(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 523 903 A2**

(12) # EUROPEAN PATENT APPLICATION

(21) Application number : **92306258.2**

(51) Int. Cl.^{5} : **G08B 5/38**

(22) Date of filing : **08.07.92**

(30) Priority : **08.07.91 IL 98755**
18.12.91 IL 100406

(43) Date of publication of application :
20.01.93 Bulletin 93/03

(84) Designated Contracting States :
BE DE ES FR GB IT NL

(71) Applicant : **INTERPLEX SOLAR CORPORATION**
120-12 28th Avenue
Flushing, New York 11354 (US)

(72) Inventor : **Chacham, Chaim**
43 Brenitsky Street, Rishon
75239 Rishon Lezion (IL)
Inventor : **Friedman, Roni**
14 Sharet Street
Petach Tikva (IL)
Inventor : **Amir, Uri**
83 Hagalil Street
Givat Savyon (IL)

(74) Representative : **Gallafent, Richard John**
GALLAFENT & CO. 8 Staple Inn
London WCIV 7QH (GB)

(54) **Light flasher apparatus.**

(57) A rechargeable electronic flasher circuit is powered by a solar panel (21) and solar-rechargeable battery. The circuit has particular application as an auxiliary safety measure for use in reflecting roadstuds (20) or in memorial symbols for mounting on, or near, gravestones and the like so as to provide substantially perpetual illumination. Minimum charging time is necessary, while operation on battery power is extended to many days, rather than hours. The circuit can also be set to flash at a rate above the critical frequency of fusion that the eye can distinguish, creating a substantially constant light. The flashing light may also be used in a roadside warning lamp.

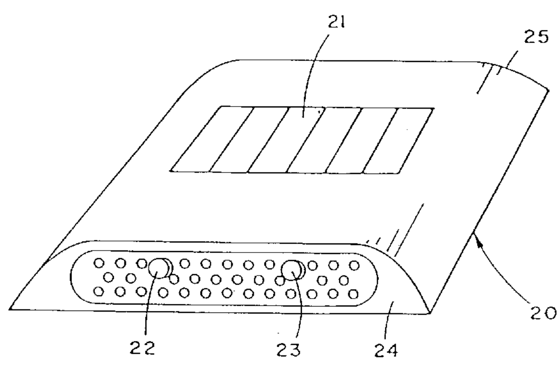

Fig. 2

Jouve, 18, rue Saint-Denis, 75001 PARIS

This invention relates to an electrical flasher circuit and, in particular, to a miniature electrical flasher circuit suitable for use in standard reflecting roadstuds, in memorial symbols, and in standard roadside warning lamps.

Reflecting roadstuds of the type widely known under the Registered Trade Mark Catseye, and including self-illuminating LED flashers are known for mounting on the boundaries between adjacent traffic lanes or on sidewalks so as to reflect a vehicle's headlamps and thereby indicate to a driver the lane boundary.

Also known are reflecting roadstuds including an electrical flasher circuit operable from a small rechargeable battery which is charged via a solar panel fixed to a housing of the roadstud so as to recharge the battery during daylight hours. The LED flashers improve the visibility of the roadstud, thereby increasing road safety.

A primary requirement of reflecting roadstuds of the kind described having integral LED flasher circuits therein is their compatibility with existing, conventional roadstuds which do not include the enhancement of flashing LEDs. Conventional roadstuds are designed to be mounted in the road surface so as to protrude therefrom only a minimal distance, their protruding edges being rounded so that, in the event of a motor vehicle mounting the roadstud, no damage will be done to the tires of the vehicle or to the roadstud itself. Typically, such roadstuds have an overall depth not exceeding 18 mm.

Existing roadstuds including LED flasher circuits have not been able to conform to this standard height and have therefore included a deeper housing adapted to be sunk into the road surface. For example, the Japanese company Kyocera manufactures a curb flasher under the name Accless having an outer casing whose height above ground is 28 mm but which has an extended casing for sinking below the ground surface having a depth of 133 mm. A pair of solar panels is mounted on an upper surface of the housing and coupled to a circuit enclosed within the lower housing and including a pair of rechargeable batteries which are recharged by the solar panel during daylight and provide electrical power to the flasher circuit at night.

Clearly, such a unit cannot easily replace existing, conventional roadstuds on account of the effort required to sink the housing into the road surface which, particularly on long stretches of road, is a major undertaking.

Likewise, a flashing light for mounting on a curb is manufactured under the trade mark Swareflex including therein an LED solar-powered flasher and a storage battery for storing electrical energy transformed by a solar cell. The storage battery has a capacity of 14 days power consumption when fully charged. In order to become fully charged, fine weather (corresponding to intense ambient illumination) is required for a minimum of four days.

It would obviously be preferable to provide an LED flasher circuit within a standard roadstud housing so as to provide the additional safety resulting from their improved visibility whilst nevertheless not requiring any major road-works for their installation.

Also, roadside warning lamps employing flashing lamps powered by a standard rechargeable car battery are known and are commonly used by road construction workers to alert drivers to the onset of hazardous conditions resulting from road works.

Such warning lamps usually conform to a standard physical dimension and light output which, in combination,-has so far militated against the battery being incorporated within the lamp housing itself and has required, instead, that the battery be provided as a completely separate unit.

This limitation results from the fact that in order to provide the required light output, a sufficiently powerful battery is a prerequisite and, so far, this has demanded a relatively large 12 V rechargeable battery having a large ampere-hour rating. Typical roadside warning lamps of the type described are manufactured under the trade name "horizont SIGNAL" and have standard dimensions of 21 cm in diameter and 21 cm in depth and this, obviously, is too small to accommodate therein such batteries.

No known solar-powered lamp has been found suitable for replacing roadside warning lamps of the type described owing to the stringent size and light output specifications associated therewith.

The problem underlying the invention is thus to provide an electrical flasher circuit suitably dimensioned that it can fit within a standard roadstud housing and/or within a standard roadside warning lamp housing, and provide that such an electrical flasher circuit has improved operating characteristics over hitherto proposed flasher circuits, in particular by providing continuous illumination for a longer period of time from a fully charged battery and employing a battery recharging facility which achieves full charge in a very much lower period of time than has been achieved with hitherto proposed systems.

According to the invention there is provided an electrical flasher circuit, comprising:

a rechargeable battery,

a solar panel coupled to the rechargeable battery,

an oscillator circuit coupled to the rechargeable battery and to the solar panel producing an output voltage which oscillates at a predetermined frequency, and

at least one lamp coupled to the oscillator circuit for flashing in response to the oscillating output voltage;

whereby the solar panel provides sufficient power to energize the oscillator circuit and to recharge the rechargeable battery when at least a predetermined threshold of light acts on the solar panel; and the rechargeable battery alone energizes the oscillator circuit for at least a first predetermined time period in the absence of said light.

In accordance with a preferred embodiment of the invention, the oscillator circuit includes an integrated circuit which facilitates miniaturization. Further, the oscillator circuit includes an integrated circuit in combination with a transistor amplifier for providing sufficient output current for sourcing the lamp. Current is supplied to the lamp for only part, e.g. 16% of the oscillator duty cycle, the current consumption being substantially zero for the remainder,of the duty cycle. Such a design facilitates miniaturization, the circuit permitting the rechargeable battery to become fully charged quickly and then to continue operating continuously for several days even in the absence of ambient illumination.

Whilst such an electrical flasher circuit has particular application as an auxiliary safety measure for use in reflecting roadstuds and warning lamps, it also has application in memorial symbols for mounting on, or near, gravestones and the like, so as to provide substantially perpetual illumination.

For a clearer understanding of the invention and to see how the same may be carried out in practice, some preferred embodiments will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1 shows schematically an electrical circuit diagram of a flasher circuit according to the invention;

Fig. 2 shows a roadstud having mounted therein the flasher circuit shown in Fig. 1;

Fig. 3 shows a first memorial symbol including therein the flasher circuit shown in Fig. 1;

Fig. 4 shows a second memorial symbol including therein the flasher circuit shown in Fig. 1;

Fig. 5 shows a third memorial symbol including therein the flasher circuit shown in Fig. 1;

Fig. 6 shows schematically an electrical circuit diagram of a flasher circuit according to another embodiment of the invention; and

Fig. 7 is a pictorial representation of a roadside warning lamp incorporating the flasher circuit shown in Fig. 6.

Referring to Fig. 1 there is shown schematically a circuit diagram of an LED flasher circuit designated generally as 10. The flasher circuit 10 comprises an LM 3909 integrated LED flasher circuit 11 manufactured by National Semiconductor and having a nominal low voltage operation from just over 1 V to 6 V and a low current drain averaging under 0.5 mA. Connected to the integrated circuit 11, in accordance with the manufacturer's data specification, is a rechargeable battery 12 having a nominal voltage of 1.2 V and rated at 280 mAH. The rechargeable battery 12 is trickle charged by a solar panel 13 having a nominal voltage of 3.6 V and rated at 55 mA, via a rectifier diode 14 which prevents current flowing from the rechargeable battery 12 to the solar panel 13.

An output of the integrated circuit 11 is connected to a light emitting diode (LED) 15 in series with a 47 μF capacitor 16 whose value in combination with the internal circuitry of the integrated circuit 11 provides a flashing frequency of approximately 0.7 Hz.

The LED is A GaAlAs (gallium aluminum arsenide) high brightness component such as manufactured by the Toshiba Company of Japan under the product code TLRA120. Such a device is operable from a drive current equal to 20 mA at a typical forward voltage of 1.8 V but can, in fact, operate at a drive current as low as 0.5 mA. This feature is exploited in the particular construction employed in the preferred embodiment so as to permit the lower operating range of the LM 3909 integrated circuit 11 to be reduced below the manufacturer's specification. This allows the circuit to operate even when the voltage of the rechargeable battery 12 falls to as low as 0.8 V, below which voltage the circuit stops operating so that the rechargeable battery 12 can never completely discharge.

The flashing circuit 10 has a current consumption of 1 mA hr at a voltage of 0.9 V such that if the voltage of the rechargeable battery 12 climbs to as little as 1.2 V, the rechargeable battery 12 has enough residual charge to energize the integrated circuit 11 on its own in the absence of sufficient ambient daylight.

However, even in moderate ambient daylight such that the solar panel 13 provides a voltage exceeding 1.2 V, the rechargeable battery 12 does not participate in energizing the integrated circuit 11 and is maintained fully charged by the solar panel 13.

On an average light intensity equivalent to 20 mA hr, the rechargeable battery 12 is rapidly recharged, achieving full charge within a time period of 2 hours and then has enough residual charge to permit continuous operation of the flashing circuit 10 for up to 20 days.

It should be noted that whilst only one LED 15 is shown in Fig. 1, up to four LEDs may be connected in parallel without derogating from the operating characteristics as described.

It should also be noted that, by adjusting the value of the capacitor 16, the oscillation frequency of the LED 15 may be raised above the critical frequency of fusion (approximately 25 Hz), so that any flicker of the LED 15 is undetectable by the human eye.

Fig. 2 shows a conventional type of reflecting roadstud including a housing 20 containing therein the flasher circuit 10 described above with reference to Fig. 1 of the drawings. A solar panel 21 is mounted on an upper surface of the housing 20, a pair of LEDs 22 and 23 being provided on each of two opposing reflecting side walls 24 and 25 of the housing 20.

During daylight hours, the solar panel 21 recharges an internal storage battery such that in the presence of sufficient ambient illumination, the solar panel 21 is alone responsible for providing power to the flasher circuit 10 (Fig. 1), any residual solar energy being used to trickle charge the rechargeable battery 12 and maintain it fully charged.

Under these conditions, the LEDs 22 and 23 flash continuously so as to provide a visual warning to motorists and thus enhanced safety.

The solar panel 21 is mounted within a small recess in the upper surface of the housing 20 so as not to protrude above the upper surface of the housing 20. This prevents damage to the solar panel 21 in the event that a vehicle's wheels mount the roadstud.

The overall height of the housing 20 protruding above a road surface is nominally 18 mm and the housing 20 is, in all respects, identical to that currently employed in standard roadstuds.

Referring now to Figs. 3 to 5 there are shown various forms of memorial symbols including therein the flasher circuit 10 shown schematically in Fig. 1.

Each of the memorial symbols depicted generally as 30, 31 and 32 is formed from a plastics molding and includes a solar panel 35 in a front surface thereof as well as a substantially candle-shaped window 36 behind which the LED 15 of the flasher circuit 10 (shown in Fig. 1) is mounted.

The memorial symbol 30 shown in Fig. 3 is particularly adapted to be fixed to a grave stone, the rear part of its housing being so shaped as to be accommodated within a recess in the grave stone and fixed therein with a suitable adhesive. On account of the operating characteristics of the flasher circuit 10, maintenance-free operation is assured for a long period of time.

The memorial symbol 31 shown in Fig. 4 has a crucifix shaped housing 39 whilst the memorial symbol 32 shown in Fig. 5 has a housing 40 in the shape of a Star of David. For these memorial symbols, it is preferred that the flasher circuit operate above about 25 Hz so that the light will appear constant to an observer.

In all cases, the housing may be of slim-line construction owing to the miniature dimensions of the flasher circuit 10 shown in Fig. 1.

Referring to Fig. 6 there is shown schematically a circuit diagram of a roadside flasher circuit designated generally as 110. The flasher circuit 110 comprises an LM555 integrated circuit timer 111 manufactured by National Semiconductor and having a nominal low voltage operation of 4.5 V and a low current drain averaging 3 mA. Connected to the integrated circuit timer 111, is a rechargeable battery 112 having a nominal voltage of 2.9 V and rated at 6 AH. The rechargeable battery 112 is trickle charged by a solar panel 113 having a nominal voltage of 15 V and rated at 1A, via a rectifier diode 114 which prevents current flowing from the rechargeable battery 112 to the solar panel 113.

The timing of the integrated circuit timer 111 is controlled by a capacitor 115 in series with a diode-resistor network 116 comprising diodes 117 and 118 in series with resistors 119 and 120. Diodes 117 and 118 are conventional germanium rectifier diodes, whilst the valves of the resistors 119 and 120 are respectively 2.5 MΩ and 0.5 MΩ. The capacitor 115 has a valve of 0.66 μF and is connected to the junction of the two resistors 119 and 120.

The capacitor 115 is connected to the resistor 119 via the diode 117 and to the resistor 120 via the diode 118. The two diodes 117 and 118 are connected in opposite sense so that, during a charge stage having a time constant determined by the 2.5 MΩ resistor 119, current flows through the diode 117 whilst, during a discharge stage having a time constant determined by the 0.5 MΩ resistor 120, current flows through the diode 118. In such an arrangement, current flows for only 1/6 th of the duty cycle, i.e. approximately 16%.

An output 125 of the integrated circuit timer 111 is connected, via a resistor 126 to the base of a first bipolar junction transistor 127 whose emitter 128 is itself connected to the base of a second bipolar junction transistor 129. The collector of the first bipolar junction transistor 127 is connected to a positive supply rail 130 and a 2.4 V, 330 mA lamp 131 is connected between the positive supply rail 130 and the collector of the second bipolar junction transistor 129.

The first bipolar junction transistor 127 functions as a switch which operates under control of the integrated circuit timer 111 for supplying current to the lamp 131 during the minor part of the duty cycle (16%) and is cut-off during the remainder of the duty cycle for preventing the supply of current to the lamp 131. The second bipolar junction transistor 129 functions as an amplifier for providing enough current to drive the lamp 131.

A photoresistor 135 (constituting a light dependent resistor) in series with a current limiting resistor 136 is connected to the integrated circuit timer 111 so as to permit operation of the integrated circuit timer 111 only when the ambient light falls below a predetermined threshold. By this means, operation of the roadside warning lamp (see Fig. 7) may be restricted to nighttime use only, thereby conserving the battery 112.

By adjusting the value of the capacitor 115, the oscillation frequency of the lamp 131 may be raised above the critical frequency of fusion, (approximately 25 Hz), so that any flicker of the lamp 131 is undetectable by the human eye.

Fig. 7 shows a roadside lamp 131 fitted within a housing 140 containing therein the flasher circuit 110 described above with reference to Fig. 6 of the drawings. The rechargeable battery 112 and the lamp 131 are both fitted within the housing 140 and the solar panel 113 is mounted on an upper surface thereof. A switch 141 fixed to the housing 140 permits the battery 112 to be disconnected from the flasher circuit 110, thereby conserving battery power.

During daylight hours, the solar panel 113 recharges the internal battery 112 such that in the presence of sufficient ambient illumination, the solar panel 113 is alone responsible for providing power to the flasher circuit 110 (Fig. 1), any residual solar energy being used to trickle charge the rechargeable battery 112 and maintain it fully charged. With the component values described above with reference to Fig. 1 of the drawings, the battery 112 is fully charged within 3 1/2 hours' illumination on a bright day. Under these circumstances, there is enough charge in the battery 112 to operate the circuit for three consecutive nights (i.e. in the absence of ambient illumination) for an average of 18 hours each night.

Whenever the ambient light falls below the predetermined threshold established by the photoresistor 135, the lamp 131 flashes continuously so as to provide a visual warning to motorists and pedestrians and thus to enhance their safety.

Both the diameter and depth of the lamp 131 are nominally 21 cm and the lamp 131 may be, in all respects, identical to that currently employed in standard roadside warning lamps.

It will further be noted that the miniaturization of the flasher circuit 110 permits the battery 112 to be of such dimension that it too can be accommodated within the housing 140. This, of course, is distinct from hitherto proposed roadside warning lamps of comparable light output which require much larger batteries which must be provided as a separate unit.

Claims

1. An electrical flasher circuit (110) comprising
   a rechargeable battery (112),
   a solar panel (113) coupled to the rechargeable battery,
   an oscillator circuit coupled to the rechargeable battery and to the solar panel for producing, during a minor proportion of a duty cycle of the oscillator circuit, an output voltage which oscillates at a predetermined frequency,
   at least one lamp (131) coupled to the oscillator circuit for flashing in response to the oscillating output voltage;
   whereby the solar panel (113) provides sufficient power to energize the oscillator circuit and to recharge the rechargeable battery when at least a predetermined threshold of light acts on the solar panel, and the rechargeable battery (112) alone energizes the oscillator circuit for at least a first predetermined time period in the absence of said light.

2. An electrical flasher circuit according to Claim 1 wherein the oscillator circuit includes an integrated circuit (111), and an amplifier (129) is provided having an input coupled to an output of the integrated circuit and having an output coupled to the lamp (131) for amplifying an output current thereof in order to provide sufficient current to source the lamp.

3. An electrical flasher circuit according to Claim 1 or 2 further including a light dependent resistor (135) coupled to the oscillator for permitting the oscillator to function only when an ambient light level falls below a predetermined threshold.

4. A roadside warning lamp comprising:
   a housing (140) for accommodating therein a lamp (131) having a depth substantially no greater than 21 cm and a diameter substantially no greater than 21 cm, and an electrical flasher circuit according to any one of Claims 1 to 3 of which the lamp (131) forms a part.

5. A roadside warning lamp according to Claim 4 wherein the minor proportion of the duty cycle of the oscillator circuit forming part of the flasher circuit is between 5% to 20%.

6. An electrical flasher circuit, comprising:
   a rechargeable battery (12) having a nominal voltage no greater than about 1.2 V,
   a solar panel (13) having a nominal current rating of about 70 mA and a nominal output voltage of about 3.6 V coupled to the rechargeable battery (12),
   an oscillator circuit (11) coupled to the rechargeable battery and to the solar panel having a nominal current drain under 0.5 mA and operative from a supply voltage in excess of 0.5 V for producing an output voltage which oscillates at a predetermined frequency, and
   at least one LED (15) having a nominal drive current of about 0.5 mA coupled to the oscillator circuit for flashing in response to the oscillating output voltage;
   whereby the solar panel (13) provides sufficient power to energize the oscillator circuit and to recharge the rechargeable battery when at least a predetermined threshold of light acts on the solar panel, and the rechargeable battery alone energizes the oscillator circuit for at least a first predetermined time period in the absence of said light.

7. An electrical circuit according to Claim 1 wherein the predetermined frequency is greater than the critical frequency of fusion.

8. A reflecting roadstud comprising:

a housing (20) having a depth adapted to be partially embedded in a roadway, and

an electrical flasher circuit according to Claim 6 or 7.

9. A roadstud according to Claim 8 wherein the solar panel (21) is fixed to an upper surface of the housing (20) adapted to extend above a roadway.

10. A roadstud according to Claim 8 or 9 wherein at least one LED is provided on respective opposing sides (24, 25) of said housing (20) adapted to extend above a roadway.

11. A memorial symbol, comprising:

a housing containing therein a flasher circuit in accordance with Claim 6 or 7 and having a window of predetermined shape for displaying the flashing LED.

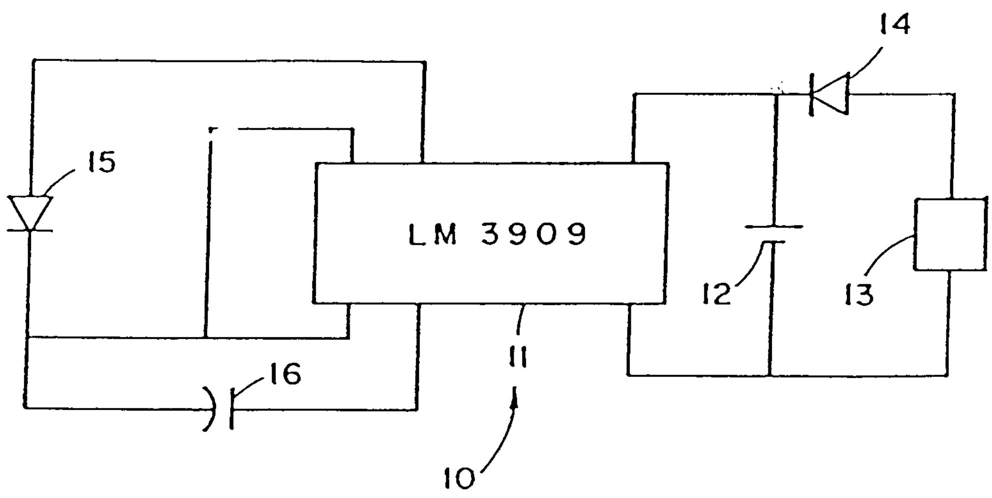

Fig.1

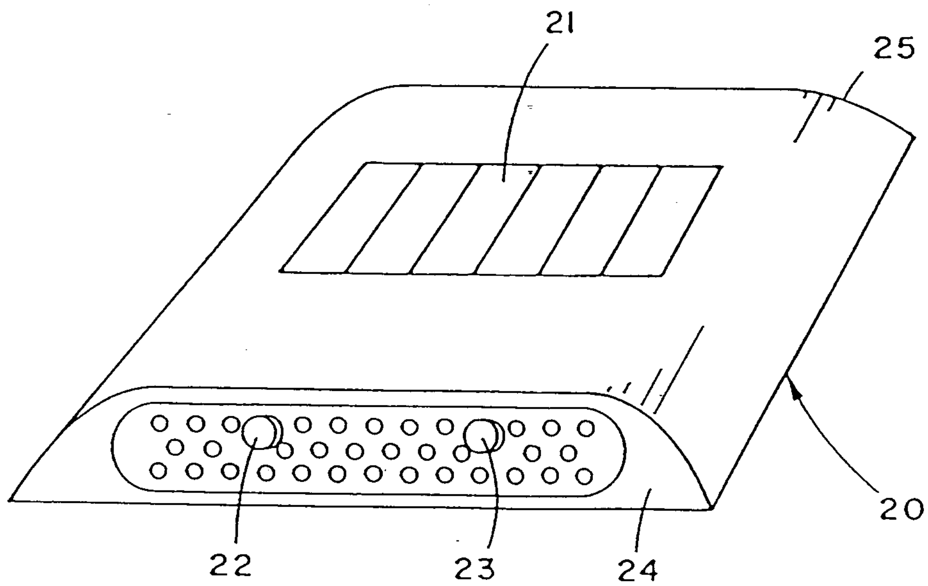

Fig.2

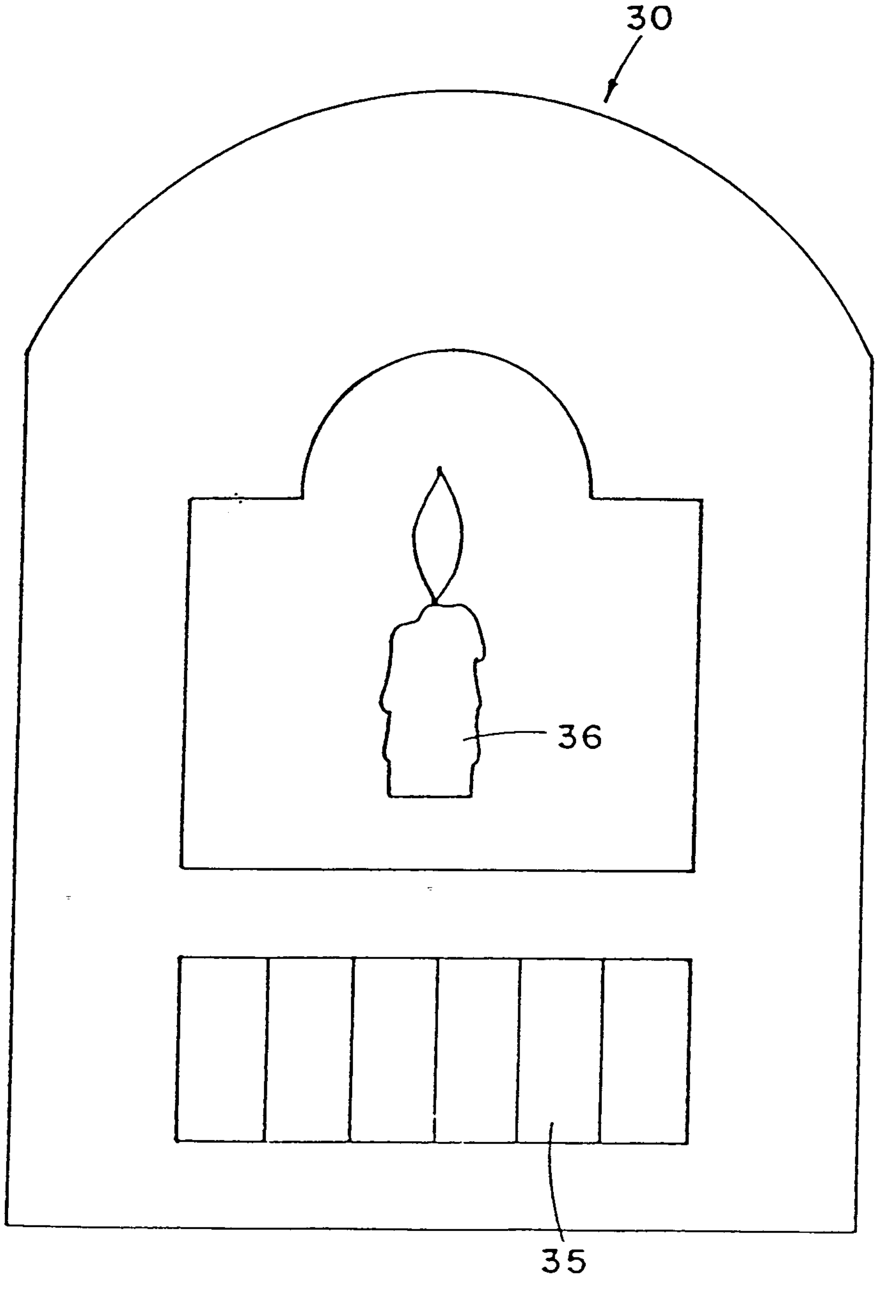

Fig.3

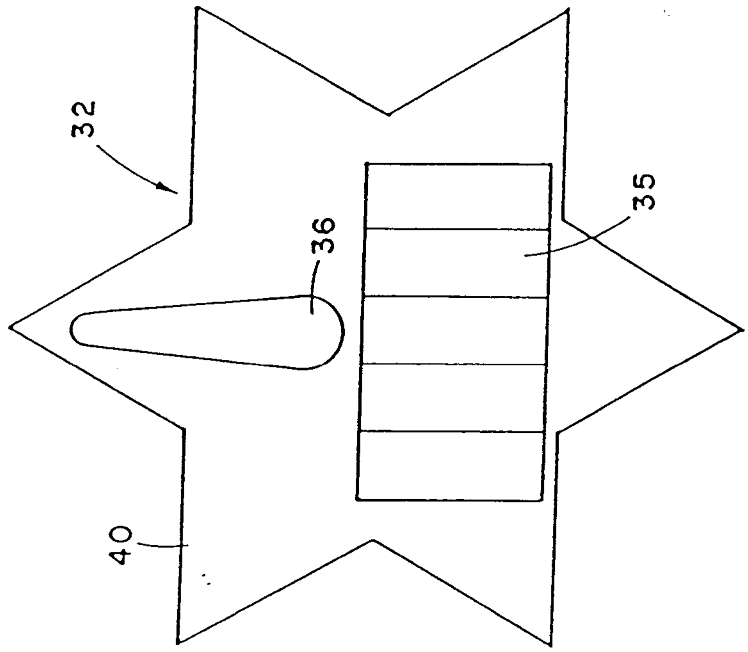

Fig. 5

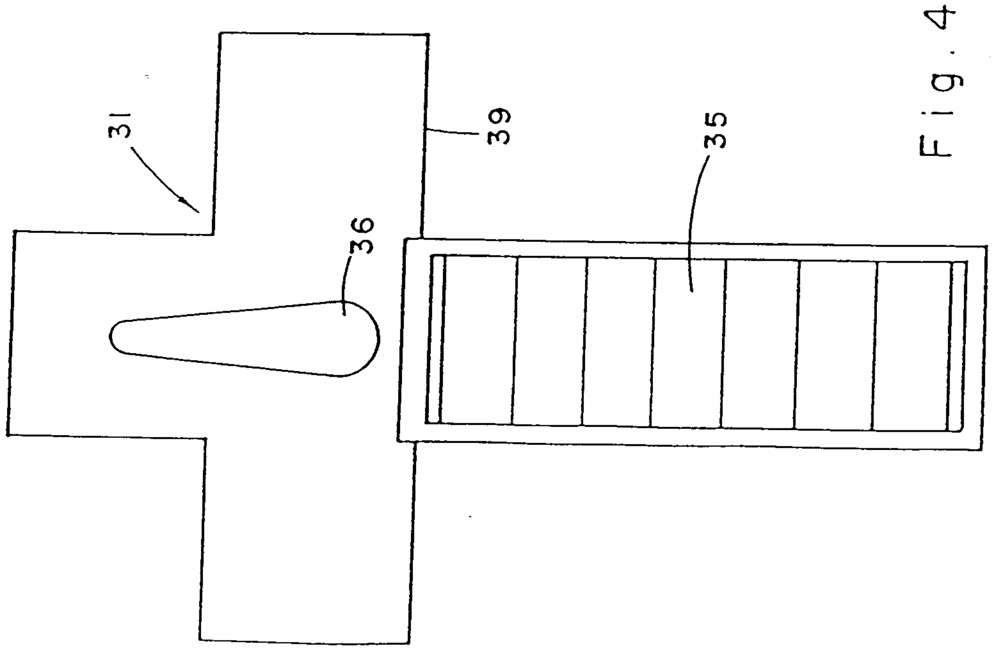

Fig. 4

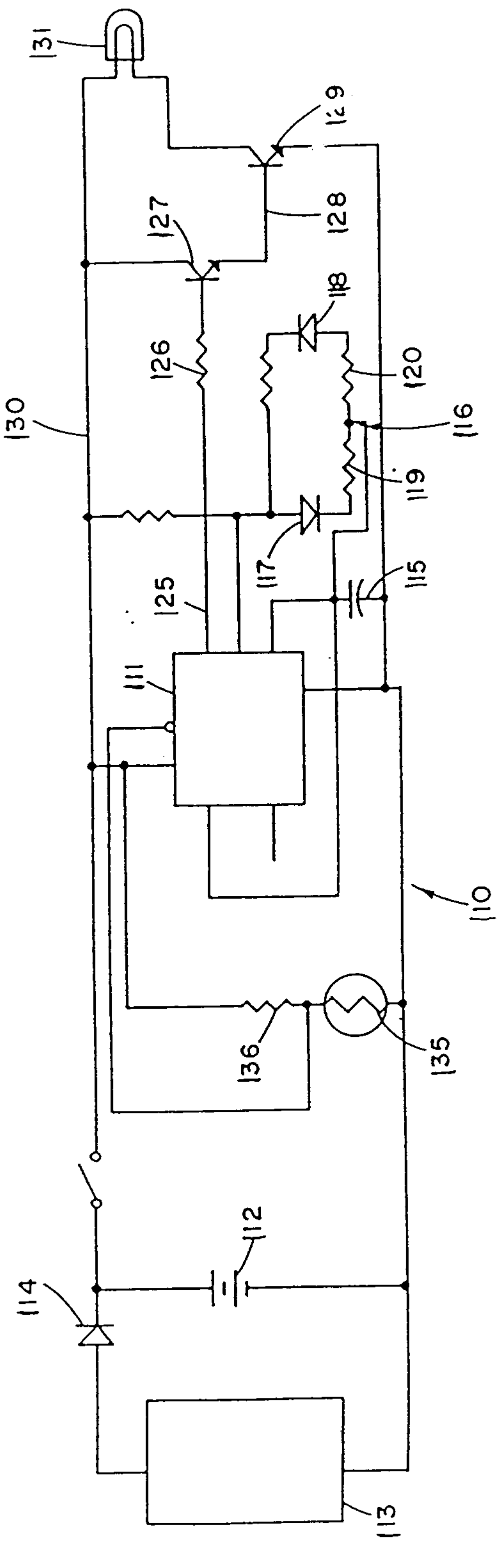
131
129
127
128
130
126
118
120
116
119
117
115
125
111
110
136
135
112
114
113

Fig. 6

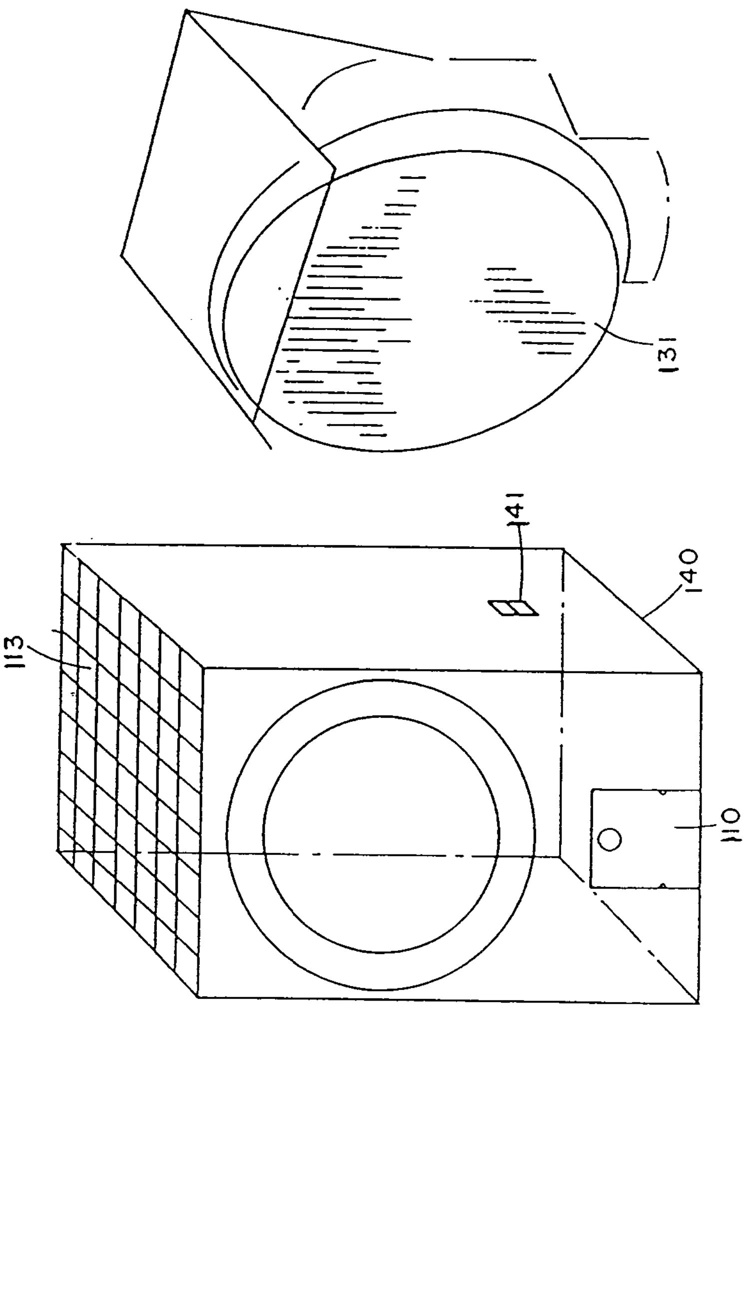

Fig. 7