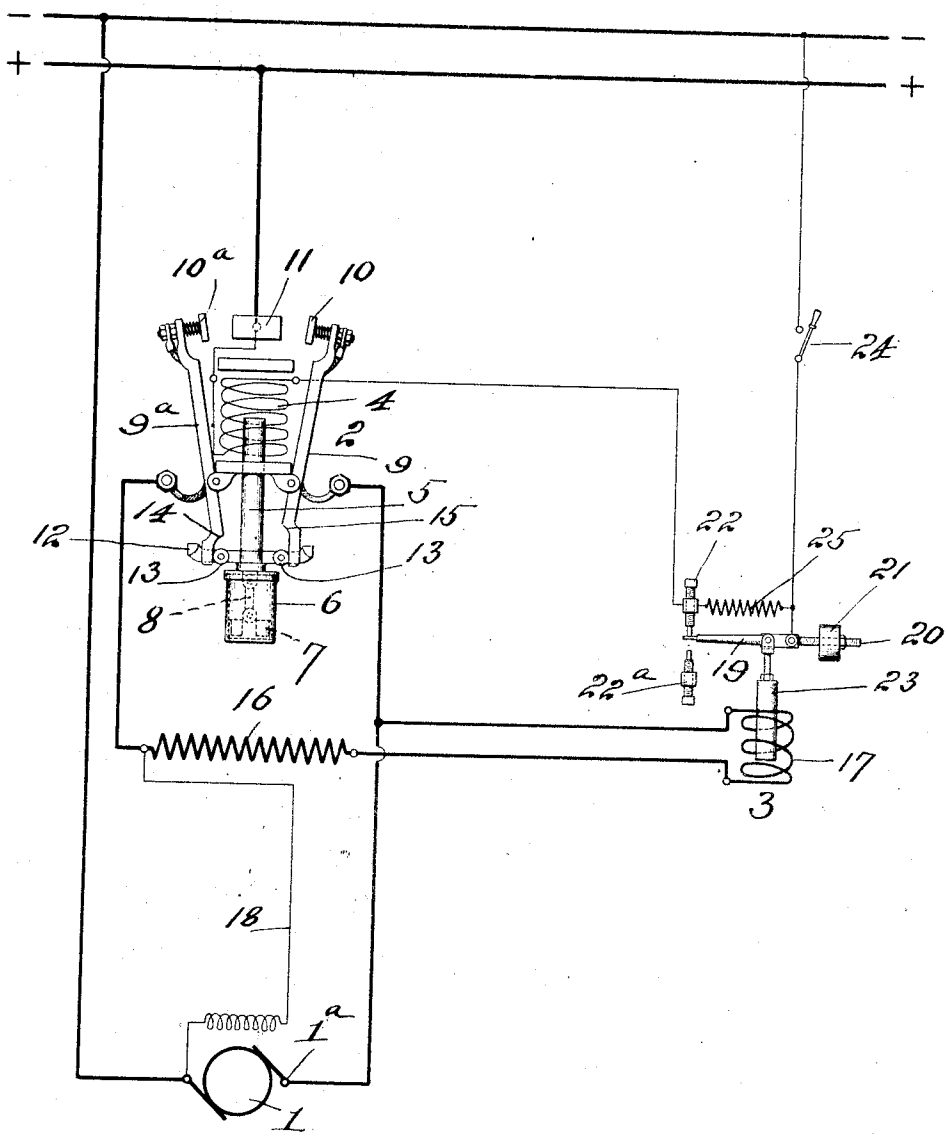
F. W. SMITH.

SOLENOID CONTROLLER.

APPLICATION FILED APR. 5, 1910.

1,022,707.

Patented Apr. 9, 1912.



Witnesses:
F. R. Miller.
A. E. Petterson.

Frank W. Smith
Inventor
By his Attorneys Dawson & Dawson

UNITED STATES PATENT OFFICE.

FRANK W. SMITH, OF WESTFIELD, NEW JERSEY, ASSIGNOR TO SUNDH ELECTRIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SOLENOID-CONTROLLER.

1,022,707. Specification of Letters Patent. Patented Apr. 9, 1912.

Application filed April 5, 1910. Serial No. 553,546.

To all whom it may concern:

Be it known that I, FRANK W. SMITH, a citizen of the United States, and resident of the town of Westfield, county of Union, and State of New Jersey, have invented certain new and useful Improvements in Solenoid-Controllers, of which the following is a specification, reference being had therein to the accompanying drawing, in which—

Figure 1 is a diagrammatic view of a motor, a motor starting solenoid, and the controller device.

In starting electric motors having great inertia to overcome, and requiring a considerable current over-load to move them, it has been the practice, heretofore, to insert in the motor circuit enough resistance to prevent the burning out of the motor armature when the current is applied, and then cutting out the resistance by some form of apparatus having a step-by-step operation, whereby the resistance will be gradually reduced as the motor speed is accelerated, and the inertia of the mass to be moved by the motor is overcome, or the motor load otherwise reduced.

It is the main object of this invention to provide a solenoid controlling means by means of which when the motor circuit is completed the movement of the solenoid core will be retarded or stopped until the load on the motor is reduced and consequently the amount of current taken by the motor is also reduced, the solenoid core being permitted to complete its movement only when the current taken by the motor has been reduced to the desired extent. It is, of course, obvious that the amount of current taken by the motor may be reduced in various ways. When the inertia of the load is overcome and the motor has increased its speed the load thereon is reduced, and consequently the amount of current taken by it is correspondingly reduced. It is also obvious that as the speed of the motor increases there is a reduction in the amount of current taken by the motor by reason of the back pressure or counter-electromotive force.

It is the object of this invention to take advantage of this reduction in current taken by the motor in whatever way it may be brought about, for the purpose of controlling the operation of the solenoid, and it is, of course, obvious that there may be many variations in the specific apparatus for carrying this invention into effect, and I therefore desire it understood that I am not to be limited to the precise construction shown and described, except as the same may be made the subject-matter of specific claims.

Referring to the various parts by numerals, 1 designates a motor, 2 a motor starting solenoid, and 3 a solenoid controller.

4 designates a solenoid coil, 5 a solenoid core, 6 a dash pot in which is arranged a small piston 7 connected by a link 8 to the lower end of the core, said dash pot piston being of any suitable construction, and designed to retard the upward movement of the core whereby said core will move into the coil slowly, and at the desired speed.

Pivoted to the solenoid frame are two contact levers 9 and 9^a which carry contacts 10 and 10^a at their upper ends adapted to engage the fixed contact 11, this latter contact being electrically connected to the source of supply and to the solenoid coil. The contact levers are electrically connected to pole 1^a of the motor armature, as will be more fully hereinafter described.

Carried by the solenoid core at its lower end is a frame 12, and in said frame are arranged rollers 13. These rollers are arranged to engage cams 14 and 15 formed on the inner sides of the contact levers at the lower ends thereof. The cam 14 is located near the end of its contact lever, while the cam 15 is some distance above the cam 14, whereby one of the rollers 13 will first contact with the cam 14, and thereby bring contact 10^a into engagement with the contact 11, the cam 15 being operated upon at a later period, as will be more fully hereinafter set forth.

Contact lever 9^a is connected to one pole 1^a of the motor armature through the resistance coil 16 and a retarding coil 17, said retarding coil being of large capacity to permit the motor current to pass therethrough. The contact lever 9 is electrically connected to the same pole of the motor armature as lever 9^a, as clearly shown in the diagram. The fields of the motor are connected through a shunt 18, with the lever 9^a.

Above the retarding coil 17 is pivoted a horizontal lever 19, said lever being provided with a threaded arm 20 in which is arranged a counterbalancing weight 21. The

end of this lever is arranged to contact with stops 22 and 22ª. Pivotally connected to this balanced lever 19 is a depending core 23 which fits within, and reciprocates through retarding coil 17. The solenoid coil is in circuit with the stop 22 and balanced lever 19, a switch 24 being interposed in said circuit between the balanced lever and the source of supply. Between the stop 22 and the circuit wire connected to the balanced lever is a resistance coil 25, so that when the said lever is drawn downwardly away from the contact or stop 22, the solenoid coil circuit will be through said resistance, said circuit being broken between the stop 22 and the balanced lever 19.

The operation of this apparatus may be briefly described as follows: When the switch 24 is closed, current passes through the balanced lever 19, stop 22 and the solenoid coil, but not through the resistance coil 25. By means of the weight 21 the lever 19 and the core 23 are nicely balanced so that said lever will be normally in contact with the stop 22, but may be readily drawn from stop 22 by means of the coil 17 and the core 23. Upon the completion of the circuit through the solenoid coil, the core 5 will be drawn upwardly, said upward movement being retarded to the desired extent by the dash pot 7. When the roller 13 contacts with the cam 14, the upper end of the lever 9ª will be thrown inwardly to bring the contact 10ª into engagement with the rigid contact 11. Current will then flow from the lever 9ª through the resistance coil 16, the retarding coil 17 to the pole 1ª of the motor armature. When current passes through the retarding coil 17, the core or plunger 23 will be drawn downwardly into said coil thereby breaking the solenoid coil circuit at the stop 22, and causing said circuit to be completed through the resistance 25. The resistance 25 is sufficient to reduce the effective pull of the solenoid coil, and to thereby prevent further upward movement of the solenoid core. The core and the sliding frame 12 will, therefore, be held stationary after the said frame has been raised above the cam 14, the outwardly projecting part of the cam 14 engaging under the end bar of frame 12 and assisting the coil in maintaining the core in its stationary intermediate position. This condition of the apparatus will be maintained until the load on the motor has been reduced, and consequently the amount of current taken by the motor is correspondingly reduced. This reduction in current may be brought about by the motor overcoming the inertia of the mass to be moved by it, or by the actual reduction of the load on the motor, or by the counter-electromotive force developed by the motor. It is clear that as the current flowing through the motor is reduced the pull of the coil 17 will be correspondingly reduced, and when said pull has been lowered to the desired extent it will fail to overcome the weight 21, and said weight will then throw lever 19 into engagement with stop 22, thereby cutting out the resistance 25 and permitting the full current to flow through the solenoid coil. As soon as this occurs the solenoid coil will complete its upward movement, thereby causing contact lever 9 to swing inwardly and bring contact 10 into engagement with the fixed contact 11. The motor circuit will then be completed through said lever 9, and directly to pole 1ª of the armature motor, thereby cutting out the resistance coil 16 and the retarding coil 17, and supplying the full current to the motor.

From the foregoing it is clear that the retarding coil 17 will hold the lever 19 away from the contact 22 until the current flowing to the motor and through the coil 17 has been reduced sufficiently to so diminish the pull of the coil 17 that the weight 21 will overcome it and swing the arm 19 into engagement with the contact 22. It is manifest that the operation of the solenoid will be intermittent, and that the final step or movement thereof will be dependent upon the reduction of the current taken by the motor. It is also clear that the interval between the completion of the solenoid coil circuit and the cutting out of the resistance in the motor circuit will depend entirely upon the time required to reduce the current flowing to the motor through retarding coil 17 sufficiently to release the core 23.

It will, of course, be understood that the solenoid retarding device may be employed in many ways, and on any desired form of solenoid.

It is also clear that the motor circuit may be completed through the retarding coil in any suitable manner, the arrangement shown in the drawings being merely by way of illustration.

It will, of course, be understood that by varying the position of the weight 21 on the arm 20 the amount of pull required to move the arm 19 from the stop 22 may be varied, and consequently the amount of reduction in current flowing through said coil to bring about the release the core 23 will be correspondingly varied.

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

1. A controller comprising a solenoid coil, means connecting said solenoid coil directly in circuit with the source of supply, a core for said coil, a pair of contacts brought together by the initial movement of said core, a motor, a motor circuit adapted to be completed by the contacts first operated by the solenoid core, a resistance and a controlling coil in said motor circuit, a movable core

for said controlling coil, means in the solenoid coil circuit and connected to the movable core of the controlling coil to place resistance in the said solenoid circuit when excess of current is flowing through said motor circuit, means to return said solenoid coil circuit to its normal condition when the current flowing through the motor circuit is reduced, and to thereby permit the solenoid core to complete its movement, and contacts operated by said core as it completes its movement to cut the resistance and the controlling coil from the motor circuit.

2. A solenoid controller comprising a solenoid coil, a single core movable into and out of said solenoid coil, a pair of contacts arranged to be closed or opened by the movements of said core, an operating circuit arranged to be completed by the said pair of contacts, a resistance and a controlling coil in said circuit, a core movable into and out of said controlling coil, means moved by said core for cutting resistance into the solenoid coil circuit, means tending to return said movable means to its normal position to cut resistance out of the solenoid coil circuit and operating against the pull of the controlling coil, a second pair of contacts arranged to be closed by the further movement of the solenoid core, this latter pair of contacts also completing the operating circuit and cutting out the resistance and the controlling coil, thereby preventing the subsequent re-introduction of the resistance into the solenoid coil circuit.

3. A solenoid controller comprising a solenoid coil, a single reciprocable core for said coil, a circuit for said coil, a pair of contacts arranged to be closed by the movement of said core, a motor circuit adapted to be completed by the said pair of contacts, a resistance and a controlling coil in said motor circuit, a reciprocable core in said controlling coil, movable means operated by said core for cutting resistance into the solenoid coil circuit, said means tending always to return to its normal position, said controlling coil operating under an excess of current to place resistance in the solenoid coil circuit and operating when the current in the motor circuit is sufficiently reduced to cut the resistance from the solenoid circuit thereby permitting the solenoid core to continue its movement, another pair of contacts adapted to be operated by the subsequent movement of the solenoid core, this latter pair of contacts completing the circuit through the motor direct and permanently cutting out the resistance and the controlling coil of the motor circuit.

4. A solenoid controller comprising a solenoid coil, a core movable into and out of said coil, contacts adapted to be closed by said core at different points in its travel to close an electric circuit, and means in said circuit controlled by the movement of the solenoid core for neutralizing the pull of said coil to thereby arrest the movement of the core before it has completed its movement, said means operating upon a reduction of current in the circuit controlled by the solenoid to restore the solenoid to its normal action.

5. The combination of a motor, a solenoid coil, a circuit for said coil including means for opening and closing said circuit, a core movable into and out of said coil, a resistance in the solenoid circuit, means for normally short-circuiting said resistance, means in the motor circuit controlled by the movement of the solenoid core and operating upon the completion of said motor circuit by the solenoid to switch the resistance into the coil circuit to thereby arrest the core before it has completed its movement and acting upon a reduction of the current flowing to the motor to again short circuit said resistance and thereby permit the core to make a further movement.

6. A solenoid controller comprising a solenoid coil, a circuit for said solenoid coil, a reciprocable core movable into and out of said coil, a pair of contacts arranged to be brought together by the initial movement of said core into the coil, a motor circuit adapted to be completed when the said pair of contacts are brought together by the said core, a resistance and a controlling coil in said motor circuit, a movable core for said controlling coil, means in the solenoid coil circuit and connected to the core of the controlling coil to place resistance in the solenoid coil circuit when an excess of current is flowing through the motor circuit said means returning said coil circuit to its normal condition when the current flowing through the motor circuit is sufficiently reduced and to thereby permit the solenoid core to complete its movement into its coil, a pair of contacts adapted to be brought together by this second movement of the solenoid core said contacts completing the motor circuit direct and cutting out the resistance and the controlling coil and thereby permanently cutting out the resistance from the solenoid coil circuit.

In testimony whereof I hereunto affix my signature in the presence of two witnesses this 1st day of April, 1910.

FRANK W. SMITH.

Witnesses:
F. R. MILLER,
WM. R. DAVIS.