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(54) **Title:** LIGHTING FIXTURE WITH A BUILT-IN EMERGENCY LIGHTING CIRCUIT

(57) **Abstract:** A lighting fixture (LT, TL) with a built-in emergency lighting circuit, comprising a casing (B2, TE) made of a transparent and diffusing material, inside of which a first light source (S1) used for ordinary lighting is placed, said first light source (S1) being controlled by a first electronic ballast (A1) which is connected, through at least one electrical connector (T1), to a mains power source, characterized in that a second electronic ballast (A2), which supplies a second light source (S2), independent from said first light source (S1), located within said casing (B2, TE) and used for emergency lighting, is series-connected to the input conductors (F1, F2) of said first electronic ballast (A1), said second electronic ballast (A2) being electrically connected to at least one battery (B1) and to said second light source (S2) by means of respective pairs of conductors (F3, F4, F5, F6), so that said second electronic ballast (A2) is able to control said battery (B1) using the electric current flowing through said lighting fixture (LT, TL) and to control said second light source (S2) which is used only for emergency lighting.



LIGHTING FIXTURE WITH A BUILT-IN EMERGENCY LIGHTING CIRCUIT

5 The present invention generically relates to a lighting fixture, such as a led lamp or cylindrical tube, replacement of fluorescent lamps (e.g. of the T8 type) having a built-in emergency circuit.

 More specifically, the invention concerns an electronic circuit, provided with battery, that, suitably built-in as an addition to the circuits present in every standard lighting fixture, such as a led lamp, permits
10 transforming it into an emergency lighting fixture.

 Lighting lamps are devices providing a converter to convert electric power into light, an electronic circuit to supply said light source, and electro-mechanical system and a transparent protection housing.

 Lamps have different shapes on the basis of standardization
15 obtained with technical evolution to build-in possible different light sources; most widespread shapes are the bulb one, with a E27 or E14 screw coupling or GU10 bayonet coupling, created to encapsulate the incandescent filament tungsten, and light tubes with a diameter of 26 mm or 15 mm, born for fluorescent lamps with low pressure indirect emission
20 gas discharge.

 The advent of solid state light sources (LED) has evolved technology of the bulb and tube shape, replacing in both cases the content of such bulbs, but preserving their external appearance; thus, LED bulbs was born, which are characterized by a high energy efficiency, in which
25 the LEDs are driven by a built-in electronic power supply converting the 230 V AC power in a form suitable for LEDs.

 White LED bulbs have spread on the market in order to replace almost any traditional filament source, from traditional bulbs with a tungsten filament to the most modern halogen bulbs.

30 LED bulbs, thanks to the greater energy efficiency, are also replacing electronic bulbs, so-called "compact fluorescent", as well as the availability of small batteries allows the integration of the function of emergency power within the new LED bulbs.

 The object of the present invention is that of providing a lighting
35 fixture provided with a universal electronic circuit, which, built-in the traditional bulbs or LED cylindrical tubes, allowing to transform them into respective bulbs or LED tubes for emergency lighting.

Another object of the present invention is that of providing a universal circuit for emergency lighting equipment allowing for automatically and directly detect on the system where the lighting fixture is installed, a condition of activation of the emergency lighting regardless of the state of the ignition switch.

Another object of the present invention is that of providing a universal emergency circuit for lighting fixtures allowing using the traditional light bulbs and/or LED cylindrical tubes without changing lamp holders and/or existing lighting systems.

Further object of the invention is that of realising a universal emergency circuit for lighting fixtures, which is able to carry out the monitoring of the emergency condition with very low energy consumption.

These and other objects are obtained by a lighting fixture with built-in circuit for emergency lighting, according to the enclosed claim 1; other specific technical characteristics according to the invention, are provided in the further dependent claims.

Advantageously, the present invention relates to a new electronic circuit, with battery, which, when suitably provided in addition to the existing circuits in each traditional bulb or LED tube, allows to transform them into an emergency bulb or tube with the following functions:

- in presence of a 230V (AC) power on the socket or tube inlet, the bulb or tube switches on with a full light and simultaneously recharges the built-in emergency battery;
- if the disconnecting switch of one of the two wires feeding the bulb holder or tube is turned off, the tube or bulb is switched off, ceasing charging the battery and the bulb or tube is put in a waiting state (stand-by) ;
- if there is no tension on the whole circuit of the bulb holder or tube upstream the plant, the bulb or tube switches on in an emergency state with reduced light by using the built-in battery.

Said new electronic circuit, adaptable to all bulbs and all electronic LED tubes, is connected in series to the inlet of the electronic original bulb or LED tube, manages a rechargeable battery using the electrical current supplying the electronic converter of the bulb or tube, manages a dedicated set of LEDs aimed to the sole function of emergency lighting, which are isolated by LEDs dedicated to ordinary lighting of light

bulb or tube, and finally incorporates a controlling device managing the emergency function, which analyses the voltage across the power supply terminals of the bulb or tube, identifying the condition of emergency lighting and distinguishing it from a condition of switch off.

5 Further objects and advantages of the present invention will be evident from the following description, which refers to an exemplificative and preferred, but not limiting, embodiment of the lighting apparatus with built-in circuit for emergency lighting according to the invention, and from the enclosed drawings, wherein:

10 - figure 1 shows a switching on system of a conventional LT bulb with interruption of the phase L by switch I;

- figure 2 shows a switching on system of a conventional LT bulb with interruption of the phase L, by switch I, and with emphasises of the parasitic capacitances CPC to other conductors C of the electrical system subjected to phase L potential;

15 - figure 3 shows a switching on system of a conventional LT bulb with interruption of neutral N and with switch I;

- figure 4 shows a switching on system of a conventional LT bulb with interruption of neutral N, by switch I, and with emphasises of the parasitic capacitances CPN towards ground;

20 - figure 5 shows a schematic block diagram of a known light LED bulb;

- figure 5A shows schematic a block diagram of a known cylindrical LED tube;

25 - figure 6 shows a block diagram of a light LED bulb with built-in the new emergency circuit according to the invention;

- figure 6A shows a block diagram of a cylindrical LED tube with built-in the new emergency circuit, according to the invention;

30 - figure 7 shows the electrical scheme of the universal emergency circuit for lighting fixture according to the present invention;

- figure 8 shows a perspective view of a LED bulb with E14 olive shaped coupling with the circuit emergency universal according to the present invention built-in;

35 - figure 9 shows an exploded view of the bulb of Figure 8, according to the invention;

- figure 10 shows a perspective view of a cylindrical LED tube with circuit emergency universal according to the invention built-in;

- figure 11 shows a cross section view of the cylindrical LED tube of Figure 10 according to the present invention.

With particular reference to enclosed figures 5 - 9, it is pointed out that figure 5 schematizes the architecture of a known LED light bulb, with transparent plastic diffusing bulb B2, LED source S1, LED ballast A1 and connector T1, while the subsequent figure 6 schematizes the same LED light bulb in which, similarly, the connector T1, the LED ballast A1 and the LED source S1 are present and in which they were added, by building-in them, a power supply circuit A2 of the emergency lighting, a battery B1 and a series of additional LEDs S2 necessary for the function of emergency lighting.

In the enclosed figure 6 it is already evident the simplicity of the solution in which the new emergency circuit A2 is connected in series to the input conductors F1, F2 of the traditional bulb ballast A1 of the LED bulb LT; furthermore, battery B1 is connected to said emergency circuit A2 with its two inlet conductors F3, F4 and additional LEDs S2 are connected in turn to the power supply for the emergency lighting A2 with two dedicated conductors F5, F6.

The emergency ballast A2 is adaptable to all types of electronic bulbs, and consists of elements D1, D2, LV1, B1, C1, CLDE, R1, R2, Q1, LDE1, LDE2, ..., LDEN of the circuit shown in the enclosed figure 7 and is connected in series with the ballast A1 of the LED bulb LT.

Further, the emergency ballast A2 controls the battery B1 using the electric current flowing through the LED light bulb LT and also controls a dedicated set of LEDs used to the sole function of emergency lighting (LDE1, LDE2, ..., LDEN) and isolated with respect to LEDs dedicated to standard lighting (LD1, LD2, ..., LDN) and originally present in the traditional electronic bulb (in practice, one can use, for example, a flexible or rigid printed circuit board LD containing the ordinary lighting LEDs and emergency lighting LEDs, wherein LEDs are mounted insulated on the flexible or rigid printed circuit board (FR4) LD glued on an aluminium support; or it is possible realizing two separate circuits, comprised of FR4 or of IMS aluminium, each one housing respective LEDs).

The above emergency ballast A2 then incorporates a management controller of the emergency function CLDE, which analyzes the voltage across the power supply terminals of the bulb LT (connector

T1), and identifies the emergency condition, distinguishing it from a condition of system I switched off.

As for the LED bulbs (see the enclosed figures 5 and 6), enclosed figure 5A schematically shows the architecture of a LED electronic tube TL of the traditional type, while the following figure 6A enclosed schematically shows the tube led TL, to which were added, by building-in, the electronic emergency ballast A2, the battery B1 and the light source S2, which is auxiliary to the light source S1 and constituted by additional LEDs necessary for the emergency function.

Also in this case it is evident the simplicity of the solution in which the new ballast emergency A2 is connected in series to the input conductors F1, F2 of the original electronic ballast A1 of the tube TL; furthermore, the battery B1 is connected to the emergency ballast A2 with its two conductors F3, F4, and the additional emergency light source S2 is connected, in turn, to the emergency ballast A2 with two dedicated conductors F5, F6.

In practice, the operation of the lighting fixture with built-in circuit for emergency lighting, according to the present invention, is substantially the following.

According to the invention, an emergency light bulb or tube, in addition to a traditional light bulb or electronic tube, is able to detect in the electrical system where it is installed, a condition of activation of the emergency lighting (lack of AC power supply to the system), distinguishing it from a simple opening of the switch I of the bulb or tube, opening which is caused by normal switching off voluntarily controlled by the user.

In fact, with particular reference to the enclosed figures 1, 2, 3 and 4, when the switch I of the circuit is switched on, AC voltage of 230V mains is present at the ends of the two supply terminals L, N of the LED light bulb LT or tube led TL.

In this condition, the bulb TL or tube LT is normally switched on and the built-in battery needs to be recharged.

When the switch I opens the circuit, the bulb LT or tube TL switches off as a normal light bulb or as a normal tube, but the emergency ballast A2 according to the present invention continues to monitor the power line to detect the presence of 230V, 50Hz (or 115V, 60Hz) supply upstream the switch I and may occur all the cases described in Figures 1 to 4:

- switch I disconnects the phase conductor L in a system in which the two conductors are well isolated from other electrical lines, which is the typical case for a table or floor lamp, with the plug inserted in such a way that the switch I disconnects conductor L (see figure 1), or a single power line, as can easily happen in renovations of electric systems; in this case, with the switch I open, at the ends of the bulb LT or tube TL remains the residual AC voltage coupled through the parasitic capacity of few pF, of the switch I itself, wherein residual vacuum voltage AC is very small, but measurable, and of the order of a few tenths of volts;

- switch I disconnects the phase conductor L in a system in which the two conductors are adjacent to other power lines of the building, which is the typical case of a ceiling lamp or wall wired directly into an electrical civil system, wherein the terminal is disconnected from the switch I, but the part of disconnected conductor runs along ducts and electrical conduits close to other conductors connected to L, with potential of 230V, 50Hz (or 115V, 60Hz); in this case (see Figure 2), with the switch I open, measurable voltage at the ends of the bulb LT or tube TL is the sum of the AC voltage coupled through the parasitic capacity of few pF of the same switch I and the voltage induced by the parasitic capacity CPC coupling with electrical cables adjacent to the disconnected part, the latter contribution being of higher entity. The AC voltage at the ends of the bulb LT or tube TL, under vacuum, is within the range from few volts to few tens of volts, as a function of the parasite couplings;

- switch I disconnects the neutral conductor N (see figures 3 and 4); in this case, conductor L, at the highest potential of 230V, 50Hz (or 115V, 60Hz), is always connected to one of two inlets of the bulb LT or tube TL and the parasitic capacities to ground CPN easily allow to couple a voltage of several volts, under vacuum, to the ends of the bulb LT or tube TL, with switch I open.

In all the above cases, the bulb LT or tube TL, using the circuit A2 for monitoring and managing the built-in emergency lighting, supplied by battery B1, consuming only a very small part of the stored energy, measuring the residual AC voltage to its input in order to verify its presence and keeping in this case inhibited the switching on circuits of the emergency light source S2 (constituted, in particular, by a series of LEDs LDE1, LDE2, ..., LDEN); then, until voltage at 230V, 50Hz (or 115V, 60Hz)

is present upstream the switch I, the bulb TL or tube LT is able to detect its presence and to keep the light off, like any ordinary lighting fixture .

As soon as voltage 230V, 50Hz (or 115V, 60Hz) upstream of I lacks, also the residual AC at the input of bulb LT or tube TL disappears and the emergency management control device CLDE, detecting the lack, automatically turns on the emergency LEDs LDE1, LDE2, ..., LDEN, using the energy stored in the built-in battery B1, eventually adjusting its intensity to optimize the exploitation of battery B1; this operation regime continues until the management circuits of the emergency lighting do not detect again the presence of power at 230V, 50Hz (or 115V, 60Hz) upstream the switch I, in which case the emergency lighting is again inhibited by turning off the emergency power supply A2.

The bulb LT or tube TL are so realised that circuits for monitoring the AC power supply condition upstream switch I consume a very small part of the energy present in battery B1, thus guaranteeing a continuity of operation in monitoring mode with the switch I open, for several months without interruption, e.g. consuming half of the energy available in a 3 month period; in this way, it is ensured the regularity of operation of a light bulb LT or of a tube TL that are switched on at least once every few days (since switching on of the bulb LT or tube TL is the only moment during which battery B1 charges).

Operation autonomy of the bulb LT or tube TL in case of an emergency can be set between a minimum of 30 minutes and few hours, by suitably adjusting the light intensity of the emergency source S2, i.e. by varying the relative intensity of the driving current; the light intensity adjustment can possibly be managed in such a way that, initially, the brightness is more intense to permit to the user to less perceive the reduction of brightness by the ordinary operation, while subsequently, the brightness can be progressively automatically reduced so as to maximize the battery life B1.

Further, the emergency circuit A2 is so realised to turn off the emergency light when the voltage of battery B1 falls below a minimum value not to damage the battery B1.

The original ballast A1 of bulb LT or tube TL (Driver LED) is an electronic circuit with input AC voltage (230V, 50Hz or 115V, 60Hz or universal from 85V to 250V, 50 to 60Hz) and output DC, suitable for driving a series of LEDs used for lighting ordinary LD1, LD2, ..., LDN.

Said circuit can be of any type, such as, for example, passive capacitive or resistive drop, active with converter with a high frequency switching with isolation transformer (e.g. flyback) or without transformer (e.g. buck or inverted buck), or active with switching converter and power factor correction.

In all cases, the input current of the ballast A1 is an alternate current at mains frequency (50Hz or 60Hz), the intensity of which is proportional to the power absorbed by the bulb LT or by the tube TL; e.g., in case of a light LED to 3.5 W and fall capacitive drop ballast, ballast A1 absorbs about 45 mArms.

Output continuous current is adjusted by ballast A1 to the value necessary for correct supply of ordinary lighting LEDs LD1, LD2, ... LDN (source S1); in particular, this parameter depends on the configuration of LEDs employed, as if LEDs used are many, and each one with small power, current is low and voltage is high, while current is high and voltage is low when using few LEDs, each one with higher power.

It is therefore evident that it is not convenient to adapt a possible emergency lighting circuit to the output, since, at the same power of the bulb LT or tube TL, it would not be easy matching the same to the various possible output electrical configurations; as to the input, instead, the supply current at 50Hz, with the same power, is similar for all the bulbs LT or tubes TL.

Actually, in this case, current intensity depends on the power factor of the electronic ballast A1, but can vary at most by a factor of 2 to 3, from a solution to the other.

With particular reference to the enclosed figure 7, emergency electronic ballast A2 is comprised by elements D1, D2, LV1, C1, CLDE, R1, R2 and Q1, and is connected to the emergency LEDs LDE1, LDE2, ..., LDEN and to the battery B1.

Emergency circuit A2 is connected in series to input terminals of original ballast A1 of bulb LT or tube TL, between one of the input terminals CN and connector CN1 of the socket of bulb LT or tube TL; the emergency circuit A2 is then run by the input current of ballast A1, current running, for the positive half-wave, within the diode D2 and the bipole LV1/B1, and, for the negative half-wave, through the diode D1.

Battery B1 of the rechargeable type, has a nominal voltage of between 3.2V and 4V and can be constituted by a series of 3 elements

with 1.2V nominal (of the NiCd or NiMH type), or by a single ion lithium element (in one of several possible chemical, for example with nominal voltages of 3.2V, 3.6V or 3.7V), or by other technological solutions with voltages between 3.2V and 4V.

5 Emergency ballast A2 is also driven by a programmable control device CLDE consisting of a microcontroller M1 with amplifier and integrated analog converter M2; controller CLDE is directly supplied by battery B1 to which is connected in parallel and measure the AC voltage present on the socket of the bulb LT or tube TL by capacitor C1, so as to
10 accordingly drive emergency LEDs LDE1, LDE2, ... , LDEN, controlling the bipolar transistor Q1.

 Thus, in presence of 230V AC mains power at both ends of socket CN1, the AC input passes through D1 and D2 and runs at the input of the ordinary ballast A1 and LD1, LD2, ..., LDN are regularly switched
15 on.

 Current circulating for half-wave for D2 charges battery B1 and voltage at the ends of the battery B1 raises during the charging operation up to the maximum permitted value determined by the voltage adjuster (shunt) LV1; shunt LV1 intervenes shunting the charging current when
20 voltage reaches a maximum value set, e.g. 4.2V (for lithium-ion batteries), to protect battery B1 from damage due to overcharging.

 The voltage drop introduced by battery B1 for this function is negligible for ballast A1 of bulb LT or tube TL, since across battery B1 are at most 4.2V are localized, which, added to the voltage drop of diode D2
25 (equal to 0,6V), amount to 4.8V and, therefore, even in the unlucky case of a mains voltage of 110V AC, with $V_{peak}=155V$, voltage drop accounts for approximately 3% on the reduction of the voltage supply input A1 bulb LT or tube TL.

 In case of 230V AC with $V_{peak}=325V$, the reduction of the voltage at the input of the ballast A1 caused by charging battery B1 is
30 even more negligible, of the order of 1.5%.

 Shunt regulator or LV1 is characterized by a negligible current consumption to the nominal operative voltage of the battery B1.

 Control device CLDE, correctly supplied by battery B1,
35 measures the alternating voltage at the terminals of D1 of capacitor C1 and its A/D converter and, verifying the presence of an alternating voltage at the mains frequency with a peak to peak amplitude greater than the

voltage battery, detects the presence of the mains voltage, keeping switched off emergency LEDs LDE1, LDE2, ... LDEN and transistor Q1.

Shunt regulator LV1, which shunts the battery B1 regardless of its state when it to exceeds the maximum permitted voltage, advantageously allows the operation of the bulb LT or tube TL in an ordinary manner, even in case where the battery B1, aging, can no longer absorb the recharging current.

Obviously, in case of short circuit of battery B1, emergency part ceases functioning but it is however guaranteed the normal operation of the electronic ballast A1; bulb LT or tube TL, therefore maintain the functions of normal lighting fixture even in case of complete damage to the battery B1.

In case of presence of mains voltage, with switch I of the external circuit to the bulb LT or to the tube TL turned off, the bulb LT or tube TL no longer receives the necessary power for operation of ballast A1, the current within the input circuit bulb LT or tube TL is almost null and battery B1 is not charging.

Since the control device for monitoring and managing the emergency condition CLDE is powered by battery B1, the power consumption is very low, being limited to few tenths of μA , since microcontroller M1 limits its activities to the lighting periods interspersed with "sleep" periods, with intervals of some tenths of mS.

During periods of activity, microcontroller M1 measures the voltage at the terminals D1 of capacitor C1 using its A/D converter.

In particular, microcontroller M1 processes the alternating voltage measured across ends D1 with a digital filter, and compare the measured value with a set or pre-calculated internal threshold, to decide whether or not to turn on the emergency LEDs LDE1, LDE2, ..., LDEN by the piloting of transistor Q1.

If value of AC signal to the mains frequency (50 or 60 Hz) at the ends of D1 is greater than the set threshold, microcontroller M1 keeps transistor Q1 switched off, and consequently the emergency LEDs LDE1, LDE2, ..., LDEN; vice versa, if the measured alternating voltage is lower than the internal threshold, microcontroller M1 turns on transistor Q1, and consequently the emergency LEDs LDE1, LDE2, ..., LDEN.

AC voltage at the ends of D1 coincides with the switch I off, with residual AC voltage at the terminals of socket CN1 of bulb LT or tube TL;

in absence of mains voltage on the socket CN1 of bulb LT or tube TL, diodes D1 and D2 are interdicted and have a high impedance; in this condition, microcontroller M1 can measure, thanks to its high impedance amplifier input and by C1, the residual voltage at the ends of CN1.

5 Input of ballast A1 behaves, in the series circuit of measure, such as a low impedance bipole at the mains frequency, since it does not introduce any attenuation of the alternating voltage to be measured present on this socket CN1 and observed at the ends of D1; thus it is realized in a simple and advantageous way a circuit architecture allowing,
10 in a universal and effective way, to make the high impedance measurement of the residual voltage at the ends of socket CN1 of the bulb TL or tube LT, with bulb TL or tube LT switched off.

 Determination of the internal threshold of the microcontroller M1 can be a result of a pre-setting of the threshold value at the factory (not
15 changeable during operation) or following to an automatic self-adaptive determination by the bulb LT or tube TL, during its operation.

 In the latter case, bulb LT or tube TL arrives from the factory with a predetermined value and automatically adapts to the operating conditions of the system; this operation mode may be useful in managing
20 cases of systems in which the levels of the AC signal measured have a very wide dynamic, such as in circuits shown in figures 2 and 4.

 Substantially, the adaptive threshold bulb LT or tube TL arrives from the factory with a predetermined threshold value and, at the first turning off of the switch I, microcontroller M1 measures the AC signal on
25 D1 and, on the basis on the value of the measure, defines the following actions:

- if the voltage is less than the predetermined threshold value, it is an emergency condition, and then the bulb LT or tube TL is switched on an emergency mode;
- 30 • if the voltage is between the predetermined threshold value and the maximum value, the new threshold is redefined equal to $2/3$ of the measured value.

 In this way, it is possible improving the immunity of the bulb LT or tube TL, ensuring that, even in the presence of a residual spurious AC
35 voltage, in the absence of a 230V power supply of the system caused by any interference of adjacent systems, the bulb LT or tube TL can successfully activate the emergency function.

LEDs dedicated to emergency lighting LDE1, LDE2, ..., LDEN, are advantageously controlled by the bipolar transistor Q1, in order to minimize the cost and effectiveness of the driving circuit.

5 In fact, the correct matching of the battery voltage ($3.2V + 3.7V$, depending on the technology chosen for battery B1) and of LEDs used as emergency light source S2 and small powers applied for emergency, allows the use of a virtually direct connection with battery B1, in which resistance R2, having a small value, limits, together with the internal resistance of battery B1, the maximum current that can be delivered to
10 fully charge battery B1.

The discharge of battery B1, progressively reducing the voltage, naturally reduces the current in the emergency LEDs LDE1, LDE2 ... LDEN, with the perfect application result of a slow reduction of brightness, which, while not being perceived by observer's eye, helps extending at
15 most the autonomy of the emergency function, optimizing exploitation of battery B1.

The apparent simplicity of the circuit does not sacrifice the electrical efficiency, which is actually very high, since nominal voltage of battery B1 is close to the operative voltage of emergency LEDs LDE1, LDE2 ..., LDEN; every switching converter would, due to the small powers involved, with a much lower efficiency.
20

Microcontroller M1 is always able to vary the duty cycle for driving Q1 in order to further modulate intensity of the average current absorbed by battery B1, in order to optimally exploit the available energy; the modulation frequency PWM is in this case in the order of $20 + 30$ KHz.
25

Bulb LT or tube TL is also equipped with a function of inhibition of the emergency mode (function called "rest mode").

According to this function, microcontroller M1 analyzes, by means of the AC voltage measured on D1, sequence of consecutive ignitions of bulb LT or tube TL (corresponding to the sequence of switching on and off of switch I); if the user turns on and off the bulb LT or tube TL consecutively for 4 times, regularly interspersed by pauses and ignitions of the duration of about 3 seconds each, microcontroller M1 interprets said sequence as a control for inhibiting the emergency function
30 and by the last of the four switching off, the bulb LT or tube TL goes in a inhibition state.
35

At this point, bulb LT or tube TL can be uninstalled without that it is switched on in an emergency mode, preserving battery B1, and microcontroller M1 is in a condition of very low power consumption while preserving at most the state of charge of battery B1.

5 Next switching on of switch I (i.e. when the bulb LT or tube TL is again supplied at mains voltage), inhibition function is immediately eliminated and bulb LT or tube TL restores its normal operation with the function of emergency active.

10 This inhibition function is convenient for the transportation of the bulb LT or tube TL by the user and also to preserve the charge of battery B1 after manufacturing in factory of the same bulb or tube, before the sale and delivery to customers.

15 Figures 8 and 9 illustrate a possible industrial application of the emergency ballast A2 and of battery B1 to a 3.5W olive shaped LED bulb LT; it is evident that simplicity and possibility of miniaturization of the circuit easily enable integration even in smaller shapes, making it convenient extension of the function of emergency lighting to all commercial light bulbs.

20 In particular, as shown in figures 8 and 9, ballasts A1 and A2 can be inserted within an intermediate body B3 of bulb LT provided between the transparent and diffusing bulb B2 and the end portion B4 of bulb LT, provided in correspondence with the electric connection T1, while accumulator group B1 can be placed inside of the end portion B4.

25 Solution described can also be integrated in any type of electronic bulb (also not LED bulb), for example of the CFL (compact fluorescent) type; in which the electronic ballast A1 is replaced by compact fluorescent tube ballast (CFL) and the LED source S1 is replaced by the same tube, while emergency ballast A2, battery B1 and emergency source S2 remain the same of the application to the LED light bulb.

30 Figures 10 and 11 illustrate a possible industrial embodiment of an LED electronic tube TL with built-in the function of emergency lighting, according to the present invention.

35 Substantially, ordinary S1 and emergency S2 light sources are mounted side by side on an extruded aluminium TI, internally mounted within an outer polycarbonate, transparent and translucent, tube TE; central light source S1 is that comprised by ordinary lighting LEDs, while

the lateral light source S2, which is smaller, is that comprised by emergency LED.

Said lateral light source S2 is shown, only for exemplificative purposes, mounted on one side with respect to the central light source S1, but it can be placed in any location on the extruded element T1.

Emergency light source S2 can also be divided into two or more parts, e.g. one located on the right and one on the left with respect to the central light source S1, in order to maintain the lighting symmetry even under emergency conditions, or it can be mounted on one end of the tube TL to minimize the length of the wiring.

The other circuits (electronic ballast A1, emergency ballast A2) and battery B1 are housed inside the aluminium hollow extruded element T1, one after the other; battery B1, in this exemplary case, is comprised of three cells of NiCd batteries, of the AAA type, connected in series, with the total voltage equal to 3.6V.

Both in the case of bulb LT and of tube TL, circuits of the ordinary ballast A1 and of the electronic emergency ballast A2 may possibly be realised on a single base to even more strictly exploit the available space in embodiments in which the available volume for housing the electronic part is particularly small, or for reasons of convenience of industrial realization.

From the above description they are evident the characteristics of the lighting fixture with built-in circuit for emergency lighting, according to the present invention, as clear as are the advantages.

Finally, it is clear that numerous other variants can be made to the lighting fixture described, without departing from the novelty principles of the inventive idea, as it is clear that in the practical implementation of the invention, materials, shapes and dimensions of the details illustrated may be different according to the needing and that the same can be replaced by other technically equivalent.

CLAIMS

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1. Lighting fixture (LT, TL) with a built-in emergency lighting circuit, comprising a casing (B2, TE) made of a transparent and diffusing material, inside of which a first light source (S1) used for ordinary lighting is placed, said first light source (S1) being controlled by a first electronic ballast (A1) which is connected, through at least one electrical connector (T1), to a mains power source, characterized in that a second electronic ballast (A2), which supplies a second light source (S2), independent from said first light source (S1), located within said casing (B2, TE) and used for emergency lighting, is series-connected to the input conductors (F1, F2) of said first electronic ballast (A1), said second electronic ballast (A2) being electrically connected to at least one battery (B1) and to said second light source (S2) by means of respective pairs of conductors (F3, F4, F5, F6), so that said second electronic ballast (A2) is able to control said battery (B1) using the electric current flowing through said lighting fixture (LT, TL) and to control said second light source (S2) which is used only for emergency lighting.

2. A lighting apparatus (LT, TL) as claimed in claim 1, characterized in that said second electronic ballast (A2) includes an emergency lighting programmable control device (CLDE), which controls the voltage across the power terminals of said lighting fixture (LT, TL), thus identifying an emergency lighting condition and distinguishing it from a switch off (I) condition of the electrical plant on which said lighting fixture (LT, TL) is connected.

3. A lighting apparatus (LT, TL) as claimed in claim 1, characterized in that said first electronic ballast (A1) is constituted by an electronic circuit with an AC input at the frequency of the mains power and a DC output, said DC output being adjusted to a prefixed value for supplying said first light source (S1), said electronic circuit being a passive capacitive or resistive circuit, or an active circuit with high-frequency switching converter with or without insulation transformer, or an active circuit with switching converter.

4. A lighting fixture (LT, TL) as claimed in claim 1, characterized in that said current entering said first electronic ballast (A1) flows through said second electronic ballast (A2) and circulates, for a negative half-wave, through a first diode (D1), and, for a positive half-wave, through a second diode (D2) and through a first bipole (LV1, B1) which includes said battery (B1) and a voltage regulator (LV1) which sets a prefixed maximum voltage value of said battery (B1) during a charging phase of said battery (B1).

5. A lighting fixture (LT, TL) according to claim 2, characterized in that said programmable control device (CLDE) includes a microcontroller (M1) connected to an A/C amplifier (M2) and is directly supplied from said battery (B1), to which is parallel connected, said programmable control device (CLDE) being able to measure the AC voltage at the power supply terminals of said lighting fixture (LT, TL), through a capacitor (C1), in order to control said second light source (S2) by driving a bipolar transistor (Q1).

6. A lighting fixture (LT, TL) according to claims 4 and 5, characterized in that said microcontroller (M1) is able to work out said AC voltage measured across said first diode (D1) and compares said measured value with an internal pre-set or pre-calculated threshold, in order to turn on or turn off said second light source (S2) by driving said bipolar transistor (Q1).

7. A lighting fixture (LT, TL) according to claims 4 to 6, characterized in that said microcontroller (M1) controls, by using the measured voltage across said first diode (D1), a sequence of consecutive switching on of said lighting fixture (LT, TL), so as to read said sequence as a temporary command for inhibiting the emergency lighting of said lighting fixture (LT, TL).

8. A lighting fixture (LT, TL) as claimed in at least one of the previous claims, characterized in that said light sources (S1, S2) are constituted by LEDs and/or fluorescent light sources.

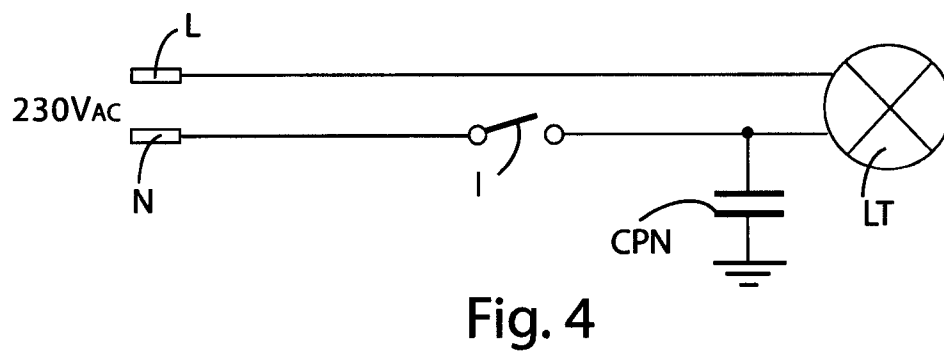
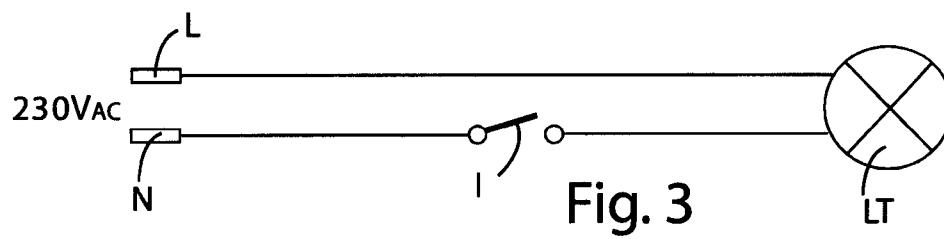
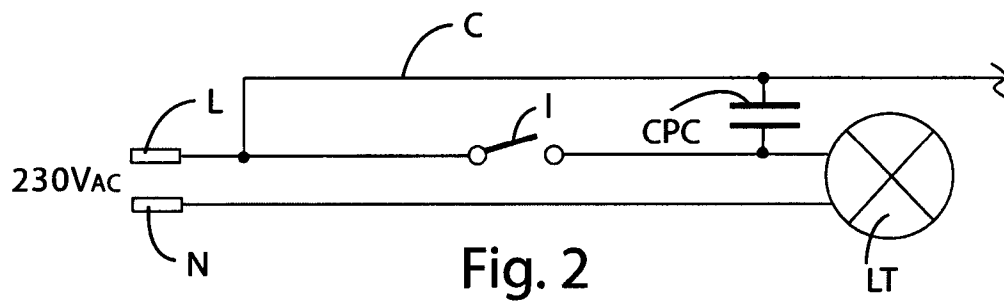
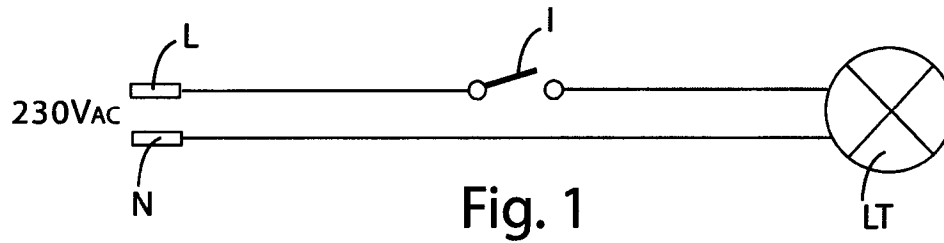
9. A lighting fixture (LT, TL) as claimed in at least one of the previous claims, characterized in that said fixture (LT, TL) includes a fluorescent light bulb or a LED electronic light bulb (LT) or a LED tube (TL).

10. A lighting fixture (LT, TL) as claimed in claim 9, characterized in that said electronic ballasts (A1, A2) are placed into a

body (B3) of said light bulb (LT), which is placed between said transparent and diffusing casing (B2) and an end portion (B4) of the light bulb (LT), said end portion (B4) being positioned in correspondence of said electrical connector (T1).

- 5 11. A lighting apparatus (LT, TL) as claimed in claim 9, characterized in that said battery (B1) is placed inside an end portion (B4) of the light bulb (LT), which is positioned in correspondence of said electrical connector (T1).

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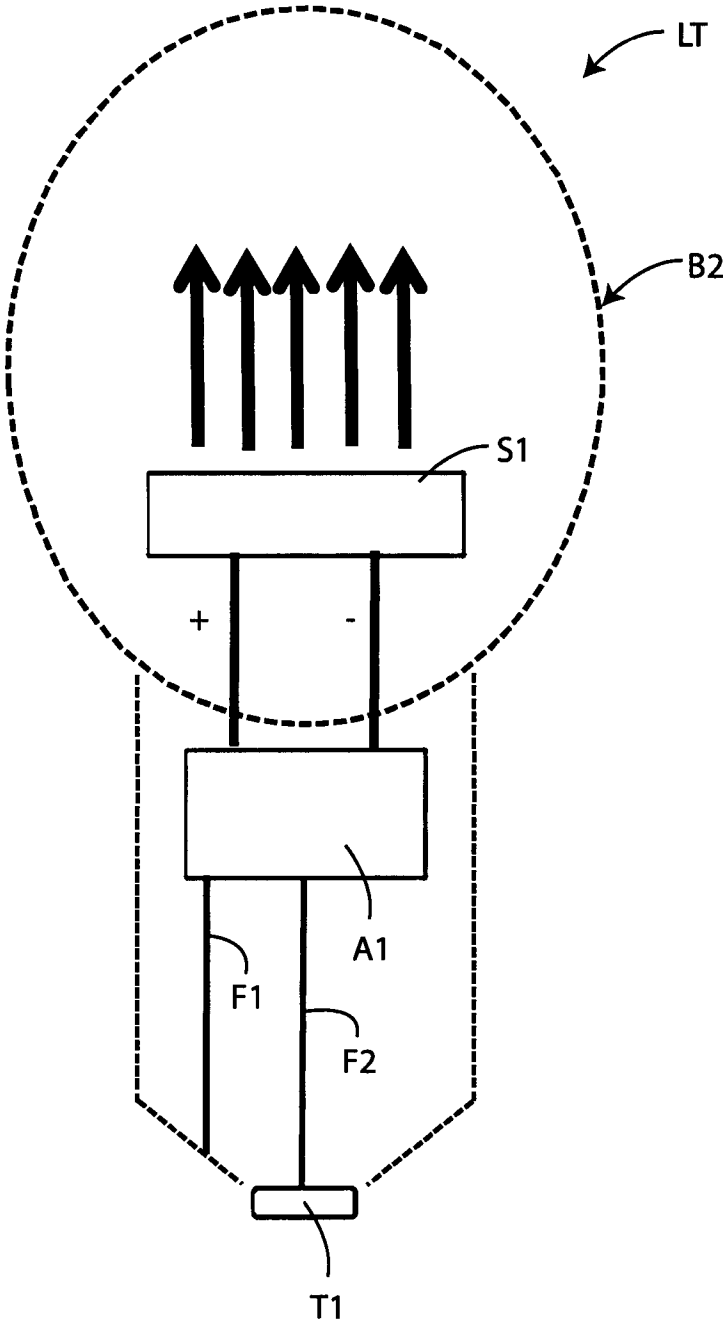


Fig. 5

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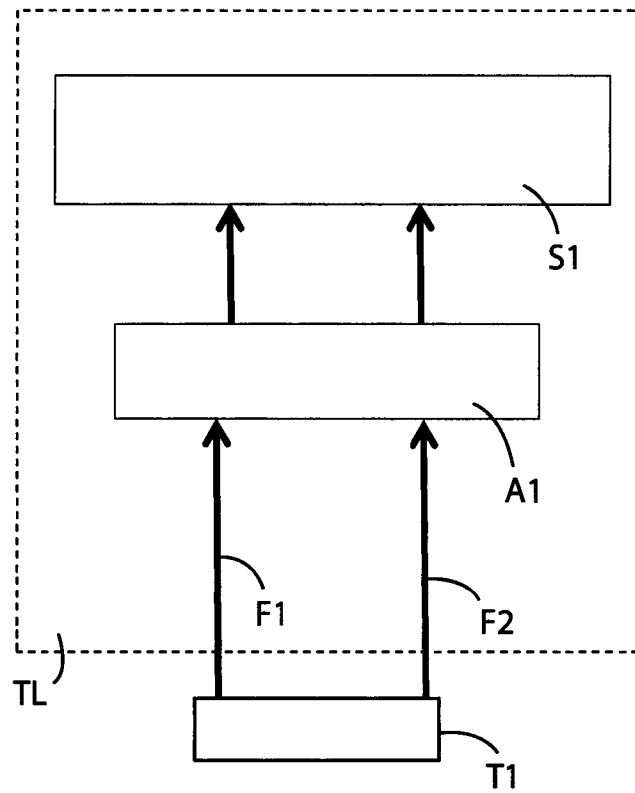


Fig. 5A

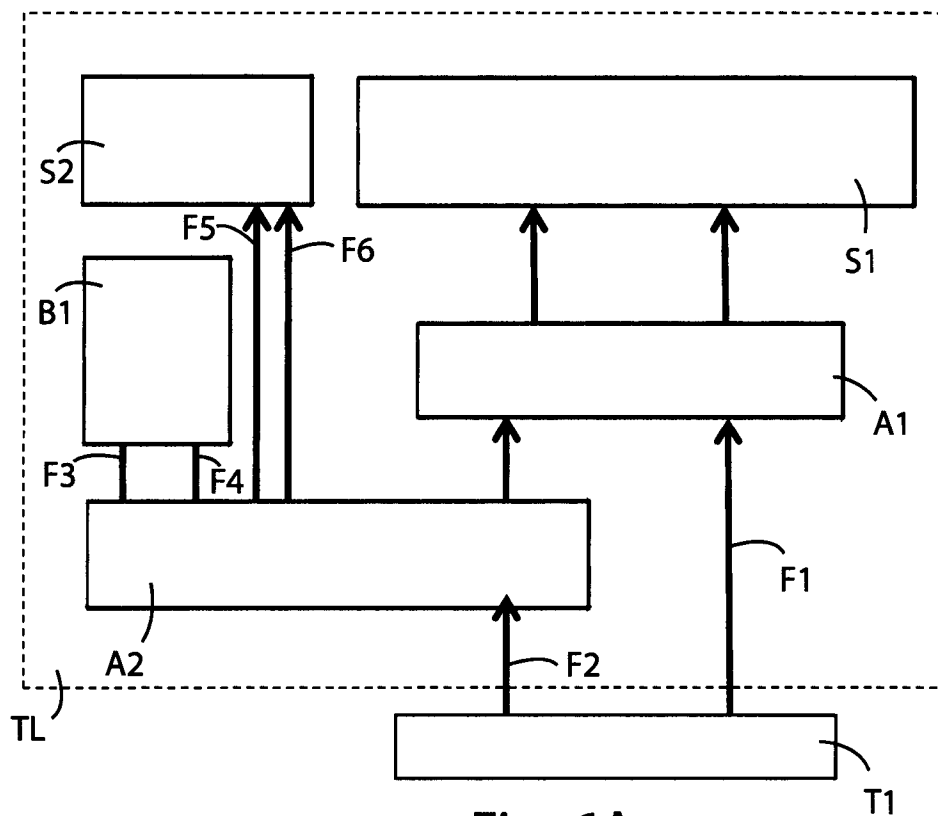


Fig. 6A

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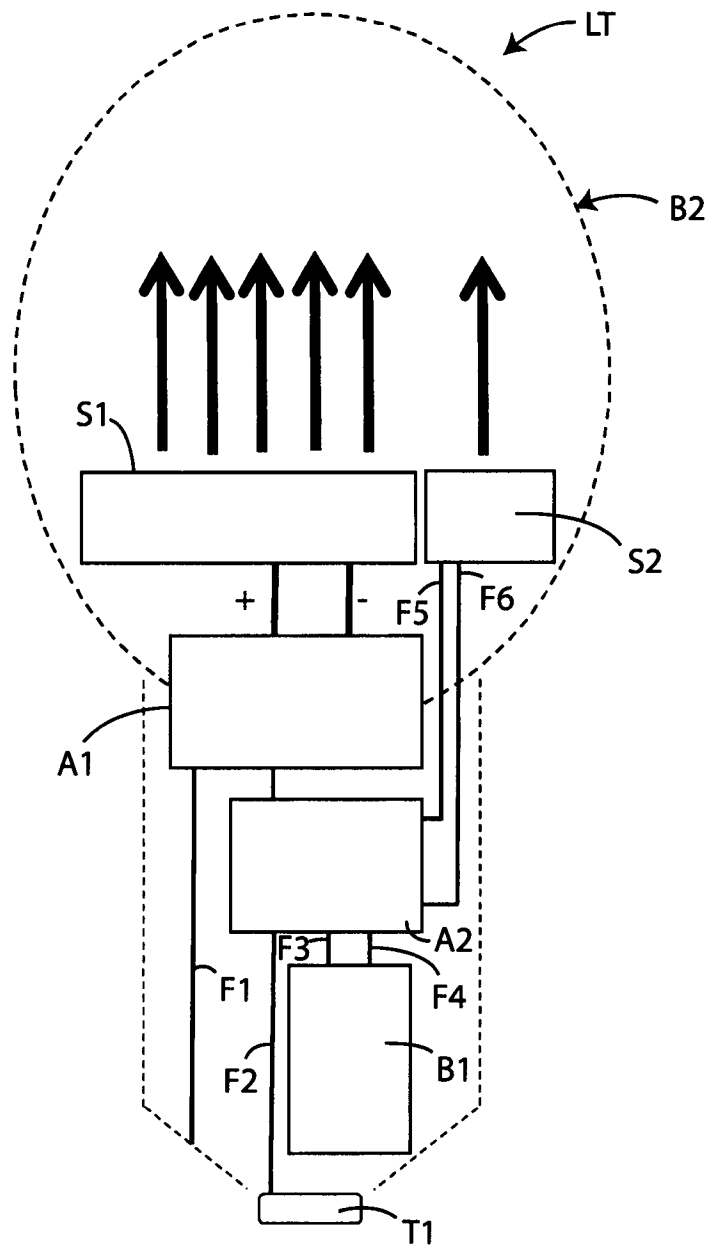


Fig. 6

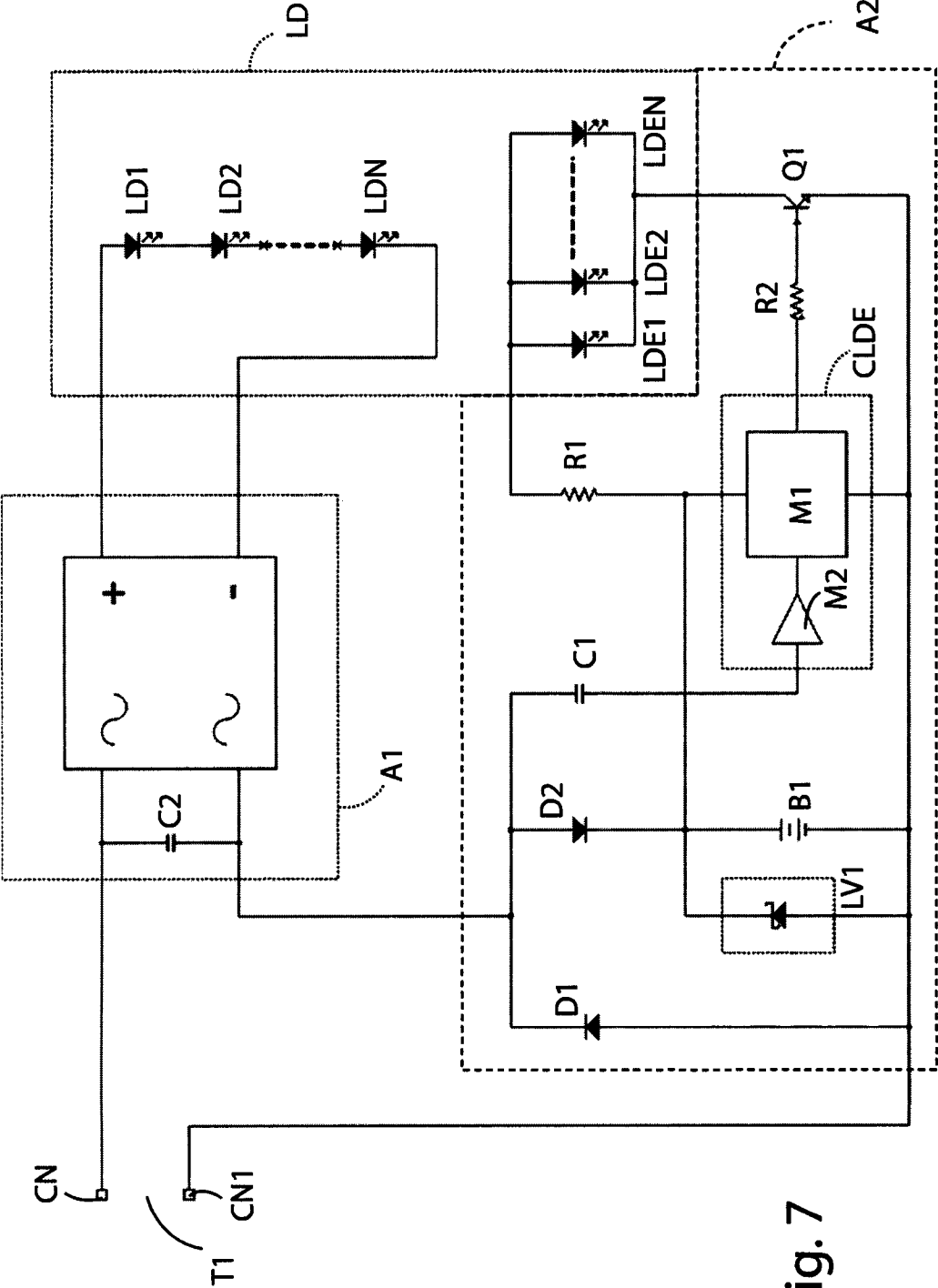


Fig. 7

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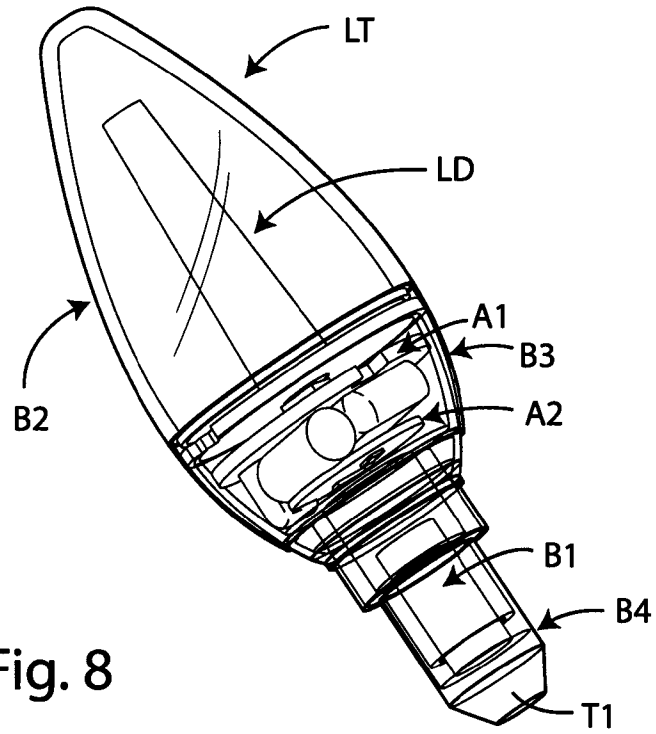


Fig. 8

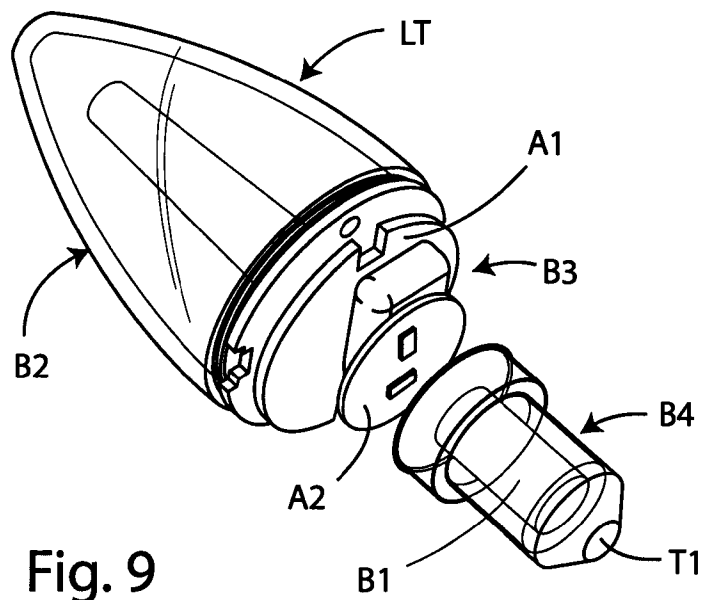


Fig. 9

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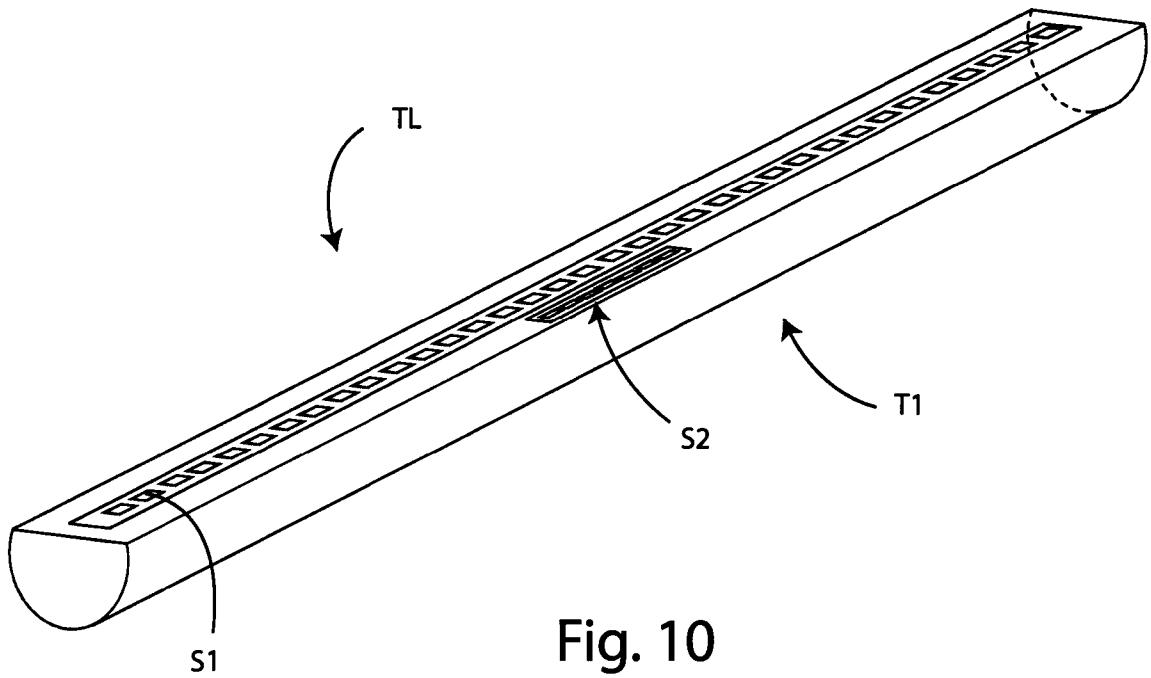


Fig. 10

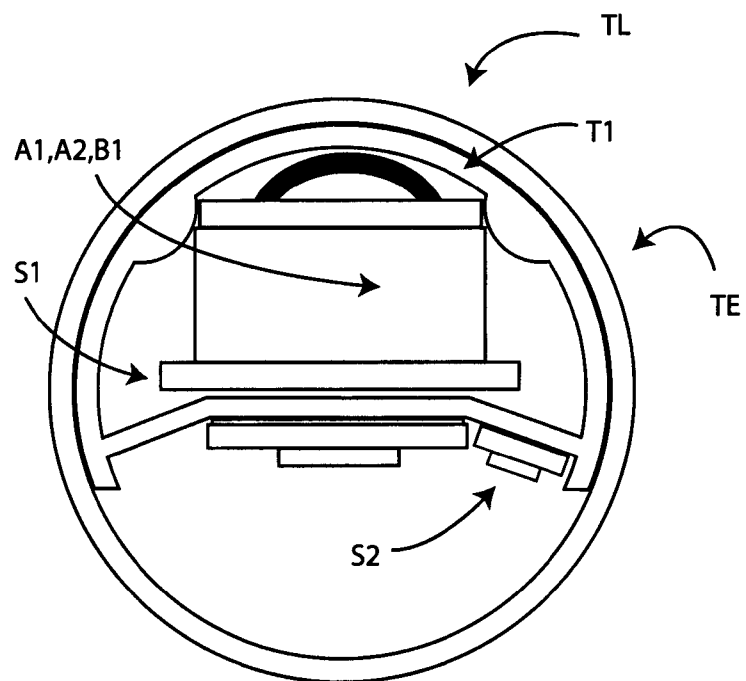


Fig. 11