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(54) AUTOMOTIVE ELECTRONIC FLASHER UNIT

(71) We, PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED, of Abacus House, 33 Gutter Lane, London, EC2V, 8AH, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an automotive electronic flasher unit of the type which comprises an astable multivibrator circuit which co-operates with an electromagnetic relay having at least one set of contacts for intermittently feeding a current supplied by the vehicle battery through the right-hand and left-hand indicator lamps of the vehicle upon actuation of the switch which is provided for this purpose. In spite of their much higher price there is a growing trend to replace the conventional hot-wire flashers by electronic flashers, at least in the top-of-the-line cars, because of their very high reliability.

The major auto makers have drawn up specifications which define certain requirements with which electronic flasher units should comply. One of these requirements is a test for a correct performance in the case of an excess current, which for example in the case of a 12 V accumulator battery is obtained with the aid of a resistor of approximately 0.5 ohms, which allows a current of 25 A to pass, which is required for a period of 20 seconds.

In this case a fuse provides no protection, for a quick fuse cannot be used because of the high current drain as a result of the low cold resistance of the lamp filaments, whilst in most cases a slow fuse cannot prevent the flasher unit from being damaged beyond repair.

The certificate of addition no. 2,185,097 to French Patent No, 2,168,660 describes a flasher unit in which the lamps L1 to L4 are directly energized by two parallel transistors T3; in the event of a short-circuit of one of the lamps the base current automatically ensures that the current drain is limited to a value which is not dangerous for the power transistors.

Such a means of protection cannot be used in the case of a flasher unit which is equipped with a relay, for in that case the excess current as a result of the short circuit is detrimental to the contacts of said relay and not to the driver transistor thereof.

A further requirement is that in the event of an interruption in the filament or the supply circuit of the lamps the flasher frequency changes substantially, so that the driver of the vehicle is immediately warned.

Moreover, it is desirable that in addition to the visual check provided by a pilot lamp an audible signal is produced; generally, this results in the use of an electromagnetic relay, which furthermore has the advantage that the use of transistors with a high current rating can be avoided, which are expensive and bulky because of the heat sinks which are necessary.

It is one of the objects of the present invention to realize an electronic flasher unit whose operation is automatically interrupted in the case of a total or partial short-circuit in the lamp circuit, and restored once the short-circuit is over.

It is a further object of the invention to obtain a substantial change of the flashing frequency of the unit in a very simple manner when the filament of one of the lamps has burnt out or when the supply circuit is interrupted.

In accordance with the invention the automotive electronic flasher unit of the type which comprises an astable multivibrator circuit which co-operates with an electromagnetic relay having at least one set of contacts for intermittently feeding a current supplied by the vehicle battery through the right-hand and left-hand indicator lamps of the vehicle upon actuation of the switch which is provided for this purpose, is characterized in that a resistor of low value is included in the lamp circuit between a terminal of the battery

and a relay contact, whilst the end which is connected to said contact is also connected both to the base of one of the transistors of a bistable multivibrator which constitutes a circuit which inhibits the operation of the astable multivibrator, and to the emitter of a transistor which constitutes an element for changing the repetition frequency of the astable multivibrator, the output terminal of the bistable multivibrator as well as the collector of the frequency changer transistor being coupled to the network which defines the time constant of the astable multivibrator.

The voltage drop across the resistor of a few hundredths of ohms which has been included in the lamp circuit, when it exceeds a certain value which corresponds to the occurrence of a partial or complete short-circuit, is employed for actuating the inhibiting circuit so as to disable the multivibrator in position "relay open" or when said voltage drop is below a value which corresponds to the presence of a burnt-out lamp or an interruption for changing the frequency of said multivibrator.

Connection to the circuitry of the vehicle in which the flasher unit in accordance with the invention is to be used is as simple as connection of the conventional "hot-wire" type, and its flashing frequency is substantially independent of the battery voltage in the range from a fully charged battery which is being charged to a discharged battery, without the use of any stabilizing circuit.

Furthermore, the power consumption of the electronic flasher unit in accordance with the invention is zero when not in use, without the necessity of employing an auxiliary circuit breaker which is coupled to the commonly used left-right switch by means of which a hot-wire flasher is actuated.

The invention will be described in more detail with reference to the sole drawing which shows the circuit diagram of an embodiment of the flasher unit in accordance with the invention.

In the Figure the emitter of a PNP-type transistor 1 is connected to the positive terminal of a battery 3 *via* a resistor 2, which battery constitutes a source supplying a voltage Vb, the collector of said transistor being coupled to the base of an NPN-type transistor 5 *via* a resistor 4; a resistor 6 is included between the base of the transistor 5 and a common earth 7 to which the emitter of the transistor 5 as well as the negative terminal of the battery 3 are connected.

The base of the transistor 1 is biassed by a voltage divider which comprises a resistor 8, which is included between said base and the positive terminal of the battery 3, and a resistor 9 which is included between said base and the positive terminal of an electrolytic capacitor 10 whose negative terminal is connected to the collector of the transistor 5; the resistor 8 is shunted by a capacitor 11 which filters out currents of high frequency.

Between the positive terminal of the capacitor 10 and a point 14 two series-connected resistors 12 and 13 are included, said point 14 being the centre contact of a left-right switch 15 which controls the lamps 16a, 16b and 17a, 17b of the indicator lights, which lamps are included in pairs between the side contacts of the switch 15 and the negative terminal of the battery 3. Between the centre contact and the side contacts of the switch 15 a double "hazard" circuit breaker 18 is included, which enables the four lamps 16a, 16b, 17a and 17b to flaps simultaneously.

The coil 19 of the flasher relay *20* is included between the positive terminal of the battery 3 and the collector of the transistor 5, said coil being shunted by an over-voltage protection diode 21 (anode connected to the collector).

The movable contacts 22a and 22b of the flasher relay *20* are connected to a point 23 which is connected to the positive terminal 3 via a resistor 24 of low value, whilst the fixed contact 25a of said relay is connected to point 14 and the fixed contact 25b to the common earth 7 *via* a pilot lamp 26.

The emitter of the PNP-type transistor 27 is connected to point 23, whilst the collector is connected to the base of the transistor 1 *via* a resistor 28; the base of the transistor 27 is biassed from the positive terminal of the battery 3 *via* a voltage divider whose one branch is constituted by a resistor 29 in series with a silicon temperature compensation diode 30 (cathode to base) and whose other branch is constituted by a resistor 31 which is connected to the collector of the transistor 5.

The inhibiting circuit *32* comprises two PNP-type transistors 33 and 34 whose emitters are directly connected to the positive terminal of the battery 3; the base of the transistor 33 is connected to point 23 *via* a resistor 35, the crosswise base-collector couplings of the two transistors being established by two resistors 36 and 37, whilst the collectors are connected to point 14 via two resistors 38 and 39 respectively. A diode 40, whose anode is connected to the collector of the transistor 33 is included between said collector and a point 41 which is common to the resistors 12 and 13.

The flasher unit in accordance with the invention operates as follows: the astable multivibrator circuit which causes the flashing comprises the PNP transistor 1 and

the NPN transistor 5, whilst detection of a burnt-out lamp is effected by the PNP transistor 27; the inhibiting circuit which cuts off the power supply to the lamps in the case of an excess current or a short-circuit is constituted by the PNP transistors 33 and 34.

In the sole Figure the parts of the circuit through which a large current flows in the normal left-hand or right-hand flashing position are represented by heavy lines.

As the emitter of the transistor 5 and the resistor 6 are the only components which are connected to the earthing point 7 when the switch 15 is in the rest position, all the transistors of the flasher unit are cut off and the current consumption is substantially zero; the capacitor 10 is discharged so that its two plates have a potential of +Vb relative to earth.

When the switch 15 is set to the left-hand or right-hand position, point 14 is momentarily connected to earth potential *via* the filament of the relevant lamps and a current flows from +Vb to −Vb via the resistors 8, 9, 12 and 13; as a result of this the base of transistor 1 becomes negative, so that this transistor becomes conductive which causes the transistor 5 to be turned on immediately.

The voltage at the negative pole of the capacitor 10 decreases, which causes the base current of the transistor 1 to increase the two transistors to bottom in a very short time owing to the cumulative effect; the relay *20* is then energized and causes the lamps to light *via* the contacts 22a and 25a, so that point 14 is brought at a potential of approximately +Vb.

The capacitor 10 is then charged at once *via* the emitter-base path of the transistor 1 and the resistor 9, and *via* the resistor 13 and 12.

When the value of the portion of the charging current of the capacitor 10 which flows in the base of the transistor 1 becomes too small, this transistor is cut off so that the transistor 5 is also cut off; at this instant the potential of the negative pole of the capacitor 10 changes suddenly to a value which is substantially equal to +Vb, whilst the potential of the positive pole changes to 2×Vb (assuming that the full charge is obtained at the instant of cut-off). As the transistor 5 is cut off, the relay *20* is deenergized and the lamps extinguish, thus marking the end of the on-period.

The portion of the positive charge of the capacitor 10 which is determined by the ratio of the values of the resistors 8 and 9 is applied to the base of the transistor 1 which then remains cut off. The capacitor 10 is then discharged to the +Vb via resistors 9 and 8 and to earth via the resistors 12, 13 and the filaments of the two lamps which are included in the circuit; when the capacitor 10 is completely discharged, it adopts a small inverse charge which causes the transistor 1 to conduct, thus marking the end of the off-period.

When the switch 15 is in the neutral position, the potential of the point 14 which is now isolated from the negative terminal becomes +Vb, which by cutting off the transistor 1 prevents the flasher unit from being actuated.

The time constant during the on-period is substantially shorter than that during the off-period, for the resistor 8 is then partially short-circuited *via* the base-emitter path of the transistor 1 and *via* the resistor 2 whose value is substantially lower than that of the resistor 8. The flashing rhythm is adjusted to approximately 100 cycles per minute.

Upon each closure of the contacts 22a and 25a of the relay *20* the current through the lamps included in the circuit produces a voltage drop of approximately 200 mV across the resistor 24 after the filament warm-up period, which voltage drop biasses the emitter of the transistor 27 so that it remains cut off.

If one of the lamps is burnt out, the current consumption is approximately halved and because the emitter of the transistor 27 is no longer biassed to approximately 110 mV, this transistor becomes conductive causing the charging current of the capacitor 10 to increase and thus the time constant of the on-period to decrease; the flashing rhythm then increases in a well visible and audible manner to approximately 150 cycles per minute.

At the instant that the switch 15 is actuated, as stated previously, point 14 is momentarily connected to earth potential *via* the lamp filaments, so that the multivibrator *32* is energized whose initial state is such that the transistor 34 is conductive and the transistor 33 is cut off; at the instant at which the contacts 22a and 25a are closed, the excess current owing to the low resistance of the lamps in the cold condition produces a voltage across the resistor 14 which suffices to keep the multivibrator *32* energized and, moreover, to cause said multivibrator to change over to its other state, bottoming the transistor 33 *via* the resistor 35.

When the situation is normal, the current decreases rapidly and stabilizes at a maximum value of approximately 8 A in the "hazard" mode (switch 18 closed); at this instant the voltage drop across the resistor 24 is too amall to energize the multivibrator *32* and the transistors 33 and 34 cut off. The short period of conduction of the transistor 33 has no effect on the operation of the astable multivibrator, because this occurs

after the transistors 1 and 5 have reached the bottomed state.

At the end of the on-period the contacts 22a and 25a open, the multivibrator *32* is again energized and the transistor 34 becomes conductive for the entire off-period.

In the event of a fault in the system owing to a more or a less serious short-circuit a comparatively substantial voltage drop of approximately 2.5 V at a current of 50 A will appear across the resistor 24 at the instant that the contacts 22a and 25a open, which voltage drop keeps the multivibrator *32* energized and the transistor 33 conductive for the entire on-period.

The multivibrator 33 remains in the same state during the off period, so that point 41 is brought at a potential of approximately +Vb *via* the diode 40 and the flasher control astable is prevented from being re-started; this results in an interruption of the defective circuit owing to the relay *20* not being energized.

In order to enable the multivibrator to be re-started, the switch 15 must be reset to the neutral position and subsequently in the flashing position. If the overload condition persists, the electronic cut-out intervenes again after the first changeover of relay *20*.

As it is necessary for the operation of the flasher unit that point 14 is alternatively at a potential of +Vb and −Vb, a second set of contacts 22b—25b is employed for controlling the pilot lamp 26 on the dashboard.

The automotive electronic flasher unit in accordance with the invention has been realized using the following components:

Transistor 1: BC 558 B — Transistor 5:BC 338
Transistors 27, 33 and 34:BC 558
Diode 21: BAX13 — Diodes 30 and 40:BAV10
Resistor 2:47 ohms — Resistor 4:470 ohms
Resistor 6:1 kohm — Resistors 8 and 9:10 kohms
Resistor 12:27 kohms — Resistor 13:2.7 kohms
Resistor 24:50 mohms — Resistor 28:1.5 kohm
Resistor 29:82 ohms — Resistor 31 and 35:10 kohms
Resistor 36:33 kohms — Resistor 37:10 kohms
Resistor 38:33 kohms — Resistor 39:15 kohms
Coil 19 or relay *20*; 12 V — 40 ohms
Lamps 16a, 16b, 17a and 17b; 12 V — 21W
Lamp 26:12 V — 4W

WHAT WE CLAIM IS:—

1. An automotive electronic flasher unit of the type which comprises an astable multivibrator circuit which co-operates with an electromagnetic relay having at least one set of contacts for intermittently feeding a current supplied by the vehicle battery through the right-hand and left-hand indicator lamps of the vehicle upon actuation of the switch which is provided for this purpose, characterized in that a resistor of low value is included in the lamp circuit between a terminal of the battery and a relay contact, whilst the end which is connected to said contact is also connected both to the base of one of the transistors of a bistable multivibrator which constitutes a circuit which inhibits the operation of the astable multivibrator, and to the emitter of a transistor which constitutes an element for changing the repetition frequency of the astable multivibrator, the output terminal of the bistable multivibrator as well as the collector of the frequency changer transistor being coupled to the network which defines the time constant of the astable multivibrator.

2. An electronic flasher unit as claimed in Claim 1, characterized in that a resistor is included between the base of the transistor of the bistable multivibrator and the end of the resistor of low value.

3. An electronic flasher unit as claimed in Claim 1 or Claim 2, characterized in that the output of the bistable multivibrator is connected to the network for the time constant of the astable multivibrator *via* a semiconductor diode.

4. An electronic flasher unit as claimed in any preceding Claim, characterized in that the collector of the transistor which changes the frequency of the astable multivibrator is connected to the network for the time constant of said multivibrator *via* a resistor.

5. An electronic flasher unit as claimed in any preceding Claim, characterized in that of the two supply lines of the bistable multivibrator one line is connected to a

battery terminal and the other to the common contact of the direction indicator switch.

6. An electronic flasher unit substantially as hereinbefore described with reference to the accompanying drawing.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*