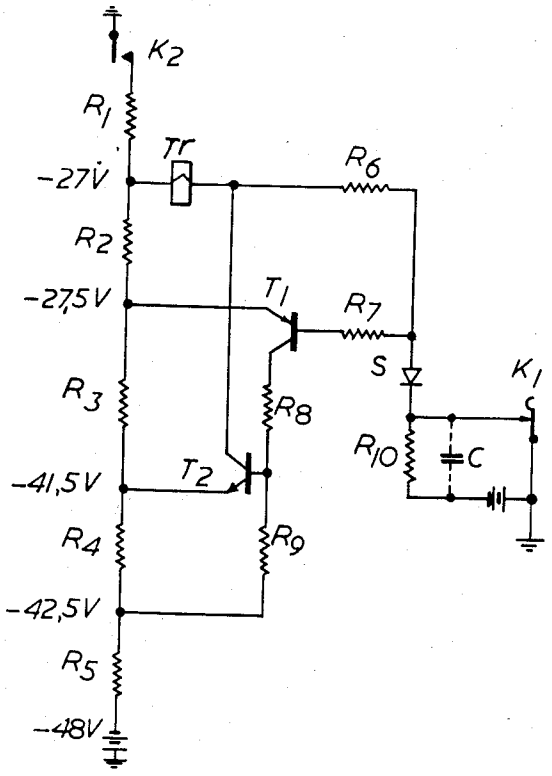
March 12, 1963 S. M. SIMON 3,081,419

ELECTRICAL TRIGGER CIRCUIT

Filed April 14, 1959



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United States Patent Office 3,081,419 Patented Mar. 12, 1963

3,081,419

ELECTRICAL TRIGGER CIRCUIT

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Filed Apr. 14, 1959, Ser. No. 806,278
Claims priority, application Belgium Apr. 28, 1958
6 Claims. (Cl. 317—148.5)

The invention relates to an electrical trigger circuit and more particularly to a circuit including two transistors of opposed conductibilities and being able to be in two distinct electrical conditions.

Such circuits can be used for various purposes and particularly in telecommunication equipments to operate relays.

Trigger circuits using transistors are already known and reference can for instance be made to U.S. Patent No. 2,744,198 where two transistors of opposite type are used. However, according to these known circuits, the operation is similar to an Eccles-Jordan circuit, i.e. the two distinct electrical conditions correspond to a reversal of the condition of the two transistors, but one of them is always conductive, while the other is locked or non-conductive.

An object of the invention is to realize an electrical trigger circuit particularly well adapted to reveal the momentary application of an electrical signal of very short duration in order to operate a relay, the order of magnitude of the duration of this electrical signal being distinctly less than the operation time of a telephone type relay.

Another object of the invention is to realize an electrical trigger circuit adapted to produce the operation of a relay after a certain predetermined time.

According to a first characteristic of the invention, an electrical trigger circuit as defined above is characterized in that the two distinct electrical conditions of this circuit correspond respectively to the two transistors being non-conductive or to the two transistors being conductive.

According to another characteristic of the invention, an electrical trigger circuit as characterized above is characterized in that the base of the first transistor is coupled to the collector of the second transistor and vice-versa.

The objects and characteristics of the invention mentioned above as well as others, will become more apparent by referring to the following detailed description of a preferred embodiment of the invention read in conjunction with the accompanying drawing and which represents a trigger circuit adapted to operate either as timing device or as a circuit reacting on very short current pulses.

The circuit will first of all be described in assuming that capacitor C is not inserted in the circuit and that the circuit is adapted to cause the operation of relay Tr during a very short-contact interruption normally ensured by a pulse source here shown generally as key K_1. This situation can for instance take place in telephone exchanges and more particularly when a registering circuit wants to cause the operation of a relay due to the operation of a change-over contact of a relay, which may be part of the circuit controlled from this register. When it is necessary to reveal e.g. the operation of a relay forming part of a selector circuit of a telephone system, the contact in its rest position can normally give a ground to the register, but as soon as the relay is operated, the change-over contact in its work position can again be connected to a ground. From this moment on, the operation of the selector relay cannot be revealed by the simple momentary interruption of the

ground. The shown circuit is particularly well adapted to this use since it permits the operation of relay Tr on condition that key K_1 is open only during a few hundredths of a microsecond.

When the circuit is put into service, contact k_2 is closed thus causing the connection of the voltage divider, constituted by resistances R_1 to R_5 in series, between earth at contact k_2 and the negative battery of 48 volts. By way of example various potentials have been indicated at the potentiometer terminals.

The least negative potential i.e. —27 volts is connected to the base of a first transistor T_1 of the p-n-p type, through an electro-mechanical load circuit such as the winding of relay Tr in series with the resistances R_6 and R_7. This potential is also connected across the winding of relay Tr to the collector of a second transistor T_2 of the n-p-n type. The next potential of —27.5 volts is directly connected to the emitter of transistor T_1, the next potential of —41.5 volts is directly connected to the emitter of transistor T_2 whereas the most negative potential of —42.5 volts is connected to the base of transistor T_2 via resistance R_9, this base being moreover coupled to the collector of transistor T_1 across resistance R_8.

The ground being normally applied to the cathode of rectifier S by means of key K_1 and the anode of this rectifier being connected to the junction point of resistances R_6 and R_7, the rectifier is normally blocked. Moreover, the emitter-base circuits of the two transistors are so biased that neither of them is conductive in the rest condition of the circuit.

When key K_1 even momentarily opens, the cathode of rectifier S is now connected to the negative battery of —48 volts across resistance R_{10} and a current flows immediately in the emitter-base circuit of transistor T_1. The emitter current of transistor T_1 is amplified in the collector circuit of this transistor and reaches the base of transistor T_2 across resistance R_8 to be again amplified in the collector of this last transistor. The greater part of the amplified current flows through the winding of relay Tr which operates while the rest of the amplified current flows in the base of transistor T_1 via resistances R_6 and R_7. The two transistors thus become conductive due to a cumulative effect and they continue to energize each other, this action being independent from the initial trigger current.

By way of example, the values of the resistances R_1 to R_9 can be 510 ohms, 10 ohms, 270 ohms, 20 ohms, 100 ohms, 120 kilo ohms, 10 kilo ohms, 7.5 kilo ohms and 18 kilo ohms.

Means are provided for applying "on" or "off" signals a selected time interval after operation of the pulse source key K_1, thereby controlling the operate time of relay Tr. Thus, if the circuit has to be used for timing delays for instance in a telephone exchange register in order to cause the automatic release of the register after a certain time of occupation, capacitor C is connected in parallel with resistance R_{10}.

In this case, the capacitor is initially charged to the full voltage of the battery, while key K_1 remains closed. When opening this key, capacitor C discharges exponentially across resistance R_{10} and as soon as the potential at the cathode of rectifier S is more negative than —27.5 volts, a current starts flowing in the base of transistor T_1 which produces the cumulative trigger effect already mentioned above.

By using a capacitor of 50 microfarads and a value of 1.5 megohms for resistance R_{10}, one could for instance obtain delay times of the order of various tenths of seconds.

While the principles of the invention have been described above in connection with specific apparatus, it is

to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

I claim:

1. An electrical trigger circuit comprising a PNP transistor and an NPN transistor, each transistor having base, collector, and emitter electrodes, means including at least one resistance for coupling the base of each transistor to an electrode of the other transistor so that current flowing through the emitter-collector circuit of each transistor is amplified by the other transistor, whereby said two transistors form a bistable circuit, means comprising a voltage pulse source for applying a reference voltage to an electrode of one of said transistors, means for applying a control voltage to the base electrode of said one transistor whereby said one transistor switches "on" or "off" responsive to changes in the polarity of said control voltage relative to said reference voltage, means associated with said control voltage applying means for selecting the time required for said one transistor to switch "on" or "off," and load circuit means controlled by current in the emitter-collector circuit of the other transistor when said one transistor is switched on.

2. The circuit of claim 1 wherein said load circuit comprises the winding of electro-mechanical means and said control voltage is supplied by a pulse source.

3. The circuit of claim 2 and a two terminal source of potential, a four terminal voltage divider connected across said two terminals of said source, said four terminals being connected to the collector of said other transistor, the emitter of said one transistor, the emitter of said other transistor, and the collector of said one transistor to provide graduated bias potentials in the order named.

4. The circuit of claim 3 wherein said time selecting means comprises a capacitor in series with a rectifier also connected to said one resistance for controlling the rise time of voltage from said pulse source, said rectifier being poled to be momentarily back biased by a voltage on said capacitor during said rise time and then forwardly biased after said rise time, thereby controlling the operate time of said electro-mechanical means.

5. An electrical trigger circuit comprising a PNP transistor and an NPN transistor, each transistor having base, collector, and emitter electrodes, means including at least one resistance for coupling the base of each transistor to an electrode of the other transistor so that current flowing through the emitter-collector circuit of each transistor is amplified by the other transistor, whereby said two transistors form a bistable circuit, means comprising a voltage pulse source for applying a reference voltage to an electrode of one of said transistors, means for applying a control voltage to the base electrode of said one transistor whereby said one transistor switches "on" or "off" responsive to changes in the polarity of said control voltage relative to said reference voltage, load circuit means controlled by current in the emitter-collector circuit of the other transistor when said one transistor is switched on, said load circuit comprising the winding of electromechanical means, two terminal sources of potential, a four terminal voltage divider connected across said two terminals of said source, said four terminals being connected to the collector of said other transistor, the emitter of said one transistor, the emitter of other said transistor, and the collector of said one transistor to provide graduated biasing potentials in the order named, a resistor connected in series with the resistor at the base electrode of said transistor, and said means for applying said control voltage comprising means for connecting said pulse source to the junction between said series connected resistors.

6. The circuit of claim 5 and means comprising a capacitor also connected to the junction between said resistors for controlling the rise time of voltage from said pulse source, thereby controlling the operate time of said electromechanical means.

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