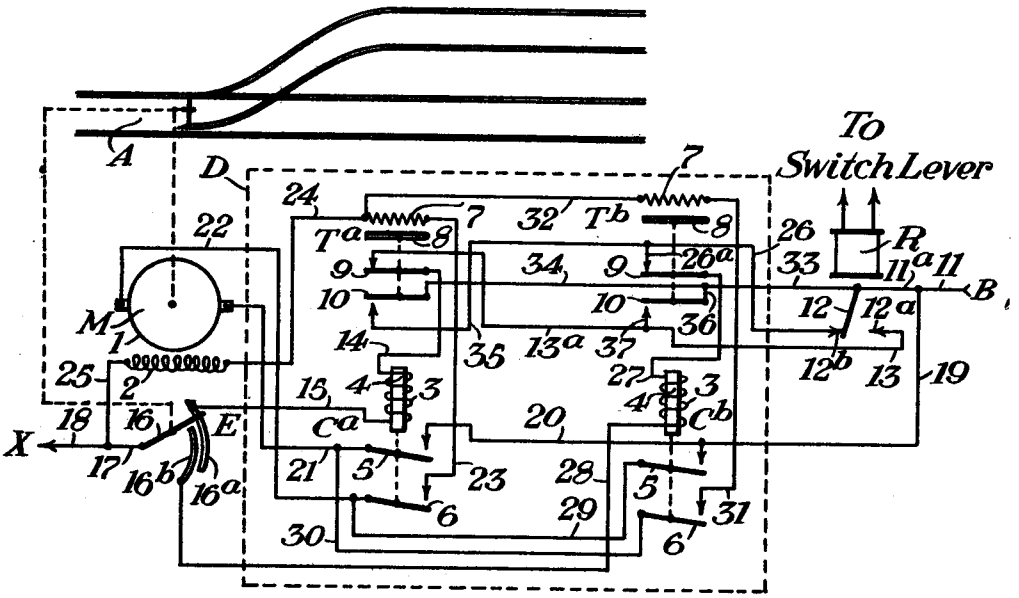
Nov. 18, 1930. B. E. O'HAGAN 1,781,880

MOTOR CONTROL APPARATUS

Filed July 5, 1929



INVENTOR:
B. E. O'Hagan,
by A. R. Vencill
His attorney.

Patented Nov. 18, 1930

1,781,880

UNITED STATES PATENT OFFICE

BERNARD E. O'HAGAN, OF SWISSVALE, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

MOTOR-CONTROL APPARATUS

Application filed July 5, 1929. Serial No. 375,976.

My invention relates to motor control apparatus.

I will describe one form of motor control apparatus embodying my invention, and will then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view illustrating one form of apparatus embodying my invention applied to the control of a motor for operating a railway switch.

Referring to the drawing, the reference character M designates an electric motor comprising, as usual, an armature 1 and a field winding 2. As here shown, the motor M is operatively connected, by suitable means, not shown in the drawing, with a railway switch A, but it will be readily understood that the motor M might be operatively connected with any other suitable form of apparatus.

The reference character E designates a circuit controller operated by the switch A and comprising a contact arm 16 and two contact segments 16^a and 16^b. The parts of circuit controller E are so arranged that the arm 16 will engage the contact segment 16^a to close contact $16—16^a$ at all times except when switch A occupies its reverse position; and that the contact arm 16 will engage contact segment 16^b to close contact $16—16^b$ at all times except when switch A occupies its normal position in which position it is illustrated in the drawing.

The motor M is controlled by a motor controller designated in general by the reference character D, which motor controller, in turn, is controlled by the circuit controller E previously described and by a polarized relay R. The polarized relay R may be controlled in any suitable manner as by pole changing contacts on a switch lever located in a signal tower.

The motor controller D in the form here shown comprises two contactors C^a and C^b. These contactors are exactly alike and each comprises a plunger 4 controlled by an energizing winding 3 and operatively connected with two contacts 5 and 6. The motor controller D also comprises two thermal relays T^a and T^b, each comprising a thermo-sensitive device which changes its shape in response to changes in its temperature, and a heating element 7 for heating the device. As here shown, each thermo-sensitive device is a bi-metallic strip arranged in such manner that the free end of the strip will deflect downwardly when the associated heating element 7 is supplied with current the magnitude of which exceeds the value of the normal operating current for motor M. Each bimetallic strip 8 operates a contact 9 which is normally closed but which is opened when the associated strip is deflected, and a contact 10 which is normally open but which becomes closed when the associated strip is deflected.

As shown in the drawing, switch A occupies its normal position and contact $16—16^a$ of circuit controller E is therefore closed, while contact $16—16^b$ of circuit controller E is open. Motor M is de-energized. Contactors C^a and C^b are both de-energized. Thermal relays T^a and T^b are also de-energized. Polarized relay R is energized in the normal direction so that its contact $12—12^b$ is closed. I will now assume that the towerman wishes to move switch A from its normal to its reverse position. To do this, he reverses relay R, so that contact $12—12^b$ of the relay is opened and contact $12—12^a$ is closed. Current then flows from terminal B of a suitable source of current, not shown in the drawing, through wires 11 and 11^a, contact $12—12^a$ of polarized relay R, wires 13 and 13^a, contact 9 of thermal relay T^a, wire 14, winding 3 of contactor C^a, wire 15, contact $16—16^a$ of circuit controller E, and wires 17 and 18 back to the other terminal X of the source. As a result, contactor C^a becomes energized, and closes its contacts 5 and 6. As a result, a circuit is closed for motor M, from terminal B through wires 11, 19 and 20, contact 5 of contactor C^a, wire 21, armature 1 of motor M, wire 22, contact 6 of contactor C^a, wire 23, heating element 7 of thermal relay T^a, wire 24, field winding 2 of motor M, and wires 25 and 18 to terminal X. Motor M therefore rotates in the direction to move switch A from its normal to its reverse position. When the

switch A reaches its full reverse position, contact 16—16ª of circuit controller E opens, thereby interrupting the circuit previously traced for contactor Cª. As a result, contactor Cª opens its contacts 5 and 6 and motor M becomes de-energized.

If the towerman now wishes to restore the switch A to its normal position, he may do so by again reversing the relative polarity of the current supplied to polarized relay R. When he does this, contact 12—12ª of relay R opens and contact 12—12ᵇ closes. Current then flows from terminal B of the source through wires 11 and 11ª, contact 12—12ᵇ of relay R, wires 26 and 26ª, contact 9 of thermal relay Tᵇ, wire 27, winding 3 of contactor Cᵇ, wire 28, contact 16—16ᵇ of circuit controller E and wires 17 and 18 to terminal X. The current thus supplied to winding 3 of contactor Cᵇ energizes the contactor, and the contactor closes its contacts 5 and 6. Current is then supplied to motor M over a circuit which passes from terminal B of the source through wires 11 and 19, contact 5 of contactor Cᵇ, wires 29 and 22, armature 1 of motor M, wires 21 and 30, contact 6 of contactor Cᵇ, wire 31, heating element 7ª of thermal relay Tᵇ, wires 32 and 24, field winding 2 of motor M, and wires 25 and 18 back to the other terminal X of the source. Motor M then operates to drive switch A to its normal position. When the switch A reaches its normal position, contact 16—16ᵇ of circuit controller E opens, thus de-energizing contactor Cᵇ, and so interrupting the circuit just traced for motor M. The parts are then restored to the positions in which they are illustrated in the drawing.

If, when the switch is being moved from one extreme position to the other extreme position, the movement of the switch is arrested before the switch reaches the desired extreme position due to some obstruction, the motor current will rise above the normal value, and cause the bi-metallic strip of the thermal relay which then has its heating element included in the motor circuit, to deflect and operate the contacts of the thermal relay. For example, if, when the switch is being moved from its normal to its reverse position, the movement of the switch is arrested before the switch reaches the full reverse position by some obstruction such as a piece of coal or ice, the motor current will rise; and since the heating element 7 of thermal relay Tª is included in the motor circuit, under these conditions, bi-metallic strip 8 of thermal relay Tª will deflect downwardly, thereby opening contact 9 and closing contact 10 of this relay. When contact 9 of thermal relay Tª opens, the circuit over which contactor Cª is normally energized, is interrupted, and contactor Cª becomes de-energized. When contactor Cª becomes de-energized, it opens its contacts 5 and 6 and thus de-energizes motor M. When contact 10 of thermal relay Tª closes, an auxiliary circuit is completed for contactor Cᵇ which passes from terminal B of the source, through wires 11, 11ª, 33 and 34, contact 10 of thermal relay Tª, wires 35 and 26ª, contact 9 of thermal relay Tᵇ, wire 27, winding 3 of contactor Cᵇ, wire 28, contact 16—16ᵇ of circuit controller E, and wires 17 and 18 to terminal X. The current supplied to winding 3 of contactor Cᵇ over this auxiliary circuit energizes contactor Cᵇ, and this contactor closes its contacts 5 and 6 so that motor M becomes energized over the circuit controlled by these contacts and returns switch A to its initial or normal position. When the switch reaches its normal position, the auxiliary circuit for contactor Cᵇ is opened at contact 16—16ᵇ of circuit controller E and this contactor therefore opens its contacts and thus de-energizes motor M. As soon as strip 8 of thermal relay Tª cools, however, contact 10 is opened and contact 9 again becomes closed. As a result, contactor Cª is again energized and motor M therefore moves switch A toward the reverse position. Thus it will be seen that under the above conditions, the switch will be driven repeatedly from the normal toward the reverse position until the obstruction is removed, or until the towerman reverses relay R to interrupt the normal circuit for contactor Cª. In similar manner, if when the switch is being moved from the reverse to the normal position, the movement of the switch is arrested before the switch reaches the full normal position, the motor current again rises, and since under these conditions heating element 7 of thermal relay Tᵇ is included in the motor circuit, the bi-metallic strip 8 of thermal relay Tᵇ deflects downwardly and opens contact 9 and closes contact 10 of this relay. When contact 9 of thermal relay Tᵇ opens, contactor Cᵇ becomes de-energized and thus de-energizes motor M. When contact 10 of thermal relay Tᵇ closes, an auxiliary circuit for contactor Cª is closed, which circuit passes from terminal B of the source through wires 11, 11ª, 33 and 36, contact 10 of thermal relay Tᵇ, wires 37 and 13ª, contact 9 of thermal relay Tª, wire 14, winding 3 of contactor Cª, wire 15, contact 16—16ª of circuit controller E and wires 17 and 18 to terminal X. The current supplied to winding 3 of contactor Cª energizes contactor Cª, so that contacts 5 and 6 of this contactor become closed. Motor M therefore becomes energized and returns the switch A to its reverse position. When the switch reaches the full reverse position, the auxiliary circuit just traced for contactor Cª is opened at contact 16—16ª of circuit controller E so that this contactor becomes de-energized, thereby de-energizing motor M. As soon as strip 8 of thermal relay Tᵇ cools and returns to its normal position the auxiliary circuit for con-

tactor C^a is then opened at contact 10 of thermal relay T^b and the normal circuit for contactor C^b is closed at contact 9 of thermal relay T^b. Contactor C^b therefore again becomes energized and completes the circuit for motor M so that motor M again moves the switch A toward the normal position. Thus it will be seen that under these latter conditions, the switch will be driven repeatedly from the reverse toward the normal position until the obstruction is removed or until the control relay R is reversed to interrupt the normal circuit for contactor C^b.

It should be pointed out that if desired, suitable indicating apparatus controlled in the usual manner may be provided to indicate the actual position of the switch so that when the switch is operating in the manner thus described the towerman will know the exact position of the switch at all times.

One advantage of apparatus embodying my invention is that, due to repeated back and forth movement of the switch, when the switch is prevented from reaching one extreme position or the other by some obstruction, the obstruction may be broken down after a few operations of the switch so that the switch can then be moved to the desired position.

Another advantage of apparatus embodying my invention is that damage to the motor due to overloads is positively prevented.

Although I have herein shown and described only one form of 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. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device, manually controlled means for supplying current to said motor to drive said device from said first position to said second position, and means responsive to the magnitude of the current supplied to said motor for at times de-energizing said motor and for subsequently automatically supplying current to the motor to restore said device to said first position.

2. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device, manually controlled means for supplying current to said motor to drive said device from said first position to said second position, a thermal relay responsive to the magnitude of the current supplied to said motor, and means controlled by said relay for at times de-energizing said motor and for subsequently automatically supplying current to said motor to restore said device to said first position.

3. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device, manually controlled means for supplying current to said motor to drive said device from said first position to said second position, a thermal relay responsive to the magnitude of the current supplied to said motor, a contactor, means controlled by said relay for at times de-energizing said motor and for subsequently energizing said contactor, and means effective when said contactor is energized for supplying current to said motor to restore said device to said first position.

4. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device, manually controlled means for supplying current to said motor to drive said device from said first position to said second position, and means effective if the current supplied to said motor increases above a predetermined value for at times de-energizing said motor and for subsequently automatically supplying current to the motor to restore said device to said first position.

5. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device, a thermal relay provided with a heating element, manually controlled means including said heating element for supplying current to said motor to drive said device from said first position to said second position, and means controlled by said relay for at times de-energizing said motor and for subsequently automatically supplying current to the motor to restore said device to said first position.

6. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device, a thermal relay provided with a heating element, manually controlled means including said heating element for supplying current to said motor to drive said device from said first position to said second position, a contactor, means controlled by said relay for at times de-energizing said motor and for subsequently energizing said contactor, and means effective when said contactor is energized for supplying current to said motor to restore said device to said first position.

7. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device, a manually controlled relay provided with a contact, means for supplying said motor with current when said contact is closed to drive said device from said first position to said second position, and means set into operation if the current supplied to said motor increases above a predetermined value when said device occupies an intermediate position for causing said motor to repeatedly drive said device from such intermediate position to its first position and back to such intermediate

position until the current no longer increases above the predetermined value at such intermediate position or until said relay is operated to open said contact.

8. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device, a first and second thermal relay each provided with a heating element, manually controlled means including the heating element of said first relay for at times supplying said motor with current to drive said device from said first position to said second position, manually controlled means including the heating element of said second thermal relay for at other times supplying said motor with current to drive said device from said second position to said first position, and means controlled by said relays for de-energizing said motor and for subsequently supplying said motor with current to drive said device to its initial position if the current supplied to said motor increases above a predetermined value when said device occupies an intermediate position.

9. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device, a first and a second contactor, a first and second thermal relay each provided with a heating element, means controlled by said first contactor and including the heating element of said first relay for supplying said motor with current to drive said device from said second position to said first position, means controlled by said second contactor and including the heating element of said second relay for supplying said motor with current to drive said device from said first to said second position, means controlled in part by said first thermal relay for at times energizing said first contactor, means controlled by said first and second thermal relays for at other times energizing said first contactor, means controlled in part by said second thermal relay for at times energizing said second contactor, means controlled by said first and second thermal relays for at other times energizing said second contactor.

10. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device, a first and a second normally closed contact, a first and a second normally open contact, means controlled at times by said first normally closed contact and at other times by said first normally closed contact and said second normally open contact connected in series for supplying said motor with current to drive said device from said second position to said first position, means controlled at times by said second normally closed contact and at other times by said second normally closed contact and said first normally open contact connected in series for supplying said motor with current to drive said device from said first position to said second position, a first thermo-sensitive device responsive to the magnitude of the current supplied to said motor when said motor is driving said device from said second position to said first position for controlling said first normally closed and said first normally open contact, and a second thermo-sensitive device responsive to the magnitude of the current supplied to said motor when said motor is driving said device from said first position to said second position for controlling said second normally closed and said second normally open contacts.

11. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device, a first and second normally closed contact, a first and a second normally open contact, a manually controlled polarized relay, a first and second winding, a first circuit for said first winding controlled by said first normally closed contact and by said polarized relay, a second circuit for said first winding controlled by said first normally closed contact and said second normally open contact, a first circuit for said second winding controlled by said second normally closed contact and by said polarized relay, a second circuit for said second winding controlled by said second normally closed contact and said first normally open contact, means controlled by said first winding for supplying said motor with current to drive said device from said second position to said first position, means controlled by said second winding for supplying said motor with current to drive said device from said first position to said second position, means for opening said first normally closed contact and for closing said first normally open contact if the current supplied to said motor increases above a predetermined value when said motor is driving said device from said second position to said first position, and means for opening said second normally closed contact and for closing said second normally open contact if the current supplied to said motor increases above a predetermined value when said motor is driving said device from said first position to said second position.

12. In combination, a device capable of assuming a first or a second position, an electric motor for operating said device; a first thermal relay comprising a first bi-metallic strip which deflects when heated, a first heating element for heating said first strip, a first normally closed contact which is opened when said first strip becomes heated, and a first normally open contact which is closed when said first strip becomes heated; a second thermal relay comprising a second bimetallic strip which deflects when heated, a second heating element for heating said sec-

ond strip, a second normally closed contact which opens when said second strip becomes heated, and a second normally open contact which closes when said second strip becomes heated; a first and second winding, means controlled by said first winding and including said first heating element for at times supplying said motor with current to drive said device from said second position to said first position, means controlled by said second winding and including said second heating element for at other times supplying said motor with current to drive said device from said first position to said second position, a first circuit for said first winding including said first normally closed contact, a second circuit for said first winding including said first normally closed contact and said second normally open contact, a first circuit for said second winding including said second normally closed contact, and a second circuit for said second winding including said second normally closed contact and said first normally open contact.

13. In combination, a railway switch having a normal and a reverse position, an electric motor operatively connected with said switch, a first and a second winding, a first and second thermal relay each provided with a heating element and each having a normally closed contact and a normally open contact, means controlled by said first winding and including the heating element of said first relay for at times supplying said motor with current to drive said switch from its normal position to its reverse position, means controlled by said second winding and including the heating element of said second relay for at other times supplying said motor with current to drive said switch from its reverse position to its normal position, a circuit controller connected with said switch and having a first contact which is closed at all times except when said switch occupies its reverse position and a second contact which is closed at all times except when said switch occupies its normal position, a first circuit for said first winding including the first contact of said circuit controller and the normally closed contact of said first thermal relay; a second circuit for said first winding including the first contact of said circuit controller, the normally closed contact of said first thermal relay, and the normally open contact of said second thermal relay; a first circuit for said second winding including the second contact of said circuit controller and the normally closed contact of said second thermal relay; and a second circuit for said second winding including the second contact of said circuit controller, the normally closed contact of said second thermal relay and the normally open contact of said first thermal relay.

14. In combination, a railway switch having a normal and a reverse position, an electric motor for operating said switch; a first thermal relay comprising a first bi-metallic strip which deflects when heated, a first heating element for heating said first strip, a first normally closed contact which opens when said first strip becomes heated, and a first normally open contact which closes when said first strip becomes heated; a second thermal relay comprising a second bi-metallic strip which deflects when heated, a second heating element for heating said second strip, a second normally closed contact which opens when said second strip becomes heated, and a second normally open contact which becomes closed when said second strip becomes heated; a first contactor comprising a first winding and a third and fourth contact controlled by said first winding, a second contactor comprising a second winding and a fifth and sixth contact controlled by said second winding, a circuit controller connected with said switch and having a seventh contact which is closed at all times except when said switch occupies its reverse position and an eighth contact which is closed at all times except when said switch occupies its normal position, means controlled by said third and fourth contacts and including said first heating element for supplying said motor with current to drive said switch from its normal to its reverse position, means controlled by said fifth and sixth contacts and including said second heating element for supplying said motor with current to drive said switch from its reverse to its normal position; a manually controlled polarized relay, a first circuit for said first winding including a contact of said polarized relay, said seventh contact, and said first normally closed contact; a second circuit for said first winding including said seventh contact, said first normally closed contact, and said second normally open contact; a first circuit for said second winding including said eighth contact, said second normally closed contact, and a contact of said polarized relay; and a second circuit for said second winding including said eighth contact, said second normally closed contact, and said first normally open contact.

In testimony whereof I affix my signature.

BERNARD E. O'HAGAN.