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POLARIZED CONTROL APPARATUS

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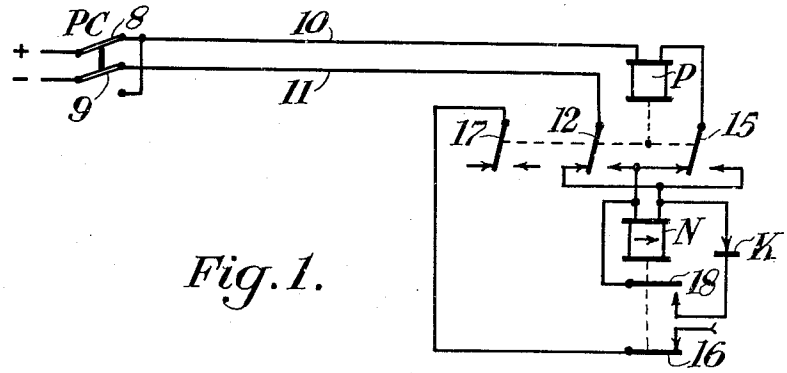


Fig. 1.

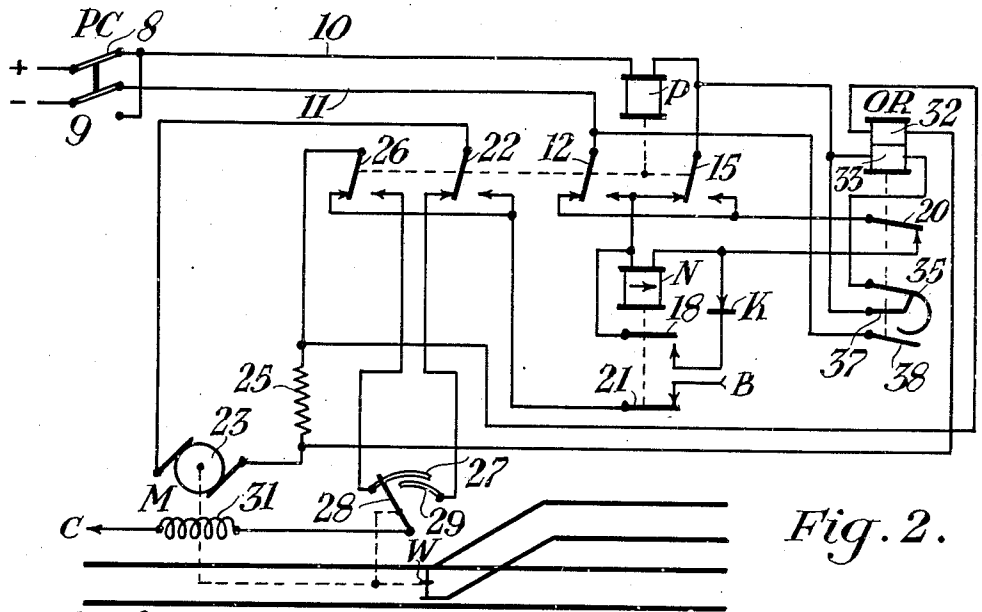


Fig. 2.

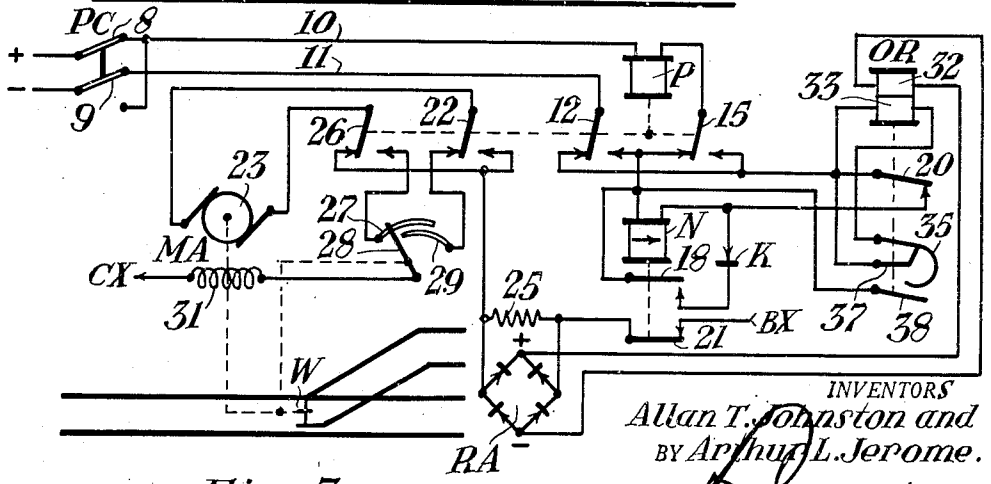


Fig. 3.

INVENTORS
Allan T. Johnston and
BY Arthur L. Jerome.

THEIR ATTORNEY.

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POLARIZED CONTROL APPARATUS

Allan T. Johnston, Mount Lebanon, and Arthur L. Jerome, Edgewood, Pa., assignors to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

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Our 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 Letters Patent of the United States No. 2,340,752, granted February 1, 1944, to Andrew Hufnagel.

In the Hufnagel patent there is shown control apparatus having a polar relay energized over a control circuit, an auxiliary relay associated with the polar relay and energized from the control circuit over connections governed by contacts of the polar relay, and having means effective on a change in the polarity of the energy supplied to the control circuit to maintain the contacts of the auxiliary relay picked up during movement of the contacts from one position to the other.

It is an object of this invention to provide improved control apparatus of the type described and in which the retained neutral feature may be eliminated.

Another object of this invention is to provide improved control apparatus for controlling electric motors for operating track switches.

A further object of this invention is to provide improved control apparatus for alternating current electric switch motors wherein positive releasing of the overload relay as a result of a change of polarity of the control circuit is provided.

We shall describe three forms of control apparatus embodying our invention, and shall then point out the novel features thereof in claims.

In practicing our invention we provide a polar relay and a neutral or polar biased neutral auxiliary relay and energize them from a polarized control circuit. The winding of the auxiliary relay is reversibly connected across the control circuit by means of polar contacts on the polar relay. The polar and auxiliary relays are selected so that on a change in the polarity of the energy supplied to the control circuit the contacts of the auxiliary relay will release before the contacts of the polar relay respond, while a contact of the auxiliary relay when released establishes a circuit independent of the winding of the auxiliary relay for supplying energy from the control circuit to the winding of the polar relay to operate the polar relay. The circuit governed by this contact of the auxiliary relay may shunt the winding of the auxiliary relay to prevent picking up of the auxiliary relay contacts until the polar relay responds and may have an asymmetric unit included therein to prevent flow of energy in the circuit when the polar relay contacts and the polarity of the energy supplied to the control circuit are in correspondence.

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In some modifications the relays are employed to control the motor for a track switch, and in these cases an overload relay interrupts the circuit of the auxiliary relay in the event of an overload, while means are provided to release the overload relay on a subsequent change in the polarity of the energy supplied to the control circuit.

In the drawings Fig. 1 is a diagram illustrating one embodiment of our invention,

Fig. 2 is a diagram illustrating a modification of our invention arranged to control a direct current switch machine motor, and

Fig. 3 is a diagram illustrating a modification of our invention arranged to control an alternating current switch machine motor.

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

Referring to Fig. 1 of the drawings, 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 in series over a polarized control circuit here shown as comprising conductors 10 and 11 which are connected by contacts 8 and 9 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.

The conductor 10 is connected to one terminal of the winding of relay P, while conductor 11 is connected to polar contact 12 of relay P. The other terminal of the winding of relay P is connected to its polar contact 15. The contacts 12 and 15 control connections for reversibly connecting the winding of the relay N in series with the winding of the relay P.

The relay N may be of the polar biased type as here shown and if such its contacts become picked up when and only when energy flows through the relay winding in the direction indicated by the arrow. The various parts of the apparatus are so arranged that the relay N picks up only when the positive terminal of the source is connected to the left-hand terminal of the relay winding.

The rectifier K is connected across the ter-

minals of the relay N by a circuit which is interrupted by a back contact of relay N. The rectifier K is poled to permit energy to flow in the direction opposite to that which is effective to pick up the contacts of relay N.

The contact 16 of relay N and contact 17 of relay P may cooperate to perform any desired control function.

When the equipment is in the condition shown in Fig. 1 of the drawings, energy from the positive terminal of the source flows over pole changer contact 8, through conductor 10, winding of relay P, and normal polar contact 15 of relay P to the left-hand terminal of relay N, through the winding of relay N, normal polar contact 12 of relay P, conductor 11, and pole changer contact 9 to the negative terminal of the source. At this time relay P and relay N are energized in series, while the polarity of the energy supplied is such that the contacts of relay P are held in their left-hand position as shown, and the direction of flow of energy through the winding of relay N is that which is effective to pick up the contacts of the relay. The circuit for rectifier K is open at contact 18 of relay N.

On a reversal of the pole changer PC the positive terminal of the source is connected by contact 8 to conductor 11 and the negative terminal of the source is connected by contact 9 to conductor 10. At the time of reversal of the pole changer PC contacts 12 and 15 of relay P are in their left-hand positions, as shown, so that energy flows from the positive terminal of the source over conductor 11 and contact 12 of relay P to the right-hand terminal of the winding of relay N, through the relay winding, contact 15 of relay P, winding of relay P, and conductor 10 to the negative terminal of the source.

The energy flowing in this direction through the winding of relay N causes relay N to release due to the reversal of current flow in the winding, which causes the magnetic flux in the relay core to decrease to zero and build up again in the opposite direction. Back contact 18 of relay N closes, and thereby establishes the circuit through rectifier K, shunting relay N. This circuit prevents relay N from picking up and provides a low resistance circuit for the energy supplied to relay P so that its contacts are certain to move. As soon as contacts 12 and 15 of relay P move out of engagement with their left-hand contacts, the circuit previously traced for energizing the windings of relays P and N is interrupted, but the operating characteristics of the relay P are such that the relay contacts will continue to move after the interruption of the supply of energy to the relay winding with the result that the relay contacts will complete their movement to their right-hand positions.

When the contacts of relay P complete their movement to their right-hand positions, a circuit is completed to energize the windings of relays P and N in series. This circuit may be traced from the positive terminal of the source, through pole changer PC, conductor 11, reverse polar contact 12 of relay P, the winding of relay N from left to right, reverse polar contact 15 of relay P, through the winding of relay R, and over conductor 10 to the pole changer PC and the negative terminal of the source. Although the circuit including rectifier K is closed at this time, the direction of the flow of energy is opposite to the direction in which the recifier is poled, thus no current can flow through the rectifier.

The direction of current flow through the winding of relay N is now such that relay N picks up its contacts, and the circuit including rectifier K is interrupted by back contact 18 of relay N. In addition, the energy supplied to the winding of relay P is effective to maintain the contacts of this relay in their right-hand positions.

The operation of the equipment on a subsequent change in the polarity of the energy supplied over the conductors 10 and 11 is similar to that described in detail above and will not be repeated.

If, on a change in polarity of the energy supplied over the conductors 10 and 11, the contacts of relay P fail to move from one position to the other, the conductors 10 and 11 will be connected to the winding of relay N in such a manner that the positive terminal of the source is connected to the right-hand terminal of the relay winding. Accordingly, the direction of flow of energy through the winding of relay N will be such that the energy is ineffective to pick up the relay contacts. Accordingly the relay N releases and remains released so that its contact 16 is open. The relay N, therefore, checks response of relay P to changes in the polarity of the energy supplied over the conductors 10 and 11, and contact 16 of relay N will not establish the circuit governed by contacts 17 of relay P unless the contacts of relay P are in correspondence with the polarity of the energy supplied to the relay.

If it is not necessary to have the relay N check the relay P, or if the relay P is of the safety type which does not require checking, the relay N may be of the neutral type.

The relays P and N are selected and arranged so that on a change in the polarity of the energy supplied to the control wires 10 and 11, contact 16 of relay N will release and interrupt the circuit controlled thereby before contact 17 of relay P moves. This mode of operation may be secured by selecting the relays P and N so that relay N responds more rapidly than relay P, or it may be secured by arranging these relays so that relay P will not respond to energy supplied through the winding of relay N and will respond only to energy supplied over the shunt circuit established by back contact 18 of relay N. Since relay P will not operate until after relay N releases, contact 17 of relay P is never required to interrupt the circuit governed thereby at a time when energy is being supplied over the circuit.

Fig. 2 of the drawings shows a modification of our invention for controlling a track switch W which is moved between a normal and a reverse position by means of an electric motor M. The motor drives the switch through suitable mechanism, not shown. In the system shown in Fig. 2 the motor M is of a type designed to operate on direct current supplied from a suitable source, not shown, the positive terminal of which is designated as C. Associated with motor M is an overload relay OR and control relays P and N.

The equipment is shown in the condition which it assumes when the switch W and its controlling device PC are in their normal positions and the contacts of the overload relay OR are released.

As the pole changer PC is in its normal position, relays P and N are energized by a circuit traced from the positive terminal of the source of control energy through the pole changer PC, conductor 10, through the winding of relay P, normal polar contact 15 of relay P, through the winding of relay N from left to right, over back contact 20 of relay OR, over normal polar contact 12 of relay P, conductor 11, and pole changer

PC to the negative terminal of the source of control energy.

Accordingly, relay N is picked up and relay P is energized to hold its left-hand or normal contacts closed.

As the switch W is in its normal position, contact 28 is out of engagement with contact 29 and interrupts the supply of energy furnished for the operation of the switch motor. The contact 28 is operated in accordance with the movement of the switch and is arranged so that it engages contact 29 in all positions of the switch except the normal position thereof, and so that it engages a contact 27 in all the positions of the switch except the reverse position thereof.

If the pole changer PC is reversed, the polarity of the energy supplied to relays P and N is reversed, and they operate in a manner substantially the same as that previously described for Fig. 1. Relay N releases, after which the contacts of relay P move from their left-hand position to their right-hand position. Since the relay N releases before the contacts of relay P move, the circuit for supplying energy to the switch motor M is always opened by contact 21 of relay N, thus interrupting any flow of energy existing at that time. Since the contacts of relay P are never called upon to interrupt the circuit for supplying energy to the switch motor M, they may be of a lighter type of construction, while the contacts of relay N are of the heavy-duty type.

After the contacts of relay P have moved to their right-hand position, relay N picks up, establishing the circuit to supply energy to the motor M. This circuit is traced from terminal B, over front contact 21 of relay N, reverse polar contact 22 of relay P, through motor armature 23, thermal resistance 25, over reverse polar contact 26 of relay P, switch operated contacts 27 and 28, and through the motor field winding 31 to terminal C. The motor armature and its field winding are energized in series and the various parts are arranged so that the motor operates to move the switch W to its reverse position.

When the switch completes its movement to its reverse position, contact 28 is moved out of engagement with contact 27 to interrupt the circuit traced above for supplying energy to the motor M and the motor ceases to operate.

When the switch is in its reverse position, if the pole changer PC is restored to its normal position, energy of normal polarity is applied to relays P and N, so that relay N will release, the contacts of relay P will move from their right-hand position to their left-hand position, after which relay N picks up, in a manner similar to that described previously for operation of relays P and N when energy of reverse polarity was applied, and a circuit is established to supply energy to the motor M to cause it to move the switch to its normal position. This circuit is traced from terminal B, over front contact 21 of relay N, normal polar contact 26 of relay P, through thermal resistance 25, motor armature 23, over normal polar contact 22 of relay P, contacts 29 and 28, and through field coil winding 31 of motor M to terminal C. Accordingly, the motor armature and field winding are energized in series, while the various parts are arranged so that the motor operates to move the switch to its normal position.

When the switch completes its movement to its normal position, contact 28 is moved out of engagement with contact 29 and interrupts the circuit traced above for supplying energy to the motor and the motor thereupon ceases to operate.

The thermal resistance 25 which is included in series with the circuit for supplying energy to the switch motor has a positive thermal coefficient of resistance, that is, the resistance of the unit increases as the temperature of the material of which it is constructed increases. Relay OR is provided with a pick-up winding 32 which is connected across resistor 25. The relay OR also has a holding winding 33, and means are provided to shunt the holding winding when the relay contacts are released, and to energize the holding winding in series with the relay P when the overload relay contacts are picked up.

The relay OR is equipped with contacts of the make-before-break type, and as shown the right-hand terminal of the holding winding 33 is connected to movable contact 35, while the contact 35, when released, engages stationary contact 37 which is connected to the left-hand terminal of the winding 33. Accordingly, as long as the contacts of relay OR are released, the holding winding 33 of relay OR is short-circuited by the circuit controlled by contacts 35 and 37. As the winding 33 is short-circuited when the relay contacts are released, the relay contacts are rendered slow in picking up and the overload relay will not respond to momentary surges in the current in the motor circuit, as occur when the motor is started or the switch is reversed in mid-stroke.

As previously explained, the energy supplied to the motor M is supplied over the circuit which includes in series therewith the resistor 25, while the terminals of the pick-up winding 32 of relay OR are connected across the resistor 25. On the supply of energy to the motor there is a voltage drop across the resistor 25 with a result that a portion of the energy supplied to the motor is supplied through the pick-up winding 32 of relay OR. As a result of the supply of energy to the motor M, the resistor 25 becomes heated and its resistance increases so that there is a corresponding increase in the value of the current supplied through the pick-up winding 32 of relay OR.

The various parts are so arranged and proportioned that under normal conditions most of the energy supplied to the motor is supplied through the resistor 25, while the current supplied through the winding 32 of relay OR is of too small value to pick up the relay contacts. Accordingly, the contacts of relay OR remain released and contact 20 maintains the circuit for connecting the winding of relay N in series with the winding of relay P so that contact 21 of relay N remains picked up and maintains the supply of energy to the motor until the switch completes its movement and causes contact 28 to interrupt the circuit of the switch motor.

The various parts of the equipment are also arranged and proportioned so that if the motor M draws current of unusually high value for an abnormally long period, as occurs when movement of the switch is obstructed, the resistance 25 will become heated to a temperature such that its resistance increases to a degree effective to cause the current supplied through the winding 32 of relay OR to be great enough to pick up the relay contacts.

On movement of the contacts of relay OR towards their picked-up position contact 38 engages

contact 35 to thereby establish a circuit to energize the holding winding 33 in series with relay P, while contact 38 moves contact 35 out of engagement with stationary contact 37 to interrupt the circuit short-circuiting the holding winding 33.

If the switch is being moved to its normal position at the time the overload condition occurs, the circuit for supplying energy to the winding 33 of relay OR is traced from the positive terminal of the source, through pole changer PC, conductor 10, winding of relay P, winding 33 of relay OR from left to right, over contacts 35 and 38 of relay OR, conductor 11, and through pole changer PC to the negative terminal of the source. When the switch is being moved to its normal position the direction of current flow through the resistor 25 is such that energy flows through the pick-up winding 32 of relay OR from left to right, and when the circuit for the holding winding 33 is completed, energy will flow through the holding winding 33 in the same direction as that flowing in the pick-up winding.

If the switch is being moved to its reverse position at the time the overload condition occurs, the circuit for supplying energy to the winding 33 of relay OR is traced from the positive terminal of the source, through pole changer PC, conductor 11, over contacts 35 and 38 of relay OR, winding of relay OR from right to left, through the winding of relay P, over conductor 10, and pole changer PC to the negative terminal of the source. At this time the direction of current flow through resistor 25 is such that energy flows through the pick-up winding 32 of relay OR from right to left, and when the circuit for the holding winding 33 is completed, energy will flow through the holding winding 33 in the same direction as that flowing in the pick-up winding.

Accordingly, when the contacts of the overload relay OR pick up the energy supplied from the control wires to the holding winding of relay OR always flows through this winding in the same direction as the energy which had been supplied to the relay pick-up winding. As a result, the energy supplied to the pick-up and holding windings of this relay causes flux of the same polarity to be developed in the relay core so that on picking up of the relay contacts, and resultant supply of energy to the relay holding winding, the relay contacts are maintained picked up.

In addition, on picking up of the contacts of relay OR its contact 20 interrupts the supply of energy to relay N, and its contact 21 releases and interrupts the supply of energy to the switch motor. Release of contact 21 also interrupts the supply of energy to the pick-up winding of relay OR, but the contacts of this relay are maintained picked up by the holding winding of the relay so that contact 20 of relay OR interrupts the circuit of relay N and it remains released and continues to interrupt the circuit of the switch motor.

After an overload has occurred, control of the switch may be regained by operation of the pole changer PC to its other position, causing a change in polarity of the supply of energy to the holding winding 33 of relay OR. As a result, there is a reversal of flux polarity in the relay core, which causes the relay OR to release. When relay OR releases, its contact 20 establishes the circuit including rectifier K and winding of relay N, and thereafter the polar contacts of relay P move to their other position followed by the contacts of relay N picking up. This results in the establishment of the circuit to supply energy to the motor M to cause it to move the switch to its other position.

In addition, on release of the contacts of relay OR, contact 38 is disengaged from contact 35 to interrupt the circuit for supplying energy to the holding winding 33, while contact 35 engages contact 37 to establish the circuit for short-circuiting the winding 33.

From the foregoing it may be seen that this system is so arranged that under any circumstances wherein the switch does not complete its movement to one position or the other, the circuit for supplying energy to the motor M is always interrupted by contact 21 of relay N, so that the contacts of this relay may be of the heavy-duty type, while the contacts of relay P, which are never called upon to interrupt the supply of energy to the motor M, may be of a lighter construction.

Fig. 3 of the drawings shows a modification of our invention which is similar to Fig. 2 and differs therefrom in that it employs a motor MA of a type adapted to operate on alternating current, and a rectifier RA is provided to supply the pick-up winding 32 of relay OR with direct current. The energy for operating the motor MA is supplied from a suitable source of alternating current, the terminals of which are designated BX and CX in the drawings.

The equipment is shown in the condition which it assumes when the switch W and its controlling device PC are in their normal positions and the contacts of the overload relay OR are released.

As the pole changer PC is in its normal position relays P and N are energized in series by a circuit traced from the positive terminal of the source of control energy, through the pole changer PC, conductor 10, through the winding of relay P, normal polar contact 15 of relay P, through the winding of relay N from left to right, over contact 20 of relay OR, over normal polar contact 12 of relay P, conductor 11, and pole changer PC to the negative terminal of the source of control energy. Accordingly, relay N is picked up and relay P is energized to hold its left-hand or normal contacts closed. As the switch W is in its normal position, contact 28 is out of engagement with contact 29 and interrupts the supply of energy to the motor MA.

If the pole changer PC is reversed, the relays P and N operate in a manner similar to that previously described for Fig. 1. When contacts 26 and 22 of relay P move to their reverse positions and contact 21 of relay N picks up, the circuit for supplying energy to the switch motor is completed in such a manner as to cause the motor to move the switch to the reverse position. This circuit is traced from terminal BX, over contact 21 of relay N, through thermal resistance 25, reverse polar contact 22 of relay P, armature 23 of motor MA, reverse polar contact 26 of relay P, over contacts 27 and 28, and through field winding 31 to terminal CX. The motor armature and its field winding are energized in series and the various parts are arranged so that the motor operates to move the switch W to its reverse position.

When the switch completes its movement to its reverse position, contact 28 is moved out of engagement with contact 27 to interrupt the circuit traced above for supplying energy to the motor MA and the motor ceases to operate.

When the switch is in its reverse position, if the pole changer PC is restored to its normal

position, energy of normal polarity is applied to relays P and N, so that relay N will release, the contacts of relay P will move from their reverse position to their normal position after which relay N picks up, in a manner similar to that previously described for operation of relays P and N when energy of reverse polarity was applied, and a circuit is established to supply energy to the motor MA to cause it to move the switch to its normal position. This circuit is traced from terminal BX, over front contact 21 of relay N, through thermal resistance 25, normal polar contact 26 of relay P, motor armature 23, normal polar contact 22, contacts 28 and 29, and through motor field winding 31 to terminal CX. The motor armature and field winding are energized in series and the various parts are arranged so that the motor operates to move the switch W to its normal position.

When the switch completes its movement to its normal position, contact 28 is moved out of engagement with contact 29 to interrupt the circuit traced above for supplying energy to the motor MA and the motor ceases to operate.

The input terminals of rectifier RA are connected across the thermal resistance 25, while the positive output terminal is connected to the right-hand terminal of the pick-up winding 32 of relay OR, while the negative output terminal of rectifier RA is connected to the left-hand terminal of pick-up winding 32 of relay OR. The holding winding 33 is supplied with energy from the control circuit in series with relay P, and is reversibly connected with the control wires by the polar contacts of relay P so that the flow of energy in the holding winding when relay OR picks up is always in the same direction as the direction of flow of energy in the pick-up winding, that is, from right to left. The contact equipment is similar and functions similarly to that previously described for relay OR in Fig. 2.

As previously explained, the voltage drop across resistor 25 increases if the motor M draws a high value of current for an unusually long period of time, and the flow of rectified current supplied to the pick-up winding 32 of relay OR through rectifier RA becomes great enough to pick up relay OR, which is then held up by the circuit supplying energy to its holding winding 33.

If the switch is being moved to its normal position at the time the overload occurs, the circuit for supplying energy to the holding winding 33 of relay OR is traced from the positive terminal of the source through pole changer contact 8, conductor 10, winding of relay P, normal polar contact 15 of relay P over contacts 38 and 35 of relay OR, through the winding 33 of relay OR from right to left, over normal polar contact 12 of relay P, and through conductor 11 and contact 9 of pole changer PC to the negative terminal of the source.

If the switch is being moved to its reverse position at the time the overload condition occurs, the circuit for supplying energy to the holding winding 33 of relay OR is traced from the positive terminal of the source through contact 8 of pole changer PC, conductor 11, over reverse polar contact 12 of relay P, contacts 35 and 38 of relay OR, through winding 33 of relay OR from right to left, over reverse polar contact 15 of relay P, through the winding of relay P, conductor 10, and over contact 9 of pole changer PC to the negative terminal of the source.

It will be seen, therefore, that on picking up of the contacts of relay OR a circuit is established

to energize the holding winding 33 of relay OR in series with relay P from the conductors 10 and 11 and that regardless of the polarity of the energy supplied to the control wires at the time the overload relay picks up, the energy flows through the winding 33 from its right-hand terminal to its left-hand terminal.

The pick-up winding 32 of relay OR is connected to rectifier RA so that energy always flows through this winding from its right-hand to its left-hand terminal.

Accordingly, the energy supplied to the pick-up and holding windings of the overload relay OR always flows through these windings in the same direction at the time the overload relay picks up, and as a result flux of the same polarity is developed in the relay core, so that on picking up of the relay contacts, and resultant supply of energy to the relay holding winding, the relay contacts are maintained picked up.

In addition, on picking up of the contacts of relay OR its contact 20 interrupts the supply of energy to relay N so that contact 21 of relay N releases and interrupts the supply of energy to the motor MA. Release of contact 21 also interrupts the supply of energy to the pick-up winding 32 of relay OR, but the contacts of this relay are maintained picked up by the holding winding of the relay so that contact 20 of relay OR interrupts the circuit of relay N and it remains released and continues to interrupt the circuit of the switch motor.

After an overload has occurred, control of the switch may be regained by operation of the pole changer PC to its other position, causing a change in the polarity of the energy supplied to the holding winding 33 of relay OR, which results in a change of polarity of the flux in the core of relay OR, whereupon relay OR releases and its contact 20 establishes the circuit including rectifier K and relay N and thereafter the polar contacts of relay P move to their other position followed by the picking up of relay N. This results in the establishment of the circuit to supply energy to the motor MA which operates to move the switch to its other position.

In addition, on release of the contacts of relay OR contact 38 is disengaged from contact 35 to interrupt the circuit for supplying energy to the holding winding 33, while contact 35 engages contact 37 to establish the circuit for short-circuiting the winding 33.

From the foregoing it will be seen that our invention provides means for controlling a polar relay and a neutral relay in such a manner that on a change in the polarity of the energy supplied to the control circuit for the relays the neutral relay releases prior to the movement of the contacts of the polar relay and the neutral relay will not pick up unless the position of the polar relay contacts is in agreement with the polarity of the energy supplied to the relays. It will also be seen that this invention provides means for controlling electric switch motors in such a manner that in any case of the motor circuit being interrupted before the switch completes its movement to one position or the other, the contacts of the neutral circuit will interrupt the motor circuit, rather that the contacts of the polar relay.

Although we have herein shown and described only three forms of circuits embodying our 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 our invention.

Having thus described our invention, what we claim is:

1. In combination, a pair of control 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 polarized relay having one terminal of its winding connected to one of said control conductors, an auxiliary relay having normally released contacts which become picked up when and only when energy flows through the relay winding from its first to its second terminal, an asymmetric unit connected across the winding of the auxiliary relay by a back contact of said auxiliary relay and poled to permit energy to flow from the second to the first terminal of said winding, and means governed by polar contacts of said polarized relay for reversibly connecting the auxiliary relay winding and said asymmetric unit in multiple between the other terminal of the polarized relay winding and the other one of said control conductors, said means being arranged so that energy from said control conductors flows through the winding of said auxiliary relay from its first to its second terminal when and only when the position of the contacts of said polarized relay and the polarity of the energy supplied to said control conductors are in correspondence, said polarized and auxiliary relays being selected so that the contacts of the polarized relay will not be operated between their two positions in response to energy of the value supplied to the relay winding through the winding of said auxiliary relay but will be operated by energy of the value supplied through said asymmetric unit, and a circuit governed by a front contact of said auxiliary relay and by a polar contact of said polarized relay.

2. In combination, a pair of control 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 polarized relay having one terminal of its winding connected to one of said control conductors, an auxiliary relay having normally released contacts which become picked up when and only when energy flows through the relay winding from its first to its second terminal, an asymmetric unit connected across the winding of the auxiliary relay by a back contact of said auxiliary relay and poled to permit energy to flow from the second to the first terminal of said winding, and means governed by polar contacts of said polarized relay for reversibly connecting the auxiliary relay winding and said asymmetric unit in multiple between the other terminal of the polarized relay winding and the other one of said control conductors, said means being arranged so that energy from said control conductors flows through the winding of said auxiliary relay from its first to its second terminal when the position of the contacts of said polar relay and the polarity of the energy supplied to said control conductors are in correspondence.

3. In combination, a pair of control 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 polarized relay having one terminal of its winding connected to one of said control conductors, an auxiliary relay, means governed by polar contacts of said polarized relay for reversibly connecting the winding of said auxiliary relay between the other terminal of the polarized relay winding and the other of said control conductors, an asymmetric unit in series with a back contact of said auxiliary relay connected across the winding of said auxiliary relay, said asymmetric unit being arranged so that energy flows from said control conductors through said asymmetric unit when said auxiliary relay is released and the position of the contacts of said polarized relay and the polarity of the energy supplied to said control conductors are out of correspondence, 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 control 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 polarized relay having one terminal of its winding connected to one of said control conductors, an auxiliary relay, means governed by polar contacts of said polarized relay for reversibly connecting the winding of said auxiliary relay between the other terminal of the polarized relay winding and the other of said control conductors, an asymmetric unit in series with a back contact of said auxiliary relay connected across the winding of said auxiliary relay, said asymmetric unit being arranged so that energy flows from said control conductors through said asymmetric unit when said auxiliary relay is released and the position of the contacts of said polar relay and the polarity of the energy supplied to said control conductors are out of correspondence, said polarized and auxiliary relays being selected so that the contacts of the polarized relay will not be operated between their two positions in response to energy of the value supplied to the relay winding through the winding of said auxiliary relay but will be operated by energy of the value supplied through said asymmetric unit, and a circuit governed by a front contact of said auxiliary relay and by a polar contact of said polarized relay.

5. In combination, a pair of control conductors to which energy of one polarity is supplied at times and energy of the other polarity is supplied at other times, a polarized relay having one terminal of its winding connected to one of said control conductors, an auxiliary relay, and means including polar contacts of said polarized relay for reversibly connecting the winding of the auxiliary relay between the other terminal of the winding of the polarized relay and the other control conductor, said means being effective in each position of the contacts of said polarized relay provided a back contact of said auxiliary relay is closed to connect in multiple with the winding of the auxiliary relay and in series with the winding of the polarized relay an asymmetric unit poled to permit flow of energy therethrough when the position of the polarized relay contacts and the polarity of energy supplied to said control conductors are out of correspondence.

6. In combination, a pair of control 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 polarized relay, an auxiliary relay having normally released contacts which become picked up when and only when energy flows through the relay winding from its first to its second terminal, means governed by polar contacts of said polarized relay for supplying energy from said control conductors to the winding of said auxiliary relay in such a manner that energy flows through the winding of said auxiliary relay from its first terminal to its second terminal when and only when the polar

contacts of said polarized relay are in correspondence with the polarity of energy supplied by said control conductors, circuit means including a back contact of said auxiliary relay for supplying from said control conductors to the winding of said polarized relay energy effective to operate the contacts of said polarized relay, and a circuit governed by a front contact of said auxiliary relay and by a polar contact of said polarized relay.

7. In combination, a pair of control 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 polarized relay, an auxiliary relay having normally released contacts which become picked up when and only when energy flows through the relay winding from its first to its second terminal, means governed by polar contacts of said polarized relay for supplying energy from said control conductors to the winding of said auxiliary relay in such a manner that energy flows through the winding of said auxiliary relay from its first terminal to its second terminal when and only when the polar

contacts of said polarized relay are in correspondence with the polarity of energy supplied by said control conductors, circuit means effective when and only when said auxiliary relay is released for supplying from said control conductors to the winding of said polar relay energy effective to operate the relay contacts, and a circuit governed by a front contact of said auxiliary relay and by a polar contact of said polarized relay.

ALLAN T. JOHNSTON.
ARTHUR L. JEROME.

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