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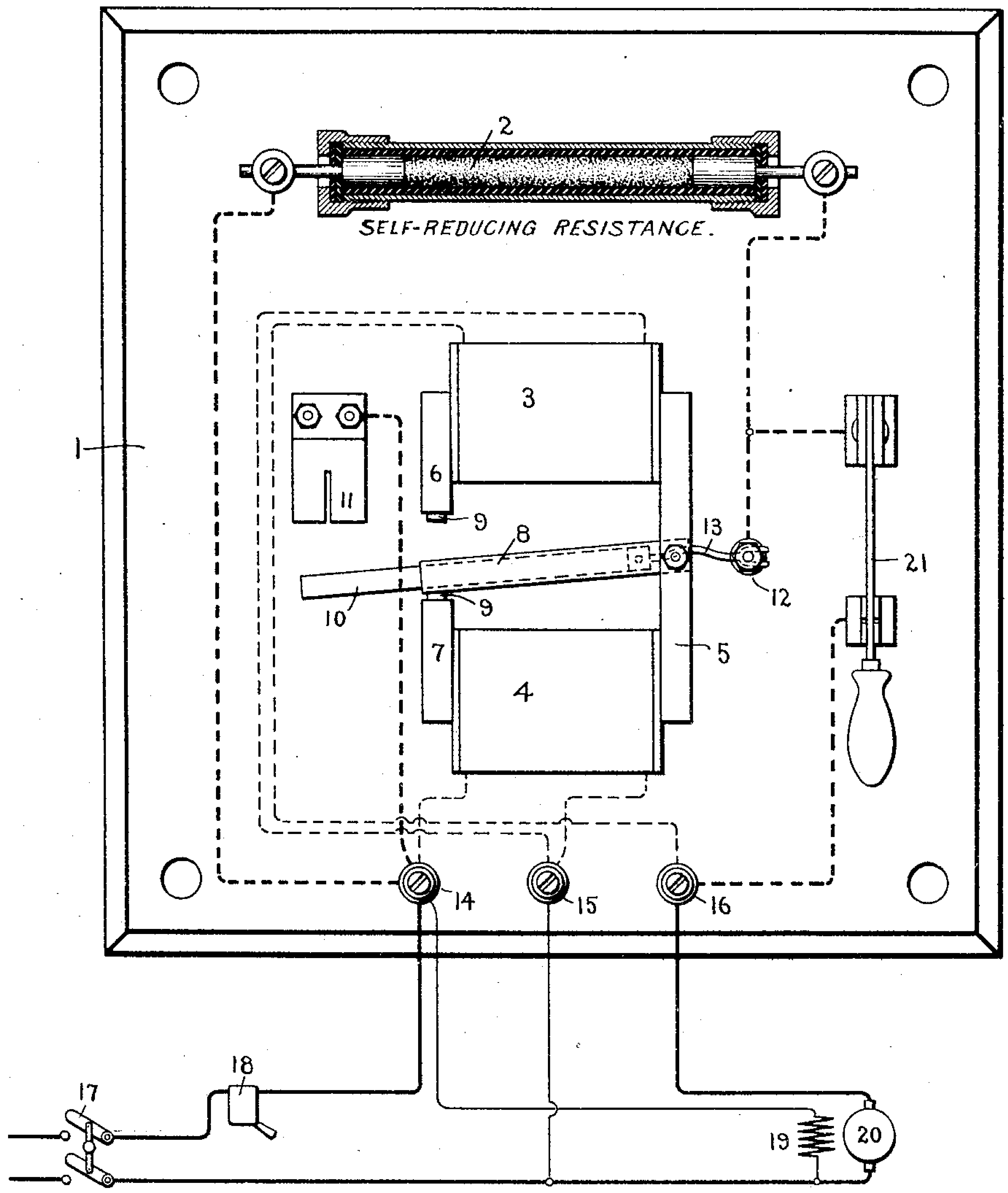
E. SCHATTNER & C. D. HASKINS.

AUTOMATIC MOTOR STARTING RHEOSTAT.

APPLICATION FILED MAY 13, 1904.



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UNITED STATES PATENT OFFICE.

ERNEST SCHATTNER AND CARYL D. HASKINS, OF SCHENECTADY, NEW YORK, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

AUTOMATIC MOTOR-STARTING RHEOSTAT.

SPECIFICATION forming part of Letters Patent No. 779,875, dated January 10, 1905.

Application filed May 13, 1904. Serial No. 207,745.

To all whom it may concern:

Be it known that we, ERNEST SCHATTNER, a subject of the King of Great Britain, and CARYL D. HASKINS, a citizen of the United States, both residing at Schenectady, in the county of Schenectady and 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 controllers for electric motors, and particularly to that type of controllers known as "automatic motor-starting rheostats." Its object is to provide such a rheostat by which a smooth resistance gradient will be obtained, and we accomplish this by employing a self-reducing resistance—that is, a resistance the ohmic value of which is decreased by the passage of the current through it.

Prior to our invention the common practice has been to provide motor-starting rheostats with wire resistances connected to studs arranged in an arc of a circle and a pivoted switch-arm coöperating with the studs. With such a device the resistance is cut into and out of the motor-circuit in steps. Obviously a starting-rheostat with which a smooth resistance gradient is obtained would give more satisfactory results. It has long been known that certain substances possess a negative temperature coefficient of resistance—that is, they decrease in ohmic value when heated—and such substances have been termed "self-reducing resistance." Some substances possess this characteristic to such an extent that they may be used in place of hand-operated resistances in electric circuits where it is desirable that the resistance be great when the current is first applied and shall then be gradually reduced. Among such substances magnetite possesses this self-reducing characteristic to a marked degree and is thus particularly well suited for use as starting resistance for electric motors and for similar purposes. In a pending application filed by E. Schattner March 31, 1904, and serially numbered 200,881, is described a self-reducing resistance unit having magnetite and a silicate mixed in proper proportions and held in a tube under pressure.

This invention relates to a motor-starting rheostat employing such a self-reducing resistance and arranged so that it can be operated automatically from a distance. As the ohmic value of the self-reducing resistance decreases gradually as the material is heated by the passage of the current through it, no electrically-actuated moving parts are necessary to vary the resistance in the motor-circuit; but in order that the resistance material may cool, and thus be in readiness to again properly start the motor whenever that is desired, we provide means by which the resistance is automatically short-circuited as soon as the motor is up to speed.

Our invention further comprises means whereby the resistance is automatically short-circuited when the counter electromotive force of the motor rises sufficiently to permit connecting the motor directly across the lines without danger of injury to the coils of the motor-armature.

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

The details of construction and the mode of operation of our improved automatic motor-starting rheostat will be better understood by reference to the following description, taken in connection with the accompanying drawing, which shows a plan view of the preferred embodiment of our invention.

In the drawing, 1 indicates a base-plate, of soapstone or similar insulating material, provided with openings therein by which it may be mounted upon a support in a vertical position. Mounted on the base-plate is a self-reducing resistance 2, preferably consisting of one or more units constructed as described in the application above referred to. Also mounted on the base-plate is a differential relay having coils 3 and 4 wound on suitable cores, which are connected at one end by an iron bridge-piece 5. On the other end of each core is a pole-piece 6 and 7, between which is a small air-gap, as shown. An armature 8 is pivoted

at one end on the bridge-piece 5, and its other end is adapted to move between the pole-pieces 6 and 7, pins 9, of brass or other non-magnetic material, being provided in the ends of the pole-pieces 6 and 7 to prevent the armature from sticking thereto. A switch-blade 10 is secured to armature 8, and a switch-clip 11 is mounted on the base-plate in position to be engaged by the switch-blade 10 when armature 8 is drawn to its uppermost position. A binding-post 12 is mounted on the base-plate and connected by a flexible conductor 13 to the switch-blade 10. Also mounted on the base-plate are the binding-posts 14, 15, and 16. A line-switch 17 and automatic circuit-breaker 18 are connected in the supply-mains leading to the motor at any convenient point, which may be at a distance from the motor. One of the lines is connected to the binding-post 14 and the other to the field 19 and armature 20 of the motor. The other side of the field is connected to binding-post 14 and the other side of the armature to the binding-post 16. Post 16 is connected to one side of the self-reducing resistance 2, a knife-switch 21 being inserted in this connection, if desired, and the other side of the resistance is connected to post 14. Binding-post 12 and the clip 11 are also connected to opposite sides of the resistance 2, so that when the switch-blade 10 engages clip 11 the resistance 2 is short-circuited. The coil 3 of the relay is connected between the posts 15 and 16, which are connected to opposite sides of the motor-armature. The coil 4 of the relay is connected between posts 14 and 15 and is therefore across the lines.

As thus constructed the operation of the rheostat is as follows: The armature 8 normally rests by gravity against the pin 9 in the pole-piece 7. To start the motor, the line-switch 17 and circuit-breaker 18 at the distant point are closed, thus closing circuit through the coil 4 of the relay, through the motor-field 19, and through the armature 20 and the self-reducing resistance 2 in series. As the coil 4 of the relay is across the lines, the current therein rises to the maximum as soon as the switch and circuit-breaker are closed, and armature 8 is held firmly against the pin in pole-piece 7. The ohmic value of the self-reducing resistance 2 is relatively high when circuit is first closed, so that only a small current is admitted to the motor-armature. The material, however, is heated by the passage of the current through it, and hence its resistance steadily decreases, and the substances which constitute the resistance material may be so proportioned that the ohmic value of the resistance falls in direct proportion to the rise in the counter electromotive force of the motor. The drop in voltage across the motor-armature when circuit is first closed is very small, so that only a very small current flows through coil 3 of the relay; but as the motor comes up to speed the counter electromotive force of the motor and hence the drop in voltage across the armature rise, so that more and more current passes through coil 3. When the motor reaches normal speed, the current in the coil 3 of the relay is so great that its magnetizing effect is sufficient to overcome that of coil 4, and armature 8 is drawn up against the pin in pole-piece 6, thus moving the switch-blade 10 into engaging relation to the contact 11 and short-circuiting the resistance 2. It will thus be seen that the motor is brought up to speed merely by the closure of a switch at a distant point, that the resistance 2 prevents dangerous overloading of the motor while coming up to speed, that the resistance is short-circuited when the motor is running at normal speed in order that it may cool, and thus be ready for a repetition of the operation, and that this short-circuiting of the resistance is dependent entirely upon the counter electromotive force of the motor, so that the resistance cannot be short-circuited until the motor has reached its proper speed. When the line-switch 17 or the circuit-breaker 18 is opened, all circuits are opened, and the armature 8 falls by gravity against the pin in the pole-piece 7, thus restoring all parts to their original positions.

We have illustrated and described herein the form of our invention which we prefer to use; but we do not wish to be understood as limited in any way to this specific device, as many modifications can be made therein which we consider within the scope of our invention and which we aim to cover in the claims appended hereto.

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

1. The combination of an electric motor, a self-reducing resistance, means distant therefrom for closing circuit through the motor-armature and the resistance in series, and automatic means for short-circuiting the resistance.

2. The combination of an electric motor, a self-reducing resistance, means distant therefrom for closing circuit through the motor-armature and the resistance in series, and automatic means for short-circuiting the resistance when its ohmic value has fallen to a predetermined amount.

3. A starting-rheostat having a self-reducing resistance, means for closing circuit through the motor-armature and the resistance in series, and means dependent upon the counter electromotive force of the motor for short-circuiting the resistance.

4. A starting-rheostat having a self-reducing resistance, means for closing circuit to the motor through the resistance, a relay having an armature, and means whereby said armature when attracted short-circuits the resistance.

5. An automatic starting-rheostat having a self-reducing resistance, means for closing cir-

cuit to the motor-armature through the resistance, an electromagnet having its coil connected across the motor-armature, an armature for said electromagnet, and means whereby said armature when attracted short-circuits the resistance.

6. An automatic starting-rheostat having a self-reducing resistance, means for closing circuit through the motor-armature and the resistance in series, a differential relay having one coil connected across the motor-armature and the other across the lines, an armature for said relay, and means whereby said armature short-circuits the resistance.

7. An automatic starting-rheostat having a self-reducing resistance, means for closing the circuit through the motor-field, and through the motor-armature and the self-reducing resistance in series, a differential relay having one coil connected across the motor-armature and the other across the lines, a pivoted armature for said relay, a stationary contact, and a contact carried by said pivoted armature cooperating with said stationary contact in one position to short-circuit the self-reducing resistance.

In witness whereof we have hereunto set our hands this 12th day of May, 1904.

ERNEST SCHATTNER.
CARYL D. HASKINS.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.