P. ZIMMER.

AUTOMATIC MOTOR STARTING RHEOSTAT.

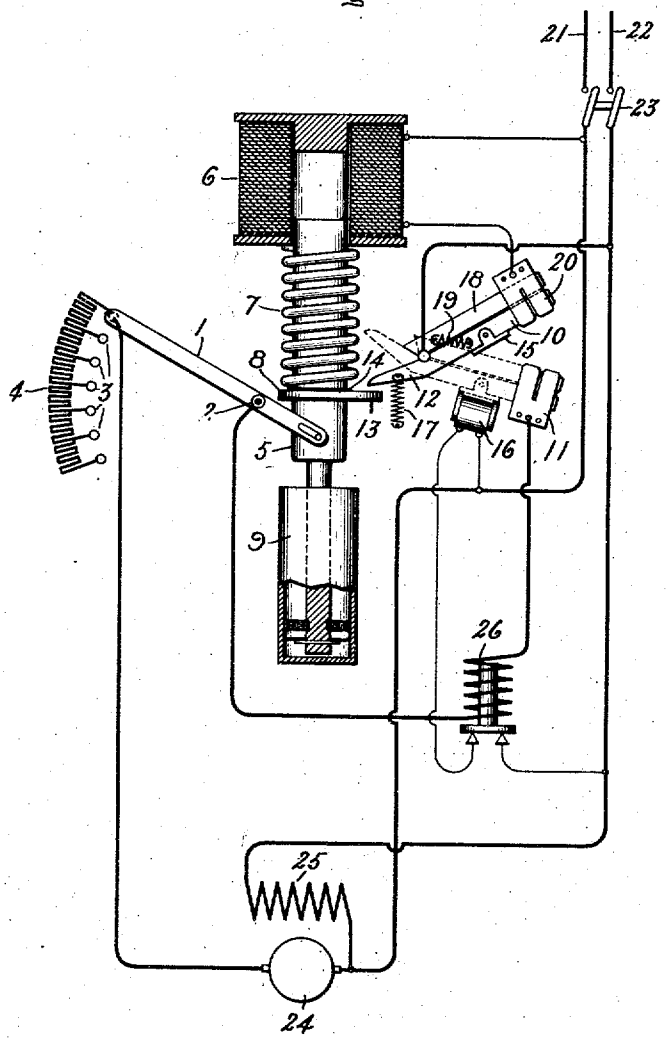
APPLICATION FILED FEB. 10, 1905.

1,021,227.

Patented Mar. 26, 1912.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

George H. Tilden

Helen Alford

Inventor:

Paul Zimmer,

by Albert G. Davis

Att'y.

P. ZIMMER.

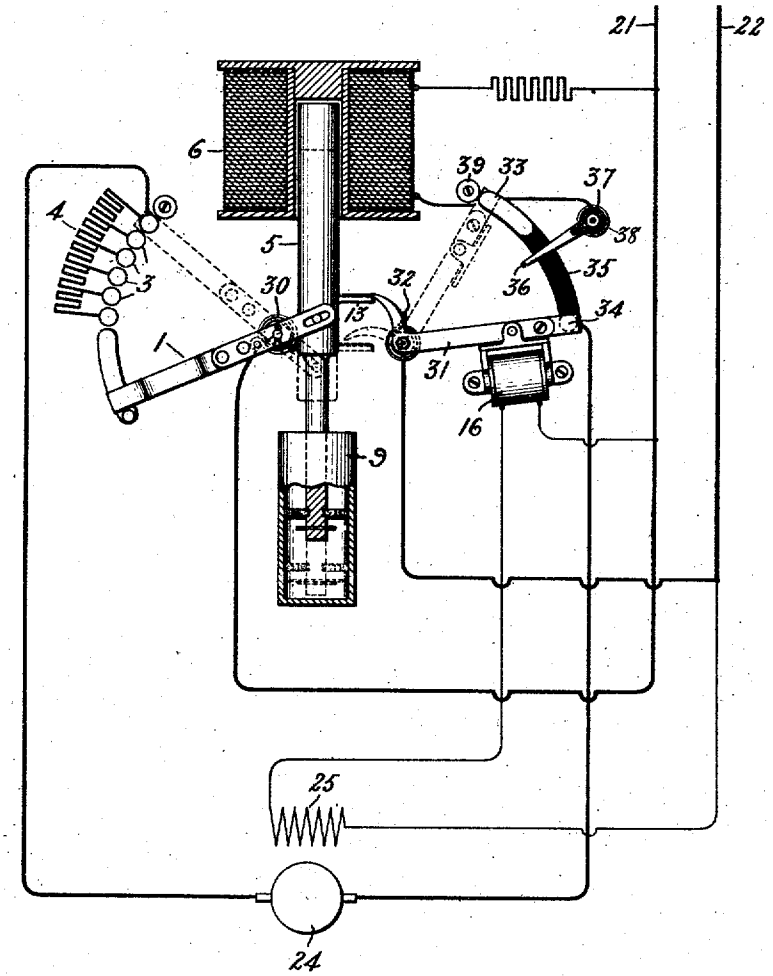
AUTOMATIC MOTOR STARTING RHEOSTAT.

APPLICATION FILED FEB. 10, 1905.

1,021,227. Patented Mar. 26, 1912.

2 SHEETS—SHEET 2.

Fig. 2.



Witnesses:

George H. Tilden.

Helen Orford

Inventor;

Paul Zimmer,

by Albert G. Davis

Att'y.

UNITED STATES PATENT OFFICE.

PAUL ZIMMER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

AUTOMATIC MOTOR-STARTING RHEOSTAT.

1,021,227. Specification of Letters Patent. **Patented Mar. 26, 1912.**

Application filed February 10, 1905. Serial No. 245,014.

To all whom it may concern:

Be it known that I, PAUL ZIMMER, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Automatic Motor-Starting Rheostats, of which the following is a specification.

This invention relates to motor-starting devices for automatically starting an electric motor and bringing it up to speed without endangering its coils by the admission of too great a current thereto.

More specifically my invention relates to automatic motor starting rheostats in which a resistance in series with the motor armature is gradually and automatically cut out as the motor speeds up, and one object of my invention is to reduce the energy loss in the operating coil of the rheostat. Automatic motor-starting rheostats, as constructed prior to my invention, have been provided with a rheostat arm movable over contacts connected to a resistance, and an actuating solenoid to move the arm to cut the resistance out of circuit against the tension of a retracting spring. In order that the arm may not move too rapidly over the contacts, a dash-pot has been provided to retard this movement. The parts are so adjusted that it takes the rheostat arm from thirty seconds to two or three minutes to move from the full "off" to the full "on" position, as a more rapid movement of the arm would cut out the resistance too rapidly and admit a dangerously large current to the motor armature. The actuating solenoid being in circuit during this entire period until at the end of the movement it is cut out by an auxiliary switch, the energy loss therein is comparatively large.

In accordance with my invention I provide a spring or equivalent means for giving the arm a bias in a direction to cut out the resistance and an operating solenoid to move the arm to cut in the resistance and put the spring under tension. I may also provide means, as, for instance, a dashpot, to retard the movement of the arm as it moves in response to its bias to cut out resistance. When the solenoid has moved the arm to the proper position and the spring is placed under suitable tension, the solenoid is cut out of circuit and the arm returns in response to its bias under the retarding influence of the dashpot, if such be provided. In practice I find that in less than one-tenth of a second the core of the solenoid is drawn up, the spring compressed and the solenoid circuit opened so that a great saving in the energy consumed is effected. Moreover, as the solenoid is in circuit for only so short a period, its coils may be of wire of much smaller cross-section than could be used if it remained in circuit for the longer period as the heating is practically inappreciable. Furthermore, the resistance is always cut out at the same rate irrespective of variations of voltage.

Another object of my invention is to provide a simple, durable and reliable automatic motor-starting rheostat which shall be inexpensive to manufacture.

These and other objects of the invention will more fully appear in the following description.

The novel features of my invention will be definitely indicated in the claims appended hereto.

In the accompanying drawings, I have illustrated diagrammatically two embodiments of my invention but it must be understood that the principles of my invention as set forth in the claims are also applicable to automatic starting devices widely different therefrom.

In the drawings, therefore, Figure 1 is a diagrammatic elevation partly in section of one form of my invention; and Fig. 2 is a similar view of a modified form.

Referring first to Fig. 1 of the drawings, 1 indicates a rheostat arm pivoted at 2 and adapted to engage a plurality of contact studs 3, which are connected at intervals to a resistance 4. The arm 1 is moved over the studs 3 by a member 5 which constitutes the core of a solenoid 6. Coiled about the core 5 is a spring 7 which is adapted to be compressed between one of the heads of the solenoid and a washer 8 secured on the core. This spring renders the action of the arm and core more positive than as if the force of gravity were depended upon to return them, and in some cases, therefore, the spring may be dispensed with. The lower end of the core 5 forms the piston of a dash-pot 9, which is arranged in any usual manner to retard the movement of the piston into the cylinder of the dash-pot, but is permitted to be drawn out of the cylinder

freely. The position of the rheostat arm 1 illustrated in the drawing is that which it occupies when all circuits are open and also when all circuits have been closed and the resistance cut out and the motor is running at normal speed. If the motor is at rest, and it is desired to start it, circuit is closed through the solenoid 6, which draws up the core 5 immediately, as the dash-pot 9 does not act to retard this movement, thus putting the spring 7 under compression. This moves the rheostat arm 1 back to the position in which the maximum resistance is cut into the motor circuit, and an auxiliary switch then operates to close the motor circuit and open the circuit of the actuating coil 6. When this occurs the spring 7 moves the arm 1 back to the "on" position but this movement is a slow one as it is retarded by the dash-pot and therefore the resistance is gradually cut out of the motor circuit and the motor is brought up to speed without danger of injury thereto.

The auxiliary switch for closing the motor circuit and opening the circuit of the actuating coil 6 comprises two pivoted switch-blades 10 and 18 arranged to enter two switch-clips 11 and 20. Blade 10 is provided with an extension 12 on the other side of its pivot which extends into the path of movement of a projecting portion 13 of the washer 8. The projection 13 is insulated in any suitable manner, as by a strip of fiber 14. The blade 10 carries an armature 15 which coöperates with a retaining magnet 16 mounted in position to hold the blade 10 when the magnet is energized and the end of the blade is in the clip 11. A retracting spring 17 has one end attached to the blade 10 and the other to a fixed post, and serves to return the blade to the position shown in full lines when the retaining magnet 16 is deënergized. The blade 10 controls the motor circuit, and in order that the circuit of solenoid 6 will not be opened until the rheostat arm 1 has reached the full "off" position, and to obtain a quick break of the solenoid circuit, I provide a second blade 18 pivoted at the same point as the blade 10, and arranged to be actuated by the blade 10 just as it reaches its final position. Blades 10 and 18 are connected by a spring 19, and a switch-clip 20 is mounted in position to be engaged by them when in the retracted position. The ends of blades 10 and 18 are cut off at such an angle that just as the blade 10 is reaching its final position, the two edges come into engagement and blade 18 is forced out of switch-clip 20 against the clamping action of the clip, whereupon spring 19 snaps it quickly to the position shown in dotted lines where it is retained by no-voltage magnet 16.

21 and 22 indicate positive and negative mains from a source of supply of electric energy, and 23 a line switch which may be located at a point distant from the motor, if desired.

24 and 25 indicate the armature and field respectively of an electric motor which is to be automatically started by the rheostat. The circuit of the motor armature 24 is completed from the main 21 through the armature, so much of resistance 4 as is cut in circuit by the rheostat arm, through the arm 1, and if desired, through an overload coil 26 controlling the no-voltage release magnet 16, to the switch-clip 11. Switch-blades 10 and 18 are connected to the negative main 22, so that when the blade 10 enters clip 11, the armature circuit is closed. The field 25 of the motor is connected across the lines so that the motor field is energized as soon as switch 23 is closed. The actuating coil 6 is connected between the positive main 21 and the switch-clip 20 so that when the blade 18 leaves the clip 20, the circuit of the coil is opened.

The operation of the device as thus constructed will now be described.

In order to start the motor, the line switch 23 is closed, thus closing the circuit of the motor field 25 and the actuating coil 6 and the latter, being energized, draws up the core 5 to compress spring 7 and set the parts in position for starting. This movement is a very rapid one, as it is not retarded by the dash-pot 9. Drawing core 5 up, pulls the rheostat arm 1 back over the contacts until it is in engagement with the first stud 3, or if desired, an open-circuiting stud or segment so that it is now safe to close the motor circuit. Also, when core 5 moves upward, the projection 13 on the washer 8 engages the extension on the end of blade 10, turning the blade on its pivot against the tension of spring 17 until it enters the clip 11, where it is held by the retaining magnet 16 which, as is seen, is connected across the lines. As blade 10 is nearing its final position, it forces the blade 18 out of clip 20, and spring 19 quickly draws blade 18 up to it, so as to give a quick-break of the circuit of solenoid 6 at the clip 20. When this occurs the spring 7 moves the core 5 back to its original position, thus moving the rheostat arm 1 over the contacts 3 to cut the resistance 4 out of the circuit of the motor armature 24, but this movement is a slow one, as movement of core 5 in this direction is retarded by the dash-pot 9. The dash-pot may be so constructed as to give any desired time interval between the "on" and "off" positions. It is evident, therefore, that the operating solenoid 6 is in circuit only for a very short interval, so that there is little loss of energy in the operating coil and the wire from which it is wound may be of much smaller cross-section than would be permissible if the coil were allowed to remain in

circuit longer. In the event of an open-circuit or an abnormal fall in the voltage, the retaining magnet 16 would release blade 10, and spring 17 would retract the blade, thus opening the motor circuit at the switch-clip 11. In the event of an overload, coil 26 would raise its core, thus opening the circuit of the magnet 16 with the same result.

Fig. 2 shows an automatic motor-starter embodying my invention, but differing in details of construction from that shown in Fig. 1. This form of my invention possesses the advantages that it is somewhat simpler and somewhat cheaper to construct than that shown in Fig. 1. Instead of the spring 7 coiled about the core 5, a spring 30 coiled about the pivot of the rheostat arm 1 is employed. The auxiliary switch for closing the motor circuit and opening the circuit of the operating coil consists of a single blade 31 instead of the switch of the double-blade type, and a spring 32 coiled about the pivot of this blade is employed to retract the arm. Two contacts 33 and 34 are mounted at the limits of movement of the arm 31, and a bridge of fiber 35 is provided to support the switch-arm when moving from one contact to the other. In order to maintain the continuity of the operating coil circuit until the arm 31 reaches the "on" position and then effect a quick break of the circuit, a pivoted contact arm 36 is provided having springs 37 and 38 coiled about its pivot and acting on the arm in opposite directions to normally center it in the position illustrated in the drawing. One terminal of the operating coil 6 is connected to the contact 33 and also to the contact arm 36. Arm 36 is so positioned that it is engaged by the switch arm 31 before the latter leaves the stud 33, in order to maintain the continuity of the operating coil circuit, and it is of such a length that it is released by the switch arm 31 and snaps back to its normal position just as the arm reaches its final position where it is held by the retaining magnet 16. If necessary the contact 33 may be elongated into the form of a segment so that when arm 31 is retracted to the "off" position against a stop 39, it will not release the arm 36 and permit it to be returned to its normal position until the arm 31 engages contact 33. In the drawing I have shown the magnet 16 connected in series with the motor field 25 across the lines, instead of directly across the lines, as in Fig. 1; and no overload coil is shown in this figure. The arrangement of these parts may be changed as desired. The operation of this embodiment of my invention is essentially the same as that shown in Fig. 1. On closure of the line switch, the circuit of the operating coil 6 is closed from main 21 through the coil to contact 33 and through switch arm 31 to main 22. The coil 6, being energized, draws up its core 5, thus moving arm 1 to the "off" position. As it is drawn up, the insulated projection 13 on the core engages the extension of switch arm 31 and turns the arm on its pivot. Before leaving the stud 33, arm 31 engages the spring-positioned contact arm 36, so that the operating coil circuit is maintained closed as the switch arm moves toward contact 34. Just as the arm reaches its final position, where it is held by the magnet 16, and where it closes the circuit of the motor armature 24, it disengages the contact arm 36 and the latter is returned to its normal position by the spring 37, so that the operating coil circuit is now open. This is the position illustrated in the drawing. The spring 30 now moves the arm 1 back over the contacts 3 to cut the resistance out of the circuit of the motor armature, and as the dashpot 9 retards this movement, the current is admitted to the motor armature at just the proper rate.

Other modifications than those which I have shown may be employed and it should be understood that I do not limit my invention in its application to resistance as distinguished from reactance or transformer coils nor to the particular arrangement or construction of my device, but only as it is limited by the scope of the claims annexed to and forming a part of this application.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. An automatic rheostat comprising an arm movable to vary the resistance in circuit, means for moving the arm to cut out the resistance, an electro-magnetic device to automatically set the arm in position for starting and put said means in an operative position, and means for deënergizing said device when the actuating means has been put into operative position.

2. An automatic rheostat comprising an arm movable to vary the resistance in circuit, a spring to move the arm in a direction to cut the resistance out of circuit, an electromagnetic device for putting the spring under tension, and means for deënergizing said device when the spring has been put under tension.

3. An automatic rheostat comprising an arm movable to vary the resistance in circuit, a spring to move the arm in a direction to cut the resistance out of circuit, means to retard movement of the arm in that direction, a solenoid for putting the spring under tension, and means to cut the solenoid out of circuit to deënergize the same when the spring has been put under tension.

4. An automatic rheostat comprising an arm movable to vary the resistance in circuit, a spring to move the arm in a direction to cut the resistance out of circuit, an electromagnetic device for putting the spring under tension, and means for effecting a

quick break of the circuit of said device to deënergize the same when the spring has been put under tension.

5. An automatic rheostat comprising an arm movable to vary the resistance in circuit, a spring to move the arm in a direction to cut the resistance out of circuit, means to retard movement of the arm in this direction, electrically controlled devices for putting the spring under tension, and means for rendering said devices inoperative when the spring has been put under tension.

6. An automatic rheostat comprising an arm movable to vary the resistance in circuit, a spring to move the arm in a direction to cut the resistance out of circuit, electrically controlled devices for moving the arm in a direction to cut in the resistance and for putting the spring under tension, and means for rendering said devices inoperative when the resistance has been cut into circuit.

7. An automatic rheostat comprising an arm movable to vary the resistance in circuit, a spring to move the arm in a direction to cut out the resistance, an electromagnetic device for moving the arm in a direction to cut in the resistance and for putting the spring under tension, a dash-pot arranged to retard movement of the arm in a direction to cut out the resistance but permit free movement of the arm in the opposite direction, and means for deënergizing said electromagnetic device when the resistance has been cut into circuit.

8. An automatic rheostat for an electric motor comprising an arm movable to vary the resistance in the motor circuit, a spring to move the arm in a direction to cut out the resistance, electrically controlled devices for putting said spring under tension and then closing the motor circuit, and means for rendering said devices inoperative when the spring has been put under tension.

9. An automatic rheostat for an electric motor comprising an arm movable to vary the resistance in the motor circuit, a spring to move the arm in a direction to cut out the resistance, electrically controlled devices for moving the arm to cut in the resistance and for putting the spring under tension, means for closing the motor circuit when the resistance has been cut in, and means for rendering said devices inoperative when the resistance has been cut into circuit.

10. An automatic rheostat for an electric motor comprising an arm movable to vary the resistance in the motor circuit, a spring to move the arm in a direction to cut out the resistance, a solenoid for moving the arm to cut in the resistance, and for putting the spring under tension, a switch operated by the solenoid to close the motor circuit when the resistance has been cut in, means for deënergizing the solenoid when the resistance has been cut in, and a dash-pot to retard movement of the arm to cut out the resistance.

11. An automatic rheostat for an electric motor comprising an arm movable to vary the resistance in the motor circuit, a spring to move the arm in a direction to cut out the resistance, a solenoid for moving the arm to cut in the resistance and for putting the spring under tension, a switch operated by the solenoid to close the motor circuit when the resistance has been cut in, means operated by the solenoid for opening the solenoid circuit with a quick-break when the resistance has been cut in, and means to retard movement of the switch arm to cut out the resistance.

12. An automatic motor starter comprising a series of contacts, a circuit-controlling element therefor having a bias to running position, an electrically controlled device for moving said element to starting position and means for deënergizing said device when said element reaches the starting position.

13. An automatic motor starter comprising a series of contacts, a circuit-controlling element therefor having a bias to running position, an electrically controlled device for moving said element to starting position, means for closing the motor circuit when the said element reaches starting position and simultaneously deënergizing said electrically-controlled device.

14. An automatic motor starter comprising a series of contacts, a circuit-controlling element therefor having a bias to running position, an electrically controlled device for moving said element to starting position, means for deënergizing said device when said element reaches the starting position, and means for retarding said controlling element as it moves toward running position.

15. An automatic motor starter comprising a series of contacts, a circuit-controlling element therefor having a bias to running position, an electrically controlled device for moving said element to starting position, means for closing the motor circuit when the said element reaches the starting position and simultaneously deënergizing said electrically controlled device, and means for retarding said controlling element as it moves toward running position.

In witness whereof, I have hereunto set my hand this 8th day of February, 1905.

PAUL ZIMMER.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.