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RELAY CIRCUIT

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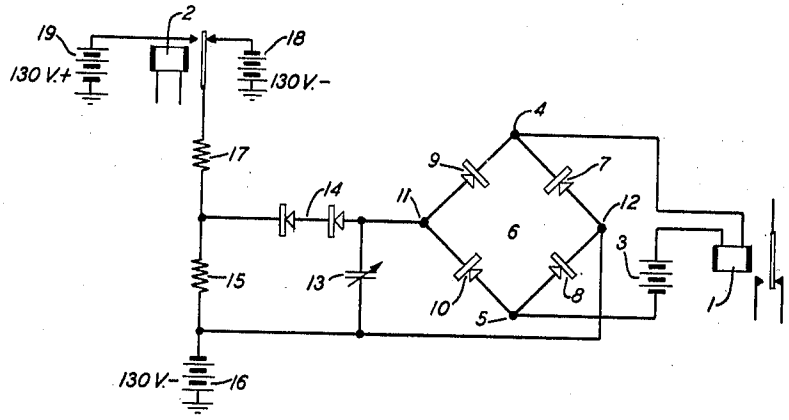

INVENTOR
W. F. KANNENBERG

BY P. C. Smith

ATTORNEY

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RELAY CIRCUIT

Walter F. Kannenberg, Rutherford, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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This invention relates to electromagnetic apparatus and more particularly to a circuit for delaying the energization of an electromagnetic device and thereby, in the case of a relay, delaying the attraction of its armature for a considerable period of time after the circuit is established.

The usual means for delaying the operation of a relay involves a short-circuited winding or copper slug on the relay core or a special construction of the relay. It is the object of the present invention to provide a novel and improved means for operating a relay after a definite and controllable interval, whereby the relay may be of standard and simple construction. A further object of the invention is in the provision of a relay controlling circuit whereby a much longer delay interval may be attained than heretofore possible with a relay having a copper slug or short-circuited winding.

In accordance with the present invention, these objects are attained by employing a controlling circuit for the relay including a copper-oxide bridge, a condenser, an asymmetric resistance and sources of potential. The relay is bridged in series with a biasing battery across the output terminals of the bridge. One input terminal of the bridge is connected to one terminal of the condenser and through an asymmetric resistance or copper-oxide rectifier to one terminal of a resistance and the other input terminal of the bridge is connected to the other terminal of the condenser and to the other terminal of the resistance whereby the condenser is connected directly across the input of the bridge and the resistance is shunted across the bridge through the rectifier. The resistance is connected in series from a source of 130 volt negative potential through a secondary resistance to the armature contact of a control relay and is completed either to a source of 130 volt negative potential or 130 volt positive potential dependent upon whether the control relay is unoperated or operated.

For a clearer comprehension of the invention and the manner in which it functions, reference may be had to the following detailed description taken in connection with the accompanying drawing.

The relay whose delayed operation is to be controlled is shown at 1. This relay may be of the usual polarized type having no provision in its construction for delaying its response. The operation of thi. .elay is controlled by any desired means as for example by the relay 2. The winding of relay 1 is bridged in series with the biasing battery 3 across the output terminals 4 and 5 of the bridge 6. The four arms of the bridge 6 comprise the copper-oxide rectifiers 7, 8, 9 and 10 poled as indicated.

The input terminal 11 of the bridge is connected to one terminal of condenser 13 and through the asymmetric resistance 14, which may be a copper-oxide rectifier, to one terminal of resistance 15. The other input terminal 12 of the bridge is connected to the other terminal of condenser 13 and to the other terminal of resistance 15. Thus the condenser 13 is connected directly across the input terminals of the bridge and the resistance 15 is shunted across the input terminals of the bridge through the rectifier 14.

The resistance 15 is included in a control circuit extending from the negative or ungrounded terminal of 130 volt battery 16 through resistance 15, resistance 17 to the armature contact of control relay 2 and is completed either to the negative or ungrounded terminal of 130 volt battery 18, which may be the same battery as the battery 16, or to the positive or ungrounded terminal of 130 volt battery 19 dependent upon whether relay 2 is unoperated or operated.

The circuit functions in the following manner: With the control relay 2 unoperated, negative potential is connected to each terminal of resistance 15, condenser 13 is uncharged, and both input terminals 11 and 12 of the bridge 6 are at the same potential. Current from the biasing battery 3 will, however, flow from the positive terminal thereof through the winding of relay 1, output terminal 4 of the bridge and thence by parallel paths over arms 7 and 8 and arms 9 and 10 of the bridge to output terminal 5 and to the negative terminal of battery 3. Since, however, the current tends to flow in the high resistance direction through the rectifiers comprising the arms of the bridge, the biasing effect of battery 3 will only be sufficient to insure that the armature contact of relay 1 will be held against its back contact.

When the control relay 2 operates to close its front contact, batteries 16 and 19 are connected in series aiding relationship and current will flow from the positive terminal of battery 19 over the front contact of relay 2 through resistances 17 and 15 to the negative terminal of battery 16 and by one parallel path through the rectifier 14 and condenser 13 and by a second parallel path through rectifier 14, input terminal 11, arm 9 and terminal 4 of bridge 6, through the winding of relay 1 and biasing battery 3, terminal 5, arm 8 and terminal 12 of bridge 6. The current flowing

through the winding of relay 1 over the path just traced, through rectifier 14 is in opposition to the biasing current from battery 3 and, although in the proper direction to cause the operation of relay 1, is of insufficient strength since the rectifier 14 is so poled as to offer high resistance to the flow of current.

Condenser 13 now charges slowly since the rectifier 14 is poled to present a high resistance in the charging circuit thereof extending as previously traced from battery 18 through resistance 17, rectifier 14 and condenser 13 to battery 16. As soon, however, as condenser 13 reaches its full charge, the difference of potential between terminals 11 and 12 of the bridge will be such that sufficient current will flow through the bridge to overcome the potential of the biasing battery 3 and relay 1 will thereupon operate. The excess of current required to overcome the biasing effect of battery 3 and to cause relay 1 to operate may be very slight.

The delay in the operation of relay 1 after the operation of relay 2 is thus determined by two factors; first, the charging time of condenser 13 as determined by the high resistance characteristic of rectifier 14 and second, by the potential of the biasing battery 3. This delay may thus be regulated by changing the resistance value of rectifier 14, by changing the potential of battery 3 or by varying the capacitance of condenser 13. To render the capacitance of condenser 13 easily alterable, this condenser might be made of the well-known adjustable type.

When control relay 2 releases the negative 130 volt battery 18 is connected over its back contact through resistances 17 and 15 to the negative 130 volt battery 16 and, with the two terminals of resistance 15 thus at the same potential, condenser 13 discharges quickly in a path through rectifier 14 in its low resistance direction and through resistance 15. Biasing battery 3 is now effective to quickly release relay 1.

The relay 1 might also be of the simple non-polarized type in which event the normal effect of the biasing battery 3 would be to energize the winding thereof insufficiently to move its armature contact from engagement with its back contact. When, however, current flows through the bridge in response to the operation of relay 2 and reaches its maximum value when condenser 13 becomes fully charged, this current will oppose the current flowing from biasing battery 3 and will be of sufficient magnitude to cause relay 1 to move its armature contact into engagement with its front contact. Thereafter, when condenser 13 quickly discharges in response to the release of relay 2, current will cease to flow through the bridge and relay 1 will therefore quickly release.

From the foregoing description, it will be apparent that provision is made for rendering relay 1 slow to operate following the operation of relay 2 and quick to release following the release of relay 2. While batteries 16, 18 and 19 have been disclosed as having a particular voltage, batteries of other voltage might be used commensurate with the voltage of biasing battery 3 and the values of other elements of the circuit.

What is claimed is:

1. In combination, a first source of current, a condenser, a rectifier bridge having its input terminals connected across said condenser, a source of biasing current, an electromagnetic device having its winding connected in series with said source of biasing current across the output terminals of said bridge, and means for connecting said first source of current with said condenser and with the input terminals of said bridge whereby when said condenser becomes charged, current of sufficient strength will flow through said bridge to overcome said source of biasing current and to operate said electromagnetic device.

2. In combination, a first source of current, a condenser, a rectifier bridge having its input terminals connected across said condenser, an electromagnetic device, a source of biasing current connected in series with the winding of said electromagnetic device across the output terminals of said bridge and of such potential as to just hold said electromagnetic device in its unoperated condition, and means for connecting said first source of current with said condenser and with the input terminals of said bridge, whereby when said condenser becomes charged, current of sufficient strength will flow through said bridge to overcome said source of biasing current and to operate said electromagnetic device.

3. In combination, a first source of current, a condenser, a rectifier bridge having its input terminals connected across said condenser, a source of biasing current, an electromagnetic device having its winding connected in series with said source of biasing current across the output terminals of said bridge, a control circuit connected with said condenser and with the input terminals of said bridge including a resistance element which presents a high resistance to the flow of charging current to said condenser, and means for connecting said first source of current to said control circuit, whereby when said condenser becomes charged, current of sufficient strength will flow through said bridge to overcome said source of biasing current and to operate said electromagnetic device.

4. In combination, a first source of current, a condenser, a rectifier bridge having its input terminals connected across said condenser, a source of biasing current, an electromagnetic device having its winding connected in series with said source of biasing current across the output terminals of said bridge, a control circuit including a resistance, said resistance being bridged across said condenser and across the input terminals of said bridge through a resistance element which presents a high resistance to the flow of current through said bridge and to the flow of charging current to said condenser, and means for connecting said first source of current to said control circuit, whereby when said condenser becomes charged, current of sufficient strength will flow through said bridge to overcome said source of biasing current and to operate said electromagnetic device.

5. In combination, a first source of current, a condenser, a rectifier bridge having its input terminals connected across said condenser, a source of biasing current, an electromagnetic device having its winding connected in series with said source of biasing current across the output terminals of said bridge, a control circuit connected with said condenser and with the input terminals of said bridge including a resistance element which presents a high resistance in the charging path and a low resistance in the discharging path of said condenser, and means effective upon its operation for connecting said first source of current to said control circuit for

establishing the charging path of said condenser and upon its release for establishing the discharging path of said condenser, whereby the operation of said electromagnetic device is delayed following the operation of said means until said condenser becomes charged and its release follows immediately after the release of said means.

6. In combination, a first source of current, a condenser, a rectifier bridge having its input terminals connected across said condenser, a source of biasing current, an electromagnetic device having its winding connected in series with said source of biasing current across the output terminals of said bridge, a control circuit including a resistance having its terminals normally maintained at the same potential, said resistance being bridged across said condenser and across the input terminals of said bridge through a resistance element which presents a high resistance to the flow of current through said bridge and to the flow of charging current through said condenser and presents a low resistance to the discharge current from said condenser through said resistance, and means effective upon its operation for connecting said first source of current to said control circuit for establishing the charging path of said condenser whereby when said condenser becomes charged, current of sufficient strength will flow through said bridge to overcome said source of biasing current and to operate said electromagnetic device, and effective upon its release for rendering the discharge path of said condenser effective whereby said electromagnetic device quickly releases.

WALTER F. KANNENBERG.