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A. C. EASTWOOD.

AUTOMATIC CUT-OUT FOR ELECTRIC CONTROLLERS.

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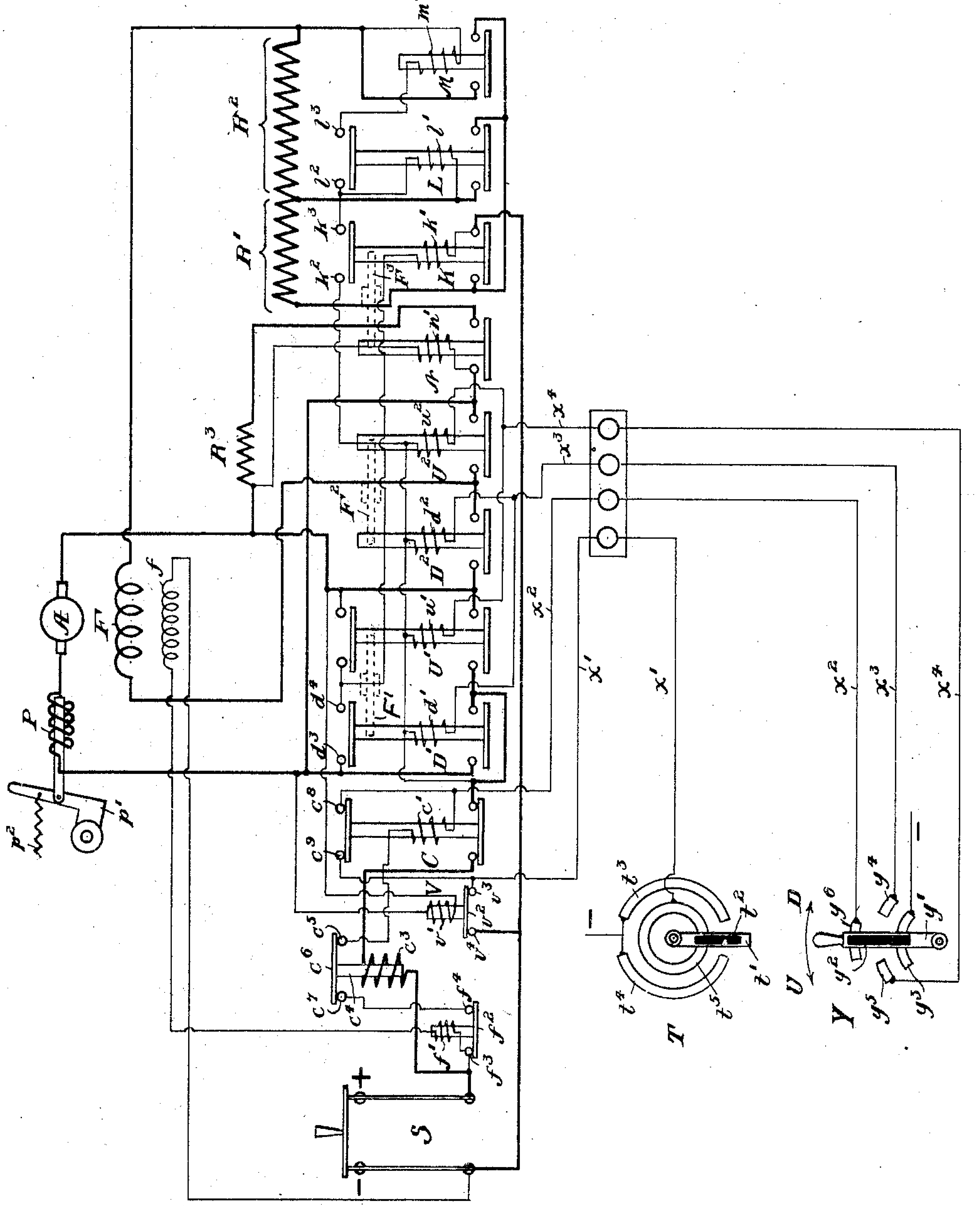

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AUTOMATIC CUT-OUT FOR ELECTRIC CONTROLLERS.

No. 873,737. Specification of Letters Patent. Patented Dec. 17, 1907.

Application filed January 15, 1907. Serial No. 352,408.

To all whom it may concern:

Be it known that I, ARTHUR C. EASTWOOD, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented or discovered new and useful Improvements in Automatic Cut-Outs for Electric Controllers, of which the following is a specification.

My invention relates to new and improved means for automatically cutting off the supply of current to an electric motor and stopping it in such a manner that, after the motor has been automatically stopped by the action of the automatic means, the operator may again start the motor in either direction by the operation of the master controller in the ordinary way, without being required to open or close additional switches to secure this result.

The drawing is a diagram of electrical connections of an electric controller equipped with my invention for controlling a compound wound electric motor.

In the drawing, S, is a knife switch connected to the source of current supply.

A, is the armature of the motor having a series field winding F and a shunt field winding *f*.

P is the winding of the magnetizing coil of an electric brake p^1, the construction of the brake being such that when current flows through the winding P, the brake is held released by the magnet and when current ceases to flow through the winding P, the brake is applied by a spring p^2 or weight, as is well known.

D^1, D^2, U^1, U^2 are magnetically operated reversing switches which serve to effect the necessary connections for causing the armature of the motor to rotate in one direction or the other in the well known way. These switches are operated by electro-magnets having windings d^1, d^2, u^1, u^2, respectively. Mechanical interlocking bars F^1, F^2 are placed between adjacent switches in such a manner that when switches D^1 and D^2 are closed, switches U^1 and U^2 can not close, and vice versa.

R^1 and R^2 are sections of resistance for limiting the flow of current through the motor during the period of acceleration. The circuit through this resistance is completed at the switch K, which has an operating coil k^1, the resistance being cut out or short circuited by the switches L and M, which have the actuating windings l^1 and m^1.

R^3 is a bank of resistance which is connected across the armature of the motor by the switch N, having the actuating coil n^1. The operation of this switch will be later described.

Y is a master controller having an operating lever y^1, which is shown in the drawing as being in the off position. The lever y^1 carries a contact brush y^2 coöperating with contact y^6 in the off position in such a manner as to connect it with the contact y^3. The brush y^2 connects contact y^4 to contact y^3 when moved to the right and connects contact y^5 to contact y^3 when moved to the left from the off position.

C is a circuit breaker which will automatically open upon the flow of a predetermined current through the motor, upon the failure of the supply of current, upon opening the circuit of the shunt field winding *f* and may also be opened by the operation of the automatic cut-out T. The circuit breaker C is made up of a magnetically operated switch having an actuating coil c^1. Current is led to the switch through a helical winding c^3 which constitutes the operating coil of the overload switch. Within the winding c^3 is a plunger c^4, which, when the current exceeds a predetermined value rises and lifts the contact member c^6 from the stationary contacts c^5 and c^7. It will be seen that this opens the circuit of the actuating coil c^1 of the circuit breaker, thus causing the circuit breaker to open. It will be further seen that the switch members f^2, f^3 and f^4 of an auxiliary switch are in circuit with the coil c^1 of the circuit breaker. The coil f^1 is in series with the shunt field winding of the motor, so that as long as current is flowing through the shunt field winding, the switch member f^2 is held in contact with the stationary contact members f^3 and f^4. If, however, through any reason such as the breaking of a connection, current should cease to flow through the shunt field, the winding f^1 will no longer be energized and the switch member f^2 will drop from contact with the terminals f^3 and f^4, thus interrupting the circuit of the coil c^1 and causing the circuit breaker to open. If for any reason the supply of current should fail, the circuit breaker C will, of course, open, since it is held closed by the electromagnet having the winding c^1, which is energized from the supply mains. It will be seen that the overload switch and the shunt field switch act upon the connection of the coil c^1 to the positive supply main. The other end of the coil c^1 is connected to a wire x^2, which is also connected to one contact c^8 of an auxiliary switch which is closed when the circuit breaker is closed. The conductor x^2 leads to the contact y^6 of the master controller, which contact is, when the master controller is in the off position connected to the negative main through the brush Y^2 and the contact y^3. The circuit breaker is, therefore, closed when the lever of the operating controller is in the vertical or off position.

T is an automatic cut-out switch having the contact arm t^1 arranged to be driven from a rotating part of the motor or machine to be controlled. The switch T is shown in the drawing as adapted to automatically stop the motor in two different positions, these positions being 180 degrees apart and corresponding to the lower and upper vertical positions of the rotating contact arm t^1. The arm t^1 carries a brush t^2 adapted to electrically connect the contact ring t^5 alternately with rings t^3 and t^4. The rings t^3 and t^4 are connected together to the negative supply main, the rings being separated at both their upper and lower extremities by a gap which cannot be spanned by the brush t^2.

As previously noted, one end of the coil c^1 of the circuit breaker is connected to an auxiliary contact c^8. A second auxiliary contact c^9 is connected to the negative main when the brush t^2 connects the ring t^5 with either of the contacts t^3 or t^4.

As previously noted the coil c^1, which causes the circuit breaker to close, receives its negative connection through the short contact y^6 of the master controller when the controller is in the off position. When the circuit breaker is closed, the contacts c^8 and c^9 are bridged by a contact member carried by the circuit breaker which serves to give the coil c^1 its negative connection through the contacts of the cut-out, T, provided the arm t^1 is not in either of its vertical positions.

The auxiliary contact c^9 is further connected to the negative main through the contacts of a counter E. M. F. switch V. This switch has a winding v^1 which is connected across the terminals of the armature of the motor so that, when the armature is revolving, the coil v^1 will be excited by the electro motive force generated in the armature and will raise the switch member v^2 from contact with the stationary members v^3 and v^4. When the armature is at rest, the coil v^1 will, of course, not be excited and the switch will be closed, the contact member v^2 spanning the contacts v^3 and v^4. This condition exists at the time of starting from rest, so that, even though the cut-out be in the position shown with its brush t^2 out of contact with either the rings t^3 or t^4, the coil c^1 of the circuit breaker, after the circuit breaker is closed, will receive its negative connection through its auxiliary contacts c^8 and c^9 and the contacts of the counter E. M. F. switch V.

With the cut out in the position shown, we will assume the lever of the master controller to be moved to the right. This causes the brush y^2 to open circuit with the contact y^6. This, however, will not cause the circuit breaker to open, since it still retains its negative connection through its own auxiliary contacts and through the contacts of the counter E. M. F. switch V. The brush y^2 then comes into contact with the segment y^4. The path of the control circuit will then be as follows: from the positive main through the circuit breaker, thence to the coils d^1 and d^2 in parallel, through the wire x^3 and the contact y^4 of the master controller, the brush y^2 and the contact y^3 to the negative main. This completes the circuit through the coils d^1 and d^2 and causes the switches D^1 and D^2 to close. The switch D^1 carries auxiliary contacts d^3, d^4, which are bridged when the switch is closed, one of these contacts d^3 being connected to the left terminal of the switch D^1, which is connected to the positive main when the switch is closed. The other auxiliary contact d^4 is connected to one end of the coil k^1 of the switch K. The other end of the winding coil k^1 is connected directly to the negative main. Therefore, as soon as switch D^1 is closed, switch K immediately closes and completes the main circuit through the motor as follows: from the positive terminal of the switch S to the overload coil c^3 and the contacts of the circuit breaker C to the switch D^1, the coil of the solenoid brake P, the armature A, the switch D^2, the series field F, the resistance R^2 and R^1, and the switch K, to the negative main. The motor should then start. As the motor speeds up, the switches L and M will automatically close in a manner fully described in U. S. Patent #772,277, issued to me October 11, 1904.

As the armature rotates, the arm t^1 of the cut out switch is rotated, we will assume toward the left or in a clockwise direction, bringing the brush into contact with the ring t^4. As soon as the armature has reached a speed at which it generates sufficient electro motive force, the counter E. M. F. switch V raises its contact member v^2 out of engagement with the contacts v^3 and v^4. The coil c^1 of the circuit breaker then depends for its negative connection entirely upon the contacts of the automatic cut out T. When the contact brush t^2 of the cut out passes from the upper segment t^4, its negative connection is interrupted. The coil c^1 is thereby deënergized and the circuit breaker opens, thus cutting off the supply of current to the motor. The circuit breaker in opening opens the positive connections of switches D^1 and D^2, K, L and M, thereby causing these switches to open.

The switch N, which we will call the dynamic braking switch, has an actuating coil n^1, the terminals of which are connected to the terminals of the armature, so that the coil n^1 is energized by the counter E. M. F. of the armature so long as the armature is in motion. The switch N, therefore, tends constantly to close while the armature is running. It is, however, prevented from closing while the switch K is closed through the action of the interlocking lever F^3. As soon, however, as switch K opens, switch N will instantly close since, although the main circuit is opened the armature will still continue to generate electro motive force due to its rotation under its own momentum and that of the driven parts in the magnetic field set up by the shunt field winding f.

It will be noted that one terminal of the switch N is connected through the winding of the magnetic brake to the terminal of the armature while the other terminal of the switch is connected through the braking resistance R^3 to the other terminal of the armature. When the switch N closes, the armature, therefore, generates current through this circuit, the amount of the current being regulated by the resistance R^3. This, of course, imposes a load on the motor and the armature is speedily brought to rest through this generation of current, the energy due to the motion of the moving parts being transformed into electric current and dissipated as heat in the braking resistance R^3. It will be noted that the coil of the magnetic brake P is in series with this circuit so that this brake will not be applied until the armature has practically ceased to generate current, or, in other words, until the armature has substantially come to rest. By this arrangement the larger part of the energy due to the motion of the parts is dissipated as heat in the resistance R^3 without wear of the braking surfaces of the magnetic brake, the magnetic brake becoming practically a holding brake capable of holding the load after it has been brought to rest through the dynamic braking action. As the armature comes to rest the coil n^1 of the switch N is no longer excited and this switch opens.

When the circuit breaker has opened through the action of the automatic cut-out T, it will not again close until the lever y^1 of the master controller is again brought to the vertical or off position so that its brush y^2 engages the contact y^6. When the lever is brought to the off position, the circuit through the coil of the circuit breaker will be as follows: from the positive main, through the contacts f^2, f^3 and f^4 of the shunt field switch, the contacts c^5, c^6 and c^7 of the overload switch, through the coil c^1, the wire x^2, the contact y^6, the brush y^2, the contact y^3 of the master controller to the negative main. This completes the circuit through the coil c^1 and causes the circuit breaker C to close. When the armature of the motor is at rest, the counter E. M. F. switch V is closed so that the motor may be again started by operating the master controller in either direction from the off position.

When the lever y^1 of the master controller is moved to the left, the brush y^2 makes contact with the segment y^5, which connects through the wire x^4 with the coils u^1 and u^2 of the reversing switches U^1 and U^2. This completes the circuit through these coils, the other end of each of them being connected to the positive main near the lower terminal of the circuit breaker C. Closure of switches U^1 and U^2 serve to make the necessary connections for causing the armature to rotate in a direction the reverse of that above described. The succeeding action of the other switches will be the same as before.

It will be understood that my invention provides simple means at one or more points for automatically stopping a motor driven machine in such a way that, as soon as it has come to rest, it may be again started at the will of the operator in either direction.

While in the drawings I have indicated only two points on the switch T, at which the motor may be automatically stopped, it will be understood that the motor may be automatically stopped at any number of desired points determined simply by the arrangement of the contacts of the cut-out switch T.

I claim:—

1. In a controller for electric motors, the combination of an electro-magnet, a circuit breaker normally held closed by the electro-magnet, an operating switch, a cut-out switch adapted to open the circuit of the winding of the electro-magnet of said circuit breaker when said cut-out switch has been actuated in a predetermined manner, a master controller, and contacts adapted to cause said circuit breaker to close when said master switch has been returned to the off-position.

2. In a controller for electric motors, the combination of an electro-magnet, a circuit breaker normally held closed by the electro-magnet, a cut-out switch, adapted to open the circuit of the electro magnet of said circuit breaker when a predetermined limit of travel has been reached, and an electro-motive force switch, adapted to close the circuit opened by said cut-out switch when the motor has come to rest.

3. In an electric controller, a motor switch, a cut-out switch for opening the motor switch when a predetermined limit of travel has been reached, and a switch controlled by the armature of the motor and causing the closure of the circuits opened by the cut-out switch when the motor has come substantially to rest.

4. In an electric controller, a motor switch, a cut-out switch for opening the motor switch when a predetermined limit of travel has been reached, and automatic means for closing the circuits opened by the cut-out switch when the motor has come substantially to rest.

5. In an electric controller, a motor switch, a cut-out switch for opening the motor switch when a limit of travel has been reached, and a magnetically operated switch having its terminals connected to short circuit the contacts of the cut-out switch and having its operating winding connected in shunt to the armature of the motor.

6. In an electric controller, a cut-out switch for automatically cutting off the supply of current to a motor when a predetermined limit of travel has been reached and means acting when the motor has come to rest for closing the circuits opened by the cut-out switch, whereby the motor may again be started in either direction.

Signed at Cleveland, Ohio, this 12th day of January, 1907.

ARTHUR C. EASTWOOD.

Witnesses:
J. E. WELLMAN,
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