

C. P. WELLS.
 REMOTE CONTROL FOR ELECTRIC MOTORS.
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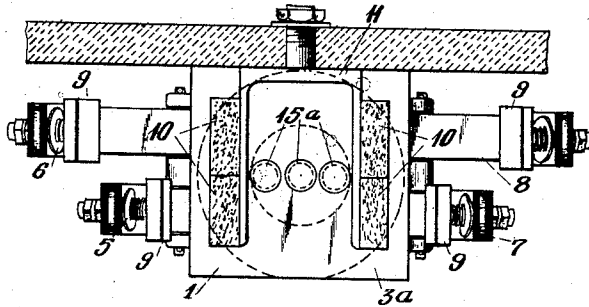


FIG. 2

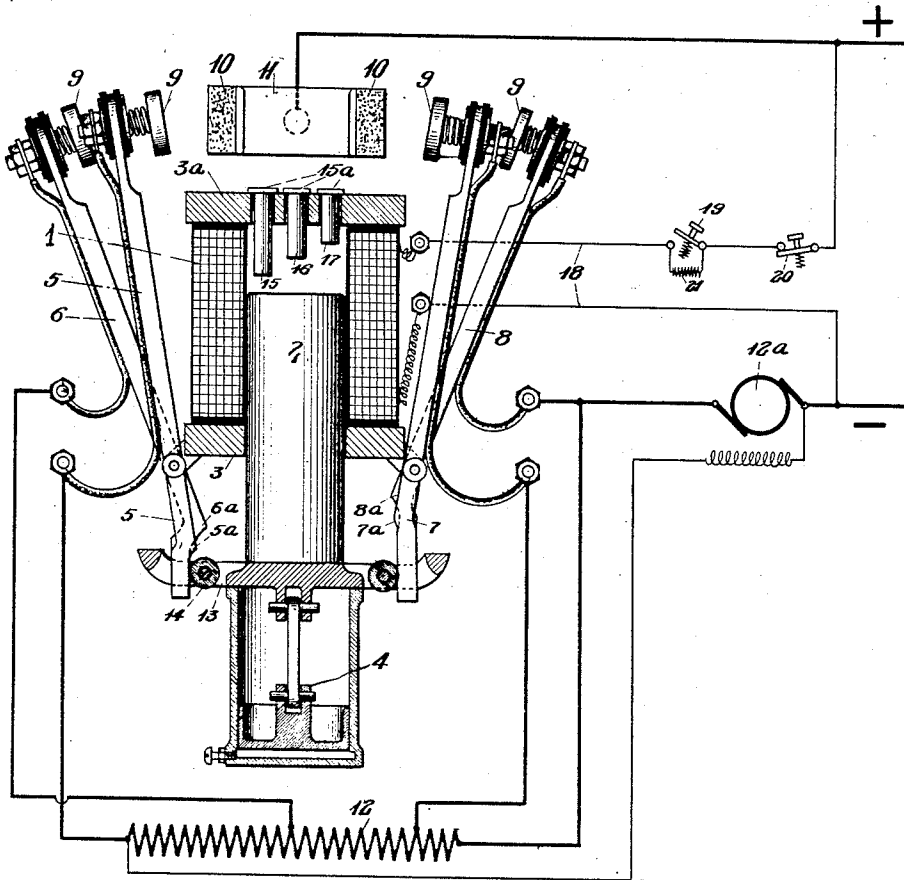


FIG. 1

WITNESSES

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UNITED STATES PATENT OFFICE

CHALMERS P. WELLS, OF NEW YORK, N. Y., ASSIGNOR TO SUNDH ELECTRIC COMPANY,
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REMOTE CONTROL FOR ELECTRIC MOTORS.

1,246,687.

Specification of Letters Patent.

Patented Nov. 13, 1917.

Original application filed July 9, 1913, Serial No. 778,158. Divided and this application filed October 22, 1914. Serial No. 867,933.

To all whom it may concern:

Be it known that I, CHALMERS P. WELLS, a citizen of the United States, and resident of the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Remote Controls for Electric Motors, of which the following is a specification.

This invention relates to electromagnetic apparatus for controlling electric motor circuits, and it is particularly adapted for use in controlling the speed of a motor from a distance.

This application is a division of my application filed July 9, 1913, Serial No. 778,158, and matters of invention not claimed herein are claimed in said original application.

The invention is shown as applied to an electric controller substantially like the apparatus shown in Patent No. 733,563, dated July 14, 1903, granted to A. Sundh.

When a solenoid core is at its lowest point the length of the air gap between the top of the core and the magnetic top bar or frame of the solenoid is at its maximum, therefore, this is the condition of greatest reluctance in the magnetic circuit. When the solenoid circuit is closed and the core begins to rise this air gap diminishes and the reduction of this gap increases the magnetic pull on the core. As the core continues to rise the air gap diminishes and the pull of the core is increased so that there is an accession of magnetic strength acting on the core as it rises.

In the embodiment of the invention shown in the drawings I have provided means progressively reducing the air gap between the solenoid core and its magnetic bracket or pole piece. I have also shown means for progressively reducing the magnetic pull on the core by automatically diminishing the pull of a portion of the lines of magnetic force drawing the core into the solenoid. I accomplish this by means of depending pins of magnetic material which are progressively engaged by the core as the said core moves upwardly or into the solenoid coil. It is to be understood that as each pin contacts with the top of the solenoid core the magnetic lines previously extending from the pin to the core and assisting in lifting the same are not strongly effective. A series of pins

is arranged to be engaged in succession by the core as the core rises so that the pulling lines of force are progressively and abruptly reduced in accordance with the number and area of pins engaged by the upper end of the core. It is manifest that as the pulling lines of force are reduced in effect, the upward pull on the core is diminished, the reduction in the magnetic lines substantially counterbalancing the increase in magnetic force due to the diminished air gap, so that the upward pull on the core remains substantially uniform throughout the upward movement thereof.

In the apparatus shown in the drawing the invention is applied to a controller designed to progressively change resistance in a motor circuit to thereby vary the speed of the motor. It is highly desirable in many instances that the motor speed be controlled from a remote point, and the controlling device must be so constructed that the remote control shall be positive, reliable and efficient. I secure these results by providing a resistance in the solenoid circuit and two circuit controlling switches or buttons, one of said switches being normally open to normally maintain the resistance in the solenoid circuit and the other button being normally closed to maintain the solenoid circuit closed. By means of this arrangement the movement of the solenoid core upward into its coil or downward from said coil may be positively controlled. When it is desired to increase the motor speed the solenoid circuit is completed around the resistance. As soon as the core contacts with the first pin of the series the resistance in series with the solenoid may be again cut into the circuit. The pulling strength of the solenoid will then not be sufficient to continue the upward movement of the core which would then tend to fall back, being retarded in its backward or downward movement by the dash pot shown. The core being sealed to the first pin of the series, however, there is sufficient magnetism produced by the coil with inserted resistance to support the core and to prevent further downward movement, the pin, of course, being supported on the upper bar of the solenoid. When it is desired to further increase the speed of the motor the resistance in the solenoid circuit is again short-circuited and the core will

then move up to the next pin, the operation just described being then repeated. If it be desired to step down the speed of the motor the solenoid circuit is broken by opening the normally closed push button and permitting the core to drop from one pin to the next longest pin in the series. By then closing the circuit at the proper instant the core will be held. By this means the movement of the core into and out of its coil may be readily, accurately and continuously controlled, thereby varying the resistance in the motor circuit, either increasing or decreasing it, as may be desired.

In the drawing, Figure 1 is a vertical sectional view of the controller, a motor circuit and a series resistance being diagrammatically shown; and

Fig. 2 a plan view of the controller.

Referring to the various parts by numerals, 1 designates a solenoid provided with a core 2 and the magnetic brackets or pole pieces 3 and 3^a. The lower end of the core is connected to a dash pot 4 of any desired construction. Pivoted to the solenoid pole piece 3 is a series of contact arms 5, 6, 7, and 8. Each of these arms is provided with a contact block 9 which is adapted to engage a complementary contact piece 10 carried by a rigid terminal bracket 11 above the solenoid. One end of the motor circuit is connected to this terminal bracket, the other end of said circuit being connected through a resistance 12 with the contact arm 5. The contact arm 6 is also connected to the motor circuit in such manner that when it is brought into engagement with the terminal bracket 11 a portion of the resistance will be cut out of the motor circuit. The contact arm 7 is similarly connected to the motor circuit so that upon its movement to the circuit closing position a still further portion of the resistance will be cut out; and when the contact arm 8 has been moved to its circuit closing position, the motor circuit will be completed direct to the motor and all of the resistance will be cut out. The resistance is in series with the motor armature so that as it is progressively reduced, the speed of the motor is progressively increased until it has reached its maximum.

The solenoid core carries a cam bracket 13 having cam engaging rollers 14 which are adapted to engage cam surfaces 5^a, 6^a, 7^a and 8^a on the lower ends of the cam arms to force said arms to their circuit closing positions. These cams are arranged to be engaged by the cam bracket at different points in the vertical movement of the core so that said arms will be brought to their closed position in succession as the core moves into the solenoid, as is fully pointed out in the Sundh patent hereinbefore referred to.

Extending through the magnetic pole piece 3^a of the solenoid and into the path of

the upper end of the solenoid core are three loosely supported pins 15, 16 and 17 of magnetic material. These pins are of different lengths and extend different distances toward the core from the said pole piece. The pins are in direct contact with the pole piece and are provided with heads or collars 15^a on their upper ends which in their normal positions rest on the pole piece. It is manifest that these pins alter the air gap between the pole piece 3^a and the end of the core; and it is also obvious that the magnetic lines of force will extend between the said pins and the core. As the core rises and engages the ends of these pins, the magnetic lines exerting their influence upon the core in effect are reduced abruptly and, consequently, the upward pull on the solenoid core is diminished. It is also obvious that this reduction in the magnetic lines is progressive as the core rises, the maximum point of reduction being reached as the core contacts with the third pin.

To control the solenoid I provide the solenoid circuit 18 in which is arranged a closing push button 19; an opening switch or push button 20, and a resistance 21. The resistance 21 is sufficient to reduce the effective pull on the solenoid core so that when the switch 19 is open and the resistance 21 is in circuit with the solenoid there will be no effective pull on the solenoid core. The switch or push button 19 is normally open, while the switch 20 is normally closed. In order, therefore, to shunt the resistance 21 the switch 19 must be closed.

The operation of the device may be briefly described as follows:

Upon closing the solenoid circuit through the push button or switch 19, thereby shunting the resistance 21, the core immediately moves upwardly and operates the first circuit closing arm 5, thereby closing the motor circuit through the resistance 12. This upward movement of the solenoid core brings its upper end into contact with the pin 15, the longest of the three pins. The contact between this pin and the core eliminates the magnetic lines which had previously extended between said pin and the solenoid core. Upon now opening the switch 19 and again throwing the resistance 21 into said circuit the effective pull of the coil on the core will be reduced and practically eliminated and said core will settle down until the head of the pin 15 rests on the top of the solenoid pole piece 3^a. The core, however, will then be held in its raised position by the magnetic attraction between the end of pin 15 and the end of the solenoid core. If it were not for the pin, with its head engaging the top bar of the solenoid frame the core would continue its downward movement, but as the pin 15 and the core are sealed, that is to say in direct contact, there is enough magnetism

produced by the coil when the resistance 21 is in circuit therewith to support the core and the attached dash pot.

The motor will then operate at its lowest speed. When it is desired to increase the motor speed the switch 19 is again closed, thereby causing the core to again move upwardly until it contacts with the pin 16 which is the next longest pin of the series. This further reduces the lines of force and diminishes the pull on the core. Upon again placing the resistance 21 in the solenoid circuit the solenoid core will be held in its upward position by means of the attraction between the pin 16 and the core, the head of this serving as means to hold the core against downward movement. This operation may be repeated when it is desired to still further increase the speed of the motor. It is clear, therefore, that I progressively reduce the lines of force or magnetic pull on the solenoid core as the air gap between the upper magnetic pole piece of the solenoid and the core is diminished.

To progressively increase the resistance in the motor circuit and thereby progressively decrease the speed of the motor the operation just described is substantially reversed. Assuming the core to be in contact with pin 17 and the motor to be operating at its highest speed, and it be desired to reduce the speed of the motor the switch 20 is opened thereby opening the solenoid circuit. The core will immediately drop, being, of course, retarded by the dash pot. When the core has left pin 17 and it be desired to hold it on pin 16, switch 20 would then be closed. By thus completing the solenoid circuit through the resistance 21 the core would be held sealed to the pin 16 precisely as hereinbefore described. This operation would be again repeated when it is desired to drop the core to the end of the pin 15. It is, of course, to be understood that the number of pins corresponds to the number of steps in the resistance so that the speed of the motor may be stepped up or down, as desired.

What I claim is:

1. A motor control comprising a solenoid, a motor circuit including a resistance, a series of contacts adapted to be progressively operated by the solenoid core to progressively change the resistance in the motor circuit, a resistance in the solenoid circuit, means for shunting said resistance, a series of pins extending into the path of the solenoid core and adapted to be progressively engaged by said core as it moves in its coil, whereby the core will be magnetically held by the engaged pins when the resistance is in the solenoid circuit.

2. A motor control comprising a solenoid, a motor circuit including a resistance, a series of devices adapted to be operated in

succession by the action of the solenoid core, means whereby said devices will progressively change the resistance in the motor circuit, a series of pins of different lengths projecting into the path of the solenoid core and adapted to be progressively engaged by said core as it moves in its coil, a solenoid circuit including a resistance sufficient to reduce the effective pull on the core of the solenoid, and means for shunting said resistance.

3. A motor control comprising a solenoid, a motor circuit including a resistance, a series of contact devices adapted to be operated in succession by the action of the solenoid core, means whereby said contact devices will progressively change the resistance in the motor circuit, a series of pins of different lengths projecting into the path of the solenoid core and adapted to be progressively engaged by said core as it moves in its coil, a solenoid circuit including a resistance sufficient to reduce the effective pull on the core of the solenoid, means for shunting said resistance and a dash pot connected to the solenoid core and retarding the movement thereof.

4. A motor control comprising a solenoid, a motor circuit including a resistance, a series of contacts adapted to be progressively operated by the solenoid core as it moves in its coil to change the resistance step by step in the motor circuit, a resistance in the solenoid circuit sufficient to reduce the effective pull of the coil, manually operable means for shunting said resistance, said means being also operable to insert said resistance in the solenoid circuit, and a series of loose pins of different lengths adapted to be progressively engaged by said core as it moves in its coil, each one of said pins when engaged by the core being adapted to magnetically hold the core in its position in the coil when the said resistance is in the solenoid circuit.

5. A motor control comprising a solenoid including a core, magnetic devices adapted to be progressively engaged by said core as it moves into its coil, means for reducing the effective pull on said core by reducing the electromotive force of the coil circuit a predetermined amount, each of said magnetic devices serving to hold the core in a definite position in the coil when the effective pull on the core is reduced, a motor, a circuit therefor including a series of resistance units, contact devices for cutting said resistance units out of the motor circuit, means whereby the core will operate said contact devices substantially simultaneously with the engagement between the said core and the magnetic devices, and means to retard the movement of the solenoid core.

6. A motor control comprising a solenoid including a core, magnetic means located at

a series of points along the travel of the core, a resistance in the solenoid circuit, manually operable means for shunting said resistance, said means being also operable to insert said
5 resistance in said circuit, means for opening the solenoid circuit, a motor, a circuit therefor including a series of resistance units, means operable by the core for varying said resistance units when said core is under a direct influence of any one of the said mag-
10 netic devices.

7. A motor control comprising a solenoid, a motor circuit including a series of resistance units, a series of contacts adapted to be
15 progressively operated by the solenoid core as it moves in its coil to change the resistance in the motor circuit step by step, a single resistance unit in the solenoid circuit, manually operable means for shunting said
20 resistance and for inserting it in said circuit, a series of loose magnetic pins of different lengths formed with stops on one end and adapted to seal the solenoid coil at different points in its travel, and manual means for
25 opening and closing the solenoid circuit.

8. A motor control comprising a solenoid, a core therefor, a series of magnetic devices adapted to be progressively engaged by the core, said magnetic devices serving to hold
30 the core in a definite position when the effective pull on the core is reduced, a normally closed circuit through said solenoid, a resistance unit in said solenoid circuit for reducing the pull on the core, a motor, a circuit therefor including a series of resistance
35 units, contact devices for cutting said resistance units out of said motor circuit, means whereby the core will operate said contact devices as the core engages said mag-
40 netic means, a dash pot connected to the

core, means for shunting the resistance in the solenoid circuit to cause the core to progressively engage the magnetic holding devices, and means for opening the solenoid circuit to release said core from the holding
45 devices.

9. A motor control comprising a solenoid, means operated by the solenoid core to vary the resistance in the motor circuit, a normally closed circuit through said solenoid, a
50 resistance unit normally interposed in the solenoid circuit, a series of magnetic contact devices adapted to be engaged by the solenoid core at different points in its travel, manual means for shunting the resistance in
55 the solenoid circuit, and manual means for opening the solenoid circuit.

10. A motor control comprising a solenoid, a core therefor, a normally closed circuit through said solenoid, magnetic means
60 adapted to engage said core, means for reducing the effective pull on said core, said magnetic means serving to hold the core in a definite position in the coil when the effective pull on the core is reduced a prede-
65 termined amount, means for releasing the core from said holding means, a motor, a circuit therefor including a series of resistance units, means for changing said resistance units in the motor circuit, and
70 means whereby the core will operate said resistance changing means as the core engages said magnetic means.

In testimony whereof I hereunto affix my signature in the presence of two witnesses. 75

CHALMERS P. WELLS.

Witnesses:

F. R. MILLER,
MINERVA VAN ALLEN.