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LOW-VOLTAGE TRANSISTORIZED ELECTRIC LIGHT FLASHER CIRCUIT FOR BARRICADE LIGHTS ETC.

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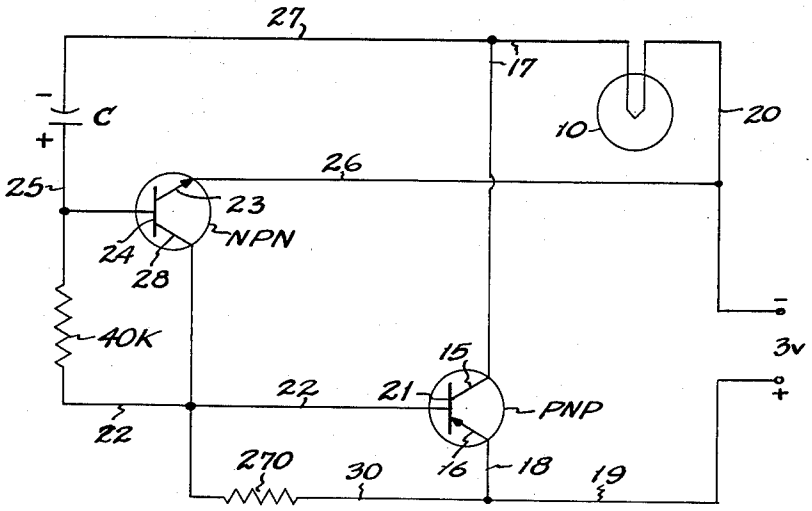


Fig. 2

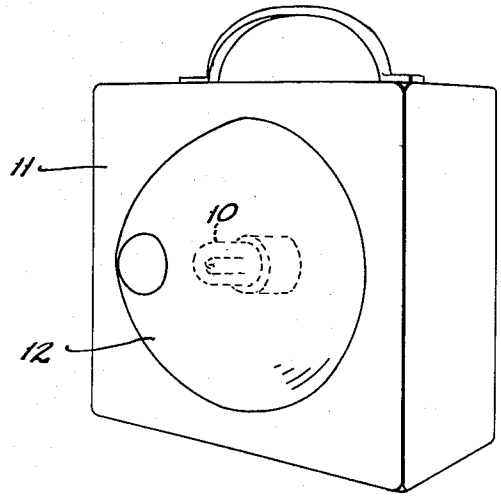


Fig. 1

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LOW-VOLTAGE TRANSISTORIZED ELECTRIC LIGHT FLASHER CIRCUIT FOR BARRICADE LIGHTS, ETC.

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This invention relates to electric light flasher circuits of the type utilizing coupled NPN and PNP transistors for developing an intermittent or fluctuating electric current such as to intermittently energize an electric lamp with a flashing action. The invention is applicable to barricade lights, such as are used for warning motorists to avoid barricaded areas where road repairs are in progress, or of dangerous roadway conditions or obstructions; and it is also applicable to indicator lights such as are used on instrument panels of complex mechanism, as in airplanes, for providing a warning indication of any fault or other condition occurring in any of the several components of such mechanism, requiring the attention of an operator or attendant.

The general object of the invention is to provide a flasher circuit of this general type, which is particularly adapted for operation on a low voltage such as is conveniently utilized in a portable barricade light flasher unit.

A more specific object is to provide a transistorized flasher circuit in a portable barricade light unit. Another object is to provide an improved, simplified transistorized flasher circuit.

Other objects and advantages will become apparent in the ensuing specification and appended drawing in which:

FIG. 1 is a perspective view of a barricade light embodying the invention;

FIG. 2 is a schematic diagram of my improved circuit.

Referring now to the drawing in detail, and in particular to FIG. 1, I have shown therein, as an example of one form in which the invention may be embodied, a barricade light unit which, physically, embodies a lamp bulb **10** mounted in a rectangular casing **11** adapted to be seated upon a street barricade, and a lens **12** mounted in the casing **11** in front of lamp bulb **10**. Lens **12** may be of transparent or translucent glass or plastic material, which may in some cases be of a red color to impart warning red glow to the light flashes. Lamp bulb **10** may be a small filament lamp adapted to operate on 3 volts. A flasher control unit, mounted within the casing **11**, is connected to the lamp **10** as will be more fully described hereinafter.

The flasher control circuit includes a pair of transistors PNP and NPN, resistors **40K** and **270**, and a capacitor C. As indicated by their reference characters, the transistors are of the NPN and PNP types, respectively.

A source of three volt direct current is indicated at **3v**. It may be a small dry battery such as is used in a flashlight (e.g. two flashlight dry cells). Lamp **10** is connected in series with the collector **15** and emitter **16** of transistor PNP across current source **3v** by conductors **17**, **18**, **19** and **20**, so that when transistor PNP becomes conductive, its load current will energize lamp **10**. Base **21** of transistor PNP is connected to resistor **40K** by a conductor **22**.

Transistor NPN functions to apply a fluctuating bias to the emitter **16** of transistor PNP. Transistor NPN in turn is biased by a fluctuating voltage applied across its emitter **23** and base **24**, the latter being joined to a connection **25** between resistor **40K** and the positive side of capacitor C. Where it has previously been considered necessary, however, to utilize a separate voltage source

to apply the bias for developing an emitter current in the NPN transistor, or to interpose the load and an additional resistance in series between the emitter and the current source, the present invention achieves more dependable operation and simplicity through a direct connection **26** from the negative side of source **3v** to emitter **23**.

The negative side of capacitor C is joined by a connection **27** to the conductor **17** of the lamp circuit, and thus is directly connected to the collector **15** of transistor PNP.

Collector **28** of transistor NPN is connected by a conductor **29** and conductor **22** to the base **21** of transistor PNP, in parallel with resistor **40K**. To this parallel connection is also joined one side of resistor **270**, the other side thereof being connected by a conductor **30** and the conductor **19** to the positive side of current source **3v**.

The invention is particularly characterized by the direct connection between condenser C and lamp **10**, with substantially no voltage drop between them, and the parallel connection of the other side of condenser C to the bases of both transistors, with the relatively high resistance **40K** interposed in the connection to base **21** of transistor PNP.

The invention is further characterized by the direct connection of collector **28** of transistor NPN to the base **21** of transistor PNP, without any interposed resistance.

Resistor **40K** is of high resistance value (e.g. 40,000 ohms) whereas resistor **270** is of relatively low resistance value (e.g. 20 ohms). Capacitor C has a capacity of about 20 microfarads.

In operation, when the capacitor C is discharged, the transistors will be in a non-conducting state and the potential on NPN transistor base **24** will be low (negative). A small charging current will flow in the circuit including conductors **20** and **27**, capacitor C, resistor **40K**, conductor **22**, resistor **270** and conductors **30** and **19**, gradually charging capacitor C and causing the base of transistor NPN to gradually become more positive with respect to its emitter **23**, which remains negative, at the same potential as the negative side of current source **3v**.

As the base **24** becomes more positive, the resulting control current flow between emitter **23** and base **24** will render transistor NPN conducting, and collector current will flow in its collector circuit including conductors **26** and **29** and resistor **270**. The resistance value of the latter is just sufficient to restrain this current at a relatively weak intensity, which is adequate, however, to maintain the potential on emitter **16** of transistor PNP at a high level while dropping the potential on plate **21** of transistor PNP to a more negative value than that which existed when no collector current was flowing in transistor NPN.

During the transition from non-conduction to conduction in transistor NPN which results in a drop in the potential of collector **28** from a previous value just slightly less than that at terminal **7** of source **3v** (the resistor **270** being of relatively low value) to a much more negative value because of the flow across transistor NPN, the potential of plate **21** of transistor PNP will drop exactly in step with the drop in collector **28**. The action of transistor PNP therefore follows closely the action of transistor NPN, and as a positive bias thus is established on the emitter **16** of transistor PNP, the latter will become conducting to a sufficient extent to light the lamp **10** and to simultaneously discharge the capacitor C.

As capacitor C loses its charge, the potential on its positive side will drop, and plate **24** of transistor NPN will correspondingly become more negative, until the bias across this transistor in its emitter circuit will have been reduced to the point where the transistor becomes non-conducting. With the collector current of the transistor NPN thus cut off, the plate **21** of transistor PNP

by leakage current through the relatively low resistance of resistor **270**, will gradually be restored to a potential only slightly below that of terminal **7** at the positive side of current source **3v**, thus cutting off the forward bias in the emitter circuit of transistor PNP and causing this transistor to become non-conducting and the lamp **10** to be extinguished. This restoration of positive potential on plate **21** proceeds relatively rapidly, while the positive side of capacitor C is held at substantially zero potential (i.e. the capacitor remains in a substantially discharged state) due to the high resistance value of resistor **40K**. This completes a cycle of operation, with both transistors non-conducting and with capacitor C discharged. A new cycle of operation will immediately commence with the charging of capacitor C by the relatively weak current passing through lamp **10** and resistors **40K** and **270** in series.

The circuit of this invention is particularly adapted for flashing a low voltage lamp such as may be used for a barricade warning light, the red glow of the ruby lens **12** being quite visible although of low intensity. Such a barricade light can be energized for long periods by a low voltage battery.

The direct, low resistance connection **26** between the NPN emitter **23** and source **3v** makes it possible to operate the circuit satsifactorily on the three volt current source.

I claim:

1. In a low voltage electric light flasher apparatus, in combination: a lamp; positive and negative terminals for connection to a low voltage source; a PNP transistor arranged with its emitter and collector connected in series with and connected respectively to said lamp and positive terminal; an NPN transistor having a direct connection, without substantial resistance, between its emitter and the negative terminal; means including a low value resistor in series connecting the collector of said NPN transistor to the PNP emitter and to said positive terminal; a direct connection, without substantial resistance, between said NPN collector and the base of the PNP transistor; a capacitor having a negative side connected to said lamp by a direct connection without substantial resistance, with the lamp in series between said capacitor and the negative terminal; a direct connection, without substantial resistance, between the positive side of said capacitor and the base of said NPN transistor; and means including a high resistance value resistor providing a connection between said last mentioned direct connection and said low value resistor and providing a parallel connection between said last mentioned direct connection and said PNP base, providing a weak current path from said source through said lamp, said capacitor, and said high and low value resistors, for charging said capacitor while positive potential is built up on the PNP base for rendering the PNP transistor non-conducting.

2. In a low voltage electric light flasher apparatus, in combination: a lamp; positive and negative terminals for connection to a low voltage source; a direct shunt connection between one side of said lamps and said negative terminal a PNP transistor arranged with its emitter and collector having respective shunt connections to said lamp and positive terminal and thereby connected in series with the other side of said lamp and source when said transistor is conducting; an NPN transistor having a direct shunt connection between its emitter and the negative terminal; means including a low value resistor in series connecting the collector of said NPN transistor to the PNP emitter and to said positive terminal; a direct shunt connection between said NPN collector and the base of the PNP transistor, said resistor providing a minimum voltage drop between said PNP emitter and base for establishing emitter bias in said PNP transistor; a capacitor and a high value resistor in series with one another, connected in parallel to said other side of said lamp and the PNP collector on one side and in parallel to said low value resistor and the PNP emitter and positive terminal on the other side, the base of said NPN transistor being connected between said capacitor and said high value resistor; said lamp, capacitor, and resistors in series providing a weak current path for gradually charging said capacitor while simultaneously raising the base potential of said NPN transistor to back-bias the same until it becomes conductive, the direct connection between said NPN collector and said PNP base utilizing the load current of said NPN transistor to drop the potential on the base of said PNP transistor until the latter becomes conducting and provides a collector current which is effective to illuminate said lamp and to simultaneously discharge said condenser for the beginning of another cycle of operation.

3. A light flasher apparatus as defined in claim 2, wherein said low voltage source is a dry battery, and including a casing in which said battery, transistors, resistors and connections are encased.

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