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(54) Electronic connection device for a lamp

(57) The invention relates to a lamp, comprising a fluorescent lamp (100) for the generation of illuminating radiation. The lamp comprises an electronic connection device (102) for providing an ignition voltage for the fluorescent lamp for activating the generation of illuminating radiation, the electronic connection device (102) comprises at least two switching transistors (Q1, Q2) for feeding current to a coil (L1) which develops an ignition voltage for the fluorescent lamp (100). The electronic connection device (102) has integrated therewith a control circuit (104) which measures the current of the at least two switching transistors (Q1, Q2) and, while in the process of measuring, the control circuit (104) detects whether an excessively high current is flowing through one or more switching transistors (Q1, Q2), whereby the control circuit (104) limits the excessively high current to a lower current level.

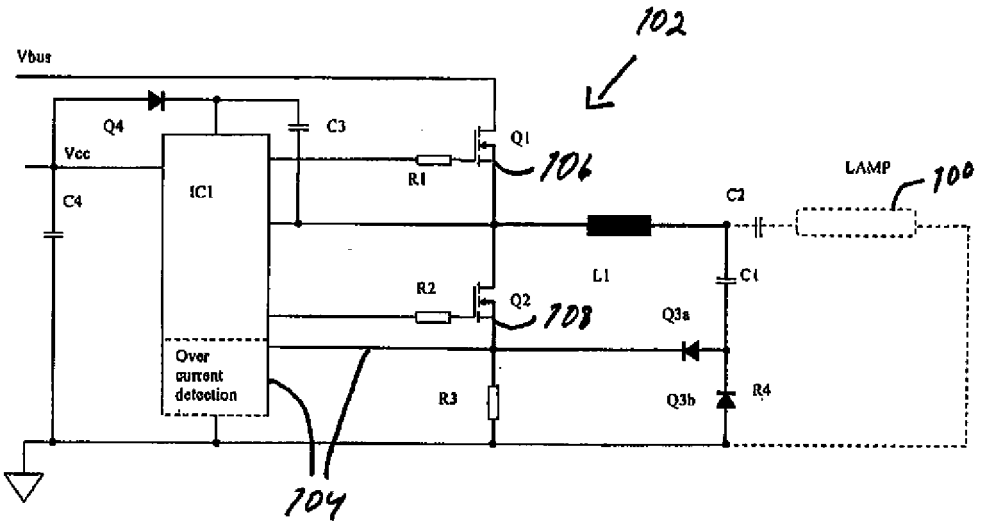

Fig. 3

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Description

Field of the invention

[0001] Tubular fluorescent lamps and HID lamps (High Intensity Discharge) are connected by way of electronic connection devices with a supply of electric power, receiving therefrom the energy needed thereby for illumination while being switched to the ON state.

Prior art

[0002] The fluorescent tube of fluorescent lamps and HID lamps is filled with a gas, such as for example argon or krypton. The generation of light further requires "a drop" of mercury which gasifies in response to an electrical discharge which produces ultraviolet radiation as electricity discharges through the fluorescent lamp. The fluorescent lamp has its inner surface coated with a fluorescent material, converting the ultraviolet radiation, which has been generated by the electrical discharge taking place in mercury vapor, into visible light.

[0003] In addition to a fluorescent tube, the fluorescent lamp and the HID lamp comprise either an electronic connection device or a magnetic inductor. At present, magnetic inductors have been almost completely displaced by electronic connection devices. The current generated in electronic connection devices and flowing through a fluorescent lamp is generally 20-100 kHz in frequency, most typically 50-60 kHz.

[0004] Fig. 1 illustrates a lamp according to the prior art, comprising a fluorescent lamp 100 and an electronic connection device 101. The electronic connection device comprises an electronic circuit used for providing the fluorescent lamp with a current needed for illumination, for example at a frequency of 50 kHz. The physical size of a resonance coil L1 is determined by losses in a normal illumination space, but even more importantly by a saturation current produced at the ignition moment of a fluorescent lamp. As the in-coil ferrite becomes saturated, the coil has its inductance falling quite sharply at the ignition moment of a fluorescent lamp. At the same time, there occurs an intensification of the voltage working across a still not-ignited fluorescent lamp. The situation is not under control as the prior art technology only enables monitoring the current of what is a bottom switching transistor Q2 in a half-bridge Q1, Q2. In the circuitry of fig. 1, the current flowing through the transistors can only be regulated by measuring the switching transistor's Q2 current from a resistor R3. The flow of the transistor's Q1 current cannot be directly regulated or discontinued. Thus, the saturating coil L1 may result in the fluorescent lamp being supplied with an excessively high voltage causing the destruction of transistors or a safety hazard (e.g. a fire hazard).

Summary of the invention

[0005] An objective of the invention is to gain control over the current of a lamp coil at the ignition moment of a fluorescent lamp in a manner which ensures that the coil current is maintained at safe values. This is achieved with a lamp of the invention, which comprises a fluorescent lamp for the generation of illuminating radiation. The lamp comprises an electronic connection device for providing an ignition voltage for the fluorescent lamp for activating the generation of illuminating radiation, the electronic connection device comprises at least two switching transistors for feeding current to a coil which develops an ignition voltage for the fluorescent lamp, and the electronic connection device has integrated therewith a control circuit which measures the current of the at least two switching transistors and, while in the process of measuring, the control circuit detects whether an excessively high current is flowing through one or more switching transistors, whereby the control circuit limits the excessively high current to a lower current level.

[0006] The invention is based on a continuous measurement of currents flowing through the switching transistors of a coil, and upon detecting that an excessively powerful current is flowing through one or more switching transistors, the flow of current is interrupted for the duration of an appropriate inactivity period to enable limiting the coil current to a lower level.

[0007] A benefit of the invention is that the lamp's coil current is maintained within an appropriate range regarding the lamp's functionality and regarding, for example, fire safety. Limiting the coil current also enables the use of smaller-size and hence economically more efficient coils.

List of figures

[0008]

Fig. 1 shows a lamp according to the prior art.

Fig. 2 shows a lamp according to the invention.

Fig. 3 shows a measuring process according to a preferred embodiment of the invention for the current of an ignition capacitor with the same resistor as the one used for the half-bridge by using a diode couple Q3a and Q3b.

Fig. 4 shows a preferred embodiment of the invention, which has been supplemented with a measuring feature for the cathode of a fluorescent lamp.

Detailed description of the invention

[0009] Fig. 2 shows a lamp of the invention, which comprises a fluorescent lamp 100 and an electronic connec-

tion device 102 designed with a control circuit 104 according to the invention. The electronic connection device 102 of fig. 2 has the control circuit 104 integrated therewith in such a way that the connection device can be used for monitoring separately the current of both an upper switching transistor Q1 and a lower switching transistor Q2 and, if necessary, the current of a coil L1 can be limited to an appropriate level. The upper switching transistor's Q1 current can be monitored by measuring the current of a resistor R4 prior to the ignition of the fluorescent lamp 100. The same current can also be measured elsewhere along the current's path (Vbus - Q1 - L1 - C1) either by way of a resistor or with a current transformer, for example. Respectively, the current of the switching transistor Q2 is measured by way of a resistor R3.

[0010] The control circuit 104 is fitted with a current level limit value, which may not be exceeded by a current flowing through either one of the switching transistors Q1 and Q2. The installation of a current level limit value in the control circuit is performed for example programmatically.

[0011] Each switching transistor is measured at the moment of ignition and, upon detecting that the current of either one of the switching transistors exceeds the accepted limit value, the flow of current is discontinued with a switch 106, 108 through this particular switching transistor. In preferred embodiments of the invention, which have been depicted for example in figures 2, 3 and 4, the switch 106, 108 refers to the actual switching transistor Q1, Q2 which functions the way of a relay in a current control process effected through the intermediary of the control circuit 104. The switching transistors Q1, Q2 presented in figures 2, 3 and 4 are MOSFET transistors. The switching transistors may also be transistors manufactured by other techniques, such as bipolar or IGBT transistors.

[0012] The control circuit 104 has also programmed therein a current travel inactivity period, after which the flow of current is re-activated by means of the switch 106, 108. By measuring the currents of both switching transistors Q1, Q2 pulse by pulse and by discontinuing the flow of a limit-value exceeding current through the switching transistor, in other words by deactivating the switching transistor immediately for the duration of a sufficiently long inactivity period, the current of a coil L can also be limited to a sufficiently low level. Consequently, this serves to ensure that the switching transistors do not sustain damage or that the fluorescent lamp's 100 maximum voltage values are not exceeded.

[0013] In a situation, in which a detection is made at the moment of ignition that both switching transistors Q1, Q2 have a limit-value exceeding current flowing therethrough, the switching transistors Q1, Q2 will be deactivated for an inactivity period. This creates a condition in which the currents flowing through both switching transistors increase in frequency and since frequency is directly proportional to voltage, the fluorescent lamp's 100 ignition voltage increases towards its sufficient ignition value.

[0014] Fig. 3 shows a measuring process according to a preferred embodiment of the invention for the current of an ignition capacitor with the same resistor as the one used for the half-bridge Q1, Q2 by using a diode couple Q3a and Q3b. The embodiment of the invention shown in fig. 2 involves the use of two resistors for measuring a current and, if an IC circuit board (Integrated Circuits) is available, the measurement is performed at two separate measuring points. On the other hand, in the preferred embodiment of the invention shown in fig. 3, the diode couple Q3a and Q3b enables measuring the current of an ignition capacitor C1 and measuring the current of a half-bridge, comprising the switching transistors Q1 and Q2, by means of one and the same resistor R3. Respectively, the IC circuit board has just a single measuring point at which such measurements of currents are performed. In the preferred embodiment of the invention shown in fig. 3, it is possible to regulate at the moment of ignition the current of both switching transistors Q1 and Q2 from a single circuitry connected to the IC circuit board.

[0015] Fig. 4 shows a preferred embodiment of the invention, which has been supplemented with a measuring circuit 110 for the cathode of a fluorescent lamp 100, said circuit comprising resistors (R4, R5, R6), a diode Q5, and a capacitor C5. An operating voltage Vcc needed by a measuring circuit is supplied to the measuring circuit 110 by way of the resistor R5. In other respects, fig. 4 comprises an embodiment similar to the one shown in the context of fig. 3. Since the current of the ignition capacitor C1 is monitored continuously in the circuitries of figs. 3 and 4, the same measuring point on the IC circuit board can also be used for measuring the fluorescent lamp 100 for its voltage while the fluorescent lamp is in an illuminating state.

[0016] The ignition capacitor's C1 current is directly proportional to the frequency, the value of which is known. Correspondingly, the ignition capacitor's C1 current is directly proportional to the voltage of the fluorescent lamp 100. Accordingly, the deactivation or switch-off of the fluorescent lamp can also be detected from the same measuring point. It is also possible to utilize the same measuring point in the identification of a rectifying fluorescent lamp, based on unequal magnitudes of the currents of rectifying fluorescent lamps. Likewise, the absence of a fluorescent lamp, in other words the absence of the cathode of a fluorescent lamp, or its presence can be confirmed by a measurement effected at the same measuring point.

[0017] Although the invention has been described in the above specification with reference to the circuit diagrams depicted in the figures, the invention is not limited to the specification and the circuit diagrams of figs. 2-4 but, instead, the invention can be varied within the scope defined in the appended claims. As one example, it can be noted that the order of a capacitor C2 and a fluorescent

lamp 100 can be other than what is depicted without the change making any substantial functional difference in the embodiment of the invention. Similarly, other types of circuitry combinations and components within the scope defined by the claims can also be relevant as embodiments according to the invention. In embodiments of the invention, the lamp can be for example a fluorescent lamp or a HID (high intensity discharge) lamp.

Claims

1. A lamp, comprising a fluorescent lamp (100) for the generation of illuminating radiation, **characterized in that** the lamp comprises an electronic connection device (102) for providing an ignition voltage for the fluorescent lamp for activating the generation of illuminating radiation, the electronic connection device (102) comprises at least two switching transistors (Q1, Q2) for feeding current to a coil (L1) which develops the ignition voltage for the fluorescent lamp (100), and the electronic connection device (102) has integrated therewith a control circuit (104) which measures the current of the at least two switching transistors (Q1, Q2) and, while in the process of measuring, the control circuit (104) detects whether an excessively high current is flowing through one or more switching transistors (Q1, Q2), whereby the control circuit (104) limits the excessively high current to a lower current level.

2. A lamp as set forth in claim 1, **characterized in that** the lamp is a tubular fluorescent lamp.

3. A lamp as set forth in claim 1, **characterized in that** the lamp is an HID lamp (High Intensity Discharge).

4. A lamp as set forth in claim 1, **characterized in that** the electronic connection device (102) comprises the control circuit (104) for monitoring the current of the switching transistor (Q1) by measuring, at the ignition moment of the fluorescent lamp (100), the current of a resistor (R4) set in series with the coil (L1).

5. A lamp as set forth in claim 1, **characterized in that** the electronic connection device (102) comprises the control circuit (104) for monitoring the current of the switching transistor (Q2) by measuring the current of a resistor (R3) present in the current's path.

6. A lamp as set forth in claim 1, **characterized in that** the control circuit (104) comprises a current transformer for measuring the current of one or more switching transistors (Q1, Q2) from the current's path.

7. A lamp as set forth in claim 1, **characterized in that** the control circuit (104) has set therein a current level limit value, which may not be exceeded by the current flowing through one or more switching transistors (Q1, Q2).

8. A lamp as set forth in claim 7, **characterized in that** the current level limit value is set in the control circuit (104) programmatically.

9. A lamp as set forth in claim 7, **characterized in that** the electronic connection device (102) comprises switches (106, 108) for the interruption of currents which exceed the current level limit value.

10. A lamp as set forth in claim 1, **characterized in that** the control circuit (104) has programmatically set therein a current flow inactivity period, after which the current flow is re-activated by means of the switch (106, 108).

11. A lamp as set forth in claim 1, **characterized in that** the electronic connection device comprises a diode couple (Q3a, Q3b) for measuring the currents of an ignition capacitor (C1) and the switching transistors (Q1, Q2) with one and the same resistor (R3).

12. A lamp as set forth in claim 1, **characterized in that** the electronic connection device (102) is implemented in an IC (Integrated Circuit) circuit board embodiment, comprising a circuitry by way of which the currents of the switching transistors (Q1, Q2) can be regulated.

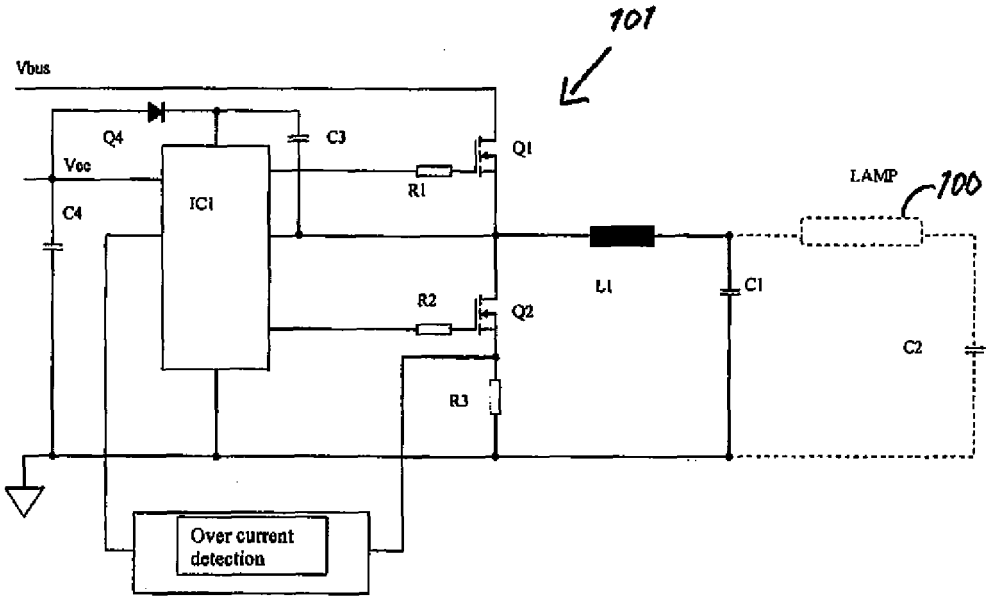
13. A lamp as set forth in claim 1, **characterized in that** the electronic connection device (102) has integrated therewith a measuring circuit (110) for the cathode of the fluorescent lamp (100).

14. A lamp as set forth in claim 1, **characterized in that** the electronic connection device (102) is implemented in an IC (Integrated Circuit) circuit board embodiment, comprising a circuitry by way of which the voltage of the fluorescent lamp (100) is measured while the fluorescent lamp is in an illuminating state.

15. A lamp as set forth in claim 1, **characterized in that** the electronic connection device (102) is implemented in an IC (Integrated Circuit) circuit board embodiment, comprising a circuitry by way of which a deactivation of the fluorescent lamp (100) is detected by measuring.

16. A lamp as set forth in claim 1, **characterized in that** the electronic connection device (102) is implemented in an IC (Integrated Circuit) circuit board embodiment, comprising a circuitry by way of which is identified which fluorescent lamp is in question, based on unequal magnitudes of the currents in the fluorescent lamps.

17. A lamp as set forth in claim 1, **characterized in that** the electronic connection device (102) is implemented in an IC (Integrated Circuit) circuit board embodiment, comprising a circuitry by way of which is detected whether the fluorescent lamp (100) is in place.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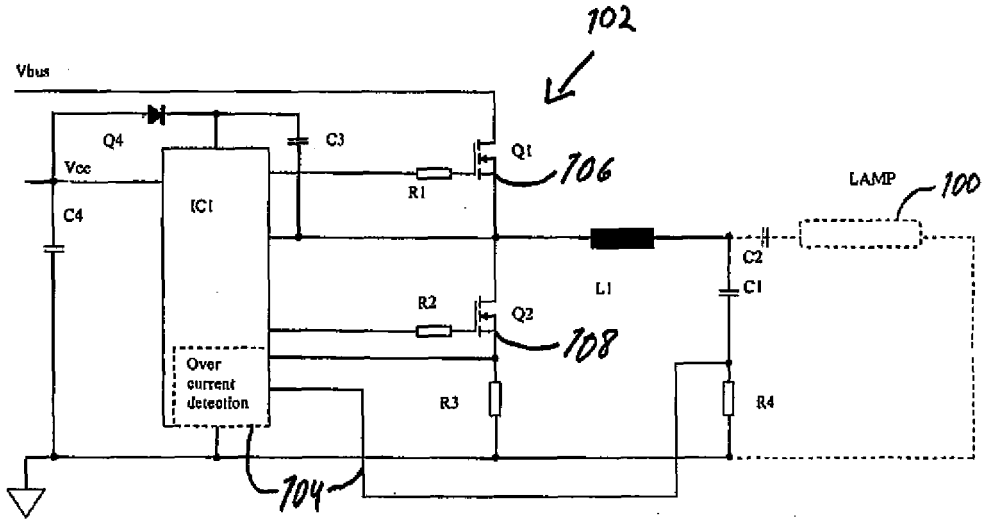
Q4
Vcc
C4
IC1
C3
R1
Q1
LAMP
100
L1
C1
R2
Q2
C2
R3
Over current detection

Fig. 1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Q4
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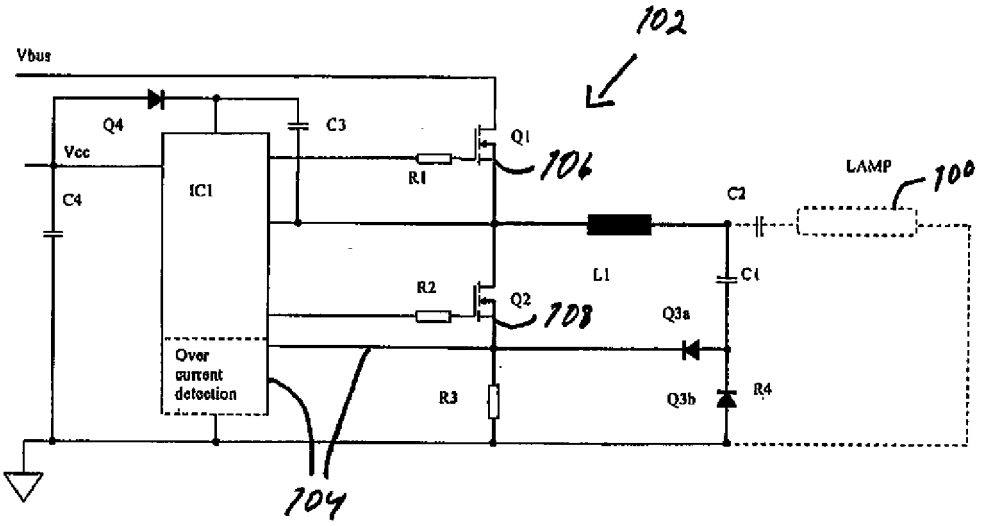
C4
IC1
C3
R1
Q1
106
LAMP
100
C2
L1
C1
R2
Q2
108
Over current detection
R3
R4
104

Fig. 2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R1
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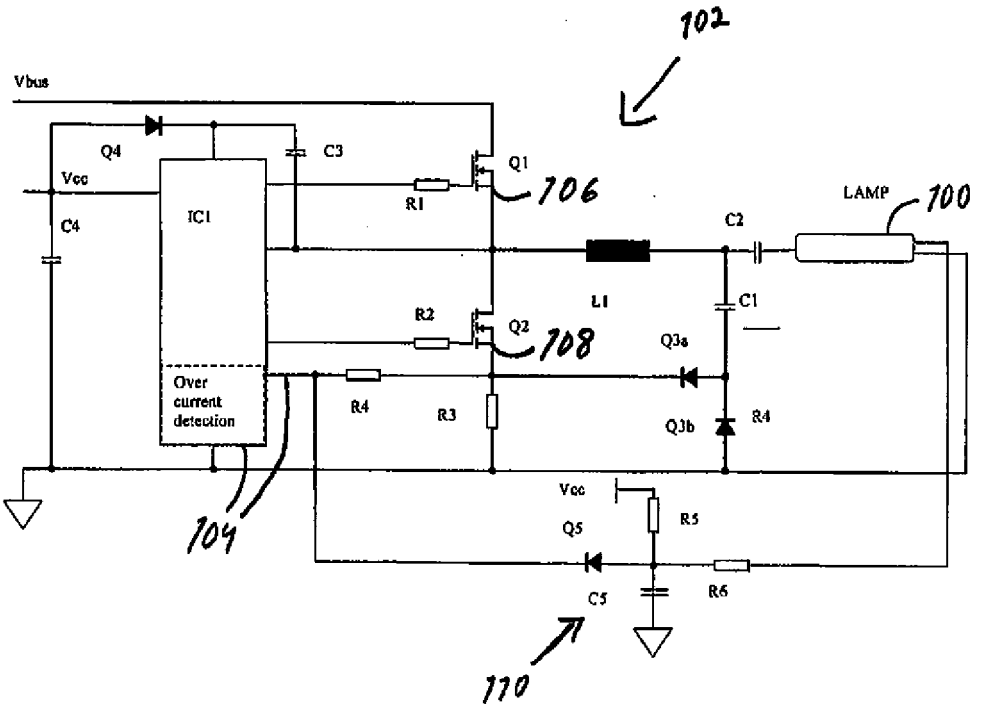
Q2
108
Q3a
Over current detection
R3
Q3b
R4
104

Fig. 3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100
C2
L1
C1
R2
Q2
108
Q3a
Over current detection
R4
R3
Q3b
R4
Vcc
Q5
R5
C5
R6
104
110

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 08 16 4248

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 4 873 471 A (DEAN THOMAS E [US] ET AL) 10 October 1989 (1989-10-10) * columns 4-7,15; figures 1,7 *	1-17	INV. H05B41/298 H05B41/292
X	US 2006/197470 A1 (RIBARICH THOMAS J [US] ET AL) 7 September 2006 (2006-09-07) * paragraphs [0044] - [0047]; figure 4 *	1	
A	DOSHI M ET AL: "Low frequency architecture for multilamp CCFL systems with capacitive ignition" APPLIED POWER ELECTRONICS CONFERENCE AND EXPOSITION, 2005. APEC 2005. TWENTIETH ANNUAL IEEE AUSTIN, TX, USA 6-10 MARCH 2005, PISCATAWAY, NJ, USA,IEEE, US, vol. 2, 6 March 2005 (2005-03-06), pages 1072-1078Vol.2, XP010809429 ISBN: 978-0-7803-8975-5 * page 1073 - page 1075; figures 2,3a,4a *	1-17	

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	28 January 2009	Morrish, Ian

CATEGORY OF CITED DOCUMENTS

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4873471 A	10-10-1989	NONE	
US 2006197470 A1	07-09-2006	NONE	

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