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(71) Applicant: **Mass Technology (H.K.) Ltd.**
Tsimshatsui, Kowloon, Hong Kong (CN)

(72) Inventor: **FOO, Onn Fah,**
c/o Mass Technology (H.K) Ltd.
Tsumshatsui, Kowloon, Hong Kong (CN)

(74) Representative: **Jorio, Paolo, Dr. Ing. et al**
Studio Torta S.r.l.,
Via Viotti, 9
10121 Torino (IT)

(54) **Electronic ballast for fluorescent lamp using silicon-controlled phase-luminosity modulator for adjusting luminosity**

(57) The present invention relates to an electr onic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity. The ballast comprises: (a) a filter and rectification circuit having an output port and connected to a municipal alternating current power supply; (b) a frequency-control and switch circuit having an output port; including an integrated circuit (IC) for controlling frequency and producing switch -triggering signals; (c) an output circuit, having an input port connected to the output port of the frequency -control and switch circuit; (d) light -modulating signal processing circuit, connected to the output port of filter and rectification circuit and the input port of frequency control and switch circuit; (e) direct -current high voltage stabilization circuit, with an input port connected to the output port of filter and rectification circuit, an output port connected to the input port of frequency control and switch circuit, and feedback port connected with the output circuit. This electronic ballast requires only three simple circuits and few components. Thus, it can be manufactured at a lower cost with a smaller dimension. With its stable capacity of light modulating, the ballast of the present invention can be applied easily and widely, especially in the integrated and compact fluorescent lamps.

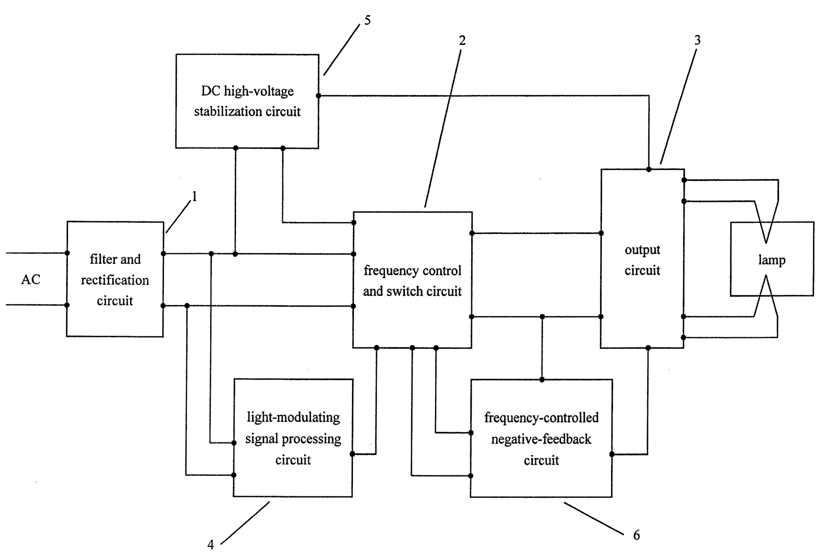

Fig. 2

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Description

FIELD OF THE INVENTION

[0001] This present invention relates to a light modulating device for fluorescent lamps, and in particular to an electronic ballast for fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting and maintaining stable luminosity.

BACKGROUND OF THE INVENTION

[0002] It is always desirable that the light of fluorescent lamps could be modulated as an incandescent lamp applying a commonly used silicon-controlled light modulator, as shown in FIG. 1. However, it is not easy for a fluorescent lamp to apply a general silicon-controlled phase-luminosity modulator since it is a non-linear load with a dynatron chara cteristic. With the improvement of electronic ballast technology, studies on applications of silicon-controlled phase-luminosity modulator on adjusting luminosity for fluorescent lamps have been reported on both patent literatures and technical magazines, and related products have been developed. Nevertheless, in order for the light modulating capacity to reach the stable, uniform and non-flickering levels, the ballasts usually have complicated circuits with numerous components, resulting in high manufactur ing costs and bulky size. Thus it is hard to apply this technology widely. On the other hand, if the circuits are simplified, flickering will result and light will become non-uniform during modulation. It is therefore desirable to find better light modul ating control circuit to improve light modulation technology for fluorescent lamps.

[0003] A fluorescent lamp applying a silicon-controlled phase-luminosity modulator for adjusting luminosity was disclosed in Chinese Patent No. CN01269679.X. Although the phase-modulating light modulation was accomplished in this light-modulated fluorescent lamp, it is advantageous to enhance the effect and capacity of light modulating.

SUMMARY OF THE INVENTION

[0004] An objective of the present invention is to provide a novel electronic ballast for a fluorescent lamp using a silicon-controlled phase-luminosity modulator to adjust luminosity in order to overcome the shortcomings of prior ballasts with complicated circuits, numerous components, high manufacturing cost, bulky dimensions, difficulties in being applied widely, and frequent flickering and nonuniform light modulation.

[0005] In order to achieve the above objective, the present invention provides an electronic ballast for a fluorescent lamp applying silicon-controlled light modulator for adjusting luminosity. The ballast according to the present invention is comprised of:

(1) (a) a filter and rectification circuit, connecting with a municipal alternating current power supply; (b) a frequency control and switch circuit, including an integrated circuit (IC) which controls frequency and produces switch-triggering signals, two switch transistors Q1, Q2 and the corresponding resistors and capacitors; (c) an output circuit, including inductances and capacitors, with its input port connect ing with the output port of above frequency control and switch circuit; (d) a light-modulating signal processing circuit connecting with the output port of filter and rectification circuit and the input port of frequency control and switch circuit; (e) a d irect-current, high-voltage stabilization circuit, with its input port connecting with the output port of filter and rectification circuit, output connecting with the input port of frequency control and switch circuit, and feedback port connecting with out put circuit;

(2) a frequency-control negative-feedback circuit, with its output port connected to IC-6 of the above frequency control and switch circuit, and an input port connected to the output circuit;

(3) a light modulating signal processing circuit having a voltage divider and a voltage control oscillator wherein the voltage divider is set up by connecting resistor R1, NPN transistor Q3 and resistor R4 in series, and the voltage control oscillator is composed of connected voltage stabilization tube Z2, Z3, diode D8, resistors R6, R7, R8, capacitor C9 and connecting to port IC-7 of the integrated circuit (IC);

(4) a direct-current high-voltage stabilization circuit described previously composed of diodes D6 and D7 connected in series and capacitor C19, wherein one point of C19 connects the point between D6 and D7, and the other point connects the output circuit;

(5) a frequency-control negative-feedback circuit comprised of a parallel circuit of two RC in series, R15, diode D11 and Zener diode Z5, wherein the parallel circuit of two RC in series includes R16/C18 and R17/C17, respectively, and the lamp current negative feedback circuit includes diode D11, Zener diode Z5, resistor R17 and capacitor C17; and

(6) an integrated circuit (IC) such as type L6574.

[0006] Since the electronic ballast of the present invention requires only three simple circuits and few components, it can be manufactured at a lower cost with a smaller dimension. With its stable capacity of light modulating, it can be applied easily and widely, especially on the integrated and, compact fluorescent lamps.

[0007] Further objects and advantages of this invention will be apparent from the following detailed description of a presently preferred embodiment which is illustrated schematically in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1 is a schematic illustration of a circuit connection for light modulating of a fluorescent lamp applying a silicon-controlled phase-luminosity modulator.

FIG. 2 is a circuit flowchart of an electronic ballast for a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity in accordance with the present invention.

FIG. 3 is a circuit diagram of an electronic ballast for a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity in accordance with the present invention.

FIG. 4 shows the curve relationship of light-modulating phase angle and light-modulating voltage on frequency control (Line 1) and light-modulating phase angle and direct-current high voltage (Line 2) using a triode as a non-linear resistor in the light-modulating signal processing circuit.

FIG. 5 shows the curve relationship of light-modulating phase angle and light-modulating voltage on frequency control (L ine 1) and light-modulating phase angle and direct-current high voltage (Line 2) using a general linear resistor in the light-modulating signal processing circuit.

FIG. 6 is a filter and rectification circuit diagram of another embodiment of an electronic ballast for a fluorescent lamp using a silicon-controlled phase-modulating phase-luminosity modulator for adjusting luminosity in accordance with the present invention.

FIG. 7 is a light-modulating signal processing circuit diagram of another embodiment of an electronic ballast for a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity in accordance with the present invention.

FIG. 8 is a light-modulating signal processing circuit diagram of a further embodiment of an electronic ballast for a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EM BODIMENT

[0009] Referring to FIG. 2 and FIG. 3, the, electrical ballast of the present invention includes a filter and rectification circuit 1, a frequency control and switch circuit 2, an output circuit 3, a light-modulating signal processing circuit 4 and a direct-current high-voltage stabilization circuit 5.

[0010] The filter and rectification circuit 1 comprises filter components, π-shape filter and bridge rectifier. Through the light modulator its input port connects to a municipal alternating current power supply, thereby the high-frequency disturbing wave is filtered out and the input alternating current voltage is transformed as direct current pulse voltage. The filter and rectification circuit shown in FIG. 6 can additionally comprise resistor R18 parallel connected directly to input port, and resistor R19 parallel connected to input port after connecting a capacitor in series. The effect of light modulating will be enhanced based on selecting suitable resistors and capacitors properly, thus allowing more silicon-controlled phase-modulating phase-luminosity modulators to be applicable to more fluorescent lamps capable of light modulating.

[0011] Frequency control and switch circuit 2 includes an integrated circuit IC, such as type L6574, which controls frequency and produces a switch-triggering signal. Its input port VS connects with the output port of filter and rectification circuit 1 through resistor R3 and provides a working voltage for the IC. Switch transistors Q1, Q2 are composed of two field effect transistors, and their corresponding resistor and capaci tor components are applicable to produce controllable high-frequency, high voltage with the input port connected with the output port of direct-current high voltage stabilization circuit 5 described below.

[0012] The output circuit 3 comprises inductances and ca pacitors. The connection of its input port and the output port OUT of frequency-control and switch circuit 2 produces resonance and heats up the fluorescent lamp filament to enable normal working of the fluorescent lamp.

[0013] The light-modulating signal proces sing circuit 4 is novel in this invention. It connects to the output port of filter and rectification circuit 1 and another input port IC-7 of frequency control and switch circuit 2. Consequently, the lower light modulating frequency control voltage on IC, the higher working efficiency on IC. The light modulating signal processing circuit 4 is composed of a voltage divider, configured in series of resistor R1, NPN transistor Q3 and resistor R4, and a voltage control oscillator, composed of voltage stabilization tube Z2, Z3, diode D8, resistors R6, R7, R8, and capacitor C9, and connecting to port IC-7 of the integrated circuit (IC). With this voltage divider, it is possible to provide the required relationship for sharp, nonlinear changed light modulating pha se angle and light modulating frequency-control voltage. The sampling point B of light modulating signal processing circuit 4 connects with the output port of filter and rectification circuit 1 and presents as direct-current pulse voltage. It is evident that the virtual value of this voltage is inversely proportional to the light-modulating phase angle of the silicon-controlled phase-luminosity modulator, i.e. the larger is the phase angle, the lower the voltage virtual value. With circuit processing, the larger the phase angle, the lower the output voltage by frequency control and the lower light modulating voltage by frequency control entering the integrated circuit IC and consequently resulted in, higher IC working frequency. It is shown that light modula tion is achievable based on the corresponding changes in the working frequency of the fluorescent lamps with the changes on the phase angle. In order to have the ideal state existing in the relationship curve of phase angle and light modulating voltage by frequency control, a NPN transistor is used in the voltage divider in the circuit. For example, if the base of NPN transistor Q3 is connected with current bias resistor R2, it will provide a resistor changing non-linearly with the voltage at point B, resul ting in non-flickering, uniform and stable light modulating with the sharp changing required on the resistor.

[0014] Besides NPN transistor, N-channel field effect transistor (N-channel MOSFET) can be used as Q3 in the light-modulating signal processing circuit 4 as shown in FIG. 7. Using voltage divider configured in series connecting resistor R1, field effect transistor Q3 and resistor R4, it is feasible to have the desired, sharply non-linearly changed relationship of light modulating phase angle and light modulating frequency-control voltage to enable the light modulation to reach an ideal state. In another application sample shown in FIG. 8, light modulating signal processing circuit 4 is composed of a voltage divider, configured in series connecting resistor R22, N-channel MOSFET Q3 and resistor R24, a voltage control oscillator, composed of voltage stabilization tube Z2, Z3, diode D7, resistors R25, R26, R27, and capacitor C10, and further connects with connection port IC-7 and IC-15 of integrated circuit IC (such as type UBA2014). Light-modulating signal processing circuit 4 can stabilize the working state during the light modulation of the fluorescent lamp without flickering and improve the effects of light modulation.

[0015] In order to provide stable direct-current high voltage, the input port of direct-current high-voltage stabilization circuit 5 is connected with the output port of the filter and rectification circuit 1, and the output port of the latter in turn connects with frequency-control and switch circu it 2. The feedback port is connected with output circuit 3 and then feeds high-frequency electrical energy of output circuit 3 back to the storage capacitor in the direct-current high-voltage stabilization circuit 5. The direct-current high-voltage stabilization circuit 5 is composed of diodes D6 and D7 connected in series, and capacitor C19 with one of its points connecting the point between diodes D6 and D7. It obtains high-frequency energy from one point of C14 with connection to output circuit, and the high-frequency energy through C19 enters storage capacitor C4 after rectification of D6, thus eliminating lamp flickering.

[0016] In another preferred application example, the electronic ballast of the present invention additionally includes a frequency-control negative feedback circuit 6. With its output port connected to IC-6 of frequency-control and switch circuit 2 and its input port connected to output circuit, the decreasing signals of lamp current is being negatively fed back to integrated circuit IC by frequency control when the current of fluorescent lamp decreases very sharply with modulation. The frequency-control negative feedback circuit 6 comprises a parallel circuit of two RC connected in series (i.e. R16/C18 and R17/C17), R15, diode D11 and Zener diode Z5. The circuit composed of R15, R16, R17, C17 and C18 provides a voltage on IC-6 to reach the threshold voltage required by integrated circuit IC. Lamp current negative feedback circuit is composed of diode D11, Zener diode Z5, R17, and C17. With res istor R15, circuit 6 connects to IC-VS and IC-10 of integrated circuit. It is common knowledge that flickering happens when lamp current decreases very sharply by modulating. Accordingly, the decreased signal of lamp current is fed back negatively to frequency controlled IC, so that flickering can be avoided.

[0017] The invention relates to an electronic ballast for a fluorescent lamp using a silicon-controlled phase-modulating phase-luminosity modulator. It can be combined with a fluorescent tube as an integrat ed fluorescent lamp, or work as an independent electronic ballast and operates as such after it is connected to a fluorescent lamp. Whether the ballast is integrated or separated, it should be connected to a silicon-controlled phase-modulating phase-luminosity modulator in order to accomplish light modulation, as shown in FIG. 1.

[0018] The present invention provides for frequency-modulating light modulation. In order to provide ballast function for a working lamp tube, it is necessary to set a ballast inductor in the working circuit of a fluorescent lamp to avoid burning the lamp by a strong current. Inductor inductance increases with increased working frequency, hence the current through the lamp tube decreases, and the luminous flux of lamp decreases correspon dingly, thus modulating the brightness of the lamp.

[0019] As a special technology of light modulating for a fluorescent lamp using a silicon-controlled phase-luminosity modulator, the biggest difficulty is that fluorescent lamps flicker when light modulation drops in the middle and late stages, particularly when the fluorescent lamp is nearly extinguished. Based on practices and comprehensive analysis, it was found that the flickering arises from: (1) when using frequency-modulating light modulation mode, it is difficult for the lamp to maintain stable discharge in the late stage of light modulation since direct-current high voltage decreases to a very low level; (2) since fluorescent lamp is a special non-linear load, its voltage wave shape input to the electronic ballast presents serious distortion, even jumping distortion in the middle and late stage of light modulation when a fluorescent lamp is combined with a silicon- controlled phase-luminosity modulator to accomplish luminosity adjustment. Consequently, flickering occurs due to unstable power supply to the lamp tube. Based on the above analysis and practice, three technical measures are used as solutions. The first solution is to alter the change relationship between light-modulating phase angle and light-modulating frequency-control voltage from smooth change to sharp change, i.e. light-modulating frequency-control voltage decreases more quickly when phase angle increases. This means working frequency increases more rapidly to cause current decreases more in the lamp, thus mitigating power supply load, while direct-current high-voltage decreases only slightly. Consequently, it maintains relatively high direct-current voltage. The second solution is that high-frequency energy feedback stabilization provided on direct-current high voltage of electrical ballast causes direct-current high voltage of light modulation to increase with certain degree of compensation. The third solution is that the lamp flickering can be prevented by the frequency negative feedback circuit set for avoiding twinkling caused by resonance from sharp decrease of lamp current when the light is being modulated too fast.

[0020] In order to realize above three solutions and to obtain good light modulation without lamp flickering, three special circuits have been used in the present invention. The first special circuit is light modulating signal processing circuit 4 used to obtain ideal relationship curve of light-modulating phase angle and light-modulating frequency-control voltage. As we known, since the wave shape of input voltage transferred to fluorescent lamp through controllable phase-modulating light modulator takes on a tangent phase angle shape, this means that the larger the tangent phase angle, the lower the virtual voltage transferred to fluorescent lamp whether the light-modulating phase angle increases. Therefore, light-modulating phase angle is inversely proportional to input virtual voltage. After high-frequency is filtered and rectified (see 1 in FIG 3), input voltage at point B takes on the same shape as input voltage waveform but only positive, and twice as high as input voltage. As B is a sampling point for a light modulating signal, virtual voltage of B is inversely proportional to light-modulating phase angle. With R1, Q3, and R4, the electrical signal becomes a voltage divider. A NPN transistor Q3 connecting current bias resistor R2 forms a resistor with non-linear change with voltage at point B. Thus, a sharply change in this resistor is needed. Divided voltage on resistor R4, changed as direct-current voltage through filtration by capacitor C6, then entering the voltage-control oscillator composed of Z2, R6, D8, R7, Z3, R8, C9 and IC, creates corresponding frequency with light-modulating frequency-control voltage to accomplish frequency modulation. It is known that frequency-control voltage is proportional to the virtual voltage value at point B, i.e. frequency-control voltage is inversely proportional to phase-modulating angle. This means that the larger the phase angle; the lower the frequency-control voltage thus resulting in higher IC working efficiency, hence frequency-altering light modulation for fluorescent lamp is accomplished.

[0021] The characteristic of frequency modulation for a 15W fluorescent lamp installed in the electrical ballast circuit as shown in FIG. 3 is measured in this study. FIG. 4 shows the curve relationship of light-modulating phase angle and light-modulating voltage on frequency control (Line 1) and light-modulating phase angle and direct-current high voltage (Line 2) using a NPN transistor as a non-linear resistor in light-modulating signal processing circuit. In order to investigate the function of NPN transistor Q3 as a non-linearly changed resistor in light-modulating signal processing circuit 4, a NPN transistor Q is replaced by a general linear resistor (23 ° phase angle). The results are shown in FIG. 5. In FIG. 4, frequency-control voltage is 0.2V (point M in FIG. 3), whereas direct-current high voltage is as high as 190V when phase angle is 130 ° when the lamp is nearly extinguished. However, in FIG. 5, which shows the curve relationship between light-modulating phase angle and light-modulating voltage by frequency control and direct-current high voltage respectively, using a general linear resistor in light-modulating signal processing circuit, frequency-control voltage is still as high as 0.9V, whereas direct-current high voltage decreases to 110V and the lamp flickers with phase angle of 120 °, when it is nearly extinguished. Flickering at that insta nt results from not being capable of keeping the lamp's burning point with the sharp decrease on direct-current high voltage. In addition, low working frequency, resulted from high light-modulating frequency-control voltage, goes against maintaining discharge thus resulting in the lamp flickering. It is evident from the above analysis that it is useful to prevent lamp flickering by applying NPN transistor Q3 as non-linear resistor in the circuit. In order to obtain more proper curve of light-modulating frequency-control voltage, it is necessary to adjust R2, R1, and R4 in FIG. 3.

[0022] The second special circuit is a direct-current high-voltage stabilization circuit composed of C19, D6 and D7. The high-frequency feedback energy out of one point of capacitor C14 (see figure 3) supplies energy to electrolysis capacitor C4 through rectification of D6. Reduction of fluorescent lamp flickering is achieved by properly adjusting energy feedback amount (i.e. adjusting the capacitance of C19 capacitor) to prevent the divi ded voltage of electrolysis capacitor to decrease too fast due to light modulation. This stabilizes direct-current high voltage.

[0023] The third special circuit is a control negative feedback circuit 6. It is feasible to apply negative feedback to prevent fluor escent lamp flickering due to sudden quick frequency changes when light modulation is too fast. In this circuit, sampling of feedback signal is derived from the sharp changes of current through the lamp tube. The current changes are being transformed to voltage changes, and then transferred to IC, resulting in negative feedback on frequency change. As shown in figure 3, lamp current runs through D11, C17, R17 and Z5, and a direct-current voltage value corresponding to current value is formed on R17. A required threshold voltage suitable for IC comprises R15, R16, R17 and C17, C18. It is therefore possible to accomplish frequency-control negative feedback with superposition of above two voltages to IC.

[0024] While the invention has been described, disclosed, illustrated and shown in various terms of certain embodiments or modifications which it has presumed in practice, the scope of the invention is not intended to be, nor should it be deemed to be, limited thereby and such other modifications or embodiments as may be suggested by the teachings herein are particularly reserved especially as they fall within the breadth and scope of the claims here appended.

Claims

1. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity comprising in combination:

    (i) a filter and rectification circuit, connectable with an alternating current power and having an output port;
    (ii) a frequency control and switch circuit, including an integrated circuit (IC) which controls frequency and produces switch-triggering signals, two switch transistors Q1, Q2 and the corresponding resistors and capacitors and having an output port and an input port;
    (iii) an output circuit, including inductances and capacitors, with its input port connecting with the output port of said frequency control and switch circuit;
    (iv) a light-modulating signal processing circuit connecting with the output port of said filter and rectification circuit and the input port of said frequency control and switch circuit; and
    (v) a direct-current, high voltage stabilization circuit with its input port connecting with the output port of said filter and rectification circuit, an output connecting with the input port of frequency control and a switch circuit, and feedback port connecting with said output circuit.

2. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 1, including a frequency-control negative-feedback circuit with its output port connecting with the IC of the frequency control and switch circuit, and input port connecting with the output circuit.

3. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 1, wherein the light modulating signal processing circuit includes a voltage divider and a voltage control oscillator, wherein said voltage divider is set up by connecting resistor R1, NPN transistor Q3 and resistor R4 in series and wherein said voltage control oscillator is composed of connected voltage stabilization tube Z2, Z3, diode D8, resistors R6, R7, R8, capacitor C9 and a connecting point with the integrated circuit (IC).

4. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 3, wherein said NPN transistor Q3 is used as a N-channel field effect transistor (N-channel MOS FET).

5. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 1, wherein said direct-current high-voltage stabilization circuit comprises diodes D6 and D7 connected in series and capacitor C19 with one point of C19 connected to a point between D6 and D7, and another point of C19 connected to the output circuit.

6. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 1, wherein the frequency-control negative-feedback circuit comprises a parallel circuit of two RC in series, R15, diode D11 and Zener diode Z5, whereby said parallel circuit of said two RC in series includes R16/C18 and R17/C17, and said lamp current negative feedback circuit includes diode D11, Zener diode Z5, resistor R17 and capacitor C17.

7. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 1, wherein the type of integrated circuit IC is L6574.

8. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 1, wherein the type of integrated circuit IC is UBA2014.

9. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 1, wherein the filter and rectification circuit comprises filter components, π-shape filter and bridge rectifier, whereby said input port is connected to a municipal alternating current power supply with light modulator.

10. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 9, wherein the filter and rectification circuit further comprises resistor R18 connected in parallel directly with input port, and resistor R19 connected in parallel with input port aft er connecting capacitor in series.

11. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 2, wherein the light modulating signal processing circuit includes a volt-

age divider and a voltage control oscillator, wherein said voltage divider is set up by connecting resistor R1, NPN transistor Q3 and resistor R4 in series and wherein said voltage control oscillator is composed of connected voltage stabilization tube Z2, Z3, diode D8, resistors R6, R7, R8, capacitor C9 and a connecting point with the integrated circuit (IC).

12. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 2, wherein said direct-current high-voltage stabilization circuit comprises diodes D6 and D7 connected in series and capacitor C19 with one point of C19 connected to a point between D6 and D7, and another point of C19 connected to the output circuit.

13. An electronic ballast of a fluorescent lamp using a silicon-controlled phase-luminosity modulator for adjusting luminosity of claim 2, wherein the frequency-control negative-feedback circuit comprises a parallel circuit of two RC in series, R15, diode D11 and Zener diode Z5, whereby said parallel circuit of said two RC in series includes R16/C18 and R17/C17, and said lamp current negative feedback circuit includes diode D11, Zener diode Z5, resistor R17 and capacitor C17.

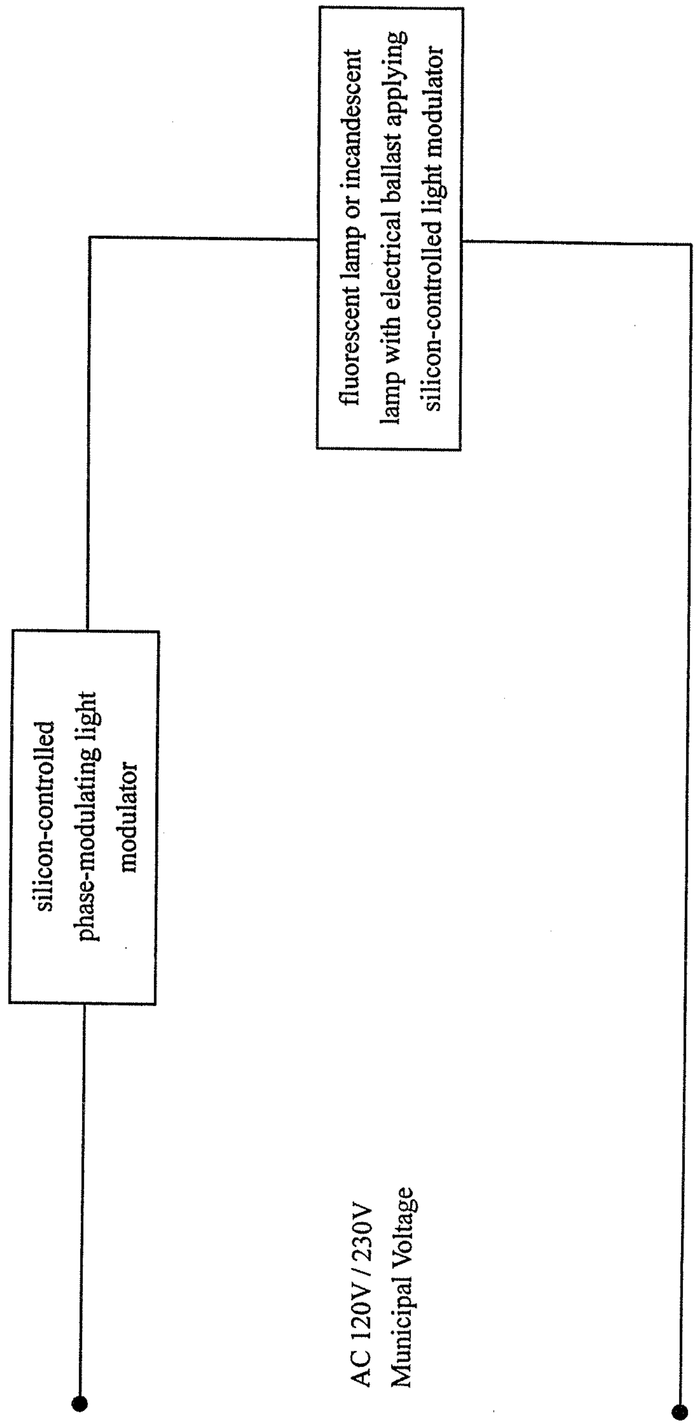

fluorescent lamp or incandescent lamp with electrical ballast applying silicon-controlled light modulator
silicon-controlled phase-modulating light modulator
AC 120V / 230V Municipal Voltage

Fig. 1

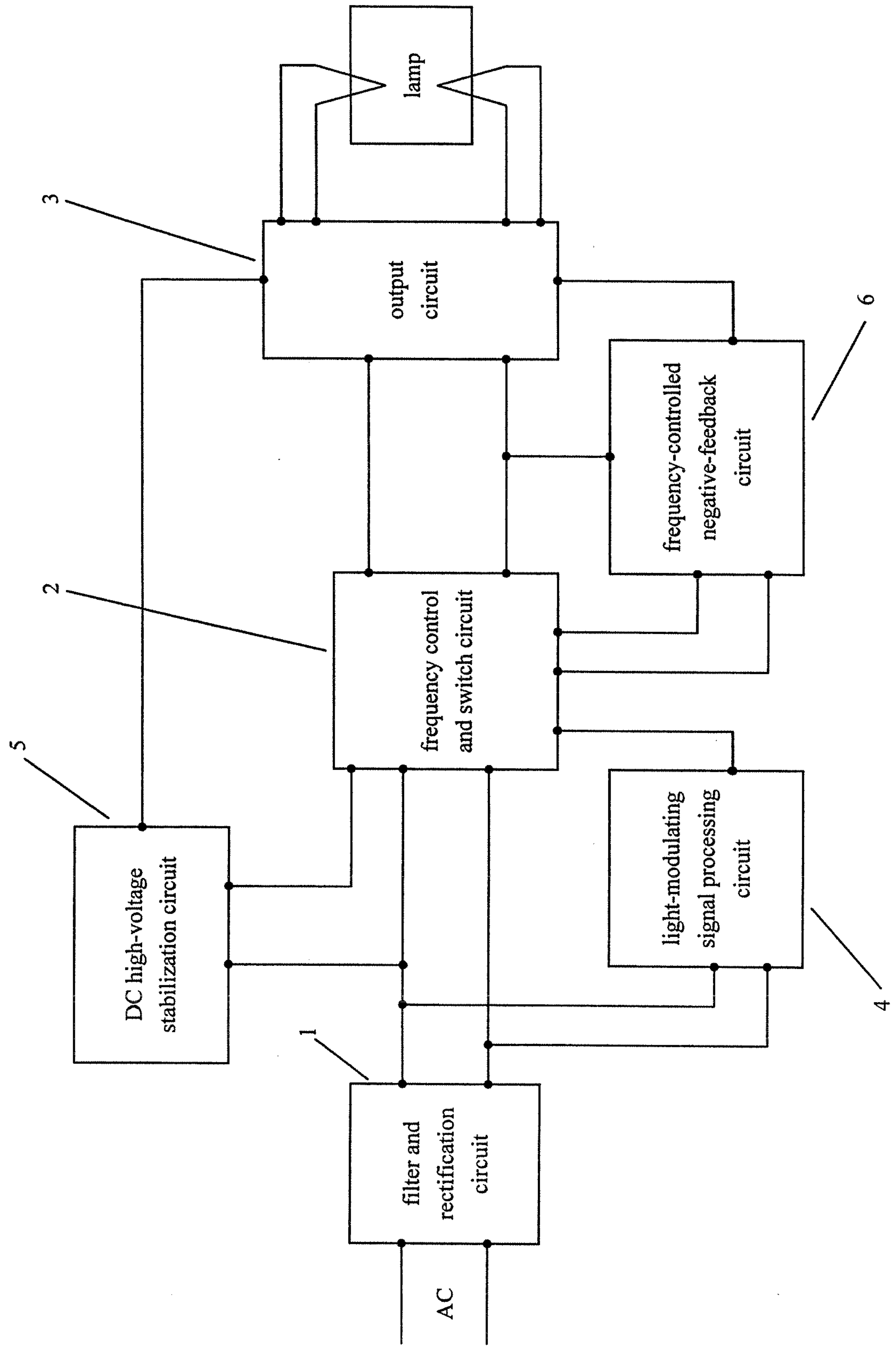
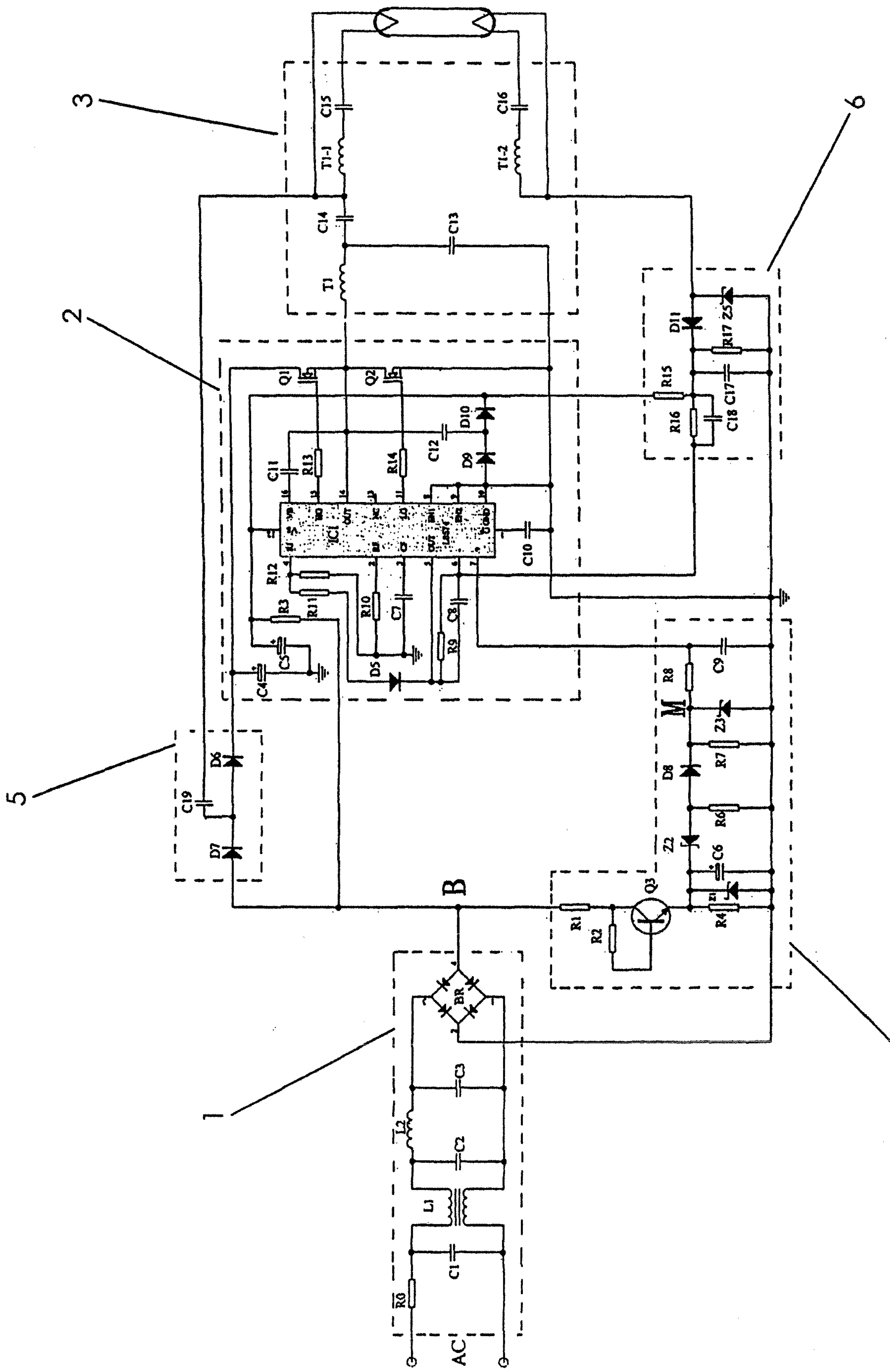

lamp
3
output circuit
6
frequency-controlled negative-feedback circuit
2
frequency control and switch circuit
5
DC high-voltage stabilization circuit
light-modulating signal processing circuit
4
1
filter and rectification circuit
AC

Fig. 2


1
2
3
4
5
6
B
M
AC
R0
C1
L1
C2
L2
C3
BR
R1
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Q3
R4
C6
Z2
R6
D8
R7
Z3
R8
C9
C19
D6
D7
C4
C5
R3
R11
R12
D5
R10
C7
C8
R9
C10
IC1
R13
C11
R14
C12
D9
D10
Q1
Q2
R15
R16
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D11
T1
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C13
T1-1
C15
T1-2
C16

Fig. 3

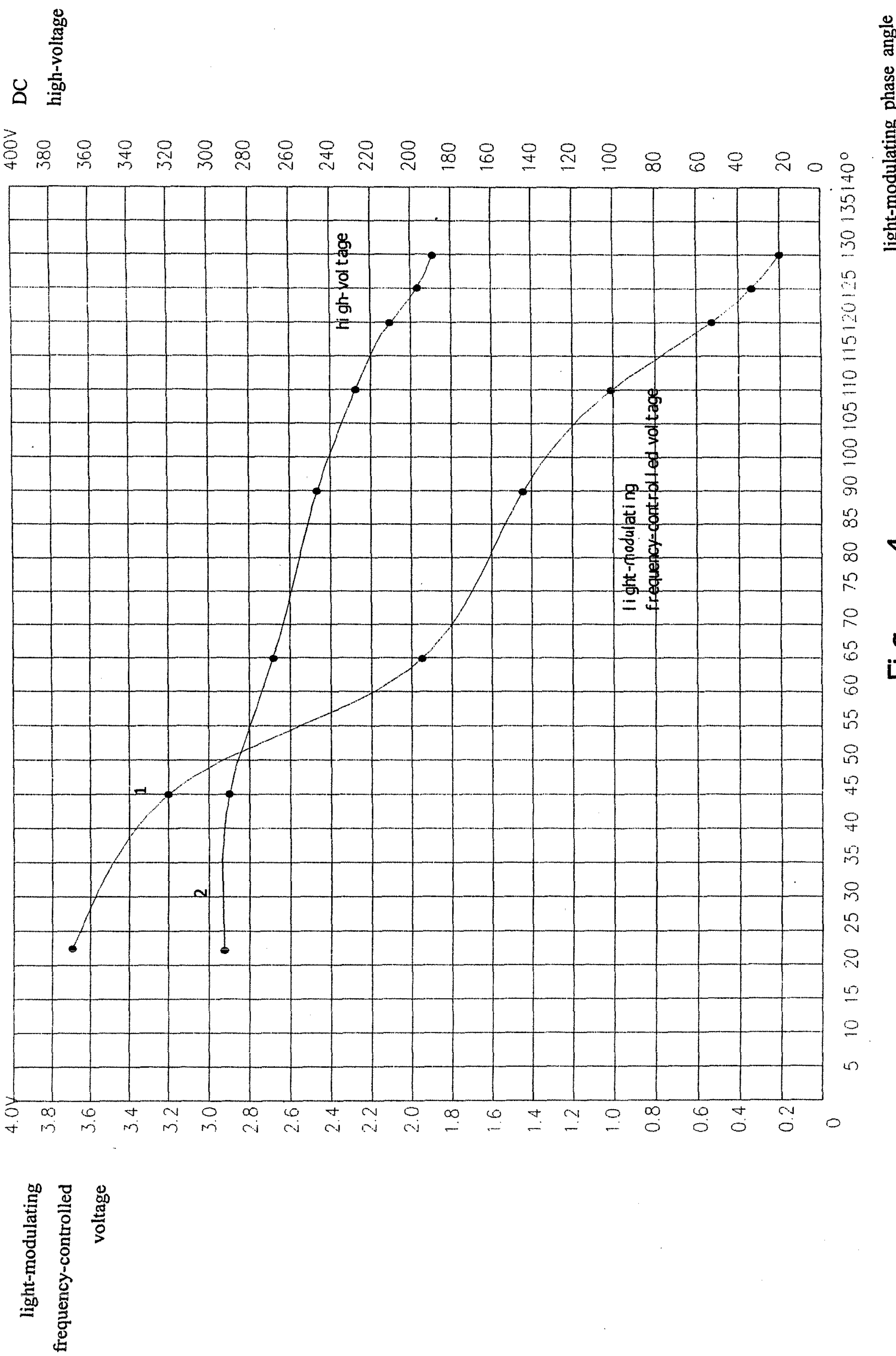
DC
high-voltage
light-modulating phase angle
light-modulating
frequency-controlled
voltage
high-voltage
light-modulating
frequency-controlled voltage
1
2
400V
4.0V
140°

Fig. 4

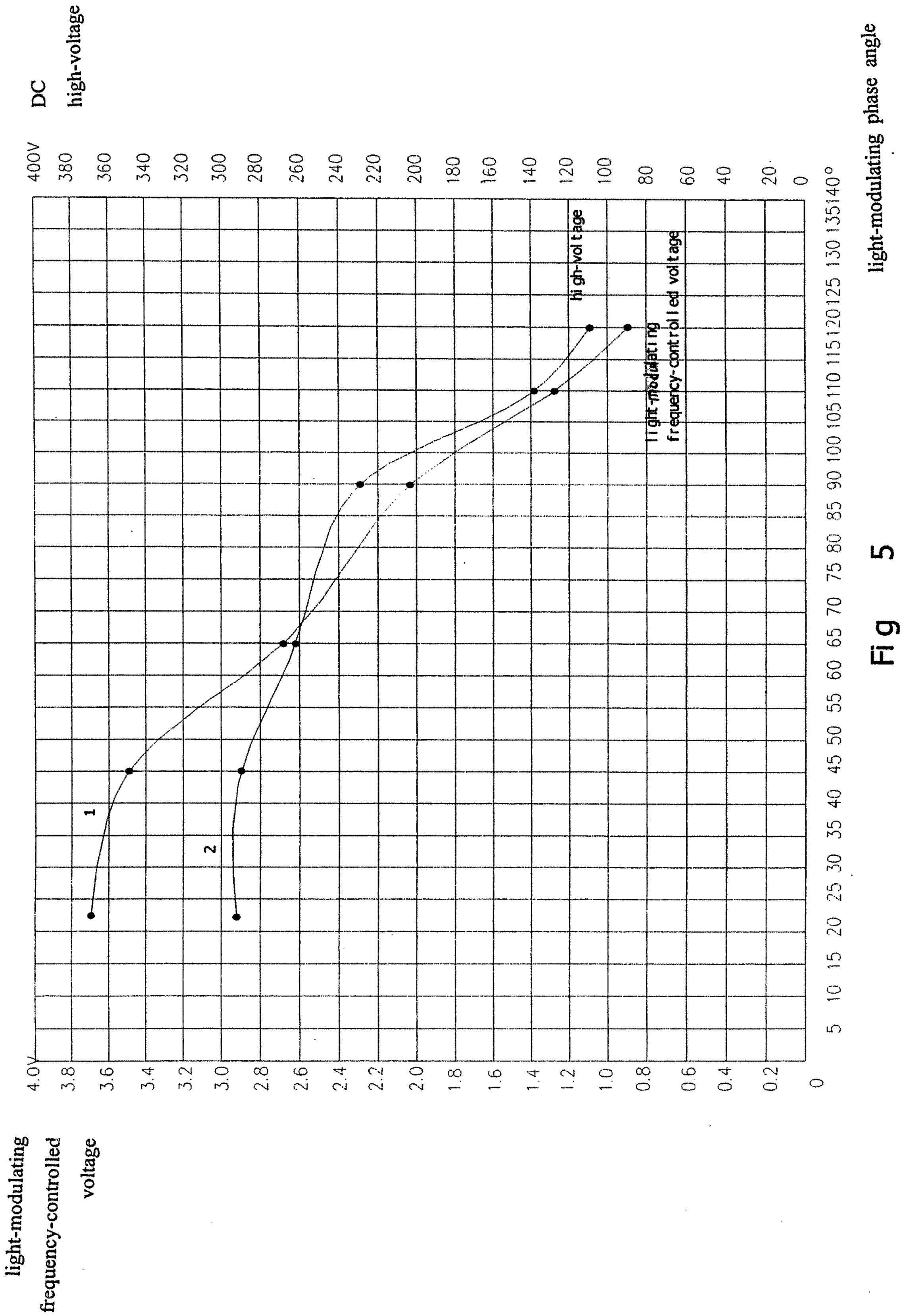
DC
high-voltage
400V
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
light-modulating
frequency-controlled
voltage
4.0V
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 100 105 110 115 120 125 130 135 140°
light-modulating phase angle
1
2
high-voltage
light-modulating
frequency-controlled voltage

Fig 5

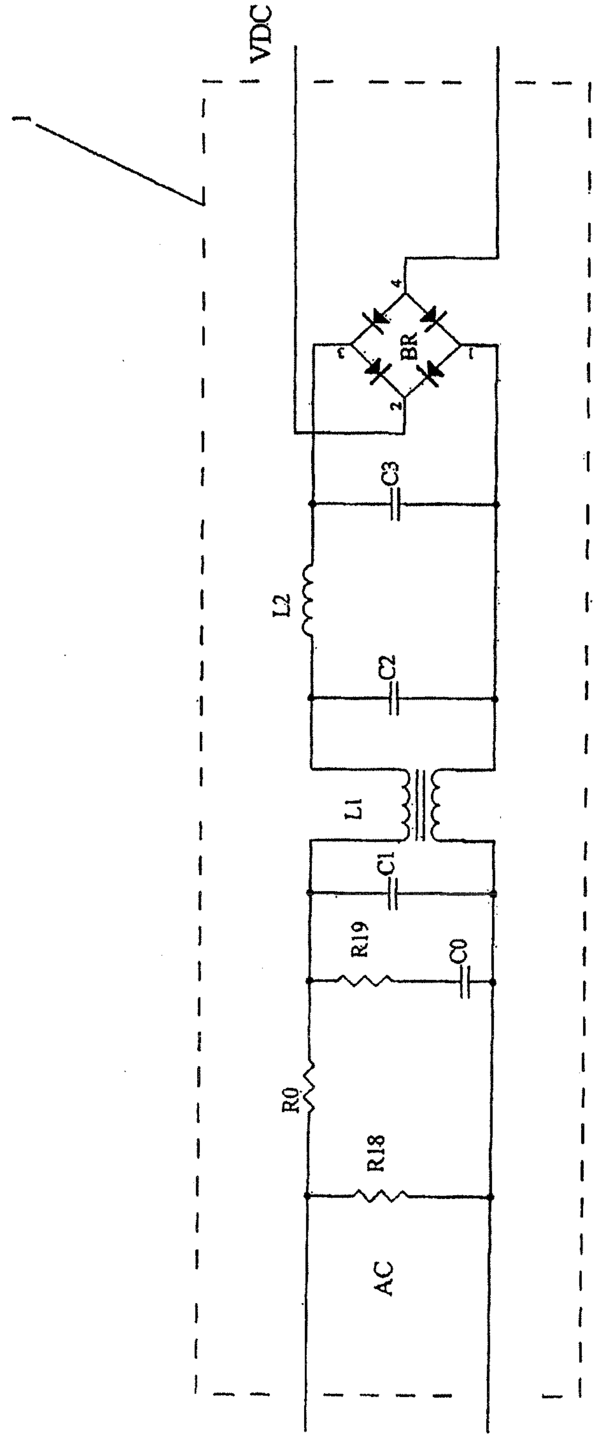

Fig. 6

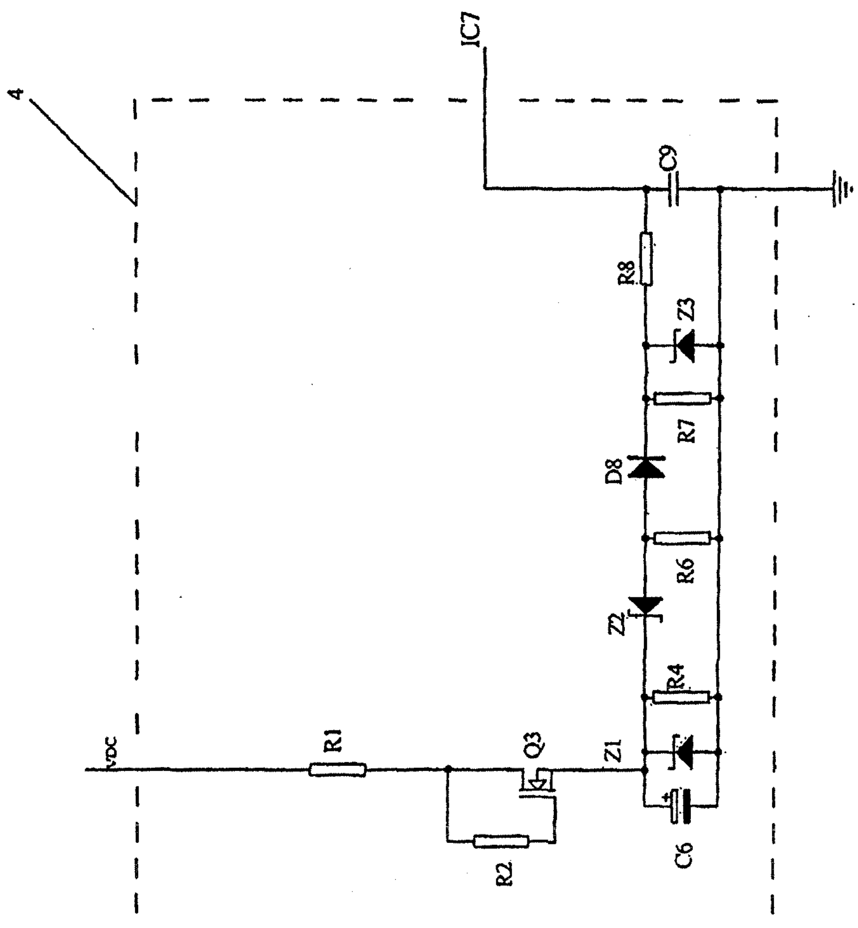

Fig. 7

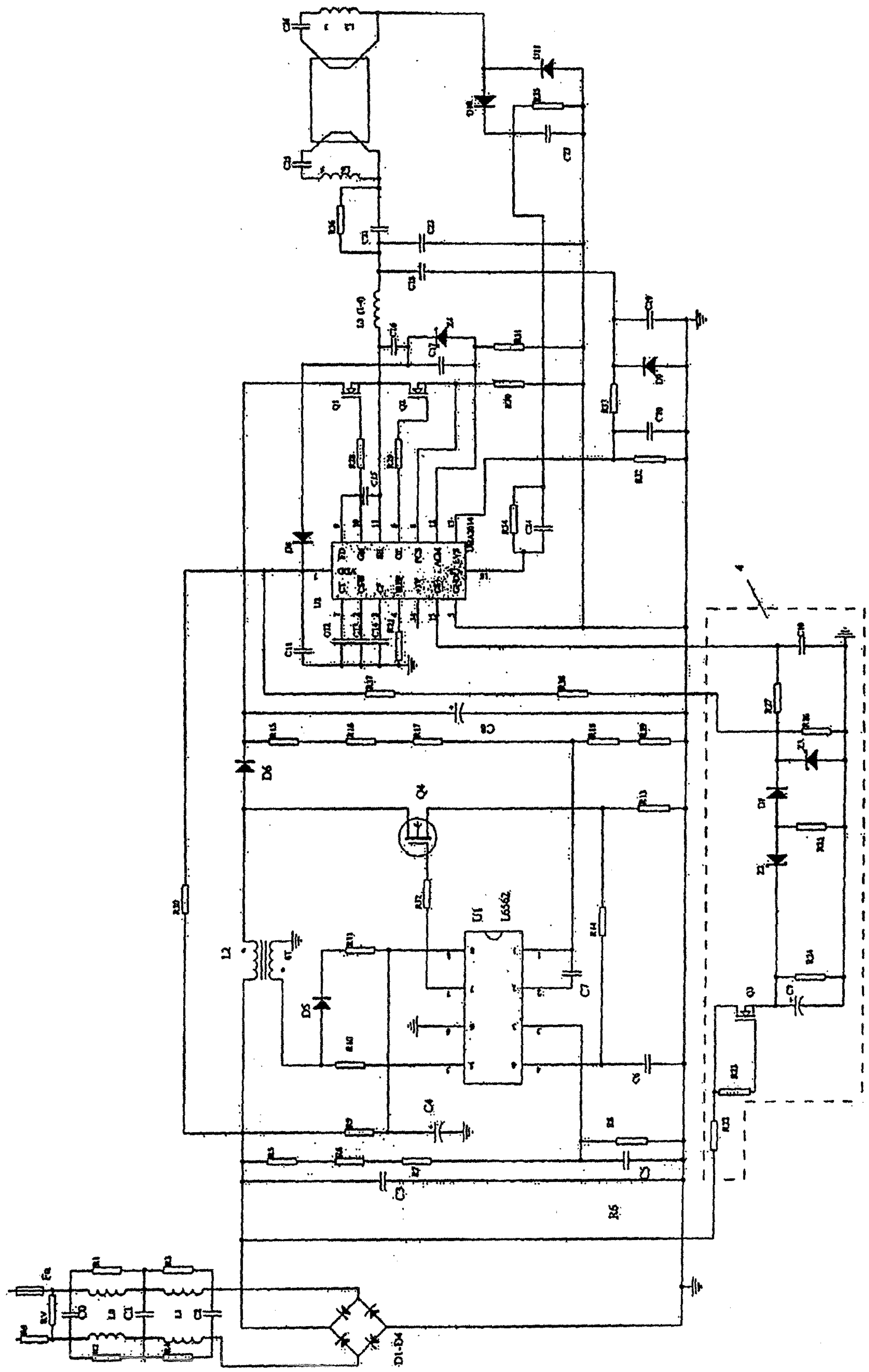

Fig. 8