Exit Light and Emergency Light Which Have Function to Indicate Residual Charge of Battery

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1. Background

An exit light and an emergency light are escape apparatuses which last for 60 minutes when a building experiences a fire and a power outage. A storage battery is generally used as an energy source of the escape apparatus to sustain for a certain period of time. When the storage battery is aged and out, the exit light and the emergency light cannot perform for a certain period of time. Therefore, how well the storage battery is charged is important for the operation of the escape apparatus.

2. Introduction

Conventionally, it was necessary to turn off the general exit light and emergency light for a certain period of time to check the residual charge of battery thereof. However, it requires quite a long time to check batteries of many exit lights and emergency lights, and the availability of the lights for operation is hardly evaluated after the check. To solve the problems, users do not turn off the exit light and emergency light but operate a check switch to determine the state of the exit light and emergency light. However, even if the check switch indicates no sign of malfunction sign, it does not guarantee that exit light and emergency light will maintain for a certain period of time. During operation, the check switch of the exit light and emergency light indicates through a green LED the state of the utilized power supply, and charged or discharged state through a red LED, but the check switch does not indicate the residual charge of the battery. Manufacturers can check the abnormality of the general exit light and emergency light, but users cannot check the residual charge of the battery.

3. Methods

As illustrated in FIG. 1, the exit light and the emergency light with a function that displays the residual charge of a storage battery includes a power input unit, a rectifier circuit, a power supply unit, a light emitting unit, a charging circuit, a storage battery, a bar graph indicating unit, a check switch and an emergency power control unit .

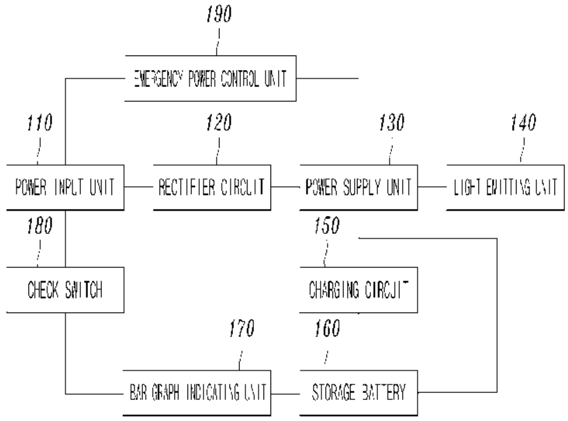

Fig. 1. Block Diagram

The power input unit receives an outside utilized power, applies the utilized power to a transformer to decrease voltage, and applies the voltage to the rectifier circuit. The rectifier circuit transforms AC power applied from the power input unit into DC power and applies the DC power to the power supply unit. The power supply unit applies DC power applied from the rectifier circuit to the light emitting unit or the charging circuit. The light emitting unit emits light using the DC power applied from the power supply unit. The light emitting unit may use a light emitting device such as LED to emit and light up a place where an exit light or an emergency light is installed, but a light emitting device of the light emitting unit according to an embodiment is not limited to the above specific example only. The storage battery regulates the DC power applied from the power supply unit suitable enough for charging the storage battery and supplies the DC power to the storage battery to charge the storage battery. The charging circuit includes a first light emitting diode (not illustrated). The light emitting diode may indicate presence of abnormality of the storage battery by lighting the first light emitting diode if the storage battery is not charged or the charging circuit and the storage battery are not electrically connected to each other. The charging circuit may additionally include a second light emitting diode (not illustrated), and indicate the input state of the utilized power by lighting the second light emitting diode using the DC power applied from the power supply unit.

The storage battery is charged with the DC power applied from the charging circuit, but this should not be construed as limiting the kinds of the storage batteries. The bar graph indicating unit indicates the residual charge of the storage battery. The bar graph indicating unit may include variable resistance (not illustrated) formed therein to indicate the residual charge of the storage battery by controlling so that a decrease in the discharge voltage of the storage battery and decrease of bar graph are proportional to each other. The bar graph indicating unit operates only when the check switch operates, to indicate the residual charge of the storage battery. The bar graph indicating unit does not operate when the utilized power is not supplied. Therefore, the bar graph indicating device does not decrease the operating time even in the case of a blackout. When a user switches on the check switch to 180, the check switch cuts off the utilized power, and discharges the voltage of the storage battery to the bar graph indicating unit so as to indicate the residual charge of the storage battery on the bar graph indicating unit.

FIG. 2 is a flowchart provided to explain a method for estimating the residual lifespan of a storage battery according to an embodiment. At step 1, the electric parameter of a battery is estimated, and the estimated electric parameter includes voltage (V_b), reference voltage (V_{ref}), electric current (i_b) of a battery. Step 2 computes estimated residual charge of the battery using the electric parameter measured at step 1.

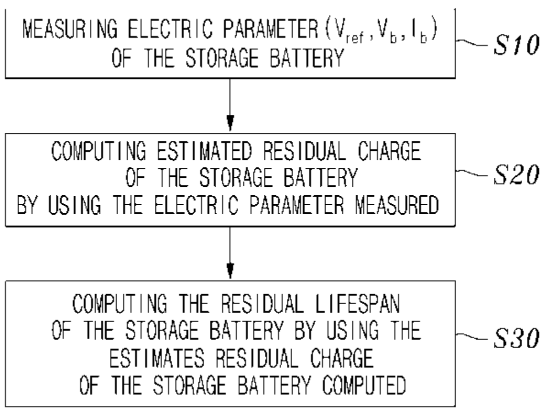

Fig. 2. Flowchart

At Step 2, the estimated residual charge of the battery is computed with mathematical formula 1 and mathematical formula 2 below. The mathematical formula 1 below computes the estimated residual charge of the battery by measuring a rate of the voltage and average current changes of the storage battery.

$$RC = SC*(soc + C*(1-soc) + \frac{v_b^2 - v_{ref}^2}{K_{soc}*i_b^2})$$

$$soc = \frac{SC - \sum_{k=0}^{t} i_k}{SC}$$

wherein 'RC' is residual charge of a storage battery, 'SC' is a standard capacity of the storage battery obtained within a standard sampling time, 'soc' is therate of residual charge obtained by subtracting the sum of electric currents obtained until the measurement point of discharge, from the standard capacity of the storage battery obtained within the standard sampling time, 'V_b' is a voltage of the battery, 'V_{ref}' is a reference voltage of the battery, 'i_b' is the average value of electric current of the battery obtained for one minute, and 'C' and 'K_{soc}' are non-linear characteristic constant. At step 3, the residual lifespan of the storage battery is computed using the estimated residual charge of the battery obtained at step 2, and by computing the characteristic of decrease of the residual charge of the battery. The characteristic of decrease of residual charge of the battery may be computed by the mathematical formula 3 below.

$$\Delta RC_n = (RC_{n-2} - RC_{n-1})*\exp^{-\beta} = (1-\exp^{-\beta})*RC_{n-1} - RC_{n-2}$$

Wherein 'β' is discharging characteristic constant of the battery. The mathematical formula 3 represents decreasing pattern of residual charge of the storage battery in consideration of the characteristic of the residual charge based on the estimated residual charge of the storage battery, as a result of conducting two or more sampling.

REFERENCES

1. Korean Patent Application No. 10-2010-0021274