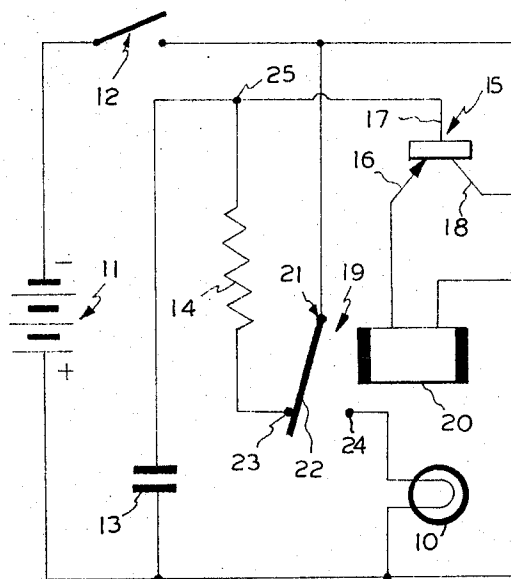


Aug. 23, 1966

G. C. RANDOLPH
LAMP FLASHING CIRCUIT
Filed May 28, 1964

3,268,765



INVENTOR
GERALD C. RANDOLPH

BY *Robert D. Sommer*
AGENT

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3,268,765

LAMP FLASHING CIRCUIT

Gerald C. Randolph, Detroit, Mich., assignor to Essex Wire Corporation, Fort Wayne, Ind., a corporation of Michigan

Filed May 28, 1964, Ser. No. 371,038
1 Claim. (Cl. 315-209)

This invention relates to flashing circuits for signal lamps such as are used for directional signals and hazard warning signals in automotive vehicles.

Nearly all automotive vehicles are equipped with directional signal systems in which selected lamps are alternately energized and de-energized to indicate the direction in which it is intended to turn the vehicle. Such signal systems commonly employ thermally actuated circuit interrupters or flashers which open and close the directional signal electric circuits at a predetermined frequency with substantially equal on and off periods. The reliability and electrical characteristics of these thermally actuated flashers have not been entirely satisfactory, especially with the relatively heavy lamp currents in the present day automotive signal systems and it has been proposed to employ flasher circuits having a magnetic relay controlled by a transistor oscillator. In general, these transistor relay systems have been complicated and costly or else required a precisely adjusted sensitive relay. Some of such systems have the further disadvantage that the flashing rate is dependent upon the lamp load.

The present invention provides an improved lamp flashing circuit employing readily available low cost circuit elements. In a specific illustrative embodiment of this invention a lamp load is intermittently energized at a predetermined rate from a direct current power source by a simple lamp flashing circuit consisting of a transistor, a relay having its coil connected in the emitter circuit of the transistor, and a capacitor having one end connected to the base electrode of the transistor and charged from the power supply through a resistor and a normally closed relay switch. The relay coil which is connected in series with the emitter and collector electrodes of the transistor across the terminals of the power source opens the normally closed relay switch when the voltage across the capacitor increases to a value causing the transistor emitter current to reach the relay pick-up value. The opening of the relay switch interrupts the capacitor charging circuit and the capacitor then discharges through the base-emitter circuit of the transistor and the relay coil. When the voltage across the capacitor diminishes to a value reducing the transistor emitter current to the relay drop-out value, the relay contacts reclose to re-establish the capacitor charging circuit and the cycle is repeated. The relay includes additional switching contacts connecting the lamp load to the power source for switching the lamp load off and on at a predetermined rate under the control of the flashing circuit.

A full understanding of the invention may be had from the following detailed description with reference to the drawing in which:

The single figure is a schematic circuit diagram of the preferred embodiment of the invention.

Referring now to the single figure of the drawing there is shown a circuit diagram wherein a load 10 such as a vehicle warning signal lamp is connected to the positive terminal of a direct current voltage source 11. The voltage source 11 may be the usual vehicle storage battery or any other suitable means for providing a direct current voltage. The negative terminal of the voltage source 11 is connected by an on-off switch 12 to a flashing circuit which alternately closes and opens an energizing circuit for the lamp load 10 at a predetermined frequency or rate.

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The flashing circuit of this invention comprises a capacitor 13, a resistor 14, and a PNP junction transistor 15 with emitter, base and collector electrodes 16, 17, and 18 respectively. The flasher circuit also includes an electromagnetic relay 19 having an operating coil 20 and a single pole, double throw switch 21. Relay switch 21 has a movable contact element 22 normally engaging a stationary contact 23 but movable to engage a stationary contact 24 when the electric current flowing in the relay coil 20 exceeds a minimum pick-up value. The movable contact element 22 is returned to engage the stationary contact 23 when current flow through the relay coil 20 decreases below a maximum drop-out value substantially less than the pick-up value.

The relay coil 20 is connected to the voltage source 11 in an energizing circuit which consists of the path from the negative terminal of the voltage source 11 through the switch 12, collector electrode 18 of the transistor 15, emitter electrode 16 and relay coil 20 to the positive terminal of the voltage source 11.

The capacitor 13 is connected in series with the resistor 14 in a biasing or control circuit for the transistor 15. This biasing circuit extends from the negative terminal of the voltage source 11 to the switch 12, movable contact element 22 of the relay switch 21, normally closed contact 23, resistor 14 and capacitor 13 to the positive terminal of the voltage source 11. The junction 25 of the capacitor 13 and the resistor 14 is connected to the base electrode 17 of the transistor. The movable contact element 22 of the relay switch 21 when engaging the normally open stationary contact 24 completes a load energizing circuit consisting of the path from the negative terminal of the voltage source 11 through the switch 12, movable contact element 22, contact 24 and load 10 to the positive terminal of the voltage source 11.

The operation of the circuit is as follows:

When the switch 12 is open no current flows through the relay coil 20 and the relay switch 19 will be in the position shown in the drawing. The capacitor 13 will also be completely discharged. After the switch 12 is closed the capacitor 13 charges at a rate determined largely by the time constant of the resistance-capacitance network of resistor 14 and capacitor 13. As the capacitor 13 charges current also flows from resistor 14 through the emitter-base junction of transistor 15 to render the latter conductive and its emitter current flows through the relay coil 20. Since the voltage across the base and emitter electrodes 17 and 16 of transistor 15 is very low the voltage across the relay 20 is substantially equal to the voltage across capacitor 13. As the voltage across capacitor 13 continues to increase, the base current of transistor 15 increases and hence the transistor emitter current will increase until the current of the relay coil 20 reaches the pick-up value necessary to shift the movable contact element 22 from contact 23 to contact 24.

The engagement of the contact 24 by the contact element 22 completes the load energization circuit to energize the lamp load 10 from the voltage source 11. At the same time separation of the contact element 22 from the contact 23 interrupts the charging circuit through resistor 14 to capacitor 13. Capacitor 13 then discharges through the relay coil 20 and the emitter-base circuit of transistor 15. As the voltage across the capacitor 13 decreases, the base current of the transistor 15 and the emitter current decrease until the current through the relay coil 20 diminishes to the drop-out value necessary for the return of the contact element 22 from contact 24 to contact 23.

The separation of the contact element 22 from the contact 24 interrupts the load energization circuit to de-energize the load 10. At the same time, the engagement of the contact element 22 with the contact 23 re-establishes the capacitor charging circuit through the resistor 14.

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The capacitor 13 then charges through this circuit until the emitter current of the transistor 15 reaches the pull-in value of the relay 20 and the cycle will repeat as long as switch 12 remains closed.

It will be noted from the foregoing description that the time interval in which the lamp load 10 is energized is determined by the rate at which the capacitor 13 is discharged through the relay coil 20 and the emitter-base circuit of transistor 15. The effective resistance of this discharge path is approximately equal to the product of the short circuit current amplification factor of the transistor and the sum of the transistor emitter resistance and the resistance of the relay coil 20. The emitter resistance is small in comparison with the resistance of the relay coil 20 and thus the time constant of the capacitor discharge circuit depends largely upon the resistance of the relay coil 20. The time interval in which the lamp load 10 is de-energized is determined by the rate at which the capacitor 13 is charged through the resistor 14. The resistance values of the resistor 14 and the relay coil 20 may be selected with respect to the capacitance value of the capacitor 13 to provide the desired relation between the periods in which the load is energized and de-energized. The values of capacitor 14, resistor 13 and relay coil 20 may be also selected to provide the desired cycling rate at which the load is switched off and on. In a constructed embodiment of the invention operated from a 12 volt power source 11 at a cycling rate of 90 cycles per minute with on and off periods of substantially equal duration, the capacitor 13 had a capacitance of 150 mfd., the resistor 14 had a resistance of 50 ohms, and the relay coil 22 had a resistance of 70 ohms.

While the invention has been described with transistor 15 as a PNP type it will be understood that the circuit can be used with transistor 15 as a NPN type provided the polarity of the power source 11 is reversed.

What is claimed is:

A lamp flashing circuit for intermittently energizing a signal lamp load from a source of direct voltage at a given cycling rate comprising in combination with said lamp load and said source:

- (a) first and second terminals for connection to said source;
- (b) a transistor having emitter, base and collector electrodes; said collector electrode being connected to said first terminal;
- (c) an electromagnetic relay having an operating coil connected between said emitter electrode and said second terminal; said relay including a single pole, double throw switch actuated by said coil and comprising a movable contact element connected to said first terminal and first and second stationary contacts alternately engaged by said contact element; said contact element engaging said first contact when said coil is deenergized and being transferred from said first contact to said second contact when the current flow in said operating coil attains a predetermined

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pick-up value; said contact element returning from said second contact to said first contact when the current flow through said relay coil diminishes from said pick-up value to a drop-out value of less magnitude;

- (d) a capacitor connected between said base electrode and said second terminal; said capacitor when charged affording a bias voltage for said transistor and thereby controlling the emitter current flow through said relay coil;
- (e) a resistor connected between said first contact and said base electrode for charging said capacitor from said source when said movable contact is in engagement with said first contact; said capacitor charging at a rate dependent upon the resistance value of said resistor to a particular voltage establishing an emitter current through said coil of said pick-up value whereupon said contact element is transferred from said first contact to said second contact to terminate charging of said capacitor; said capacitor upon separation of said contact element from said first contact discharging through a discharge path comprising the emitter-base junction of said transistor and the relay coil at a rate dependent upon the resistance value of said discharge path to a voltage lower than said particular voltage establishing an emitter current through said relay coil of said drop-out value whereupon said contact element returns from said second contact to said first contact to reinstitute charging of said capacitor through said resistor whereby the capacitor is alternately charged and discharged to alternately vary the emitter current flow through said relay coil between said pick-up and drop-out values;
- (f) and circuit means connecting said lamp load between said second contact and said second terminal for cyclically opening and closing a circuit between said source and said lamp at a given rate determined solely by the rates at which said capacitor is charged through said resistor and discharged through said discharge path.

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JOHN W. HUCKERT, *Primary Examiner.*

R. F. POLISSACK, *Assistant Examiner.*