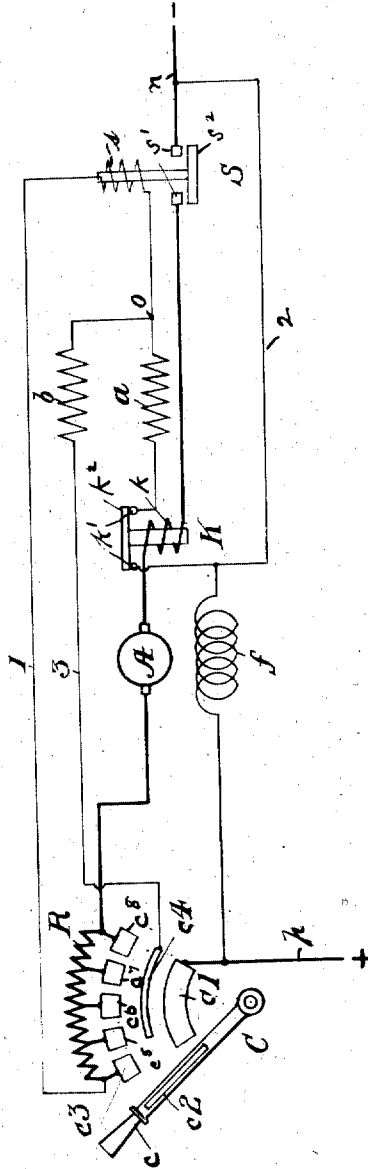


J. H. HALL.
CIRCUIT CONTROLLING SYSTEM.
APPLICATION FILED NOV. 23, 1910.

Patented Aug. 22, 1911.
2 SHEETS—SHEET 1.

1,001,023.

FIG. 1



WITNESSES

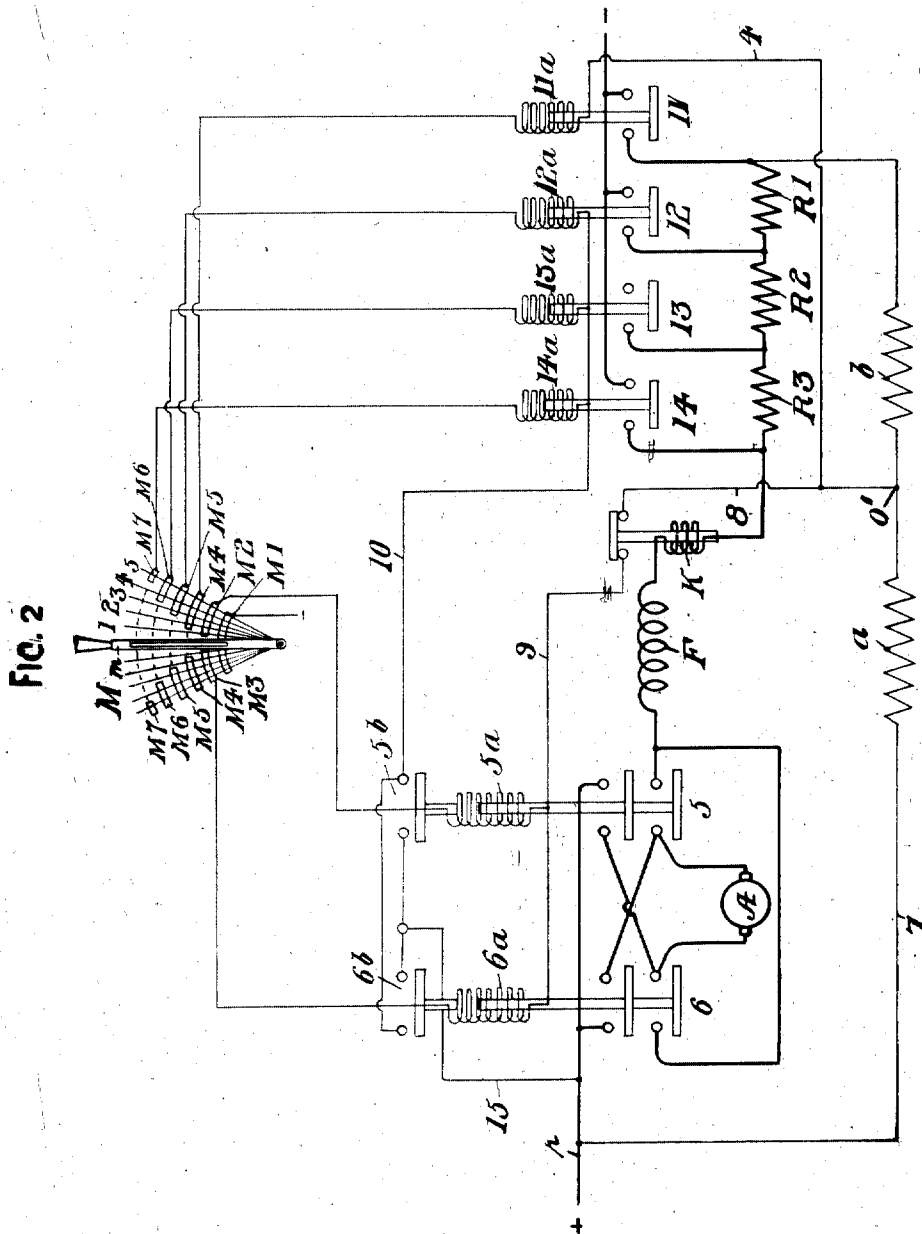
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2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

JAY H. HALL, OF CLEVELAND, OHIO, ASSIGNOR TO THE ELECTRIC CONTROLLER AND MANUFACTURING COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

CIRCUIT-CONTROLLING SYSTEM.

1,001,023.

Specification of Letters Patent.

Patented Aug. 22, 1911.

Application filed November 23, 1910. Serial No. 593,800.

To all whom it may concern:

Be it known that I, JAY H. HALL, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented new and useful Improvements in Circuit-Controlling Systems, of which the following is a specification.

My invention relates to circuit controlling systems, particularly that type in which the use of one or more magnetically operated switches is involved.

The object of my invention is to provide protection for a motor or other translating device in a circuit against an overload, and to provide means for preventing the restarting of such motor or device upon a failure of current and the consequent return of the same with all of the starting resistance cut out, these results to be obtained without the use of auxiliary contacts on the magnetic switches.

Referring to the accompanying drawings, Figure 1 shows diagrammatically my invention in connection with a manually-operated starting controller, or master switch. Fig. 2 shows my invention adapted to a reversing controller with magnetically-operated resistance switches.

Referring first to Fig. 1, C is a manually-operated master-switch having the arm c provided with the brush c^2 to bridge in its first operating position the fixed segments, or contacts, c' and c^3 . The segment c' is connected to the positive wire p , and the segment c^3 to one end of the starting resistance R . c^5 , c^6 , c^7 , and c^8 are segments connected successively to portions of the resistance R . The remaining end of the resistance R is connected to the negative wire n through the armature A , the winding k of the overload relay K , and the fixed contacts s' of the switch S . The wire 1 leads from the segment c^3 through the winding s of the switch S to the point o , to which two other wires are connected, one leading through the resistance a , the contacts k' and k^2 of the relay K , and the wire 2 to the negative wire n ; and the other through the resistance b and the wire 3 to the segment c^4 which lies parallel to the segment c' and extends from the segment c^5 to the segment c^8 . The shunt field f is connected to the wires p and 2, that is, directly across the line.

The connections are such that to operate

the switch the resistance a is connected in series with the winding s , and to prevent the operation of the switch the resistance b is connected in parallel with the winding s . These resistances are so proportioned that if the winding s is connected across the source of supply in series with the resistance a , the switch will operate, and if the resistance b is connected in parallel with the winding s and this parallel circuit is connected across the source of supply in series with the resistance a , the switch S will not operate, but after it has once been closed it will remain closed with the connections thus arranged, due to the smaller air gap in the magnetic circuit, thus requiring a smaller amount of current in the winding s to hold the switch closed than to operate it.

The operation of the system shown on Fig. 1 is as follows: When the arm c is moved to the first position, connecting the segments c' and c^3 , a circuit is established from the positive wire p through segments c' and c^3 , the wire 1, the winding s of the switch S , the resistance a , the contacts k' , k^2 of overload device K , and the wire 2 to the negative wire n . This causes the switch S to close its contacts s' , s^2 causing a motor circuit to be established through the resistance R , the armature A , the winding k of the overload device K , and the contacts s' , s^2 of the switch S . On further movement of the arm c^2 to the right, the starting resistance R is gradually cut out until the last position at c^8 is reached, at which place the motor armature A is connected directly across the line and operates at its normal speed. As soon, however, as the brush c^2 has moved off of the first position, it comes in contact with the segment c^4 , and a circuit is established from the positive wire p through the wire 3, the resistance b , to a point o between the winding s and the resistance a , thence through the resistance a , the contacts k' , k^2 of the overload device K , and the wire 2 to the negative wire n . This places the resistance b in a parallel circuit with the winding s , the parallel circuits both being in series with the resistance a , which causes a smaller amount of current to flow through the winding s due to the increased current through the resistance a , causing a correspondingly greater drop in potential between the negative source of supply and the bottom terminal of the winding s . This reduced current

allows the switch S to remain closed, and has the effect of reducing the heating of the winding *s*. If an overload now occurs causing the motor to take a current larger than it can safely stand, the overload device K opens its contacts, cutting off the current from the winding *s* and causing the switch S to open. The overload device K immediately closes its contacts again, but the current which now flows through the winding *s*, due to its being shunted by the resistance *b*, will prevent the closure of the switch S until the handle *c* of the controller is moved back to the first position, at which place all of the starting resistance R is inserted in the circuit before the motor can be restarted. If, while the controller handle is in the full running position, the voltage on the circuit should fail for any reason, such as the opening of the circuit breakers in the power house, the switch S will open, and upon the return of current to the line the switch S will not close, since its winding *s* is shunted by the resistance *b*. To restart the motor it will be necessary for the controller arm *c* to be moved back to the position in which all the resistance R is inserted in circuit therewith.

Fig. 2 shows a reversing controller for a series wound motor, with the armature A and the field F, in which all the switches are magnetically operated and controlled by the master controller M. On moving the master controller arm to the position 1 a circuit is established as follows: from the positive wire *p* through the wire 7, the resistance *a*, the point *o'*, the wire 8, contacts of the overload device K, the wire 9, the winding 5^a of the switch 5, the contacts M² and M^{2'} to the negative. This circuit closes the reversing switch 5. Upon moving the master controller to position 2, a circuit is established from the positive wire *p* through the wire 7, the resistance *a*, the wire 4, the winding 11^a of the switch 11, and the contacts M¹ and M^{1'} to the negative, which causes the switch 11 to close the motor circuit with all the starting resistances R', R², and R³ in series with the armature A and the field F. As the controller arm is moved to the positions 3, 4, and 5, the switches 12, 13, and 14 close successively, cutting out the resistances R', R², and R³ in succession, until, finally, the motor is connected directly across the source of supply. The windings 12^a, 13^a, and 14^a obtain their positive connection through the wires 10 and 15 and through the auxiliary contacts of the reversing switch 5^b or 6^b. As soon as the switch 11 closes, the resistance *b* is connected in parallel with the windings 5^a and 11^a, the parallel circuits being in series with the resistance *a*, and the windings 5^a and 11^a have their current thereby reduced, but not sufficiently to cause the switches to open. If, while the master con-

troller is in any of the running positions, an overload should occur, causing the overload device K to open its contacts, current will be cut off from the winding 5^a, causing the switch 5 to open, but the switch 11 remains closed, since its winding is still excited. Upon the closure of the contacts of the overload device K, the small amount of current which now flows through the winding 5^a will not cause the reversing switch to close, and the motor will not be restarted until the master controller arm is moved back to the position 1. If, while the master controller arm is in any of the running positions a failure of voltage occurs, all of the switches will open and cut off current from the motor. The winding 11^a may be so proportioned that it will cause sufficient current to flow through the resistance *a* to prevent sufficient current flowing through the winding 5^a to close the switch 5 upon the return of the voltage to the line. This would cause the switch 11 to close, but no motor current would flow. The resistance *b* would then be connected in parallel with the windings 11^a and 5^a, thus reducing the current in both of the above windings, protecting them from overheating. In order to restart the motor, the master controller arm *m* must be moved back to the position 1 in order that all the starting resistances R', R², R³ may be inserted and gradually cut out in bringing the motor up to speed. The switch 11 may be designed to close much quicker than the switches 5 and 6 to accomplish this last described feature in case the arm of the controller is on one of the running positions and there should be a failure and a return of voltage. The quick closure of the switch 11 would place the resistance *b* in parallel with the windings 11^a and 5^a, thus preventing the reversing switch 5^a from closing. The same description applies when the master controller is moved to the opposite side except that reversing switch 6 will close instead of the reversing switch 5, and the armature connections will be reversed, causing the motor to run in the opposite direction.

I claim—

1. In an electric controller, a resistance, a magnetically-operated switch, means for connecting the winding of the switch to a source of supply in series with the resistance, and a shunt around the winding, the shunt including the said means and controlling the current in the winding.

2. In an electric controller, a resistance, a magnetically-operated main switch, a master switch for connecting the winding of the main switch in series with the resistance and a shunt around the winding, the shunt including contacts on the master switch and controlling the current in the winding.

3. In an electric controller, a resistance, a magnetically-operated main switch, means

for connecting the winding of the switch in series with the resistance, a second magnetically-operated switch, means for subsequently connecting the winding of the second switch in parallel with the winding of the first switch and in series with the said resistance.

4. In an electric controller, a resistance, a magnetically-operated main switch, a winding therefor, a master switch for connecting the winding to a source of supply in series with the resistance, and a second magnetically-operated switch, having its winding arranged to be connected in parallel with the first winding so that the current in the first winding will not be large enough to operate the main switch, the winding of the second switch being connected in series with the said resistance.

5. In an electric controller, a resistance, a magnetically-operated switch having its winding connected to a source of supply with the resistance in series therewith, a second resistance, a second switch which when closed causes the second resistance to be connected in shunt with the winding of the first switch, and means for connecting the winding of the second switch as a shunt around the winding of the first switch and in series with the said first resistance.

6. In a motor control system, a resistance, a main switch and a resistance switch, a master switch connecting the winding of the switches in parallel to a source of supply and in series with the said resistance, and means for opening the circuit of the main switch when the motor current exceeds a predetermined value.

7. In a motor control system, a resistance, two magnetically-operated switches, means connecting their windings in parallel branches, the parallel branches being in series with the resistance, and means responsive to the motor current for opening the parallel branch containing one of the windings.

8. In an electric controller, a resistance, a circuit, two switches connected thereto, means connecting the windings of the switches in parallel to a source of supply in series with the resistance, and means for reducing the current in one of the windings when the current in the circuit is larger than a predetermined value.

9. In an electric controller, two resistances, a circuit, a switch therein having an operating winding, the winding and the two resistances having a common connection, means connecting the winding and one of the resistances to one side of a source of supply, the other resistance being connected to the other side of the source of supply, and means for opening the circuit of the winding when the current in the circuit becomes greater than a predetermined value.

10. In a motor control system, a resistance, a switch, means connecting the winding of the switch to a source of supply in series with the resistance, a second switch which when closed causes a shunt to be connected around the winding, means for opening the circuit through the winding when the motor current exceeds a predetermined value without causing the second switch to open.

11. In an electric controller, a resistance, a circuit, a switch having contacts in the circuit, a master switch for connecting the winding of the switch to a source of supply in series with the resistance, a second resistance, means subsequently connecting the second resistance as a shunt around said winding, and means responsive to the current in the circuit for opening the circuit through the winding.

12. In a motor control system, a resistance, a magnetically-operated switch having contacts in the motor circuit, a master switch for connecting the winding of the switch to a source of supply, the resistance being in series with the winding, and means including the said contacts to cause a decrease of current in the winding.

13. In an electric controller, a circuit, a resistance, a magnetically operated switch having contacts in said circuit, means for connecting the winding of the switch to a source of supply in series with the resistance, and means including the said contacts of the switch for connecting a shunt around said winding when the switch is closed.

14. In an electric controller, a resistance, a main circuit, a magnetically-operated switch having contacts in the circuit, a second resistance, means connecting the operating winding of the switch and the resistance in parallel circuits, and in series with the second resistance, an overload device operative, when the current in said main circuit exceeds a predetermined value, to decrease the current flowing in the parallel circuit containing the winding.

15. In an electric controller, a resistance, a main circuit, a magnetically-operated switch having contacts in the circuit, means connecting the winding of the switch to a source of supply in series with the resistance to operate the switch, means connecting a shunt around the winding, and means responsive to the current in the main circuit for opening the circuit of the winding when the current in the main circuit exceeds a predetermined value.

16. In a circuit controlling system, a resistance, a switch, an operating winding therefor, means connecting said winding and the resistance in parallel circuits, a second resistance, means connecting the parallel circuits in series with the second resistance, and means for opening the branch

containing the winding when the current through the contacts of the switch exceeds a predetermined value.

17. In a motor control system, a resistance, a reverser, an operating winding therefor, means for connecting the winding in series with a resistance to operate the reverser, means for connecting a shunt around the winding to prevent the operation of the

reverser, and means for opening the circuit containing the winding when the current in the motor is above a predetermined value.

Signed at Cleveland, Ohio, this 9th day of November, A. D. 1910.

JAY H. HALL.

Witnesses:

R. H. BENNETT,
H. M. DIEMER.