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[54] **TRANSISTOR-CONTROLLED EMERGENCY EXIT UNIT**
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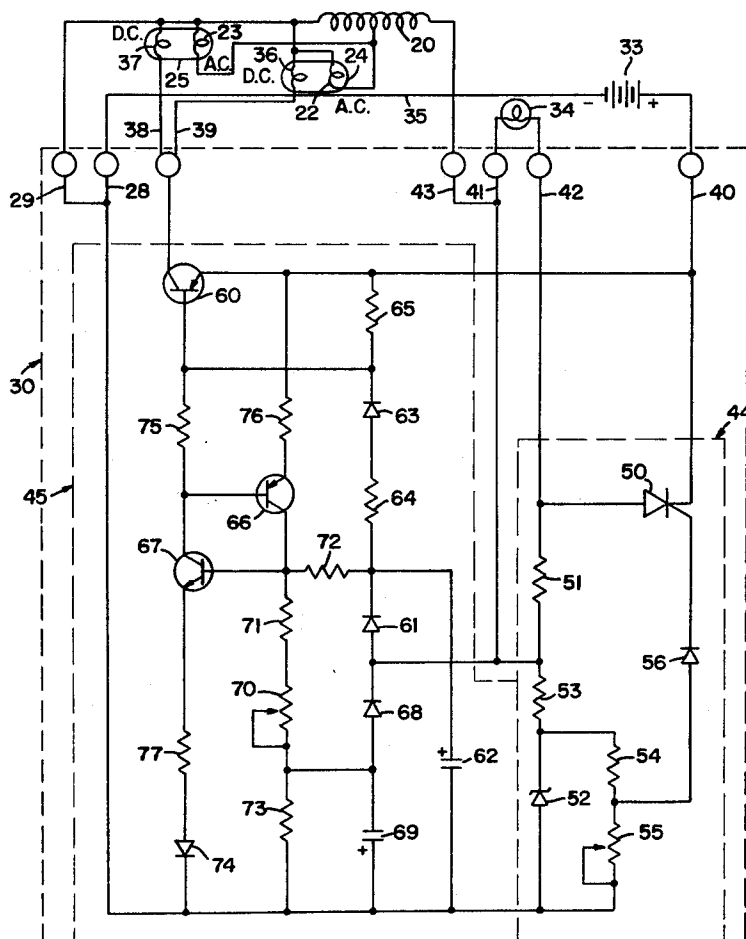
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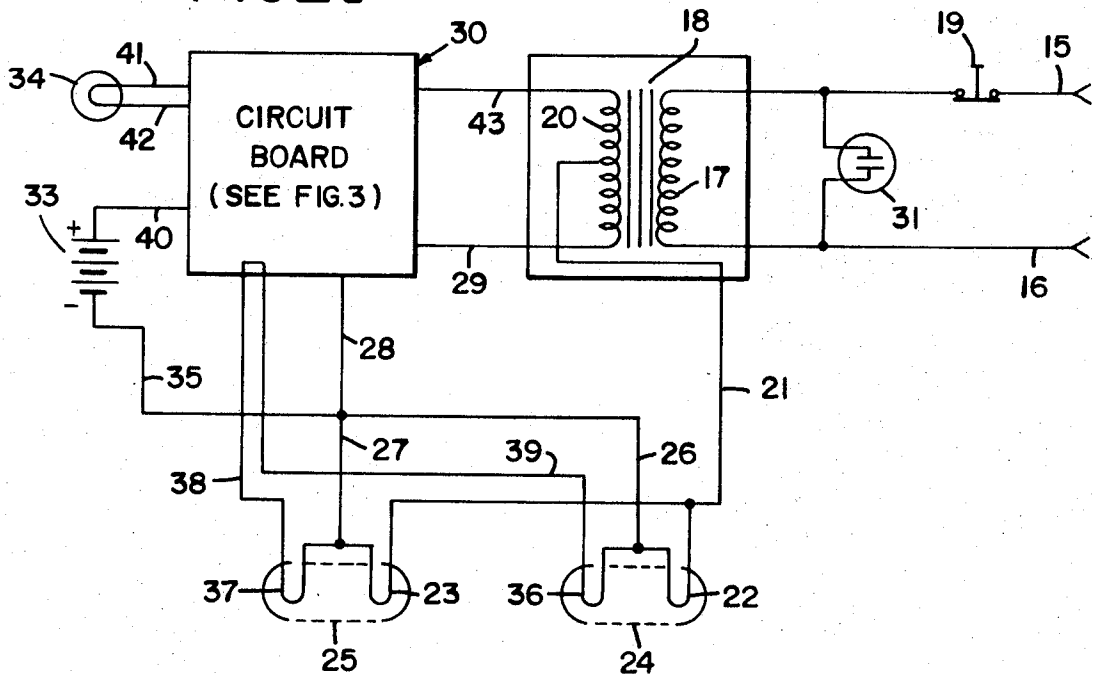
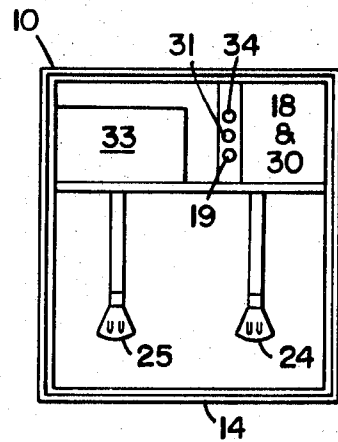
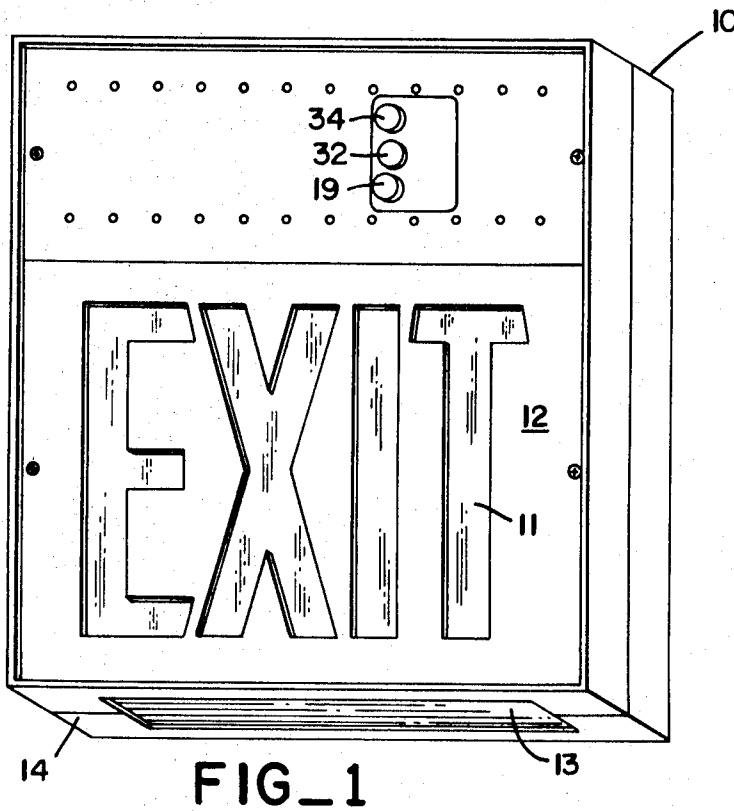
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ABSTRACT: A changeover device for an emergency exit unit having lamps with AC filaments normally operated by a main power supply and normally unenergized DC filaments for operation by a standby battery, which is normally kept charged by a charger circuit. A transistor circuit, when conductive, sends power from the battery to the DC filaments, but the circuit provides for reverse-biasing the base of the transistor while the main power supply is on. An electric charge is created and stored while the main power supply is on, and upon discharge sends bias voltage to the transistor to make it conductive. Self-holding means is energized by the same discharge through said transistor, for retaining the connection between the battery and the DC filaments, and the self-holding means is released when the voltage of the battery drops a predetermined amount below normal, thereby disconnecting the battery from said DC filaments and preventing further battery discharge.





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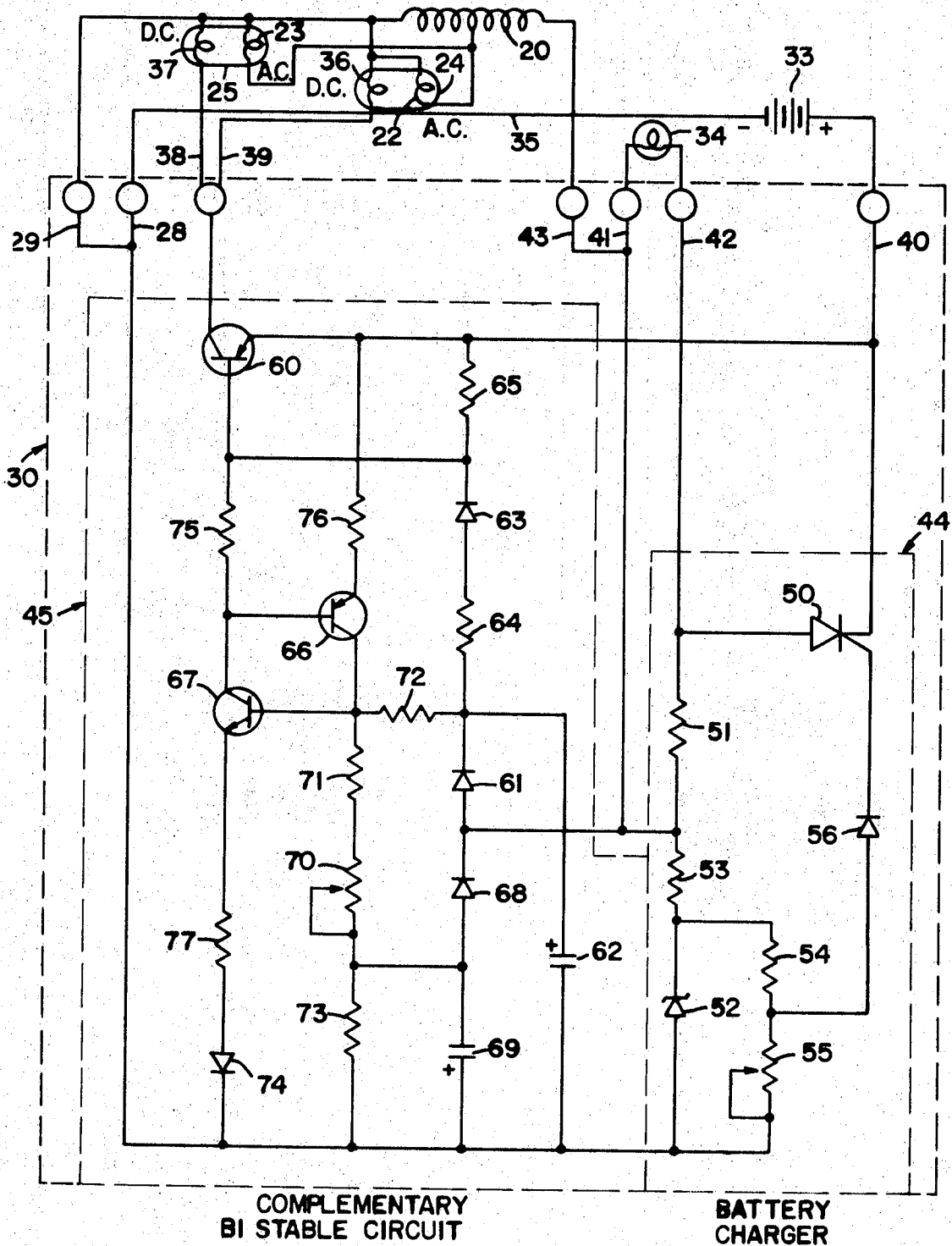


FIG_3

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TRANSISTOR-CONTROLLED EMERGENCY EXIT UNIT

This invention relates to emergency exit lights. More particularly, the invention relates to an improved emergency light or sign with a self-contained auxiliary power source for operating the light or sign when the normal power supply fails.

The exit lights required in theaters and auditoriums are normally lighted by the public power supply. However, some of the conditions which give rise to emergencies or are caused by them, cut off this power supply at the time when the lights are most needed. As a result, many governmental units have promulgated fire and safety regulations requiring that emergency lighting and signs, including exit signs, have auxiliary power available at all times to operate them in the absence of their conventional power supply. However, currently available auxiliary power sources have been bulky, have been expensive to install, and have been expensive to maintain in good working order. Many of the attempts to meet these requirements have proved either unsuccessful or so expensive that authorities have sometimes winked at their own regulations and have allowed people to get by with less than what the law requires. In other instances, a severe financial burden has been placed upon those complying with the requirements, and with none too satisfactory operation either.

The present invention is addressed to the solution of this problem by a compact and relatively low-cost device providing an inexpensive, easily maintained auxiliary power source with automatic switching from the normal power supply to the auxiliary power supply. An important feature of the invention is that the entire combination of exit sign, exit lights, and auxiliary power supply need be very little larger, if any, than standard exit signs having only the normal power supply. Another feature of the invention is that the device consumes an insignificant amount of power in keeping the auxiliary power supply in working order.

A very important feature is that the device automatically shuts itself off when it has been on long enough to begin substantial depletion of the battery; so that the battery can recover for reuse without being drained.

Other objects and advantages of the invention will become apparent from the following description of a preferred form thereof.

In the drawings:

FIG. 1 is a fragmentary view in perspective of an exit door having an exit unit embodying the principles of this invention mounted above the door and including both an exit sign and emergency lighting shining down on the floor, as well as the auxiliary power supply and switching circuits.

FIG. 2 is a simplified electrical circuit diagram for the sign of FIG. 1.

FIG. 3 is an electrical circuit diagram of the circuit board element of FIG. 2.

FIG. 4 is a view in elevation on a reduced scale of the unit of FIG. 1 with the front wall removed.

The invention comprises a housing 10, which may be made from cast aluminum, with a translucent exit panel 11 on at least one main wall 12 and a translucent panel 13 in a bottom wall 14 for down-lighting. The translucent exit panel may be replaced with other panels for emergency signs of other kinds or with translucent panels for illumination, and there may be minor modifications; for example, the sign or light may be either surface, pendant, or end mounted.

Under normal conditions the sign is lighted from house current coming in through lines 15 and 16, shown in FIG. 2, to the primary 17 of a transformer 18 inside the housing 10. A test switch 19 is provided in the line 15. From a secondary 20, a tapped lead 21 goes to AC filaments 22 and 23 of dual-filament lamps 24 and 25, returning through leads 26, 27, 28, and 29, via a circuit board 30, all inside the housing 10.

In parallel across the primary 17, is a power indicating light 31 which illuminates a dim panel 32 when the normal power supply is on. If the lights 24 and 25 go out and the light 31 is still on, the trouble is not with the power supply but with the internal circuit.

The auxiliary power supply is preferably a rechargeable battery 33, such as a nickel-cadmium battery, also inside the housing 10. Normally, the battery 33 is kept in standby conditions and is not used but is kept charged by a battery charging circuit, described below; a charge indicator 34 indicates when the battery 33 is being charged. No power is drawn from the battery 33 except when the main power supply fails or is cut off from the transformer 18; then a changeover circuit, described below, puts the battery 33 into the lamp circuit, via a lead 35 and leads 26 and 27, to light DC filaments 36 and 37 of the lamps 24 and 25, with return leads 38 and 39 going to the circuit board 31, which is connected to the battery 33 by a lead 40 (via a transfer transistor 60, as explained below) and to the charge indicator 32 by leads 41 and 42 (via a charging SCR 50, as explained below). A lead 43 goes from the circuit board 30 to the transformer secondary 20.

The circuit indicated by the schematic diagram of FIG. 2 and the wiring diagram of FIG. 3 performs three basic functions: namely, (1) battery charging, (2) transfer from AC power to battery power upon interruption of the AC line power, and (3) disconnecting the battery 33 when the battery voltage has discharged to a minimum recommended value, determined by battery life considerations. For these purposes, the circuit board 30 comprises a battery charger circuit 44 and a complementary bistable circuit 45. (See FIG. 3)

Battery charging current is provided to the charge circuit 44 from the full voltage of the transformer secondary 20 via a silicon controlled rectifier SCR 50, which is connected across the leads 40 and 42, and a current limiting resistor 51 connected to the lead 42 and the SCR 50. When the terminal voltage of the battery 33 is below the gate threshold voltage of the SCR 50, the SCR 50 conducts on each half-cycle of the transformer secondary voltage. The SCR gate voltage is determined by the voltage across a zener diode 52 as divided by resistors 53, 54, and 55. The resistor 53 serves as a source of current to the zener diode 52. A diode 56 protects the SCR gate from reverse voltages in excess of the SCR gate-cathode ratings. As the battery voltage builds up to the SCR gate-cathode threshold voltage, the SCR 50 ceases to conduct, and charging current is reduced to zero. Charge indication is provided by the lamp 34, which is connected across the current limiting resistor 51.

Turning now to the complementary bistable circuit 45, sign illumination is normally provided by the tapped transformer secondary voltage as supplied to the AC filaments 22 and 23 of the two lamps 24 and 25. Battery voltage is not impressed across the DC filaments 36 and 37 as long as a series PNP transistor 60, which is part of the circuit 45, is nonconducting. When AC power is present, a positive DC voltage is present at the base of the transistor 60, which is developed by half-wave rectification of the transformer secondary voltage via a rectifier 61. This rectified voltage is filtered by a capacitor 62 and applied to the base of the transistor 60 via a diode 63 and a resistor 64. A resistor 65 provides a path for collector-to-base leakage current of the transistor 60. The positive voltage present at the base of the transistor 60 is then higher than the battery voltage; thus, the base-emitter junction of the transistor 60 is reversed-biased, as is the base-emitter junction of a PNP transistor 66, and this insures that both of these PNP-type transistors are nonconducting when a AC power is present.

A third transistor 67 is at this time also rendered nonconducting by the negative base-emitter voltage developed by a rectifier diode 68 and a filter capacitor 69. This negative voltage across the capacitor 69 is divided down to the base of the transistor 67 via resistors 70, 71, and 72. These resistors 70, 71, and 72, in conjunction with a resistor 73, are chosen such that the resultant base voltage of the transistor 67 is negative in sign, even though a positive voltage source is present across the capacitor 62. A diode 74 protects the base-emitter junction of the transistor 67 against reverse voltages in excess of maximum ratings. A resistor 75 lies between the base of the transistor 66 and the base of the transistor 60, and between

the collector of the transistor 67 and the base of the transistor 60.

When the AC power is interrupted, as by power failure or by throwing the test switch 19, the positive DC voltage across the transistor 67 and the negative voltage across the capacitor 69 begin to decrease at a rate determined by the values of the capacitors and the resistors in the discharge paths. These time constants are chosen so that the negative voltage diminishes before the positive voltage. Presence of a positive voltage on the base of the transistor 67 causes the collector current to flow into the bases of both of the transistor 60 and 66. The transistors 66 and 67 comprise a complementary regenerative circuit providing a latching action which holds the transistor 66 on, thus providing base current to transistor 60 sufficient to saturate this transistor. With the transistor 60 saturated, a low-resistance path is provided from the battery 33 to the DC lamp filaments 36 and 37. The circuit has, thus, transferred battery power to the lamps when AC power is interrupted. When AC power returns, the reverse-bias conditions are again present, and the battery is disconnected from the lamps, while the AC lamp filaments are again lighted.

When the circuit is in the "on" state, the base current of the transistor 67 is provided from the battery 33, via a resistor 76 and the transistor 66. The transistor 66 is in saturation from base current provided by the transistor 67. The current from the battery 33 via the resistor 76 is divided at the base of the transistor 67 by the ratio of the values of a resistor 77 (in parallel with the total series resistance of the resistors 70, 71, and 73), to the resistor 76. When the battery voltage falls below a level where the base current into the transistor 67 is insufficient to maintain saturation of the transistor 67, its collector current begins to decrease, thereby reducing the base current into the transistor 66. When the base current into the transistor 66 is insufficient to hold the transistor 66 in saturation, the transistor 66 becomes less conductive, and the current from its collector decreases. The effect is regenerative and the transistors 66, 67, and 60 turn off, and the battery 33 is thereby disconnected from the lamp filaments 36 and 37. For a nickel-cadmium battery 33, the resistor 70 is adjusted so that this disconnect threshold is normally 87 percent of the normal battery terminal voltage, which is the level suggested by the manufacturer to accommodate maximum battery life.

Typical characteristics of the circuit of FIG. 3 are as follows:

Transistors:

60	PNP 2N 3613
66	PNP 2N 3638
67	PNP 2N 3569

Rectifiers:

56	A 14F
61	A14F
63	A 14F
68	A 14F
74	A 14F

SCR 50 2N 4441

Capacitors:

62	100 mf., 35 v.
69	50 mf., 25 v.

Resistors:

51	5 ohms
52	270 ohms
54	47 ohms
55	1000 ohms
64	2700 ohms
65	2200 ohms
70	100 ohms
71	270 ohms
72	1500 ohms
73	1500 ohms
75	27 ohms
76	27 ohms
77	220 ohms

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. The disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

We claim:

1. A changeover device for an emergency exit unit having lamps with AC filaments normally operated by a main power supply and normally unenergized DC filaments, and having a standby battery, including in combination:

transistor means, which, when conductive, sends power from said battery to said DC filaments;

bias means for reverse-biasing the base of said transistor means while said main power supply is on, to render it nonconducting;

charge means for creating and storing an electric charge while said main power supply is on, said charge means upon discharge sending bias voltage to said transistor means to make it conductive;

self-holding means energized by discharge of said charge means through said transistor means for retaining said connection between the battery and said DC filaments; and

release means for releasing said self-holding means when the voltage of said battery drops a predetermined amount below normal, thereby disconnecting said battery from said DC filaments and preventing further battery discharge.

2. The device of claim 1 having battery-charging means connected to said battery and to said main power supply for keeping said battery charged while said main power supply is operative.

3. The device of claim 2 wherein said battery-charging means includes a silicon-controlled rectifier SCR in series with and between said battery and said main power supply and having a gate bias provided across a zener diode and resistance means.

4. The device of claim 3 wherein a diode protects the SCR gate from reverse voltages in excess of the SCR gate-cathode threshold voltage.

5. The device of claim 1 wherein said transistor means comprises a main transistor and said self-holding means comprises a pair of transistors comprising a complementary regenerative circuit with latching action for said main transistor to provide base current to said main transistor sufficient to saturate said main transistor when said main power supply is off and thereby to provide a low-resistance path from said battery to said DC filaments.

6. The device of claim 1 having release means for releasing said self-holding means when the voltage of said battery drops a predetermined amount below the normal voltage of said battery, thereby disconnecting said battery from said DC filaments and preventing further battery discharge.

7. A changeover device for an emergency exit unit having lamps with AC filaments normally operated by a main power supply and normally unenergized DC filaments, and having a standby battery, including in combination:

a battery charger for said battery for retaining the strength of said battery when the main power supply is on, and a complementary bistable circuit comprising;

a transistor for sending power from said battery to said DC filaments when its base is forwardly biased;

reverse-bias means connected to the base of said transistor while said main power supply is on to render said transistor nonconductive;

capacitor means for creating and storing an electric charge while said main power supply is on, said capacitor means upon discharge sending forward bias voltage to said transistor to make it conductive;

self-holding means energized by discharge of said capacitor means through said transistor for retaining the connection between the battery and said DC filaments; and

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release means for releasing said self-holding means when the voltage of said battery drops a predetermined amount below normal, thereby disconnecting said battery from said DC filaments and preventing further battery discharge.

8. The device of claim 7 wherein said self-holding means comprises a pair of additional transistors comprising a complementary regenerative circuit to provide base current to the aforesaid transistor sufficient to saturate it and thereby latch it on when said main power supply is off.

9. An automatic changeover device for a unit normally operated by a main AC power supply and having a standby battery, including in combination:

transistor means, which, when conductive, sends power from said battery to said unit;

bias means for reverse-biasing the base of said transistor means while said main power supply is on, to render it nonconducting;

charge means for creating and storing an electric charge while said main power supply is on, said charge means upon discharge sending bias voltage to said transistor means to make it conductive;

self-holding means energized by discharge of said charge means through said transistor means for retaining said connection between the battery and said unit; and

release means for releasing said self-holding means when the voltage of said battery drops a predetermined amount below normal, thereby disconnecting said battery from said unit and preventing further battery discharge.

10. The device of claim 9 having battery-charging means connected to said battery and to said main power supply for keeping said battery charged while main power supply is operative.

11. The device of claim 10 wherein said battery-charging means includes a silicon-controlled rectifier SCR in series with and between said battery and said main power supply and having a gate bias provided across a zener diode and resistance means.

12. The device of claim 11 wherein a diode protects the SCR gate from reverse voltages in excess of the SCR gate-cathode threshold voltage.

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13. The device of claim 9 wherein said transistor means comprises a main transistor and said self-holding means comprises a pair of transistors comprising a complementary regenerative circuit with latching action for said main transistor to provide base current to said main transistor sufficient to saturate said main transistor when said main power supply is off and thereby to provide a low-resistance path from said battery to said unit.

14. The device of claim 9 having release means for releasing said self-holding means when the voltage of said battery drops a predetermined amount below the normal voltage of said battery, thereby disconnecting said battery from said unit and preventing further battery discharge.

15. A changeover device for a unit normally operated by a main AC power supply having a standby battery, including in combination:

a battery charger for said battery for retaining the strength of said battery when the main power supply is on, and a complementary bistable circuit comprising;

a transistor for sending power from said battery to said unit when its base is forwardly biased;

reverse-bias means connected to the base of said transistor while said main power supply is on to render said transistor nonconductive;

capacitor means for creating and storing an electric charge while said main power supply is on, said capacitor means upon discharge sending forward bias voltage to said transistor to make it conductive;

self-holding means energized by discharge of said capacitor means through said transistor for retaining the connection between the battery and said unit; and

release means for releasing said self-holding means when the voltage of said battery drops a predetermined amount below normal, thereby disconnecting said battery from said unit, and preventing further battery discharge.

16. The device of claim 15 wherein said self-holding means comprises a pair of additional transistors comprising a complementary regenerative circuit to provide base current to the aforesaid transistor sufficient to saturate it and thereby latch it on when said main power supply is off.

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