Aug. 28, 1928. 1,682,541

J. F. SCHNABEL

ELECTRIC CONTROLLER CONSTRUCTION

Filed April 7, 1927 3 Sheets-Sheet 1

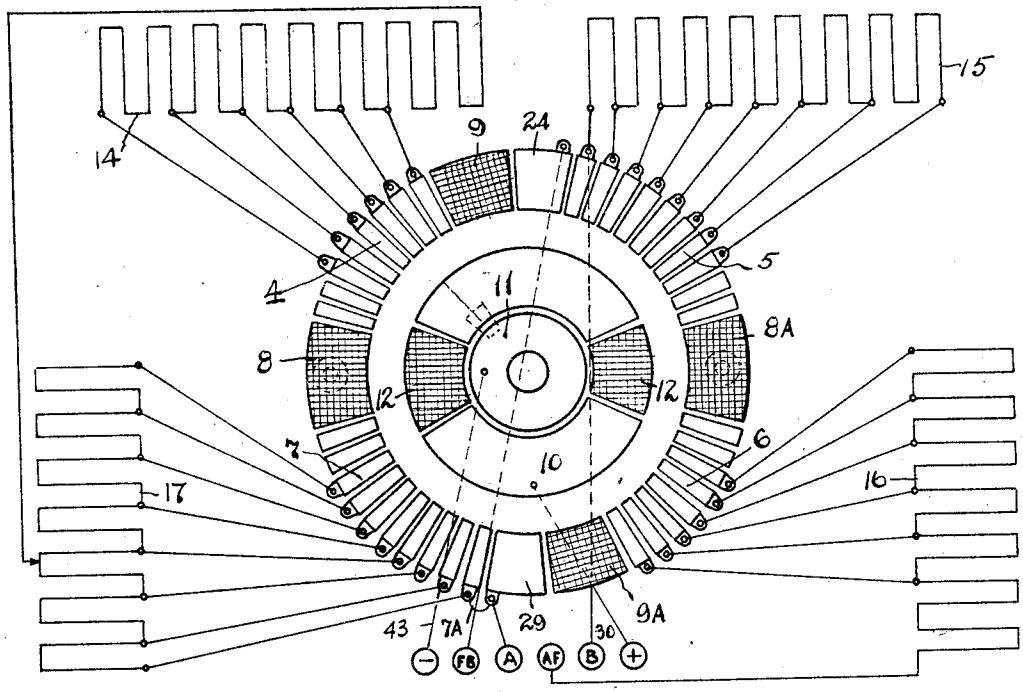


Fig. 1

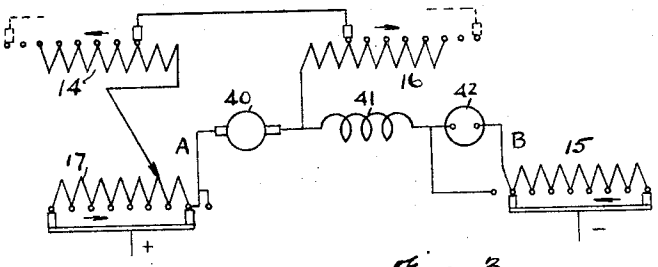


Fig. 3.

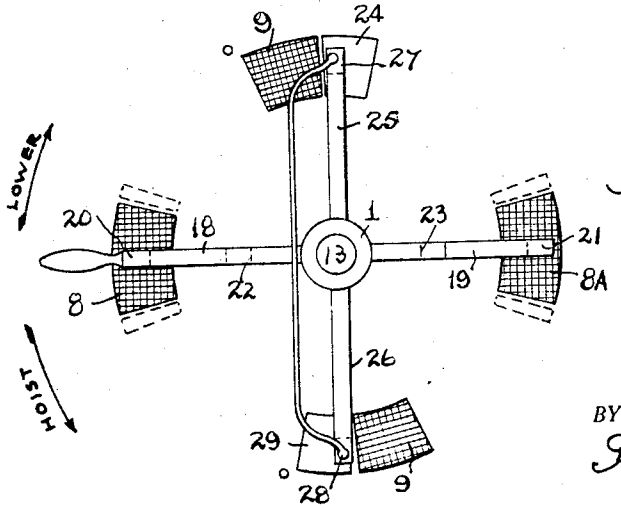


Fig. 2

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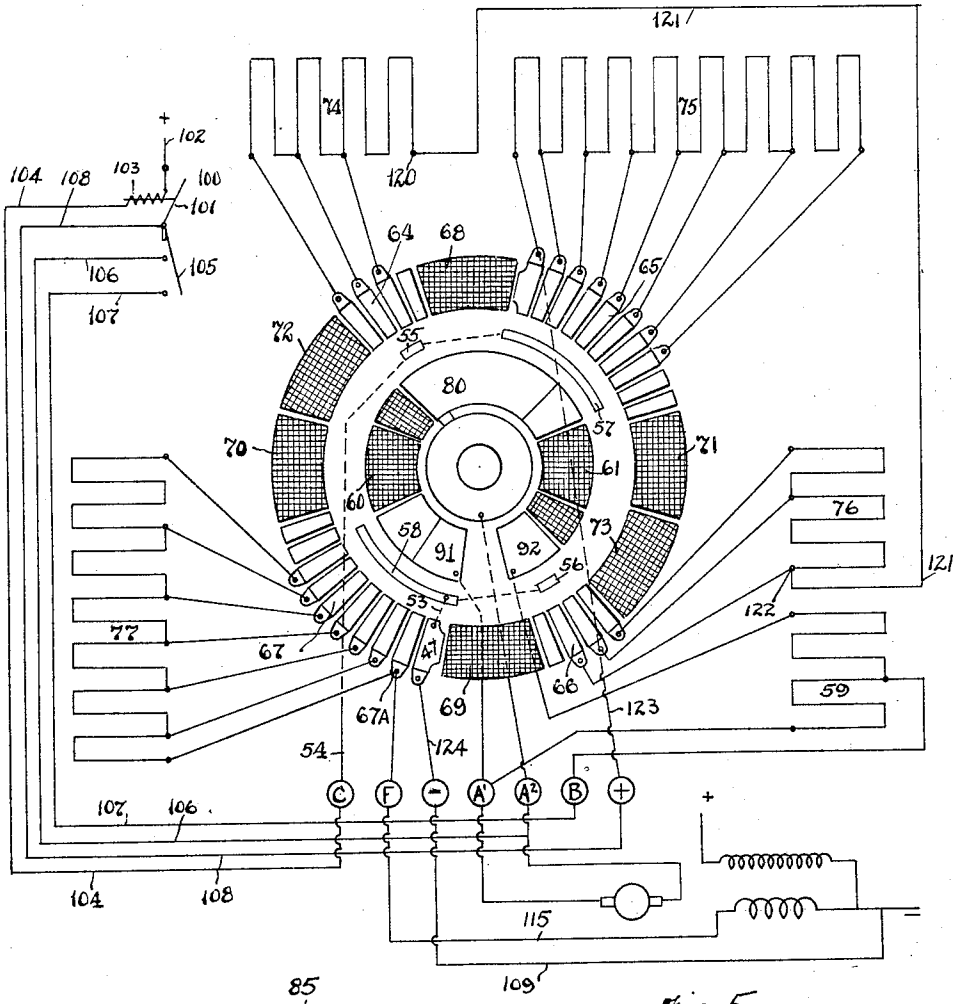


Fig. 5

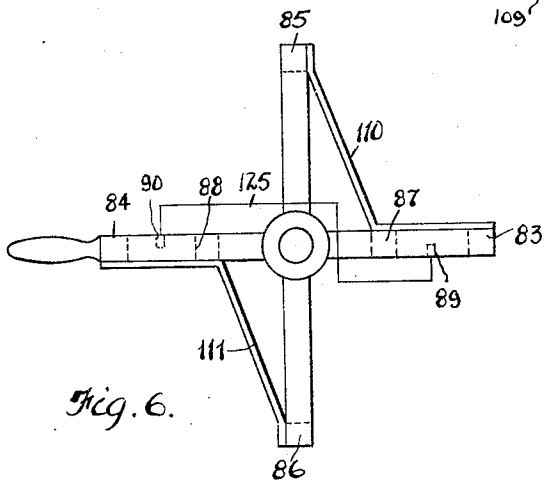


Fig. 6.

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ELECTRIC CONTROLLER CONSTRUCTION

Filed April 7, 1927 3 Sheets-Sheet 3

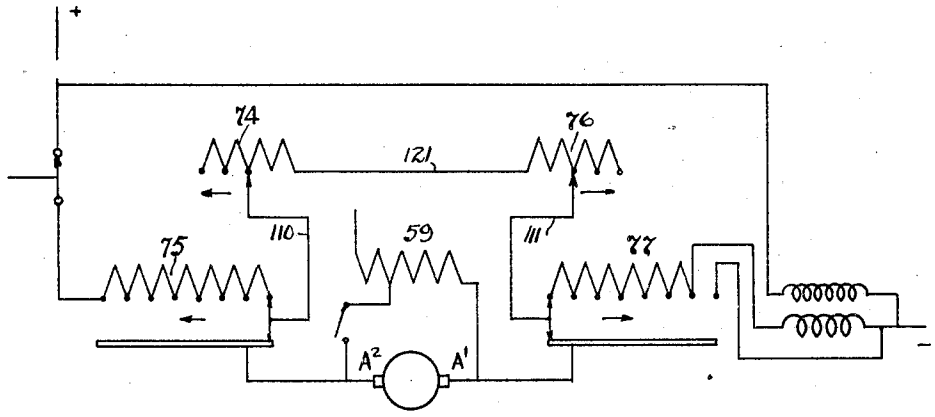


Fig. 7

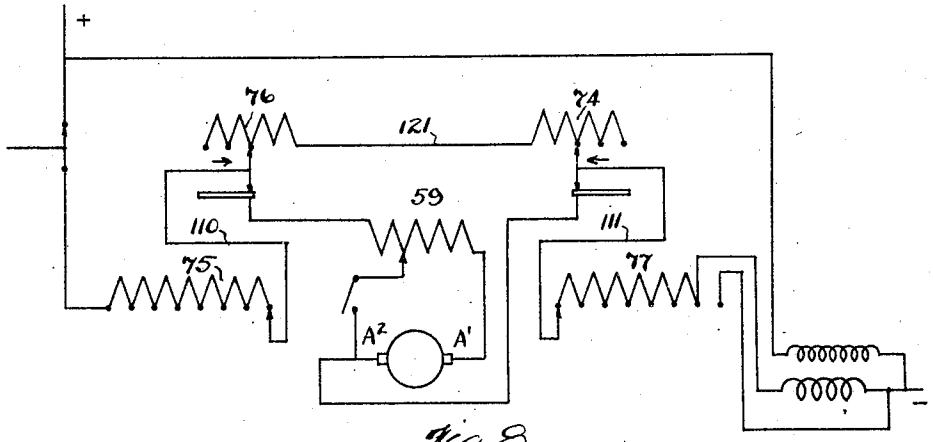


Fig. 8.

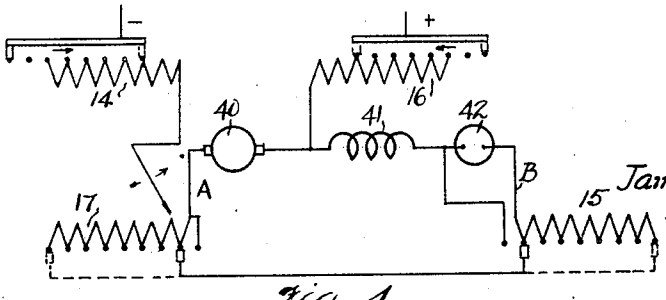


Fig. 4

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Patented Aug. 28, 1928. 1,682,541

UNITED STATES PATENT OFFICE.

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ELECTRIC-CONTROLLER CONSTRUCTION.

Application filed April 7, 1927. Serial No. 181,677.

The present invention relates to electric controllers for motors such as are used for cranes and other hoisting mechanism and also for controlling motors such as are used on wire blocks and the like. The invention more particularly relates to face plate type of controllers in which provision is made for smooth and accurate control of the motor during movement of the operating mechanism in both directions.

The present type of controller provides a face plate on which are mounted four groups or series of contacts, each of these series being connected to a bank of resistors and with these four series of contacts on the face of the controller, a controller arm is used which provides brushes engaging with all four series of contacts when this single controller arm is moved in both directions from its normal off position. By this construction each bank of contacts and its associated resistance is used in the motor controlling circuit both during hoisting and lowering where the motor is a hoisting motor, or in both directions of driving where the motor is used for other purposes. Each bank of resistors, however, is cut in by one of the brushes when the controller arm is moved in one direction and is cut out by a different brush when the controller arm is moved in the opposite direction. Certain of the brushes on the arms may be interconnected in order to obtain a closed circuit where this is desired, and this interconnection is such as to obtain the desired results for operating the motor in its two directions. To the accomplishment of the foregoing and related ends, said invention, then consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawing and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawing:

Fig. 1 is a diagrammatic layout of the controller contacts showing the resistors and the connections between the resistors and the contacts; Fig. 2 is a diagrammatic view of the controller arm showing one system of cross contacts and diagrammatically showing the off position of the controller; Fig. 3 is a wiring diagram showing the motor circuit as arranged by the controller shown in Figs. 1 and 2 for a hoisting motor with the contacts arranged for the hoisting position; Fig. 4 is a wiring diagram showing the motor circuit as arranged by this same controller for the lowering position; Fig. 5 is a diagrammatic view similar to Fig. 1 but showing a slightly different arrangement of contacts and face plates on the controller to show the controller arranged to operate a motor running a wire block or the like; Fig. 6 is a diagrammatic view of the controller arm used with the layout shown in Fig. 4; and Figs. 7 and 8 are diagrammatic wiring views showing the circuits obtained by using the controller as shown in Figs. 5 and 6 in its two positions from the normal off position.

As shown in the present drawings, the controller is of the face plate type, the contacts of the face of the controller being arranged in concentric circles. In the form shown in Fig. 1 there are four groups or series of contacts, 4, 5, 6 and 7 with banks of resistors 14, 15, 16 and 17 connected to the contacts of each group. Between these groups of contacts are dead plates 8, 8A, 9 and 9A. Within the circle of the group contacts are a positive center plate 10 and a negative center plate 11 with its associated blow out coil and two dead plates 12.

The controller arm 13 has a hub portion and four radially extending arms here shown as being at right angles to each other. On two of the arms 18 and 19 which as illustrated are those normally resting on the dead plates 8 and 8A, there are four brushes of which the outer brushes 20 and 21 contact with the dead plates 8 and 8A and the group contacts and the inner brushes 22 and 23 contact with the dead plates 12 and the center plates 10 and 11. The other arms 25 and 26 have a single brush each, the arm 25 having a brush 27 normally resting on an extra contact 24 at the end of group 5 and the arm 26 having its brush 28 normally resting on an extra contact 29 at the end of group 7 and connected to the last contact of this group by a jumper 7A and then to the armature terminal (A).

When this controller is used with a hoisting motor and the controller arm moved in the hoisting direction as shown by the arrow in Fig. 3, the positive line terminal (+) is connected through a line 30 to the

positive center plate 10, brushes 22 and 20 to group contacts 7 and associated resistors 17 to the motor armature terminal A, the armature 40, series field winding 41, magnetic brake 42 and terminal B resistors 15 and contacts 5 to brush 21 and thus to brush 23 and negative plate 11, and connecting circuit 43 to the negative terminal (−).

The other two brushes close a shunt circuit around the motor armature, through the group contacts 4 and 6 and associated resistors 14 and 16, the contacts of these groups being less in number than those of the other groups so as to break the armature shunt circuit before the full on position of the controller is reached as best shown in the wiring diagram Fig. 3. The contacts 24 and 29 at the ends of groups 4 and 7 are connected to the armature and the field line so that in the off position of the controller a safety, dynamic braking, circuit is closed including the armature and series field.

It will be noted that as the controller is moved in its hoisting direction, the banks of resistors 15 and 17 are gradually cut out of the line circuit while the banks 4 and 6 are gradually added into the armature shunt circuit until this circuit is finally broken which takes place before the full on position as shown in Fig. 3.

In the lowering direction the banks 15 and 17 are gradually inserted in the dynamic braking circuit while the banks 14 and 16 are gradually cut out of the line circuit which of course includes the motor armature and field connected in parallel or as a shunt field. It will thus be seen that each group of contacts and its associated bank of resistors are in use during movement of the controller arm in both directions from normal and that each bank is cut into the circuit by one of the brushes moving over the group contacts in one direction and is cut out of the circuit by a different brush moving in the opposite direction. By making the resistors of the banks of graduated resistance value, the resistors may be cut out of the motor circuit in steps of decreasing value for hoisting or accelerating the motor, while in lowering these same resistors may be cut into the dynamic braking circuit in steps of increasing value and this is accomplished by having brushes pass over the controlling contacts in opposite directions. This is the desirable practice in controllers of this type and the resistors of the other two banks are likewise preferably of graduated value so that the resistance, in hoisting, is cut into the armature shunt circuit in steps of increasing value and the same banks cut out of the motor circuit, in lowering, in steps of decreasing value.

In Figs. 5 to 8 inclusive a slightly modified controller arrangement is shown in which use is made as in the other forms of four groups of contacts 64, 65, 66 and 67 with their associated banks of resistors 74, 75, 76 and 77. In this form certain contacts at the ends of groups 64 and 66 are removed and replaced by extra dead plates 72 and 73 respectively. The regular dead plates 68, 69, 70 and 71 are also employed. The center plates consist of an upper segment 80 with its connected blow out coil which is connected to an armature terminal (A^2), side dead plates 60 and 61 and two spaced segments 91 and 92, the segment 91 being connected to the other armature terminal (A^1) while the segment 92 is connected to one end of an extra bank of resistance 59, the other end of which is connected to the armature terminal (A^1). In addition there are two arcuate rings 57 and 58 mounted between groups 65 and 67, the center plates respectively and two short rings 55 and 56 mounted radially opposite groups 64 and 66. The rings 55 and 57 are connected together and then connected by a conductor 54 to a contactor terminal (C). The rings 56 and 58 are connected together and are then connected by a conductor 53 to a contact 47 at the end of group 67 which is connected to the negative terminal (−).

The bank of resistors 74 has individual resistors connected to the contacts 64 and the end 120 of the bank is connected by a wire 121 to the end 122 of bank 76, which bank has its individual resistors connected to the contacts 66. Group 65 has one end contact connected by line 123 to the positive terminal (+) the resistors being of course connected to the contacts 65. Bank 77 has its end contact 67^A connected to the field terminal (F) and between contact 67^A and dead plate 69 is the contact 47 not connected to the bank 77 but connected directly by wire 124 to the negative terminal (−).

The controller arm in this form has the same four spaced outside brushes 83, 84, 85 and 86 and two of the radial members of the arm carry two brushes each, the members carrying brushes 83 and 84 also having brushes 87 and 88 respectively. The brushes 83 and 84 are connected to the brushes 87 and 88 respectively and the brushes 85 and 86 are also connected to the brushes 87 and 88 respectively by means of connectors 110 and 111. The normal off position of the controller as indicated in Fig. 6 is with brushes 83, 84, 85 and 86 resting on dead plates 71, 70, 68 and 69 respectively.

In this form there is also shown a main circuit contactor 100 with the circuit closing arm 101 connected to the positive line wire 102. There is also shown the actuating coil 103 of the contactor which is connected by a wire 104 to the contactor terminal (C) of the controller. The positive line 102 is connected to the positive terminal (+) by

a conductor 108. In addition the contactor is provided with a secondary arm 105 adapted to close a circuit through two wires 106 and 107 when the main arm 101 is open and wire 106 is connected to one armature terminal A^2 while the other is connected to the magnetic brake terminal (B). In addition there is the negative terminal (−) which is connected directly to the negative line (−) by a connection 109, the second armature terminal A^1, and a series field terminal (F), which is connected to the series field winding and then to the negative line.

In operating the controller and motor in the form shown in Figs. 5 to 8 the controller is moved counter-clockwise for the forward direction of the motor and clockwise from the off position to reverse the motor. As the controller is moved counter-clockwise the brushes 84 and 88 engage with the contacts 67 and the plate 91, the brush 90 with the segment 58, the brushes 83 and 87 with contacts 65 and the plate 80 and brush 89 with the ring 57. The actuating magnet winding 103 of the main contactor is in a closed circuit from the positive line 102, line 104 contactor terminal (C) to rings 55 and 57 through brush 89 jumper connection 125 to ring 58 and brush 90 and thence to the negative line through ring 58, connection 53, contact 47, wire 124 and negative terminal (−) and wire 109. This pulls the main contactor arm 101 in and opens the dynamic braking circuit by moving arm 105 away from contact with lines 106 and 107. The arm 101 closes the motor circuit through wire 108, the positive terminal (+), connector 123, end contact of group 65, resistors 75 and brush 83 to plate 80 and connecting wire to armature terminal A^2 and then through armature to terminal A^1 and plate 91, brushes 88 and 84, contacts 67 and resistors 77 to the field terminal (F) and then by line 115 through the series field to the negative line.

The armature shunt circuit is closed by brushes 85 and 86, the brush 85 connecting with armature terminal A^2 through jumper 110 and plate 80 and the circuit then passing through the contacts 64, resistors 74, connecting line 121 to end point 122 of resistors 76 from which it passes through this bank and to contact 66, brush 86, jumper 111, brush 88 and plate 91 and then to armature terminal A^1. As the controller is moved toward its full on position the banks of resistors 75 and 77 are gradually cut out of the motor armature circuit, while the banks 74 and 76 are gradually inserted into the shunt circuit until this is broken by the brushes 85 and 86 passing onto the extra dead plates 72 and 73 respectively. (See Fig. 6.)

In reversing the motor, the armature circuit is not closed until the brushes 89 and 90 contact with the small rings 56 and 55 at which time the armature shunt circuit is closed, through brushes 84 and 83, contacts 64 and 66 and associated resistors 74 and 76, connector 121, plate 92, extra resistors 59 to A^1 and armature and terminal A^2 and thence back to brush 84 through plate 80 and brush 88. These two banks of resistors are cut out of the circuit in reversing and all of contacts 64 and 66 may be passed over when the motor circuit is closed, leaving merely a closed shunt circuit through the end contacts, this depending upon the position and size of rings 55 and 56.

The motor circuit is closed, the positive wire 108 and positive terminal being connected to armature terminal A^1 by connector 123, contacts 65, resistors 75 and brush 85 to brush 87, plate 92, and resistance 59 and then through the armature to A^2 and to the negative line by plate 80, brushes 88 and 86, contacts 67 to the field terminal (F) and then through the field to the negative line wire.

The dynamic braking circuit in the present form is closed by the supplemental arm 105 of the main contactor whenever the main or motor circuit is open and thus always includes the extra resistance 59 in this circuit as the brake terminal B at the end of line 107 is connected to a point in bank 59 which has one end connected to terminal A^1 while the terminal A^2 is connected to the other side of the brake circuit through wire 106.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In a face plate type of controller for electric motors the combination of four groups of contacts on said plate, banks of resistors connected to said groups of contacts, a controller arm provided with four spaced brushes, said arm in its normal position having all of said brushes free of said contacts and being adapted to be moved in both directions from normal whereby each bank of resistors is cut in by one brush and cut out by a second brush passing in opposite directions over the group of contacts for the bank.

2. In a face plate type of controller for electric motors, the combination of four groups of contacts on said plate, banks of resistors connected to said groups of contacts, a controller arm provided with four spaced brushes, said arm in its normal position having all of said brushes free of said contacts and being adapted to be moved in both directions from normal whereby each

bank of resistors is cut in by one brush and cut out by a second brush passing in opposite directions over the group of contacts for the bank, and an electrical connection between two of said brushes on said controller arm.

3. In a face plate type of controller for electric motors, the combination of four groups of contacts on said plate, banks of resistors connected to said groups of contacts, a controller arm provided with four spaced brushes, said arm in its normal position having all of said brushes free of said contacts and being adapted to be moved in both directions from normal whereby each bank of resistors is cut in by one brush and cut out by a second brush passing in opposite directions over the group of contacts for the bank, and electrical connections between pairs of brushes.

4. In a face plate type of controller, the combination of a face plate having contact plates and four groups of contacts, banks of resistors connected to said groups of contacts, and a crossed controller arm having contact brushes adapted to engage with said four groups of contacts and plates to simultaneously control all of said banks of resistors from said contact groups and plates during movement of said controller arm in both directions from the normal off position, two of said brushes being connected to the line terminals and two of said brushes being electrically connected together to form a closed circuit for control purposes.

5. In a face plate type of controller, the combination of a face plate having contact plates and four groups of contacts, banks of resistors connected to said groups of contacts, and a crossed controller arm having contact brushes adapted to engage with said four groups of contacts and plates to simultaneously control all of said banks of resistors from said contact groups and plates during movement of said controller arm in both directions from the normal off position, two of said brushes being connected to line terminals to place two of said banks of resistors in the line circuit, and two of said brushes being electrically connected to each other to place the other two resistance banks in a closed circuit for control purposes.

6. In a face plate type of controller, the combination of a face plate having contact plates and four groups of contacts, banks of resistors connected to said groups of contacts, and a crossed controller arm having four radially extending members, two of said members being each provided with a brush for engaging with a group of contacts and a second brush for engaging with the contact plates, the other two members each having a single brush for engagement with a group of contacts.

7. In a face plate type of controller for hoisting motors, the combination of four groups of contacts, four banks of resistors connected to said groups of contacts, a crossed controller arm having four brushes for operating over all of such groups of contacts to simultaneously control all of said banks of resistors during movement of said controller arm in both directions from its normal off position, and an adjustable tap connection from the end resistor of one bank to a point on a second bank.

8. In a face plate type of controller for hoisting motors, the combination of four groups of contacts, four banks of resistors connected to said groups of contacts, a crossed controller arm having four brushes for operating over all of such groups of contacts to simultaneously control all of said banks of resistors during movement of said controller arm in both directions from its normal off position, and an adjustable tap connection from the end resistor of one bank of resistance connected to the line in one direction of arm movement to a point in a second bank of resistors to obtain a predetermined adjustable circuit strength on the last point of such group of contacts to suit varying operating conditions.

Signed by me this 8th day of February, 1927.

JAMES F. SCHNABEL.