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(54) **Method and device for remote monitoring of led lamps**

Verfahren und Anordnung zur Fernüberwachung von LED Leuchten

Procédé et appareil de télésurveillance de luminaires LED

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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 and methods 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] CA-A-2,225,005 discloses a LED lamp with a fault-indicating impedance changing circuit.

OBJECTS OF THE INVENTION

[0009] 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.

[0010] 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.

[0011] Yet another object of the invention is to provide a control circuit for enabling/disabling the power supply to LED lamps in relation to the level of the line voltage.

SUMMARY OF THE INVENTION

[0012] The present invention relates to a system as defined in enclosed claim 1.

[0013] 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

[0014] 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 afuse blow-out circuit to be combined with a system according to the invention;

Figure 2B is a schematic electrical circuit diagram of another fuse blow-out circuit;

Figure 3 is a schematic electrical circuit diagram of a cold filament detection circuit in accordance with the present invention; and

Figure 4 is a schematic electrical circuit diagram of a turn-off voltage circuit to be combined with a system according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] 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.

[0016] 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.

[0017] 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/paratlel 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 cathodes 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.

[0018] 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.

[0019] 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

[0020] Referring to Figure 2A, a 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] Referring to Figure 2B, a second 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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

[0029] 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.

[0030] 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.

[0031] 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.

[0032] 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.

[0033] 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

[0034] The turn-off voltage circuit 30 of Figure 4 simply inhibits the power factor controller 28 (see Figure 1) when the input voltage on fine 11 of the circuit 30 is below a first predetermined trigger voltage.

[0035] 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.

[0036] 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.

[0037] 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 2 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.

[0038] 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.

[0039] 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).

[0040] Although the present disclosure describes particular types of transistors in the different circuits of Figures 2A, 2B, 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 system comprising a voltage and current supply source (10) which supplies voltage and current through first and second lines to a light-emitting load (22) to which current is only supplied after a set-up time following application of power ; and a cold filament detection circuit (18) connected between the first and second lines, said cold detection circuit (18) comprising :

a) a first resistor (51);
b) a second resistor (52);
c) a switching element (53) connected in series to the second resistor (52);
d) a switching control element (54) that controls the state on or off of the switching element (53);
e) means (18, 23) which connects said second resistor (52) between the first and second lines (15, 101) by turning on the switching element (53) as soon as the voltage and current are supplied through the first resistor (51) to thereby establish through said second resistor (52) a current path between said first and second lines; and
f) means (18, 23) which disconnects said second resistor (52) from between the first and second lines (15, 21) when power is applied for longer than the set-up time, by turning on the switching element (54) which thereby turns off the switching element (53),
whereby, during the set up time no current is supplied to the light-emitting load (22) and the current path is established through said second resistor (52) to emulate the impedance of an incandescent lamp, and when current is supplied to the light-emitting load (22), the second resistor (52) is disconnected from between said first and second lines (15,101).

2. A system according to claim 1, wherein the switching element (53) includes a current-conductive junction established in response to the voltage on the first and second lines to thereby establish through said second resistor (52) a current path between said first and second lines ; and
wherein the switching control element (54) prevents said current-conductive junction to establish a connection, when current is supplied to the light-emitting load (22).

3. A system as in claim 1 or 2, wherein said light-emitting load (22) comprises a light-emitting diode.

4. A system as in one of claims 1 to 3, wherein said switching element (53) includes a controllable switch member which comprises a first transistor (53) having a control electrode (104) responsive to the voltage on said first and second lines.

5. A system as in claim 4, wherein said switching control element (54) comprises a switch-disabling circuit which comprises a second transistor (54) interposed between the control electrode (104) of the first transistor (53) and one of said first and second lines, said second transistor having a control electrode responsive to the current supplied to the light-emitting load.

6. System according to any of the preceding claims, further comprising:

a) a rectifier unit (14) rectifying an alternating voltage and current from an ac source and supplying the rectified voltage and current to first and second voltage and current supply lines;
b) a converter (20) of the rectified voltage and current .into the dc voltage and current supplied to the light-emitting load;
c) a controller (28) of the ,converter (20) in response to the rectified voltage on the first and second lines.

Patentansprüche

1. System, bestehend aus einer Spannungs- und Stromquelle (10), die Spannung und Strom über eine erste und zweite Leitung an eine Lichtlast (22) liefert, die erst nach einer auf die Stromanlegung folgende Abstimmungszeit mit Strom versorgt wird, und aus einer Schaltung zur Kaltfadenüberwachung (18), die zwischen der ersten und der zweiten Leitung geschaltet ist, wobei die Schaltung zur Kaltfadenüberwachung (18) folgendes umfasst:

   a) einen ersten Widerstand (51),
   b) einen zweiten Widerstand (52),
   c) ein Schaltelement (53), das serienmässig mit dem zweiten Widerstand (52) geschaltet ist,
   d) eine Schaltkontrolleinrichtung (54), die den On/Off-Zustand des Schaltelements (53) überwacht,
   e) Mittel (18, 23), die den zweiten Widerstand (52) zwischen der ersten und der zweiten Leitung (15, 101) durch Einschalten des Schaltelements (53) schalten, sobald Spannung und Strom durch den ersten Widerstand (51) fließen, um dadurch zwischen der ersten und der zweiten Leitung durch den zweiten Widerstand (52) einen Strompfad zu erstellen und
   f) Mittel (18, 23) zum Abschalten des zweiten Widerstands (52) zwischen der ersten und der zweiten Leitung (15, 21) wenn Strom länger als die Abstimmungszeit fließt, durch Einschalten der Schaltkontrolleinrichtung (54), wodurch das Schaltelement (53) ausgeschaltet wird, wobei die Lichtlast (22) während der Abstimmungszeit nicht mit Strom versorgt wird und der Strompfad durch den zweiten Widerstand (52) fließt, um den Scheinwiderstand einer Glühlampe nachzubilden, und wenn die Lichtlast (22) mit Strom versorgt wird, der zweite Widerstand (52) von der ersten und zweiten Leitung (15, 101) getrennt ist.

2. System nach Anspruch 1, **dadurch gekennzeichnet, dass** das Schaltelement (53) einen stromleitenden Übergang umfasst, der auf die Spannung der ersten und der zweiten Leitung anspricht, um dadurch durch den zweiten Widerstand (52) einen Strompfad zwischen der ersten und der zweiten Leitung zu erstellen und
   dass die Schaltskontrolleinrichtung (54) den stromleitenden Übergang daran verhindert, eine Verbindung zu erstellen, wenn die Lichtlast (22) mit Strom versorgt wird.

3. System nach einem der Ansprüche 1 oder 2, **dadurch gekennzeichnet, dass** die Lichtlast (22) eine Leuchtdiode umfasst.

4. System nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** das Schaltelement (53) ein steuerbares Schaltorgan beinhaltet, das einen ersten Transistor (53) mit einer Steuerelektrode (104) umschließt, die auf die Spannung der ersten und der zweiten Leitung anspricht.

5. System nach Anspruch 4, **dadurch gekennzeichnet, dass** die Schaltkontrolleinrichtung (54) eine Sperrschaltung umfasst, die einen zweiten Transistor (54) beinhaltet, der zwischen der Steuerelektrode (104) des ersten Transistors (53) und einer der ersten oder zweiten Leitung zwischengeschaltet ist, wobei der zweite Transistor mit einer Steuerelektrode versehen ist, die auf den der Lichtlast zugeführten Strom anspricht.

6. System nach einem der vorangehenden Ansprüche, das außerdem folgendes beinhaltet:

   a) eine Gleichrichterstation (14), die Wechselspannung aus einer Wechselspannungsquelle korrigiert und die korrigierte Wechselspannung der ersten und der zweiten Spannungsleitung sowie der Stromleitung zuführt,
   b) einen Wandler (20), der die korrigierte Wechselspannung in die der Lichtlast gelieferte Gleichspannung umwandelt,
   c) einen Regler (28) des Wandlers (20), der auf die korrigierte Spannung auf der ersten und zweiten Leitung anspricht.

Revendications

1. Système comprenant une source d'alimentation en tension et en courant (10) qui délivre une tension et un courant, par l'intermédiaire de première et deuxième lignes, à une charge électroluminescente (22) à laquelle un courant n'est délivré qu'après un temps d'établissement à la suite de l'application de puissance ; et un circuit de détection de filament froid (18) connecté entre les première et deuxième lignes, ledit circuit de détection de filament froid (18) comprenant :

   a) une première résistance (51) ;
   b) une deuxième résistance (52) ;
   c) un élément de commutation (53) connecté en série à la deuxième résistance (52) ;
   d) un élément de commande de commutation (54) qui commande l'état fermé ou ouvert de l'élément de commutation (53) ;
   e) des moyens (18, 23) qui connecte ladite deuxième résistance (52) entre les première et deuxième lignes (15, 101) en fermant l'élément de commutation (53) dès que la tension et le courant sont délivrés par l'intermédiaire de la

première résistance (51) pour établir de ce fait, par l'intermédiaire de ladite deuxième résistance (52), un trajet de courant entre lesdites première et deuxième lignes ; et

f) des moyens (18, 23) qui déconnectent ladite deuxième résistance (52) d'entre les première et deuxième lignes (15, 21) lorsqu'une puissance est appliquée pendant un temps plus long que le temps d'établissement, en fermant l'élément de commutation (54), ce qui ouvre l'élément de commutation (53),

moyennant quoi, pendant le temps d'établissement, aucun courant n'est délivré à la charge électroluminescente (22) et le trajet de courant est établi à travers ladite deuxième résistance (52) pour émuler l'impédance d'une lampe à incandescence, et lorsqu'un courant est délivré à la charge électroluminescente (22), la deuxième résistance (52) est déconnectée d'entre lesdites première et deuxième lignes (15, 101).

2. Système selon la revendication 1, dans lequel l'élément de commutation (53) comprend une jonction conductrice de courant établie en réponse à la tension sur les première et deuxième lignes pour, de ce fait, établir, à travers ladite deuxième résistance (52), un trajet de courant entre lesdites première et deuxième lignes ; et
dans lequel l'élément de commande de commutation (54) empêche ladite jonction conductrice de courant d'établir une connexion, lorsqu'un courant est délivré à la charge électroluminescente (22).

3. Système selon la revendication 1 ou 2, dans lequel ladite charge électroluminescente (22) comprend une diode électroluminescente.

4. Système selon l'une des revendications 1 à 3, dans lequel ledit élément de commutation (53) comprend un élément formant commutateur pouvant être commandé qui comprend un premier transistor (53) comportant une électrode de commande (104) sensible à la tension sur lesdites première et deuxième lignes.

5. Système selon la revendication 4, dans lequel ledit élément de commande de commutation (54) comprend un circuit de désactivation de commutateur qui comprend un deuxième transistor (54) interposé entre l'électrode de commande (104) du premier transistor (53) et l'une desdites première et deuxième lignes, ledit deuxième transistor comportant une électrode de commande sensible au courant délivré à la charge électroluminescente.

6. Système selon l'une quelconque des revendications précédentes, comprenant en outre :

a) une unité de redressement (14) redressant une tension et un courant alternatifs d'une source alternative et délivrant la tension et le courant redressés à des première et deuxième lignes d'alimentation en tension et en courant ;

b) un convertisseur (20) qui convertit la tension et le courant redressés en la tension et le courant continus délivrés à la charge électroluminescente ;

c) un contrôleur (28) qui commande le convertisseur (20) en réponse à la tension redressée sur les première et deuxième lignes.

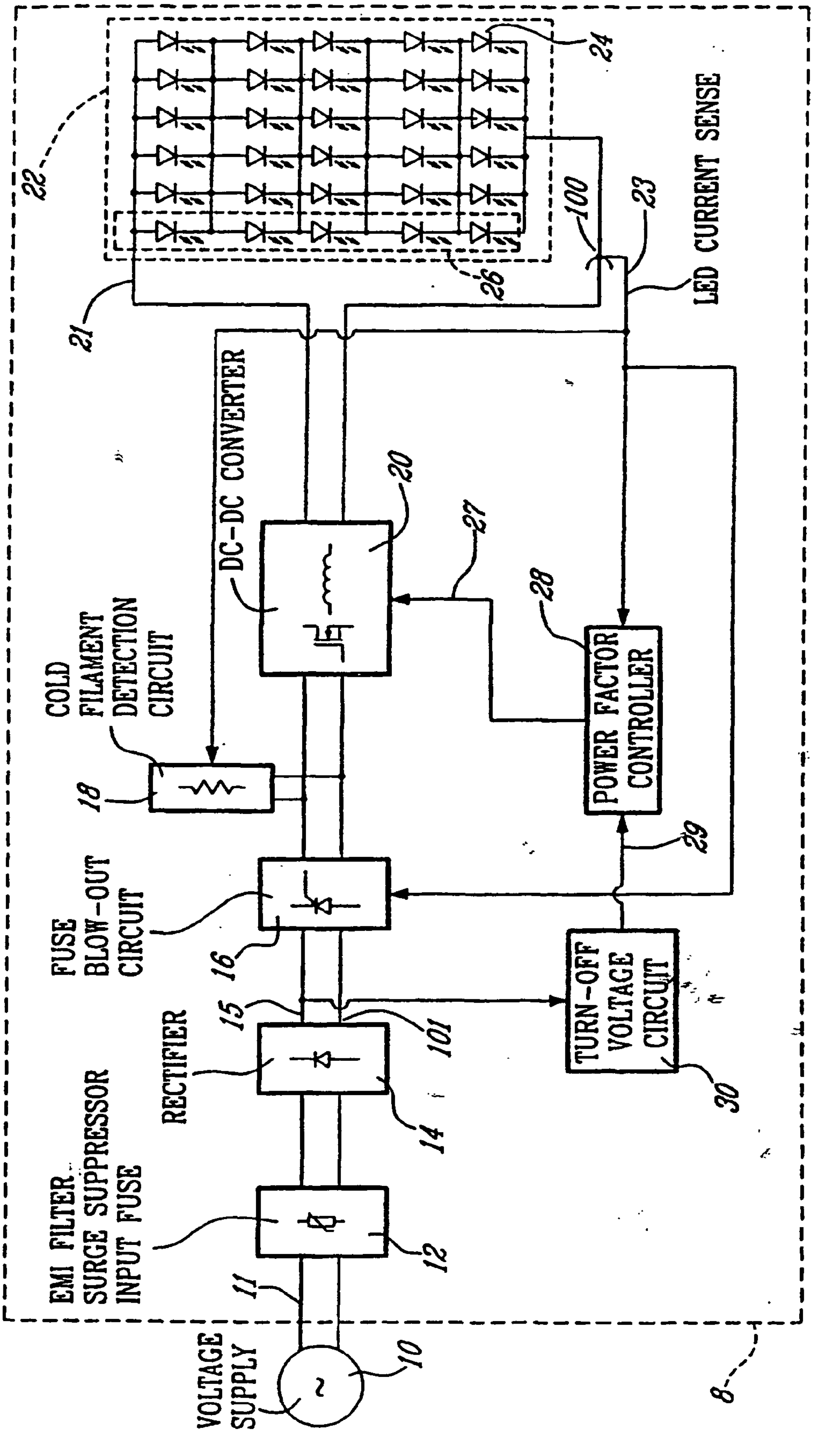
VOLTAGE SUPPLY
10
11
EMI FILTER SURGE SUPPRESSOR INPUT FUSE
12
RECTIFIER
14
15
101
FUSE BLOW-OUT CIRCUIT
16
COLD FILAMENT DETECTION CIRCUIT
18
DC-DC CONVERTER
20
21
22
23
24
26
27
28
29
30
100
POWER FACTOR CONTROLLER
TURN-OFF VOLTAGE CIRCUIT
LED CURRENT SENSE
8

FIG - 1

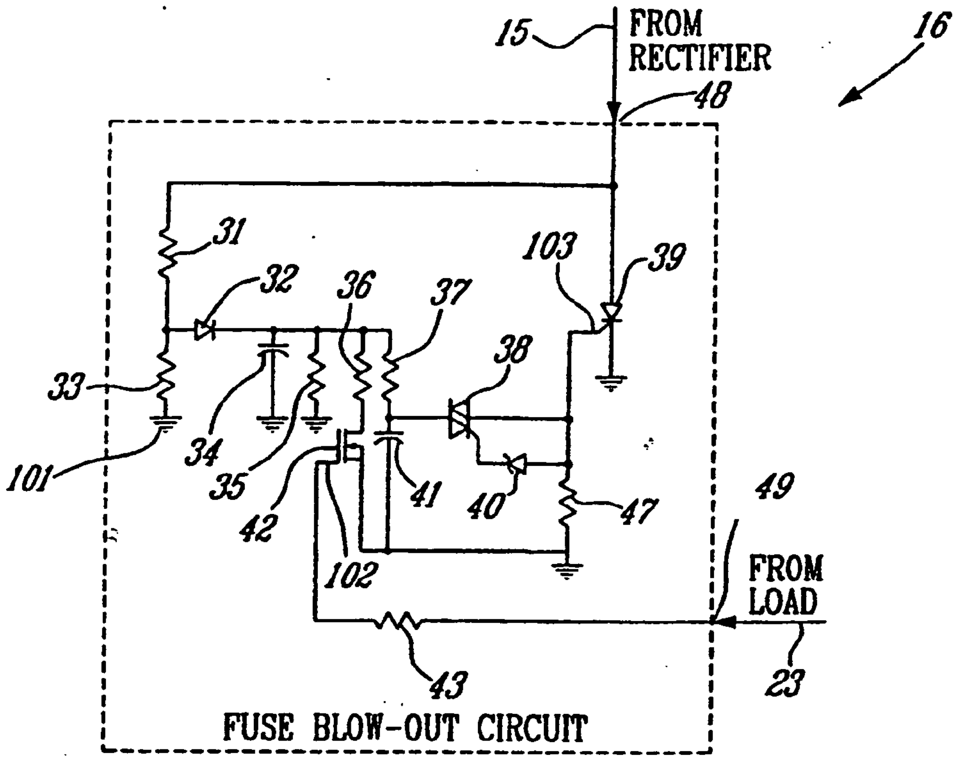
15
FROM
RECTIFIER
16
48
31
32
36
37
103
39
38
33
34
35
42
41
40
47
101
102
49
FROM
LOAD
43
23
FUSE BLOW-OUT CIRCUIT

FIG. 2A

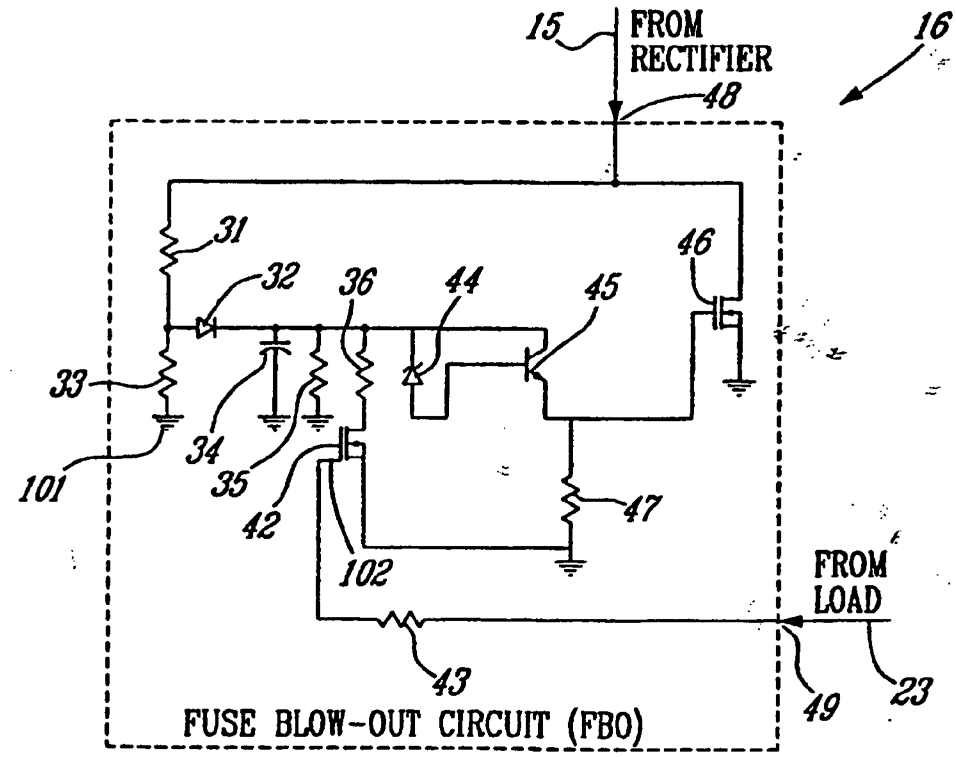
15
FROM
RECTIFIER
16
48
31
32
36
44
45
46
33
34
35
42
47
101
102
FROM
LOAD
43
49
23
FUSE BLOW-OUT CIRCUIT (FBO)

FIG. 2B

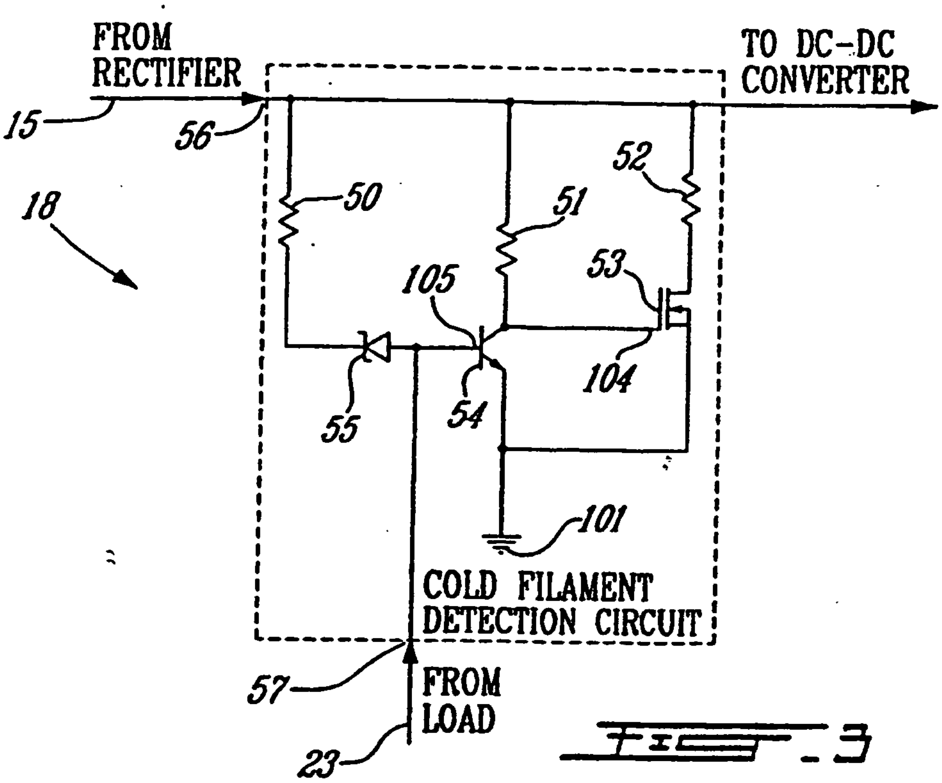
FROM
RECTIFIER
TO DC-DC
CONVERTER
15
56
52
50
51
18
105
53
104
55
54
101
COLD FILAMENT
DETECTION CIRCUIT
57
FROM
LOAD
23

FIG. 3

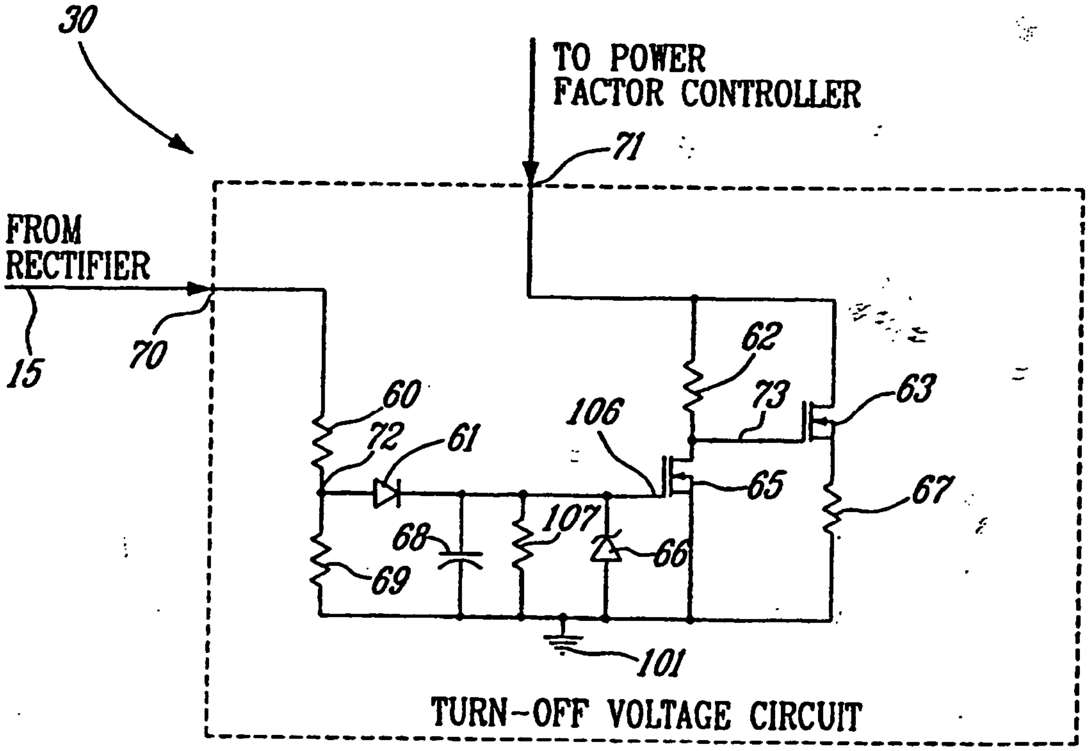
30
TO POWER
FACTOR CONTROLLER
71
FROM
RECTIFIER
15
70
62
60
73
63
106
72
61
65
67
68
107
66
69
101
TURN-OFF VOLTAGE CIRCUIT

FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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