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VOLTAGE CONTROL SYSTEM

Filed Aug. 7, 1957

Fig. 1.

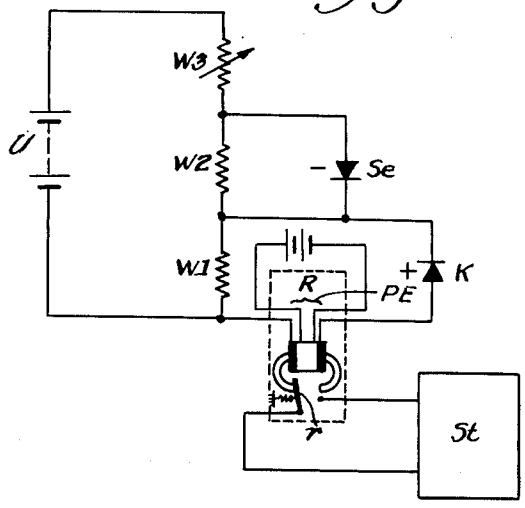
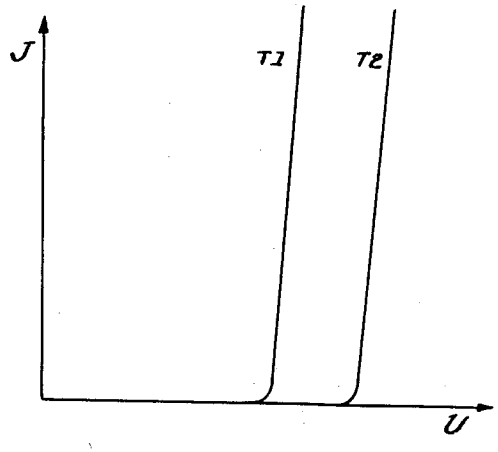


Fig. 2.



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VOLTAGE CONTROL SYSTEM

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5 Claims. (Cl. 317—157)

This invention relates to voltage supervising or control systems and is particularly concerned with a circuit arrangement for increasing the sensitivity of electromagnetic relays for voltage supervision or control purposes.

It is known to provide for the supervision of direct voltages relays, operating at an adjustable energization either as overload relays or at adjustable restoration as underload relays. The purpose of such relays is to initiate signalling or regulation operations responsive to deviation of the voltage, increase or decrease, from a predetermined desired value, to restore the corresponding desired voltage conditions. The adjusting operations required for restoring the desired voltage conditions may be effected manually or automatically; automatic operation is as a rule always required when the possible voltage fluctuations are of relatively short duration. The resulting voltage supervision protects the equipment supplied by current against overload and underload, respectively. This protection against possible voltage fluctuations is particularly important in the case of signalling or protecting equipment comprising relays which might cause error even if the supply voltage fluctuates within relatively narrow limits.

The object of the invention is to provide a switching arrangement that makes it possible to operate supervision relays responsive to very small voltage fluctuations. It will be possible in this manner to effect voltage supervision within a relatively small tolerance range and to prevent, despite slow increase or decrease of voltage to be supervised, creeping contact actuation as it occurs ordinarily in such cases.

The objects of the invention are realized by the provision of a crystal rectifier operated in blocking direction and connected in series with an electromagnetic relay, and placing the working point of the rectifier within the region of the Zener voltage. The working point of the crystal rectifier may be suitably adjusted by means of a voltage divider connected in parallel with the current source the voltage of which is to be controlled

Silicon diodes are particularly suitable for use as crystal rectifiers because they fulfill in a high degree the requirement of producing responsive to small voltage variations high current variations. Silicon diodes are in addition less sensitive to temperature influences than other semiconductors and a relatively constant temperature response may be expected in the operation thereof.

In order to obtain in the presence of a given percentage-voltage variation a current variation as high as possible, it is of advantage to have the steep portion of the characteristic current curve in the neighborhood of the normal or resting position. In a silicon diode operated in the blocking direction, this is the case within the region of the Zener-voltage, that is to say, within the voltage region in which the blocking current increases rapidly.

In accordance with another feature of the invention, it is in connection with increasing the sensitivity of a relay by connecting a crystal rectifier in blocking direction, advantageous to connect for the compensation of temperature errors a semiconductor with negative temperature coefficient cooperating with a voltage divider, ahead of the crystal rectifier which operates with a positive temperature coefficient. A suitably dimensioned selenium rectifier is, for example, suitable for this purpose.

The various objects and features of the invention will appear from the description which will be rendered below with reference to the accompanying drawing.

FIG. 1 shows an example of the switching arrangement of the invention; and

FIG. 2 shows as an aid for explaining the invention, the voltage-current characteristic of a crystal rectifier in blocking direction for two different temperature ranges.

Letter U in FIG. 1 indicates the direct current source the voltage of which is to be supervised, as to predetermined voltage limits, by a relay R. Relay R controls a contact *r* for governing the operation of a suitable device *St* which may be either a signaling device or an adjusting device operative to correct voltage fluctuations recognized by the actuation of relay R. A crystal rectifier, for example, a silicon diode rectifier K is connected in series with relay R. A voltage divider comprising resistors W1, W2 and W3 serves for the adjustment of the working point of the crystal rectifier K. The voltage required for the resting position is obtained at the resistor W1. The variable resistor W3 serves the purpose of matching the circuit with the supply voltage to be supervised. The fixed resistor W2 disposed between the resistors W1 and W3 serves in conjunction with a parallel disposed selenium rectifier *Se* the purpose of compensating to a far-reaching extent temperature influences affecting the crystal rectifier.

As will be seen from FIG. 2, the Zener voltage of the crystal rectifier will increase responsive to a temperature increase, for example, from T1 to T2, which characteristic is indicated in FIG. 1 by a "plus" sign. This means, that an increased resting voltage must be connected to the crystal rectifier K so as to maintain uniform operating conditions, which is effected by the selenium rectifier *Se*. The resistance of the selenium rectifier *Se* will decrease responsive to temperature increase, which characteristic is indicated in FIG. 1 by a "minus" sign, causing an increase of the voltage across the resistor W1. The original resting current accordingly continues to flow, that is, the desired working point of the crystal rectifier K is maintained in spite of the altered temperature conditions.

The winding of relay R which is in series with the crystal rectifier K is preferably of low resistance in order to alter the steep characteristic of the curve, caused by the Zener current, as little as possible. Since the capacity of the crystal rectifier is often limited, it is, in the case of series connection of relays operating with higher current, suitable to produce part of the current requirement for the control of the relays by constant preparatory energization at a value that does not cause operation thereof. The crystal rectifier can then be loaded with a current supplying only the further energization that is required for effecting operative actuation of the control relay. The preparatory energization may be effected by an additional winding PE placed on the relay R or, if desired, by premagnetization through the medium of a permanent magnet.

Changes may be made within the scope and spirit of the appended claims.

I claim:

1. In a circuit arrangement for increasing the sensitivity of an electromagnetic control relay, said circuit arrangement comprising a voltage divider including a plurality of serially related resistors connected in parallel with said current source, a crystal rectifier operating in blocking direction with positive temperature coefficient and connected in parallel with one of said resistors with said control relay operatively connected between said crystal rectifier and said one resistor, said voltage divider setting the working point of said crystal rectifier which lies within

the range of the Zener voltage, a device for compensating temperature influences affecting said crystal rectifier, said device comprising a semiconductor member operating with negative temperature coefficient, circuit means for connecting said semiconductor member in parallel with another one of said resistors, further circuit means for connecting said semiconductor member with said crystal rectifier, and control contact means governed by said control relay responsive to operative actuation thereof.

2. A structure and cooperation of parts according to claim 1, comprising a silicon diode constituting said crystal rectifier.

3. A structure and cooperation of parts according to claim 2, comprising a selenium rectifier constituting said semiconductor member.

4. A structure and cooperation of parts according to claim 1, comprising means for producing constant preparatory energization of said control relay which is insufficient to effect operative actuation thereof, the current flowing across said crystal rectifier causing further energization of said control relay which is superimposed upon said preparatory energization and causes operative actuation thereof.

5. A structure and cooperation of parts according to claim 1, wherein the winding of said control relay has relatively low resistance for the purpose of increasing the operative effect of said crystal rectifier.

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