H. W. LEONARD.

ELECTRIC CONTROLLING DEVICE.

APPLICATION FILED OCT. 23, 1908.

1,042,130. Patented Oct. 22, 1912.

Fig. 1.

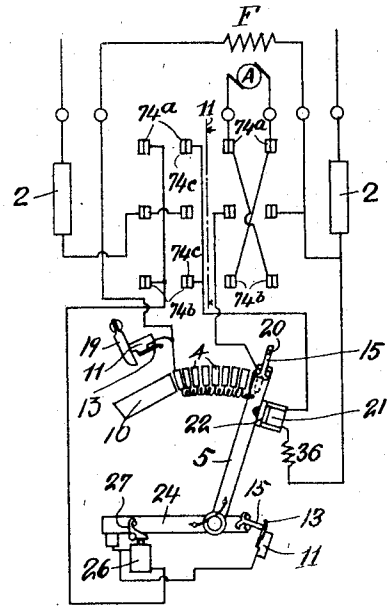


Fig. 2.

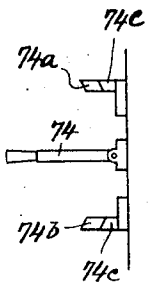
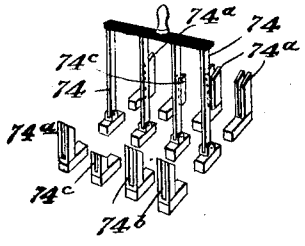


Fig. 3.



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UNITED STATES PATENT OFFICE.

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ELECTRIC CONTROLLING DEVICE.

1,042,130. Specification of Letters Patent. Patented Oct. 22, 1912.

Original application filed May 13, 1905, Serial No. 260,198. Divided and this application filed October 23, 1908. Serial No. 459,180.

To all whom it may concern:

Be it known that I, HARRY WARD LEONARD, a citizen of the United States, residing at Bronxville, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Electric Controlling Devices, of which the following is a full, clear, and exact specification.

My invention relates to devices for controlling electric motors and other translating devices, and especially to rheostatic controlling means provided with automatic protective devices.

This application is a division of my copending application filed May 13, 1905, Serial No. 260,198, granted Oct. 27, 1908, Patent No. 902,307.

The object of my invention is to improve the efficiency, reliability and construction of such controlling devices, and to accomplish these results, I embody in combination various important features among which the following may here be referred to. I provide means for automatically protecting the motor armature, or other translating device, upon the occurrence of "no-voltage" or "low voltage." In my preferred form the no-voltage device is an electro-magnetic device responsive solely to the voltage to which the motor armature may be subjected, and which is independent of the current in the motor armature or field winding. I also provide means for automatically protecting the motor armature against abnormally large currents. In my preferred form this overload protective device is in the form of an electro-magnetic circuit breaker, so functionally related to the circuit to be protected, that the circuit breaker is always in a protective condition, regardless of the condition or position of other devices affecting the device to be protected. I also provide rheostatic means for controlling the flow of current in the circuit. In my preferred form, the resistance controlling arm or device, is so functionally related to the overload device, that a protective amount of resistance must be in the path of the circuit to be established before the circuit can be closed by closing the overload device or otherwise. In my preferred form, the circuit can be opened by the resistance controlling arm. In order to reduce the arc, which is formed when the circuit is opened either by the resistance controlling arm or by the circuit breaker, to a minimum amount and thus practically eliminate its destructive effect, I provide efficient arc-rupturing means. This is preferably an auxiliary, automatically, quick acting switch by which the circuit is finally broken and which acts quickly independently of the slowness of movement of the part breaking the circuit, such as the resistance controlling arm. I also preferably provide a magnetic blow-out which produces a strong magnetic field at the point, or points, where the circuit is finally broken and so reduce the arc formed to its minimum amount. I may provide either the resistance controlling means, or the overload device, or both, with such protective means, and in my preferred form both such parts are thus protected. I also provide means which automatically acts to quickly and efficiently close the circuit, independently of the slowness of movement of the operator's hand, when he performs the acts necessary to close the circuit. This will prevent the operator from making an improper or insufficient contact in closing the circuit. The circuit connections of the armature and field of the motor are such as to always keep the armature and field windings in a closed circuit so as to avoid any detrimental effect due to the inductive discharge of the field.

My invention will be understood by reference to the accompanying drawings taken in connection with the following description.

Figure 1 is a face view of one form of construction embodying my invention; Fig. 2 is a detail of the reversing switch; and Fig. 3 is a perspective view of said switch.

The controlling and protective devices are preferably mounted upon a panel of insulating material, such as slate, and are thus all united into one complete unit. At the top of Fig. 1 are indicated the supply wires. Protective fuses of the inclosed type are indicated at 2. The supply wires are connected directly to these fuses, which act after a certain time interval and thus protect the motor and all parts on the panel from overload currents and serve as a protective means in addition to the electromagnet circuit breaker in case the latter should fail to act. The reversing switch is connected in the main circuit which opens both poles of the supply circuit. The rheostat contacts of the motor starter shown in this figure are

indicated at 4, and I preferably mount the starting resistance on the back of the panel.

The movable starting arm is shown at 5, its outer end moving over the contacts 4. The arm 5 is arranged to open the circuit when in the off position on the insulating strip or blind contact 10. In order to obtain a quick break of the circuit in the presence of a strong magnetic field, I mount upon the panel adjacent to the initial resistance contact an iron clad magnet 11, shown more in detail in Figs. 4 and 5 of my above referred to original application. Fixed to the face of the magnet and extending between the central core and a protecting portion of the top of the shell, is a non-magnetic contact piece 13, preferably of copper. This is thus located in the path of an intense magnetic field from the end of the core to the top portion of the shell and any rupture of circuit taking place in the contact piece will be in the presence of a strong magnetic field, giving an efficient magnetic blow-out.

The controlling arm carries the auxiliary contact piece 15 which is movably mounted upon the arm and electrically connected thereto by a flexible connection, this construction being more fully described in my said original application. If the controlling arm is moved to off position, the auxiliary contact will engage the contact 13 before contact is broken at the initial resistance contact. As the movement is continued, the electrical connection will be broken with the initial resistance contact, and the piece 15 will be deflected by engaging the side of contact 13. Upon further movement, the piece 15 will move over the face of the contact 13, and when the contact is finally broken, the auxiliary contact 15 will be rapidly thrown away from 13 by a spring which always tends to return the auxiliary contact from a deflected position. The final rupture of the circuit will, therefore, take place in a strong magnetic field and with a very quick action. Furthermore, the parts which are subjected to wear or deterioration are readily replaceable in a simple manner.

In order to avoid the objectionable effects of a slow or insufficient closing of the circuit, I provide means for a quick make indicated by the part 19, the construction and operation thereof being described in my said original application.

In the final position of the arm 5 the no-voltage, or low voltage magnet 21, will retain the arm in place by attracting the armature 22 pivoted to said arm. In the final position the auxiliary contact 15 will engage a post, as shown in Figs. 1 and 2 of my original application, and cause the field connections to be connected across the supply line independently of the armature resistance.

In addition to the controlling arm 5, I have provided an arm 24 pivoted on the same pivot with arm 5 and coupled thereto by a spiral spring within the hub on arm 24, which spring tends to force the two arms together. The arm 24 carries the main current from one supply line and acts as the overload circuit breaker in conjunction with the overload coil 26. When the circuit is closed, the latch 27 retains the arm 24 in position against the spring pressure, and upon overload, the plunger of coil 26 rises and trips the latch to release the arm 24. The latch is pivoted on a pin or post and actuated by a spring so as to cause the latch to engage the pin on the side of arm 24. The arm 24 carries a contact which in closed position engages a fixed contact at the left of the magnet coil 26 and which fixed contact is electrically connected to a terminal of coil 26. An extension of arm 24 carries an auxiliary contact 15 similar to that carried by arm 5 and which acts in conjunction with a blow-out magnet similar to that above described. In this case the auxiliary quick break with magnetic blow-out will act to break the circuit; that is, when the arm is released, due to the overload current, contact between the main contacts is first broken. The auxiliary contact 15 is deflected in the meanwhile and, after the main contact is broken, the auxiliary contact will be broken with a quick action in the presence of a strong magnetic field.

After the circuit is opened by the overload device, the overload switch is closed only by movement of the controlling arm 5. This is accomplished by means of arm 5 or a projection thereof engaging the arm 24 and forcing it to the closed position. This necessitates a returning of the starting arm to its initial open circuit position and, in starting again, the circuit will be closed by the starting arm in the manner above described. The starting arm will, therefore, always be in a protective position when the circuit is closed.

The supply line is connected to the fuses 2 and current passes from them to the main switch. One line from this switch passes to the overload coil 26, and thence through the main contacts to arm 24 when the latter is in operative position. Current also passes in another path to this arm from the same line, through the coil of the blow-out magnet 11 and auxiliary contacts. The arm 5 is in electrical connection with arm 24. The other line from the main switch passes to the armature A of the motor, and thence to the final resistance contact, and then through the resistances to the coil of the magnetic blow-out 11. Thus when the arm is moved to start the motor after the overload switch is closed, the circuit will first be closed across the line by the quick make of the auxiliary contact on arm 5, and continued

movement of the arm will cut out the armature resistance and bring the motor up to speed. The field winding F of the motor is shown as a shunt winding and is connected from one side of the supply line to the blow out coil 11 to the arm 5, or to the initial resistance contact. The circuit through the field from the supply line is, therefore, closed when the armature is connected to the supply line. The no-voltage magnet 21 is connected from one side of the supply line through a resistance 36 to the other side of the supply line through the main switch. When its circuit is closed, the no-voltage magnet will, therefore, be connected across the line in a circuit independent of the armature or field winding, and will therefore act independently of such windings and cannot be subjected to any dangerously high electromotive force due to field discharge voltage.

By the construction shown and described herein, a reversal of the motor is obtainable, all parts are protected from sparking, and protection to the circuit is always secured. The main switch is a double throw switch having four switch blades 74 in this instance, which coöperate with four contacts 74^a when thrown in one direction, and with four contacts 74^b when thrown in the opposite direction. Of these contacts, one of each set, namely 74^c, is provided with shorter contact clips than the others as shown in Figs. 2 and 3, and these shorter clips are connected in the circuit of the no-voltage magnet 21.

In operation, the switch blades 74 will be thrown to engage say the upper set of contacts. The circuit breaker arm will be closed by means of the resistance controlling arm and the circuit will be finally closed by means of the resistance arm. Current will then pass from one side of the line through the left-hand switch blade to the left-hand contact 74^a, through the overload coil 26, overload switch, arm 5, armature resistance, to third switch blade 74 from the left, through the armature A, to fourth switch blade, to the other side of the line. The field F is connected across the line from the initial resistance contact to the other side of the line. The resistance arm will be held in final position by the magnet 21 which is connected across the line in an independent circuit, current passing from the second switch blade, to the short contact 74^c, through magnet 21 and resistance 36 to the other side of the line. Now if it is desired to reverse the motor, the double throw switch may be raised from contact 74^a to open the circuits. In doing this, contact with the short clip 74^c will first be broken which will interrupt the no-voltage circuit and release the arm 5. The arm will be quickly thrown to off position and open the circuit. Meanwhile the motor armature and field will form a closed circuit through the starting resistance and any objectionable effect of inductive discharge of the field will be overcome. Consequently when the double throw switch is opened to break the remaining contacts, the only circuit to be broken will be this closed circuit of field and armature and as the current therein will be very slight or practically absent, there will be no sparking at the switch contacts. On throwing the double throw switch to engage the lower contacts, the connections will be similar to those above described except that the current through the armature will be reversed, which will reverse the rotation of the armature. In raising the reversing switch from the lower contacts, the circuit of the no-voltage magnet will first be broken as above explained and no sparking takes place at the main switch contacts. It will be observed by this construction that all burning of the contacts of the knife blade switch 74 will be avoided as this switch is closed only under conditions of open circuit and is opened only while the insignificant field current is flowing through it.

Although I have described various modified forms of construction it will be understood that my invention is not restricted to the various forms described, and that I am limited only as indicated by the following claims.

Instead of mounting the quickly movable auxiliary contact on the movable element and the coöperating contact, or magnetic blow-out, in a fixed position, these parts may be reversed in position in some cases.

Having thus described my invention what I declare as new and desire to secure by Letters Patent, is:

1. The combination of an electric motor, two switches in series with the armature of said motor, one of said switches being a reversing switch for reversing the current in one element of said motor, and means whereby the opening movement of one of said switches first causes the opening of the circuit at the other side before opening the circuit at its own contacts, the movement of one of said switches being mechanically independent of the other of said switches.

2. The combination of an electric motor, two circuit controlling movable elements in series with each other and with the motor armature, one of said switches being a reversing switch for reversing the current in one element of said motor, an electroresponsive device for normally restraining one of said elements, and means whereby the movement of the other element deënergizes said electroresponsive device causing automatic movement of said restrained element, and then by further movement of the said other element controls the motor armature circuit elsewhere.

3. The combination of a translating device, two circuit controlling movable elements in series with each other and with said device, one of said elements being a reversing switch for reversing the current through said device, an electroresponsive device for normally holding one of said elements in a certain position, means for causing the automatic movement of said element when said electroresponsive device is deënergized, and means whereby the movement of the other element first deënergizes said electroresponsive device to cause the automatic movement of the element normally held by said device and then by its further movement controls the circuit elsewhere.

4. The combination of an electric motor, two switches in series with each other and with the motor armature, one of said switches being a resistance controlling switch automatically responsive to no voltage, and the other of said switches being adapted when moved to first cause the automatic opening of the first switch and then to open the circuit at its own contacts.

5. The combination of an automatic resistance controlling switch and a non-automatic switch in series with each other, means whereby the movement of the latter switch causes the automatic opening of the circuit at the first named switch and then opens the circuit at its own contacts.

6. The combination of a manually and automatically movable circuit controlling element automatically responsive to no voltage, a hand-operated switch in series with said element for reversing the circuit connection, and means whereby said element is responsive to the manual movement of said switch.

7. The combination of a reversing switch comprising two rigidly connected movable contact elements, automatic circuit controlling means, and means whereby the movement of said switch causes the automatic movement of said means before said reversing switch opens the circuit at its own circuit contacts.

8. The combination of an electric motor, three switches in series with each other and with the motor armature, one of said switches being a resistance controlling switch provided with an electro-responsive winding controlling its automatic opening, and one of said switches being adapted when moved to first operatively control said winding and thereby cause the automatic opening of the switch controlled thereby, and then by further movement to open the circuit at its own contacts.

9. The combination of a current carrying movable element adapted to be moved without breaking the circuit with which said element is connected and then by a further movement to break said circuit and to make the circuit connections in the reverse sense, a second element for also controlling said circuit, and means controlled by the movement of said first named element prior to breaking its circuit connection for automatically controlling the movement of said second element.

10. The combination of a movable circuit controlling element, an automatic overload switch, a second switch, and means for causing said element to be automatically responsive to no voltage, to the automatic opening of the circuit by said overload switch, and to the movement of said second switch before the latter opens its main contacts.

11. The combination of a movable circuit controlling element, means comprising an electro-responsive winding responsive to no voltage for controlling said element, a switch in series with said element, and means associated with said switch whereby the initial movement of said switch deënergizes said no voltage winding and whose later movement opens a circuit in which said element is connected.

12. The combination of an electric motor, a no voltage starting device, a reversing switch, said device and switch being connected in series with each other and with the motor armature, and means for causing the automatic opening of the circuit at the no voltage starting device when the movable element of the reversing switch is moved to reverse position and prior to the opening of the circuit at said reversing switch.

13. The combination of an electric motor, a reversing switch, an automatically openable switch, said switches being in series with each other and with the motor armature, and means for insuring the automatic opening of the circuit at the automatic switch when the movable element of the reversing switch is moved so as to reverse the circuit connections and prior to the opening of the circuit at said reversing switch.

14. The combination of a motor having a field winding energized independently of its armature current, a reversing switch therefor comprising a unitary movable current carrying switch element, a no-voltage switch in series with the armature of said motor, and electrical means protectively relating said latter switch and said element as to the sequence of their opening when the operator opens said reversing switch.

15. The combination of an electric motor, an automatically openable switch, a manually openable switch, said switches being in series with each other and with the motor armature, and electrical means protectively relating said switches whereby the circuit is always opened first at the automatic switch when the operator opens the said manually openable switch, said means comprising an

auxiliary movable switch element rigidly connected with said switch.

16. The combination of an electric motor, a no voltage motor starter comprising a resistance varying movable element, a manual switch in series therewith, and electrical means protectively relating said element and said switch for insuring the protective movement of said element prior to the opening of said manual switch by the operator.

17. The combination of a switch having auxiliary contacts, a second switch in series therewith, and means controlled by the initial movement of said second switch for causing the automatic opening of the circuit at said first switch prior to the opening of said second switch at the main contacts.

18. The combination of an electric motor, an automatically movable element whose automatic movement protects the circuit, a switch in series therewith and with the motor armature, and electrical means protectively relating said switch and element for insuring the automatic protective movement of said element during the opening movement of said switch and prior to its opening the circuit at its own contacts, said means being dependent upon the movement of said switch.

19. The combination with a starting rheostat having a no-voltage magnet, of a reversing switch, and means controlled thereby for deënergizing the said magnet.

20. The combination with a starting rheostat having a no-voltage magnet connected across the line, of a reversing switch in the motor circuit, and means controlled by the actuation of said switch for deënergizing the said magnet.

21. The combination with an electric motor, of a switch in the motor circuit biased to open position, an electro-responsive device for maintaining said switch in the closed position, a reversing switch, and means for deënergizing the said electro-responsive device on the actuation of said reversing switch.

22. The combination with an electric motor, of a switch in the motor circuit biased to open position, an electromagnetic device responsive to no voltage connected across the line and arranged to maintain said switch in the closed position, a reversing-switch, and means for deënergizing the electro-magnetic device by the actuation of the said switch.

In testimony whereof I affix my signature in presence of two witnesses.

HARRY WARD LEONARD.

Witnesses:
L. K. Sager,
Geo. A. Hoffman.