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(54) **An emergency luminaire**

(57) An emergency luminairc, including a case made of a front cover, a back cover and an electronic circuit fixed on the back cover, the electronic circuit comprising an AC-DC converter, a charging circuit, a control circuit, a DC-DC converter, a DC-AC converter, an output AC-DC converter and a conversion circuit, wherein: the AC-DC converter converts an input AC into two groups of output DC, the first group being connected with the charging circuit and the second being connected with the control circuit; the charging circuit is adapted to conduct current-limited charge to the battery by the first group of DC; the control circuit is adapted to control conversion between normal lighting and emergency lighting, the voltage test of battery discharge, and conversion status test by the second group of DC; the DC-AC converter includes an oscillating circuit and a boost circuit to produce an output high-frequency and a high-voltage AC with a transformer; the output AC-DC converter further comprises a rectification circuit, a filtering and a current-limited circuit; the DC-DC converter is adapted to convert the battery voltage to high voltage DC suitable for an electronic ballast to work through DC-AC converter and output AC-DC converter, and functions when the AC is turned off, being under-voltage or in test condition; the conversion circuit is adapted to control the conversion between normal lighting and emergency lighting.

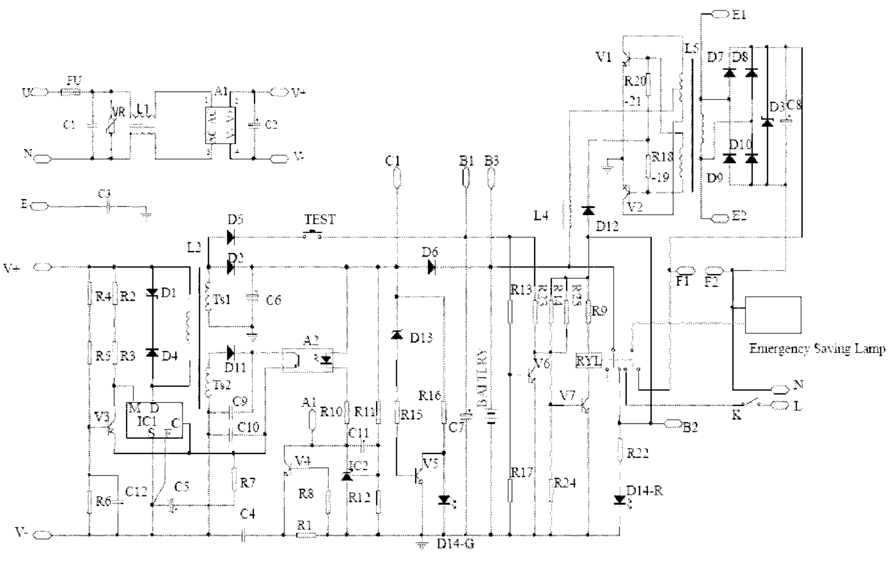

Figure 3

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Description

Technology Field

[0001] This invention is related to a type of emergency luminaire, specifically speaking, is related to an easily-installed emergency device which can be used to prolong the service life of the fluorescent lamp.

Technology Background

[0002] At present, the emergency luminaire both at home and abroad are loaded by fluorescent lamp. The installation of the device is complex for the fluorescent lamp has to be mated with ballast and inverter. Generally, in emergency luminaire, the high-frequency and high-voltage AC power shifted from the battery by inverter is directly connected with the two ends of the fluorescent lamp. The fluorescent lamp will emit light after being punctured by high voltage. Since the fluorescent lamp does not start up and work in the matching state, the two ends of the bulb become dark quickly and the filament is easily broken. This largely shortens the service life of the fluorescent lamp.

Content of Invention

[0003] In order to overcome the above mentioned problem in using fluorescent emergency luminaire, this invention is concerned with designing an electronic circuit with complete functions, using the most basic and easiest electronic components. It intends to convert AC into DC with electronic circuit in the interests of lightening the weight of the product and reducing the heat generated. Another feature of this new practical invention is that it simplifies the installation and maintenance program as well as increases the maintenance efficiency.

[0004] This new practical device provides an emergency luminaire which includes the case made up of front cover, back cover and electronic circuit. The electronic circuit, fixed on the interior side of the back cover, is comprised of an AC-DC converter, a charging circuit, a control circuit, a DC-DC converter, a DC-AC converter, an output AC-DC converter and a conversion circuit:

The AC-DC converter is used to convert the input AC into two groups of output DC. The first group is connected with the charging circuit and the second is connected with the control circuit;

The charging circuit makes use of the first group of DC mentioned above to conduct current-limited charge to the battery;

The control circuit makes use of the second group of DC to control the conversion between normal lighting and emergency lighting, the voltage test of battery discharge, and conversion status test;

The DC-AC converter, including oscillating circuit and boost circuit, produce output high-frequency and high-voltage AC with transformer;

The output AC-DC converter comprises of rectification circuit, filtering and current-limited circuit;

The DC-DC converter is used to convert the battery voltage to high voltage DC suitable for the electronic ballast to work through DC-AC converter and output AC-DC converter. It functions when the AC is turned off, being under-voltage or in test condition;

The conversion circuit controls the conversion between normal lighting and emergency lighting.

[0005] In the emergency luminaire mentioned in the present invention, the electronic circuit board is installed with many plug terminals connected respectively with power line, test switch, charging indicator, discharging indicator, rechargeable battery and electronic ballast.

[0006] In the emergency luminaire mentioned in the present invention, the input AC-DC circuit also includes over-current and over-voltage protection circuits made up of fuses in series or parallel connection with the Input end of the AC as well as varistors.

In the emergency luminaire mentioned in the present invention, the input AC-DC circuit also includes anti-interference circuit composed of capacitances in series or parallel connection with the input end of the AC and common-mode Inductances. This is used to eliminate the mutual interference between AC and post-circuit.

[0007] In the emergency luminaire mentioned in the present invention, the input AC-DC also includes AC automatic detecting circuit made up of a triode and three divider resistances and capacitances in series, which is connected with the two ends of the rectification circuit in the input AC-DC circuit.

[0008] In the emergency luminaire mentioned in the present invention, the charging circuit also includes:

The charging detecting circuit is used to detect whether the battery is installed;

The charging current-limited circuit, a charging current-limited protection circuit comprised of a triode and resistances connected between the base and emitter of the triode.

[0009] The charging display circuit used to indicate the charging condition of the battery.

[0010] The emergency luminaire mentioned in the present invention also includes:

The detection and control circuit made up of two triodes and four resistances. The collector of the first triode is connected with the base of the second one and is then linked to the two sides of the filtering capacitance C9.

The over-discharge voltage detecting circuit, consisting of three resistances, is connected with the both ends of the battery using the normal open contacts of the relay;

The discharging indicator circuit, made up of resistance and light-emitting diode, is connected with the two ends of the battery using the normal open contacts of the relay;

[0011] The battery abnormity over-current protection is completed by the recoverable over-current fuse.

[0012] The emergency luminaire mentioned in the present invention also includes:

The output over-voltage protection circuit is brought under the safe operating area of the electronic ballast after the output voltage is pressure-limited by the varistor.
The corrugated inhibition circuit is composed of output filtering capacitances.
The conversion circuit controls the conversion between normal lighting and emergency lighting; the emergency output voltage is high-voltage DC directly connected with the input terminal of the electronic ballast.

[0013] The emergency luminaire in the present invention features high efficiency, powerful functions, low power consumption, long service life of the fluorescent lamp and convenient installation.

[0014] The present invention is simple in structure and convenient to fix. Comparing to the ordinary emergency luminaire, it reduces more than 1/3 of the assembly connection. The emergency output in the present invention directly affects the electronic ballast so that the fluorescent lamp can work in the matching state. Comparing to the ordinary emergency luminaire, it can prolong the service life of the fluorescent lamp for several dozens of times. Comparing to the ordinary emergency luminaire, the present invention possesses even more perfect functions. For example, it is provided with charging over-current and over-discharge protection for the rechargeable battery, discharge over-current protection circuit, AC under-voltage protection, charging and discharging indicator, and integrated testing function.

Explanations with Figures are as follows:

[0015]

Figure 1 is the front appearance view;
Figure 2 is the installation structure of recoverable over-current fuse and battery;
Figure 3 is the interior circuit diagram;
Figure 4 is the input AC-DC converter diagram;
Figure 5 is the limited-current charge-circuit diagram;
Figure 6 is the control circuit diagram;
Figure 7 is the charging and discharging indicator circuit;
Figure 8 is the DC-AC converter diagram;
Figure 9 is the output AC-DC converter diagram;
Figure 10 is the converter circuit.

Implementation Method:

[0016] The device in the present invention is loaded by electronic ballast, which makes the assembly extremely easy and minimizes the number of the assembly connection used. In this invention, the emergency output is high voltage direct current and is directly connected with the input terminal of electronic ballast. In emergency, the electric power of the fluorescent lamp is supplied by the original electronic ballast for this will bring the fluorescent lamp under the best working condition; thus the service life of the fluorescent lamp can be maximized.

[0017] The emergency luminaire in an implementation example of this invention include the case. Figure 1 is the diagram of the case of this emergency luminaire. This case comprises front cover (11), back cover (12), battery (13) (not showed in the Figure), and electronic circuit board (not showed in the Figure). In Figure 1, when the AC is switched on with the wiring terminal, the electronic circuit inside the emergency luminaire for energy-saving lights is started up. When the electronic circuit works, the electronic ballast (not showed in the Figure) and the fluorescent lamp (not showed in the Figure) connected with the output terminal start to emit light.

[0018] The electronic circuit board is the core component and the control function of the case. It is fixed on back cover (12) by bolts and is covered with front cover (11), leaving only the input and output plug terminals which are connected respectively with charging and discharging indicators, safety ground lead, test switch, N line, U line (L line not connected with control switch), L line (connected with control switch), battery and interface of the electronic ballast.

[0019] Figure 2 is the installation structure diagram of recoverable over-current fuse and battery; the battery can be damaged when it is short-Circuited or faces other abnormal situations which will cause a large-current discharge. Recoverable over-current fuse can disconnect to protect the battery when a large-current discharge takes place; it can also come back to the normal state after the breakdown is excluded.

[0020] Figure 3 is the interior circuit diagram of the electronic circuit board of the emergency luminaire in the present invention. It includes the input AC-DC converter diagram, the charge-circuit diagram; the control circuit diagram; the charging and discharging indicator circuit; the DC-AC converter diagram; the output AC-DC converter diagram; and the converter diagram. The specific explanations of these circuits are given with Figures as follows:

[0021] Figure 4 is the input AC-DC converter diagram. The input AC-DC converter part of the circuit adopts a new type of switching power supply featuring high efficiency of conversion, stable working condition, wide range of application voltage, and protection of under-voltage. Thus it can substitute the traditional power transformer component which is low in conversion efficiency and working stability, and narrow in the range of application voltage.

[0022] The 220V AC is commutated by the rectifier bridge A1. The 220V unstable direct voltage was produced after the power factor correction circuit made up of diodes D3, D4 and D5 and capacitances C3 and C4 is filtered; Tube fuse FU is connected in series with the input terminal of the 220V AC for over-current protection; Varistor VR1 and FU comprise the over-voltage and over-current protection circuit of the AC. The common mode L1 connected in series with and C1 and C2 connected in parallel with the 220V AC is used to eliminate the mutual interference between AC and post-Circuit; resistances R2 and R3 are the starting-resistor of integrated circuit IC1. When the currents in R2 and R3 reach the start current of IC1, IC1 starts to work in the PWM working condition; resistances R4, R5 and R6, capacitance C16 and triode V3 comprise the under-voltage protection circuit. When the AC voltage decreases, the base voltage of triode V3 reduces to 0.6V, triode V3 is then conducted and potentials of the collector and the emitter become identical. It is to make the M foot and the C foot of IC1 clamped on the same voltage to force IC1 to stop working. The clamping diode D1 connected in parallel with the primary coil of transformer and fast diode D6 series circuit can absorb and clamp reverse spike voltage on the coil to guarantee IC1 in safe operating area. The induced voltage on the secondary coil of transformer Ts1 is converted to two groups of DC after commutated by diode D2 and D7 and then filtered by capacitances C8 and C9; one group charges the battery through diode D6; the other is fed to the control circuit with test switch TEST. The voltage induced on the secondary coil of transformer Ts2 is commutated through switching diode D13, filtered through C12 and then is fed on the control terminal C through photoelectric coupler A2; IC2, the voltage reference, tests the output voltage through resistances R11 and R12 to compare with the reference voltage 1.25V; when the direct voltage charging the battery rises, the current of the photoelectric coupler A2 flowed through photodiode increases and intensifies the conduction of the photosensitized receiving device through the photoelectric coupler A2. As a result, the output pulse length of IC1 becomes narrowing and is coupled through transformer to the secondary coil Ts1 in order to make the output voltage decrease, and vice versa, namely when the output voltage rises, the pulse length is made to be narrowing though feedback in order to make the output voltage decrease; when the output voltage decreases, the pulse length is made to be widening though feedback in order to make the output voltage rise. All is to guarantee the stabilizing of the output voltage. Capacitances C13, C14 and C15 are anti-interference capacitance.

[0023] The resistance R7 and the capacitance C5 are soft-start circuits. When starting, the C voltage of IC1 rises slowly for it has to charge C5 in order to reduce the impact to IC1 during starting. Detector switch TEST, the status-detect switch of the emergency luminaire in the present invention, is for the use of testing the switch between normal lighting and emergency lighting. When AC is normal, the test switch is switched on. The emergency luminaire is being charged and the energy of the fluorescent lamp is provided by electronic ballast. Now switch off the test switch. Because AC is still fed to the Input end of the emergency luminaire for energy-saving light, it is still charging. However, the control circuit switches by reason of the power cut, and thus batteries change the circuit by DC-AC and output AC-DC to form a high voltage direct current which provides the fluorescent lamp with lighting power through electronic ballast.

[0024] Figure 5 is the current-limited charging circuit diagram. This circuit is made up of resistance R8 and triode V4. While the battery is being charged, the current flowed through R1 forms a voltage drop on R1. When the current increases and the voltage drop reaches 0.6V as a result, V4 is saturated and conducted, IC2 becomes a short circuit and the current flowed through the photoelectric coupler A1 increases. Then with the help of feedback circuit, the output pulse length of IC1 is made to be narrowing and the output voltage decreases. Sequentially the increase of charge current is curbed.

[0025] Figure 6 is the control circuit diagram; When AC is normal, the direct voltage on the control circuit is shared by R13 and R17 and is fed on the base of triode V6 in order to make V6 saturated and conducted; then the base voltage of triode V7 is 0V and the voltage connected with the base of triode V7 through resistance R23 does not take effect. Relay RYL does not work, the battery voltage cannot be connected with B3 through the normal open contact of the relay, and DC-AC circuit does not work for short of power. Capacitance C11 and diode D15 make up the protection circuit of relay RYL.

[0026] When AC is powered off, or the test switch is turned off or the input AC-DC converter in Figure 4 is under-voltage protection action, the direct voltage of the control circuit disappears and the charge storage on capacitance C9 forms the loop discharge using resistances R13, R17 and R23, R24; since resistance R13 is far larger than resistance 23, the discharge circuit is mainly completed by resistances R23 and R24; at this moment, triode V6 is closed for the base voltage is less than 0.6V Its collector is on high level; triode V7 is conducted for the base adds voltage, relay RYL starts to function with power, and the normal open contact is turned on; the battery voltage turns on the normal open contact through relay and gives B2 power; its voltage is battery voltage. This voltage is divided by resistances R14, R25 and resistance R24 in order to maintain the continuous saturation and conduction of triode V7; at the same time, it provides power to DC-AC circuit through diode D14. Adjusting the resistance value of resistances R14, R24 and R25 can force triode V7 to stop working under different voltages in order to achieve the over-discharge protection of the battery as well as to avoid the damage of the battery from over-discharge.

[0027] Figure 7 is the charging and discharging indicator circuit. When AC is normal and the battery is not connected, the direct voltage formed after commutated through diode D2 and then filtered through capacitance C8 is larger than the breakdown voltage of stable diode D16, so stable diode D16 is conducted; direct voltage is fed on the base of triode V5 with stable diode D16 and current-limiting resistance R15 in order to make triode V5 saturated and conducted. The collector voltage of triode V5 is 0V; light-emitting diode D17-G does not work for short of power, and it shows battery unconnected. After connecting the battery, the direct voltage formed after commutated through diode D2 and then filtered through capacitance C8 is far less than the breakdown voltage of stable diode D16 so that stable diode D16 is closed. The base of triode V5 is powerless so that Triode V5 is closed. The collector voltage of triode V5 keeps the high level; light-emitting diode D17-G starts to emit light with power, and it shows battery connected; the resistance value of adjusting resistance R15 can change the light brightness of D17-G.

[0028] When AC is powered off, or the test switch is turned off or the input AC-DC converter in Figure 4 is under-voltage protection action, the control circuit acts, B2 gets power from relay RYL, and the normal open contact gets power after turning on and is fed on light-emitting diode D17-R through current-limiting resistance R22; light-emitting diode D17-R starts to emit light with power and shows the discharge is in progress. The resistance value of adjusting resistance R22 can change the light brightness of light-emitting diode D17-R. After over-discharge protection action, relay RYL stops working for lack of power, the normal closed contact disconnects, and the discharge condition is over; B2 is powerless, and light-emitting diode D17-R does not emit light for lack of power.

[0029] Figure 8 is the DC-AC converter diagram. Triodes V1 and V2 make up the current-feedback push-pull oscillator; resistances R18, R19, R20 and R21 make up the start circuit; the battery voltage is fed on the center tap point of transformer L5 through Inductance L4.When AC is powered off, or the test switch is turned off or the input AC-DC converter in Figure 4 is under-voltage protection action, the control circuit acts, relay RYL gets power, the normal open contact is turned on, and the battery gets power from B2 through the normal open contact; diode D14, start resistances R18, R19, R20 and R21 trigger the oscillator to work and drive triodes V1 and V2 is driven to work and conducted alternatively; sinusoidal waveform high-frequency AC is formed at E1 and E2, both ends of the secondary coil of transformer. This circuit can still work continuously when loading changing or even open circuit. Adjusting the resistance value of resistances R18, R19, R20 and R21 as well as the parameter of transformer L5 can change the output voltage and the oscillation frequency.

[0030] Figure 9 is the input AC-DC converter diagram. It is to convert high-frequency and high-voltage AC into high-voltage DC. When AC is powered off, or the test switch is turned off or the input AC-DC converter in Figure 4 is under-voltage protection action, the control circuit acts. Figure 8 is the output high-frequency and high-voltage AC of DC-AC Converter. It becomes DC after flowing through the bridge rectifier circuit made up of diodes D9, D10, D11 and D12. Capacitance C10 is filtering capacitance. It is used to smooth the ripple of DC. Varistor VR2 can absorb the spike voltage and limit the maximum direct voltage in order to convert the output DC to the DC within the applicable voltage range of electronic ballast.

[0031] Figure 10 is the converter circuit. When AC is normal, relay RYL does not work, and the normal open contact is turned on. Line L in AC is connected with the normal closed contact (non-common end) of relay through control switch K and then is connected with terminal L of the input terminal of electronic ballast through the normal closed contact; Line N in AC is directly connected with terminal N of electronic ballast; electronic ballast starts to work with power; the fluorescent lamp emits light.

[0032] When AC is powered off, or the test switch is turned off or the input AC-DC converter in Figure 4 is under-voltage protection action, the control circuit acts, relay RYL gets power, the normal closed contact is turned off, and the normal open contact is turned on; in the first line, the battery gets power from B2 through the normal open contact; DC-AC circuit in Figure 8 and AC-CD circuit in Figure 9 work to output high-voltage DC suitable for electronic ballast. In the second line, E1 (DC+) is connected with terminal L of electronic ballast through the normal open contact of relay; E2 (DC-) is connected with terminal N of electronic ballast; electronic ballast starts to work with power; the fluorescent lamp emits light.

[0033] Since the emitting of fluorescent lamp is controlled by electronic ballast and the bulb is mated with electronic ballast, so the service life of the bulb can be maximized. Comparing to the ordinary emergency luminaire, it can prolong the service life of the fluorescent lamp for several dozens of times.

Claims

1. An emergency luminaire, including a case made of a front cover, a back cover and an electronic circuit fixed on the back cover, the electronic circuit comprising an AC-DC converter, a charging circuit, a control circuit, a DC-DC converter, a DC-AC converter, an output AC-DC converter and a conversion circuit, wherein:

    the AC-DC converter converts an input AC into two groups of output DC, the first group being connected with the charging circuit and the second being connected with the control circuit;
    the charging circuit is adapted to conduct current-limited charge to the battery by the first group of DC;
    the control circuit is adapted to control conversion between normal lighting and emergency

lighting, the voltage test of battery discharge, and conversion status test by the second group of DC;

the DC-AC converter includes an oscillating circuit and a boost circuit to produce an output high-frequency and a high-voltage AC with a transformer; the output AC-DC converter further comprises a rectification circuit, a filtering and a current-limited circuit;

the DC-DC converter is adapted to convert the battery voltage to high voltage DC suitable for an electronic ballast to work through DC-AC converter and output AC-DC converter, and functions when the AC is turned off, being under-voltage or in test condition;

the conversion circuit is adapted to control the conversion between normal lighting and emergency lighting.

2. The emergency luminaire according to claim 1, **characterized in that** it comprises several plug terminals for connection with a power line, a test switch, a charging indicator, a discharging indicator, a rechargeable battery, and electronic ballast, respectively.

3. The emergency luminaire according to claim 1 or 2, **characterized in that** the input AC-DC circuit includes over-current and over-voltage protection circuits made up of fuses in series or parallel connection with the input end of the AC as well as varistors.

4. The emergency luminaire according to claim 1 or 2, **characterized in that** the input AC-DC circuit includes an anti-interference circuit composed of capacitances in series or parallel connection with the input end of the AC and common-mode inductances to eliminate the mutual interference between AC and post-circuit.

5. The emergency luminaire according to claim 1 or 2, **characterized in that** the input AC-DC circuit includes an AC automatic detecting circuit made up of a triode and three divider resistances and capacitances in series, which is connected with the two ends of the rectification circuit in the input AC-DC circuit.

6. The emergency luminaire according to claim 1 or 2, **characterized in that** the charging circuit is adapted to detect whether a battery is installed and includes a charging current-limited circuit, which is a charging current-limited protection circuit comprised of a triode and resistances connected between the base and emitter of the triode, and a charging display circuit for indicating the charging condition of the battery.

7. The emergency luminaire according to claim 1 or 2, **characterized by**

a detection and control circuit made up of two triodes and four resistances, the collector of the first triode being connected with the base of the second triode and then linked to the two sides of the filtering capacitance C9.

an over-discharge voltage detecting circuit, consisting of three resistances, being connected with both ends of the battery using the normal open contacts of the relay;

a discharging indicator circuit, made up of a resistance and light-emitting diode, being connected with the two ends of the battery using the normal open contacts of the relay;

wherein a battery abnormity over-current protection is completed by the recoverable over-current fuse.

8. The emergency luminaire according to claim 1 or 2, **characterized in that:**

the output over-voltage protection circuit is brought under the safe operating area of the electronic ballast after the output voltage is pressure-limited by the varistor;

the corrugated inhibition circuit is composed of output filtering capacitances.

the conversion circuit controls the conversion between normal lighting and emergency lighting; the emergency output voltage is high-voltage DC directly connected with the input terminal of the electronic ballast.

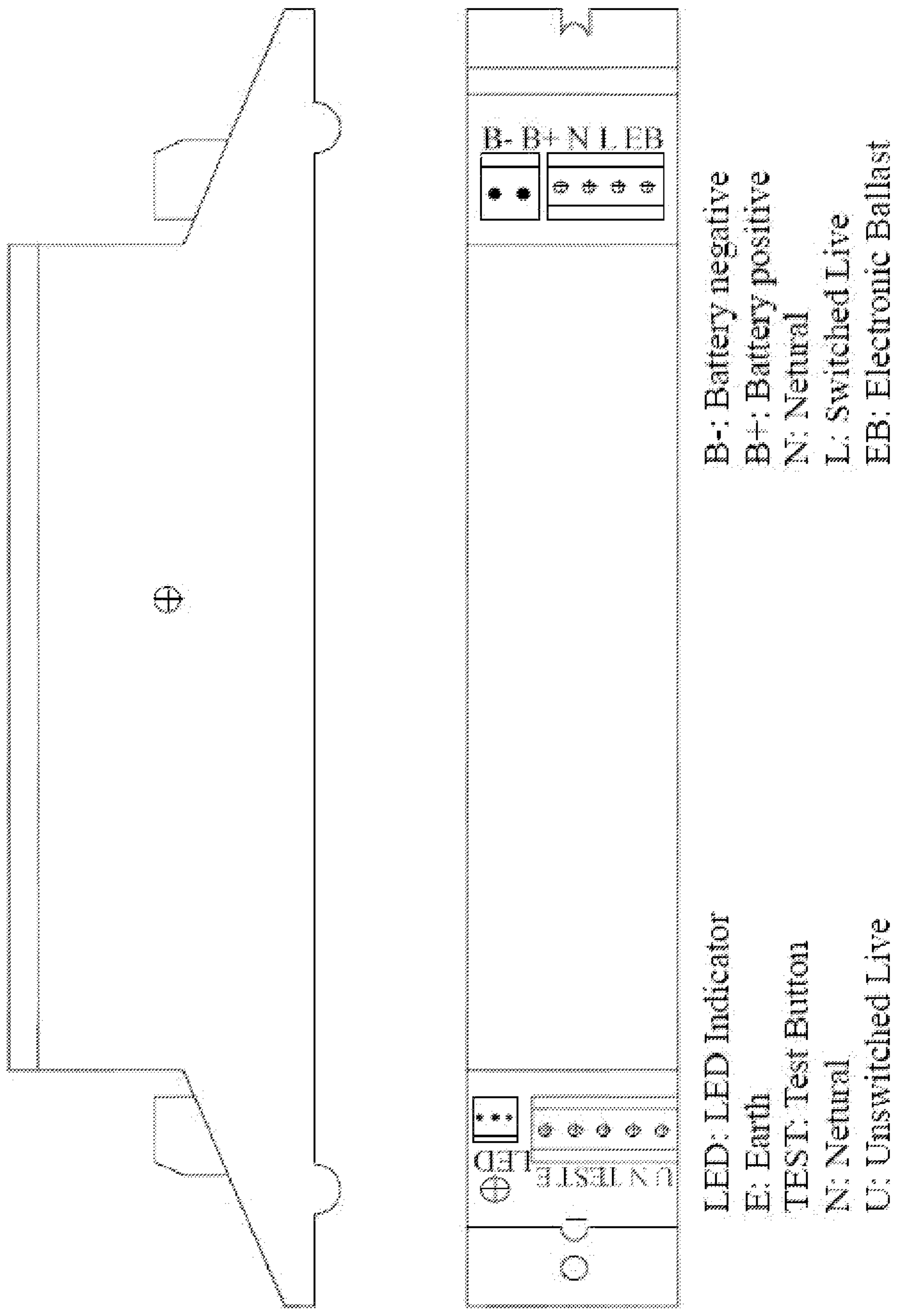

B- B+ N L EB
B-: Battery negative
B+: Battery positive
N: Netural
L: Switched Live
EB: Electronic Ballast
LED
U N TEST E
LED: LED Indicator
E: Earth
TEST: Test Button
N: Netural
U: Unswitched Live

Figure 1

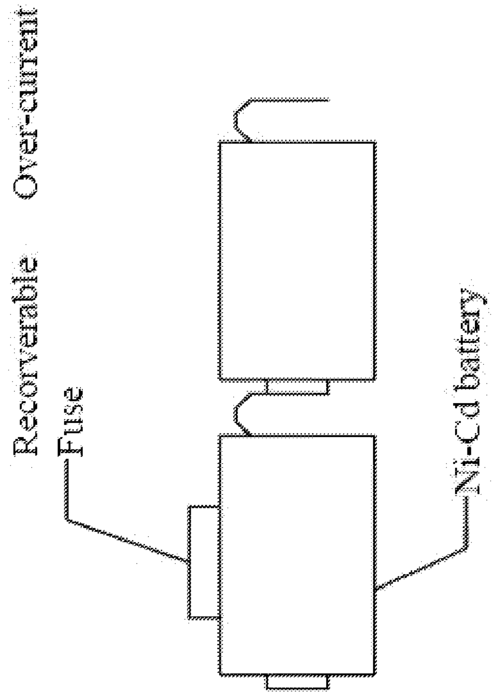


Figure 2

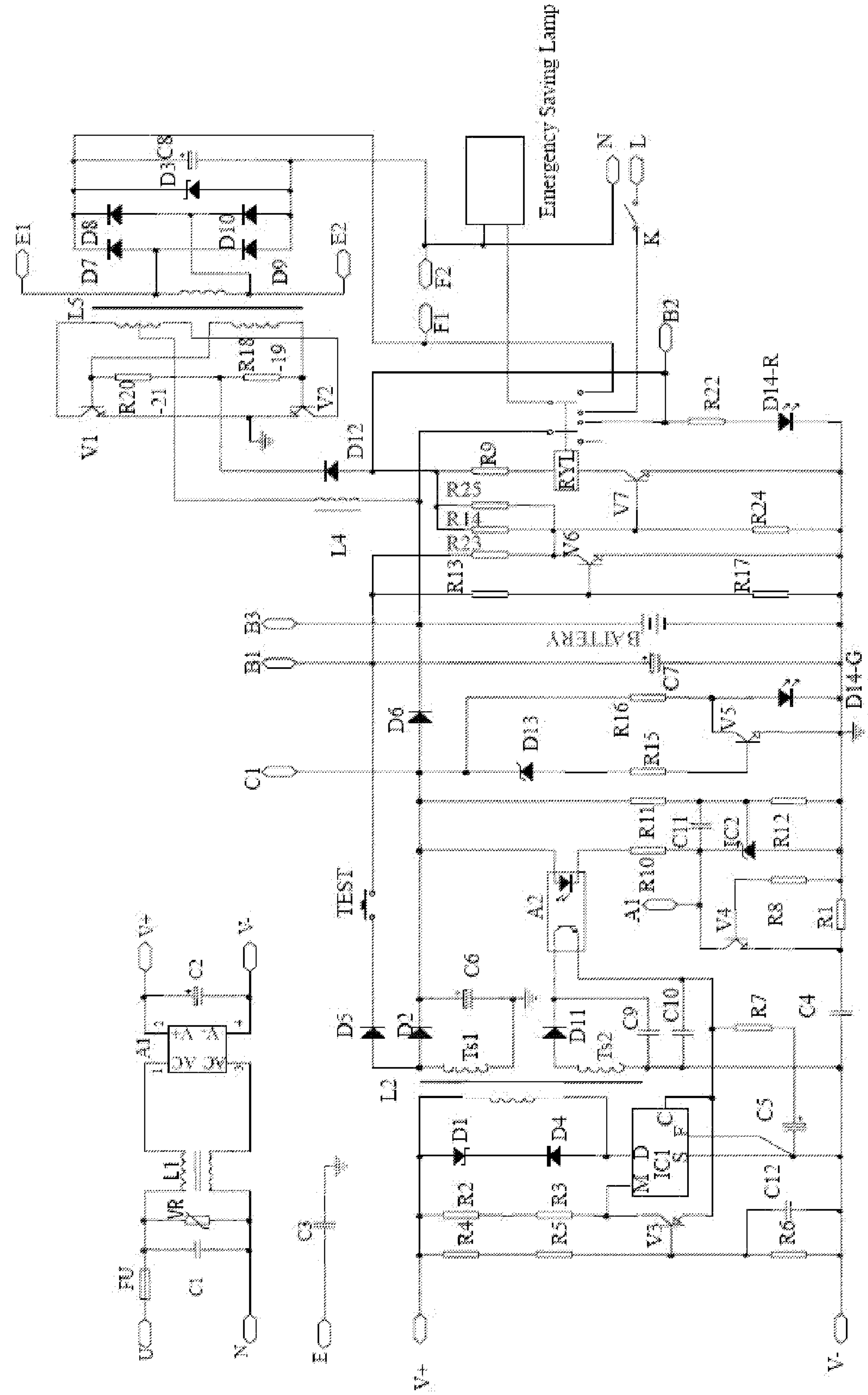
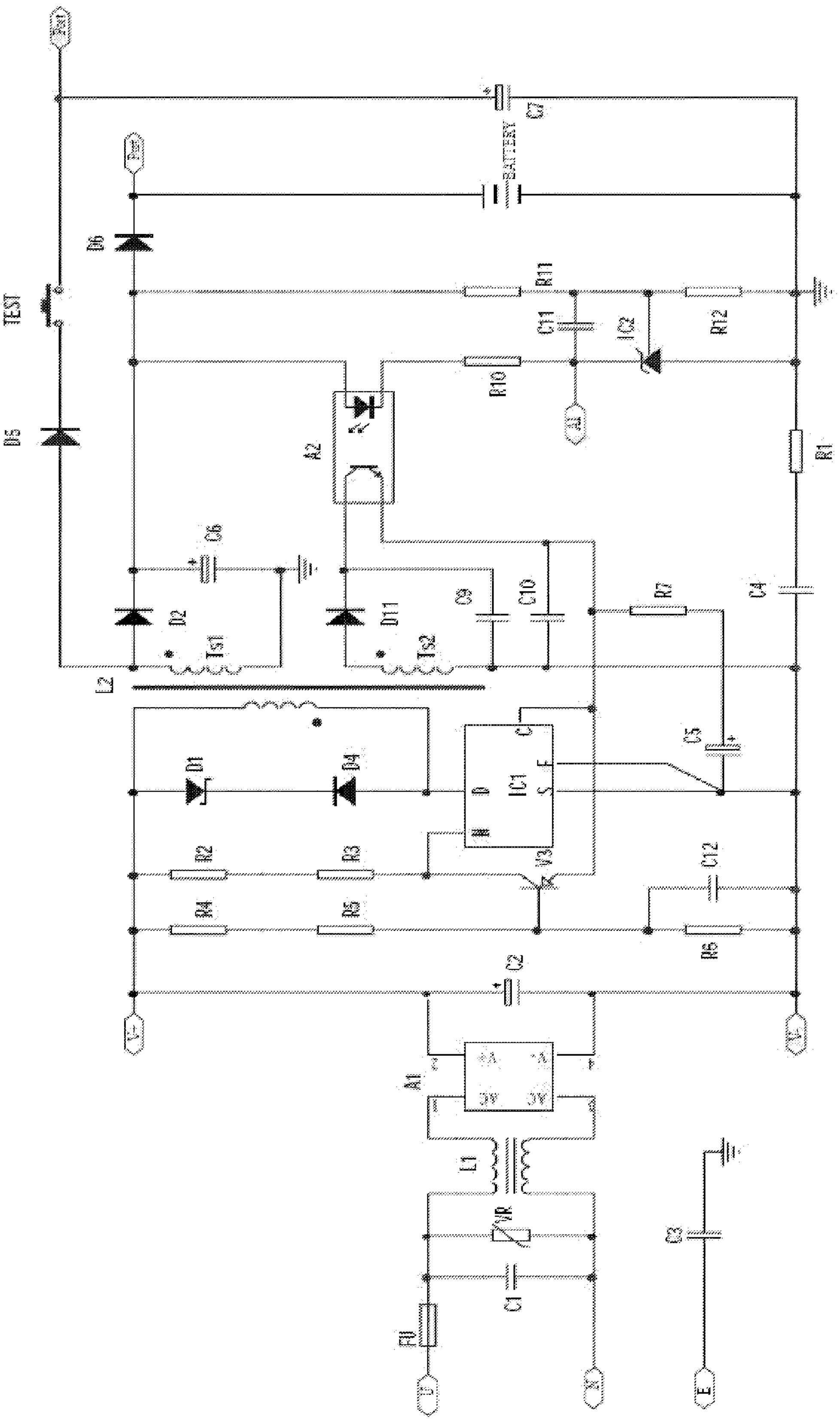

Emergency Saving Lamp
BATTERY
TEST
N
L
K
E1
E2
F1
F2
B1
B2
B3
C1
A1
A2
IC1
IC2
L1
L2
L4
L5
V+
V-
RYL
D14-R
D14-G

Figure 3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Ts2
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C4
C5
D1
D4
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L1
VR
C1
FU
C3

Figure 4

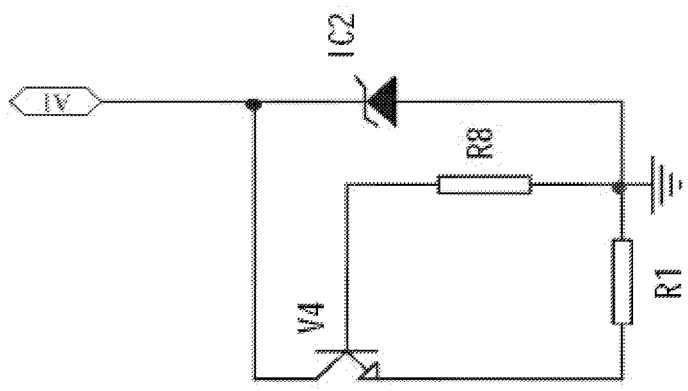

Figure 5

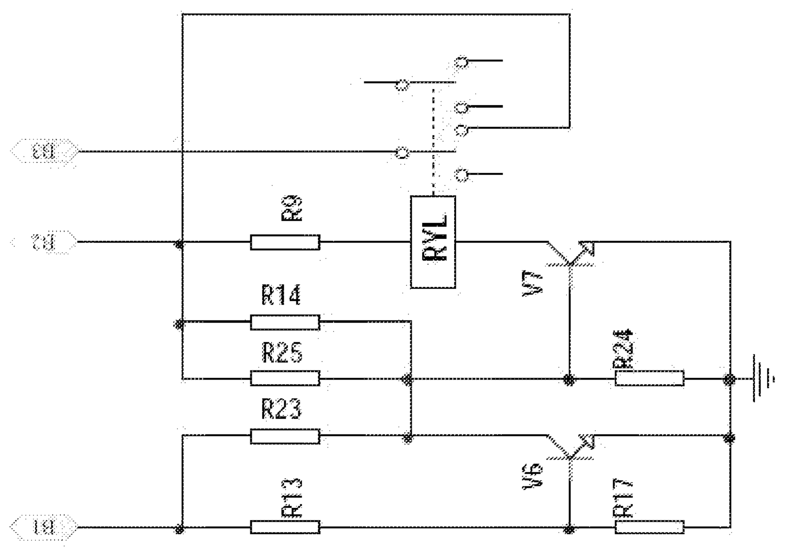

Figure 6

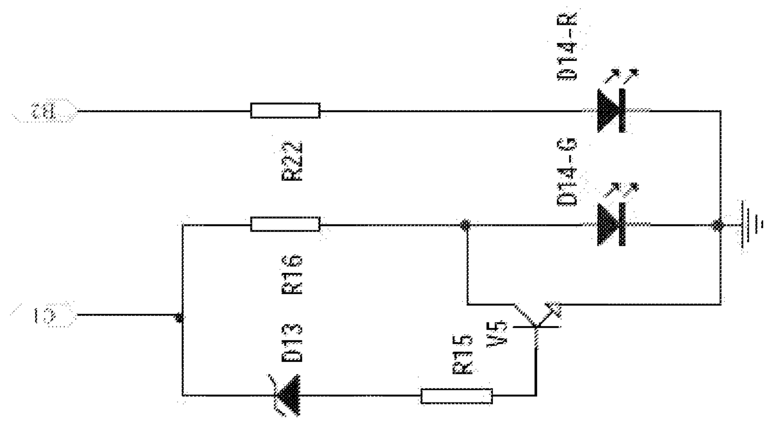

Figure 7

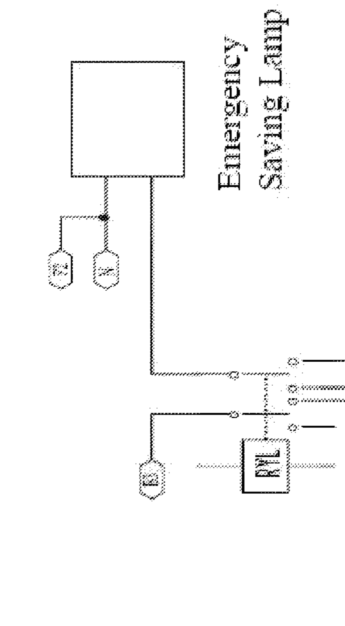

Figure 10

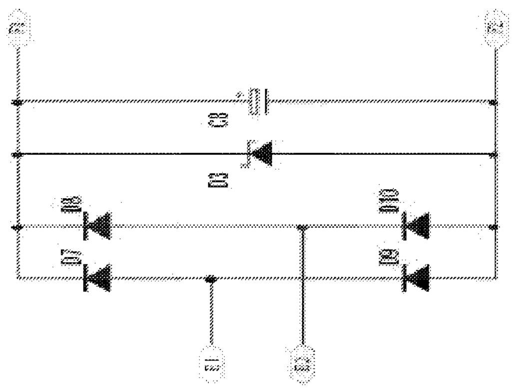

Figure 9

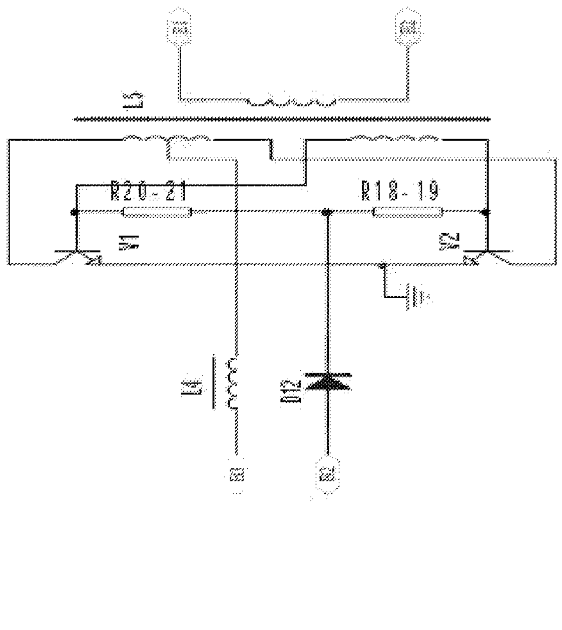

Figure 8