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(54) LED DRIVE CIRCUIT, LED DRIVE DEVICE AND LAMP

(57) The present application relates to the technical field of LED driving, and provides an LED drive circuit, an LED drive device and a lamp. The AC voltage is converted into a DC voltage through a rectifier circuit, and a constant current drive module is provided to receive a drive control signal and the DC voltage, and generate a constant current drive signal based on the drive control signal and the DC voltage, a switch control module is provided to generate a switch control signal according to the constant current drive signal to control On or Off of the switch module, so that a leakage current of the capacitor loop formed by the capacitor module is reduced, thereby solving the problem of afterglow effect of the light source module caused by the current leakage in the current LED drive circuit during a standby state.

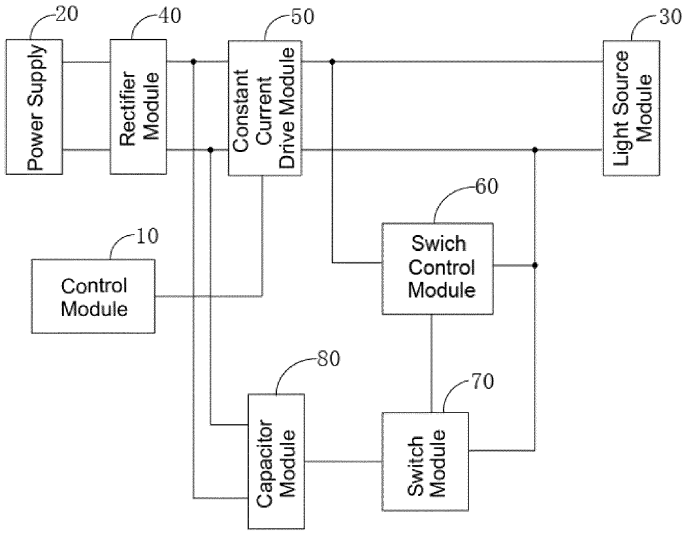


FIG.1

EP 3 879 934 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to the technical field of LED driving, and more particularly to an LED drive circuit, an LED drive device and a lamp.

BACKGROUND

[0002] With the progress of technology, the advantages of LED light sources in lighting applications have gradually become prominent. On the one hand, its light efficiency and color rendering performance have reached or even surpassed traditional light sources such as incandescent lamps and gas discharge fluorescent lamps. On the other hand, its adjustable ability has more space for development than the traditional light sources and is especially suitable for the general lighting field such as modern household and commerce. However, the lamps realized by the LED light source also have obvious defects. Considering the semiconductor device with LED light source output, the driving power supply of which usually requires low voltage, thus a corresponding driver will be provided to the LED lamp. In an LED drive circuit, there is a capacitance between the input end and the output end, when the LED drive circuit is in a standby state, it will lead to a current leakage between the input end and the output end, and the leakage current flowing through the light source module will cause a problem of afterglow effect of the light source module.

SUMMARY OF INVENTION

[0003] In order to solve the above technical problem, embodiments of the present application provide an LED drive circuit, an LED drive device, and a lamp, aiming to solve the problem of afterglow effect of the light source module caused by the current leakage in the current LED drive circuit during a standby state.

[0004] The first aspect of the present application provides an LED drive circuit, the LED drive circuit includes:

a rectifier module, which is configured to convert a received AC voltage into a DC voltage;

a constant current drive module, which is connected to the rectifier module, and is configured to receive a drive control signal and the DC voltage and generate a constant current drive signal based on the drive control signal and the DC voltage;

a switch control module, which is connected to the constant current drive module, and is configured to collect the constant current drive signal and generate a switch control signal according to the constant current drive signal;

a switch module, which is connected to the switch control module, and is configured to receive the switch control signal and turn on or off according to the switch control signal; and

a capacitor module, which is respectively connected to the switch module and the rectifier module.

[0005] Optionally, the LED drive circuit further includes a filter module, which is connected to the constant current drive module, and is configured to receive the constant current drive signal and filter the constant current drive signal.

[0006] Optionally, the switch module is any one of a MOS transistor, a triode, and a relay.

[0007] Optionally, the rectifier module includes a fuse, a first capacitor, a first diode, a second diode, a third diode and a fourth diode; where a first end of the fuse serves as a first input end of the rectifier module, a second end of the fuse, a cathode of the first diode and an anode of the third diode are connected in common, a cathode of the third diode, a cathode of the fourth diode and a first end of the first capacitor are connected in common and serves as a first output end of the rectifier module, a cathode of the second diode and an anode of the fourth diode are connected in common and serves as a second input end of the rectifier module, and an anode of the second diode, an anode of the first diode, and a second end of the first capacitor are connected in common and serves as a second output end of the rectifier module.

[0008] Optionally, the constant current drive module includes a first switch tube and a transformer, where a first input end of the transformer serves as a first input end of the constant current drive module and is connected to a first output end of the rectifier module, a second input end of the transformer is connected to a current input end of the first switch tube, a current output end of the first switch tube serves as a second input end of the constant current drive module and is connected to a second output end of the rectifier module, a control end of the first switch tube serves as a control end of the constant current drive module, a first output end of the transformer serves as a first output end of the constant current drive module, and a second output end of the transformer serves as a second output end of the constant current drive module.

[0009] Optionally, the filtering module includes a fifth diode and a second capacitor, where an anode of the fifth diode severs as a first end of the filter module and is connected to a first output end of the constant current drive module, a cathode of the fifth diode and a first end of the second capacitor are connected in common and serves as a second end of the filter module, and a second end of the second capacitor serves as a third end of the filter module and is connected to a second output end of the constant current drive module.

[0010] Optionally, the switch control module includes a sixth diode, a third capacitor, a first resistor and a sec-

ond resistor; where an anode of the sixth diode serves as a first end of the switch control module and is connected to a first output end of the constant current drive module, a cathode of the sixth diode, a first end of the third capacitor and a first end of the first resistor are connected in common, a second end of the third capacitor and a first end of the second resistor are connected in common to serve as a second end of the switch control module and is further connected to a second output end of the constant current drive module, a second end of the first resistor and a second end of the second resistor are connected in common to serve as a third end of the switch control module and is further connected to a control end of the switch module.

[0011] Optionally, the capacitor module includes a first safety capacitor and a second safety capacitor; where a first end of the first safety capacitor serves as a first end of the capacitor module and is connected to a first output end of the rectifier module, a first end of the second safety capacitor serves as a second end of the capacitor module and is connected to a second output end of the rectifier module, a second end of the first safety capacitor and a second end of the second safety capacitor are connected in common to serve as a third end of the capacitor module and is further connected to a first end of the switch module.

[0012] The second aspect of the embodiments of the present application also provides an LED drive device, which includes the LED drive circuit described in any one of the above solutions.

[0013] The third aspect of the embodiments of the present application also provides a lamp, and the lamp includes:

a control module

a light source module; and

the LED drive circuit according to any one of the above, the LED drive circuit is respectively connected to the control module and the light source module.

[0014] The embodiments of the present application provide an LED drive circuit, an LED drive device, and a lamp. The AC voltage is converted into a DC voltage through a rectifier circuit, a constant current drive module is provided to receive the drive control signal and the DC voltage, and generate a constant current drive signal according to the drive control signal and the DC voltage, a switch control module is provided to generate a switch control signal according to the constant current drive signal to control On or Off of the switch module, so that a leakage current of the capacitor loop formed by the capacitor module is reduced, thereby solving the problem of afterglow effect of the light source module caused by the current leakage in the current LED drive circuits during a standby state.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

FIG. 1 is a schematic diagram of the circuit structure of an LED drive circuit provided by an embodiment of the present application;

FIG. 2 is a schematic diagram of the circuit structure of another LED drive circuit provided by an embodiment of the present application;

FIG. 3 is a schematic diagram of the circuit structure of another LED drive circuit provided by an embodiment of the present application.

DETAILED DESCRIPTION

[0016] In order to make the technical problems to be solved, technical solutions and beneficial effects of this application more comprehensible, the present application will be further described in detail below with reference to the accompanying drawings and embodiments. It is understood that the specific embodiments described herein are merely used to illustrate the present application and do not intend to limit the present application.

[0017] It should be noted that when an element is referred to as being "fixed to" or "disposed on" another element, it can be directly or indirectly on the other element. When an element is referred to as being "connected to" another element, it can be directly or indirectly connected to the other element.

[0018] It should be understood that terms "length", "width", "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer" etc., indicating directions or positional relationships, are based on the directions or positional relationships shown in the drawings, which are only used for the convenience of describing the present application and simplifying the description, without indicating or implying that the referred device or element must have a specific orientation, be constructed and operated in a specific orientation, and therefore cannot be understood as a limitation to the present application.

[0019] In addition, the terms "first" and "second" are merely used for illustration purposes, and cannot be understood as indicating or implying relative importance or implicitly indicating the number of indicated technical features. Therefore, the features defined with "first" and "second" may explicitly or implicitly include one or more of these features. In the description of this application, "multiple" or "a plurality of' means two or more than two, unless otherwise specifically defined.

[0020] An embodiment of the present application provides an LED drive circuit. As shown in FIG. 1, the LED drive circuit in the embodiment of the present application includes a rectifier module 40, a constant current drive module 50, a switch control module 60, a switch module

70 and a capacitor module 80. The rectifier module 40 is configured to convert a received AC voltage into a DC voltage; the constant current drive module 50 is connected to the rectifier module 40, and is configured to receive the drive control signal and the DC voltage, and generate a constant current drive signal based on the drive control signal and the DC voltage. The switch control module 60 is connected to the constant current drive module 50 and is configured to collect the constant current drive signal and generate a switch control signal according to the constant current drive signal. The switch module 70 is connected to the switch control module 60 is configured to receive the switch control signal and turn on or off according to the switch control signal. The capacitor module 80 is connected to the switch module 70 and the rectifier module 40 respectively.

[0021] In this embodiment, the capacitor module 80 and the switch module 70 is connected in series, the switch control module 60 is configured to detect the constant current drive signal output from the constant current drive module 50, and generate a corresponding switch control signal based on the detection result. The switch control signal is configured to control the On and Off of the switch module so as to control the On and Off of the capacitor loop formed by the capacitor module 80, so that the leakage current of the capacitor circuit can be reduced by turning off the switch module 70 when the constant current drive module enters the standby state, which solves the problem of afterglow effect of the light source module during a standby state.

[0022] In specific work, the rectifier module 40, two input ends of which are respectively connected to two output ends of the power supply 20, and is configured to convert the AC voltage provided by the power supply 20 into a DC voltage, and the constant current drive module 50 is configured to receive the drive control signal provided by the control module 10 to control the output current of the constant current drive signal. When the drive control signal is a standby signal, the constant current drive module 50 enters a standby mode. At this time, the constant current drive module 50 stops output, the switch control module 60 collects a low level signal, and sends the corresponding switch control signal to the switch module 70 to control the switch module 70 to be switched off so as to turn off the capacitor circuit formed by the capacitor module 80, thereby reducing the leakage current of the capacitor circuit, and solving the problem of afterglow effect of the light source model 30 during the standby state.

[0023] In one embodiment, referring to FIG. 2, the LED drive circuit further includes a filter module 90, which is connected to the constant current drive module 50, and configured to receive the constant current drive signal and filter the constant current drive signal.

[0024] In an embodiment, the switch module 70 may be one of a MOS transistor, a triode and a relay.

[0025] In one embodiment, referring to FIG. 3, the switch module 70 is a MOS transistor Q2. A first end and a second end of the MOS transistor Q2 are respectively connected to the capacitor module 80 and the constant current drive module 50, and a control end of the MOS transistor Q2 is connect to the switch control module 60.

[0026] In one embodiment, the MOS transistor Q2 may be a P-type MOS transistor.

[0027] In one embodiment, referring to FIG. 3, the rectifier module 40 includes a fuse FR1, a first capacitor C1, a first diode D1, a second diode D2, a third diode D3 and a fourth diode D4. A first end of the fuse FR1 serves as a first input end of the rectifier module 40. A second end of the fuse FR1, a cathode of the first diode D1 and an anode of the third diode D3 are connected in common. A cathode of the third diode D3, a cathode of the fourth diode D4 and a first end of the first capacitor C1 are connected in common and serves as a first output end the rectifier module 40. A cathode of the second diode D2 and an anode of the fourth diode D4 are connected in common and serves as a second input end of the rectifier module 40. An anode of the second diode D2, an anode of the first diode D1 and a second end of the first capacitor C1 are connected in common and serves as a second output end of the rectifier module 40.

[0028] In this embodiment, the first diode D1, the second diode D2, the third diode D3, and the fourth diode D4 constitute a rectifier bridge, which rectifies the AC voltage provided by the power supply 20, and filter the rectified DC voltage with the voltage capacitor C1.

[0029] In one embodiment, referring to FIG. 3, the constant current drive module 50 includes a first switch tube Q1 and a transformer T1. A first input end of the transformer T1 serves as a first input end of the constant current drive module 50 and is connected to the first output end of the rectifier module 40. A second input end of the transformer T1 is connected to a current input end of the first switch tube Q1. A current output end of the first switch tube Q1 serves as a second input end of the constant current drive module 50 and is connected to the second output end of the rectifier module 40. A control end of the first switch tube Q1 serves as a control end of the constant current drive module 50, a first output end of the transformer T1 serves as a first output end of the constant current drive module 50, and a second output end of the transformer T1 serves as a second output end of the constant current drive module 50.

[0030] In this embodiment, the control end of the first switch tube Q1 is configured to receive a drive control signal, which controls the current of the constant current drive signal output by the rectifier drive module 50 by controlling the switch frequency of the first switch tube Q1.

[0031] In an embodiment, the first switch tube Q1 maybe an N-type MOS transistor.

[0032] In one embodiment, referring to FIG. 3, the filter module 90 includes a fifth diode D5 and a second capacitor C2. Specifically, an anode of the fifth diode D5 serves as a first end of the filter module 90 and is connected to the first output end of the constant current drive module

50. A cathode of the fifth diode D5 and a first end of the second capacitor C2 are connected in common and serves as the second end of the filter module 90. A second end of the second capacitor C2 serves as a third end of the filter module 90 and is connected to the second output end of the constant current drive module 50.

[0033] In this embodiment, the constant current drive signal output by the constant current drive module 50 is further filtered through the filter circuit constituted with the fifth diode D5 and the second capacitor C2.

[0034] In one embodiment, referring to FIG. 3, the switch control module 60 includes a sixth diode D6, a third capacitor C3, a first resistor R1, and a second resistor R2. Specifically, an anode of the sixth diode D6 serves as a first end of the switch control module 60 and is connected to the first output end of the constant current drive module 50. A cathode of the sixth diode D6, a first end of the third capacitor C3 and a first end of the first resistor R1 are connected in common. A second end of the third capacitor C3 and a first end of the second resistor R2 are connected in common to serve as a second end of the switch control module 60 and is connected to the second output end of the constant current drive module 50. A second end of the first resistor R1 and a second end of the second resistor R2 are connected in common to serve as a third end of the switch control module 60 and is connect to a control end of the switch module 70.

[0035] In this embodiment, the switch control circuit constituted with the sixth diode D6, the third capacitor C3, the first resistor R1 and the second resistor R2 has an advantage of short response time. Among them, the first resistor R1 and the second resistor R1 R2 form a voltage divider circuit, which is used to divide the voltage of the constant current drive signal and generate the corresponding switch control signal. When the constant current drive signal is output normally, the switch control signal is a high level signal, and the switch module 70 turns on at this time. When the constant current drive signal is output abnormally, that is, when the constant current drive module 50 enters the standby state, the switch control signal is a low level signal, and the switch module 70 turns off at this time.

[0036] In one embodiment, referring to FIG. 3, the capacitor module 80 includes a first safety capacitor CY1 and a second safety capacitor CY2. A first end of the first safety capacitor CY1 serves as a first end of the capacitor module 80 and is connected to the first output end of the rectifier module 40. A first end of the second safety capacitor CY2 serves as a second end of the capacitor module 80 and is connected to the second output end of the rectifier module 40. A second end of the first safety capacitor CY1 and a second end of the second safety capacitor CY2 are connected in common to serve as a third end of the capacitor module 80 and is connected to a first end of the switch module 70.

[0037] In this embodiment, the first end of the switch module 70 is connected to the third end of the capacitor module, a second end of the switch module 70 is connected to the light source module 30, and the control end of the switch module 70 is connected to the switch control module 60 configured to receive the switch control signal and control a connection state of the first end and the second end of the switch module 70 based on the switch control signal. The second end of the first safety capacitor CY1 and the second end of the second safety capacitor CY2 are connected in common to the first end of the switch module 70. Thus, by switching off the switch module 70 during the standby state, the capacitor circuit constituted with the safety capacitor CY1 and the second safety capacitor CY2 is turned off to reduce the leakage current of the capacitor circuit.

[0038] An embodiment of the present application also provides an LED drive device, which includes the LED drive circuit described in any one of the above embodiments.

[0039] The embodiment of the present application also provides a lamp. The lamp in this embodiment includes a control module 10, a light source module 30 and the LED drive circuit according to any one of the above embodiments, the LED drive circuit is connected to the control module and the light source module, respectively. In this embodiment, the control module 10 is configured to send a drive control signal to the constant current drive module 50 to adjust the constant current drive signal, so that the light source module 30 is dimmed and toned.

[0040] In one embodiment, referring to FIG. 3, the light source module 30 may be a light emitting diode string.

[0041] The embodiments of the present application provide an LED drive circuit, an LED drive device and a lamp. The AC voltage is converted into a DC voltage through a rectifier circuit. A constant current drive module is provided to receive a drive control signal and the DC voltage, and generate a constant current drive signal based on the drive control signal and DC voltage. A switch control module is provided to generate a switch control signal according to the constant current drive signal to control On or Off of the switch module, so that the leakage current of the capacitor loop formed by the capacitor module is reduced, thereby solving the problem of afterglow effect of the light source module caused by the current leakage in current LED drive circuit during a standby state.

[0042] It can be clearly understood to those skilled in the art that, for the convenience and conciseness of the description, only the division of the above-mentioned functional units and modules are used as an example. In practical applications, the above-mentioned functions can be allocated to different functional units and modules as required. That is, the internal structure of the device may be divided into different functional units or modules to complete all or part of the functions described above. The functional units and modules in the embodiments can be integrated into one processing unit, or each unit can exist alone physically, or two or more units can be integrated into one unit. The above-mentioned integrated units can be realized in the form of hardware, and can

also be realized in the form of software functional unit. In addition, the specific names of the functional units and modules are merely for the convenience of distinguishing each other, and are not intended to limit the protection scope of the present application. For specific working processes of the units and modules in the foregoing system, reference may be made to the corresponding processes in the foregoing method embodiment, which will not be repeated here.

[0043] In the above-mentioned embodiments, the description of each embodiment has its own focus. For parts that are not detailed or recorded in an embodiment, reference may be made to related descriptions of other embodiments.

[0044] The units described as separate components may or may not be physically separated, and the components displayed as units may or may not be physical units, that is, they may be located in one place, or they may be distributed on multiple network units. Some or all of the units may be selected according to actual needs to achieve the objectives of the solutions of the embodiments of the present application.

[0045] In addition, the functional units in the various embodiments of the present application may be integrated into one processing unit, or each unit may exist alone physically, or two or more units may be integrated into one unit. The above-mentioned integrated unit can be realized in the form of hardware or software functional unit.

[0046] The above-mentioned embodiments are merely used to illustrate the technical solutions of the present application, and do not intend to limit the present application. Although the present application has been described in detail with reference to the foregoing embodiments, it should be understood for those of ordinary skill in the art to modify the foregoing technical solutions recorded in the embodiments, or replace some of the technical features equivalently can be possible. These modifications or replacements do not cause the essence of the corresponding technical solutions to deviate from the spirit and scope of the technical solutions of the embodiments of the present application, and thus should be included within the protection scope of the present application.

Claims

1. An LED drive circuit, **characterized in that**, the LED drive circuit comprises:

   a rectifier module configured to convert a received AC voltage into a DC voltage;
   a constant current drive module connected to the rectifier module, and configured to receive a drive control signal and the DC voltage and generate a constant current drive signal based on the drive control signal and the DC voltage;
   a switch control module connected to the constant current drive module, and configured to collect the constant current drive signal and generate a switch control signal according to the constant current drive signal;
   a switch module connected to the switch control module, and configured to receive the switch control signal and turn on or off according to the switch control signal; and
   a capacitor module connected to the switch module and the rectifier module, respectively.

2. The LED drive circuit of claim 1, **characterized in that**, the LED drive circuit further comprises a filter module which is connected to the constant current drive module, and is configured to receive the constant current drive signal and filter the constant current drive signal.

3. The LED drive circuit of claim 1, **characterized in that**, the switch module is one of a MOS transistor, a triode and a relay.

4. The LED drive circuit of claim 1, **characterized in that**, the rectifier module comprises a fuse, a first capacitor, a first diode, a second diode, a third diode, and a fourth diode;
   wherein a first end of the fuse serves as a first input end of the rectifier module, a second end of the fuse, a cathode of the first diode and an anode of the third diode are connected in common, a cathode of the third diode, a cathode of the fourth diode and a first end of the first capacitor are connected in common and serves as a first output end of the rectifier module, a cathode of the second diode and an anode of the fourth diode are connected in common and serves as a second input end of the rectifier module, and an anode of the second diode, an anode of the first diode, and a second end of the first capacitor are connected in common and serves as a second output end of the rectifier module.

5. The LED drive circuit of claim 1, **characterized in that**, the constant current drive module comprises a first switch tube and a transformer, wherein a first input end of the transformer serves as a first input end of the constant current drive module and is connected to a first output end of the rectifier module, a second input end of the transformer is connected to a current input end of the first switch tube, a current output end of the first switch tube serves as a second input end of the constant current drive module and is connected to a second output end of the rectifier module, a control end of the first switch tube serves as a control end of the constant current drive module, a first output end of the transformer serves as a first output end of the constant current drive module, and a second output end of the transformer serves as a

second output end of the constant current drive module.

6. The LED drive circuit of claim 2, **characterized in that**, the filter module comprises a fifth diode and a second capacitor;
wherein an anode of the fifth diode severs as a first end of the filter module and is connected to a first output end of the constant current drive module, a cathode of the fifth diode and a first end of the second capacitor are connected in common and serves as a second end of the filter module, and a second end of the second capacitor serves as a third end of the filter module and is connected to a second output end of the constant current drive module.

7. The LED drive circuit of claim 1, **characterized in that**, the switch control module comprises a sixth diode, a third capacitor, a first resistor and a second resistor;
wherein an anode of the sixth diode serves as a first end of the switch control module and is connected to a first output end of the constant current drive module, a cathode of the sixth diode, a first end of the third capacitor and a first end of the first resistor are connected in common, a second end of the third capacitor and a first end of the second resistor are connected in common to serve as a second end of the switch control module and is further connected to a second output end of the constant current drive module, a second end of the first resistor and a second end of the second resistor are connected in common to serve as a third end of the switch control module and is further connected to a control end of the switch module.

8. The LED drive circuit of claim 1, **characterized in that**, the capacitor module comprises a first safety capacitor and a second safety capacitor; wherein a first end of the first safety capacitor serves as a first end of the capacitor module and is connected to a first output end of the rectifier module, a first end of the second safety capacitor serves as a second end of the capacitor module and is connected to a second output end of the rectifier module, a second end of the first safety capacitor and a second end of the second safety capacitor are connected in common to serve as a third end of the capacitor module and is further connected to a first end of the switch module.

9. An LED drive device, **characterized in that**, the LED drive device comprises the LED drive circuit according to any one of claims 1-8.

10. A lamp, **characterized in that**, the lamp comprises:

a control module

a light source module; and
the LED drive circuit according to any one of claims 1-8, wherein the LED drive circuit is respectively connected to the control module and the light source module.

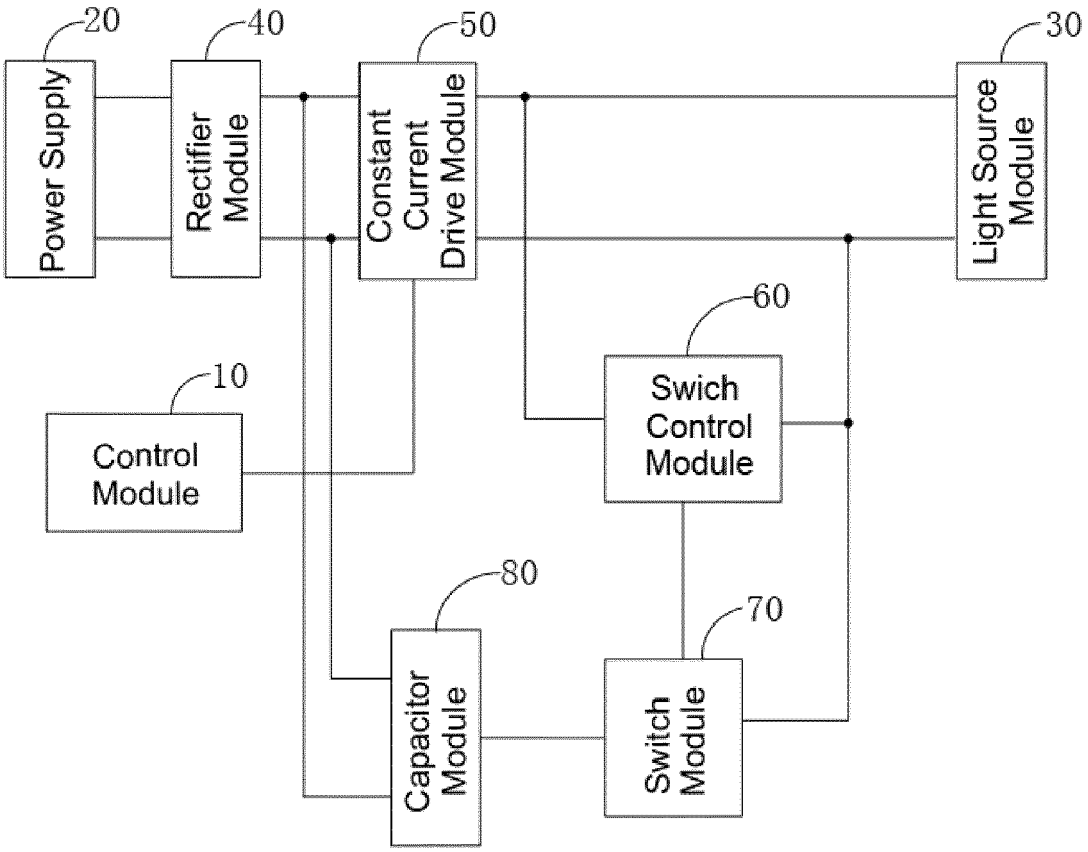
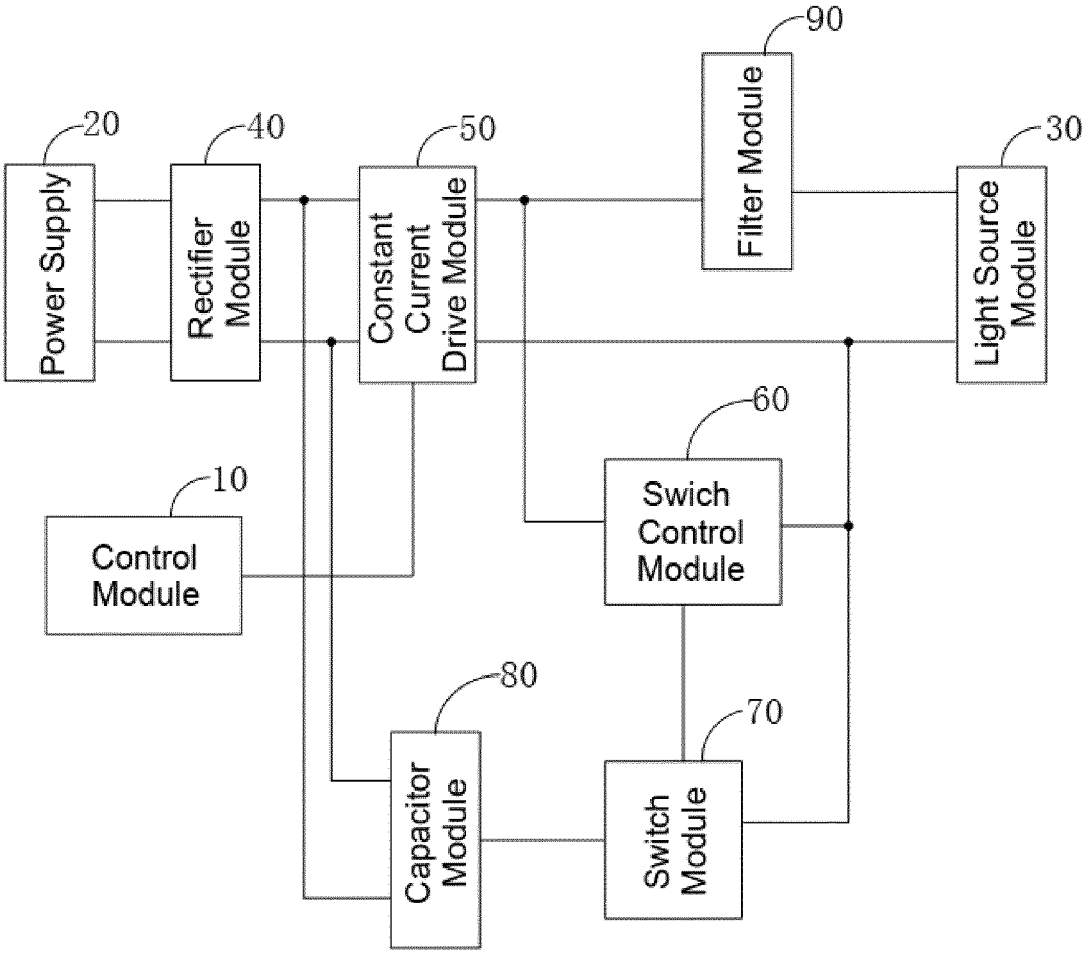

20
Power Supply
40
Rectifier Module
50
Constant Current Drive Module
30
Light Source Module
60
Swich Control Module
10
Control Module
80
Capacitor Module
70
Switch Module

FIG.1


20
Power Supply
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Rectifier Module
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Constant Current Drive Module
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Filter Module
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Light Source Module
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Control Module
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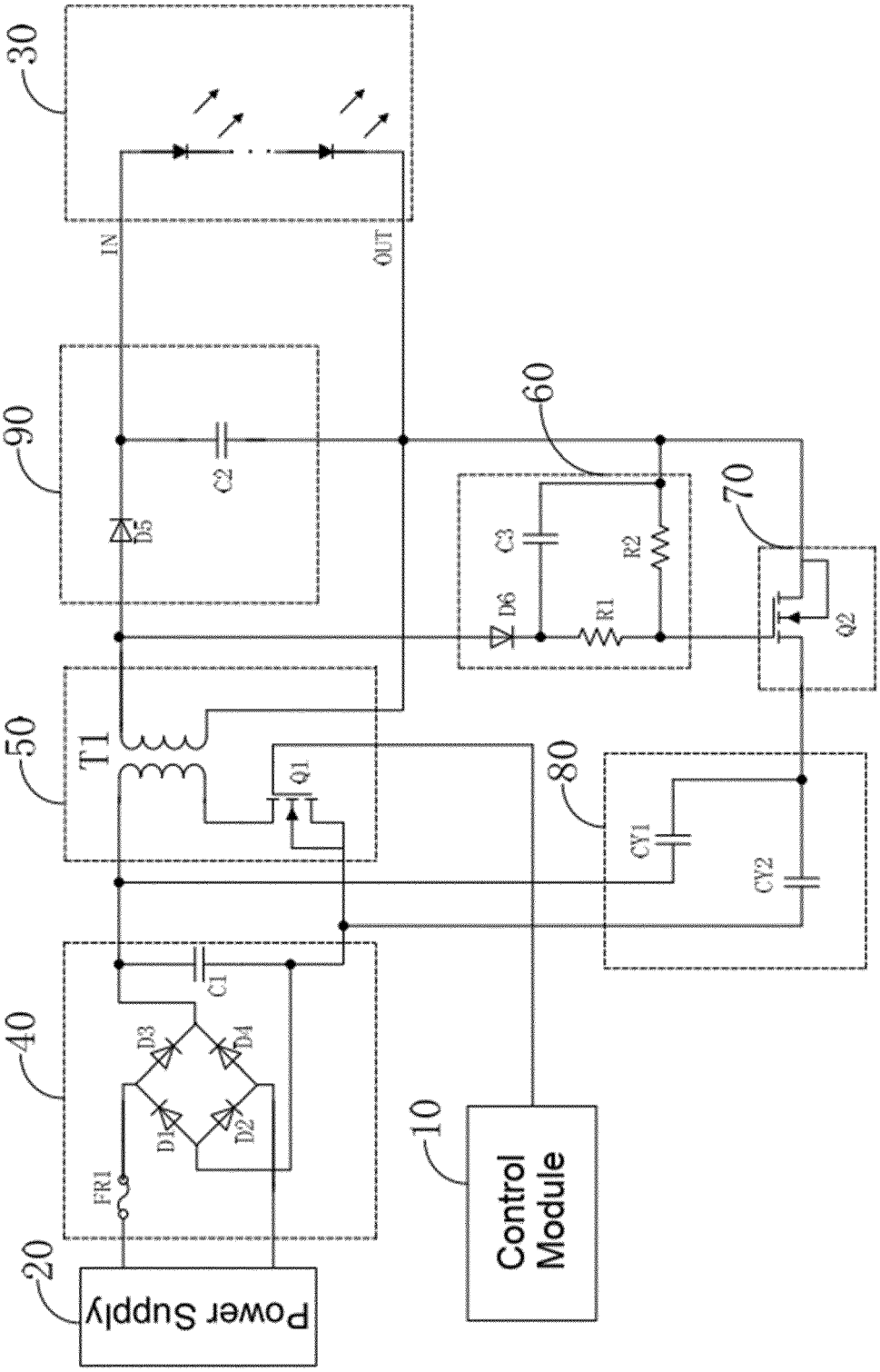
Swich Control Module
80
Capacitor Module
70
Switch Module

FIG.2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IN
OUT
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C2
D5
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C3
R2
D6
R1
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Q2
50
T1
Q1
80
CY1
CY2
C1
40
D3
D4
D1
D2
FR1
20
Power Supply
10
Control Module

FIG.3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 21 15 5270

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2016/073471 A1 (WYNNYCZENKO OLIVER [AT]) 10 March 2016 (2016-03-10) * figures 1, 2, 3, 4 * * paragraph [0036] - paragraph [0040] * * paragraph [0043] - paragraph [0048] * -----	1-10	INV. H05B45/30 H05B45/50

TECHNICAL FIELDS SEARCHED (IPC)

H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 June 2021	Alberti, Carine

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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