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AUTOMATIC SELF STARTER.

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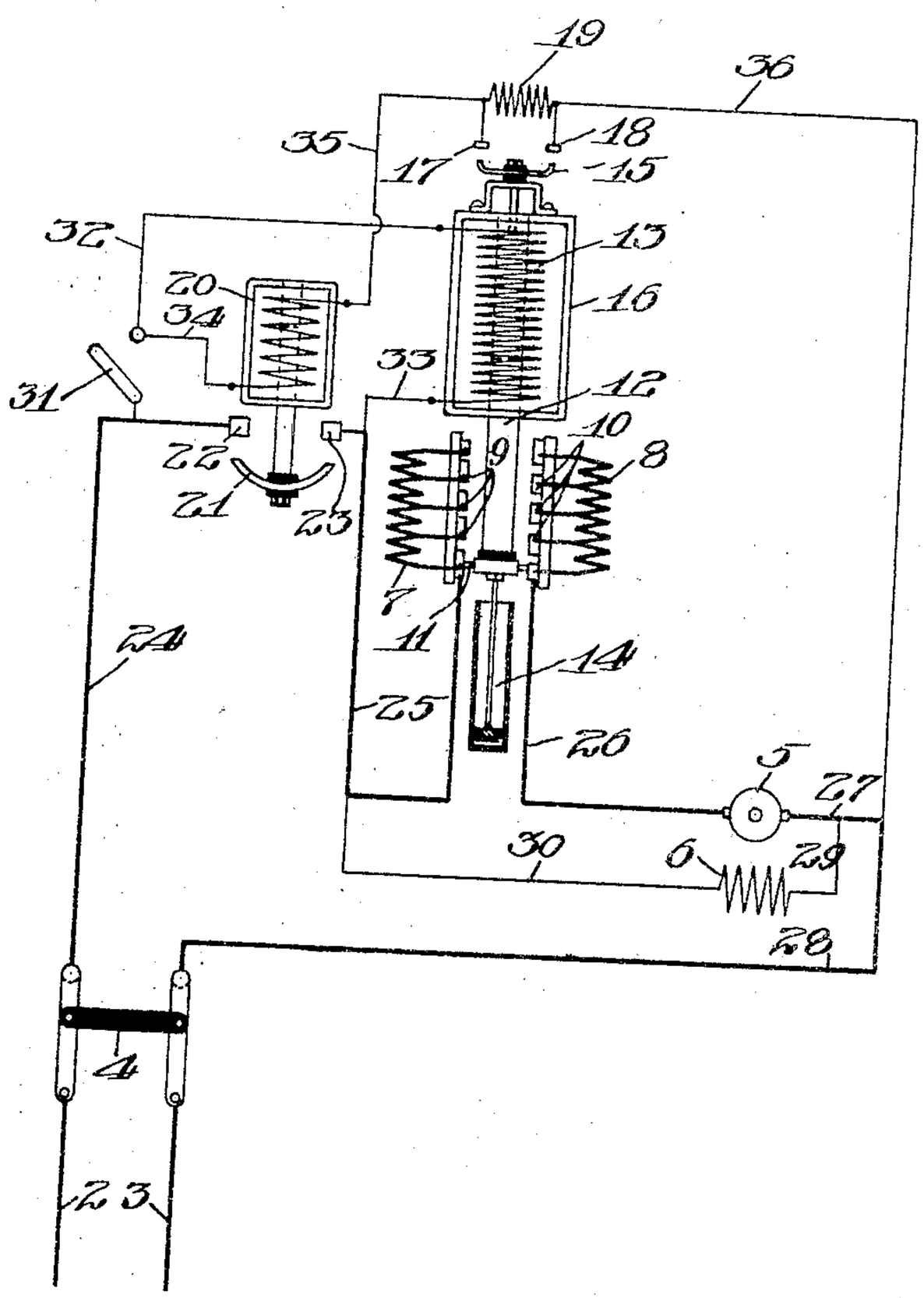

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UNITED STATES PATENT OFFICE.

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AUTOMATIC SELF-STARTER.

No. 905,734. Specification of Letters Patent. Patented Dec. 1, 1908.

Application filed April 10, 1905. Serial No. 254,755.

To all whom it may concern:

Be it known that I, CHARLES H. MILLER, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Automatic Self-Starters, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates specifically to self starters for electric motors, but in some of its features is of more general application.

As is well known, a protective resistance is inserted in the motor circuit at the moment of starting and is gradually cut out as the speed of the armature increases and the counter electro-motive force builds up. It is thus essential to provide some means for cutting out such resistance during the starting period of the motor, and two general classes of devices have been devised for the purpose. These comprise hand starters in which means are provided for manually cutting out the resistance as the motor speeds up, and self starters in which the mere closing of the motor circuit suffices, so far as the attendant is concerned, to cause the self starter to automatically and gradually cut out the resistance. It is to the latter class of starters that the present invention is more especially directed, the object being, in connection with such devices, to provide a self starter that shall consist of but few and simple parts, and therefore is inexpensive to manufacture, and which shall be efficient and durable in actual use.

Other objects and advantages will appear from the detailed description and claims.

In the accompanying drawing in which the figure is a diagram of the invention used in connection with a shunt motor on a constant potential circuit, 2 and 3 indicate the main circuit, 4 a switch interposed in the main circuit, and 5 and 6 the motor armature and winding respectively. The starting resistance is indicated in two sections 7 and 8, terminating at the contacts 9 and 10 with which a movable contact bar or arm 11 is adapted to successively engage as it is raised or lowered. This arm or bar in the present instance is carried upon but is insulated from the lower end of a solenoid plunger 12, which is adapted to be drawn up into the winding 13 of the solenoid 16 when it is energized. A dash pot 14, which may be of any desired type and arranged in any way desired, is connected with the plunger or core 12 in such manner as to retard its downward movement but not to affect its upward movement.

An insulated short circuiting switch 15 is arranged at the upper end of the solenoid 16 and is lifted into engagement with its contacts 17 and 18 by the plunger 12 when the latter is drawn up into the winding 13, thereby short circuiting a suitable resistance 19. An auxiliary solenoid 20 is provided with a movable contact 21 and stationary contacts 22 and 23, serving to control the motor circuit. The motor circuit is extended from the main conductor 2 by way of conductor 24, contacts 22, 21 and 23 of the auxiliary solenoid 20, thence by way of conductor 25 to the lowest terminal 9 of the starting rheostat and from the opposite terminal 10 of said rheostat by a conductor 26 to one side of the armature 5 of the motor; from the other side of the motor wires 27 and 28 lead to the other terminal of the switch 4 and to the main conductor 3. The field winding 6 of the motor is connected with the conductor 27 on one side by a suitable branch 29 and upon the other side by branch 30 with the conductor 25.

Normally the parts are in the position shown in the drawing, the movable contact 11 of the starting rheostat being at its lowermost position and cutting out the resistance 7 and 8. Upon the closing of the switch 31, however, current passes from the wire 24 through said switch, thence by way of conductor 32 to one terminal of the winding 13 of the solenoid 16, thence through said winding conductor 33, and conductor 25 to the lowermost contacts 9 and 10 of the rheostat which are bridged by contact 11, conductor 26, armature 5 of the motor, wire 27 and conductor 28 to the other side of the main circuit. The current in this path energizes the solenoid winding 13 so quickly that it immediately draws or jerks up the plunger 12 to the limit of its movement thereby cutting in the whole resistance of the rheostat and at the same time short circuiting the resistance 19 above the solenoid. The resistance 19 is so adjusted relatively to the winding of the auxiliary solenoid 20 with which it is in circuit as to prevent the latter from being energized after switch 31 is closed until the resistance 19 is short circuited. As soon

as this occurs, sufficient current flows through the shunt circuit from the switch 31, conductor 34, winding of solenoid 20, conductor 35, contacts 17, 15 and 18 of solenoid 16, conductor 36 to conductor 28. The current in this path suffices to energize the solenoid 20 thereby causing its contact 21 to bridge contacts 22 and 23 thereby admitting current direct to the motor armature via conductor 25. At this time, however, all of the resistance 7 and 8 is in circuit with the armature and the motor is properly started. As soon as auxiliary solenoid 20 is energized, it short circuits the winding 13 of the solenoid 16 which is deënergized and permits its plunger to descend to cut out the resistance 7 and 8, the plunger in this movement being retarded by dash pot 14 in order to gradually cut out the resistance to properly start the motor 5. As soon as the plunger 12 descends, the short circuiting contact 15 at the upper end of the solenoid opens the short circuit about the resistance 19 which is cut into circuit with the auxiliary solenoid 20 to thereby cut down the current flowing through it but not to such an extent as to cause it to release its plunger and prevent the same from maintaining the motor circuit closed. When the plunger 12 reaches its normal position, the whole resistance is cut out and the motor 5 is up to a speed that enables it to withstand the full voltage of the main circuit.

When it is desired to stop the motor the switch 31 is opened thereby deënergizing the auxiliary solenoid 20 and opening the motor circuit. Any failure of the current on the main line opens the solenoid switch "20", and this switch will not again close to start the motor until all of the resistance "7", "8" is inserted in the motor circuit by the lifting of the solenoid plunger "12" and the short-circuiting of the resistance "19" by such operation of the plunger. After the motor has stopped and the power is turned on again, the conditions are identical with those for starting, the motor up originally when switch "31" is closed. The resistance "7", "8" is thus immediately inserted as soon as the power is turned on, and is thereafter gradually cut out to start the motor properly as soon as the auxiliary solenoid "20" is operated. The resistance 7 and 8 is thus normally out of the circuit but is immediately inserted as soon as the controlling switch 31 is closed and is thereafter gradually cut out to properly start the motor as soon as the auxiliary solenoid 20 is operated. The solenoid 16 may be smaller and cheaper than the usual starting magnet by reason of the fact that it receives current for only a short time, ordinarily not over a fraction of a second, whereas in the common arrangement the starting solenoid must be fully energized during the starting period which may require as long as fifteen seconds. Again the auxiliary solenoid may be made small and with less insulation due to the fact that the resistance 19 is cut into the circuit. This device is adapted also for alternating current work for the reason that the solenoid "16" is in circuit such a short time that it is not deleteriously affected by the heating effect of the heavy current necessary to pass through it to cause the plunger to lift. Since the self-induction of the solenoid increases very rapidly as the plunger ascends and the magnetic circuit becomes shortened and its pull on the plunger correspondingly weakened, it is necessary to depend upon the large force exerted on the plunger when in its lowest position to give the plunger and its parts a very rapid acceleration and high velocity to carry the same clear to the top by their inertia. On account of this action of the solenoid when the plunger rises, causing the force to decrease very rapidly, the device is particularly well adapted to be operated by alternating current on alternating current circuits. The same fact is true of the solenoid switch 20, so that the resistance 19 for such a self starter for alternating current motors would be used to interlock the two parts only and would not be required to keep coil 20 from overheating. The main switch "4" ordinarily remains closed, but may be opened when it is desired to cut off the current from the whole device.

While the various parts have been shown only diagrammatically it is believed that their practical construction and application is sufficiently well understood by those skilled in the art at the present day to make further illustration and description unnecessary.

Any sort of rheostatic device capable of performing the desired functions may obviously be employed.

Various changes and alterations may be made in the invention without departing from its scope or principle.

It is evident that this self starter may be made to operate in connection with pressure regulators, float switches, reversing switches for elevators and the like.

Having thus described my invention, what I claim as new and desire to cover by Letters Patent is:—

1. In an automatic starter for electric motors, a starting resistance for the armature circuit, a resistance varying member arranged to move automatically from the starting position to the running position, said member being normally out of the starting position and normally excluded from the main armature circuit, a circuit closing device for including said member in the main armature circuit when said member is moved into the starting position, an electromagnetic device adapted to move said member from the nor-

mal position to the starting position when the main switch is closed, said device having windings connected in shunt to the terminals of said circuit-closing device and in series with the armature of the motor, and means for retarding said member in its movement from the starting to the running position.

2. In an automatic starter for electric motors, a starting resistance for the armature circuit, a resistance varying member arranged to move automatically from the starting position to the running position, said member being normally out of the starting position and normally excluded from the main armature circuit, a circuit-closing device for including said member in the main armature circuit when said member is moved into the starting position, a solenoid adapted to move said member from the normal position to the starting position when the main switch is closed, said solenoid having windings connected in shunt to the terminals of said circuit closing device and in series with the armature of the motor, and means for retarding said member in its movement from the starting toward the running position.

3. In an automatic starter for electric motors, a starting resistance, a resistance varying member arranged to move automatically from the starting position to the running position, said member being normally out of the starting position and excluded from the main armature circuit, an electromagnetic device adapted to move said member from the normal position to the starting position when the main switch is closed, an automatic circuit closing device for including said member in the main armature circuit, means actuated by said resistance varying member upon reaching starting position to cause the operation of the circuit closing device, said electromagnetic device having a winding connected in shunt to the terminals of said circuit closing device and in series with the armature of the motor.

4. In an automatic starter for electric motors, a starting resistance, a resistance varying member arranged to move automatically from starting position to running position, said member being normally out of starting position and excluded from the main armature circuit, an electromagnetic device adapted to move said member from normal position to the starting position when the main switch is closed, a circuit closing device for including said member in the armature circuit, an operating winding for said circuit closing device, means actuated by said resistance varying member upon reaching starting position to render said winding effective to actuate said circuit closing device, said electromagnetic device having a winding connected in shunt to the terminals of said circuit closing device and in series with the armature of the motor, and means for retarding said member in its movement from the starting to the running position.

5. In an automatic starter for electric motors, a starting resistance, a resistance varying member arranged to move automatically from starting to the running position, said member being normally out of starting position and excluded from the main armature circuit, an operating winding for moving said member to starting position, an electromagnetic circuit closing device for including said member in the main armature circuit, a resistance in circuit with the operating winding of said circuit closing device, and a switch operated by said member upon reaching starting position to short-circuit said last mentioned resistance to cause said circuit closing device to operate, the winding of said resistance varying member being connected in shunt to the terminals of said circuit closing device and in series with the armature of the motor.

6. In an automatic starting device for electric motors, a resistance adapted to be included in the armature circuit, an automatically movable member adapted to remove said resistance from the armature circuit, said movable member being normally out of starting position, a solenoid adapted to move said member to starting position, an electromagnetic circuit closing device, a resistance for the winding thereof, a switch for short-circuiting said last mentioned resistance, arranged to be closed when said movable member reaches starting position, whereby the circuit closing device will be operated, the winding of the solenoid for the movable member being in shunt to the terminals of the circuit closing device and in series with the armature of the motor, and means for retarding said member in its movement from the starting to the running position.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

CHARLES H. MILLER.

Witnesses:
T. E. BARNUM,
F. S. WILHOIT.