

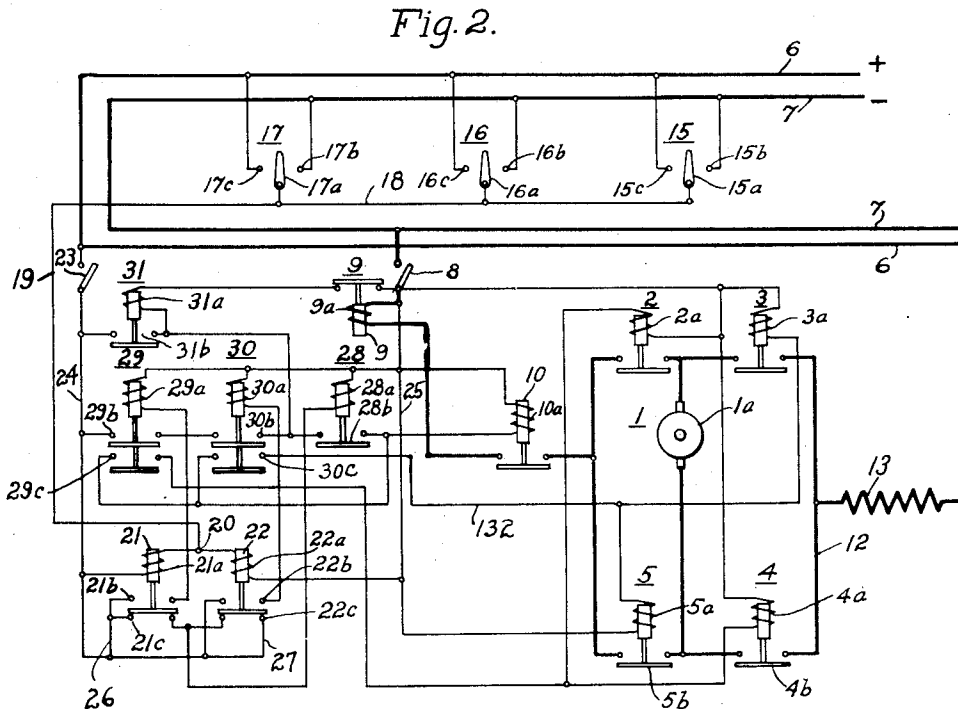
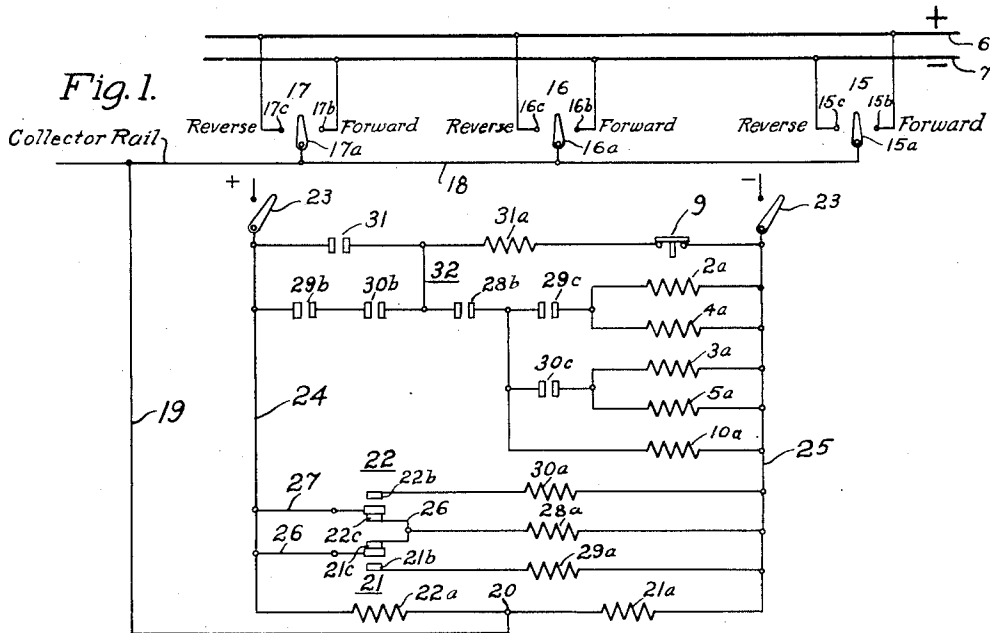
Oct. 1, 1929.

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1,730,283

CONTROL SYSTEM

Filed Sept. 19, 1927



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CONTROL SYSTEM

Application filed September 19, 1927. Serial No. 220,502.

My invention relates to improvements in control systems and particularly to control systems for a main controller actuated from remote control stations.

5 The object of my invention, generally stated, is to provide a remote control system, which will be simple in construction and reliable in operation.

10 It is also an object of my invention to provide for operating a plurality of magnetic devices from a number of distant control stations by means of a single control conductor connecting the magnetic devices and the remote control stations.

15 Another object of my invention is to provide in a system of the indicated character for preventing the further operation of the system after the applied voltage has fallen below a predetermined amount.

20 Other objects of my invention will become apparent when the description set forth hereinafter is taken in connection with the accompanying drawing, wherein;

25 Figure 1 is a simplified schematic diagram of a control system connected in accordance with this invention, and

Fig. 2 is a diagrammatic view of the control system shown in Figure 1 adapted for controlling the operation of a reversible motor.

30 While the invention may be utilized for many purposes it may be illustrated to advantage in connection with a system for controlling the operation of the motor 1 illustrated in Fig. 2. To simplify the following description, all elements illustrated in the schematic diagram of Fig. 1 and those illustrated in Fig. 2 which are similar are noted by the same indicating numerals. The control circuits for operating the various mechanisms in the two figures being identical, they may be more easily traced by considering Fig. 1 in connection with Fig. 2.

35 The motor 1 being a series type direct-current motor, the reversal of the same can be accomplished by simply reversing the direction of current flowing through the armature and to accomplish this reversal, two pairs of reversing contactors 2 and 3 and 4 and 5
40 of a well known construction, having actuat-

ing coils 2a, 3a, 4a and 5a, respectively, are utilized.

The motor 1 may be connected to any source of supply which in this case is the line conductors 6 and 7, as illustrated in Fig. 2. A switch 8 is provided for closing a circuit which extends from the line conductor 7, through actuating coil 9a of the overload relay 9, the interlock on contactor 10, and assuming the reversing contactors 2 and 4 are closed, contactor 2, armature 1a of the motor 1, contactor 4, the series field winding 13, to the positive line conductor 6. If the motor reversing contactors 3 and 5 are closed instead of the reversing contactors 2 and 4, the circuit leading through the armature will be by way of contactor 5, through the armature 1a in a direction opposite to that previously traced through the contactor 3, the series field winding 13 to the positive line conductor 6, and the motor 1 will operate the opposite direction.

In order to actuate the reversing contactors as desired from any number of remote control stations, such as 15, 16, and 17, the system illustrated in both Figs. 1 and 2 is provided. The remote control stations are illustrated by single pole switches 15a, 16a and 17a connected to a single conductor or collector rail 18 and disposed to make contact with a pair of contact points 15b and 15c, 16b and 16c, 17b and 17c, respectively, which are connected to the positive and negative sides of the line conductors 6 and 7 respectively. It will be seen, therefore, that when one of the remote control switches such as 15c is thrown into engagement with one or the other of the contact points 15b or 15c connected to line conductors 6 and 7, respectively, that the voltage impressed upon the single conductor 18 will be either positive or negative depending upon whether it is connected to the positive line conductor 6 or the negative line conductor 7.

In the controller proper there is provided a pair of selector contactors 21 and 22 which are double acting types of contactors and have their actuating coils 21a and 22a connected directly across the source of supply that is the positive and negative conductors 24 and 25,

respectively. To control the action of the selector contactors 21 and 22, a single control conductor 19 is connected to a point 20 midway between the actuating coil 21a and 22a.

5 When there is no voltage impressed upon the single control conductor 19, the two actuating coils 21a and 22a of the selector contactors will be energized and the contactors closed, since they are connected in series relation
10 across the conductors 24 and 25 leading from the source of supply. When the control conductor 19 becomes energized by actuating any one of the switches 15, 16 and 17 to its closed position, a shunting circuit connecting the
15 point 20, between coils 21a and 22a, is completed. It will be readily understood that one of the coils 21a or 22a will become deenergized, depending upon which power conductor is connected to the single control conductor 19 upon the operation of any one of the
20 switches 15, 16 and 17.

The two selector contactors 21 and 22 in turn control the operation of the main controller, because the actuating coils of all the other contactors are in circuit relation with
25 these contactors.

When the selector contactors 21 and 22 are deenergized and in the position as shown, a circuit is established which extends from conductors 26 and 27 through the interlock 21c
30 and 22c and the actuating coil 28a of a magnetic contactor 28. When contactor 21 is energized and held open, a circuit is established which may be traced from conductor 26, interlock 21b and the actuating coil 29a of a
35 magnetic contactor 29. When contactor 22 is energized and held open, a circuit is established through conductor 27, interlock 22b and the actuating coil 30a of magnetic contactor 30. The contactors 28, 29 and 30 together with a low voltage relay 31 are provided
40 for controlling the operation of the reversing switches 2 and 4, and 3 and 5, and the motor line contactor 10 since these contactors are in circuit relation with the actuating coils of the relays and contactors 28, 29
45 and 30. The actuating coil 31a of the low voltage relay 31 may be energized through two paths, one through the interlocks 29b and 30b on the magnetic contactor 29 and 30 and the coil 31a while the other which is a holding circuit is through the interlock 31b and the
50 actuating coil 31a. The first circuit or actuating circuit as will be seen by reference to Fig. 1 or 2 can be completed only when contactors 29 and 30 are closed simultaneously.

The motor 1 may be connected to the power source through a line contactor 10 which may be closed when the low voltage relay 31 and
60 the magnetic contactor 28 are closed. The circuit to the actuating coil 10a of the line contactor 10 being through the interlocks 31b of the low voltage relay 31, the interlock 28b on the contactor 28 and the actuating coil
65 10a. The actuating coils of the reversing

contactors 2 and 4, and 3 and 5 are energized when the two interlocks 31b, 28b and the interlock 29c and 30c are closed.

Upon closing the knife switch 23 when no voltage is impressed upon the conductor 19, the actuating coils 21a and 22a of the selector
70 contactors 21 and 22 will be energized and the contactors 21 and 22 actuated to their upper positions, as viewed in Fig. 2 of the drawing, to bridge contact members 21b and 22b respectively. The closure of contactors 21 and
75 22 upon the energizing of the actuating coils 21a and 22a closes the circuit traced hereinbefore through the actuating coils 29a and 30a of the contactors 29 and 30.

When the two coils 29a and 30a, respectively, have been energized, the contactors 29 and 30 are actuated to their closed position to establish a circuit which may be traced from the positive line conductor 24, through the interlocks 29b and 30b of the contactor 29 and
85 30, the actuating coil 31a of the low voltage relay, and the overload relay 9 to the negative line conductor 25. The completion of this circuit will energize the actuating coil 31a of the low voltage relay 31 and cause the same to close, thereby establishing a holding circuit which extends from the line conductors 24,
90 through the low voltage relay 31, the actuating coil 31a and the overload relay 9 to the negative line conductor 25.

When the contactors 29 and 30 are closed, the interlocks 29b and 30b and the interlocks 29c and 30c are closed.

Assuming now that one of the control station switches 15, 16 or 17 has been actuated to a position to impress either positive or negative line voltage upon the conductor 19, then one of the actuating coils 21a or 22a
100 will be deenergized as previously described. Therefore, one of the contactors 21 or 22 will fall open, interrupting the circuit to one or the other of the actuating coils 29a or 30a of the contactors 29 and 30. Assuming that the voltage impressed on conductor 19
110 is such that the actuating coil 22a will become deenergized, then the actuating coil 30a, which is in series circuit relation with the interlocks 22b on the contactor 22, will become deenergized and the contactor 30 will
115 fall to its lower position. Upon the opening of the contactor 22 a circuit is established which extends from the positive line conductor 24, through conductor 27, the interlock 22c, and the actuating coil 28a of the
120 contactor 28 to the negative line conductor 25. This will cause contactor 28 to close and energize coil 10a of the motor line contactor 10 which is connected in a circuit that may be traced from the line conductor 24, low
125 voltage relay 31, interlocks 28b and coil 10a to the negative line conductor 25. Therefore, when the contactor 28 closes, the motor line contactor 10 will close. The contactor 30 being opened, when the coil 30a was de-

energized, and the contactor 29 remaining in the closed position, a circuit will be established from positive line conductor 24 through the low voltage relay 31, contactor 28, the interlocks 29c the two actuating coils 2a and 4a associated with the reversing contactors 2 and 4, to the negative line conductor 25. The circuit will actuate the reversing contactors 2 and 4. Therefore, the motor will start to operate in the direction corresponding to the current flowing through these two contactors.

Assuming now that it is desired to reverse the operation of the motor, then one of the master switches 15, 16 or 17 will be thrown to change the polarity of the voltage impressed upon the line conductor 19. In this instance, the actuating coil 21a of contactor 21 becomes short circuited, and full line voltage is impressed upon coil 22a of contactor 22. Upon the closure of contactor 22, the contactor 30 closes as described hereinbefore, thereby establishing an operating circuit for the reversing contactors 3 and 5. This circuit may be traced from line conductor 24, through relay 31, contactor 28, interlocks 30c of contactor 30, conductor 32, and thence through a parallel circuit comprising coils 3a and 5a, to the line conductor 25.

The closure of the reversing contactors 3 and 5 thereby establishes a circuit extended through the armature of the motor 1 in a direction opposite to that when the other two reversing contactors were closed. This will cause the motor 1 to reverse and operate in the opposite direction.

It will be noted that if the voltage to the system should fail or fall below a predetermined amount, that the low voltage relay 31 will fall open, and the same can not be again closed until the circuit previously traced through the interlocks 29b and 30b is established, which occurs only when all the master switches are in their off positions. Thereby a low voltage protection is provided to prevent the apparatus to which the controller is attached from starting up, after voltage is again restored to the line, unless the control switches themselves are first returned to their neutral position. This low voltage protection can be very readily appreciated where a system incorporating the invention is applied to steel mill operation in which it is necessary at all times to exercise the greatest of care in the operation of the machinery to avoid accidents.

While I have illustrated and described a particular embodiment of the invention, it is intended that all matter contained herein shall be interpreted as illustrative and not in a limiting sense, since manifestly the same may be considerably varied without departing from the spirit of the invention as set forth in the appended claims.

I claim as my invention:

1. In a motor-control system, in combination, a motor, a main controller, a source of power for the motor, a plurality of remote-control stations for actuating the controller, a single control conductor for connecting the remote-control station to the controller, means in the remote-control station for connecting said control conductor to the power source, means in the main controller responsive to the energization of the control conductor for governing the direction of operation of the motor, and a low-voltage relay disposed to render said main controller inoperative in response to a predetermined voltage reduction, said relay being dependent for its closure upon said governing means.

2. In a control system, in combination, a main controller, a plurality of control stations for operating the controller, a single control conductor for connecting the control stations to the controller, said main controller being provided with a plurality of selecting switches for governing the operation of the controller, said selecting switches being responsive to the energization of the control conductor, and a low-voltage relay disposed to render the main controller inoperative in response to a predetermined reduction in voltage, said low-voltage relay being dependent for its closure upon said selecting switches.

3. In a motor-control system, in combination, a motor, a source of power for the motor, means for establishing a motor circuit, a plurality of reversing switches disposed to be operated in pairs, relays for controlling the energization of each pair of reversing switches, said relays being disposed to effect the operation of the reversing switches when deenergized, manually operable means for controlling the energization of the relays, a low-voltage relay for interrupting the motor circuit, said low-voltage relay being dependent for its closure on said relays.

4. In a motor-control system, in combination, a motor, a source of power for the motor, means for establishing a motor circuit, reversing switches for controlling the direction of operation of the motor, means for selectively operating the reversing switches, a manually operable switch for controlling the operation of the means for selectively operating the reversing switches, a no-voltage relay for interrupting the motor circuit upon the failure of voltage, said reversing switches being responsive to the opening of the no-voltage relay, said no-voltage relay being dependent for its closure upon the means for selectively operating the reversing switches, whereby, when the relay is opened, upon the failure of voltage, it cannot be reclosed until the manually operable switch is operated.

5. In a motor-control system, in combination, a motor, a source of power for the motor, means for controlling the supply of power to the motor, reversing switches for controlling the direction of operation of the motor, means for selectively operating the reversing switches to operate the motor in a predetermined direction, a no-voltage relay for governing the means for controlling the supply of power to the motor upon the failure of voltage, said relay controlling the operation of the reversing switches through said selective means, said selective means being disposed for operation to effect the setting of the relay in the closed position.

6. In a motor-control system, in combination, a motor, a source of power for the motor, reversing switches for controlling the direction of operation of the motor, a switch for controlling the supply of current to the reversing switches, means cooperative with said control switch for selecting and operating predetermined reversing switches, and a low-voltage relay responsive to the voltage across the source of supply disposed to control said switch, said low-voltage relay being dependent, when it has opened, on the selecting means for its closure.

7. In a motor-control system, in combination, a motor, a source of power for the motor, reversing switches for controlling the direction of operation of the motor, a switch for controlling the supply of current to the reversing switches, means cooperative with said control switch for selecting and operating predetermined reversing switches, a low-voltage relay responsive to the voltage across the source of supply disposed to control said switch, said low-voltage relay being dependent, when it has opened, on the selecting means for its closure and manual means for initiating the operation of the selecting means.

8. In a motor-control system, in combination, a motor, a source of power for the motor, reversing switches for controlling the direction of operation of the motor, a switch for controlling the supply of current to the reversing switches, means cooperative with said control switch for selecting and operating predetermined reversing switches, a low-voltage relay responsive to the voltage across the source of supply disposed to control said switch, said low-voltage relay being dependent, when it has opened, on the selecting means for its closure, a plurality of manual control stations for controlling the operation of the selecting means, and a single control conductor disposed to connect said manual control stations to the selecting means.

In testimony whereof, I have hereunto subscribed my name the 12th day of September, 1927.

PHELAN McSHANE.