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(71) Applicant *(for all designated States except US)*: **MASS TECHNOLOGY (H.K.) LTD.** [CN/CN]; Room 2902-6, Tower 6, The Gateway, 9 Canton Road, Tsimshatsui, Kowloon, Hong Kong (CN).

(71) Applicant *(for SD only)*: **WIESNER, Werner, Th.** [DE/DE]; Birkenweiher Str. 2, 63505 Langenselbold (DE).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **ONN FAH, Foo** [SG/CN]; Room 2902-6, Tower 6, The Gateway, 9 Canton Road, Tsimshatsui, Kowloon, Hong Kong (CN).

(74) Agent: **STOFFREGEN, Hans-Herbert**; Friedrich-Ebert-Anlage 11b, Postfach 21 44, 63411 Hanau (DE).

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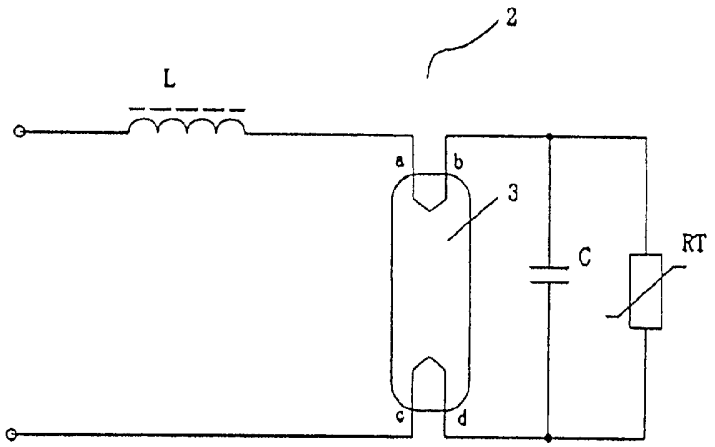
(54) Title: LUMINOSITY-ADJUSTABLE HIGH FREQUENCY FLUORESCENT LAMP ILLUMINATING DEVICE



(57) Abstract: A luminosity-adjustable high frequency fluorescent lamp illuminating device comprises a frequency-adjustable power source (1), a fluorescent lamp (2) composed of a lamp tube (3) and coordinated circuit elements, the coordinated circuit elements comprise an inductor (L), a capacitor (C) and a thermistor (RT), one terminal of the inductor (L) is connected with one of the terminals of the power source (1), the other terminal is connected with a terminal point (a) of one of the two cathodes of the lamp tube (3), the capacitor (C) and thermistor (RT) after being connected in parallel are connected with the other terminal point (b) of the cathode and one terminal point (d) of the other cathode of the lamp tube (3). The outstanding characteristic of the present device is under the condition of greatly simplified coordinated circuit elements of fluorescent lamp that is able to acquire steady luminosity modulating function. The high frequency power source (1) and the luminosity-adjustable high frequency fluorescent lamp (2) are two separately independent products, however, they are also usually used in coordination mutually and have advantages of low cost, compact volume and reliable performance.

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Luminosity-Adjustable High Frequency Fluorescent Lamp Illuminating Device

Field of the invention

The invention relates to a fluorescent lamp illuminating device, and particularly is a luminosity-adjustable high frequency fluorescent lamp illuminating device utilising frequency-adjustable high frequency power source to conduct luminosity modulation to fluorescent lamp.

Background of the invention

Presently in interior illumination, there have appeared various types of fluorescent lamps, and in many occasions they are replacing incandescent lamps to became main-body of the interior illumination, however, the luminosity modulation of fluorescent lamps up to now has yet no sound solution, hence under condition in need of luminosity modulation it is still to apply an incandescent lamp bulb in coordination with a simple "TRIAC dimmer" to acquire satisfactory luminosity modulating effect.

Lately, there appears on market a product applying "TRIAC dimmer" to conduct luminosity modulation to compact type fluorescent lamps, however, the drawbacks of this kind of luminosity-adjustable fluorescent lamp are of very complicated circuit, rather bulky volume, low reliability, and very high cost, hence this kind of luminaire is very difficult to popularize.

Summary of the invention

The object of the invention is to solve the existing drawbacks of the current luminosity-adjustable fluorescent lamps and to provide a luminosity-adjustable high frequency fluorescent lamp illuminating device composed of a frequency-adjustable high frequency power source and a fluorescent lamp circuit adaptable to conduct luminosity modulation,

moreover, the above-mentioned power source is not restricted to conduct luminosity modulation to a fluorescent lamp but can also be extensively used in applications not for luminosity modulation.

Summary of the invention

The technical scheme to realize the above-mentioned object according to the invention is: A luminosity-adjustable high frequency fluorescent lamp illuminating device comprises a frequency-adjustable power source, a fluorescent lamp composed of a lamp tube and coordinated circuit elements, wherein, the coordinated circuit elements comprise an inductor and a tow-pole network composed of a capacitor and a thermistor, one terminal of said inductor is connected with one of the output terminals of the power source, the other terminal of said inductor is connected with one terminal point of one of the two cathodes of the lamp tube, said two-pole network is connected with the other output terminal of said cathode and one of the terminal points of the other one of the two cathodes of the lamp tube, the other terminal point of said other cathode is connected with the power source. Preferably said capacitor and said thermistor of said two-pole network are connected in parallel.

According to another aspect of the invention said capacitor and said thermistor of said two-pole network are connected in series.

According to still another aspect of the invention said inductor has two additional windings, one additional winding is connected to the two terminal points of one of the two cathodes of the lamp tube and the other additional winding is connected to the two terminal points of the other cathode of the two cathodes of the lamp tube.

According to yet another aspect of the invention the inductive reactance of said inductor is 1 mH – 20 mH, the capacitance of said capacitor is 1 nF – 20 nF and the cold resistance of said thermistor is less than 10 kΩ.

According to another aspect of the invention said power source comprises a filtering and rectifying circuit, a power factor regulating circuit and a frequency control and switch circuit, its frequency regulating or modulating range is 10 – 200 KHz.

It can be seen from the above, since the fluorescent lamp circuit elements in the luminosity-adjustable high frequency fluorescent lamp illuminating device according to the invention have only one inductor, one capacitor and one thermistor, i. e. three elements, it will be distinctly found that its circuit elements are greatly reduced in number as compared with fluorescent lamps of low frequency power supply, for instance, with those in the compact type fluorescent lamps having scores of circuit elements. Besides, as for straight tube shape fluorescent lamps with separate traditional electronic ballast, its independent electronic ballast has also scores of elements, however, when adopting high frequency supply line or circuit of the invention, they can be simplified as the above-mentioned three elements as well; moreover, as for fluorescent lamps of inductive ballast and starter, they can also be simplified to use an inductor of very small volume, a capacitor and a thermistor. It can be seen form the above-mentioned technical specification, the outstanding characteristic of the invention is the coordinated circuit and elements available to very big simplification, this will make the cost of the fluorescent lamp of high frequency power supply drop greatly and will be of lessened volume, reliable performance, simultaneously also able to acquire steady luminosity regulation or modulating function.

Thus, despite the fact that the frequency-adjustable high frequency power source and the luminosity-adjustable high frequency fluorescent lamp are two independent products, however, they are usually used mutually in coordination. Hence, particularly at the time of using the illuminating system composed of the frequency-adjustable high frequency power source and coordinated luminosity-adjustable fluorescent lamp of the invention, it is possible to attain the object of steady luminosity modulation through freely regulating or modulating the frequency of the power source.

The above principles, advantages and features of the invention are described in further detail below in conjunction with the following drawings.

Brief description of accompanying drawings

Figure 1 is a schematic block diagram of circuit principle of the invention;
Figure 2 is a circuit diagram of a frequency-adjustable high frequency power source of the invention;
Figure 3 is a connection diagram of a first embodiment of a fluorescent lamp and coordinated circuit elements of the invention;
Figure 4 is a connection diagram of a second embodiment of a fluorescent lamp and coordinated circuit elements of the invention;
Figure 5 is a connection diagram of a third embodiment of a fluorescent lamp and coordinated circuit elements of the invention;
Figure 6 is a schematic block diagram of an applied circuit composed of a power source and fluorescent lamp, etc. through power transmission feeder line of the invention.

Detailed description of preferred embodiments of the invention

Referring to Figure 1 to Figure 3, the luminosity-adjustable high frequency fluorescent lamp illuminating device of the invention comprises a frequency-adjustable high frequency power source 1, a fluorescent lamp 2 composed of a lamp tube 3 and coordinated circuit elements, wherein, the power source 1 is an independent device composed of a filtering and rectifying circuit 11, a power factor regulating circuit 12 and a frequency control and switch circuit 13. The input of this power source is mains supply while the output is power source of high frequency. In order to realize luminosity modulation to fluorescent lamp, in the frequency control and switch circuit 13 of this device there is provided a manual knob to conduct regulating or modulating of the output frequency of the power source. The working range of the frequency of the power source is 10 kHz – 200 KHz, its output (high frequency) voltage is generally 230 V, the same as the commercial power voltage 230 V, however, being possible over commercial power voltage. Thus, the output feeder line of output terminal of said power source is the same as the transmission feeder line used for the commercial power. This is due to higher frequency, the twisted flexible electric wire is unsuitable for use. During use, the fluorescent lamp can be introduced into the high frequency power source mentioned-above through adaptable common lamp holder.

The fluorescent lamp 2 is the luminosity-adjustable high frequency fluorescent lamp comprising a lamp tube 3, a coordinated circuit and elements. It differs from the common fluorescent lamp using commercial power by disparity of coordinated circuit and elements to be specified below, while the lamp tube 3 used is entirely the same, for instance, as straight tube type, annular type, etc. fluorescent lamps, only the discrete type electronic ballast or inductive ballast is different, while the lamp tube of straight tube type, annular type, etc. fluorescent lamp is the same. Its reason is that the adjustable high frequency fluorescent lamp, in addition to the necessity to adapt to use high frequency power source, has to attain the object of luminosity modulation, too.

The coordinated circuit and elements compries an inductor L and a two-pole network composed of a capacitor C and a thermistor RT, they can be connected with the lamp tube 3 in three connecting modes as follows:

In the first one of coordinated circuit and elements, said inductor L is a single inductive element, with one terminal connected with one of the output terminals of the power source 1, the other terminal connected with one terminal point a of a cathode of the lamp tube 3, said capacitor C and said thermistor RT after being connected in parallel are connected with the other terminal point b of the cathode and with terminal point d of the other cathode of the lamp tube 3, besides, the other one of output terminals of power source 1 is connected with the other terminal point of the cathode of the lamp tube 3.

Referring to Figure 4, in the second one of coordinated circuit and elements, said inductor L adopts a main inductor with a winding and an inductor with two additional windings l1 and l2, one winding l1 is connected with terminal points a, b of one cathode of the lamp tube 3, the other winding l2 is connected with terminal points c, d of the other cathode of the lamp tube 3, and the connection between coordinated circuit and elements of the fluorescent lamp 2, such as the main inductor, capacitor C and thermistor RT, power source 1 and the lamp tube 3, etc. is the same as that in the first of coordinated circuit and elements.

The luminosity modulation principle of illuminating device of the above-mentioned arrangement is as follows: The luminosity modulation of the lamp tube 3 is attained through modulating the output frequency of the power source. Since an inductor L is placed gener-

ally in the circuit elements of fluorescent lamp 2 to conduct current smoothing (referring to Figure 3), and the inductive reactance of the inductor L ascends following the ascent of working frequency, at the time of ascending of inductive reactance, the power supplied to the lamp tube 3 will drop to make the illuminating luminosity of the lamp tube drop. Hence regulation to raise the output frequency of the power source 1 will attain the action of luminosity modulation.

Temperature compensating principle of cathode during luminosity modulation is as follows: The fluorescent lamp tube 3 usually adopts hot cathode working, i. e. during lighting of the lamp tube, its cathode must have a certain temperature to maintain sufficient thermo-electron emitting ability. When the cathode temperature is lower than the minimum value required, the cathode will be subjected to bombardment of ion with enormous energy to make the cathode damaged very soon. During luminosity modulation, due to output power drop resulting in temperature drop of the cathode, the cathode temperature will certainly occur lower than required, hence temperature compensating is the necessary measure to secure lamp tube life. For this reason, in the invention, the lamp tube 3 during working has primarily two sources of heat quantity able to make the cathode of the lamp tube acquire sufficient temperature. The first one is that the cathode, during the lamp tube 3 discharges, is subject to ion bombardment to be heated up: the second one is the current flowing through capacitor C to heat the cathode. Referring to figure 3, during luminosity modulation, due to change of frequency raising makes the capacity reactance of the capacitor C drop, hence the current flowing through capacitor C will then increase, so as to compensate the drawback problem of cathode temperature deficiency brought about due to power cost-down of the lamp tube 3.

In order to acquire more temperature compensation, we design the circuit as shown in Figure 4. In the rectifying inductor L of the circuit, two coupled windings l1 and l2 are added to be connected respectively into or with two cathodes of the lamp tube. During luminosity modulation, due to ascent of frequency, the inductive reactance of rectifying or smoothing inductor ascends, i. e. voltage of the inductor increases, and consequently the voltage induced to be coupled windings also ascends, so as to make temperature of cathodes acquire more compensation.

Referring to figure 5, in the third one of coordinated circuit and elements, except the connection between inductor L, power source 1 and a lamp tube 3 bring the same as that in the first of coordinated circuit and elements, the disparity is that said capacitor C and the thermistor RT after being connected in series are connected with terminal points b, d of the cathodes of the lamp tube 3.

In a circuit application of an embodiment according to the invention, there can be an illuminating device or system composed of one power source and one or more fluorescent lamps, for instance in Figure 6 the lead-in fluorescent lamps are 4 in number, they compose a transmission circuit able to modulate luminosity to lamp tubes through a transmission feeder line connection. Now, regardless of the number of lead-in fluorescent lamps, it will do only if the total power or summing power of lead-in lamps will not surpass the rated output power of the high frequency-adjustable fluorescent lamp power source 1. However, when the number of lead-in lamp tubes is rather numerous and all are lighted together, there will occur an instantaneous large load impact to the power source 1. In order to lessen this kind of impact, we design a luminosity-adjustable high frequency fluorescent lamp circuit as shown in Figure 5. It can be seen in this circuit form Figure 5, the current flowing through capacitor C, when lamps are lighting will be subjected to the restriction of the thermistor RT, so as to reduce the instantaneous impact current. This is the measure to reduce impact to high frequency power source at the time of lighting lamps. In the first of the third of coordinated circuits and elements, the inductive reactance of inductor L is 1 mH – 20 mH, capacitance of capacitor C is 1 nF – 20 nF and the cold resistance of thermistor RT is less than 10 KΩ.

Now an applicable embodiment of the present illuminating device is illustrated, wherein, a high frequency power source of rated output power of 100 W is adopted which through a parallel feeder line of 15 m length is evenly distributed and connected in parallel lead-in to 10 E27-Type standard fluorescent lamp tubes of which the power of each is 9 W. The circuit of said high frequency power source can be composed of a few existing circuit portions, as shown in figure 2. In the frequency control and switch circuit 13 at the right portion of the Figure 2, there is a variable resistor R19, which is used to modulate output frequency of the power source.

The coordinated circuit and elements of the luminosity-adjustable high frequency fluorescent lamp are made up by adopting components as shown in Figure 5. Then, the performance test is conducted to lead-in lamp tubes.

The test result is as follows:

1. The output high frequency power source voltage is 200 V – 350 V;
2. The basic frequency of the output high frequency power source voltage is 40 KHz;
3. The change of frequency during luminosity modulation is 40 – 90 KHz;
4. The variable amplitude of brightness of "luminosity-adjustable high frequency fluorescent lamps" is 100 % - 20 %.
5. During the entire luminosity modulating procedure, the lighting of fluorescent lamps is steady without occurrence of blinking phenomenon, cathodes are maintained at sufficient temperature, thus not to affect the life of lamps;
6. The power factor of system during the entire luminosity modulating procedure is over or more than 0.95;
7. The device is conforming to the demand of EN55015 electromagnetic disturbance.

Claims

1. A luminosity-adjustable high frequency fluorescent lamp illuminating device comprising a frequency-adjustable power source (1), a fluorescent lamp (2) composed of lamp tube (3) and coordinated circuit elements, characterized in that the coordinated circuit elements comprise an inductor (L), and a two-pole network composed of a capacitor (C) and a thermistor (RT), one terminal of said inductor (L) is connected with one of the output terminals of the power source (1), the other terminals of said inductor is connected with one terminal point (a) of one of the two cathodes of the lamp tube (3), said two-pole network is connected with the other terminal point (b) of said cathode and one (d) of the terminal points (c, d) of the other one of two cathodes of the lamp tube (3), the other terminal point (c) of said other cathode is connected with the power source (1).

2. A luminosity-adjustable high frequency fluorescent lamp illuminating device according to claim 1, characterized in that said capacitor (C) and said thermistor (RT) of said two-pole network are connected in parallel.

3. A luminosity-adjustable high frequency fluorescent lamp illuminating device according to claim 1, characterized in that said capacitor (C) and said thermistor of said two-pole network are connected in series.

4. A luminosity-adjustable high frequency fluorescent lamp illuminating device according to at least one of the preceding claims, characterized in that said conductor (L) has two additional windings (l1, l2), one additional winding (l1) is connected with the two terminal points (a, b) of one of the two cathodes of the lamp tube (3) and the other additional winding (l2) is connected with the two terminal points (c, d) of the other cathode of the two cathodes of the lamp tube (3).

5. A luminosity-adjustable high frequency fluorescent lamp illuminating device according to at least one of the preceding claims, characterized in that the inductive reactance of said inductor (L) is 1 mH-20 mH, the capacitance of said capacitor (C) is 1 nF – 20 nF and the cold resistance of said thermistor (RT) is less than 10 kΩ.

6. A luminosity-adjustable high frequency fluorescent lamp illuminating device according to at least one of the preceding claims, characterized, in that said power source (1) comprises a filtering and rectifying circuit (11), a power factor regulating circuit (12) an a frequency control and switch circuit (13), its frequency regulating or modulating range is 10 – 200 KHz.

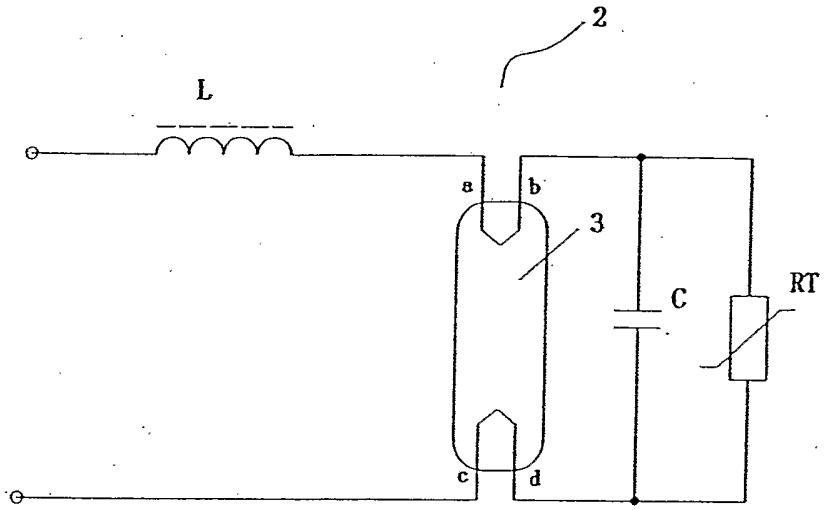

Fig. 3

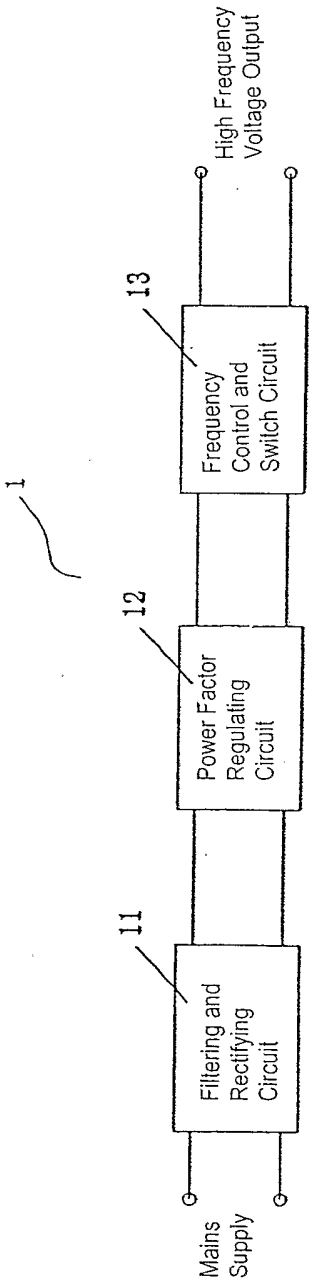
1
13
Frequency Control and Switch Circuit
12
Power Factor Regulating Circuit
11
Filtering and Rectifying Circuit
High Frequency Voltage Output
Mains Supply

Fig. 1

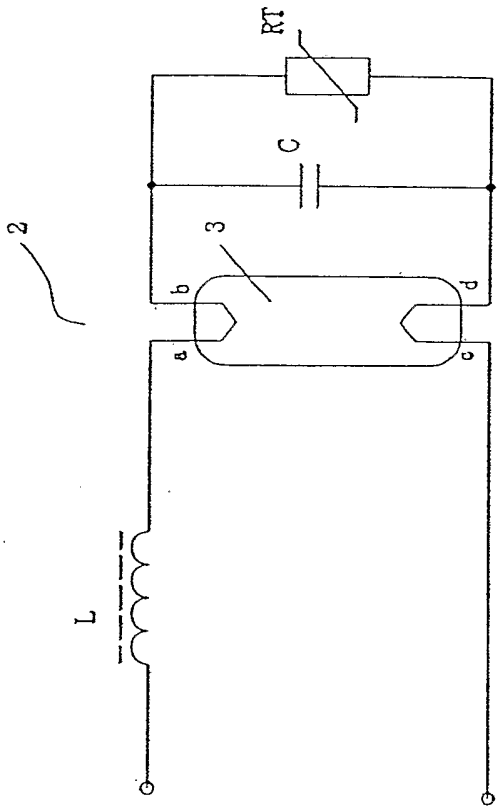
2
RT
C
3
b
d
a
c
L

Fig. 3

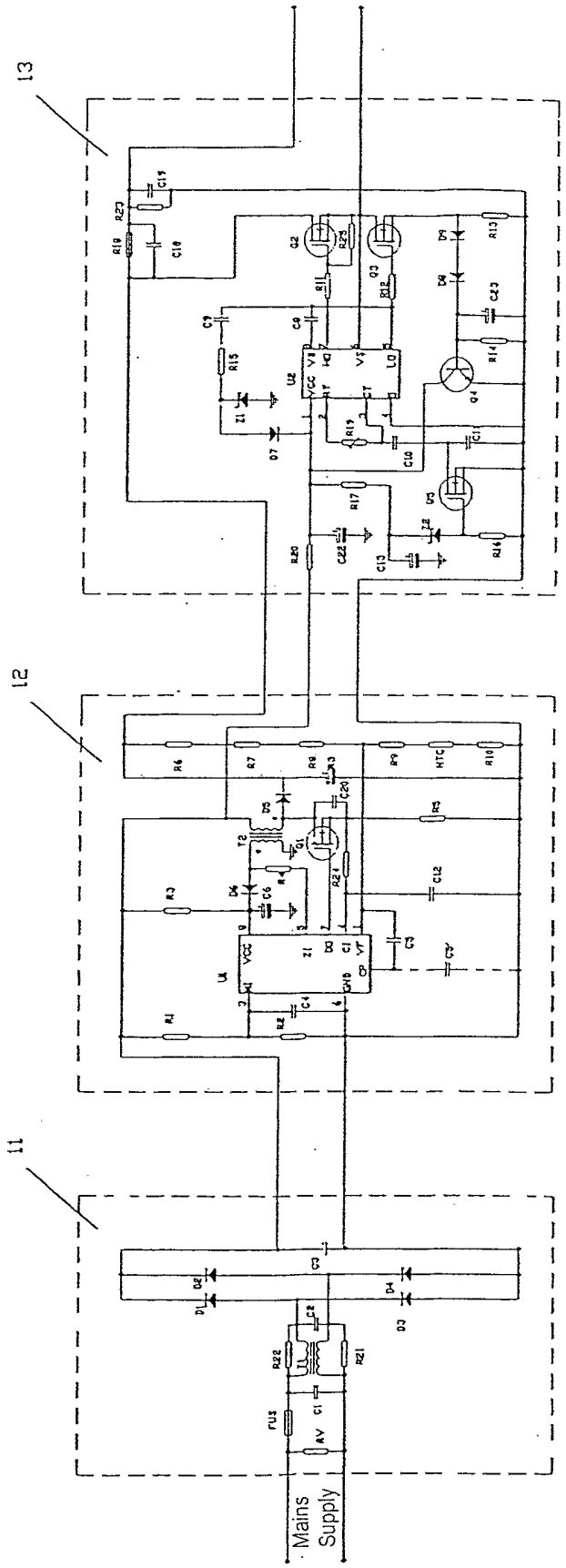

Fig. 2

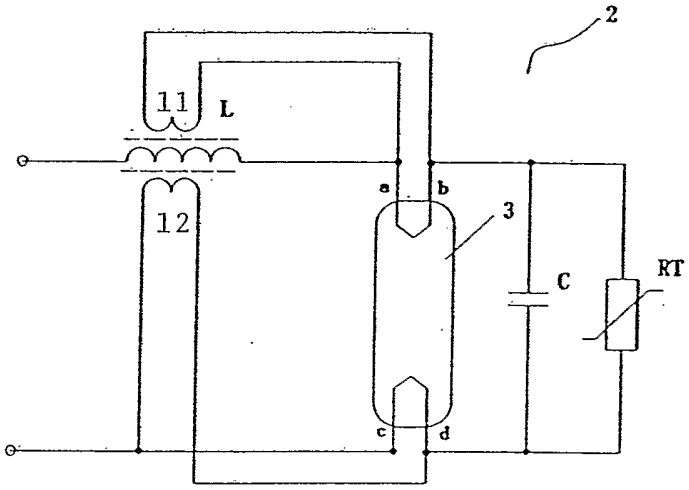

Fig. 4

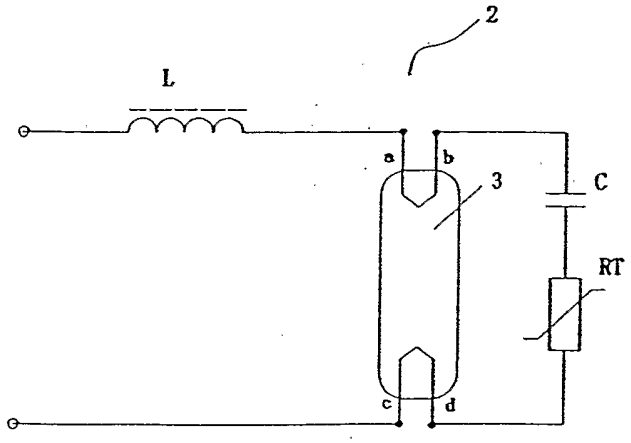

Fig. 5

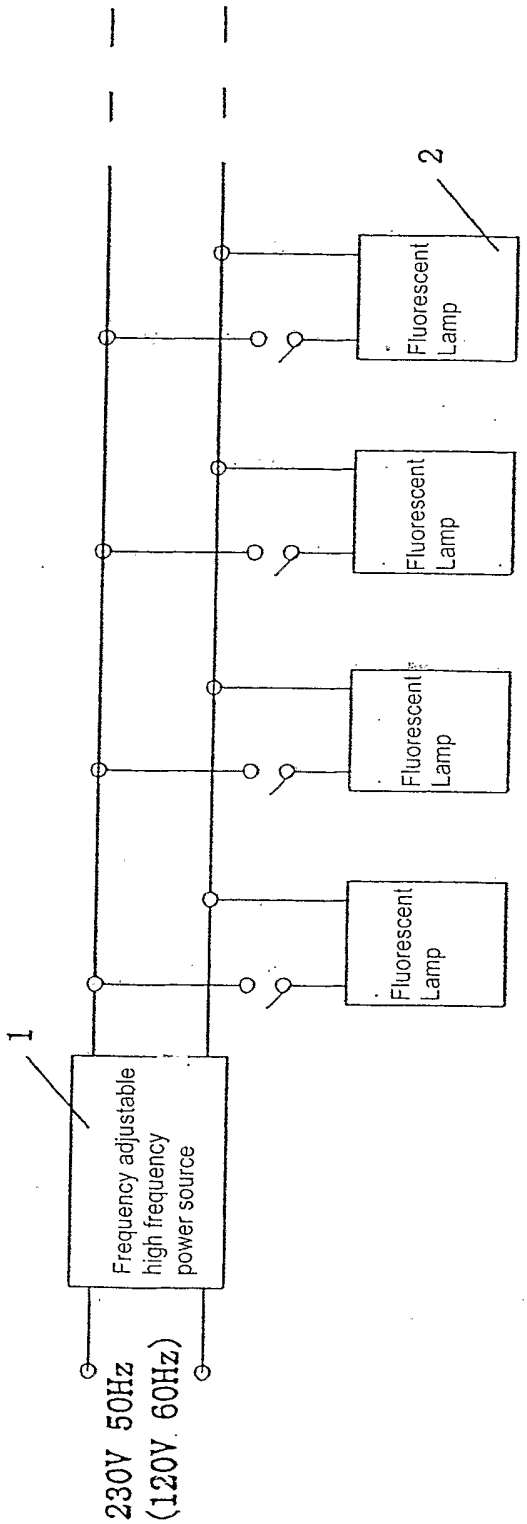
1
Frequency adjustable high frequency power source
230V 50Hz
(120V. 60Hz)
2
Fluorescent Lamp
Fluorescent Lamp
Fluorescent Lamp
Fluorescent Lamp

Fig. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 02/12905

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H05B41/392

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)
IPC 7 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 practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 5 406 174 A (SLEGERS FRANS) 11 April 1995 (1995-04-11) column 3, line 4 -column 4, line 16; figures 1,2	1,4
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in 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
19 February 2003	27/02/2003

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Internati[redacted] Application No
PCT/EP 02/12905

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
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