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Seiter et al.

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[54] **EMERGENCY LIGHT UNIT FOR MOUNTING TO AN ELECTRICAL WALL OUTLET**

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[73] Assignee: **said Christensen, by said Seiter**

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[52] **U.S. Cl.** ..... **315/86,** 174/56, 240/2 SP, 240/10.6 CH, 240/37.1, 307/66, 315/156, 320/9

[51] **Int. Cl.** **H05b 37/04**

[58] **Field of Search** ..... 315/86, 87, 149–159; 320/9, 10; 340/333; 307/66; 240/2 S, 2 SP, 10.6, 10.6 CH, 37.1; 174/53, 54, 55, 56

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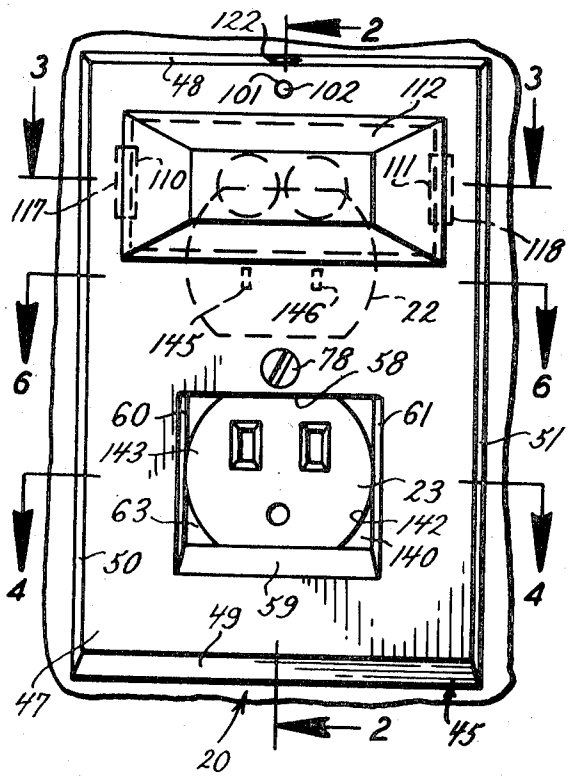
[57] **ABSTRACT**

This invention relates to an emergency light unit of a size for plugging into a standard electrical wall outlet. The unit is self-contained and includes means for energizing the light when the main electrical power fails and the ambient light in the area in which it is mounted is below a prescribed level. The light is powered during emergency conditions from rechargeable batteries which are continuously and automatically charged when the main power is operational. All of the components of the unit, including the batteries, are mounted in a casing of unitary construction at the front of which are exposed light bulbs for supplying the emergency light, the light-sensitive surface of a photocell for sensing the ambient light level in the area, and an electrical utility outlet. Means accessible from the front of the unit are also provided for testing its operability. The unit is plugged into a standard electrical wall outlet with the cover plate removed and is secured in the same manner as a conventional cover plate.

12 Claims, 9 Drawing Figures



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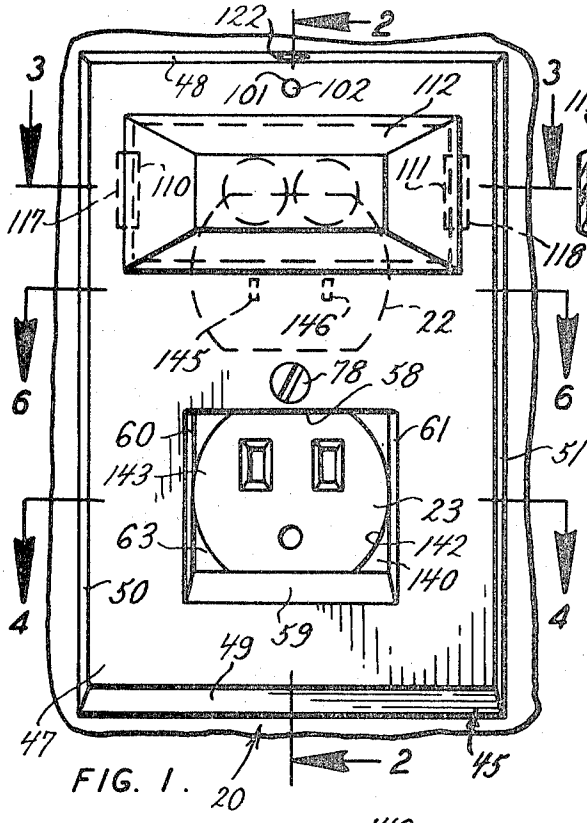

FIG. 1.

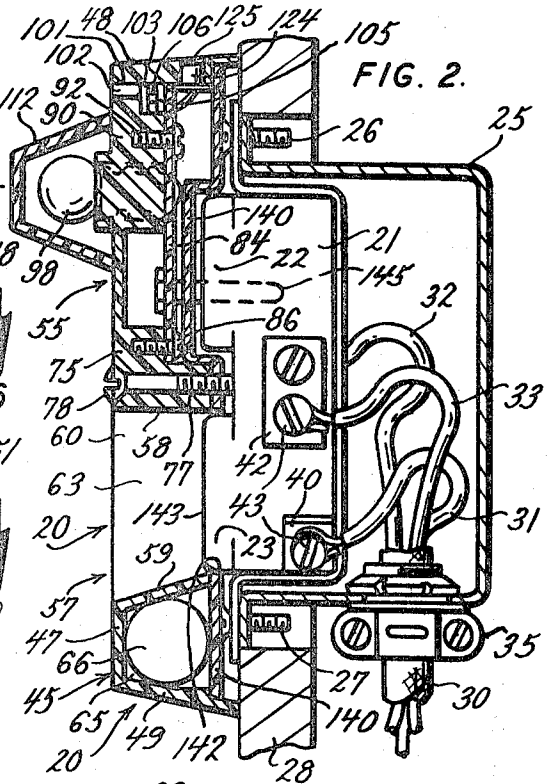

FIG. 2.

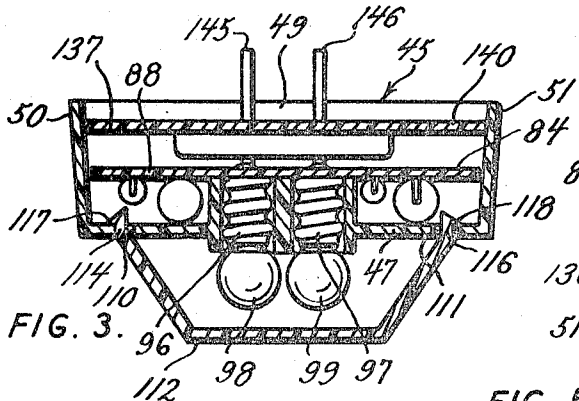

FIG. 3.

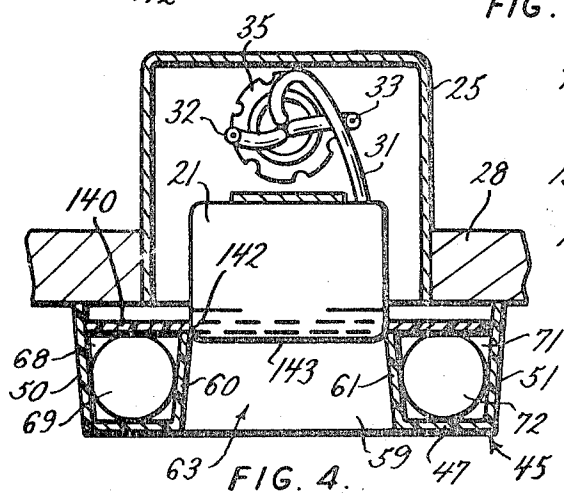

FIG. 4.

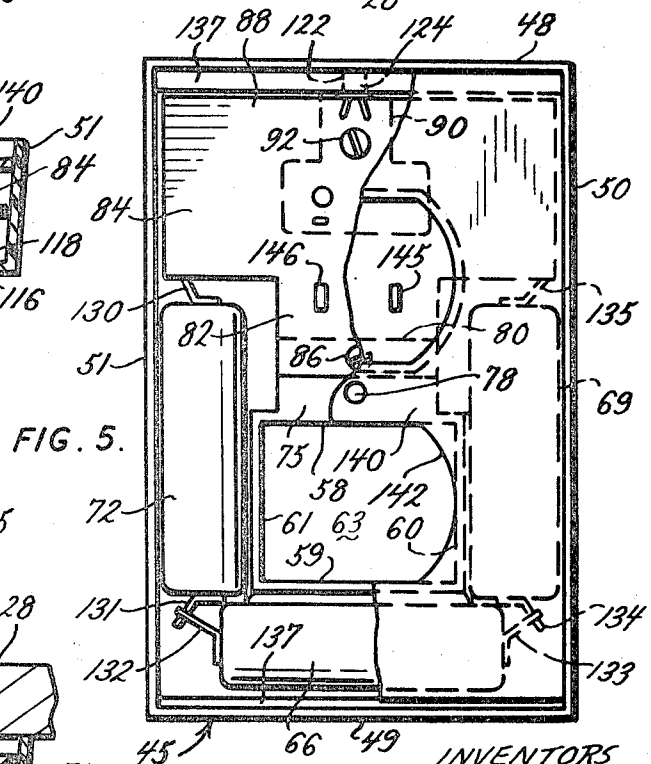

FIG. 5.

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FIG. 7.

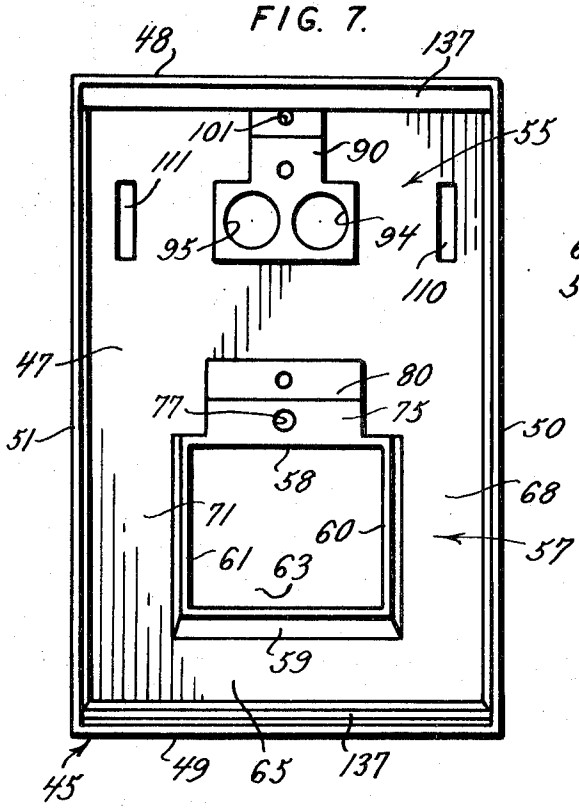


FIG. 6.

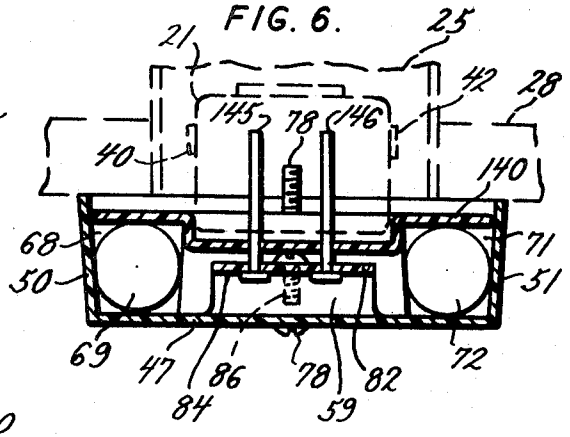


FIG. 8.

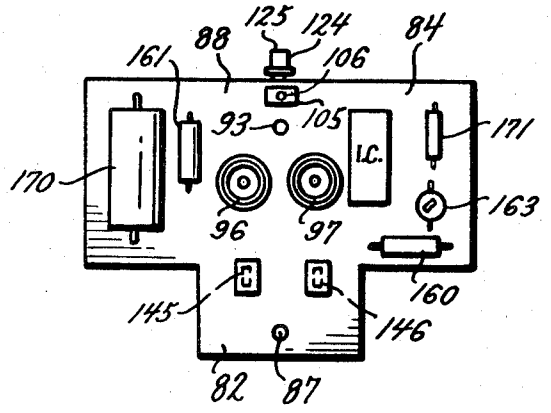
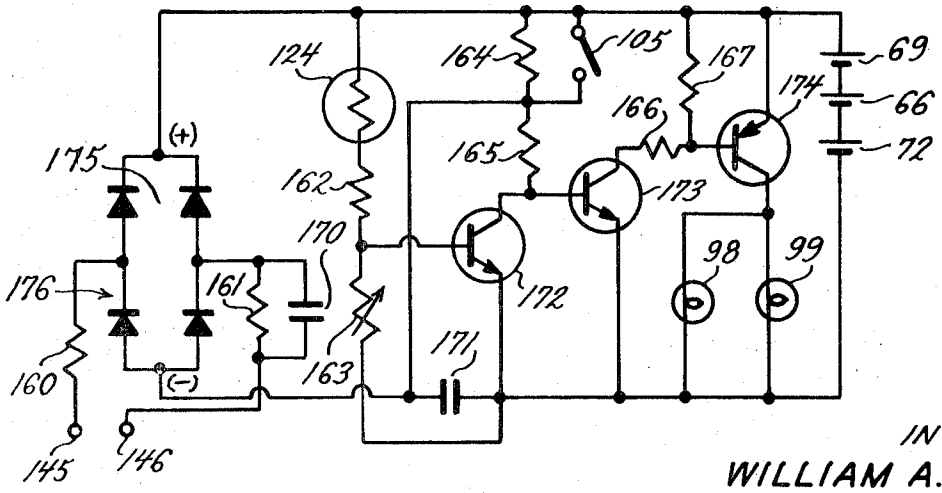


FIG. 9.



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EMERGENCY LIGHT UNIT FOR MOUNTING TO AN ELECTRICAL WALL OUTLET

BACKGROUND OF THE INVENTION

Various types of emergency light devices have been developed for supplying light to an area, such as the room of a building, when the building's main power fails. Such devices may also include means for energizing the light only when the light in the room is below a prescribed level, and for automatically recharging emergency power batteries when the main power is on. Examples of these are found in U.S. Pat. Nos. 3,159,755; 3,294,977; and 3,486,068. Such devices, however, are relatively large, requiring sophisticated installation for mounting in the wall or ceiling of a room, and even where mounted externally on the wall or ceiling, requiring special wiring. Hence, the prior art devices are not readily adaptable for installation in buildings initially unequipped for their use.

It is therefore desirable to provide an automatic device for supplying emergency light to the room in which it is installed during a main power failure, and which is relatively low in cost, attractive, and easy to install even in buildings initially unequipped for its use. This invention is such a device.

SUMMARY OF THE INVENTION

The emergency light unit of this invention is a completely self-contained unit which is made to mount to a standard electrical wall outlet. The front of the unit is a combination face plate and casing for holding a lamp which provides the emergency light, the light-sensitive end of a photocell for sensing the ambient light level in the room, and a test switch actuating rod used for testing the operability of the unit. An opening in the unit provides access to one of the outlet receptacles for conventional use. The dimensions of the unit are approximately those of a standard wall switch or wall receptacle cover plate although thicker to house emergency power batteries and other electrical and mechanical components of the unit.

For electrical connection and mounting to an electrical wall outlet only the wall face plate need be removed and the unit substituted therefor. Hence, even in buildings not designed for emergency light units, the unit of this invention can be easily installed, and without complete loss of the outlet.

Electrical circuit means are contained in the casing for automatically sensing a main power failure and the ambient light in the room, and for energizing the emergency light when the main power fails and the ambient light is below a prescribed level. Means are also provided for testing the unit's operability, and, except during periods of power failure, automatically recharging its emergency power batteries from the main electrical power. The unit includes novel structural and circuit design features which provide exceptional long, trouble free, reliable operation.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view at approximately full scale of the emergency light unit of this invention;

FIG. 2 is a view in section taken along the line 2—2 of FIG. 1 including the major internal components of the unit;

FIG. 3 is a view in section taken along the line 3—3 of FIG. 1 including the major internal components of the unit;

FIG. 4 is a view in section taken along the line 4—4 of FIG. 1 including the major internal components of the unit;

FIG. 5 is a rear elevational view of the unit with part of the back cover plate broken away;

FIG. 6 is a view in section taken along the line 6—6 of FIG. 1 including the major internal components of the unit.

FIG. 7 is a rear elevational view of the unit casing with the back cover plate and components removed.

FIG. 8 is a front elevational view of the circuit board used in the unit of this invention; and

FIG. 9 is a schematic drawing of the circuit of this invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

There is shown in the drawing the emergency light unit 20 of this invention plugged into a standard electrical wall outlet 21 having an upper receptacle 22 and a lower receptacle 23. The outlet 21 is mounted in a standard electrical wall box 25 by means of mounting screws 26 and 27. The electrical box 25 in turn is shown mounted in a wall 28, which could be a wall in any room in which the unit 20 is to be mounted. The electrical outlet 21 and box 25 are of types commonly known in the art for providing an electrical wall terminal, and are of sizes very nearly to that shown in the drawings (approximately 4½ inches long, 3 inches wide, and 1 inch deep). In fact, with the exception of FIG. 9 each of the figures is drawn to approximately full scale to better illustrate the actual sizes of the components involved. It is one of the primary novel features of this invention that the emergency light unit 20 is of a size small enough to be directly connected to a standard electrical wall outlet in place of the face plate, greatly facilitating installation of the unit.

A suitable power cable 30 including a ground lead 31 and conductors 32 and 33 extends through an appropriate electrical cable connector 35 mounted in an aperture in the box 25 with the electrical leads 31, 32, and 33 connected to terminals 40, 41, and 42, respectively, of the outlet 21 by means of terminal screws 43. The power transmitted through the cable 30 is 110 volt AC, 60 cycle, with a safety ground connection.

The emergency light unit 20 of this invention generally includes a unitary casing 45 having a front wall 47, a top wall 48, a bottom wall 49, and side walls 50 and 51. The casing 45 can be thought of as having an upper portion 55 in which light bulbs and certain other electrical components are mounted as will be described, and a lower portion 57 having inner walls 58, 59, 60, and 61 defining an opening 63 for access to the lower receptacle 23. The inner wall 59, front wall 47, and bottom outer wall 49 further define a cavity portion 65 for housing a battery 66; the inside wall 60, front wall 47, and outer side wall 50 define a cavity portion 68 for housing a battery 69; and the inner wall 61, front wall 47, and outer side wall 51 define a cavity portion 71 for housing a battery 72.

The front wall 47 of the casing 45 is substantially thicker in the center as at 75 just above the opening 63. Directly in the center of the casing and through the thickened portion 75 is a bore 77 for receiving a screw

78 for mounting the unit 20 to the electrical outlet 21. The thickened portion 75 is formed in a ledge 80 just above the bore 77 on which is mounted one end 82 of a circuit board 84 by means of a mounting screw 86 extending through an aperture 87 in the board 84 and into the thickened portion 75. The circuit board 84, as shown in FIG. 8, has mounted thereon the electrical circuit components of this invention.

The other end 88 of the circuit board 84 is mounted to another thick front wall portion 90 centrally located near the top of the unit 20 by means of a mounting screw 92 extending through an aperture 93 in the board 84 and into the thickened portion 90. The upper thickened portion 90 has two relatively large apertures 94 and 95 into which the ends of a pair of bulb sockets 96 and 97, respectively, extend, the other ends of the bulbs sockets 96 and 97 being mounted both physically and electrically to the circuit board 84 in accordance with the electrical circuit to be described. Light bulbs 98 and 99 of the appropriate sizes shown in FIG. 3 and having voltage ratings of approximately 3.6 volts, are mounted in the sockets 96 and 97, respectively.

As best shown in FIG. 2 the casing directly above the apertures 94 and 95 is formed to define a cylindrical housing 101 extending parallel to the apertures 94 and 95 toward the circuit board 84 and in which a rod 102 is mounted, the rod having a head portion 103 which acts to limit the forward movement of the rod. A test switch 105, for testing the operability of the emergency unit, is mounted at the top of the circuit board 84 as best shown in FIG. 2, with its spring biased push-type actuating arm 106 extending forward of the circuit board 84 and into contact with the head portion 103 of the rod 102. The switch 105 is of a type that, when the rod 102 is pushed rearwardly with an appropriate instrument, the actuator arm 106 is pushed against its spring bias to close the switch. Preferably, the switch contacts are gold plated for long wear.

Symmetrically on either side of the apertures 94 and 95 in which the bulb sockets 96 and 97 are mounted, are parallel elongated vertical slots 110 and 111. A dome cover 112, shaped as shown in FIGS. 1, 2, and 3, has rearwardly extending snap arms 114 and 116 which fit into the slots 110 and 111, respectively, for mounting the dome over the bulbs 98 and 99. The snap arms 114 and 116 have shoulders 117 and 118 which engage the inside surface of the casing as best shown in FIG. 3 to hold the dome in position. The dome may be either clear or translucent to diffuse the light from the bulbs 98 and 99.

Centrally located in the top wall 48 of the casing 45 is an aperture 122. A photocell 124 is mounted in the aperture 122 with its light-sensitive surface 125 exposed to the ambient light surrounding the unit. The back end of the photocell 124 is electrically and mechanically connected to the circuit board 84. Its purpose is to measure the ambient light in the room in which the emergency light unit is mounted to insure that the bulbs 98 and 99 light only when the ambient light level is below a prescribed value as will be described in more detail in connection with the circuit of FIG. 9.

The batteries 66, 69, and 72 are rechargeable and are preferably of the nickel-cadmium type. They are mounted between suitable battery terminals 130, 131, 132, 133, 134, and 135, the terminals 130 and 135 being electrically and mechanically connected to the circuit board 84. As will be explained in describing the circuit of FIG. 9, the batteries power the lights 98 and 99 when there is main power failure and the ambient room light is below a prescribed level as sensed by the photocell 124, and are charging whenever the main power is on.

The rear of the casing 45 is formed in an inwardly extending ledge 137 at the top and bottom of the casing on which is mounted a backplate 140 which encloses the back of the casing 45 and which has an opening 142 through which the front portion 143 of the lower receptacle 23 protrudes.

A pair of plug terminals 145 and 146 are electrically and mechanically attached to the circuit board 84 and extend through the back plate 140. The plug terminals 145 and 146 plug into the upper receptacle 22 of the outlet 21 to supply main power for charging the batteries 66, 69, and 72. Other than the batteries the electrical components, as represented on the circuit board 82 of FIG. 8 and shown schematically in FIG. 9, are mounted in front of the circuit board 84 in the areas around the bulb sockets 94 and 95.

INSTALLATION OF THE UNIT

The emergency light unit 20 is installed by removing the cover plate of any standard electrical wall outlet in an area where the unit is to be used. With the cover plate removed, the plug terminals 145 and 146 are plugged into the upper receptacle 22 such that access can be had to the lower receptacle 23 through the opening 63 formed by the unit casing, thereby supplying main power to the unit. The receptacle 23 is used as a spare receptacle as desired. The unit is held firmly in this position by the mounting screw 78 which screws into the same hole in the outlet 21 as the screw for holding the cover plate. The unit is now operational.

ELECTRICAL OPERATION OF THE EMERGENCY UNIT

Referring to the schematic of FIG. 9, the electrical operation of the emergency unit 20 of this invention will be explained. There is shown schematically the terminals 145 and 146 which plug into the upper electrical receptacle 22 of the outlet 21. Power is supplied to the outlet 21 through the cable 30 and conductors 31, 32, and 33 from the main power of the building. Hence, whenever power is delivered through the cable 30, the receptacles 22 and 23 are operational for use in supplying electrical power as an ordinary wall outlet. The other electrical components of the unit 20 are connected as shown schematically in FIG. 9, and consist of resistors 160, 161, 162, variable resistor 163, and resistors 164, 165, 166, and 167, capacitors 170 and 171, transistors 172, 173, and 174, the switch 105, the photocell 124, the lamps 98 and 99, the batteries 66, 69, and 72, and a diode bridge 175.

The resistors 160 and 161, capacitor 170, and diode bridge 175 are connected as shown to form a fullwave rectifier circuit 176 for converting the main AC power to charging power for the batteries 66, 69, and 72. Basically, the unit of this invention is designed to provide emergency light for the room in which it is mounted only when the main power to the room fails and the ambient light in the room is below a prescribed level, and to charge the batteries 66, 69, and 72, which supply emergency power for the lights, whenever the main power is on. Furthermore, the unit includes means for

testing its operability. Therefore, the device actually has five modes of operation as follows:

Mode 1 — Ambient light above the prescribed level, power on, lights off;

Mode 2 — Ambient light above the prescribed level, power off, lights off;

Mode 3 — Ambient light below the prescribed level, power on, lights off;

Mode 4 — Ambient light below the prescribed level, power off, lights on; and

Mode 5 — Test mode.

MODE 1 — Ambient light above the prescribed level, power on, lights off

With the AC power on, the rectified voltage from the full wave rectifier **176** appears across the resistor **164** which is of a relatively high value for purposes which will be explained, the switch **105** being open except in the test mode. With the ambient light in the room above the prescribed level, which in this described embodiment is set to approximately 1 foot candle by appropriate setting of the variable resistor **163**, the photocell **124** has a relatively low resistance which applies enough of the voltage from the batteries **66, 69,** and **72** across the resistor **163** to bias the transistor **172** to the "on" condition.

With the transistor **172** on, the resistors **164** and **165** drive the collector of the transistor **172** to a very low voltage, this voltage being insufficient to turn on the transistor **173**. With the transistor **173** "off", there is no bias current for the transistor **174** so that the transistor **174** remains off, keeping the lights **98** and **99** from turning on. While the batteries **66, 69,** and **72** are supplying only a very little current (probably in the microamp range) through the resistors **162** and **163** to bias the transistor **172** to the on condition, the batteries **66, 69,** and **72** are being charged by the rectified power from the diode bridge **175** with the positive side of the rectified power applied directly to the positive side of the batteries, and the negative side of the rectified power supplied through the resistor **165** and collector and emitter of the transistor **172** to the negative side of the batteries. The resistor **164** is relatively large and the resistor **165** relatively small so that most of the rectified power goes to charge the batteries with very little loss through the resistor **165** and transistor **172.**

MODE 2 — Ambient light above the prescribed level, power off, lights off

With the AC power off, the only power to the circuit is from the batteries **66, 69,** and **72** which, of course, is of a relatively low voltage (approximately 3.6 volts) compared to the rectified voltage from the rectifier network **176.** With the ambient light in the room above the prescribed level, the resistance of the photocell **124** is relatively low so that most of the voltage of the batteries **66, 69,** and **72** appears across the resistor **163** to turn on the transistor **172.** With the transistor **172** on, the transistors **173** and **174** and the lamps **98** and **99** are off as heretofore described in connection with Mode 1 operation. Of course, since the power is off, there is no rectified power to charge the batteries. However, the battery energy is being used very sparingly as the lamps **98** and **99** are off, and as previously described only a few microamps are used from the batteries to turn on the transistor **172.** Also, as previously described, the resistor **164** is relatively large to offer a high impedance path through the transistor **172** across the batteries, keeping the current drain very low. Under this condition, the batteries will last for many hours and still have plenty of power to operate the lamps **98** and **99,** should the ambient light become lower than the prescribed level.

MODE 3 — Ambient light below the prescribed level, power on, lights off

Just as with the operation in Mode 1, the rectified power from the diode network **175** appears across the resistor **164.** However, because the ambient light in the room is below the prescribed level as set by the variable resistor **163,** the resistance of the photocell **124** is extremely high so that the biasing voltage across the resistor **163** is insufficient to turn on the transistor **172.** If the AC power were not on, the batteries **66, 69,** and **72** would supply enough voltage across the resistor **165** to turn on the transistors **173** and **174** and the lamps **98** and **99.** However, with the AC power on, the power supply network **176** of the circuit is trying to deliver as much charging current as required up to a maximum of 60 milliamps, the maximum current capacity of 60 milliamps being determined by the values of the resistors **160** and **161** and the capacitor **170.** With the power supply of the circuit trying to deliver the required charging current, the potential at the junction between the resistors **164** and **165** becomes negative with respect to the emitter potential of the transistor **173,** the emitter of the transistor **173** being at the same potential as the negative side of the batteries **66, 69,** and **72.** When the potential across the base-emitter junction of the transistor **173** drops to approximately −8 volts, the transistor **173** goes into a reverse bias Zener mode, causing current to flow from emitter to base in the transistor **173,** thus providing a complete path for supplying the rectified charging power from the network **176** to the batteries **66, 69,** and **72.** With the base-emitter junction of the transistor **173** reverse biased and operating in a reverse Zener mode, the transistor **173** is off so that the transistor **174** and lamps **98** and **99** are also off.

MODE 4 — Ambient light below the prescribed level, power off, lights on

With the ambient light in the room below the prescribed level, the transistor **172** is off as heretofore described in connection with Mode 3 operation. With the transistor **172** off and with the power supply network **176** of the circuit supplying no rectified power to create a reverse Zener condition in the transistor **173,** current supplied by the batteries **66, 69,** and **72** is fed through the resistors **164** and **165** to bias the transistor **173** to an on condition. With the transistor **173** on, the transistor **174** is biased to an on condition, and with the transistor **174** on, sufficient current (approximately 350 milliamps) is supplied from the batteries **66, 69,** and **72** through the emitter-collector junction of the transistor **174** to light the lamps **98** and **99.**

MODE 5 — Test Mode

To operate in the test mode, the operator simply simulates the conditions of Mode 4 by covering the light-sensitive surface **125** of the photocell **124** to simulate a darkened condition in the room, while simultaneously depressing the rod **102** to close the switch **105,** which in effect shorts out the rectified power supply. This

causes the lamps **98** and **99** to light as described in regard to the operation of the circuit in Mode **4**.

By way of example, the following chart gives values for the circuit components of FIG. **9** for one embodiment of the invention:

COMPONENT	VALUE
160	1 ohm, ¼ W
161	20 K, ½ W
162	18K, ¼ W
163	500 K, Pot.
164	5.6 K, ¼ W
165	470 ohm, ¼ W
166	150 ohm, ¼ W
167	18K, ¼ W
170	1.5 microfarad, 200 V, mylar
171	0.68 microfarad, 50V, ceramic
172	2N 3704 NPN, general purpose
173	2N 3704 NPN, medium power
174	2N 3055 PNP, medium power
66, 69, and 72	each 1.24V., 600 mah, nickel cadmium
124	5K at 2 ft. candles
98 and 99	each pilot lamp No. 13, gold plated contacts

The circuit of this invention has several unique features. As the current in the collector of the transistor **174** decreases due to a decrease of power from the batteries **66, 69,** and **72,** the resistance in the emitter-collector junction of the transistor **174** decreases producing more voltage across the lamps **98** and **99** thus acting as a compensating device to maintain the light output of the lamps constant with slight variations in battery power. Actually the nickel-cadmium batteries used in this described embodiment of the invention sustain their power very well over the two hours of operation. Not until the last five or ten minutes of operation does their power diminish rapidly.

Another feature is the use of NPN and PNP type transistors for the transistors **173** and **174.** With these transistors connected as shown, the only time there is a heavy drain on the batteries (500 milliamps) is when the lamps are on. In all other modes the battery drain is perhaps 1 milliamp. The batteries themselves are rechargeable hundreds of times and will power the lamps continuously for about 2 hours.

Another unique feature is that nearly all of the charging current from the power supply is supplied across the batteries. Because the batteries require a maximum charging current of approximately 60 milliamps, the current capacity of the power supply need be only approximately 60 milliamps, which allows the capacitor **170** to be a non-polarized, non-electrolytic type for much longer life. If the circuit were designed, as many of the prior art devices, with considerable current loss, the power supply current capacity would have to be much higher to provide sufficient charge for the batteries. This in turn would require the capacitor **170** to be much larger so that a non-electrolytic type capacitor could not be used.

Along these same lines, the purpose of the capacitor **171** is to filter out ripple at the base of the transistor **173** that might otherwise cause the light to come on inadvertently, such as in Mode 1 or Mode 3 operation. Because the current at base of the transistor **173** is in the microamp range, the capacitor **171** can be much smaller than if the current were 50 milliamps as in some prior art devices, again allowing for the use of a non-polarized, non-electrolytic capacitor. Hence, the circuit design allowing the capacitors **170** and **171** to be small and therefore non-electrolytic is considered very important in providing a reliable, long life, emergency light unit. In fact, it is contemplated that the design of this described embodiment could be guaranteed to operate trouble-free for a period of 10 years.

Thus, there has been described a self-contained emergency light unit of a size that can be easily mounted at a standard electrical wall outlet in a matter of minutes to provide emergency light when there is a power failure and when the ambient light in the room is below a prescribed level.

Various change and modifications may be made within this invention as will be readily apparent to those skilled in the art. Such changes and modifications are within the scope and teaching of this invention as defined by the claims appended hereto.

What is claimed is:

1. A combination emergency light unit and wall plate for mounting to a standard electrical wall outlet of a building, the outlet having a plurality of electrical receptacles and being supplied with main power from the building, the unit comprising a casing covering the areas between the electrical receptacles and the surrounding wall so as to provide an attractive finishing plate for the outlet, a lamp means for supplying the emergency light, means for mechanically mounting the lamp means so that its light emanates from the front of the casing, electrical circuit means housed within the casing, plug terminals electrically and mechanically connected to the electrical circuit means and extending rearwardly of the casing, the plug terminals being adapted to plug into one of the electrical receptacles to supply main power to the unit, said casing having an opening in front of at least one of the other receptacles for accessibility for other use, emergency power supply means mounted in the casing, means associated with the electrical circuit means for sensing a power failure in the main power supply of the building, means for supplying electrical power from the emergency power supply means to the lamp means when a main power failure is sensed, thereby energizing the lamp means, whereby the emergency light unit plugs into an electrical receptacle of a standard electrical wall outlet for ease in assembly, provides a cover plate for the outlet, and provides accessibility to another receptacle of the outlet for use as desired.

2. The emergency light unit of claim **1** including photosensitive means for detecting the ambient light level in the immediate area outside the unit, and means associated with the electrical circuit means and responsive to the photosensitive means for supplying power from the emergency power supply means to the lamp means only when the light in the room is below a prescribed level.

3. The emergency light unit of claim **2** wherein the emergency power supply means includes rechargeable batteries, and including means associated with the electrical circuit means for charging the batteries whenever the main power is on.

4. The emergency light unit of claim **1** wherein the casing defines cavities around the opening, and wherein the emergency power supply means includes rechargeable batteries mounted in said cavities.

5. The emergency light unit of claim **4** wherein the cavities for the batteries are located at the sides and end of the casing around the opening.

6. The emergency light unit of claim **1** including switch means mounted in the wall of the casing and ac-

tuatable from outside the unit, and means associated with the electrical circuit means and responsive to actuation of the switch means for testing the operability of the unit.

7. The emergency light unit of claim 6 wherein the actuation of the switch means simulates a power failure, thereby causing the lamps to light if the unit is operational.

8. The emergency light unit of claim 6 wherein the switch means is actuated by axial movement of a spring bias rod, the rod being reciprocally mounted in a wall of the casing with one end exposed at the outer surface of the unit and the other end contacting the switch means for actuation thereof as the rod is moved rearwardly.

9. The emergency light unit of claim 1 wherein the unit casing is approximately 4½ inches long, 3 inches wide, and 1 inch deep.

10. The emergency light unit of claim 1 wherein except when the lamp means is energized, the maximum current drain on the emergency power supply means in only approximately 1 milliamp.

11. The emergency light unit of claim 3 wherein when the main power is on, all but approximately 1 milliamp of charging current produced from the main power supply is delivered to charge the emergency power supply batteries, the circuit means offering a relatively high impedance path for the charging current except through the emergency power supply batteries.

12. The emergency light unit of claim 11 wherein the main power is approximately 110 volts, AC, 60 Hertz, and including means for converting the main power to rectified power of a maximum current capacity of approximately 60 milliamps, whereby approximately 59 milliamps are delivered to charge the batteries, and only approximately 1 milliamp is lost in operating the remainder of the electrical circuit means.

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