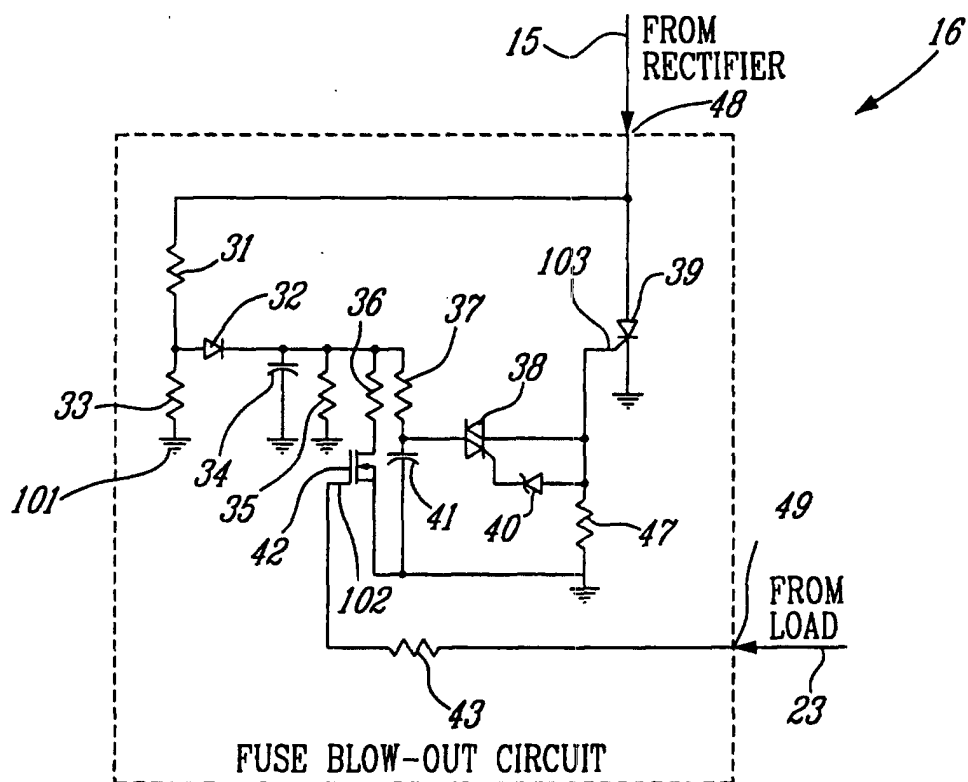


FIG. 1



IS 2A

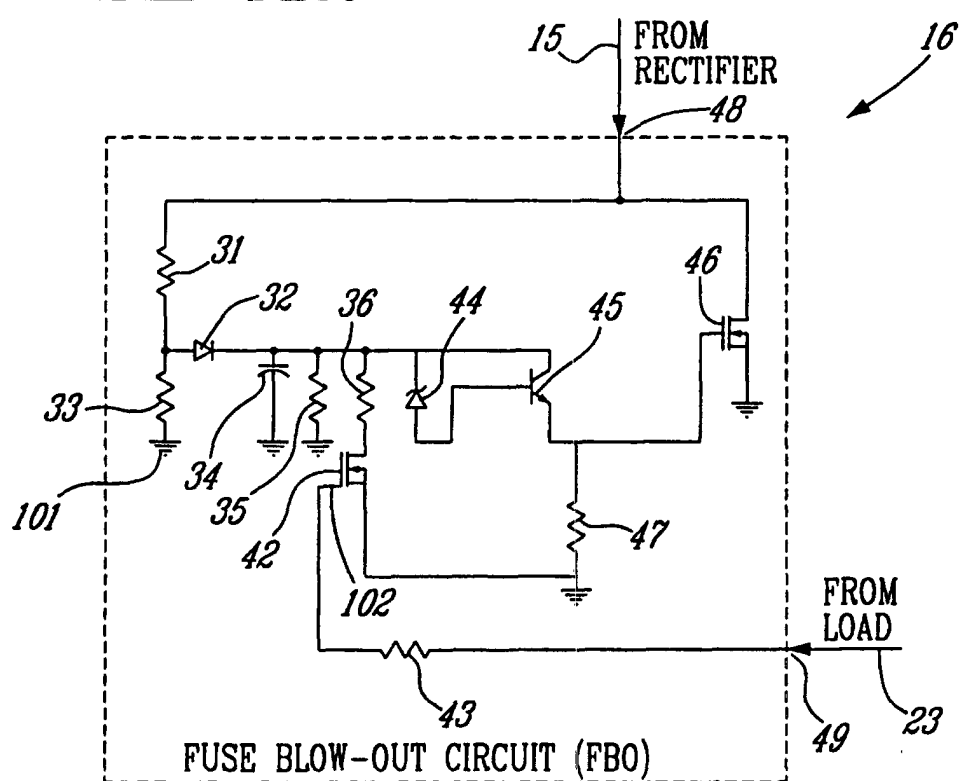


FIG. 28

