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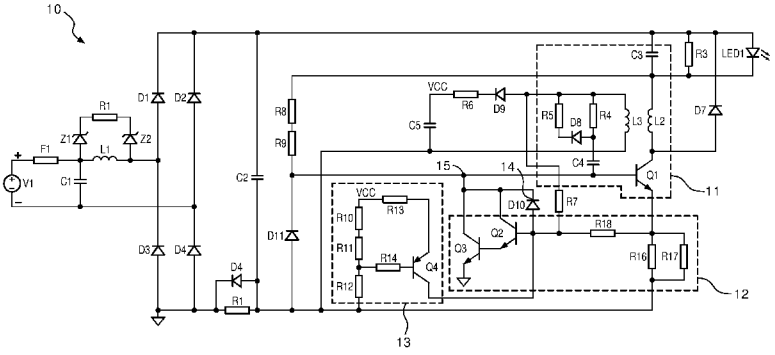


FIG. 2

(57) Abstract: This utility model provides a drive circuit, comprising: a power converter comprising a power switch oscillating between ON and OFF states to convert the power supply; a control circuit coupled to the power switch to turn off the power switch; a sensing circuit coupled to a control end of the control circuit for sensing the working state of the drive circuit to generate a compensation signal, and providing the compensation signal to the control circuit to change the turn-off time of the power switch; an inductive voltage point generating a first inductive voltage for turning off the control circuit when the power switch is turned off; and a first circuit coupled between the inductive voltage point and the control circuit to apply the first inductive voltage to the control circuit to turn off the control circuit, thereby stabilising the working time sequence of the power converter and the control circuit, and extending the input voltage range of the drive circuit of the low-cost integrated lighting lamp.

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Drive circuit and integrated light source

TECHNICAL FIELD

[0001] This utility model relates to the field of illumination devices, more particularly to a drive circuit for use in integrated light sources or lamps.

BACKGROUND ART

[0002] Since the cost of the ringing choke converter (RCC)-based drive circuit is lower than that of the integrated circuit in the field of application of low-voltage power supply, the RCC-based drive circuit is widely used in LED lamps and LED systems. However, when the RCC-based drive circuit is used as a separate constant current output source, many problems may inevitably occur, such as electromagnetic ballast compatibility, input voltage adjustment rate, load adjustment rate, output current drift, input voltage range and so on.

[0003] Particularly when the RCC-based drive circuit is used e.g. in a TLED lamp, the drive circuit is required to meet a certain input voltage adjustment rate, total harmonic distortion (THD), electromagnetic ballast compatibility etc. Meeting these conditions will result in the input voltage range being too narrow; or when a better THD performance is required in certain applications, the problem that the input voltage range is too narrow will also occur. For example, the drive circuit is generally mounted together with a circuit for linear adjustment; said so-termed linear adjustment means that the output voltage will not change substantially in dependence on the fluctuation of the input voltage; for example, when the voltage of the ideal 220V power supply network fluctuates between 210V-240V in an abnormal manner, the output voltage can remain constant. Such a compensation circuit generally collects input voltage and thus adjusts the time sequence in the drive circuit; for example, when the input voltage is relatively large, the time sequence in the drive circuit is controlled to be cut off earlier so as to obtain less energy from the input.

SUMMARY OF THE UTILITY MODEL

[0004] The current compensation circuit has a drawback, i.e., when the input voltage is too large, for example, higher than 240Vac, the compensation circuit in the drive circuit may possibly cause the control switch in the control circuit to be turned on before the power switch is turned on, so as to turn off the power switch. In such a case, the power switch will no longer be turned on, hence, the load will not be driven. The load cannot be driven normally until the voltage amplitude value is decreased to the normal working range. Thus, this easily results in flicker of the output signal. This utility model mainly focuses on solving the problem that the input voltage range of the RCC-

based drive circuit is too narrow.

[0005] Therefore, one object of this utility model is to provide a RCC-based drive circuit that can realize an extended input voltage range.

[0006] According to one aspect of this utility model, a drive circuit is provided, comprising: a power converter comprising a power switch oscillating between ON and OFF states to convert the power supply; a control circuit coupled to the power switch to turn off the power switch; a sensing circuit coupled to a control end of the control circuit for sensing the working state of the drive circuit to generate a compensation signal, and providing the compensation signal to the control circuit to change the turn-off time of the power switch; characterized in that the drive circuit further comprises: an inductive voltage point that generates a first inductive voltage for turning off the control circuit when the power switch is turned off; and a first circuit coupled between the inductive voltage point and the control circuit to apply the first inductive voltage to the control circuit to turn off the control circuit, thereby solidifying the working time sequence of the power converter and the control circuit.

[0007] By means of this aspect, in an embodiment, when the power switch is turned off, the first inductive voltage can ensure that the control circuit is turned off, so that the control circuit will not act before the power switch is closed such that the power switch is turned off; in this way, the power switch can be ensured to be closed normally so as to begin oscillating, thereby enabling the drive circuit to work normally. In a more particular example, even if the input voltage is excessively large, the first inductive voltage may also prevent the input voltage from activating the control circuit to turn off the power switch, hence, an acceptable input voltage range is extended. In this embodiment, the so-called working time sequence of the power converter and the control circuit means that the control circuit operates to turn off the power switch only when the power switch is closed.

[0008] According to an embodiment of this utility model, the inductive voltage point comprises the control end of the power switch. Alternatively, the inductive voltage point further comprises a non-ground end of the auxiliary winding.

[0009] This embodiment provides several applicable implementations of the inductive voltage point.

[0010] According to an embodiment of this utility model, the first circuit comprises a general diode connected between the control end of the first control switch and the control end of the power switch, such that the first and second control switches are turned off before the power switch is turned on.

[0011] In this embodiment, since the potential of the control end of the power switch is relatively low when the power switch is turned off, the first inductive voltage can be provided at the control

end of the power switch. The sum of the turn-on voltage of the general diode and the first inductive voltage enables the first and second control switches to be turned off.

[0012] In a further embodiment, the control end of the power switch is connected to ground in a reverse-bias way through a diode, the first inductive voltage comprises a negative voltage, the sum of the negative voltage and the turn-on voltage of the general diode is smaller than the startup threshold of the first control switch.

[0013] In an embodiment according to this utility model, the control circuit comprises a first control switch, a second control switch cascaded with the first control switch, and a resistor coupled to the power converter and the control end of the control circuit, for transmitting the load current to the control circuit, wherein the control end of the control circuit comprises a control end of the first control switch, and current inflow ends of the first control switch and the second control switch are coupled to the control end of the power switch.

[0014] This embodiment provides a specific implementation of the control circuit.

[0015] The sensing circuit at least comprises a compensation circuit connected to the control end of the control circuit for input voltage adjustment or temperature adjustment, the compensation circuit at least comprising a power supply, a resistor and a third control switch.

[0016] This embodiment provides several sensing circuits applicable for this utility model, i.e., the working state in this utility model includes input voltage, working temperature. It can be understood that the working state may comprise other states related to the working of the drive circuit; any other sensing circuit that senses the working state to generate a compensation signal so as to control the control circuit to change the turn-off time of the power converter may use the implementations of this utility model to ensure that the control circuit will not be affected by the sensing circuit such as to malfunction, e.g., turn off the power switch before the closure of the power switch, thereby preventing the sensing circuit, due to the sensed working state, from inhibiting that the control circuit can close the power switch when needed.

[0017] The power converter comprises a main power circuit, which main power circuit at least comprises an output end connected to the load, a main winding, and the power switch.

[0018] The power converter further comprises an auxiliary winding, the auxiliary winding being coupled to the main winding and to the control end of the power switch, such that when the power switch turns off and resonates through the load current of the main winding, a voltage is induced to turn on the power switch again, wherein the non-ground end of the auxiliary winding generates a first inductive voltage before the power switch is turned on.

[0019] In this embodiment, since the auxiliary winding generates a relatively low, even negative, potential when the power switch is turned off, a first inductive voltage can be provided at the

negative potential end of the auxiliary winding.

[0020] Alternatively, the first circuit comprises a general diode in parallel or series connection with the resistor, and the first circuit is connected between the control end of the first control switch and the non-ground end of the auxiliary winding, such that the first and second control switches are turned off before the power switch is turned on.

[0021] In this embodiment, the sum of the turn-on voltage of this general diode and the first inductive voltage enables the first and second control switches to be turned off.

[0022] According to an embodiment of this utility model, the drive circuit oscillates based on the ringing choke converter (RCC).

[0023] According to the other aspect of this utility model, an integrated light source is provided, characterized in that it comprises: a drive circuit as stated above; and a light emitting device connected with the drive circuit.

[0024] According to an embodiment of this utility model, the integrated light source comprises a tubular LED (TLED).

[0025] According to the above embodiment of this utility model, the drive circuit can extend the input voltage range of the drive circuit of a low-cost integrated lighting lamp.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The characteristics and advantages of this utility model will be clearer based on the exemplary embodiments of this utility model described in combination with the following drawings, in which:

Fig. 1 shows a block diagram of functions of a drive circuit for use in an integrated light source according to this utility model;

Fig. 2 shows a structural diagram of a drive circuit for use in an integrated light source according to an embodiment of this utility model;

Fig. 3 shows a structural diagram of a drive circuit for use in an integrated light source according to another embodiment of this utility model;

Figs. 4(a)-(b) show a schematic view of a waveform of voltage V(c) at point c of the power switch Q1 when the general diode D10 is added and removed.

Embodiments

[0027] The embodiments of this utility model will be explained in more detail in combination with the drawings. However, for the ordinary skilled person in the art, this utility model may be embodied in various forms, and should not be construed as being limited to the embodiments and

particular details mentioned here. Throughout the text, the same reference signs refers to the same components.

[0028] Fig. 1 shows a block diagram of functions of a drive circuit 10 for use in an integrated light source according to this utility model. The drive circuit 10 oscillates based on the ringing choke converter (RCC). As shown in Fig. 1, the drive circuit 10 comprises the following parts: a power converter 11, a control circuit 12, a sensing circuit 13, a first circuit 14, and an inductive voltage point 15.

[0029] Fig. 2 shows a detailed structural diagram of a drive circuit 10 for use in an integrated light source according to an embodiment of this utility model. The structures of respective parts of the drive circuit and the working principle of the drive circuit will be described specifically in combination with Fig. 1 and Fig. 2.

[0030] The power converter 11 at least comprises a power switch Q1 oscillating between the ON and OFF states so as to convert the power supply. Specifically, the power converter 11 comprises a main power circuit, the main power circuit at least comprising an output end connected to the load, a main winding L2, and the power switch Q1.

[0031] As shown in Fig. 2, the power converter 11 further comprises an auxiliary winding L3, the auxiliary winding L3 being coupled to the main winding L2 and to the control end of the power switch Q1. Here, the control end refers to the base of the power switch Q1, such as point b in the figure. When the power switch Q1 turns off and resonates through the load current of the main winding, a voltage is induced to turn on the power switch Q1 again. The non-ground end of the auxiliary winding L3 may generate an inductive voltage before the power switch Q1 is turned on. The inductive voltage is a negative voltage.

[0032] The control circuit 12 is coupled to the power switch Q1 to turn off the power switch Q1. The control circuit 12 comprises a first control switch Q2, a second control switch Q3 cascaded with the first control switch Q2, which form a Darlington Bridge structure, and a resistor R16, R17 coupled to the control end of the control circuit 12 and the power converter 11, the resistor R16, R17 being used for transmitting the load current to the control circuit 12. Here, the control end of the control circuit 12 comprises a control end (i.e. the base of Q2) of the first control switch Q2, and the current inflow ends of the first control switch Q2 and the second control switch Q3 are coupled to the control end (i.e., the base of Q1) of the power switch Q1.

[0033] The sensing circuit 13 is coupled to a control end of the control circuit 12 for sensing the working state of the drive circuit 10 to generate a compensation signal, and providing the compensation signal to the control circuit 12 to change the turn-off time of the power switch Q1. The sensing circuit 13 may comprise at least a compensation circuit connected to the control end of

the control circuit 12 for input voltage adjustment or temperature adjustment. The compensation circuit may comprise at least a power supply Vcc, a resistor R13 and a third control switch Q4. The Vcc is responsible for providing an auxiliary power supply in response to the input voltage, for compensating the change of the input voltage by controlling the control switches Q2, Q3. In an embodiment, the source of the Vcc is a voltage obtained from a capacitor C5 coupled with the auxiliary winding L3 charged by the auxiliary winding L3 via D9, as shown by the Vcc close to the upper side of Fig. 2.

[0034] The inductive voltage point 15 generates an inductive voltage, when the power switch Q1 is turned off, for turning off the control circuit 12. The inductive voltage point 15 may comprise the control end of the power switch Q1, i.e., the base of Q1 or point b in the figure. The control end of the power switch Q1 is connected to ground in a reverse-bias way through a diode D11; the inductive voltage is a negative voltage, the sum of the negative voltage and the turn-on voltage of the general diode D10 being smaller than the startup threshold of the first control switch Q2, thereby ensuring that the first and second control switches Q2, Q3 are turned off before the power switch Q1 is turned on again.

[0035] The first circuit 14 is coupled between the inductive voltage point 15 and the control circuit 12 to apply the inductive voltage to the control circuit 12, thereby turning off the control circuit 12 and achieving the purpose of solidifying the working time sequence of the power converter 11 and the control circuit 12. Specifically, the first circuit may comprise a general diode D10 connected between the control end of the first control switch Q2 and the control end of the power switch Q1, for ensuring that the first and second control switches Q2, Q3 are turned off, using the negative voltage at the control end of the power switch Q1, before the power switch Q1 is turned on again.

[0036] Fig. 3 shows a structural diagram of a drive circuit 10 for use in an integrated light source according to another embodiment of this utility model.

[0037] Similarly, in the embodiment as shown in Fig. 3, the drive circuit 10 also comprises a power converter 11, a control circuit 12, a sensing circuit 13, a first circuit 14, and an inductive voltage point 15. Except for the first circuit 14 and the inductive voltage point 15, the structures and functions of other parts such as the power converter 11, the control circuit 12, and the sensing circuit 13 are the same as those described in the embodiment as shown in Fig. 2, which will not be repeated here.

[0038] In another embodiment, as shown in Fig. 3, alternatively, the inductive voltage point 15 may further comprise a non-ground end of the auxiliary winding L3.

[0039] Also, alternatively, the first circuit 14 may further comprise a general diode D10 in parallel or series connection with the resistor R15, the first circuit 14 being connected between the control

end of the first control switch Q2 and the non-ground end of the auxiliary winding L3, such that the first and second control switches Q2, Q3 are turned off, using the induced negative voltage at the non-ground end of the auxiliary winding L3, before the power switch Q1 is turned on.

[0040] Therefore, in order to solve the problem of an excessively narrow input voltage range of the drive circuit, this utility model can make use of the first circuit (e.g. the general diode D10) to connect the base of the control switch Q2 in the control circuit to the low voltage point, such as the base of the power switch Q1, generated when the power switch Q1 is turned off, the base being -0.7V before the Q1 is turned on. In addition, the first circuit can also be used to connect the base of the control switch Q2 in the control circuit to another low voltage point, such as the non-ground end of the auxiliary winding L3. In this way, it can be ensured that the control switches Q2 and Q3 will not be turned on before the power switch Q1 is turned on, hence, Q1 will not be in the non-working state, nor will it cause the output to generate flicker.

[0041] Next, the specific working process of the drive circuit 10 will be described in combination with Fig. 2. After power on, the inputted alternating current becomes a direct current at the two ends of the capacitor C2 after being rectified by bridge rectifiers (including diodes D1, D2, D3, D4), after which the direct current flows through the LED load LED1, and through the resistor R8, R9, and then through a capacitor C4, and through a network formed by a parallel connection of a resistor R4 and a diode D8, a resistor R5, and then it flows through the auxiliary winding L3 to ground; in this process, the capacitor C4 is charged, and due to the increase of the voltage of C4, when the voltage at point b of the power switch Q1 has reached 0.7V, Q1 is turned on, at which point the main power circuit (including load LED1, main winding L2, power switch Q1, resistor R16/R17) starts working, and the current flows through the load LED1, L2, Q1, R16/R17 to ground, the current flowing through L2 will increase linearly, causing an inductive current to be generated on the auxiliary winding L3, which flows through R4, C4, thereby accelerating turn-on of Q1, when the current that flows through R16/R17 reaches a preset value (e.g.1A); since the voltage at point c of Q1 will reach 0.7V, there will be a current that flows to Q2, Q3, which turns on the control switches Q2, Q3 together with a voltage adjustment compensation network consisting of resistors R10, R11, R12, R13, R14 and a control switch Q4, thereby enabling Q2, Q3 to be saturated and turned on; since Q2, Q3 are saturated and turned on, the voltage at point b of Q1 will be pulled down to below 0.4V, thereby enabling Q1 to be turned off, at which point, the current that flows through the main winding L2 starts to flow to the diode D7 and the load LED1, i.e., it starts to freewheel, a new loop is formed, the current starts to decrease linearly, and an inductive negative voltage is generated on L3, which accelerates the turn-off of Q1 through R4, C4; meanwhile, due to clamping action of the diode D11, the voltage at point b is -0.7V, and due to the existence of the

first circuit (including diode D10), Q2, Q3 are also turned off; when the current that flows through L2 decreases to zero, the distributed capacitances between L2 and the points c, e of Q1 form a resonance, thereby enabling the current that flows through the main winding L2 to flow in an opposite direction initially, and then in a positive direction; when it flows in the positive direction, the positive voltage induced at the auxiliary winding L3 enables Q1 to be turned on again through R4, C4, and when Q1 is turned on, the inductive voltage of L3 will be strengthened, thereby accelerating turn-on of Q1, causing the main power circuit (LED1, L2, Q1, R16/17) to start working again. The process is repeated again and again.

[0042] In this process, if the voltage induced by L3 is intended every time to turn on Q1, and if Vcc is excessively large, a relatively large voltage will be provided at the base of Q2 which is sufficient to enable Q2, Q3 to be in the turned-on state, as a result of which malfunction may occur, such that the collector of Q2, Q3 pulls down the voltage that is originally provided to the base of Q1 or extracts the current from the base of Q1, thereby failing to turn on Q1. However, in the embodiment of this utility model, such a case is avoided.

[0043] Specifically, if in an application in which the input voltage range is 180Vac-240Vac, the input voltage is higher than 230Vac, the inductive voltage generated by the auxiliary winding L3 is higher than the normal value, and Vcc (originated from the input voltage) is also higher than the normal value. When the current through R16, R17 is equal to the preset value, the control switches Q2, Q3 will be turned on, and then the power switch Q1 will be turned off. As a result, the auxiliary winding L3 will generate a negative voltage, which process is accelerated due to the clamping action of the diode D11, and the voltage V(b) at the point b (base) of the power switch Q1 will be -0.7V. Due to the connection of the first circuit (e.g. the general diode D10), the potential of the base of the control switch Q2 is clamped to 0V by the diode D10, and the control switches Q2, Q3 are also turned off; when the auxiliary winding L3 generates a positive voltage next time, Q1 is turned on. Thereafter, the power is converted from the power supply to the load through the main winding; subsequently, as the current of the power switch Q1 increases, the potential on R16 and R17 causes Q2, Q3 to be turned on, and then the power switch is turned off normally. The process is reproducible. It shows that, in such a case, the power switch can always be closed at the appropriate time when needed, the control circuit can turn it off at the appropriate time, so that the case that the power switch is still turned off by the control circuit when it needs to be closed will not occur, hence, the output will not flicker.

[0044] If the first circuit (e.g. the general diode D10) is absent, Q2 and Q3 will not be turned off. In such a case, when the auxiliary winding L3 generates a positive voltage again, the current passes through Q3 to ground, the voltage V(b) at the point b of Q1 will be lower than 0.7V, hence, Q1

cannot be turned on, and the drive circuit will stop working, thereby generating flicker.

[0045] Therefore, the structure according to the embodiment of this utility model can ensure that the control switches Q2 and Q3 can be turned off before the power switch Q1 is turned on next time in the event that the power switch Q1 is turned off.

[0046] This utility model makes use of a first circuit (e.g. the general diode D10) to extend the input voltage range of the drive circuit. When the diode is added, the input voltage range can reach 305Vac. Specifically, when the diode D10 is added, the V(c) waveform diagram at point c (collector) of the power switch Q1 is as shown in Fig. 4(a). When the diode D10 is removed, the V(c) waveform diagram at point c is as shown in Fig. 4(b). During half a period, the drive circuit does not work, thereby causing the output to generate flicker.

[0047] In the embodiment as shown in Fig. 2, the first circuit may be a general diode D10, the base of the control switch Q2 is connected to point b (base) of the power switch Q1 by using the first circuit. The voltage at point b is appropriate. If the voltage (?) is connected to the negative voltage point of the auxiliary winding L3, it will be required to add a resistor R15 as stated above to adjust the voltage, as shown in Fig. 3.

[0048] As for an application of a full input voltage range (e.g. 85Vac-305Vac), generally, the main defect of the drive circuit lies in a deficient input voltage adjustment rate, making flicker obvious. If a compensation circuit is used to obtain improved input voltage adjustment rates, the input voltage range will become very narrow. Based on the simulation result, in the case of a full input voltage range, when the input voltage is higher than 200Vac, flicker will occur. However, according to the structure provided by the embodiment of this utility model, the first circuit is used to connect the base of the control switch Q2 to the control end of the power switch Q1 or the negative voltage point generated by the non-ground end of the auxiliary winding L3 to ensure the proper working time sequence of the control switch and the power switch, thereby eliminating flicker.

[0049] From a broad perspective, in the case of including the control switches Q2 and Q3, similar to voltage adjustment, temperature compensation can also be applied to control the operation of the control switches Q2 and Q3, for example, in the case of excessive temperatures, Q2 and Q3 are closed sooner so as to turn off the power switch Q1. Then, the embodiment of this utility model can also avoid malfunction due to temperature compensation applied to the control switches Q2 and Q3; the principle thereof is similar, therefore this utility model will not be repeated here.

[0050] The drive circuit provided according to the embodiment of this utility model can be applied for example in a low-cost tubular LED (TLED) of 20w. The input voltage range of this drive circuit may be extended from 230Vac to 305Vac.

[0051] The drive circuit of this utility model can be applied in an integrated light source or lamp. The integrated light source or lamp may comprise a drive circuit 10 according to the embodiment of this utility model and a light emitting device connected with the drive circuit. The integrated light source or lamp may comprise a tubular LED, i.e., TLED.

[0052] Correspondingly, this utility model further provides a method of driving a load, comprising the steps of:

closing and turning off the power switch (Q1) to convert the power supply;

controlling turn-off of the power switch (Q1) using a control circuit;

sensing the working state when driving the load so as to generate a compensation signal, and controlling the control circuit based on the compensation signal so as to change the turn-off time of the power switch (Q1);

characterized in that it further comprises the steps of:

generating a first inductive voltage when the power switch (Q1) is turned off for turning off the control circuit;

applying the first inductive voltage to the control circuit (12) to turn off the control circuit (12), thereby solidifying the working time sequence of the power converter (11) and the control circuit (12).

[0053] The terms used here are only for describing particular embodiments, rather than limiting this utility model. As used herein, the singular form is also intended to include the plural form, except when explicitly stated otherwise. It should be further understood that the words "comprise", "include" as well as their variants in use represent the presence of a feature, integrity, operation, step, element, and/or component, but do not exclude the presence of one or more other features, integrities, steps, operations, elements, components

[0054] Although this utility model has been shown and described in detail with reference to the exemplary embodiments of this utility model, the ordinary skilled person in the art should understand that without departing from the spirit and scope of this utility model as defined by the attached claims, various modifications can be made formally and specifically. The exemplary embodiments should be regarded as only for explanation rather than for limitation. Therefore, the scope of this utility model is not defined by the detailed description of this utility model, but is defined by the attached claims.

What is claimed is:

1. A drive circuit (10), comprising:
a power converter (11) comprising a power switch (Q1) oscillating between ON and OFF states to convert a power supply;
a control circuit (12) coupled to the power switch (Q1) to turn off the power switch (Q1);
a sensing circuit (13) coupled to a control end of the control circuit for sensing a working state of the drive circuit to generate a compensation signal, and providing the compensation signal to the control circuit (12) to change the turn-off time of the power switch (Q1);
characterized in that the drive circuit (10) further comprises:
an inductive voltage point (15) for generating a first inductive voltage to turn off the control circuit when the power switch (Q1) is turned off;
and
a first circuit (14) coupled between the inductive voltage point and the control circuit (12) to apply the first inductive voltage to the control circuit (12) to turn off the control circuit (12), thereby solidifying the working time sequence of the power converter (11) and the control circuit (12).

2. The drive circuit (10) as claimed in claim 1, wherein the control circuit (12) comprises a first control switch (Q2), a second control switch (Q3) cascaded with the first control switch (Q2), and a resistor (R16, R17) coupled to the control end of the control circuit (12) and the power converter (11) for transmitting a load current to the control circuit (12), wherein the control end of the control circuit comprises the control end of the first control switch (Q2), and current inflow ends of the first control switch (Q2) and the second control switch (Q3) are coupled to the control end of the power switch (Q1).

3. The drive circuit (10) as claimed in claim 2, wherein the inductive voltage point comprises the control end of the power switch (Q1), the first circuit comprises a general diode (D10) connected between the control end of the first control switch (Q2) and the control end of the power switch (Q1), such that the first and second control switches (Q2, Q3) are turned off before the power switch (Q1) is turned on.

4. The drive circuit (10) as claimed in claim 3, wherein the control end of the power switch (Q1) is connected to ground in a reverse-bias way through a diode (D11), the first inductive voltage comprises a negative voltage, the sum of the negative voltage and a turn-on voltage of the general

diode (D10) is smaller than a startup threshold of the first control switch (Q2).

5. The drive circuit (10) as claimed in claim 1, wherein the sensing circuit (13) at least comprises a compensation circuit connected to the control end of the control circuit (12) for input voltage adjustment or temperature adjustment, and the compensation circuit at least comprises a power supply (Vcc), a resistor (R13) and a third control switch (Q4).

6. The drive circuit (10) as claimed in claim 1, wherein the power converter (11) comprises a main power circuit, the main power circuit at least comprises an output end connected to a load, a main winding (L2), and the power switch (Q1).

7. The drive circuit as claimed in claim 6, wherein the power converter (11) further comprises an auxiliary winding (L3), the auxiliary winding (L3) is coupled to the main winding (L2) and to the control end of the power switch (Q1), such that when the power switch (Q1) turns off and resonates through load current of the main winding, a voltage is induced so as to turn on the power switch (Q1) again, wherein a non-ground end of the auxiliary winding (L3) generates a first inductive voltage before the power switch (Q1) is turned on.

8. The drive circuit (10) as claimed in claim 7, wherein the first circuit (14) comprises a general diode (D10) in parallel or series connection with a resistor (R15), the first circuit (14) is connected between the control end of the first control switch (Q2) and the non-ground end of the auxiliary winding (L3), such that the first and second control switches (Q2, Q3) are turned off before the power switch (Q1) is turned on.

9. The drive circuit (10) as claimed in claim 7, wherein the drive circuit (10) oscillates based on a ringing choke converter (RCC).

10. An integrated light source, characterized in that it comprises:
- a drive circuit (10) as claimed in any one of the preceding claims 1 to 9; and
- a light emitting device connected with the drive circuit (10).

11. The integrated light source as claimed in claim 10, characterized in that it comprises a tubular LED (TLED).

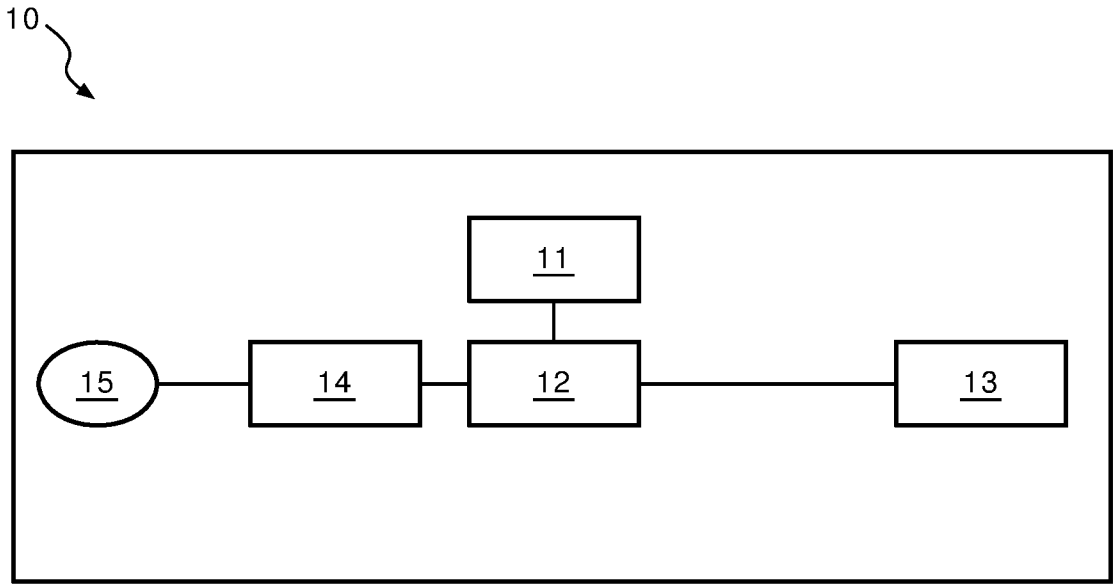


FIG. 1

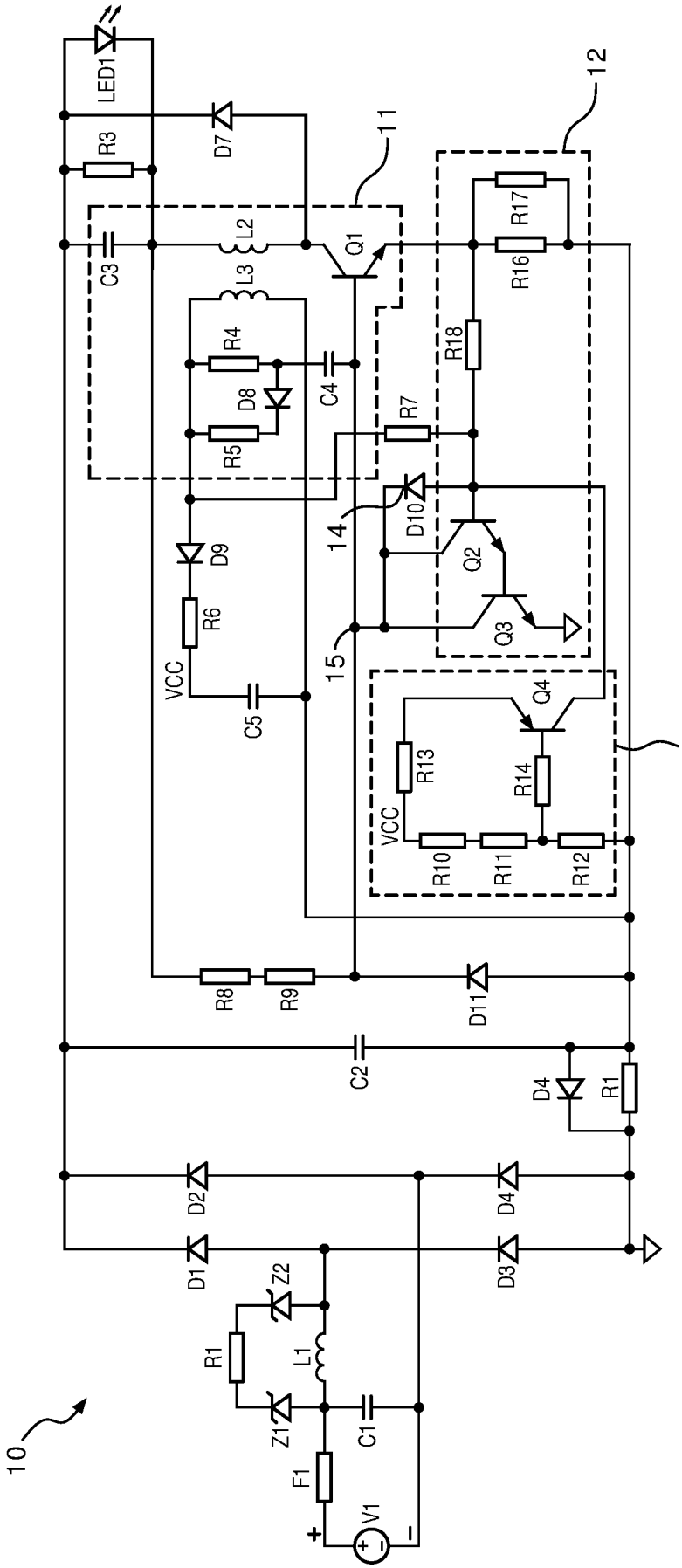

LED1
R3
D7
11
12
C3
L2
Q1
R17
R16
L3
R4
R18
D8
C4
R7
R5
D10
14
D9
Q2
R6
Q3
VCC
15
C5
Q4
13
R13
R14
VCC
R10
R11
R12
R8
R9
D11
C2
D4
R1
D2
D4
D1
D3
Z2
R1
L1
Z1
C1
F1
V1
10

FIG. 2

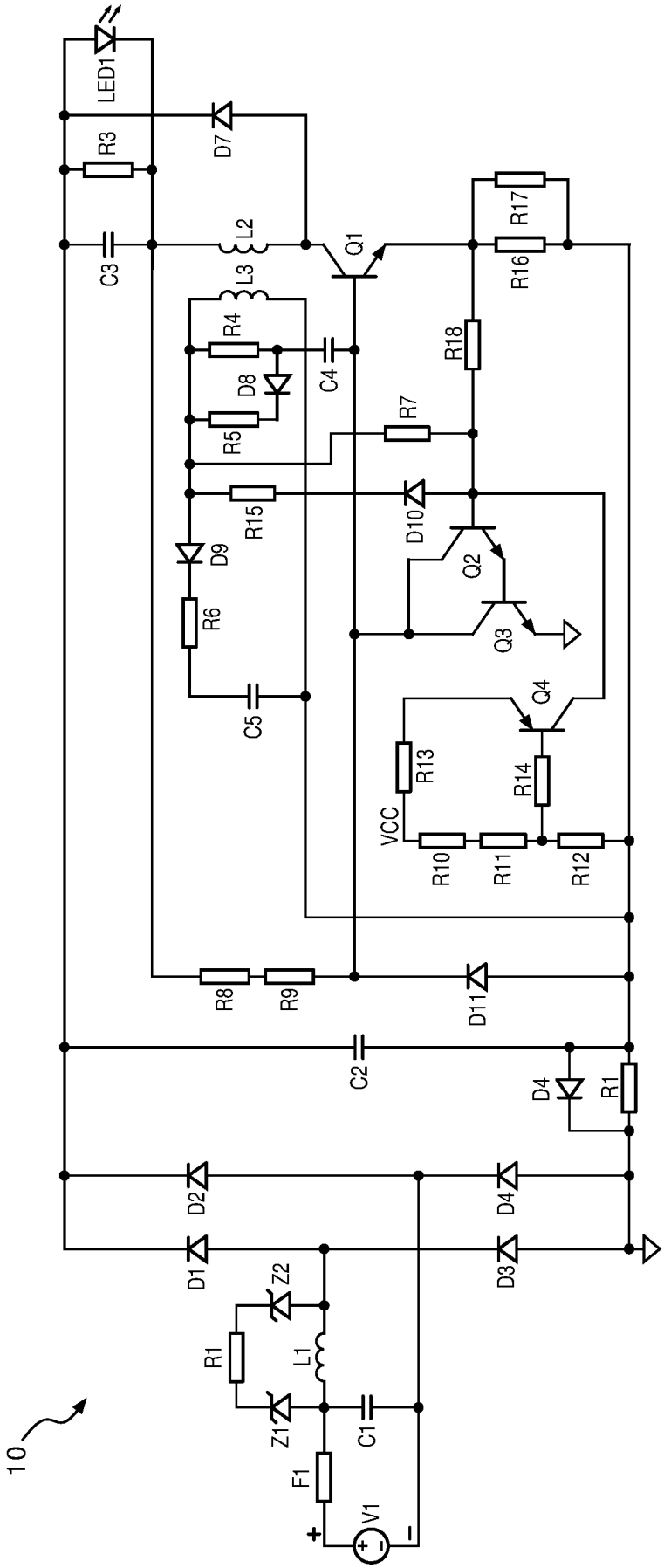

LED1
R3
D7
C3
L2
Q1
R17
R16
L3
R4
C4
R18
D8
R5
R7
R15
D10
D9
Q2
R6
Q3
C5
Q4
R13
R14
VCC
R10
R11
R12
R8
R9
D11
C2
D4
R1
D2
D4
D1
D3
Z2
R1
L1
Z1
C1
F1
V1
10

FIG. 3

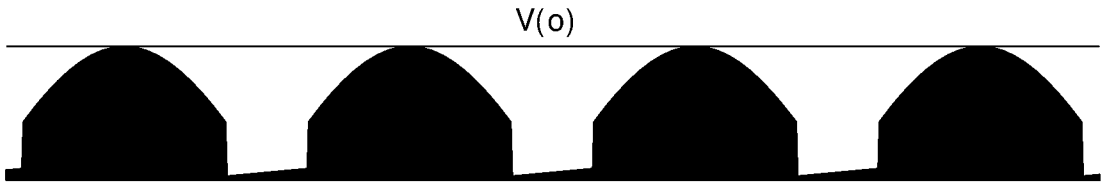


FIG. 4(a)



FIG. 4(b)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/053506

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02M3/338 H05B33/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H02M H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2003/142521 A1 (HOSOTANI TATSUYA [JP] ET AL) 31 July 2003 (2003-07-31)	1,2,5-11
A	paragraphs [0018] - [0027], [0106], [0146] - [0149]; figures 1,10	3,4

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 August 2015	17/08/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Waters, Duncan

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2015/053506

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