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STATIC TIME-LAG RELAY

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Fig. 1

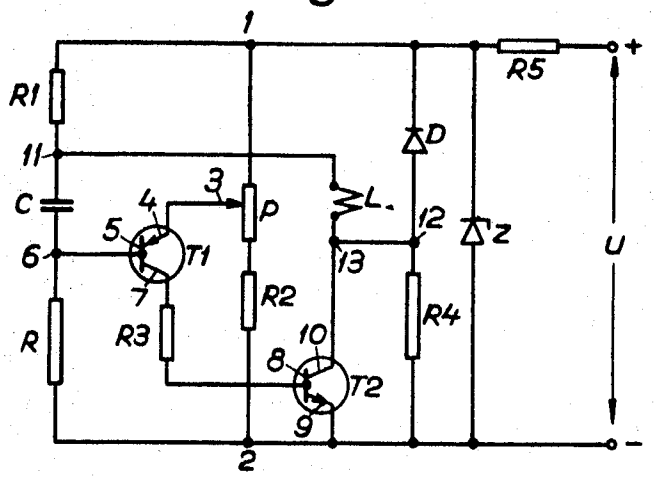
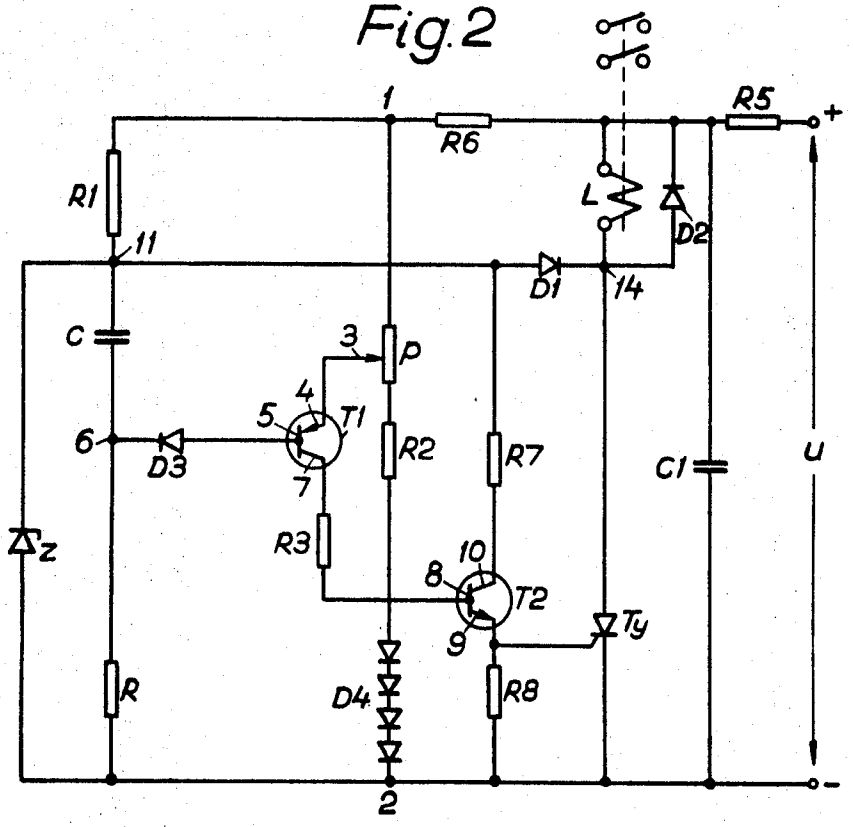


Fig. 2



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STATIC TIME-LAG RELAY

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ABSTRACT OF THE DISCLOSURE

A time-lag relay has an RC circuit and a potentiometer circuit forming two parallel branches of a resistor bridge. The diagonal of the bridge constituted by the base emitter part of a transistor is connected to the RC circuit between the resistor and the capacitor and to the movable contact of the potentiometer circuit. The collector of this transistor is connected to a second transistor which regulates the current to the relay winding. A compensating resistor connected in the capacitor part of the RC circuit has such a value that in a releasing operation the voltage across it created by the charge current of the capacitor is of the same value as the forward drop voltage of the base-emitter circuit of the first transistor, so that the delay normally required for charging the capacitor to a voltage corresponding to the base-emitter voltage of the transistor is eliminated.

BACKGROUND OF THE INVENTION

(1) Field of the invention

The invention relates to a static time lag relay with an RC circuit.

(2) The prior art

In static time-lag relays with an RC-circuit, where the tripping of the relay is determined by the charging cycle for the capacitor in the RC-circuit it is known to arrange the RC-circuit in a bridge connection as one branch, while the second branch contains a potentiometer circuit for adjustment of the charging level of the capacitor. The diagonal of the bridge contains the base-emitter part of a transistor and is connected to the RC-circuit between the resistor and the capacitor. The connection to the potentiometer circuit occurs across the movable contact of the potentiometer. The collector of the transistor is connected to an element for regulating the current to the excitation winding of the relay.

Due to the unavoidable voltage drop in the base-emitter circuit of the transistor, the transistor does not open until the capacitor voltage has increased to the value corresponding to the mentioned voltage drop. The shortest value at which the relay can be adjusted is, therefore, equal to the sum of the relay's own operating time and the time necessary for the capacitor to be charged to a voltage equal to the base emitter voltage drop of the transistor in the bridge branch.

SUMMARY OF THE DISCLOSURE

The present invention relates to a time-lag relay with an RC-circuit and a potentiometer circuit, where the RC-circuit forms one branch and the potentiometer circuit the other branch of two parallel-connected branches of a resistor bridge and where the diagonal, containing the base emitter part of a transistor, is connected to the RC-circuit between its resistor and capacitor and to the movable contact of the potentiometer circuit, while the collector of the transistor is connected to a control element for controlling the current through the excitation winding of the relay. The invention is characterised in that, in that part of the RC-circuit containing the capacitor, a compensating resistor is connected, the resistance of which has such a value that during a releasing operation the voltage drop across the resistor, caused by the charging current of the capacitor, is of the same value as the forward drop voltage in the base-emitter circuit of the transistor.

By this arrangement the increased tripping time of the relay is eliminated, which otherwise is an unavoidable due to the fact that the capacitor has to be charged to the voltage corresponding to the base-emitter voltage drop of the transistor when this becomes conducting, as is the case with known relay connections.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawing shows two embodiments of a time-lag relay according to the invention. FIG. 1 shows a connection for short intervals, while FIG. 2 shows a time-lag relay for longer intervals.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the embodiment shown in FIG. 1 the time-lag relay comprises an RC-circuit, consisting of a resistor R and a capacitor C. Between a point **1** and the capacitor C a resistor R1 is connected. The other end of the RC-circuit is connected to a point **2**, which is connected to the negative pole of the feeding voltage source of the relay with the voltage U. Further, between the points **1** and **2** a potentiometer circuit is connected, consisting of a resistor R2 and a potentiometer P with a movable contact **3**. A first transistor T1 has its emitter **4** connected to the movable contact **3**. The base **5** of the transistor is connected to the RC-circuit at a point **6** between the resistor and the capacitor. The collector **7** of the transistor is connected to the base **8** of a second transistor T2 across a resistor R3. The emitter **9** of the transistor is connected to the minus-pole, while the collector **10** is connected across the excitation coil L of the relay to the end of the resistor R1 at a point **11** facing the capacitor C.

Parallel with the potentiometer circuit there is a circuit comprising a diode D and a resistor R4. A point **12** between the diode and the resistor is connected with a point **13** between the relay coil L and the transistor T2. This circuit has many important functions. As soon as the relay has been connected to the voltage source, the voltage U will lie across the limiting resistor R5, the resistor R1, the relay coil L and the resistor R4. By suitably dimensioning the resistors, and particularly the resistor R1, there will be a voltage across resistor R1, equal to the voltage of the base emitter circuit of the transistor T1. This makes the transistor conductive as soon as the capacitor C has a voltage corresponding to the situation of the potentiometer P. The voltage across the resistor R will thus compensate the base-emitter voltage drop in the transistor. If the contact 3 of the potentiometer is placed in its upper position in the figure, the relay will in principle switch instantaneously, which cannot occur if the compensating resistor R1 is lacking, as the capacitor first has to be charged to a voltage corresponding to the base emitter-voltage of the transistor.

When the relay has tripped and after it has been disconnected from the voltage source, the inductive energy stored in the relay coil L has to be discharged. This is done by means of the circuit D, R1, L. The voltage impulse thus arising across R1 will considerably speed up the discharging of the capacitor across R1, P, the base-emitter circuit of T1 and C. The resistor R1 thus causes an extra rapid discharging of the capacitor resulting in a short resetting time of the relay and, besides, it will be

quite independent of the forward voltage drop in the base-emitter circuit of the transistor T1.

When tripping the relay, the resistor R1 has another advantage. When the capacitor voltage has increased to such a value that the transistor T2 becomes conducting, the current through R1 and L will increase and the voltage across R1 increases. Thereby also the voltage of the base of the transistor T1 increases and the two transistors will be more conductive. This together results in a positive feed back and the transistors T1 and T2 will operate as switches which means that the spread of the tripping time will be quite negligible.

The voltage of the relay is stabilized by means of the Zener diode Z parallel with D and R4.

FIG. 2 shows a somewhat modified embodiment of the invention. The voltage U lies across the resistors R5, R6 and R1 and the Zener diode Z. The compensating resistor R1 is so dimensioned that the voltage across it is about 1 v. The blocking voltage of the Zener diode is about 18 v. In the diagonal part between the potentiometer P and the point 6 in the RC-circuit there is inserted a diode D3, which makes it possible to use a higher voltage on the capacitor in the RC-circuit and thus longer tripping time for the time-lag relay. The higher reverse voltage in the diagonal part is blocked by the diode D3 and thus it protects the transistor. In the potentiometer circuit four diodes D4 are connected, which together give a voltage drop of about 2 v. in the forward direction to compensate the voltage drops across the resistor R1 and the diode D1 and the thyristor Ty at relay tripping.

The collector 7 of the transistor T1 is connected by the resistor R3 to the base 8 in the transistor T2 and said transistor is connected in parallel with the Zener diode by the resistors R7 and R8. The emitter 9 of the transistor is connected to the control electrode of a thyristor Ty. The relay coil is series connected with the thyristor. The connection point 14 between the relay coil and the thyristor is connected to the point 11 between the resistor R1 and the capacitor C in the RC-circuit across a diode D1. Further, the relay coil L is connected in parallel with another diode D2. A capacitor C1 in parallel with L and Ty when the relay is being connected causes the voltage across it to be obtained with a certain time-lag, which is necessary partly as a voltage derivative protection for the thyristor and partly to prevent the output capacitance of the transistors from transmitting a trigger pulse to the thyristor.

The time-lag relay is connected to the voltage U being 110 v. By means of the voltage divider R5, R6, R1 and Z about 100 v. is obtained across L and Ty. Across R1 lies about 1 v. and across the Zener diode about 18 v. The capacitor C of the RC-circuit starts charging across R. Gradually the voltage of the capacitor corresponds to the adjusted voltage across the potentiometer P. The forward voltage drops in T1 and D3 are compensated by the voltage across R1. T1 then becomes conducting and can in its turn control the second transistor T2 which gives a trigger pulse to the thyristor Ty. The resistors R7 and R8 give suitable voltage division to trigger the thyristor.

When the thyristor ignites, its anode voltage drops instantaneously from 100 v. to about 0.5 v. The relay trips, and the diode D1 opens and takes over the current which earlier has fed the Zener diode so that the voltage across it drops from 18 to 1 v. The capacitor C is discharged across R1, P, T1 and D3 and the discharge is made in such a way that the capacitor voltage becomes zero. The forward voltage drop of T1 and D3 is compensated by the voltage drop across R1. The diodes D4 together take up 2 v. and due to this the potentiometer becomes dead and the discharging of the capacitor becomes independent of the adjustment of P. The diodes also have a temperature compensating function.

What is claimed is:

1. Time-lag relay having an RC circuit comprising a resistor (R) and a capacitor (C) in series and a potentiometer circuit, comprising a movable contact (3) where the RC circuit forms one and the potentiometer circuit the other of two parallel branches in a resistor bridge and where the diagonal of the bridge, which comprises the base emitter part of a transistor (T1) is connected to the RC circuit between its resistor (R) and its capacitor (C) and to the movable contact (3) of the potentiometer circuit, whereas the collector (7) of the transistor (T1) is connected to a control element (T2) for regulating the current to the excitation winding (L) of the relay, in which, in that part of the RC circuit containing the capacitor (C), a compensating resistor (R1) is connected, the resistance of which has such a value that in a releasing operation the voltage drop across the compensating resistor, which is created by the charge current of the capacitor, is of the same value as the forward drop voltage of the base-emitter circuit of the transistor.

2. Time-lag relay according to claim 1, in which the control element for regulating the current comprises a second transistor (T2), the emitter-collector circuit of which comprises the relay winding (L) and the compensating resistor (R1).

3. Time-lag relay according to claim 2, in which parallel to the series connection of the second transistor (T2), the relay coil (L) and the compensating resistor (R1), a diode (D) and a resistor (R4) are connected, these two branches being connected to each other so that the diode (D) is in parallel with the relay winding and the compensating resistor (R1) while the resistor (R4) is in parallel with the second transistor (T2).

4. Time-lag relay according to claim 1, in which the diagonal also comprises a diode (D3) which is connected between the transistor (T1) and the RC-circuit.

5. Time-lag relay according to claim 1, in which the control element for regulating the current to the excitation winding (L) of the relay comprises a thyristor (Ty) which has its control electrode connected to a second transistor (T2), which in turn is controlled by the transistor (T1) in the diagonal.

6. Time-lag relay according to claim 1, in which a Zener diode (Z) is parallel-connected with the capacitor (C) and the resistor (R) in the RC-circuit.

7. Time-lag relay according to claim 6, in which the potentiometer circuit includes a number of diodes (D4).

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