March 18, 1930. W. C. KENNEDY 1,750,892

CONTROLLER FOR ELECTRIC MOTORS

Filed Nov. 15, 1926

Fig. 1.

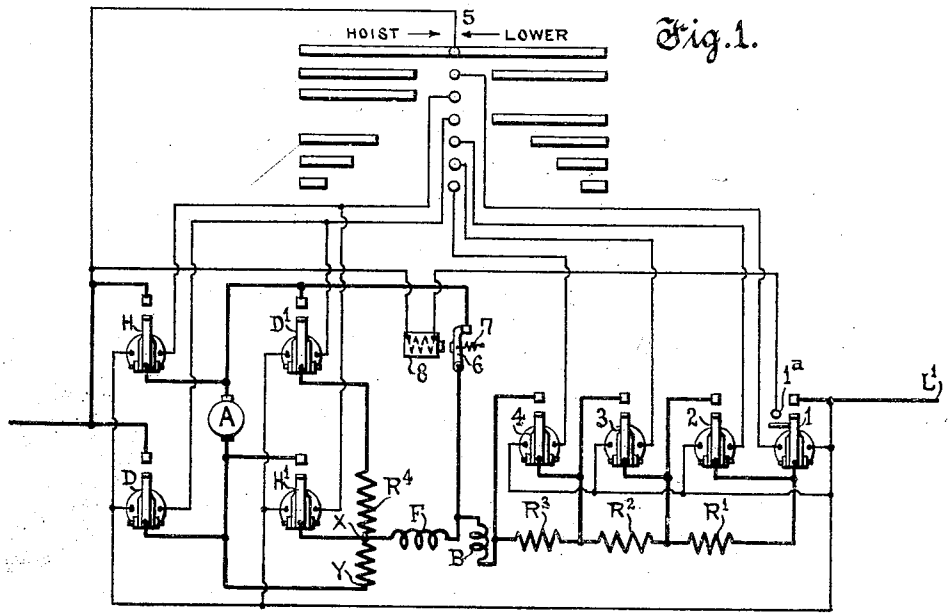


Fig. 2.

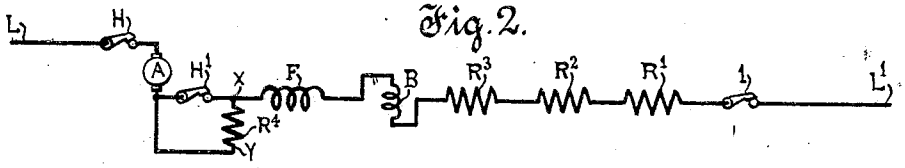


Fig. 3.

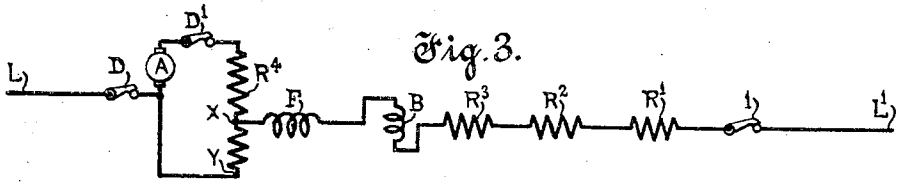
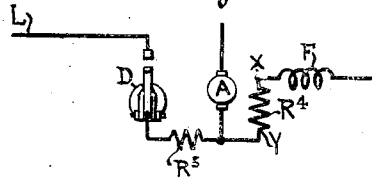


Fig. 4.



Fig. 5.



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UNITED STATES PATENT OFFICE

WALTER C. KENNEDY, OF LLANERCH, UPPER DARBY, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CUTLER-HAMMER, INC., OF MILWAUKEE, WISCONSIN, A CORPORATION OF DELAWARE

CONTROLLER FOR ELECTRIC MOTORS

Application filed November 15, 1926. Serial No. 148,489.

This invention relates to improvements in controllers for electric motors.

While the invention may have other advantageous applications, it is particularly applicable to motors employed in hoist service.

In the control of a hoist motor of the series type it is desirable to connect a resistance across the armature of the motor in lowering whereby in case of an overhauling load the motor will act as a generator to limit the lowering speed. Also it is desirable to provide a dynamic brake circuit for the motor when its controller is in off position and the present invention has among its objects to provide an improved controller affording the aforementioned connections.

A further object of the invention is to provide a controller wherein a portion of the resistance used for lowering connections may be employed as the resistance for the last mentioned dynamic braking connections and wherein any desired resistance may thus be obtained for each set of connections.

A further object is to provide a controller of the aforesaid character wherein the number of switches required is reduced to a minimum.

A further object is to provide such a controller with means for limiting as desired the amount of current traversing the series field of the motor during lowering.

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

The accompanying drawing illustrates diagrammatically one embodiment of the invention which will now be described, it being understood that the invention is susceptible of various modifications without departing from the scope of the appended claims.

In the drawing Figure 1 is a diagrammatic view showing both power and control circuits.

Fig. 2 is a simplified diagram of hoisting connections.

Fig. 3 is a simplified diagram of lowering connections.

Fig. 4 is a simplified diagram of the connections established in off position of the controller, and

Fig. 5 is a diagrammatic view showing a modification.

Referring to Fig. 1 there is shown a series motor having an armature A and a series field winding F to be connected across lines L and L^1 through starting resistances R^1, R^2 and R^3. Also there is shown in this figure a coil B for that type of electromagnetic brake commonly employed for hoists, such brake being applied by spring pressure and being released by its electromagnet.

The control instrumentalities shown comprise the usual main switch 1 and set of reversing switches comprising hoist switches H and H^1 and lowering switches D and D^1. Also the control instrumentalities shown comprise accelerating switches 2, 3 and 4 for short-circuiting resistances R^1, R^2 and R^3 respectively. All of the aforementioned switches which may be of any preferred type, are shown as of the normally open type to be closed by separate electromagnetic windings under the control of a drum type master switch 5.

The control circuits for these switches being obvious and well known the same will not be described. The circuits are such that when the master switch is moved in hoisting direction it energizes main switch 1 and reversing switches H and H^1 and thereafter energizes accelerating switches 2, 3 and 4 progressively. When the master switch 5 is moved in lowering direction it energizes main switch 1 and reversing switches D and D^1 and thereafter energizes accelerating switches 2, 3 and 4 progressively.

The controller further comprises a resistance R^4 to be connected across the motor armature by reversing switch D^1, the series field of the motor having one terminal connected to said resistance R^4 at an intermediate point X. As will appear, the resistance R^4 serves in its entirety as a speed limiting means in lowering while the lower portion thereof or that section between points X and Y is utilized for the dynamic braking circuit which is provided in the off position of the master switch by a switch 6 biased to closed position by a spring 7 and having electromagnet 8 to open the same. As shown, the electromagnet

8 has its energizing circuit controlled by auxiliary contacts 1^a of main switch 1 whereby switch 6 is opened when the motor circuit is completed and is permitted to be reclosed when the motor circuit is interrupted by the main switch.

When the master switch is moved in a hoisting direction to close main switch 1 and reversing switches H and H^1, the motor circuit extends as shown in Fig. 2 from line L through switch H to and through the motor armature A and thence through switch H^1 to and through the series field F of the motor, brake coil B, resistances R^3, R^2 and R^1 all in series and to line L^1 through main switch 1. Thus the usual starting connections are provided and as will be understood closure of switches 2, 3 and 4 progressively will short-circuit resistances R^1, R^2 and R^3 to accelerate the motor. As shown in this figure the field of the motor has a connection to the motor armature through portion XY of resistance R^4, but this section of the resistance is short-circuited by reversing switch H^1.

When the master switch is moved to lowering position to close main switch 1 and reversing switches D and D^1 the motor circuit extends as shown in Fig. 3 from line L through reversing switch D to and through the motor armature A and thence through reversing switch D^1 to and through the upper portion of resistance R^4, the motor field F, brake coil B and resistances R^3, R^2 and R^1 all in series, to line L^1 through main switch 1. Also circuit may be traced from line L through reversing switch D and portion XY of resistance R^4 to the motor field F.

Thus the motor field receives a supply of current shunting the motor armature and if in lowering the motor is overhauled by its load it will act as a generator, the current generated thereby flowing in the loop around the motor armature including the entire resistance R^4. Under such conditions the current generated by the motor traverses the lower portion of the loop including section XY of resistance R^4 in the same direction as the current supplied from line L. As will be understood, part or all resistances R^1, R^3, R^4 may be excluded at will by further movement of the master switch.

Whenever the master switch is in its off position as shown in Fig. 1, the main switch 1 and all reversing and resistance switches are opened to disconnect the motor from lines L and L^1, whereas switch 6 is closed to establish the connection shown in Fig. 4. Thus the right hand terminal of the motor armature is connected through section XY of resistance R^4 to one terminal of the motor field while the other terminal of the motor field is connected through switch 6 to the left hand terminal of the motor armature. Accordingly the motor is provided with dynamic braking connections in the off position of the master switch.

As will be apparent, any desired portion of the resistance R^4 may be included in the dynamic braking circuit controlled by switch 6 by adjustment of the connection between the series field of the motor and said resistance and the total amount of resistance R^4 utilized in lowering may be varied without affecting the value of resistance desired for the first mentioned connections.

With the form of controller illustrated it is possible to limit the current supplied to motor field during lowering by use of a resistance R^5 as shown in Fig. 5 if such limitation is desired.

It is of course to be understood that the novel features of control herein disclosed may be embodied in controllers of various other forms, the form illustrated in the accompanying drawings having been selected for convenience of disclosure.

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

1. In combination, a series motor, a resistance and means to connect said motor to a supply source with said resistance in parallel with its armature and with the motor field connected directly to the supply source through a portion of said resistance and means to establish for said motor when disconnected from its supply source a dynamic braking circuit inclusive of said portion of said resistance.

2. The combination with a series motor, of a resistance means providing for operation of said motor in one direction with said resistance excluded from circuit and in a reverse direction with said resistance in parallel with the armature of said motor and with the field of said motor connected directly to the supply source through a portion of said resistance and means for establishing a dynamic braking circuit for said motor inclusive of said portion of said resistance when said motor is disconnected from its supply source by said former means.

3. The combination with a series motor, of a resistance having one terminal thereof permanently connected to the motor armature and a tap permanently connected to the motor field, two switches to connect said motor armature and field to one side of a supply circuit with said resistance excluded, two switches for connecting said motor armature and field to the same side of said circuit for reversal, one of the last mentioned switches establishing a loop including said motor armature and said resistance and the other establishing a line connection to said motor field through said motor armature and a part of said resistance and another line connection direct to said motor field through another portion of said resistance and a switch to connect said motor armature and

field in a closed loop including the last mentioned portion only of said resistance.

4. The combination with a motor, of a resistance, means for connecting said motor to a supply source and for establishing a shunt for its armature exclusive of its series field winding but including said resistance, and voltage responsive means to act upon disconnection of said motor from the supply source or upon no voltage conditions in said source, to establish a dynamic braking circuit for said motor including a part only of said resistance.

5. The combination with a series motor, of a resistance, means for connecting said motor to a supply source and for establishing a shunt for its armature including said resistance and a normally closed electroresponsive switch for establishing a dynamic braking circuit for said motor including the series field winding of said motor and a part only of said resistance, said switch being responsive to interrupt said dynamic braking circuit immediately upon connection of said motor to its supply source by said former means.

6. The combination with a series motor, of a resistance having a tap for connection to one terminal of the series field winding of said motor, means to connect said motor to a supply source for operation in reverse directions selectively and to connect said resistance in parallel with the motor armature when said motor is connected for operation in a given direction and means including a normally closed switch under the control of said former means for establishing a dynamic braking circuit for said motor when the same is disconnected from its supply source, said dynamic braking circuit including a part only of said resistance.

7. The combination with a series motor, of electroresponsive switches for selectively establishing reverse power connections therefor, a resistance to be connected in parallel with the motor armature when said motor is connected for operation in a given direction and having a tap for connection to one terminal of the series field winding of said motor, a master switch for selectively controlling said switches, and a normally closed electroresponsive switch under the control of certain of said former switches for establishing a dynamic braking circuit for said motor when the same is disconnected from its supply source, said dynamic braking circuit including the series field winding of said motor and a part only of said resistance.

8. The combination with a series motor, of a master switch, electroresponsive switches controlled by said master switch for connecting said motor to a supply source for operation in reverse directions selectively, a resistance to be connected in parallel with the armature of said motor by certain of said switches, a second resistance to be connected in series with the motor armature by said switches, electroresponsive accelerating switches under the control of said master switch, and a normally closed electroresponsive switch under the control of certain of said first mentioned electroresponsive switches for establishing a dynamic braking circuit for said motor upon disconnection thereof from its power source, said dynamic braking circuit including a part only of said first mentioned resistance.

In witness whereof, I have hereunto subscribed my name.

WALTER C. KENNEDY.