July 13, 1943. A. E. DODD 2,324,200

ELECTRICAL CONTROL APPARATUS

Filed Dec. 23, 1941

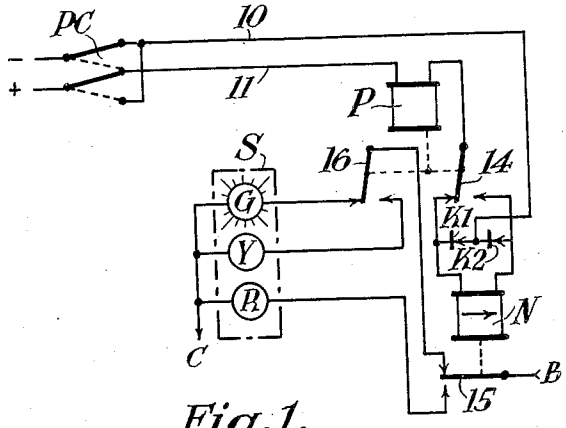


Fig. 1.

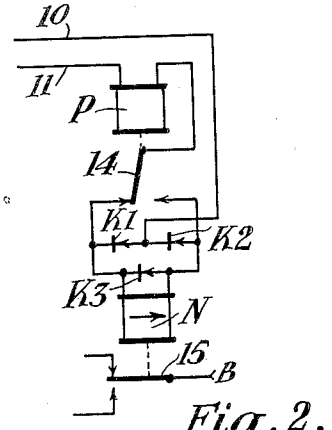


Fig. 2.

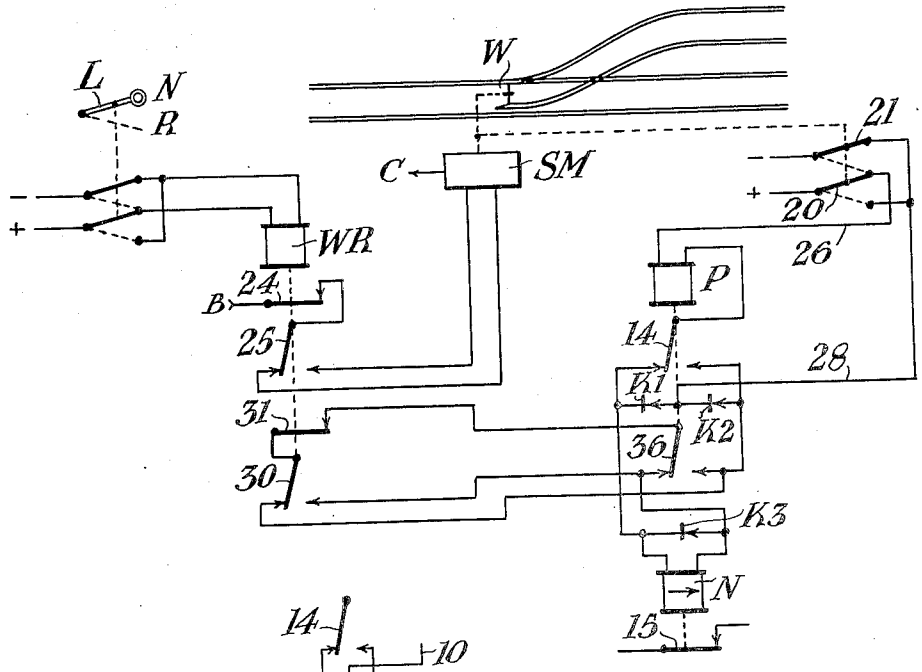


Fig. 3.

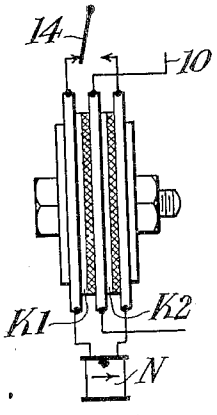


Fig. 4.

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ELECTRICAL CONTROL APPARATUS

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Application December 23, 1941, Serial No. 424,151

16 Claims. (Cl. 246—219)

My invention relates to electrical control apparatus and particularly to apparatus for effecting one function when a control circuit is energized by current of one relative polarity and another function when the control circuit is energized by current of the other relative polarity.

The apparatus of this invention is an improvement on that shown and claimed in application Serial No. 311,955 of Harry E. Ashworth, filed December 30, 1939, now Patent No. 2,250,214 dated July 22, 1941, and in application Serial No. 402,609 of Andrew Hufnagel, filed July 16, 1941.

The above-mentioned applications show control apparatus employing a polar relay and a biased polar relay energized from a polarized control circuit, and arranged so that the biased polar relay checks the polar relay to insure that it responds to a change in the polarity of the energy supplied over the control circuit.

The system shown in the application of Andrew Hufnagel is arranged so that the windings of the polar relay and of the biased polar relay are energized in series, while in some of the modifications shown in that application a rectifier is connected across the terminals of the biased polar relay to render the relay contacts slow in releasing, and to provide increased protection against picking up of the relay contacts when energy of the wrong polarity is supplied to the relay winding.

It is an object of this invention to provide an improved system of the type described and incorporating means to check the integrity of the circuits of the rectifiers employed in the system.

A further object of the invention is to provide an improved system of the type described which is arranged so that fewer contacts of the polar relay are required than have been necessary in the systems heretofore known.

A further object of the invention is to provide an improved system of the type described which is adapted to be employed to indicate the position of a track switch, and is arranged to check correspondence between the positions of the contacts of the polarized switch control relay and of the polarized switch indication relay.

Another object of the invention is to provide improved control apparatus.

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

I shall describe several forms of apparatus embodying my invention and shall then point out the novel features thereof in claims.

In the drawing Fig. 1 is a diagram illustrating one embodiment of my invention,

Fig. 2 is a diagram showing a modification which I may employ,

Fig. 3 is a diagram showing a modification of the invention adapted to indicate the position of a track switch and to check correspondence between a switch control relay and a switch indication relay, and

Fig. 4 is a diagram showing means which I may employ to establish connection with the rectifiers.

Similar reference characters refer to similar parts in each of the several views.

Referring to Fig. 1 of the drawing the reference character P designates a polar relay, while the reference character N designates an auxiliary relay. The windings of the relays P and N are energized over a polarized control circuit here shown as comprising conductors 10 and 11 which are connected by contacts of a pole changer PC with a suitable source of direct current, such as a battery, the terminals of which are designated + and —. The conductors 10 and 11 may be line wires, or they may be the track rails of a section of railway track, while the pole changer PC may be a manually operated device, it may be the contacts of a relay, or it may be any other suitable mechanism.

Rectifiers or asymmetric elements K1 and K2 are connected in series across the terminals of the relay N. The rectifiers K1 and K2 together form a rectifier unit having a first and a second terminal and the rectifier elements are both poled to permit energy to flow from the second or right-hand terminal of the unit to the first or left-hand terminal of the unit. The rectifier unit also has an intermediate terminal to which the control wire 10 is connected.

Although the rectifiers K1 and K2 have been described as constituting a unit they may be constructed as separate elements and connected together as shown.

The relay N is preferably but not necessarily of the polar biased type and its contacts become picked up when and only when energy flows in one direction through the relay winding. One relay which I may employ is shown in application Serial No. 194,160 of Harry E. Ashworth, now Patent No. 2,203,888 dated June 11, 1940, while another relay which I may employ is shown in United States Patent No. 2,057,695, issued October 13, 1936, to Herman G. Blosser. The various parts of the apparatus are arranged so that relay N picks up only when the positive terminal

of the source is connected to the left-hand terminal of the relay winding.

The relay P is of the polar stick type, being constructed in such manner that the contacts of the relay when moved to either position remain in that position until energy of the polarity effective to move the relay contacts to their other position is supplied to the relay winding.

The contact 15 of relay N, and contact 16 of relay P may cooperate to perform any desired control function, as, for example, to control the lamps of a signal S.

When the equipment is in the condition shown in the drawing energy from the positive terminal of the source flows through conductor 11, winding of relay P and contact 14 of the relay to the left-hand terminal of the winding of auxiliary relay N, through the winding of this relay, and thence through the rectifier K2 and conductor 10 to the negative terminal of the source.

Under this condition the windings of the relays P and N are energized in series, while the polarity of the energy supplied to the relay P is such that the relay contacts occupy their left-hand positions, as shown, and the direction of flow of energy through the winding of relay N is that which is effective to pick up the contact of the relay. Accordingly, contact 15 of relay N and contact 16 of relay P cooperate to establish the circuit of the lamp G of signal S.

On a reversal of the pole changer PC the positive terminal of the source is connected to conductor 10 and the negative terminal of the source is connected to conductor 11. At the instant of reversal of the pole changer PC contact 14 of relay P is in its left-hand or normal position, as shown, so that energy flows from the positive terminal of the source over conductor 10, through rectifier K1, contact 14 of relay P to the right-hand terminal of the winding of relay P, and thence through the relay winding and conductor 11 to the negative terminal of the source.

The energy flowing in this direction through the winding of the relay P causes the contacts of the relay to move to their right-hand or reverse position. As soon as contact 14 moves out of engagement with its left-hand contact the circuit traced above for energizing the winding of relay P is interrupted, but because of the operating characteristics of the relay the contacts of the relay continue to move and complete their movement to their right-hand or reverse positions.

When the contacts of the relay P complete their movement to their right-hand positions a circuit is completed to energize the windings of the relays P and N in series.

At this time the relays P and N are energized over the circuit which is traced from the positive terminal of the source over control wire 10, and rectifier K1 to the left-hand terminal of the winding of relay N, through this winding, contact 14 of relay P to the right-hand terminal of the winding of relay P, through this winding and over the control wire 11 to the negative terminal of the source.

As the positive terminal of the source is connected to the left-hand terminal of the winding of relay N energy flows through this winding in the proper direction to pick up the relay contact, and as the positive terminal of the source is connected to the right-hand terminal of the winding of relay P the contacts of this relay are maintained in their right-hand or reverse positions.

As a result of movement of the contacts of relay P from their left-hand to their right-hand positions contact 16 interrupts the circuit of the lamp G of signal S and establishes the circuit of the lamp Y.

The operation of the equipment on a subsequent change in the polarity of the energy supplied to the control circuit is similar to that just described. On the supply of energy of normal polarity to the control circuit at a time when the contacts of relay P are in their right-hand or reverse positions the relay P is energized over the circuit which is traced from the positive terminal of the source over control wire 11, winding of relay P, right-hand polar contact 14, rectifier K2, and control wire 10 to the negative terminal of the source. This energy causes the contacts of relay P to shift to their left-hand or normal positions, so that the windings of relays P and N are again energized in series over the circuit which is traced from the positive terminal of the source over control wire 11, winding of relay P, left-hand contact 14 of relay P to the left-hand terminal of the winding of relay N, through this winding, and thence through rectifier K2 and control wire 10 to the negative terminal of the source. The direction of flow of energy through the winding of relay N is proper to maintain the relay contacts picked up, while the flow of energy through the winding of relay P is in the direction to maintain the contacts of this relay in their left-hand or normal positions.

If for any reason the supply of energy over the control wires 10 and 11 is interrupted the contact 15 of relay N will release and interrupt the circuit of the lamp Y or G of signal S, and establish the circuit of the lamp R of this signal.

The rectifiers K1 and K2 provide a snubbing circuit for the relay N and the various parts of the equipment are selected and proportioned so that the release of the contacts of the relay N is delayed long enough as a result of the presence of the snubbing circuit provided by the rectifiers K1 and K2 that the relay contacts remain picked up during a change in the polarity of the energy supplied to the control wires. This is desirable as it prevents a flash of the red lamp which would otherwise be present at these times.

The system of this invention is arranged so that the circuits of the rectifiers K1 and K2 are checked to detect interruption of the connections with the rectifier terminals, or of failure of either rectifier to prevent flow of energy in the wrong direction.

The system provided by this invention, like those shown in the applications of Ashworth and Hufnagel, also operates so that the relay N checks response of the relay P to a change in the polarity of the energy supplied to the control wires.

The modification shown in Fig 2 is similar to that shown in Fig. 1 and differs therefrom in that a rectifier K3 is connected directly across the terminals of the winding of relay N in multiple with the rectifiers K1 and K2. The rectifier K3 is poled to permit energy to flow in the same direction as the rectifiers K1 and K2, that is, from the second to the first terminal of the rectifier unit. Accordingly, the rectifier K3 provides an additional snubbing circuit of low resistance for the relay N and prolongs the release time of the relay contacts. In addition, the rectifier K3 serves to prevent improper energization of the relay N in the event of failure of the rectifiers

K1 and K2 or of the connections with the rectifier terminals.

If, while the contacts of the relay P are in their normal positions, energy of reverse polarity is supplied to the control wires and the contacts of relay P fail to move to their reverse positions energy will normally flow through rectifier K1 and is prevented from flowing through the winding of relay N by the rectifier K2. If the connection with the left-hand terminal of the rectifier K1 is broken or disconnected in such manner as to leave the left-hand terminal of the winding of relay N connected to the left-hand polar contact 14 of relay P, and if at the same time the rectifier K2 breaks down, energy would flow through the winding of relay N in the wrong direction to pick up the relay contacts, but this energy would maintain the relay contacts picked up if they became picked up in some other manner. The rectifier K3 eliminates this possibility as it shunts the relay N, and under the conditions outlined too little energy will flow in the winding of relay N to maintain the relay contacts picked up.

Similarly, if while the contacts of relay P are in their reverse positions energy of normal polarity is supplied to the control wires and the contacts of the relay P fail to move to their normal positions, energy normally will flow through the rectifier K2 and will be prevented from flowing through the winding of relay N by the rectifier K1. If the connection with the right-hand terminal of rectifier K2 is broken or disconnected in such manner as to leave the right-hand terminal of the winding of the relay N connected to the right-hand polar contact 14 of relay P, and if at the same time the rectifier K1 breaks down, energy would flow through the winding of relay N, except for the rectifier K3 which shunts the relay winding and reduces the flow of energy in the winding to a value ineffective to maintain the relay contacts picked up.

The modification shown in Fig. 2, therefore, provides increased protection against false operation of the relay N. The operation of the modification shown in Fig. 2 is otherwise the same as that shown in Fig. 1 and a detailed explanation thereof is unnecessary.

Instead of employing the rectifier K3 to prevent energization of the relay N by current of the wrong polarity in the event the circuit of a rectifier is defective, the improper operation of the apparatus due to failure of a connection with a rectifier may be eliminated by establishing connection with the rectifiers in the manner well known in the art and illustrated in Fig. 4 of the drawing.

Although this invention is not limited to the use of rectifiers or asymmetric units of any particular type I prefer to use units constructed substantially in accordance with United States Patent No. 1,640,335 of Lars O. Grondahl, while a rectifier designed for use in connection with this invention is shown in application Serial No. 430,642 of B. Lazich and R. Williams, filed February 12, 1942.

Referring to Fig. 4 of the drawing the rectifier unit shown therein consists of copper washers or discs K1 and K2 which are mounted between spacers which may serve as terminal plates. The rectifying washers and the spacers are mounted on, but are insulated from a tie bolt.

The wire leading from the left-hand polar contact 14 of relay P is connected to one point on the terminal plate at the left-hand or output side of the rectifier element K1, while the wire leading from the left-hand terminal of the winding of relay N is connected to a different point on this terminal plate.

In like manner the wires leading from the right-hand polar contact of relay P and the right-hand terminal of the winding of relay N are connected to different points on the terminal plate at the right-hand or input side of the rectifier K2.

This arrangement of the connections between the rectifier terminal plates and the polar contacts of relay P and the terminals of the winding of relay N insures that the connection with a rectifier terminal will be maintained as long as a connection between a polar relay contact and a terminal of the winding of relay N is maintained since this connection includes the rectifier terminal plate in series therewith.

Furthermore, as a wire leading from a polar relay contact and a wire leading from a terminal of the winding of the relay N are connected to a rectifier terminal plate at different points on this member there is no possibility that these wires will become disconnected from the rectifier terminal plate while remaining connected to each other.

The foregoing method of connecting a rectifier in a circuit so that an element of the rectifier is included in series with the circuit to insure that the rectifier is connected in the circuit as long as the circuit is maintained is not a part of this invention, but has been illustrated herein to show the manner in which these connections are made when they are employed in the system of my invention.

It is preferred that the method shown in Fig. 4 for making connection with the rectifier terminals be employed in each of the various species shown in this application. However, in order to simplify the drawing and the disclosure the connections with the rectifiers have been shown in the conventional manner.

Although the modifications shown in Figs. 1 and 2 have been illustrated and described in connection with control circuits in which steady energy is employed, it should be understood that they are equally applicable to control circuits in which coded or periodically interrupted energy is employed. In such a system the relay N serves as a code following relay, while the relay N has associated therewith decoding means which may be of the type shown in United States Patent No. 2,237,788 issued to Frank Nicholson and Leslie R. Allison, and the system may be organized as shown in application Serial No. 367,972 of Frank H. Nicholson, filed November 30, 1940.

The systems shown in Figs. 1 and 2 of the drawing are adapted for use in a switch correspondence circuit to indicate when the switch control relay and switch indication relay associated with a railway track switch are in correspondence, and Fig. 3 is a diagram illustrating this application of the invention.

Referring to Fig. 3 there is shown therein a track switch W which is movable between a normal and a reverse position by a switch machine SM. The machine SM may be of any appropriate construction and is controlled by a polarized switch control relay WR, which in turn is controlled by a control lever L. The switch has associated therewith contacts 20 and 21 which are governed in accordance with the position of the switch, and control the supply of energy to the relay P and to the auxiliary relay N, while the

circuits of these relays are controlled by neutral and polar contacts of relay WR.

The system shown in Fig. 3 employs a rectifier unit similar to that shown in Fig. 1 and consisting of rectifier elements K1 and K2.

The system shown in Fig. 3 is shown in the condition which it assumes when the switch control lever L, the switch control relay WR, the switch W, and the switch indication relay P are in their normal positions.

As the switch control lever L is in its normal position energy of normal polarity is supplied to the switch control relay WR and its polar contacts occupy their left-hand or normal positions so that neutral contact 24 and polar contact 25 establish the circuit to cause the switch machine SM to move the switch W to its normal position.

As the switch W is in its normal position the switch operated contacts 20 and 21 establish connections to supply energy of normal polarity to the indication wires 26 and 28 and the relays P and N are energized in series over the circuit which is traced from the positive terminal of the source through contact 20, indication wire 26, winding of relay P, left-hand or normal polar contact 14 of relay P, left-hand terminal of the winding of relay N, through the winding of relay N, left-hand or normal contact 36 of relay P, front neutral contact 31 and normal polar contact 30 of relay WR, rectifier K2, indication wire 28, and contact 21 to the negative terminal of the source.

The energy supplied to the relay P causes the contacts of this relay to occupy their left-hand or normal positions, while at this time energy flows through the winding of relay N from its left-hand to its right-hand terminal and is effective to pick up the contact 15 of the relay.

On movement of the controll ever L to its reverse position energy of reverse polarity is supplied to relay WR and the polar contacts of this relay shift to their right-hand or reverse positions so that contact 25 establishes the circuit to cause the switch machine SM to move the switch W to its reverse position.

On movement of the contact 30 of relay WR to its reverse position the circuit traced above for energizing the relays P and N in series is interrupted so that relay N is deenergized and its contact 15 releases.

When the switch W completes its movement to its reverse position the contacts 20 and 21 establish connections to supply energy of reverse polarity to the indication wires 26 and 28 and the relay P is energized over the circuit which is traced from the positive terminal through contact 20, wire 28, rectifier K1, left-hand contact 14, winding of relay P, wire 26, and contact 21 to the negative terminal and the contacts of relay P shift to their right-hand or reverse positions.

When the contacts of relay P complete their movement to their reverse positions a circuit is established to energize the relays P and N in series. This circuit is traced from the positive terminal through contact 20, wire 28, and rectifier K1 to the left-hand terminal of the winding of relay N, through this winding, reverse polar contact 30 and front neutral contact 31 of relay WR, reverse polar contacts 36 and 14 of relay P, winding of relay P, wire 26, and contact 21 to the negative terminal of the source. The energy supplied to the relay N flows through the relay winding in the proper direction to pick up the contact of this relay, while the energy supplied to relay P is effective to maintain the contacts of this relay in their reverse positions.

On subsequent movement of the lever L to its normal position the contacts of relay WR shift to their normal positions and contact 25 establishes the circuit to cause the switch machine SM to move the switch W to its normal position, while contact 30 interrupts the circuit traced above for energizing the relays P and N in series so that contact 15 of relay N releases.

When the switch W completes its movement to its normal position the contacts 20 and 21 establish circuits to supply energy of normal polarity to the indication wires 26 and 28 and the relay P is energized over the circuit which is traced from the positive terminal through contact 20, wire 26, winding of relay P, right-hand contact 14 of relay P, rectifier K2, wire 28, and contact 21 to the negative terminal. Accordingly, the contacts of relay P move to their normal positions and establish the previously traced circuit for energizing the relays P and N in series so that the contacts of relay P are maintained in their normal positions and the contact 15 of relay N is picked up.

The system provided by this modification of the invention is arranged so that continuity of the circuits of the rectifiers K1 and K2 is checked, and so that integrity of these rectifiers is also checked.

As explained in connection with the modification shown in Fig. 2 the rectifier K3 prevents energization of the relay N by current of the wrong polarity when the connection with one terminal of one of the other rectifiers is defective and the remaining one of the rectifiers breaks down.

The modification shown in Fig. 3 of the drawing is also arranged so that the relay N cannot be energized when the contacts of relays WR and P are out of correspondence, or when energy of the incorrect polarity is supplied to the indication wires.

From the foregoing it will be seen that the modification shown in Fig. 3 provides a check on the switch control and switch indication relays as this modification is arranged so that the relay N is energized when and only when the contacts of the relays WR and P are in correspondence, and when, in addition, energy of the proper polarity is supplied to the indication wires.

Although I have herein shown and described several forms of electrical control apparatus embodying my invention, it is 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. Apparatus for selectively responding to the polarity of current supplied to a circuit including a pair of conductors and comprising a polar relay connected in series in said circuit, an auxiliary relay, and means for connecting said auxiliary relay across said conductors including a contact of said polar relay for connecting one of said conductors with one or the other of the terminals of the auxiliary relay according as the polar relay is operated to one position or the other, and a pair of rectifiers having unlike terminals connected with the other of said conductors and the free terminals of said recti-

fiers connected with the terminals respectively of said auxiliary relay.

2. In combination, a pair of conductors to which energy of one polarity is supplied at times and to which energy of the other polarity is supplied at other times, a polar relay connected in series with one of said conductors, an auxiliary relay, a pair of rectifiers having unlike terminals connected with one of said conductors and having their free terminals connected to the terminals of said auxiliary relay, a contact of said polar relay being effective to connect the other of said conductors to one or the other of the terminals of said auxiliary relay according as the contact of said polar relay is in one or the other of its positions, and a circuit governed by a contact of said auxiliary relay.

3. In combination, a pair of conductors to which energy of one polarity is supplied at times and to which energy of the other polarity is supplied at other times, a polar relay connected in series with one of said conductors, an auxiliary relay, a pair of rectifiers having unlike terminals connected with one of said conductors and having their free terminals connected to the terminals of said auxiliary relay, a contact of said polar relay being effective to connect the other of said conductors to one or the other of the terminals of said auxiliary relay according as the contact of said polar relay is in one or the other of its positions, and a circuit governed by a contact of said auxiliary relay and by a contact of said polar relay.

4. In combination, a pair of conductors to which energy of one polarity is supplied at times and to which energy of the other polarity is supplied at other times, a polar relay connected in series with one of said conductors, a rectifier unit comprising a pair of rectifier elements connected in series between a first and a second terminal and having unlike terminals connected to an intermediate terminal, one of said conductors being connected to the intermediate terminal of said rectifier unit, a contact of said polar relay being effective to connect the other of said conductors to the first or the second terminal of said rectifier unit according as the contact of said polar relay is in one or the other of its positions, an auxiliary relay, means for connecting one terminal of the winding of the auxiliary relay to the first terminal of said rectifier unit and for connecting the other terminal of the winding of the auxiliary relay to one of the other terminals of said rectifier unit, and a circuit controlled by a contact of said auxiliary relay.

5. In combination, a pair of conductors to which energy of one polarity is supplied at times and to which energy of the other polarity is supplied at other times, a polar relay connected in series with one of said conductors, a rectifier unit comprising a pair of rectifier elements connected in series between a first and a second terminal and having unlike terminals connected to an intermediate terminal, one of said conductors being connected to the intermediate terminal of said rectifier unit, a contact of said polar relay being effective to connect the other of said conductors to the first or the second terminal of said rectifier unit according as the contact of said polar relay is in one or the other of its positions, an auxiliary relay, means for connecting one terminal of the winding of the auxiliary relay to the second terminal of said rectifier unit and for connecting the other terminal of the winding of the auxiliary relay to one of the other terminals of said rectifier unit, and a circuit controlled by a contact of said auxiliary relay.

6. In combination, a pair of conductors to which energy of one polarity is supplied at times and to which energy of the other polarity is supplied at other times, a polar relay connected in series with one of said conductors, a rectifier unit comprising a pair of rectifier elements connected in series between a first and a second terminal and having unlike terminals connected to an intermediate terminal, one of said conductors being connected to the intermediate terminal of said rectifier unit, a contact of said polar relay being effective to connect the other of said conductors to the first or the second terminal of said rectifier unit according as the contact of said polar relay is in one or the other of its positions, an auxiliary relay, means for connecting one terminal of the winding of the auxiliary relay to the first terminal of said rectifier unit and for connecting the other terminal of the winding of the auxiliary relay to one of the other terminals of said rectifier unit, a rectifier connected across the terminals of the auxiliary relay in multiple with said rectifier unit and poled to permit energy to flow in the same direction as the rectifier elements of said rectifier unit, and a circuit controlled by a contact of said auxiliary relay.

7. In combination, a control circuit comprising a first and a second conductor to which energy of one polarity is supplied at times and to which energy of the other polarity is supplied at other times, a polar relay connected in series with one of said conductors and having a contact movable to one position or another according as energy of one polarity or the other is supplied to the relay winding, a rectifier unit comprising a first and a second rectifier element connected in series between a first and a second terminal and both poled to permit energy to flow from said second to said first terminal, said unit also having an intermediate terminal between said rectifier elements, the first conductor being connected to the intermediate terminal of said rectifier unit, the contact of said polar relay being effective when in the position which it occupies when the positive terminal of the source is connected to the first conductor to connect said second conductor to the second terminal of said rectifier unit and being effective when in the position which it occupies when the positive terminal of the source is connected to the second conductor to connect said second conductor to the first terminal of said rectifier unit, an auxiliary relay, means for connecting one terminal of the winding of said auxiliary relay to the first terminal of said rectifier unit and for connecting the other terminal of the winding of said auxiliary relay to the second terminal of the rectifier unit, and a circuit governed by a contact of said auxiliary relay.

8. In combination, a control circuit comprising a first and a second conductor to which energy of one polarity is supplied at times and to which energy of the other polarity is supplied at other times, a polar relay connected in series with one of said conductors and having a contact movable to one position or another according as energy of one polarity or the other is supplied to the relay winding, a rectifier unit comprising a first and a second rectifier element connected in series between a first and a second terminal and both poled to permit energy to flow from said second to said first terminal, said unit also having an intermediate terminal between said rectifier ele-

ments, the first conductor being connected to the intermediate terminal of said rectifier unit, the contact of said polar relay being effective when in the position which it occupies when the positive terminal of the source is connected to the first conductor to connect said second conductor to the second terminal of said rectifier unit and being effective when in the position which it occupies when the positive terminal of the source is connected to the second conductor to connect said second conductor to the first terminal of said rectifier unit, an auxiliary relay having a winding having a first and a second terminal and having a contact which becomes picked up when and only when energy flows through the relay winding from the first to the second terminal thereof, means for connecting the first terminal of the auxiliary relay winding to the first terminal of the rectifier unit and for connecting the second terminal of the auxiliary relay winding to the second terminal of the rectifier unit, and a circuit governed by a contact of said auxiliary relay.

9. In combination, a railway track switch, a machine for moving said switch between a normal and a reverse position, a polarized switch control relay to which energy of normal polarity is supplied at times and to which energy of reverse polarity is supplied at other times, said relay having polar contacts effective when in their normal position to cause the switch machine to move the switch to its normal position and effective when in their reverse position to cause the switch machine to move the switch to its reverse position, an indication circuit comprising a first and a second conductor, means effective when the switch is in its normal position to supply to the indication circuit energy of normal polarity in which the positive terminal of the source is connected to the first indication conductor and effective when the switch is in its reverse position to supply to the indication circuit energy of reverse polarity in which the positive terminal of the source is connected to the second indication conductor, a rectifier unit comprising a pair of rectifier elements connected in series between a first and a second terminal and both poled to permit energy to flow from said second terminal to said first terminal, said unit also having an intermediate terminal between said rectifier elements to which said second indication conductor is connected, a polar indication relay having its winding connected in series with one of said indication conductors, a contact of said polar relay being effective when in its normal position to connect said first indication conductor to the first terminal of said rectifier unit and being effective when in its reverse position to connect said first indication conductor to the second terminal of said rectifier unit, an auxiliary relay, means for connecting one terminal of the winding of said auxiliary relay to the first terminal of said rectifier unit and for connecting the other terminal of the winding of said relay to one of the other terminals of said rectifier unit, the circuit of the winding of said auxiliary relay being governed by polar contacts of said switch control relay and of said switch indication relay and being complete only when said contacts are in correspondence and a circuit governed by a contact of said auxiliary relay.

10. In combination, a railway track switch, a machine for moving said switch between a normal and a reverse position, a polarized switch control relay to which energy of normal polarity is supplied at times and to which energy of reverse polarity is supplied at other times, said relay having polar contacts effective when in their normal position to cause the switch machine to move the switch to its normal position and effective when in their reverse position to cause the switch machine to move the switch to its reverse position, an indication circuit comprising a first and a second conductor, means effective when the switch is in its normal position to supply to the indication circuit energy of a polarity in which the positive terminal of the source is connected to one of said conductors and effective when the switch is in its reverse position to supply to the indication circuit energy of a polarity in which the positive terminal of the source is connected to the other of said conductors, a rectifier unit comprising a pair of rectifier elements connected in series between a first and a second terminal and both poled to permit energy to flow from the second to the first terminal, said unit also having an intermediate terminal between said rectifier elements, a polar indication relay having its winding connected in series with one of said indication conductors and having polar contacts which are moved to a normal or a reverse position according as energy of normal or reverse polarity is supplied to said indication conductors, one of said indication conductors being connected to the intermediate terminal of the rectifier unit, a contact of the polar indication relay being effective according as it is in its normal or its reverse position to connect to the first or second terminal of said rectifier unit the indication conductor other than that which is connected to the intermediate terminal of said rectifier unit, an auxiliary relay, means for connecting one terminal of the winding of the auxiliary relay to the first terminal of the rectifier unit and for connecting the other terminal of the auxiliary relay winding to the second terminal of said rectifier unit, the circuit of the auxiliary relay winding being controlled by polar contacts of said switch control relay and of said switch indication relay and being complete only when said contacts are in correspondence, and a circuit governed by a contact of said auxiliary relay.

11. In combination, a pair of conductors to which energy of one polarity is supplied at times and to which energy of the other polarity is supplied at other times, a rectifier unit comprising a pair of rectifier elements connected in series between a first and a second terminal and having unlike terminals connected to an intermediate terminal, one of said conductors being connected to the intermediate terminal of the rectifier unit, a polar relay having a contact effective to connect the other of said conductors to the first or the second terminal of said rectifier unit according as said contact is in one or the other of its positions, the winding of said polar relay being connected in series with one of said conductors, an auxiliary relay, means for connecting the winding of auxiliary relay in multiple with one of said rectifier elements, said means being so arranged as to cause said auxiliary relay to be energized by current supplied over said conductors, and a circuit controlled by a contact of said auxiliary relay.

12. In combination, a pair of conductors to which energy of normal polarity is supplied at times and to which energy of reverse polarity is supplied at other times, a polar relay having its winding connected in series with one of said con-

ductors, a polar contact of said relay being effective when in its normal position to connect said conductors together through a first asymmetric unit poled to permit flow of energy of reverse polarity and effective when in its reverse position to connect said conductors together through a second asymmetric unit poled to permit flow of energy of normal polarity, and two auxiliary circuits for connecting said conductors together, each of said auxiliary circuits including electroresponsive means in series therewith, said polar relay contact being effective in its normal position to establish one of said auxiliary circuits in multiple with said first asymmetric unit, and being effective when in its reverse position to establish the other of said auxiliary circuits in multiple with said second asymmetric unit.

13. In combination, a pair of conductors to which energy of normal polarity is supplied at times and to which energy of reverse polarity is supplied at other times, an auxiliary relay, a polar relay having its winding connected in series with one of said conductors, means including a normal polar contact of said polar relay for connecting said conductors together through a first asymmetric unit poled to permit flow of energy of reverse polarity and to also connect said conductors together through the winding of said auxiliary relay, and means including a reverse polar contact of said polar relay for connecting said conductors together through a second asymmetric unit poled to permit flow of current of normal polarity and to also connect said conductors together through the winding of said auxiliary relay.

14. In combination, a first and a second conductor, means for reversibly connecting said conductors with a source of direct current, a first relay having its winding connected in series with one of said conductors and having a contact movable between a first and a second position, said first relay being of a type the contact of which when in its first position is moved to its second position when and only when energy flows through the relay winding from said first to said second conductor, said relay contact being effective when in its second position to connect said conductors together through a first asymmetric unit poled to permit flow of energy from the second to the first conductor and to also connect said conductors together through the winding of an auxiliary relay, said first relay contact being effective when in its first position to connect said conductors together through a second asymmetric unit poled to permit flow of energy from said first to said second conductor and to also connect said conductors together through the winding of said auxiliary relay.

15. In combination, a first and a second conductor, means for reversibly connecting said conductors with a source of direct current, a first relay having its winding connected in series with one of said conductors and having a contact movable between a first and a second position, said first relay being of a type the contact of which when in its first position is moved to its second position when and only when energy flows through the relay winding from said first to said second conductor, a rectifier unit comprising a first and a second rectifier element connected in series between a first and a second terminal and both poled to permit energy to flow from said second to said first terminal, said unit also having an intermediate terminal between said rectifier elements, one of said conductors being connected to the intermediate terminal of said rectifier unit, said contact of said first relay being effective when in its first position to connect the other of said conductors to the second terminal of said rectifier unit and being effective when in its second position to connect said other conductor to the first terminal of said rectifier unit, an auxiliary relay, and means for connecting one terminal of the winding of said auxiliary relay to the first terminal of said rectifier unit and for connecting the other terminal of the winding of said auxiliary relay to the second terminal of said rectifier unit.

16. In combination, a first and a second conductor, means for reversibly connecting said conductors with a source of direct current, a first relay having its winding connected in series with one of said conductors and having a contact movable between a first and a second position, said first relay being of a type the contact of which when in its first position is moved to its second position when and only when energy flows through the relay winding from said first to said second conductor, a rectifier unit comprising a first and a second rectifier element connected in series between a first and a second terminal and both poled to permit energy to flow from said second to said first terminal, said unit also having an intermediate terminal between said rectifier elements, one of said conductors being connected to the intermediate terminal of said rectifier unit, said contact of said first relay being effective when in its first position to connect the other of said conductors to the second terminal of said rectifier unit and being effective when in its second position to connect said other conductor to the first terminal of said rectifier unit, an auxiliary relay, and means for connecting one terminal of the winding of said auxiliary relay to the first terminal of said rectifier unit and for connecting the other terminal of the winding of said auxiliary relay to one of the other terminals of said rectifier unit.

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