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MOTOR CONTROLLER.

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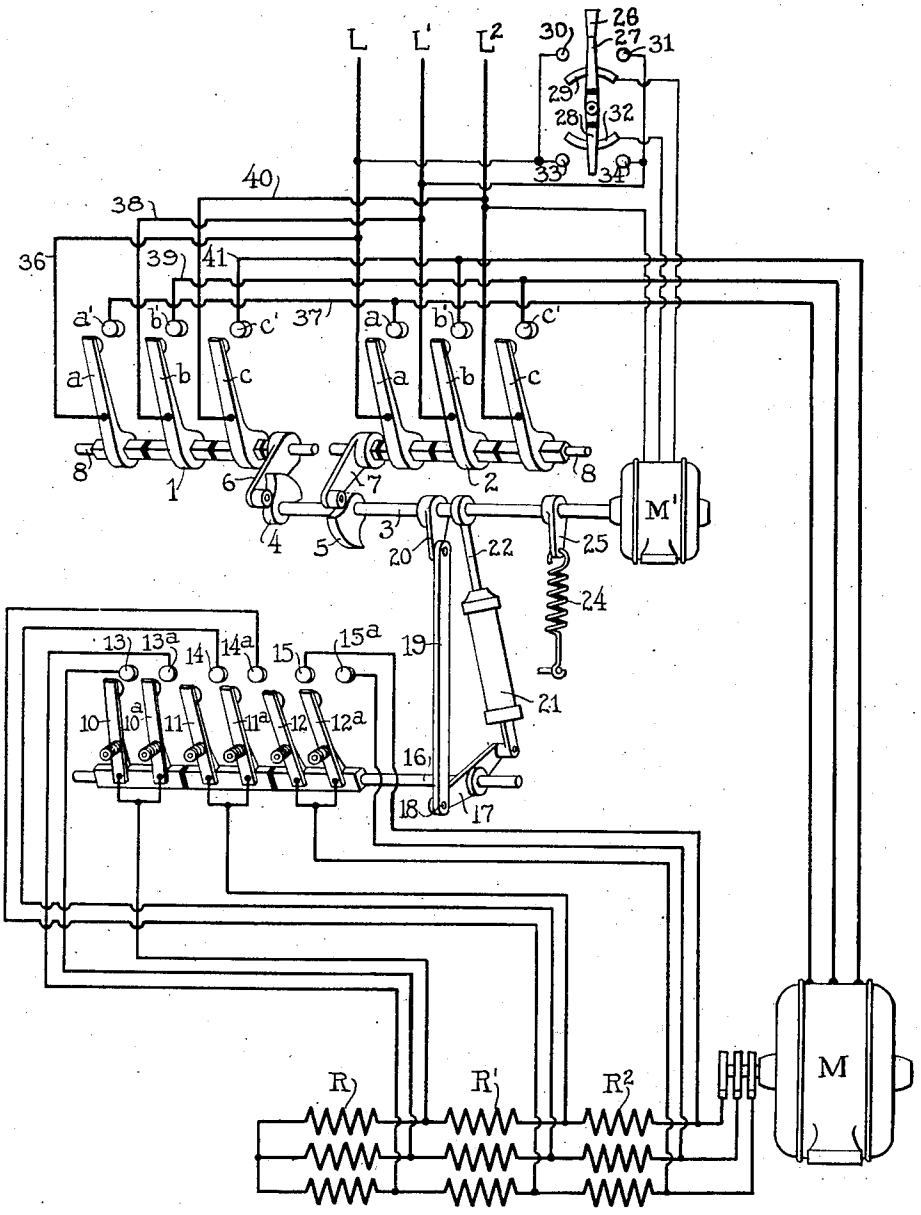

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MOTOR-CONTROLLER.

1,335,418. Specification of Letters Patent. Patented Mar. 30, 1920.

Application filed June 21, 1917. Serial No. 176,021.

To all whom it may concern:

Be it known that I, THOMAS E. BARNUM, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Motor-Controllers, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

This invention relates to controllers for alternating current motors and more particularly to controllers having alternating current operating means adapting the same for remote control.

The present invention has among its objects to provide a controller of the aforesaid type which will obviate the noise of operation and subsequent hum or chatter which results from the employment of A. C. electromagnets and solenoids and which is often so objectionable that where quiet is demanded, as in hospitals, the use of such operating means is impractical.

A further object is to provide a quietly operable controller wherein a single torque motor will serve to effect numerous functional operations and will moreover serve to give phase failure protection.

A still further object is to provide a reversing controller wherein a single torque motor will serve to effect both reversing and accelerating operations and will moreover serve to give phase reversal protection.

Various other objects and advantages of the invention will hereinafter appear.

The accompanying drawing schematically and diagrammatically illustrates one embodiment of the invention which will now be described, it being understood that the invention may be embodied in other forms falling within the scope of the appended claims.

Referring to the drawing, the controlled motor M is of a three phase slip ring type to be supplied with power from lines L, L′ and L^2 and to be accelerated through the medium of sets of resistances R, R′ and R^2 connected in its rotor circuit in the usual manner.

The reversing means comprises two triple pole switches 1 and 2 operable selectively by reverse movements of a shaft 3 through the medium of cams 4 and 5 which respectively coact with rollers on crank arms 6 and 7 operatively connected to the movable elements of the two switches. More specifically, each switch comprises three contact arms *a*, *b* and *c* adapted to coöperate with stationary contacts *a′*, *b′* and *c′* respectively, said arms being fixed to and insulated from a common shaft 8 and said shaft also having fixed thereto one of the cam operated arms above described.

The switches 1 and 2 serve to reverse the connections between two of the supply lines and two of the motor terminals as hereinafter specified and the cams 4 and 5 are constructed to permit continued rotation of the shaft 3 for a purpose hereinafter set forth following the closure of the selected reversing switch.

The accelerating means comprises three pairs of switch arms 10—10^a, 11—11^a and 12—12^a coöperable with contacts 13—13^a, 14—14^a and 15—15^a to short circuit the resistance R, R′ and R^2 respectively by well known connections. The three pairs of switch arms are yieldingly mounted in a well known manner upon an oscillatable shaft 16 and insulated from one another, said pairs of arms being set at different angles upon said shaft to be moved progressively into engagement with their respective contacts upon clockwise rotation of said shaft, the latter being so operable by shaft 3. More specifically, the shaft 16 has fixed thereto a crank arm 17 connected by a pin 18 to a link 19, which is connected at its upper end to a crank arm 20 fixed to shaft 3. With both reversing switches open the link 19 and crank arm 20 are alined whereby rotation of shaft 3 to operate either reversing switch also lifts said link to rotate shaft 16, the arrangement, however, being such as to insure against closure of any accelerating switch until after closure of the selected reversing switch.

Conversely upon return rotation of the shaft 3 the link 19 is forced downwardly to rotate the shaft 16 in a counter-clockwise direction to release the accelerating switches, which then automatically move to open position. Further, the shaft 16 is shown as provided with a dash pot 21 to oppose its clockwise movement and to thereby provide a time element in the exclusion of the accelerating resistances. This dash pot is mounted upon a tail piece of the crank arm 17 and for convenience of illustration the piston of the dash pot has been shown as connected to the shaft 3 by a member 22.

A torque motor M′ is provided to operate

the shaft 3 for closure of the switches described, subject to return of said shaft by a spring 24 upon a given reduction in the torque of said motor, said spring having one end connected to a fixed part and its opposite end connected to a crank arm 25 fixed to shaft 3. The motor M′ is of the squirrel cage type and is of the same number of phases as motor M. Also, as will hereinafter appear, it is connected through a master switch 26 to the supply circuit whereby it is subject to the same phase reversals as the motor M.

Thus the torque motor provides for selective operation of the reversing switches and also for operation of the accelerating switches and moreover provides for quiet operation of all of said switches and firm retention thereof in closed position.

The master switch 26 comprises a manually operable arm having two insulated contact sections 27 and 28, the former to continuously engage a segment 29 and to engage selectively contacts 30 and 31 and the latter to continuously engage a segment 32 and to engage selectively contacts 33 and 34. The segments 29 and 32 are respectively connected to two terminals of the motor M′, the third terminal of said motor being directly connected to line L, while contacts 30 and 33 are connected to line L and contacts 31 and 34 to line L′. Accordingly it will be observed that the switch 26 serves to complete the circuit of motor M′ and to reverse the connections between two terminals thereof and lines L and L′ to effect operation of said motor in either direction at will, that is, assuming a constant phase relation. For example, it may be assumed that clockwise movement of the controller effects clockwise rotation of the shaft 3 and consequent closure of reversing switch 2 for clockwise rotation of motor M and that reverse movement of the master controller effects counter-clockwise rotation of the motor M′ and shaft 3 to close the reversing switch 1 for counter-clockwise rotation of motor M. Further, it will be observed that should the supply line be subject to a phase reversal with the result of effecting counter-clockwise operation of motor M upon closure of reversing switch 2 and clockwise rotation of said motor upon closure of reversing switch 1, such phase reversal would also cause motor M′ to operate in a reverse manner relative to the master switch. For example, should the master switch then be moved to the right the motor M would operate in a counter-clockwise direction thereby closing reversing switch 1 instead of switch 2 as previously described, with the result of insuring clockwise operation of motor M, or in other words, rotation in the same direction as though no phase reversal had occurred. On the other hand, should the master switch be moved counter-clockwise the motor M′ would operate clockwise to close the reversing switch 2 and effect counter-clockwise operation of the motor M, as though no phase reversal had occurred.

After response of the motor in either direction to close one of the reversing switches it continues to rotate the shaft 3 to operate the accelerating switches subject to retardation by the dash pot as above described, to thereby accelerate the motor, whereupon it stalls and during continuance of normal torque holds the selected reversing switch and accelerating switches in closed position. On the other hand, upon restoration of the master switch to off position, or upon a given drop in voltage, the motor M′ releases the shaft 3 whereupon the spring restores said shaft to the angular position illustrated, thereby releasing both the reversing switch and the accelerating switches. This provides for interruption of the circuit of the motor M and for reinclusion of the resistances R, R′ and R^2 whereby the motor is insured protection in restarting. Further, should a phase reversal occur after setting of the controller for operation of the motor in either direction the motor M′ would be reversed and would assist the spring 24 to release both the selected reversing switch and the accelerating switches. Also, it would further act to at once close the other reversing switch and reclose the accelerating switches to restart the motor in the direction last selected by the master switch with only a momentary interruption of the circuit of said motor.

The connections of the main motor are as follows: Assuming closure of reversing switch 1, line L is connected by conductor 36 through arm *a* and contact *a′* of said reversing switch, by conductor 37 to the left hand terminal of said motor; line L′ by conductor 38 through arm *b* and contact *b′* by conductor 39 to the center terminal of said motor, and line L^2 by conductor 40 through arm *c* and contact *c′* by conductor 41 to the right hand terminal of said motor. On the other hand, assuming closure of reversing switch 2, the left hand terminal of the motor is connected through contact arm *a* and contact *a′* to line L, while the other two terminals of the motor are reversed with respect to contacts L′ and L^2. Line L′ is then connected through arm *b* and contact *b′* by conductor 41 to the right hand terminal of said motor, while line L^2 is connected through contact arm *c* and contact *c′* by conductor 39 to the center terminal of said motor.

What I claim as new and desire to secure by Letters Patent is:

1. In a controller for alternating current motors, in combination, reversing means, accelerating means and an alternating current

motor for operating both of said means and holding the same against return movement.

2. In a controller for alternating current motors, in combination, reversing means, accelerating means, an alternating current motor and operative connections between both of said means and said motor providing for operation of said means progressively by said motor, both of said means being adapted to return to their initial positions upon release thereof by said motor.

3. In a controller for alternating current motors, in combination, reversing switches, a rotatable shaft having cams to actuate said switches selectively upon oscillation of said shaft, accelerating switches operatively connected to said shaft to be actuated thereby but subject to prior operation of said reversing switches and an alternating current torque motor operatively connected to said shaft for operating all of said switches and holding the same closed.

4. In a controller for alternating current motors, in combination, reversing switches, a rotatable shaft having cams to actuate said switches selectively upon oscillation of said shaft, accelerating switches operatively connected to said shaft to be actuated thereby but subject to prior operation of said reversing switches, a dash pot for retarding operation of said accelerating switches, and an alternating current torque motor operatively connected to said shaft for operating all of said switches and holding the same closed.

5. The combination with a polyphase alternating current motor and polyphase supply circuit therefor, of means controlling the continuity of circuit of said motor and the direction of operation thereof, accelerating means for said motor and common electromagnetic operating means for both of the former means to effect progressive operation thereof, said electromagnetic means being responsive to supply-circuit phase reversals for insuring against reversals of said motor thereby.

6. The combination with a polyphase alternating current motor and polyphase supply circuit therefor, of means controlling the continuity of circuit of said motor and the direction of operation thereof, accelerating means for said motor, common electromagnetic operating means for both of the former means to effect progressive operation thereof, said electromagnetic means being responsive to supply-circuit phase reversals for insuring against reversals of said motor thereby and means controlling said electromagnetic means to effect reversal of said motor at will.

7. The combination with a polyphase alternating current motor and polyphase supply circuit therefor, of a circuit controlling device for said motor to start and stop the same and to effect reversal thereof, an accelerating device for said motor, a polyphase motor operatively connected to said devices to actuate the same progressively and to operate said first mentioned device in opposite directions for reversal of said first mentioned motor and connections for said second mentioned motor rendering the same responsive to supply-circuit phase reversals.

8. The combination with a polyphase alternating current motor and polyphase supply-circuit therefor, of a circuit controlling device for said motor to start and stop the same and to effect reversal thereof, an accelerating device for said motor, a polyphase motor operatively connected to said devices to actuate the same progressively and to operate said first mentioned device in opposite directions for reversal of said first mentioned motor, and a reversing switch and circuit connections for said second mentioned motor whereby the selection of operation of said first mentioned motor may be selected by said switch irrespective of supply circuit phase reversals.

9. In a motor controller, in combination, means to control the continuity of the motor circuit and to effect reversals of the motor, accelerating means, and a single torque motor operatively connected to both of said means to effect operation thereof progressively for reverse operations of the controlled motor, both of said means being biased against operation by said torque motor and being dependent for retention in operative positions upon continued torque of said motor.

10. In a motor controller, in combination, reversing switches for the motor, a common operating shaft therefor having cams thereon to actuate said switches selectively upon rotation of said shaft in opposite directions, said shaft being thereupon capable of continued rotation, accelerating switches, means operatively connecting said accelerating switches and said shaft for operation of the former by rotation of the latter in either direction but only after operation of the selected reversing switch, said shaft being biased to release all of said switches and a torque motor for operating said shaft in opposite directions against its bias for selective operation of said reversing switches and progressive operation of said reversing and accelerating switches.

In witness whereof, I have hereunto subscribed my name.

THOMAS E. BARNUM.