

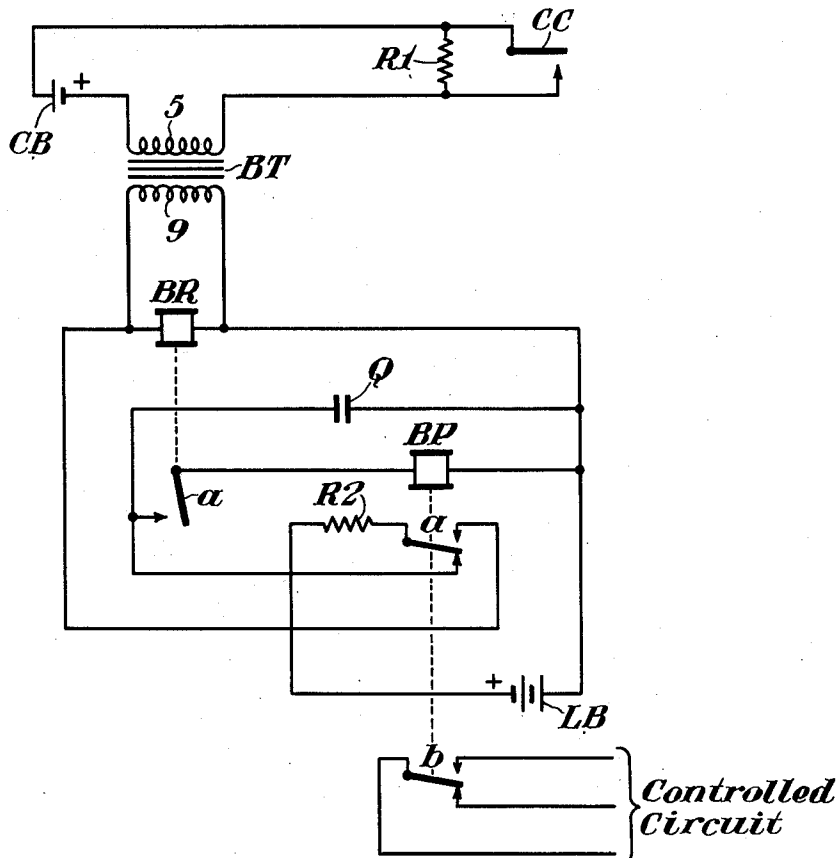
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IMPULSE OPERATED RELAY CIRCUITS

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IMPULSE OPERATED RELAY CIRCUITS

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My invention relates to impulse operated relay circuits, and particularly to an improved circuit arrangement for operating a repeater relay by an impulse operated relay, with provision for restoring the impulse operated relay to its normal position at a predetermined time after it has been operated by an impulse.

It has previously been proposed to provide means for restoring impulse operated relays including separate windings on impulse transformers which operate the relays, such separate windings being energized by suitable means to cause a restoring impulse to be supplied to the operating winding of the impulse operated relay, the energization usually being controlled by a contact of the impulse relay itself. Additionally, it has previously been proposed to provide restoring means for impulse operated relays by including a separate winding on the impulse operated relay, which is energized from a suitable source by a circuit which is closed at a predetermined time interval after the impulse relay is operated, and the relay is then restored to its normal position by the energy supplied to the restoring winding.

It has been found that in order to obtain a high degree of efficiency in circuits of the type in which a relay is operated by impulses of energy supplied thereto by a transformer for a given size of transformer and a given relay structure, the efficiency is directly related to the winding space available. Accordingly, it will be seen that if a certain amount of the winding space on either the impulse transformer or the relay structure is taken to provide for a restoring winding of the type described above, the efficiency of the system as a whole will be reduced.

Accordingly, it is an object of my invention to provide an impulse operated relay circuit with restoring means which requires no additional windings on the impulse relay structure itself nor on the impulse transformer which supplies energy to the winding of the relay.

Another object of my invention is to provide an impulse operated relay circuit in which the contact capacity of the impulse relay is reduced to a minimum, so that the relay can be made more sensitive in operation.

Another object of my invention is to provide impulse operated relay circuits, wherein the impulse operated relay governs a repeater relay, having a plurality of contacts which may enter into the control of various circuits; and which repeater relay governs the restoration of the impulse operated relay to its normal position fol-

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lowing the termination of an operating impulse supplied thereto.

A further object of my invention is to provide a circuit of the type described, in which the repeater relay of the impulse operated relay is provided with means for delaying its operation, by a predetermined time interval, so that associated control equipment will have sufficient time in which to operate upon the reception of an impulse.

Still another object of my invention is to provide an impulse operated relay circuit wherein the repeater relay of the impulse operated relay is supplied with energy from a charged capacitor, and the circuit parameters are arranged so that the operating time of the repeater relay is dependent upon the charge stored in the capacitor, and the rate at which the charge is dissipated through the repeater relay.

A further object of my invention is to provide an impulse operated relay circuit which is economical in the use of contacts on the relays, in the use of winding space on the relay and the transformer which supplies the impulses thereto, and in the use of energy for the operation of the repeater relay and the restoration of the impulse operated relay, to thereby provide increased efficiencies in the overall system.

Other objects of my invention and features of novelty thereof will become apparent from the following description, taken in connection with the accompanying drawing.

In practicing my invention, I provide, in addition to the impulse transformer and the associated sensitive impulse relay, a repeater relay, an energy storage device such as a capacitor, and a source of low voltage direct current energy for supplying energy to the capacitor and for additionally providing energy for restoring the contact of the impulse relay. These parts are arranged in such manner that the capacitor is normally charged by energy supplied thereto from the low voltage source of direct current energy over a normally released contact of the repeater relay. When the contact of the impulse relay is operated as a result of an impulse supplied to the winding of the relay from a winding of the impulse transformer, the energy stored in the capacitor is supplied through the winding of the repeater relay, so that the repeater relay picks up its contacts. When the contacts of the repeater relay are picked up, the supply of charging energy to the capacitor is cut off, and accordingly the repeater relay will release after a short time interval, which is dependent upon the

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value of the capacitor and the resistance of the relay. During the time that the contacts of the repeater relay are picked up, a circuit is established for supplying energy from the low voltage direct current source, over a picked up contact of the repeater relay, to the winding of the impulse relay and the winding of the impulse transformer, which are thereby effectively connected in multiple across the source at this time. The polarity of the energy supplied to the winding of the impulse relay at this time is such that the contact of the relay is retained in its operated position. After the charge on the capacitor has dissipated sufficiently the contacts of the repeater relay will release, and when the circuit for supplying energy to the windings of the impulse relay and impulse transformer is interrupted, the self-induced energy in the winding of the impulse transformer will cause the contacts of the impulse relay to operate to their normal position. At the same time, the release of the repeater relay again establishes the circuit for supplying energy to the capacitor so that the capacitor receives a new charge, to enable it to operate the relay for a following impulse. Circuits which are to be controlled in accordance with the impulses are governed by suitable contacts on the repeater relay.

I shall describe one form of the impulse operated relay circuit embodying my invention and shall then point out the novel features thereof in claims.

In the single accompanying drawing, there is shown a diagrammatic view of a circuit arrangement embodying my invention, as used to detect changes of current in a circuit in which the resistance is at times changed.

Referring to the drawing, there is shown a source of control energy such as the low voltage battery CB, which is connected in series with a first winding 5 of an impulse transformer BT, and a resistor R1. The resistor R1 is adapted to be shunted at times by a control contact CC, so that the value of current flowing through the series circuit is at times changed abruptly from a low value to a relatively higher value. It is to be understood that the circuit shown in connection with the primary or first winding 5 of transformer BC is for the purpose of describing the invention, and the circuit arrangement of the controlling circuit is not limited to that shown, but may take any form in which changes of current in the primary winding of a transformer will cause impulses of voltage and current in its secondary winding. It will be seen therefore that normally current flows from the positive terminal of battery CB, through the first winding 5 of transformer BT and through the resistor R1 to the negative terminal of the battery. This current will have a constant value depending upon the resistances of the transformer winding, the resistor R1, and the connecting wires, as well as the voltage of the battery CB. When the control contact CC is closed, the resistor R1 is shunted, so that the resistance of the circuit as a whole is suddenly reduced. This causes a corresponding sudden increase in the current supplied through the winding 5 of transformer BT, and as is well-known in the art, such a sudden change in the current flowing through the first winding of the transformer will cause an impulse of energy to be induced in the second winding 9 of transformer BT.

The winding of an impulse relay BR is connected across the second winding 9 of trans-

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former BT, so that impulses of energy induced in the second winding 9 are supplied to the winding of the impulse relay, and cause the operation of the contact *a* of the relay. It will be assumed for the sake of this description, that the parts are arranged and constructed so that when energy flows through the winding of relay BR from left to right, the contact *a* of relay BR is operated from its first or right-hand position to its second or left-hand position. The relay BR is of the polar stick type, having a "stay-where-put" contact, that is, a contact which remains in its last operated position until energy of opposite polarity is supplied to the winding of the relay, at which time the contact will take up a position corresponding with the new polarity. It will be assumed for the purposes of this description that the polarity of the impulse induced in the secondary winding 9 of transformer BT and supplied to the winding of relay BR when the controlling contact CC shunts the resistor R1 is such as to cause the contact of the relay to operate to its left-hand position.

Associated with the impulse relay and impulse transformer are a suitable source of low voltage direct current energy, such as the battery LB shown, a repeater relay BP, which is of the ordinary neutral electromagnetic type, a capacitor Q, and a limiting resistor R2, the functions of which will be subsequently described. The contact *b* of relay BP is employed to control other circuits, and to produce proper response in these circuits to the reception of an impulse. These controlled circuits per se form no portion of my invention, and are therefore not illustrated.

With the apparatus in its normal condition, as shown, energy is supplied with current flowing from the positive terminal of battery LB, through the limiting resistor R2, over back contact *a* of the repeater relay BP to the left-hand element of the capacitor Q. The right-hand plate or element of capacitor Q is connected to the negative terminal of battery LB, and accordingly, it will be apparent that the capacitor Q will have a charge thereon determined by the value of the capacitor and the voltage of the energy supplied thereto from the battery LB. The winding of relay BP is supplied with energy by a circuit which includes contact *a* of the impulse relay BR, but since this contact is in its right-hand or first position at this time, no energy is supplied to the relay BP. It will be apparent that at this time there is no energy drain from the battery LB, except for possible leakage current through the capacitor, which in any event would be negligible.

It will now be assumed that the controlling contact CC is closed, which, as previously described, will cause an impulse of energy to be supplied from the winding 9 of the transformer BT to the winding of the impulse relay BR, having a polarity such that the impulse relay BR will operate its contact *a* to its second or left-hand position. When contact *a* of relay BR closes, a circuit is established for supplying energy from the capacitor Q through the winding of the relay BP, as will be obvious from the drawing. Additionally, when the contact *a* of relay BR first closes a circuit is established for supplying energy from the battery LB to the winding of relay BP over the back contact *a* of relay BP, but as relay BP picks up its contacts, this circuit is interrupted, and relay BP is energized solely by the energy supplied thereto from the capaci-

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tor Q. Accordingly, relay BP will pick up and remain picked up during the time that the energy stored in capacitor Q is being dissipated through the winding of the relay. This time interval will, of course, be dependent upon the voltage to which the capacitor Q is charged, the capacity of the capacitor, and the resistance of the winding of relay BP. After the charge on the capacitor Q is dissipated to a value such that the current flow through the winding of relay BP is insufficient to retain the relay in its picked up position, the contacts of the relay will release. The value for capacitor Q may be selected to provide any desired release time for relay BP, as governed by requirements of the circuits controlled by contacts b.

During the short picked-up time, which may be of the order of several seconds, of the relay BP, a circuit is established for supplying energy to the winding of the impulse relay BR and the second winding 9 of the transformer BT, which circuit may be traced from the positive terminal of battery LB, through the limiting resistor R2, front contact a of relay BP, and through the winding of the impulse relay and impulse transformer in multiple to the negative terminal of the battery. Accordingly, the polarity of the energy flowing through the winding of relay BR is such as to retain the contact a of the relay in its left-hand or second position. In addition, the flow of current through the winding 9 of transformer BT causes energy to be stored in the magnetic circuit of the transformer. When relay BP releases, the flow of current through the winding 9 is interrupted, and the magnetic field of the transformer collapses. This collapse of the field causes a voltage to be induced in the winding 9 of the transformer BT which will have a polarity such that current will flow through the winding of relay BR from right to left. The flow of energy from the winding 9 of transformer BP, with current through the winding of relay BR in this direction, will cause the contact a of relay BR to be restored to its normal or right-hand position.

When the relay BP releases, its back contact a reestablishes the circuit for supplying energy from battery LB to the capacitor Q, the charging time of the capacitor being determined by the value of the capacitor and the resistance of the limiting resistor R2. Resistor R2 serves to limit the initial charging current of the capacitor to a safe value. The value of R2 may also be selected within limits of resistance that will be sufficiently high to insure against BP picking up again before BR has restored, and sufficiently low to insure that capacitor Q will be fully charged before the next operation of the impulse relay. Resistor R2 additionally serves, when relay BP is in its picked up position, to limit the current flow through the transformer and relay winding to a suitable value.

When the controlling contact CC in the circuit associated with the first winding 5 of transformer BT is opened, the value of current flowing in this circuit is suddenly diminished, and accordingly an impulse of energy is induced in the second winding 9 of the transformer BT. However, this impulse of energy is of a polarity such as to cause the contacts of relay BR to remain in their right-hand or first position.

It will be apparent from the foregoing that each time the impulse relay BR is operated as a result of the supply thereto of an impulse of energy from the impulse transformer BT, the re-

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peater relay BP is picked up, for a time interval which is dependent upon a number of factors including the size of the capacitor Q. Thereafter the relay BP will release, and thereby cause the restoration of the impulse relay to its normal position, and the preparation of the circuits for subsequent actuation. The control circuits may be governed by contact b of repeater relay BP, and the time interval of the operation of relay BP may be adjusted so that sufficient time is allowed for actuation of the circuits controlled by the repeater relay.

Although I have herein shown and described only one form of impulse operated relay circuit embodying my invention, it is to be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, an impulse relay having a contact operated between a first and a second position in accordance with the polarity of energy supplied to a winding of the relay, a transformer having a first and a second winding, circuit means connected to said first winding including a source of control energy and means for at times changing the value of current supplied from said source to said first winding whereby impulses of energy are induced in said second winding at times, said second winding being connected to the winding of said impulse relay to cause operation of the contact of said relay from said first to said second position by each impulse of energy, a repeater relay governed by the contact of said impulse relay, and means for restoring the contact of said impulse relay to its first position after each operation thereof to its second position, comprising circuit means including a contact of said repeater relay for momentarily supplying energy to said second winding when the contact of said impulse relay is in its second position, the polarity of the energy being such that the contact of the impulse relay is operated to its first position by the induced energy supplied to the winding of the relay when the supply of energy to the second winding is interrupted by the contact of said repeater relay.

2. In combination, an impulse relay having a contact operated between a first and a second position in accordance with the polarity of energy supplied to a winding of the relay, a transformer having a first and a second winding, circuit means connected to said first winding including a source of control energy and means for at times changing the value of current supplied from said source to said first winding whereby impulses of energy are induced in said second winding at times, said second winding being connected to the winding of said impulse relay to cause operation of the contact of said relay from said first to said second position by each impulse of energy, a slow acting repeater relay governed by the contact of said impulse relay, and means for restoring the contact of said impulse relay to its first position after each operation thereof to its second position, comprising circuit means including a contact of said repeater relay for supplying energy to said second winding when the contact of said impulse relay is in its second position, the polarity of the energy supplied to the winding being such that the contact of the impulse relay is operated to its first position by the induced energy supplied to the winding of the

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relay when the supply of energy to the second winding is interrupted by the contact of said repeater relay.

3. In combination, an impulse relay having a contact operated between the first and a second position in accordance with the polarity of energy supplied to a winding of the relay, a transformer having a first and a second winding, circuit means connected to said first winding including a source of control energy and means for at times changing the value of current supplied from said source to said first winding whereby impulses of energy are induced in said second winding at times, said second winding being connected to the winding of said impulse relay to cause operation of the contact of said relay from said first to said second position by each impulse of energy, a slow release repeater relay governed by a contact of said impulse relay and means for restoring the contact of said impulse relay to its first position after each operation thereof to its second position, comprising circuit means including a contact of said repeater relay for supplying energy to said second winding when the contact of said impulse relay is in its second position, the polarity of the energy supplied to the winding being such that the contact of the impulse relay is operated to its first position by the induced energy supplied to the winding of the relay when the supply of energy to the second winding is interrupted by the contact of said repeater relay.

4. In combination, an impulse relay having a contact operated between a first and a second position in accordance with the polarity of energy supplied to a winding of the relay, a transformer having a first and a second winding, circuit means connected to said first winding including a source of control energy and means for at times changing the value of current supplied from said source to said first winding whereby impulses of energy are induced in said second winding at times, said second winding being connected to the winding of said impulse relay to cause operation of the contact of said relay from said first to said second position by each impulse of energy, a repeater relay governed by a contact of said impulse relay and arranged to be operated momentarily when the contact of said impulse relay moves from its first to its second position, and means for restoring the contact of said impulse relay to its first position after each operation thereof to its second position, comprising circuit means including a contact of said repeater relay for supplying energy to said second winding when the contact of said impulse relay is in its second position, the polarity of the energy supplied to the winding being such that the contact of the impulse relay is operated to its first position by the induced energy supplied to the winding of the relay when the supply of energy to the second winding is interrupted by the contact of said repeater relay.

5. In combination, an impulse relay having a contact operated between a first and a second position in accordance with the polarity of energy supplied to a winding of the relay, a transformer having a first and a second winding, circuit means connected to said first winding including a source of control energy and means for at times changing the value of current supplied from said source to said first winding whereby impulses of energy are induced in said second winding at times, said second winding being connected to the winding of said impulse relay to cause operation of the

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contact of said relay from said first to said second position by each impulse of energy, a capacitor, a repeater relay, circuit means for charging said capacitor with direct current energy, a circuit including said contact of said impulse relay closed in its second position for discharging said capacitor through a winding of the repeater relay, whereby said repeater relay is momentarily operated when the contact of the impulse relay is operated from its first to its second position, and means for restoring the contact of said impulse relay to its first position after each operation thereof to its second position, comprising circuit means including a contact of said repeater relay for supplying energy to said second winding when the contact of said impulse relay is in its second position, the polarity of the energy supplied to the winding being such that the contact of the impulse relay is operated to its first position by the induced energy supplied to the winding of the relay when the supply of energy to the second winding is interrupted by the contact of said repeater relay.

6. In combination, an impulse transformer having a first and a second winding, a polar stick relay having a winding connected to said second winding of the impulse transformer and having a contact operable between a first and a second position in accordance with the polarity of the energy supplied to the winding of the relay, circuit means connected to the first winding of said transformer including a source of control energy and means for at times changing the value of current supplied from said source to said first winding and effective at times to induce impulses of energy in said second winding of a polarity to cause the contact of the impulse relay to operate from its first to its second position, a repeater relay having a winding and having contacts which are operable from a first to a second position when energy of a predetermined value is supplied to the winding of the relay, a source of direct current, a capacitor, a first circuit for charging said capacitor to an energy value exceeding said predetermined value including a contact of said repeater relay closed in its first position, a second circuit for discharging the energy stored in said capacitor through the winding of said repeater relay including the contact of said polar stick relay closed in its second position, and a third circuit including a contact of said repeater relay closed in its second position for supplying energy from said source to said second winding of the impulse transformer, said third circuit being arranged so that the polarity of the energy supplied to said second winding from said source is effective to retain the contacts of said impulse relay in their second position.

7. In combination, an impulse transformer having a first and a second winding, a polar stick relay having a winding connected to said second winding of the impulse transformer and having a contact operable between a first and a second position in accordance with the polarity of the energy supplied to the winding of the relay, circuit means connected to the first winding of said transformer including a source of control energy and means for at times changing the value of current supplied from said source to said first winding and effective at times to induce impulses of energy in said second winding of a polarity to cause the contact of the impulse relay to operate from its first to its second position, a repeater relay having a winding and having contacts which are operable from a first to a second posi-

tion when energy of a predetermined value is supplied to the winding of the relay, a source of direct current, a capacitor, a first circuit for charging said capacitor to an energy value exceeding said predetermined value including a 5 contact of said repeater relay closed in its first position, a second circuit for discharging the energy stored in said capacitor through the winding of said repeater relay including the contact of said polar stick relay closed in its second position, a third circuit including a contact of said 10 repeater relay closed in its second position for supplying energy from said source to said second winding of the impulse transformer, said third circuit being arranged so that the polarity of the 15 energy supplied to said second winding from said

source is effective to retain the contacts of said impulse relay in their second position, and a controlled circuit governed by a contact of said repeater relay.

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