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FLASHER LAMP CIRCUIT WITH POSITIVE GROUND

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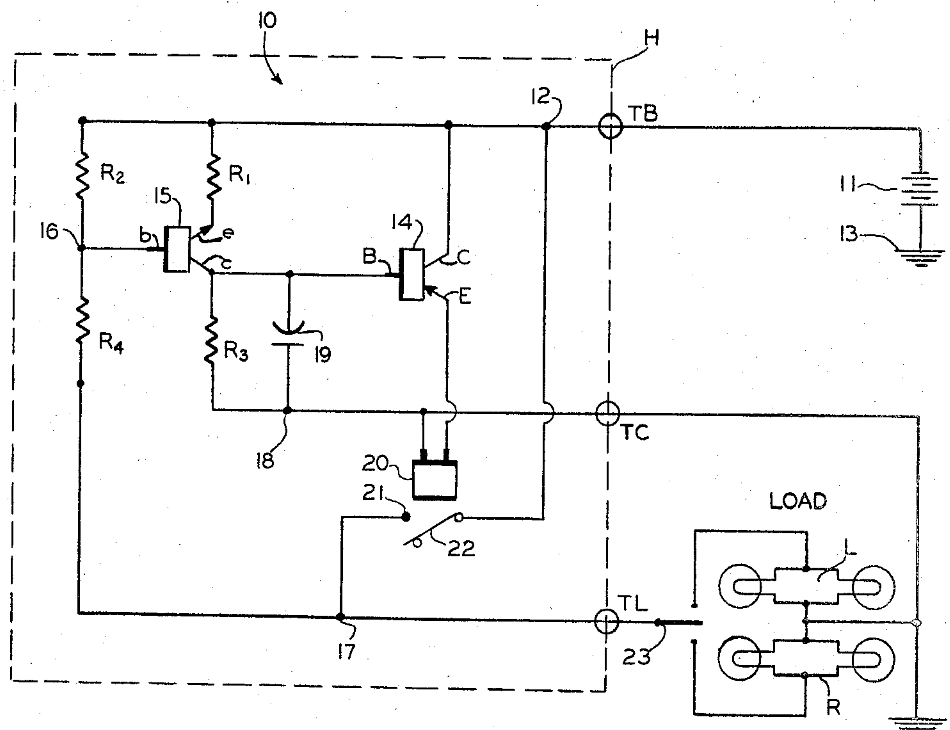

Fig. 1

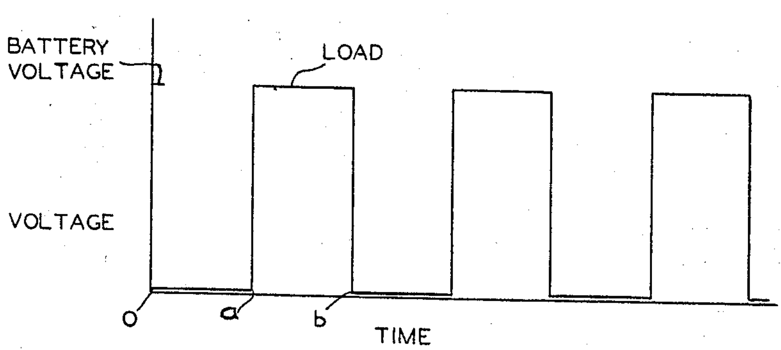

Fig. 2

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FLASHER LAMP CIRCUIT WITH POSITIVE GROUND

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This invention relates generally to electrical oscillator circuits for use in automotive vehicle turn signal devices, and more particularly to such a circuit employing semiconductor devices in conjunction with a relay for switching a heavy load current in a vehicle which has the positive terminal of its direct current electrical supply grounded to the chassis frame.

Heavy duty trucks require as many as 8 or more signal lights with a consequent current load of the order of 16 amperes which must be switched on and off by the turn signal circuit, and many of these trucks have their batteries grounded on the positive side. In the circuit of the present invention the load current is carried by heavy duty relay contacts so that heavy load currents may be switched on and off. The circuit employs low cost components and is arranged for convenient installation in vehicles having a lighting system in which the positive terminal of the battery is grounded to the vehicle frame. By a proper choice of components, the flash frequency may be set for any convenient value, such as 60 or 120 per minute.

The primary object of the invention, accordingly, is to provide a unitary electronic switching device for flashing automotive lamps which may be installed in the vehicle wiring between the lamps and the negative terminal of the battery.

Another important object is to provide an efficient electronic switching device which is capable of switching heavy load currents in uniform timing and operating cycles.

A still further object is to provide a switching device in which a relatively low value capacitor and small sized components are used to accomplish the switching.

Other objects and advantages will become apparent from the following description taken in conjunction with the accompanying drawing in which:

FIGURE 1 is a schematic circuit diagram of a transistor oscillator circuit arranged in accordance with the present invention; and

FIGURE 2 is an idealized voltage-time diagram illustrating the operation of the lamps in the circuit of FIGURE 1.

Referring to FIGURE 1, the flasher circuit **10** includes a source of direct current **11**, which for the type of flasher contemplated is a 12 volt battery. The negative terminal of battery **11** is connected to a point of reference potential **12** and the positive terminal thereof is connected or grounded to the frame of the vehicle at **13**.

The reference point **12** is connected to the collector electrode C of a PNP transistor **14** and, through resistors R1 and R2, respectively, to the emitter electrode *e* of an NPN transistor **15** and to a reference point **16**. Reference point **16**, in turn, is connected to the base electrode *b* of the NPN transistor **15**, and through resistor R_4 to reference point **17**.

The collector electrode *c* of transistor **15** is connected through resistor R_3 to a reference point **18** and is also connected to the base electrode B of transistor **14**. Capacitor **19** is connected between base B of transistor **14** and reference point **18**.

The emitter electrode E of transistor **14** is connected

to one terminal of relay **20**, the other terminal of the relay being connected to reference point **18**.

The normally open contacts **21** and **22** of relay **18** are connected respectively to reference point **17**, and to reference point **12**. Resistors R_1, R_2, R_3 and R_4 each have a different rated resistance. By adjusting these rated values the ratio of on-time to off-time of the flasher cycle can be varied and, by making one or more of the resistors temperature or voltage sensitive, compensation may be made for changes in temperature or voltage.

It will be understood that the above described components of the circuit **10**, exclusive of battery **11**, are adapted to be conveniently enclosed in a box or housing H indicated in broken lines in FIGURE 1, which may conveniently have three terminals: TB, TC and TL. TB being connected to reference point **12**, is adapted for connection to the negative terminal of battery **11**. TC is connected to reference point **18** and is adapted to be grounded at any convenient location to the frame of the vehicle and is thus connected to the positive side of battery **11**.

TL is connected to reference point **17** and is adapted for connection to a conventional turn switch **23** which can make connection to either of the loads R or L, each load being disclosed as a plurality of tungsten lamps in parallel, the other side of each load being grounded to the vehicle frame and thus connected to the positive terminal of battery **11**. It will be understood that switch **23** is normally open and manually operable to indicate the desired direction of turn by completing a circuit through either load L or load R. The manual turning of switch **23** to the left or to the right, therefore, connects contact **21** with the positive terminal of battery **11** either through load L or load R.

The operation of the above described circuit is substantially as follows:

At the start of the cycle indicated at the point 0 in FIGURE 2, the turn switch **23** is open, capacitor **19** is discharged, and transistors **14** and **15** are not conducting.

When the turn switch **23** is closed to complete a circuit through the load (either lamps L or lamps R), the first phase (indicated from 0 to *a* in FIGURE 2) of the cycle commences. Battery voltage is applied to base *b* of transistor **15** through resistors R_2 and R_4 which form a voltage divider. A current insufficient to light the lamps flows from the battery through resistors R_2 and R_4, switch **23**, and the load.

Resistors R_2, R_4 and R_1 bias the transistor **15** on and the transistor supplies an approximately constant collector current from its collector electrode *c* to resistor R_3, capacitor **19**, and the base electrode B of transistor **14**. The collector current from transistor **15** charges capacitor **19** exponentially in conjunction with resistor R_3, capacitor **19**, and the base electrode B of transistor between base electrode B to reference point **18** increases. Voltage at the emitter E of transistor **14** follows the voltage at base B and the voltage across the relay **20** rises accordingly.

Transistor **14** provides current amplification so that a small current in the base circuit through B can control a much larger circuit through relay **20**. During the period in which capacitor **19** is charging, the current through the load R or L is relatively small and the lamps do not light. This is illustrated in FIGURE 2 in which the voltage across the load is plotted as a function of time. During the first phase of the cycle shown from 0 to *a* in FIGURE 2 the voltage across the lamps is but a small fraction of the battery voltage.

When the voltage across relay **20** reaches the operating or "pull in voltage of the relay, the normally open contacts 21–22 close and place the full battery voltage across the lamp load. The lamps accordingly flash on, as indicated by the vertical line at *a* in FIGURE 2 and the lamps remain lighted during the second phase of the cycle, indicated from *a* to *b* in FIGURE 2.

During the second phase, reference point 12 is connected directly to the load through contacts 21 and 22 via reference point 17. The voltage across R_2 and R_4 drops to zero causing transistor 15 to go off. Capacitor 19 now begins to discharge through resistor R_3 and transistor 14, and the voltage at E follows the drop in voltage at B. When the voltage at E and relay 20 reaches the release or "drop out" voltage of the relay, contacts 21–22 again open, the cycle is completed, and the lamps blink out as indicated by the vertical line at *b* in FIGURE 2.

As long as switch 23 remains closed through load L or load R the cycle is repeated and the current continues to oscillate with the voltage across the relay oscillating between the values required for "pull in" and "drop out." So long as turn switch 23 is closed, current in transistor 14 flows continuously throughout the cycle since there is always a voltage drop from emitter E to base B of transistor 14 which keeps the transistor conducting. The emitter current of transistor 14 flows through relay coil 20, consequently there is no voltage surge and no large "spikes" occur during the switching action.

It will be apparent to those familiar with the art that the circuit 10 is an adaptation of the circuit disclosed in U.S. Patent 3,113,242, issued December 3, 1963, to the same inventor. The adaptation disclosed herein provides a unitary flasher device in which the resistors, transistors, capacitor, and relay may be enclosed in a common housing and installed in an automotive vehicle at any convenient location without rearranging the lighting system of the vehicle which includes a battery whose positive terminal is grounded to the frame of the vehicle.

In a constructed embodiment of the invention, a flash rate of 90 per minute was obtained by using the following circuit constants:

Resistor R_1	ohms	68
Resistor R_2	do	220
Resistor R_3	do	470
Resistor R_4	do	1500
Capacitor	microfarads	550
Relay coil	ohms	40
Relay contacts	amperes	20
Battery	volts	12

The PNP transistor 14 constitutes a low cost means of current amplification for controlling a comparatively large current in the relay 20.

The NPN transistor 15 is another low cost component which, in combination with the four resistors, furnishes the proper bias for transistor 14 and allows all the components within the broken lines H of FIGURE 1 to be installed as a unit at any convenient location between battery 11 and turn switch 23.

Resistors R_1, R_2, R_3 and R_4 are also low cost items which may be chosen for the desired adjustment of the ratio of on-time to off-time of the flasher cycle. One or more of the resistors may be temperature or voltage sensitive for causing transistor 15 to supply a collector current to compensate the overall circuit against variations in flash rate due to changes in ambient temperature and supply voltage.

As will be apparent to those familiar with the art, the invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The embodiment disclosed is therefore to be considered in all respects as illustrative rather than restrictive, the scope of the invention being indicated by the appended claims.

What is claimed is:

1. In an electronic switching circuit, a source of direct current with the positive terminal grounded; a load and switch in series with one terminal of the load grounded; a PNP transistor having emitter, base and collector electrodes and connected as an emitter follower with a relay in the emitter circuit connected across the source of direct current with the collector connected to the negative terminal of the source, the relay having a normally open contact which, when closed, connects the supply negative to the switch; and a charging circuit consisting of a voltage divider connected from the switch to the negative supply and including an NPN transistor having emitter, base and collector electrodes, its base being connected to the center point of the voltage divider and its emitter returned to the negative supply, the collector of the NPN transistor being connected to the base of the PNP transistor and to a parallel combination of a resistor and a capacitor which are in turn grounded.

2. An electronic switching circuit comprising: a battery with the positive terminal grounded; a switch and a load in series with one terminal of the load grounded; a PNP transistor; an NPN transistor, each transistor having emitter, base and collector electrodes; a series combination of a relay, the PNP transistor emitter and collector in that order connected across the battery, the collector being connected to the negative terminal of the battery; a parallel combination of a voltage divider and a pair of normally open relay contacts adapted to connect the switch to the negative terminal of the battery, the NPN transistor having its base connected to the center point of the divider and its emitter connected through a first resistor to the negative terminal of the battery; and a second parallel combination of a second resistor and a capacitor connecting both the collector of the NPN transistor and the base of the PNP transistor to ground.

3. In an electronic switching circuit: a source of direct current having its positive terminal grounded and its negative terminal connected to a first point of reference potential, a switch and load in series, one terminal of the load being grounded and the switch being connected to a second point of reference potential, an NPN transistor and a PNP transistor each having base, collector and emitter terminals, the NPN transistor having its emitter electrode connected to the first point of reference through a resistor, a PNP transistor having its base electrode connected to the NPN collector electrode, a parallel combination of a second resistor and a capacitor connected from the NPN collectors electrode to ground, a series combination of a relay coil and the emitter and collector of the PNP transistor in that order being connected across the supply source with the transistor collector connected to the negative terminal of the source, the normally open contacts of the relay being connected in series between the second and the first point of reference, and a charging circuit including a voltage divider connected from the second to the first point of reference, the base electrode of the NPN collector being connected to the center point of the voltage divider.

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